

# THE WINNING RECIPE FOR A CIRCULAR ECONOMY

What can inspiring examples show us?



© Sitra 2021

Sitra studies 182

**The winning recipe for a circular economy –**

What can inspiring examples show us?

Authors: Nina Ahola and Ella Tolonen from Deloitte.

Working group: Maria Hughes, Reetta Kohonen, Antti Lehtinen, Anu Mänty and Mika Sulkinoja (Sitra). Lauri Byckling, Nina Ahola, Ella Tolonen, Nicolas Dolce, Miikka Simanainen (Deloitte Finland). Olivier Jan, Pierrick Drapeau, Andreas Mitsios, Khai Linh Lhomme, Laura Plamondon (Deloitte France). Akira Kato, Arisa Fukuoka (Deloitte Japan). Joe Solly, Jillian Rodak, Tamara Luisce (Deloitte Canada).

ISBN 978-952-347-215-0 (PDF) [www.sitra.fi](http://www.sitra.fi)

ISSN 1796-7112 (PDF) [www.sitra.fi](http://www.sitra.fi)

PunaMusta, Helsinki 2021

**SITRA STUDIES IS** a publication series which focuses on the conclusions and outcomes of Sitra's future-oriented work.

Sitra studies 182

**The winning recipe for a circular economy**

April 2021

# Contents

|   |           |
|---|-----------|
| <b>Foreword</b>   | <b>3</b>  |
| <b>Summary</b>  | <b>4</b>  |
| <b>Tiivistelmä</b>  | <b>5</b>  |
| <b>Sammanfattning</b>   | <b>6</b>  |
| <b>1 Introduction</b>   | <b>7</b>  |
| <b>2 Methodology</b>  | <b>8</b>  |
| Development of the assessment framework                           | 8         |
| Identifying global circular economy solutions                     | 9         |
| Interviews with organisations                                     | 9         |
| Final selection of the solutions                                  | 10        |
| Limitations to the methodology                                    | 10        |
| <b>3 Existing and emerging circular economy business models</b>   | <b>12</b> |
| Circular business models – the core                               | 12        |
| Circular economy enablers   | 13        |
| Linkages between business models                                  | 14        |
| <b>4 Impacts of circular economy solutions</b>                    | <b>15</b> |
| Environmental impacts   | 15        |
| Social impacts  | 16        |
| Understanding and measuring impacts in organisations              | 17        |
| <b>5 Drivers of and challenges for a circular economy</b>         | <b>18</b> |
| Pathways to circular innovation                                   | 18        |
| Policy and regulation – barriers or drivers?                      | 19        |
| Shared challenges   | 20        |
| <b>6 The winning recipe for viable circular economy solutions</b> | <b>22</b> |
| <b>7 Ways circular economy solutions can advocate circularity</b> | <b>25</b> |
| Contribution to the Sustainable Development Goals                 | 27        |
| <b>8 Conclusions and recommendations</b>                          | <b>29</b> |
| Supporting the scaling of circular economy solutions              | 29        |
| Aspects of circular business development                          | 32        |

|   |           |
|---|-----------|
| <b>References</b>                         | <b>36</b> |
| <b>Annex 1: Overview of study results</b> | <b>37</b> |
| <b>Annex 2: Solution profiles</b>         | <b>41</b> |

# Foreword

A circular economy offers us a tool to tackle major global challenges such as the climate crisis and biodiversity loss in a sustainable and economically viable way, which enables inclusive development and increased well-being. For a thorough transition to a circular economy, we need systemic change at the policy and finance levels, as well as at the grassroots level.

The COVID-19 pandemic has increased the need to rethink our economy and provided us with an opportunity to build back better. To inspire the circular community and to support the scaling of circular solutions at the grassroots level, we need inspiring examples from different areas. In 2017 Sitra published the first list of the most interesting circular economy solutions from Finland and updated it in 2019 to show the circular community how circular economy principles can be adopted across sectors, industries and business models.

In this project, we widened our scope and challenged ourselves to identify and assess inspiring circular economy solutions from around the globe. We learned what the business incentives for circular economy solutions are, what viable circular economy solutions tell us about the transition to a circular economy, what impacts they have and how they support the creation of systemic circularity. To objectively analyse a circular economy, we needed a common framework against which the solutions could be assessed. The framework enabled us to objectively assess circular economy solutions to identify the most inspiring and impactful in their own geographic region, sector or industry.

In the transition to a circular economy, all solutions have a role to play in enabling and implementing the transition. In addition to already established circular business models, we saw that business models that enable other organisations to adopt circular principles play an important role. During the project we identified that economically and technically viable circular economy solutions often aim to tackle major environmental challenges while supporting the development of social well-being, employment and community resilience. While no circular economy solutions are the same, there are some features that are common for successful solutions.

Many circular economy solutions are still pioneering in their own environment, leading the way to a systemic change. With this project we hope to inspire the circular economy community and underline the importance of circular solutions while supporting their path to success – to achieve a systemic, inclusive and competitive circular economy.

**Mari Pantsar**

Director, Sustainability solutions  
The Finnish Innovation Fund Sitra

**Maria Hughes**

Specialist, Sustainability solutions,  
The Finnish Innovation Fund Sitra

# Summary

Our study set out to find diverse circular economy solutions that are viable and scalable, that drive systemic circularity, and that have exceptionally positive environmental and social impacts. Over 200 organisations around the world submitted their solutions for consideration. In this report, we present 39 outstanding examples of circular economy solutions that are closing material loops and driving the circular transition while being very relevant in their own environment. These solutions demonstrate the benefits of circular business operations and how different organisations across society can use circular thinking to improve the value of their business and progress towards achieving the UN's Sustainable Development Goals.

The organisations behind circular economy solutions can be divided into circular “natives”, who have based their business idea on the concept of a circular economy, and circular “adapters”, whose core business is founded in a more traditional, linear setting. With both “natives” and “adapters”, circular innovation still often stems more from the desire to create an economically viable solution that can have an impact on society. Both types of organisations are thus active in driving systemic circularity transformation.

Circular organisations can also be examined from the perspective of circular business models. Widely accepted circular economy business models include resource efficiency and recyclability, renewability, product-life extension, sharing platforms, and product-as-a-service. Our study also revealed circular business models that often act as enablers of a circular economy. It was also observed that due to interconnectedness between the business models, it is often challenging to define which business model a solution belongs to.

Our findings on the dual role of barrier and enabler that regulation can play in the circular transition are aligned with the current discussion. Similarly aligned is our finding that a lack of awareness of a circular economy is still quite prevalent among businesses and consumers. In addition to shared challenges, we also identified common themes that featured in solutions that have succeeded in becoming viable. These included effective communications of the benefits to customers and end users, early ecosystem integration, local start and scaling, key partnerships with the third sector and the community, easy implementation in existing infrastructure, and a data-driven approach.

The 39 solutions presented in this report are remarkable in contributing to the circular economy transition by generating impacts beyond their immediate operations. In their own way, they all increase the availability of sustainable production and consumption practices. Circular economy solutions also have a strong role to play in reaching the Sustainable Development Goals of UN's 2030 Agenda (SDGs). While circular economy benefits are still largely perceived through impacts on resource extraction, climate change and the local environment, awareness of the social impacts is slowly growing. Currently, the social aspects remain difficult for organisations to identify, suggesting an untapped potential in circularity to contribute to the social aspects of sustainability. Circular economy solutions also help in building the multi-stakeholder partnerships that are vital to reaching the global goals.

The circular economy has the potential to create shared prosperity while reducing the stress on our environment and societies from the use of virgin raw materials and carbon emissions. Many of the world's most pressing crises extend across many different systems and are therefore best tackled through systemic solutions. Wide-scale application of circular thinking with a consideration of all aspects of sustainable development can help us find the tools needed for the task. Every organisation and all parts of society have a role to play in the transition to a circular economy by either innovating or adapting to circular practices.

# Tiivistelmä

Jotta kiertotalouteen voidaan siirtyä riittävän nopeasti, tarvitaan tuoreita esimerkkejä toteuttamiskelpoisista ja innostavista kiertotalousratkaisuksista. Tässä selvityksessä tavoitteenamme oli löytää monimuotoinen joukko toteuttamiskelpoisia ja skaalattavia kiertotalousratkaisuja. Etsimme systeemistä muutosta edistäviä ratkaisuja, joilla on positiivisia sosiaalisia- ja ympäristövaikutuksia.

Ratkaisuja etsittiin avoimella haulla, johon vastasi yli 200 organisaatiota eri puolilta maailmaa. Tässä selvityksessä esitellään 39 valittua kiertotalousratkaisua, jotka edistävät suljettuja materiaalikierroja ja vauhdittavat kiertotaloussiirtymää eri puolilla maailmaa. Ratkaisuilla on huomattavia vaikutuksia myös omassa paikallisessa ympäristössään. Esiteltävät ratkaisut havainnollistavat kiertotalousliiketoiminnan hyötyjä. Samalla ne tarjoavat esimerkkejä organisaatioille, jotka haluavat hyödyntää kiertotalousajattelua ja samalla edistää YK:n kestävän kehityksen tavoitteiden toteutumista.

Kiertotalousratkaisuja tarjoavat yritykset voidaan jakaa kiertotalousnatiiveihin, joiden liiketoimintaidea on alusta asti perustunut kiertotalouteen sekä kiertotalouden omaksujiin, joiden ydinliiketoiminta on perustunut perinteiseen, lineaariseen talousmalliin. Selvityksessä kävi ilmi, että sekä natiiveille että omaksujille kiertotalousliiketoiminnan kehittämisenä motiivina on halu kehittää taloudellisesti kannattavaa liiketoimintaa, joka voi myös ratkaista yhteiskunnallisia ongelmia.

Kiertotalousorganisaatioita voidaan jaotella myös kiertotalouden liiketoimintamallien mukaan. Yleisesti tunnettuja kiertotalouden liiketoimintamalleja ovat resurssitehokkuus ja kierrätys, uusiutuvuus, tuote-elinkaaren pidentäminen, jakamisalustat ja tuote palveluna -mallit. Näitä malleja toteuttavien yritysten lisäksi tässä selvityksessä löytyi joukko ratkaisuja, jotka toimivat kiertotalouden mahdollistajana. Kävi myös ilmi, että liiketoimintamallit linkittyvät toisiinsa ja usein oli vaikea määritellä, mitä mallia ratkaisu edustaa.

Selvityksessä kävi ilmi, että sääntely voi sekä hidastaa että vauhdittaa siirtymää kiertotalouteen. Samoin selvisi, että sekä yritysten että kuluttajien keskuudessa tarvitaan lisää kiertotaloudesta, jotta muutos saadaan vauhtiin. Menestyviä kiertotalousratkaisuja yhdistäviä tekijöitä olivat tehokas viestintä asiakkaiden ja loppukäyttäjien hyödyistä, kyky skaalata paikallista toimintaa laajemmaksi, kumppanuuden kolmannen sektorin ja yhteisöjen kanssa, helppo toteutettavuus nykyisessä infrastruktuurissa sekä datalähtöinen lähestymistapa liiketoimintaan.

Selvityksessä esiteltävien 39 kiertotalousratkaisun vaikutukset ulottuvat niiden suoraa toimintaa pidemmälle. Ratkaisut tuovat kestäviä tuotanto- ja kulutustapoja yhä useamman ulottuville. Kiertotalousratkaisuilla voi myös olla merkittävä rooli YK:n kestävän kehityksen tavoitteiden saavuttamisessa. Tähän asti kiertotalouden hyötyinä on nähty pienempi tarve ottaa käyttöön uusia luonnonvaroja, ilmastokriisin torjunta ja vaikutukset paikalliseen elinympäristöön. Tietoisuus kiertotalouden sosiaalisista vaikutuksista on kasvussa. Näiden vaikutusten tunnistaminen on toistaiseksi vaikeaa. Selvityksessä kävi kuitenkin ilmi, että kiertotalousratkaisut voivat auttaa rakentamaan kumppanuuksia, jotka ovat välttämättömiä YK:n kestävän kehityksen tavoitteiden saavuttamiseksi.

Kiertotalouden avulla on mahdollista luoda uutta hyvinvointia samalla vähentäen hiilidioksidipäästöjä, ympäristön kuormitusta ja tarvetta neitseellisten materiaalien käyttöön otolle. Monet globaalit haasteet ulottuvat yhteiskunnan eri sektoreille ja vaativat systeemisiä ratkaisuja. Kiertotalous voi tarjota monia ratkaisuja. Mukaan muutokseen tarvitaan kaikkia joko soveltamaan nykyisiä tai kehittämään uusia kiertotalouden ratkaisuja.

# Sammanfattning

Vår utredning syftade till att hitta olika lösningar för cirkulär ekonomi som är livskraftiga och skalbara, som pådriver systemisk cirkularitet och som har exceptionellt positiva miljömässiga och sociala nyttoeffekter. Över 200 organisationer från hela världen skickade in sina lösningar för bedömning. I den här rapporten presenterar vi 39 enastående exempel på lösningar för en cirkulär ekonomi som skapar slutna materialkedjor och driver på den cirkulära övergången samtidigt som de är mycket relevanta i sin egen miljö. Dessa lösningar visar på fördelarna med cirkulära affärsverksamheter och hur olika organisationer i hela samhället kan använda cirkulärt tänkande för att öka värdet på sin verksamhet och sina framsteg mot att uppnå FN:s mål för en hållbar utveckling.

Organisationerna bakom lösningarna kan delas in i cirkulära "infödda", som har baserat sin affärsidé på begreppet cirkulär ekonomi, och cirkulära "adapters", vars kärnverksamhet grundas på en mer traditionell, linjär miljö. Både vad gäller "infödda" och "adapters" härrör de cirkulära innovationerna ofta från idén att skapa ekonomiskt lönsamma lösningar som kan påverka samhället. Båda typerna av organisationer är således aktiva för att driva på en systemisk cirkulär övergång.

Cirkulära organisationer kan även granskas ur ett perspektiv av cirkulära affärsmodeller. Brett accepterade affärsmodeller inom den cirkulära ekonomin inkluderar resurseffektivitet och återvinningsbarhet, förnybarhet, ökad produktivslängd, delningsplattformar och produkter-som-tjänster. Vår utredning avslöjade också cirkulära affärsmodeller som ofta fungerar som möjliggörare för en cirkulär ekonomi. Vi observerade även att det på grund av sammankopplingar mellan affärsmodellerna ofta är utmanande att definiera vilken affärsmodell en lösning tillhör.

Våra rön om den dubbla roll som regleringar kan utgöra som barriär och möjliggörare i den cirkulära övergången ligger i linje med den aktuella diskussionen. Samma sak gäller vår slutsats att bristande medvetenhet om cirkulär ekonomi fortfarande är ganska vanlig bland företag och konsumenter. Förutom delade utmaningar identifierade vi också vanliga teman som presenterades i de lösningar som har lyckats bli livskraftiga. Dessa omfattade en effektiv kommunikation av fördelarna för kunder och slutanvändare, tidig ekosystemintegrering, lokal start och skalning, viktiga partnerskap med tredje sektorn och samhället, enkel implementering i befintlig infrastruktur och en datadriven strategi.

De 39 lösningarna som presenteras i denna rapport är anmärkningsvärda vad gäller bidraget till en övergång till cirkulär ekonomi genom att de genererar effekter utanför deras omedelbara verksamhet. På olika sätt bidrar de alla till att öka tillgången på hållbar produktions- och konsumtionspraxis. Lösningar för cirkulär ekonomi har också en stark roll att spela för att uppnå hållbarhetsmålen i FN:s 2030-agenda (SDG). Medan fördelarna med en cirkulär ekonomi fortfarande till stor del upplevs via effekter på resursutvinning, klimatförändringar och den lokala miljön, ökar medvetenheten om de sociala effekterna långsamt. För närvarande är de sociala aspekterna fortfarande svåra för organisationer att identifiera, vilket tyder på en outnyttjad potential i att bidra till de sociala aspekterna av hållbarhet. Lösningar för cirkulär ekonomi hjälper också till att bygga partnerskap med många intressenter som är viktiga för att nå de globala målen.

Den cirkulära ekonomin har potential att skapa gemensamt välstånd och samtidigt minska påfrestningen på vår miljö och våra samhällen från koldioxidutsläpp och användningen av jungfruliga råvaror. Flera av världens mest akuta kriser sträcker sig över många olika system och hanteras därför bäst med hjälp av systemlösningar. En storskalig tillämpning av cirkulärt tänkande med hänsyn till alla aspekter av hållbar utveckling kan hjälpa oss att hitta de verktyg som behövs för uppgiften. Varje organisation och alla delar av samhället har en roll att spela i övergången till en cirkulär ekonomi genom att antingen förnya eller anpassa sig till cirkulär praxis.

# 1 Introduction

Minerals, ores, fossil fuels and biomass are among the main building blocks of our societies and everything we do, from transportation and technology to agriculture and housing. Every year almost 100 billion tonnes of raw materials are used globally, only 8.6% of which are reused; two thirds become wasted or emitted and their value is lost after a single use (International Resources Panel 2019). Our consumption levels and the resulting resource extraction and use are unsustainable and have a strong effect on climate change, environmental degradation and biodiversity loss (ibid.).

A circular economy is an economic model that seeks to reduce the consumption of materials and resources in an environmentally and socially sound way to a level that is within the planetary boundaries. The circular economy provides a tool to tackle global crises such as the climate crisis (Material Economics 2018) while providing business opportunities. This economic model focuses on maximising the circulation of materials and maintaining the value bound to them, so that waste of all kinds is avoided wherever possible. In a circular economy, manufactured goods are designed for repair, refurbishment, recycling and to last, so that products remain in use longer and material loops are closed. This can be achieved by advocating circular thinking in all phases of a product's life cycle, from design to use and ultimately to the product's end-of-life.

To bring down our raw material consumption and to increase the circulation of materials in our society, we need to transform our whole production and consumption system: rethink the ownership model of products, design things to last, share resources, use renewable materials, collaborate and co-develop (Orasmaa et al. 2020). In

a circular world, materials use is regenerative and cautious, with no waste but only different types of resources, and economic growth is decoupled from the consumption of raw materials – leading to both environmental and social prosperity. Policy development that enables the scaling of circular solutions and ensures that circular business models are competitive in relation to linear models plays an important role in ensuring a just transition to a circular economy.

Circular innovation has gathered momentum in recent years. More and more organisations are getting involved and advocating circular thinking. Further adoption of new circular business models can help create shared prosperity while reducing the extraction of virgin raw materials and contributing to carbon neutrality. Since the outbreak of the COVID-19 pandemic in early 2020, it has also become clear how a circular economy increases business resilience that supports the recovery of economies in times of unexpected disruption (Forslund 2020).

To inspire this transition, we set out to discover and make known some viable, promising, scalable and impactful circular economy solutions in the world. This report presents 39 circular economy solutions that are changing the way we think about materials and products and are enabling circular practices. The solutions are presented at the end of the report in the chapter “Solution profiles”. These solutions illustrate the strong business case of a circular economy across different industries, as well as the many environmental and social benefits circular practices yield. Through this study, we offer new insight into what drives circular innovation and what kinds of challenges and bottlenecks are hindering the further development of a circular economy.

## 2 Methodology

This study, which identifies circular economy solutions at the forefront of different geographies and industries, was performed through close collaboration between Sitra and Deloitte and drew on input from a broad range of international stakeholders. The study project was built around core teams from Deloitte and Sitra, with Deloitte providing an international project team with members from three continents and support from a global network of subject matter experts, and Sitra leveraging its vast partner network for circular economy expertise.

The project was supported by a steering committee that provided their insights throughout the project into the methodology, framework and assessment of the solutions. The members of the steering committee were Joss Blériot, Executive Lead on Institutions, Governments and Cities at the Ellen MacArthur Foundation, Kari Herlevi, Project Director on Circular economy for biodiversity at Sitra, David Hughes, President and CEO of Natural Step Canada and Executive Co-Chair of the Circular Economy Leadership Coalition, Veronique Hyeulle, Advisor at the European Commission, David McGinty, Global Director of the Platform for Accelerating the Circular Economy, William Neale, Advisor at the European Commission and Alan Young, Special Adviser at the Circular Economy Leadership Coalition.

The study was conducted in four phases.

1. Development of an assessment framework to guide the solution identification, analysis and selection throughout the project.
2. Global circular economy solution identification through a call for solutions and a subsequent sign-up survey.
3. Interviews with organisations to dive deeper into the solutions and their innovation paths, enablers and barriers.

4. Analysis and selection of solutions to be presented in the report.

Each of the phases are described in more detail below.

### Development of the assessment framework

Comparing different circular economy solutions is inherently subjective, as the solutions address different issues and their impacts vary. To bring structure to the assessment process and to improve the comparability between solutions, an assessment framework was developed. The framework was built on Deloitte's previous work on the circular economy as well as some of the existing circular economy assessment tools, such as Circulytics of the Ellen MacArthur Foundation (Ellen MacArthur Foundation 2020) and Accenture's Circular Economy Handbook (Lacey et al. 2020).

The framework was developed to highlight key features in an inspiring circular economy solution, such as economic, social and environmental impacts, links to business strategies, decoupling growth from resource dependency, greenhouse gas emissions reduction potential, just transitioning to carbon neutrality, economic and systemic impact and scalability, conceptual eminence, replicability considering geographic and economic constraints, and connection to the UN Sustainable Development Goals (SDGs).

The assessment framework contains 15 core variables in four main dimensions: economic and technical viability, geographic and industrial scalability, systemic circularity, and environmental and social impact.

- Economic and technical viability – this dimension assesses the extent to which a solution is financially viable, the business model logical and the techni-

cal implementation of the solution apparently feasible.

- Geographic and industrial scalability – this dimension seeks to determine the extent of opportunities the solution has for application and to assess the solution's dependence on specific sociocultural and regulatory preconditions.
- Systemic circularity – this dimension assesses a solution's contribution to circular transition through, for example, partnerships, policy advocacy, value chain integration and thought-leadership.
- Environmental and social impact – this dimension illustrates the type and magnitude of both direct and indirect positive impacts of the solution.

A solution with a strong performance in these dimensions is well positioned to inspire others and drive the transition to a circular economy. The assessment framework and the qualities that define an inspiring circular economy solution are presented in Figure 1.

## Identifying global circular economy solutions

To find potential solutions, an open call was put out in March 2020, and disseminated through Sitra and its partner network's social media channels. Additionally, the international team and Sitra's partner organisations actively scouted for potential candidates on all continents through multiple channels. All the organisations that responded to the call or were suggested for inclusion in this report were asked to fill in an online sign-up survey to enter the selection process. The survey asked for information on all the dimensions in the framework, as well as for some basic information on the solution and the organisation behind it.

The resulting group of over 200 signed-up solutions was subjected to a preliminary assessment against the dimensions specified in the framework, with special emphasis placed on viability and environmental and social impacts, as well as on a set of variables from different parts of the framework illuminating potential for inspiring the field. Additionally, to ensure a wide coverage of different types of solutions in various parts of the world, the geographic diversity and circular business model of the respondents were considered in the preliminary assessment. To reduce subjectivity, all solutions were peer-reviewed not only within the international team, but also by Sitra's circularity experts and partners. Based on the preliminary assessment, the expert panel selected a little over 50 solutions to be included in a shortlist and to be further examined via interviews.

## Interviews with organisations

Interviews with the shortlisted organisations were held through digital channels in spring 2020. The interviews were conducted by Deloitte's international project team. The purpose was to gain additional insight for a more detailed assessment of different variables. The solutions were then assessed against the framework, again factoring in geographic and business model diversity, to ensure showcasing a broad and inspiring take on the circular economy in the presented solutions. The interviews were also used to gather information on the various circularity innovation paths taken by the shortlisted organisations, on the barriers the organisations have encountered along the way, on the role that policy and regulation have played, on the contributions to the UN's SDGs, and on drivers enabling circularity that have helped bring the solutions to life.

## Final selection of the solutions

As the aim of the study is to drive the circular economy transition, the solutions selected to be presented are not a graded list of world's best solutions, but rather seek to make known inspiring solutions in different regions. The solutions were assessed and chosen by a group of experts from Sitra, with support from Deloitte's project team and Sitra's partner networks. The reason the solutions were selected differ; some of the solutions are widely viable, some are more niche, while some embody underrepresented fields or geographic regions or help solve a pressing underlying problem.

## Limitations to the methodology

There are some limitations to the methodology that may have affected the results of the study.

One of the most important limitations to the methodology was the inherent subjectivity of a circularity assessment. The risk of possible biases was mitigated by adhering to the framework and its content for assessment, ensuring interviewer impartiality and conducting various peer reviews within the project group as well as with Sitra's circularity experts and partners. While the actions ensure that the results reflect assessment from multiple perspectives, this report may nonetheless reflect certain subjective views held by the group of experts.

The other main limitation to the methodology was the dependence of the study results on the circular organisations' willingness or ability to actively take part in the study, since the information for the study was gathered almost exclusively through the sign-up survey and interviews. The timeline for conducting the study was quite ambitious, which may have affected the ability of some organisations to respond. Additionally, organisations may have had limited resources to take part. It must also be noted that the study took place

during the global outbreak of COVID-19, which is likely to have diminished some organisations' ability to actively respond.

The study was conducted mainly in English. Despite best efforts to overcome language barriers, this choice might have hindered the outreach to some geographic regions. Additionally, the configuration of the teams behind the study may have affected the outreach, as the call for solutions circulated predominantly among European and North American partner networks. The use of circularity terminology may also have affected which organisations identified themselves as a target audience. Therefore, it is likely that some inspiring and impactful solutions were overlooked in this study, since they were not among the respondents. Collaboration with and emergence of new regional circular economy advocacy groups might be needed in the future for a better reach across all geographies.

**Figure 1: The framework contained 15 core variables in four main dimensions: economic and technical viability, geographic and industrial scalability, systemic circularity, and environmental and social impact.**

|                                 | #  | Category                                     | Description   |
|---------------------------------|----|--|---|
| Viability                       | 1  | Business model viability                     | The solution builds on or lacks a coherent business and revenue model, link to identified client demand, and a competitive strategy connected to classic approaches.  |
|                                 | 2  | Economic viability                           | The extent to which the solution has proven economic viability through already showing a track record of the viability of the business e.g. in terms of funding, cash flow, profit, market entry.   |
|                                 | 3  | Technical viability                          | The solution's ability to show technical viability through practical innovation and access to the required technologies/ processes/ skills over the long-term   |
| Scalability                     | 4  | Scalability to other geographical areas      | Existence or absence of geographical particularities that affect the solution's ability to succeed in other regions.  |
|                                 | 5  | Scalability to other businesses/ industries  | The solutions applicability to other business environments or different sectors.  |
|                                 | 6  | Size of the underlying problem               | Urgency and impact of the problem addressed by the solutions. Measures solution's potential contribution to the society from a wider sustainability perspective, with link to SDGs.   |
| Systemic circularity            | 7  | Impact on the growth of the secondary market | The solution's potential to grow the secondary (materials) market by reducing waste sent to landfill and/or increase recycling rate<br>The solution could improve the quality and quantity of recyclates and their eventual absorption by the industry              |
|                                 | 8  | Active contribution to CE awareness raising  | The solution has a role in Advocacy and circular ambassadorship to external stakeholders.   |
|                                 | 9  | Ecosystem integration                        | Extent to which other organisations and business partners are involved with the solution - partnerships based on collaboration and joint effort rather than traditional business relationships.   |
|                                 | 10 | Purposeful vision                            | Ambition and quality of internal processes in striving towards circular economy impact  |
| Environmental and social impact | 11 | GHG emission reductions                      | The solution's potential to reduce GHG emissions in the value chain   |
|                                 | 12 | Environmental impact of the solution         | The solution's potential to reduce negative environmental impact through CE, e.g. use of virgin raw materials, waste streams, atmospheric pollution, water consumption, soil degradation, loss of biodiversity (Connection to environmental targets under the SDGs) |
|                                 | 13 | Social impact of jobs created                | How does the solution influence employment - To what extent it affects (safe and fair) jobs both downstream and upstream.<br>Leading solutions create employment especially to minorities, other vulnerable groups or groups that are difficult to employ.          |
|                                 | 14 | Fairness and inclusion of consumers          | The solution's potential to positively contribute to quality of life for consumers, and enabling of consumer behavioral changes (green lifestyle) through inclusivity and empowerment.  |
|                                 | 15 | Building community resilience                | The solution's impact on the long-term well-being of communities that rely upon and enrich the solutions's value chain, and empowers its workers.   |

# 3 Existing and emerging circular economy business models

The concept of a circular economy is relatively novel and still evolving. When circular thinking started to emerge in the agendas of businesses and governments in the 2010s, a set of business models was identified by the global circular economy community to present what advocating circular thinking by businesses can mean in practice. Sitra divides the different circular business models into five categories: product-as-a-service, renewability, sharing platforms, product-life extension, and resource use and recycling.

The five models represent the technical “core” of a circular economy; actions through which organisations can directly save natural resources and consequently their operational costs or generate new models of ownership and product offering. This study revealed that there are also other ways of value creation in a circular economy. In particular, business models focused on fostering circular practices and enabling other solutions that drive the transition to a circular economy have a strong presence in the group of solutions observed in this study. Enabler business models have previously been less represented in the circularity discussion although they are crucial for creating momentum for and mainstreaming circularity. To better reflect the discussion, development and acceleration of a circular economy, it is important to revisit and expand our understanding of existing and emerging circular economy business models.

## Circular business models – the core

**Product-as-a-service** redefines the approach to ownership, creating a service concept around a product rather than selling the product itself. In this business model the

customer pays for the end result of a service provided and the ownership of the product remains with the organisation itself. Traditional product-as-a-service business models include car rental operators and libraries. The business model can increase the usage rate of a single product, while decreasing the total amount of produced products, which improves resource efficiency and minimises waste, especially for consumer electronic goods, clothing and even food and lighting. The potential of the business model for transitioning to a circular economy and creating business potential is very high (Orasmaa et al. 2020). The solutions in this report representing this business model include BlueMovement’s home-appliances-as-a-service, Tamturbo’s compressed-air-as-a-service – which enables industrial operators to use compressed air without owning compressors – and Blendhub’s food-as-a-service, where delivery is carefully matched to needs.

Organisations with a **Renewability** business model either incorporate renewable or recyclable materials or renewable energy in their product design and manufacturing processes, or themselves produce renewable or recyclable materials or renewable energy for the market. Renewability is essentially about the use of regenerative resources and replacing non-renewable inputs with alternatives, some of which can be continuously reused. Examples representing this business model include Teemill’s renewably sourced t-shirts and BC Materials’ environmentally friendly building materials from excavated earth.

**Sharing platforms** help to optimise the usage of goods and resources and extend their life cycles through renting, selling, sharing and reuse. The platforms thus enable

*"The enabler models increase awareness and knowledge of the circular economy and support the creation of circular ecosystems."*

their users to act more sustainably and optimise their resource use, while often simultaneously contributing to social cohesion and community well-being. The business domain is rather new and fuelled by digitalisation. Examples representing this business model include FoodRescue.ca's and OLIO's food-sharing platforms that distribute excess food, and FLOW2's asset-sharing platform, where all kinds of resources can be shared.

**Product-life extension** business models aim to substantially increase the life of a product and therefore improve sustainable resource use. Organisations that employ this business model develop solutions that support the use of a product in its original form for as long as possible or alternatively enable multiple instances of reuse. The business model includes maintenance, repair and refurbishment services, but also designing to ensure the long life of a product, through maximising modularity or reparability, or making it easier to upgrade parts. The solutions in this report representing the business model include SunCrafter's used solar panel refurbishment and distribution business, Rype Office's and Green Standard's redistribution of used office furniture to new users, and Odakyu Electric Railway Company's refurbishment of old buildings into apartments to support community building.

**Resource efficiency and recycling** is one of the most common circular economy business models. Resource efficiency often translates to operational efficiency, which in turn improves profitability, making the business model an appealing domain to pursue. As regulatory and tax incentives for supporting the secondary raw materials market develop, the business model may in

time also become more lucrative than it currently is. The business model includes the development and use of material and energy-efficient solutions as well as the collection and reuse of products and raw materials that have reached the end of their life cycle. In the 39 solutions presented in this report, examples representing this business model include Li-Cycle's resource recovery technology for lithium-ion batteries, Carbon's agricultural biofilter, Renewcell's chemical textile recycling and remanufacturing technology Circulose, and Cambrian Innovations' EcoVolt waste-water treatment solution.

## **Circular economy enablers**

New business model groups that can be regarded as enablers of the circular economy emerged during the study. The enabler models increase awareness and knowledge of the circular economy in various target groups, support the creation of circular ecosystems and offer tools for obtaining and managing information across circular value chains. We observed two groups of enabler business models: circular communications and data management platforms. Additionally, a business model of compensation services may be emerging in the circular economy space.

A **circular communications** business model is based on services that enable and support the circularity actions of others through various types of communication. The area can include such services as training in sustainable materials management and reverse logistics in the supply chain, raising awareness of the environmental and social impacts of a circular economy, or giving recycling advice. The focus is on educating and increasing awareness of the circular economy among individual consumers, organisations, governments or other public representatives, with the aim of creating societal pressure to change current economic

practices. Whether the emergent influencer economy has the potential to increase circular communications with consumers is still uncertain, but warrants further study.

In the selected 39 solutions, this business model is represented by, among others, Inchainge's circular economy simulation game "The Blue Connection", in which players operate an imaginary manufacturing plant, and Ghost Island Media's "Waste Not Why Not" podcast, which focuses on raising awareness of the circular economy.

**Circular data management** platforms offer information services and tools to support decision-making for and facilitate exchange between individuals and organisations. These platforms aim to improve access to and the availability of data and to create transparency around the material content of products. Data management platforms can also help to measure the impact of circularity on an organisation's operations and thus support businesses in achieving their circular economy targets. For example, data is often fundamental to optimising product and material flows internally and across organisations, to ensuring proper recycling of products at the end of their lives, and to retrieving materials from products. Solutions that represent this business model include Excess Materials Exchange's materials matchmaking platform, SundaHus' online platform to support materials choices and management activity in the built environ-

ment, and Circular IQ's circular transition indicator software that supports the emergence of circular supply chains.

## **Linkages between business models**

The study findings revealed a strong interconnectedness between the circular economy business models. Distinctions between models may be quite academic, and not every solution or organisation operate simply under one business model. Some "circular champions" strive for systemic circularity at their core, which is why their solutions represent a combination of different circular economy business models. For example, the regenerative agricultural solutions of Soilfood were categorised under renewability, but also include elements from resource efficiency and recycling and from circular communications.

These findings suggest that it is vital to consider the different circular economy business models flexibly. Deconstructing or recombining the business models into further categories, for example to address process optimisation and secondary materials separately, is at least a valid thought exercise, which may support future research and development efforts as well as identification of inspiring solutions that do not quite fit under any of the current business models.

*"It is vital to consider the different circular economy business models flexibly."*

## 4 Impacts of circular economy solutions

Traditionally, the benefits of a circular economy are perceived more from the environmental impact angle than from the economic model's contribution to social well-being. However, in recent years, the social impacts of a circular economy have also slowly become more prominent in research and other discussions (Padilla-Rivera et al. 2020). To ensure that the solutions have positive systemic impacts across the societies in which they operate, this study carefully considered both the environmental and social impacts of circular economy solutions. The assessment focused on direct impacts, but also accounted for the potential indirect impacts. Organisations themselves assessed their impacts upon signing up, and the analysis was supplemented with information collected from the interviews and supported by the professional expertise of the working group.

### Environmental impacts

The study considered environmental impacts related to both the global environment and local ecosystems. Areas of particular interest included the solutions' contribution to the global issues of reduction of greenhouse gas emissions, primary energy use, virgin materials, fossil fuel-based raw materials, hazardous substances, waste streams to incineration or landfill, and land use or land-use change. In terms of local environmental impacts, the environmental impacts considered the solutions' contribution to the reduction of fresh water use in water-stressed areas, nutrient or chemical leakage to land or water, pollution to air, water or soil, soil degradation or the impact on restored or conserved natural carbon sinks or other ecosystem services.

A clear majority of the solutions selected for this report stated having a significant positive impact on the reduction of greenhouse gas emissions and of waste streams. Moreover, almost 90% of the solutions estimated to have at least some impact on the reduction in the use of virgin raw materials, fossil fuel-based raw materials and primary energy use.

Most of the selected solutions also have a positive impact in several other categories. Over 60% of the organisations said their solutions have an impact on reducing pollution to air, water or soil, with 41% deeming this impact to be significant. Thus, many of the solutions focus on solving local environmental problems. For example, Safi Organics' decentralised fertiliser production technology can directly improve soil health, decrease acidification and reduce aquatic pollution, which in turn affects ecosystems both in the soil and underwater.

However, only 15% of the organisations stated that they have a significant positive impact on ecosystem services and a third of the organisations indicated that they do not know whether their solution has an impact on these issues. Additionally, roughly a quarter of the organisations stated that they do not know their solution's impact on freshwater use, nutrient or chemical leakage to land or water, pollution to air, water or soil, other soil degradation, or on natural carbon sinks.

Moreover, the linkage between a circular economy and biodiversity is not clear to a majority of the listed circular economy solutions. The current rate of loss of biodiversity is a problem of comparable scale with climate change, with one million species facing threat of extinction (IPBES 2020). Since one of the main drivers of

biodiversity loss is the overuse of natural resources, a circular economy is clearly key to solving the problem. However, it currently seems that organisations behind circular economy solutions are unaware of or unable to determine the impact they may have on biodiversity, in spite of their potential to contribute to slowing down the loss of biodiversity. For example, Covestro's salt recovery and reuse technology for industrial processes prevents salty waste water from entering waterways, which reduces the impacts on aquatic ecosystems. The connection between a circular economy and halting the loss of biodiversity therefore seems to present significant untapped potential and may present the next big communication challenge.

## Social impacts

The circular economy is a tool that can and should be used to help solve challenges regarding social well-being and to move towards a fair, carbon-neutral economy. The social dimension of a circular economy has been less observed and most studies have focused on identifying the environmental and business potential of circularity (The International Institute for Sustainable Development and Sitra, 2020). In this study, the solutions' contribution to social sustainability was examined through the impacts on increased employment and employee health and safety, with additional focus on the employment of minorities and other vulnerable groups. Emphasis was also given to the improved realisation of human rights and social equality in the form of access to education and sustainable consumption choices, as well as to improved consumer well-being and community resilience.

Over 60% of the organisations stated that their solution has a significant positive impact on improved access to sustainable consumption choices. While sustainable consumption choices may still often come with a premium price or exclusive access,

these solutions focus on making sustainable living easier or more affordable. For example, Renewcell is collaborating with H&M to bring sustainable fashion to the masses with its chemical textile recycling solution Circulose. Overall, nearly 90% of the organisations stated to have at least some positive impact on access to sustainable consumption choices.

Over 70% of the organisations estimated that their solutions improved consumer health and well-being or community resilience and social well-being, and for almost half of the solutions this impact was estimated to be significant. Community resilience and social well-being in a solution's value chain can stem from, for example, utilities' service reliability, access to food, social stability or resilience against climate change-related impacts. In the solutions covered by this study, these impacts are often generated through a decrease in toxic materials in the community, increasing access to locally sourced materials and creating local circular business ecosystems. For example, DSM-Niaga's circular carpeting solution uses only non-toxic materials, which helps to preserve good air quality and reduces the risk of asthma and allergies to the client. Increased employment and improved employee health and safety were identified to be affected by around 60-70% of the solutions.

However, the interviews revealed that the organisations often struggled to explain their social impacts and to describe these impact mechanisms, revealing how the social impact component is still underdeveloped in a circular economy in comparison to the environmental impact aspect. Many organisations could also not estimate their social impacts, especially those relating to social rights. Between 25 and 30% of the organisations did not know whether their solution increased the employment of minorities or other vulnerable groups, or whether it improved the realisation of various human rights.

The findings indicate that circular economy solutions are, in most cases, still not fully optimised for social issues. Furthermore, the findings indicate that social issues are not usually a very strong motivator for the transition to a circular economy. However, there are also some organisations with strong social missions among the solutions. Ten organisations claimed to have a significant positive impact on the increased employment of minorities or other vulnerable groups. For example, Aakar Innovations' solution, a biodegradable sanitary pad, supports the employment of local women entrepreneurs in developing areas, and TECO's recycled plastic school furniture supports education in Burkina Faso.

## **Understanding and measuring impacts in organisations**

The maturity and ability of the organisations to understand and measure the positive impacts of their circularity vary markedly. Perhaps surprisingly, many organisations are not actually performing any measurements regarding their environmental and social impacts. As the size or general maturity of the organisation does not appear to be a factor in measuring maturity, the reason may be in a lack of standardised measurement protocols for a circular economy. Supporting measurement through tools and protocols could contribute to improved understanding and communication of the impacts of circular business.

Similarly, it was discovered that organisations have different levels of maturity in their ability to identify and discuss potential negative impacts or risks from the solutions on the environment or on social aspects. Many organisations initially reported having no negative impacts at all, despite having physical production processes or widespread supply chains. Upon further examination it appears that it is possible that some organisations compared the potential negative

impacts of their solution against a “business-as-usual” solution, and found them negligible, or concentrated only on the application of a solution rather than assessing its entire value chain.

In general, the organisations behind the solutions are better at identifying their environmental impacts than their social impacts. It is also possible that there is an underlying unwillingness to discuss potential negative social impacts or risks. Mostly only solutions that are based on a social mission can profoundly discuss their social impact and present data or other evidence to support the impact narrative.

This may be due to a lack of discussion on social impacts of circularity until recently, but it may also be related to social impacts often touching on complex systemic or societal problems that are currently quite removed from or feel alien to entrepreneurship. Clearly assigned value of social impacts in organisations and in society could bring social aspects closer to the core and everyday life of different organisations and encourage for-profit organisations to prioritise social aspects. Valuation of social impacts is therefore a necessary if dauntingly complex challenge to discuss and seek solutions to, in order to ensure a just transition to a circular economy as well as to drive innovation towards solutions that bring significant positive social impacts.

It was also noted that it is much easier for organisations to understand and estimate the direct impacts of their solution than the indirect impacts. Indirect social impacts – positive or negative – are the most difficult for organisations to identify, which may be a sign of a lack of understanding of systemic impacts and impact chains, and an inability to place a solution within this context. For example, improved capacity to communicate on indirect impacts could help organisations to attract investment and customers and circular economy advocacy groups to push for favourable regulatory changes.

# 5 Drivers of and challenges for a circular economy

This section explores more in detail what is driving the development of circular economy solutions – why established organisations start to advocate circular practices and what makes start-ups adopt a circular business model from the start. We also discuss the challenges that organisations face with realising their circular economy business, and present ideas on how the development of circular economy solutions could be further fostered to accelerate the transition to a circular economy. The findings are based on the interview phase of the project.

The economic logic of circular business models is clear but the drivers of the circular economy seem to lie more with market opportunities than market efficiency. Most of the circular economy solutions in this study are still pioneers in their own field and the business incentives for a circular economy often fall under resource efficiency and recyclability. In light of this, the viability of circular economy business models should be assessed against the long-term visions of organisations.

## Pathways to circular innovation

Looking more closely at the solutions and the origin of their circular innovation, we discovered that there are two types of organisations behind circular economy solutions: the circular “natives”, who have based their business idea on the concepts of a circular economy from the start, and the circular “adapters”, whose business basis is more traditional, but who have found ways to apply circular economy principles (see also Annex 1).

We found that the motivation for starting a circularity journey was similar for both

“natives” and “adapters”, and most often based on a desire to make a specific impact or to drive systemic circularity. Economic motivations to adapt to a changing operating environment were in a clear minority. It may be that society’s journey to circularity has still not progressed far enough to create innovation based solely on a perceived competitive edge from circularity.

In our study, we identified three main starting points from which organisations could begin their circular economy journey: facing a specific environmental or social problem; becoming interested in advancing the overall circularity of a specific industry or practice; or wanting to ensure the long-term viability of their business.

A substantial share of the organisations behind the circular economy solutions assessed for this study started with a **clear mission related to a particular problem they wanted to solve**. The problem was often something quite specific that the founder(s) had experienced or observed first-hand, had a personal passion about or was related to environmental or social issues in the industry or community. For example, the idea for the food-sharing platform OLIO was born out of the founder’s frustration at having to throw away edible food upon moving house. In other instances, the mission was related to removing a particular barrier that organisations struggle with when seeking to make the transition to a circular economy. Also, in these cases, the solution often stemmed from a personal encounter with the problem and the role of potential business benefits was not the main factor in the motivation to innovate.

The second pathway seemed to be driven by the circular transition as a whole: as the circular economy narrative grows stronger and extends further, **organisations and**

**individuals are starting to proactively explore how to foster circular practices in their industry or in society.** Rather than stemming from a desire to solve a specific issue or a personal passion to be a “cause champion”, the solutions are often a result of analytically looking at the big industrial challenges we are facing over the next 10 to 15 years as a whole and actively seeking out suitable niches to operate in. While the second pathway is mainly driven by the aim to drive systemic circularity, the organisations did consider the most potential niche for their solutions to thrive in. Examples of this are the traceability platform Circular, whose founders simply chose a challenge – the lack of transparency in raw material chains – to be addressed, and Compugen, which started the Green4Good programme after seeing how poorly organisations managed the end-of-life of IT assets. Others on the same pathway had decided to target all parts of their operations and value chain with circularity updates simultaneously. An example of this is Acciona, whose business divisions work closely to bring circularity into a traditionally linear industry, infrastructure.

Some of the solutions on the second pathway started from a more business-oriented perspective, such as clients’ direct requests, especially with emerging circular business models that support circular practices. The clients might have articulated a need or interest in certain circular economy services that could help them to tackle their circularity challenges. The materials data management platform for the construction industry, Sundahus, is a good example of this. The organisation started to focus on improving the transparency and availability of materials data as they had clear demand signals for such a solution from those in the construction industry.

For some of the solutions we studied, circular innovation stemmed from complying with regulation and keeping up with changing stakeholder expectations to **ensure**

**the long-term viability of business.** The organisations behind those solutions are focused on trying to ensure economic viability in the future, either from a licence-to-operate point of view or from a resource-dependency point of view. Thus, circular innovation is sometimes driven by traditional business metrics or regulation, especially for some circular “adapters” extending their business to the areas of resource efficiency and renewability. For this innovation pathway, the circular practices could be seen as a way to bring substantial cost savings and generate new revenue flows, while positively influencing the brand value. Especially in the less-developed markets, cost savings are often the main reason for adapting circular practices in our studied solutions.

## **Policy and regulation – barriers or drivers?**

Regulation and policy play a very significant role in how circular innovation develops. New regulation and policy can be designed to drive the transition to a circular economy. However, if the political environment does not support a circular economy for some reason, regulation can also be a hindrance.

Regulation is an important driver of circular innovation since it can cause entire sectors to change their practices. Regulation can, for example, modify the supply and demand of materials, increase the value of what would otherwise become waste, and change the design and production requirements to those supporting a circular economy. Many of the organisations interviewed for this study reported that their solution might not exist without a specific regulation. Moreover, **policies and regulations that guide industry development and encourage demand for circular economy solutions are something** that the organisations behind the solutions called for, to increase the pressure to make the transition to a circular

economy and therefore create more demand for circular economy solutions.

Absence of circularity-building regulation seems to be a notable challenge especially for solutions that strive to generate new products from secondary raw material flows or which deal with renewable energy. The development of sufficient regulation can also be slow in new markets. For example, as transportation becomes more electrified, a need for proper regulation on recycling batteries from electric vehicles according to circular principles is needed to enhance the circularity of an emerging market. Here, regulation such as taxation could be used to increase the price of unsustainable materials or energy and decrease the price for secondary materials or renewable energy to make them more attractive. Gate fees at landfills and extended producer ownership are good examples of using regulation to increase the value of waste products and foster recycling. For example, the demand for Optel Group's Intelligent Supply Chain Platform's tracking technology and software has been expedited by mandates on recycled materials content.

On the other hand, if regulation is outdated or slow to change and favours the linear economy, it can also pose challenges and even entirely prohibit circular practices. **Existing policies and regulations can act as impediments to circularity** by prohibiting the exchange of resources or the reuse of certain products or materials, for example. Being encumbered by outdated regulation can be very difficult and time-consuming, which hinders the scalability of circular economy solutions. This challenge is especially notable for solutions that strive to reorganise material flows, such as sharing platforms or the production of renewable materials. For example regulation has hindered the use of the Dutch FLOW2 resource exchange platform by pharmacists for exchanging medication to minimise waste.

In the European Union, the legislative framework has recently developed in a direction where it works in favour of the

development of circular economy solutions, for example with its binding targets on materials recycling and the legislation on eco-design. In addition, the EU Single Use Plastic guidelines and similar, upcoming regulation in the USA are boosting Magnum's ink technology, which allows consumer brands to meet the requirements for their packaging. Meanwhile, some aspects of the regulation, especially those related to the use of secondary raw materials, were considered to be insufficient by some of the interviewed organisations. In North America, legislation is less of a driver for a circular economy in comparison to Europe, where legislative sensibilities are different. Similarly, the organisations behind circular economy solutions in Africa reported that cost-efficiency was the main driver rather than legislation.

Where supranational regulation is lacking, national policies can still help boost some of the solutions. For example, regulation in the Brussels area regarding excavated earth mass helped create a market for BC Materials' excavated earth construction materials solution.

There are also a lot of **gaps where policy and regulation do not yet exist** for circular economy solutions. In these cases, there are no adverse effects from legislation on the development of circular economy solutions, nor any guiding regulations that could support the transition. In these spaces, the existing circular economy solutions may take a strong role in creating regulation, but would most likely also need strong support from local communities and governments to take root.

## Shared challenges

Regardless of whether they are driven or hindered by regulation, the circular economy solutions must still find their place in a mostly linear society, where circularity may not be supported as much as it could be. Based on the findings in our study, there are

some common challenges that the solutions have faced on their innovation and development path, in addition to the solutions' varying relationships with regulation. These challenges are: a lack of awareness or understanding of a circular economy among businesses and consumers; the psychological, effort-based and time-based switching costs that customers and stakeholders perceive; resistance to change by industries; the inability to formulate their own value proposition; and general challenges related to technology and business development.

**Lack of awareness and understanding about the circular economy** makes it challenging to establish partnerships and attract investment in certain geographies. Without a clear understanding of the underlying problem and the benefits of circular economy solutions, the task of illustrating the value of a circular economy solution falls onto the innovating organisation and can be quite difficult or heavy to undertake. In some instances, organisations have had to communicate their message without referring to the circular economy at all because of the customer's unfamiliarity with the concept. In many cases, circularity is discussed within the spheres of plastic-free or zero-waste solutions, with no mention of circularity.

A significant challenge related to both awareness and regulation is the **resistance by industries to change their current practices**. Deploying circular economy solutions to well-established, complex industrial systems can be extremely difficult, as it may require, for example, the reconfiguration of processes and protocols, the establishment of new partnerships and a change in customer base. For the transition to take place, the legitimacy of circular economy solutions should be supported with both increased awareness and changing policy and regulation. Often the resistance to change is coupled with profitability; as long as the use of virgin raw materials is substantially cheaper

and more readily accessible than the use of secondary or renewable raw materials, the industries, as well as consumers, will resist the transition. Similarly, cheap fossil fuels hinder the development of the renewable energy market. Introducing incentives and subsidies that drive circularity, and removing detrimental ones, could be an effective way to lower the threshold for change.

**The psychological, effort-based and time-based switching costs that customers and stakeholders perceive** to experience can be difficult to overcome, especially for solutions that require drastic behavioural change. As an example, switching to a product-as-a-service instead of owning may require a leap of faith in certain industries. Building trust for a new way of operating is often one of the barriers to scaling and can also hinder entering the market and attracting customers.

Based on the assessment of the solutions, in some cases solutions that yield great environmental and social benefits do not have a strong customer value proposition, which creates **difficulties in entering the market**. From the organisation's part, this indicates a lack of understanding of what the clients need and are willing to pay for. While the problem is related to business development, circularity-driving regulation could help by promoting the positive aims of the circular economy.

Additionally, **circular economy solutions face similar challenges related to any technology or business development**. These challenges are specific to the activity of the organisation and not explicitly related to the circular economy. Technology development is time-consuming, which translates to a need for funding in the development and testing phases of the solution. Directing both private and public investments to the development of sustainable circular economy solutions that improve environmental and societal well-being could help push the development of these solutions further and support the transition.

## 6 The winning recipe for viable circular economy solutions

While the organisations behind the solutions struggle with commonly shared challenges, we also discovered some common themes among the solutions that have been successful in turning a circular vision into a viable business. The “ingredients” are an ability to operate in a changing environment that does not yet fully support transitioning to circularity and having the attributes that are common to circular economy solutions but perhaps less represented in linear, business-as-usual solutions. The themes are not all present in all of the solutions, but in many cases the organisation behind the solution has applied more than one of these components for a “winning recipe”.

### **Clear and effective communication on the value of the solution to customers and end users**

This ingredient is applicable to all types of innovation and is not necessarily circularity-related in itself. However, circular innovations are still often built from an “invention first” perspective before then trying to find demand, which may prove challenging. The solutions that have succeeded in communicating their value to their customers and stakeholders seem to experience fewer difficulties in securing revenue and rely less heavily on external funding than circular economy solutions built solely on impact or efficiency goals. The solutions have often been built for market from the start and have included a revenue in an early phase. The organisations behind the solutions have also focused on and invested heavily in understanding their customers and their journey. The value of the solution is not necessarily framed as advancing circularity but could

also be connected to a pressing environmental or social problem or be to do with other values such as reducing costs or saving time. In consumer business, environmental benefits as well as product quality and health aspects seem to be growing drivers of demand.

### **Early ecosystem integration**

Based on this study, organisations with successful solutions do not wait for their product to be finished but engage with potential clients and other relevant stakeholders, in either the same location or industry, in the early phases of development. This helps them to ensure that their solution suits the clients’ existing processes and also responds to their goals and aspirations in the long term. For example, when developing their plastic-free barrier boards, Kotkamills collaborated with clients to ensure that the products would suit the existing board recycling processes and infrastructure. While this ingredient is likely to be significant for all new innovations, for circular economy solutions it is key to overcoming some of the shared challenges, such as perceived psychological, effort-based and time-based switching costs.

Collaboration with large well-known organisations is another success factor in attracting customers and finding the right partners to invest in sustainable solutions and to develop circular economy solutions. Early ecosystem integration and collaboration with well-known fashion brands was important for the two fashion recycling technology solutions, BRING by Jeplan and Circulose by Renewcell. Securing these key partnerships helped the organisations to

ensure the two most crucial supply-and-demand factors of their solution – the supply of old clothing and the demand for the recycled fabrics.

### **Easy implementation in existing infrastructure**

Similarly, especially for the manufacturing solutions, developing a product for an existing infrastructure and current processes minimises the need for the intended clients to make changes and can help in operating in a non-circular business environment. By avoiding reconfiguration of infrastructures or processes, these solutions also make good business sense to the clients. For example, the circular air-compressor manufacturer Tamturbo's product can seamlessly replace an old air-compressor, and the solution pays off in a short period of time. Additionally, the successful solutions sometimes emphasise easy implementation by an external partner, which helps them to scale to new areas. For example, SunCrafter's redistribution scheme for used solar panels targets regions with low energy access and no grid connection and operates through resellers, who have the local knowledge and network.

### **Local start and scaling**

Interestingly, many of the successful circular economy solutions have started their operations locally or hyper-locally, when they have identified a pressing environmental or social problem. The solutions are also scaled in co-operation with local stakeholders of various communities, through local hubs and micro units, rather than growing in a more traditional way of expanding business. For example, the food-sharing platform OLIO operates on a hyper-local, neighbourhood basis, and has relied on close partnerships with local community groups to mobilise the community around the issue of food waste and to advocate the use of the solution.

Solutions that can successfully be scaled globally through these spiderwebs of local hubs often have an operational model that is easy to replicate and needs minimal tailoring to fit each location. The business model potentially also includes licensing of the model. For example, the regenerative agricultural solutions of Soilfood are designed for local agriculture and the products are made from the side streams of local industrial partners. The solution has been scaled to neighbouring countries, where the concept is replicated with local industrial partners and sold to local clients, and there is good potential to scale further.

Locality and close co-operation with both the public and private sector appear especially crucial for solutions that aim to radically change consumer or business practices. Collaboration with the public sector might be needed to create legitimacy or gain access to resources. For instance, the recycling platform Live Love Recycle from Beirut was initially developed with private partners but later began collaboration with the municipality to scale their solution further within Beirut and tackle corruption in waste management. And CCI Bioenergy is providing its technology to the City of Toronto to support the production of renewable energy from organic waste.

### **Key partnerships with the third sector and the community**

Partnerships with those less represented by traditional business operations, such as NGOs, local community organisations, research institutions and charities, seem to be a key ingredient for circular economy solutions. These partnerships support organisations in different development phases, from technical configuration to piloting and implementation. For example, Rubicon's waste management software was developed in collaboration with renowned tech institutions and environmental organisations.

Collaboration with circular economy advocacy groups and research institutes can give organisations valuable external insight and help them understand how to proceed further, while increasing legitimacy. Collaboration with social advocacy groups and participation in community building can also help to articulate the benefits of the solution to the public. For the circularity measuring tool Circular Transition Indicators, the World Business Council's for Sustainable Development (WBCSD) uptake of the tool has been and continues to be a key element for its success.

Additionally, the organisations that partner with the third sector and the community often also work in close co-operation with the local public sector (see above in “Local start and scaling”).

### **Data-driven approach**

The use of digital solutions to measure, store and analyse data is a central element among the circular economy solutions. Digital solutions can help organisations to track

material flows, measure circularity and impact, find new business opportunities and optimise resource use, and thus improve their own internal operations and profitability. Some organisations have also developed supporting digital services for their clients to better manage or use their circular economy solution.

Many solutions are “all about the data” and their businesses focused on developing digital tools that support circularity. For example, the circular data management platform Sundahus and the digital material matchmaking platform Excess Materials Exchange collect materials data and make it available for their clients to support their circularity endeavours.

Other solutions rely heavily on digital solutions to help the end users and to simultaneously collect data to better manage and further develop their solution. For example, Food-as-a-service platform Blendhub has developed analytical software that can improve traceability, security and prediction of global food supply chains and help their clients to reach new markets.

*“The use of digital solutions to measure, store and analyse data is a central element among the circular economy solutions.”*

# 7 Ways circular economy solutions can advocate circularity

All the assessed solutions are also either consciously or unconsciously driving the transition to a circular economy in a systemic sense, beyond the immediate impacts of the application of the solution itself. In many cases, the organisations behind the solutions are taking additional action to support the adoption of circularity, in part to create demand for or to enhance applicability of their own solutions. In others, the original approach to the solution stems from circular community building and tackling several circular economy barriers at once. We identified six main mechanisms through which these organisations are driving the change.

## **Contributing to a more favourable regulatory environment**

Many of the presented solutions demonstrate a new sustainable way of doing things. As these solutions are scaled further and prove their viability, they may support regulatory advancements and changes in legislation related to both environmental and social standards. Advancing these standards and laws may be passive or active, for example through participation in advisory panels. The organisations involved in the circular business space can play a fundamental role in pushing for changes in regulation. Examples include Aakar Innovations, the creator of the Anandi Pad sanitary pad, who were called on to contribute to development of compostability standards in India, and Synergy Sustainability Foundation's Project Zero initiative, which actively seeks ripe opportunities to advocate policy changes to promote circularity.

## **Boosting adaptation of circular economy solutions by raising awareness**

Circular economy solutions often need to create demand for their solution from scratch, as the area can be completely unexplored by the identified customers. To do so, organisations need to raise awareness of the underlying problem, which in turn fosters the circular economy narrative and can also nudge customers towards more sustainable or circular practices in other areas. For example, behaviour change could be fostered by improving customers' involvement in the circular value chain or by offering consultations that accompany the solution itself. For example, ACCIONA involves local governments and communities in the design phase of its large infrastructure projects through a communication platform, which increases understanding of the holistic approach to circular infrastructure development among these groups. For its part, TECO<sup>2</sup> co-operates with national and regional NGOs to raise awareness of their solution for plastic waste issues.

## **Supporting access to and availability of data relevant to circular developments**

The measuring tools and protocols for a circular economy are still underdeveloped. However, many of the assessed organisations contribute to the creation of a universal approach by, for example, offering clear and actionable reports and dashboards to support decision-making and reporting. Businesses find it extremely challenging to navigate and adopt the numerous sustaina-

bility standards and goals that exist and, as a result, the active involvement in this space by businesses can help to fill the gap between the standards employed and the actual needs of businesses.

Collecting, storing and analysing data by circular economy solutions not only boosts and supports their own business but can also help to generate completely new innovative solutions. Solutions that offer enabling services for a circular economy are extremely important in this space. Additionally, improving access and availability to data can improve traceability of the environmental and social impacts of various circular economy solutions.

### **Supporting the transition through advocacy group participation**

Circular organisations often collaborate with circular economy advocacy groups in order to receive information on the developments in the field and for attracting more visibility for their business. Awards, lists and reports encourage organisations to make the transition to circularity, but also bring visibility to and raise awareness on circularity, thus contributing to the circular economy movement on a larger scale. For example, Li-Cycle is very active in raising awareness about the recycling possibilities for lithium-ion batteries in the circular economy space and is a key member of the Responsible Battery Coalition.

### **Creating circular ecosystems around the solutions**

Many circular innovators operate in a space that is either completely new or otherwise

still under development. The organisations behind the solutions often put great effort into ecosystem integration or the creation of fully circular ecosystems, to create opportunities and to ensure the functioning of the secondary materials market. The actions are often an inherent and vital part of the solution itself rather than an add-on service, and take the form of supporting or even building the infrastructure for materials loops through mobile solutions, such as buy-back systems, solution-supporting recycling and reverse logistics, and enabling cross-industry communication to avoid circularity-hindering siloes.

### **Connecting circular action with community building**

The connection between community building and the drive for circularity seems to be particularly strong with solutions that are close to local communities or connected to consumers. There is potential in revitalising local communities through circular action, and vice versa, and the organisations behind the solutions are maximising their connections to create social pull and drive circularity as a whole. For example, communities that participate in putting organic waste systems in place become more conscious of sustainability topics, which contributes to the overall transition to a circular economy; and circular economy solutions that participate in community building are well placed to identify demand even outside of the circularity discussion. Odakyu Electric Railway's project to revitalise a local area through circular community creation is a great example of community building in connection with circularity.

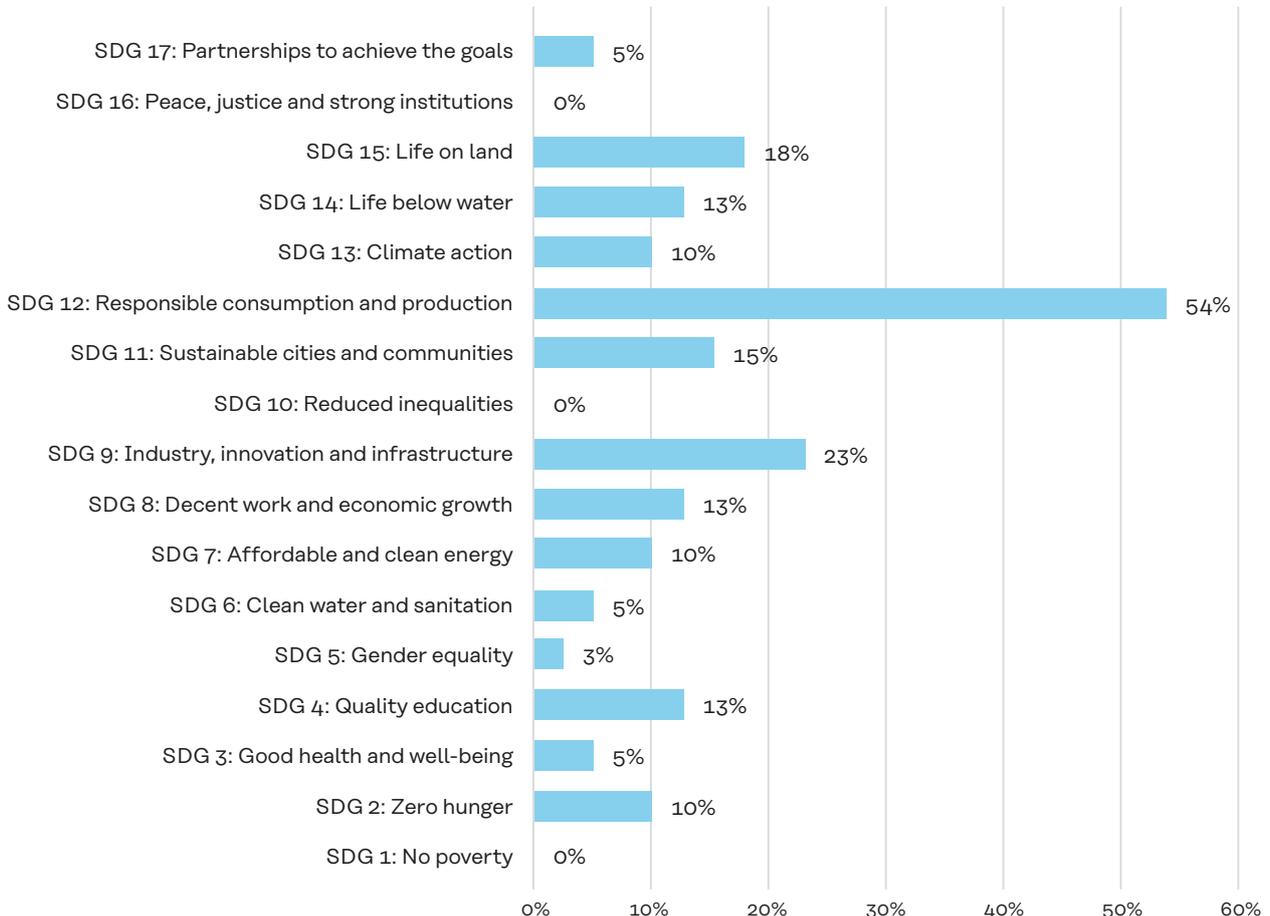
## Contribution to the Sustainable Development Goals

A circular economy can play a strong role in society's efforts to move towards a more sustainable future. Through their direct and indirect environmental and social impacts, circular economy solutions contribute to reaching the Sustainable Development Goals (SDGs) of the UN's 2030 Agenda (Schroeder et al. 2018). In this study, the impacts of the circular economy were not directly assessed from the perspective of the SDGs. However, among the listed solutions, a cross-analysis of their contribution to achieving the SDGs was carried out, based on the associated

interviews. The focus of the analysis was on the solutions' core operations and impact mechanisms and how they advance the 169 specific sub-targets within the 17 SDGs. Based on the analysis, one to three SDGs were identified as the main areas of impact for each solution. However, it is safe to say that via more indirect impact channels many of the solutions either do or at least have the potential to contribute to several more of the 17 goals.

Of the 39 listed solutions, roughly half contribute to SDG 12: Responsible consumption and production. Within the listed solutions, three goals were not directly promoted by any of the solutions: SDG 1: No

**Figure 2: Contribution of the circular economy solutions to Sustainable Development Goals. (n=39)**



poverty; SDG 10: Reduced inequalities; and SDG 16: Peace, justice and strong institutions.

Perhaps unsurprisingly, most often the listed circular economy solutions contribute directly to SDG 12: Responsible consumption and production, with the goal highly relevant to more than a half of the final 39 solutions. With the goal's underlying targets focusing on aspects such as achieving sustainable management and the efficient use of natural resources, substantial reductions in waste generation, including reduction of food waste, and ensuring access to relevant information and awareness of sustainable development, the goal is very close to the definition of a circular economy. Therefore, arguably, all circular economy solutions contribute to the goal at least indirectly. The solutions with perhaps most profound impact on SDG 12 focus on several aspects of the goal; they aim to tackle sustainable production while striving to increase awareness of sustainable consumption and to drive change in consumer behaviour.

Nearly a quarter of the solutions contribute to Goal 9: Industry, innovation and infrastructure, another natural fit with the circular economy, especially with its underlying target of upgrading and retrofitting industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.

It is important to note that in the SDG analysis, only those solutions that focus mainly on enabling global partnership for

sustainable development were recorded as contributing to SDG 17: Partnerships to achieve the goals. However, multi-stakeholder partnerships are key to most of the solutions' innovation paths and existence (see the section "Drivers of and challenges for circular economy solutions"), and it can be argued that most if not all of the listed circular economy solutions contribute to this goal at least indirectly.

Based on the analysis, the solutions contribute more to environmentally oriented goals. Sustainable use of natural resources and the reduction in pollution, the emphasis on clean energy and related climate actions and sustainable agricultural practices are at the centre of the created impact for many of the listed solutions.

On the social impact side, the solutions' contribution to the global goals was most often connected to health and well-being, either through decent work conditions or a reduction in pollution. This is well in line with other findings for social impact awareness from the study; environmental impacts seem to still be a more important driver for circularity than social impacts. Even SDG 4: Quality education is most often related to the underlying target of ensuring knowledge and skills needed to promote sustainable development, rather than ensuring access to quality education in general. Among the listed solutions, the analysis indicates that the potential for circular economy solutions to contribute to the social aspects of sustainable development seems to still be a less emphasised driver.

# 8 Conclusions and recommendations

As a concept, the circular economy has the potential to create shared prosperity while reducing the stress on our environment and societies from the use of virgin raw materials and carbon emissions. While a circular economy is still often mainly perceived as a path to environmental sustainability, the social impacts of a circular economy are also slowly becoming more prominent, as the need for a just and fair transition to a carbon-neutral society intensifies.

Many of the world's most pressing problems have environmental, social and economic dimensions, and are therefore best tackled through a systemic lens. Wide-scale application of circular thinking with a consideration of all aspects of sustainable development can help us find the tools needed for the task. The outbreak of the COVID-19 pandemic in early 2020 has increased the importance and relevance of the circular economy. The pandemic has also shown that companies that apply circular economy business models will be more resilient and adaptable in future crises.

Every organisation has a role in the transition to a circular economy. Some organisations are there to create new approaches to materials and recycling technologies, whereas others find reuse opportunities for their side streams and practice sustainable procurement. Some catalyse the efforts of others through creating spaces and ecosystems to foster circularity. The business incentive for a circular economy is increasingly clear but the transition to a circular economy is still in an early phase. For circular economy business models to truly scale, efforts are needed from all sectors.

## Supporting the scaling of circular economy solutions

Circularity offers new clever ways to think about the innovative use of natural resources and the creation of immaterial value. While the circular economy model has become more familiar across the globe and organisations are increasingly adopting circular principles, there are still several challenges that need to be acknowledged when moving towards circularity. Based on the findings of this study, we have identified themes and policy development needs that play a role in accelerating and enabling the circular transition on a solution level.

## Developing policies that guide industries towards a circular economy

Organisations are asking for regulation that facilitates modifying the supply and demand of materials to more circular patterns. This would enable the further use of secondary materials by increasing their value and change the design and production requirements to those supporting the circular economy. At the same time, there are still policies in place that favour a linear economy and pose challenges for circular practices, for example by prohibiting the exchange of resources or reuse of certain products or secondary materials. Processes steered by regulation may present unanticipated obstacles because of challenges posed by existing regulations to circular business models. Policy development therefore needs to also include steps to remove the barriers to circularity. Through policy devel-

*"A circular economy has the potential to contribute to shared prosperity and a fair transition to a carbon-free economy."*

opment, decision-makers can also send market signals and create demand by including circular principles in government procurement processes. As the readiness of regulation and policy to support a circular economy varies widely between geographical areas, international co-operation is vital in policy development.

Incentives, such as taxation and exemptions thereof, could be used to drive circularity more efficiently by increasing the price of unsustainable materials or energy and decreasing the price for secondary materials or renewable energy to make them more attractive. Transitioning to a circular economy is inherently a sizeable change for many, which quite naturally creates some resistance to it. As long as virgin raw materials or fossil fuels are cheap or easily accessible, as a result of either outdated subsidies or a lack of new ones, it will be harder for renewable solutions to take root.

### **Assigning value to the social aspects of circularity**

There is still a notable lack of discussion on the social aspects of circularity, although the topic has been given more emphasis recently. A circular economy has the potential to contribute to shared prosperity and a fair transition to a carbon-free economy and may have a positive impact on several social sustainability areas. However, since social aspects of circularity often relate to solving complex and systemic societal issues, they may seem quite removed from the role of business. The role of regulation and policy is

even more vital in tapping into the potential for a circular economy to contribute to the social aspects of sustainability, for example by bringing the social aspects closer to business management. In addition to enabling discussion on a fair transition to a circular economy, the translation of social impacts into monetary value or impacts on revenue could help drive innovation towards solutions that have significant positive social impacts.

### **Supporting scaling through local applications**

Many of the most promising circular business models are currently applied locally within a specific geographical area. Often these solutions have the potential for scalable business models that have not yet been fully tapped. However, rather than building direct replication of applications, it seems that many circular economy solutions thrive with a highly localised and adaptable implementation that can be easily tailored to different geographical areas or industries. Replication through adaptation therefore seems to be the key to scaling, therefore finding ways to support circularity in local contexts can be a very efficient way to drive the transition to circularity.

### **Creating circularity awareness**

In many cases, the technology needed for a circular transformation may already be there, but current operating models and habits as well as lack of awareness do not support new practices. There is still a significant lack of awareness about the circular economy, which makes it challenging for circular organisations to establish partnerships and attract demand and investment. Making sure that more and more people and organisations become familiar with circular thinking benefits the whole circular ecosys-

tem, since circular innovation is rooted in collaboration and requires a holistic approach by multiple stakeholders to share information and practices along value chains.

It is important to create further understanding of the role that a circular economy can play in solving global crises and how that will benefit businesses everywhere. This will ensure that the task of illustrating the value of circular economy solutions does not fall solely to the innovators. As circular businesses and associations are already making a clear effort in this area, there is a growing need for governments to lend their support in the form of regulation and incentives.

### **Unlocking potential to jointly change the system**

A circular economy is not only about closing the materials loop in large industrial systems far away, but also about the role people play on a daily basis in creating a more sustainable society. In their private life and in the organisations they work in, people help drive the transition to a circular economy. Today, our economic system and the organisations we work in are still predominantly wired to support linear business models, against which circular business models must compete at a disadvantage, as identified in this report.

A more level playing field is needed for circular economy solutions, but their focus on digital solutions and value-driven partnerships also makes it possible to gain more from the resources that we already have, not least by the willingness of the well-connected community of circularity enthusiasts to share experiences and resources. Activation remains key, and locality and close co-operation with both the public and private sector play a vital role in reconfiguring the way we consume and do business. Many of the circular economy solutions will grow out of the

needs and initiatives of communities supportive of the transition. Tangible tools such as the circular economy playbooks support businesses in identifying the opportunities in circular economy business models (2018).

### **Up-to-date terminology**

To accelerate the development of circular economy business models, it is important to keep the discussion on different approaches to a circular economy both inclusive and active while keeping in mind the goals of the circular economy. As our understanding of existing and emerging circular economy business models grows, it is important to revisit and expand the definitions and terminology we use. Discussing new emerging business models such as circularity enablers or circular champions with combinations of different models, as well as acknowledging the strong interconnectedness between different approaches, is vital for discovering innovation that may not fall into original circular economy categories.

### **Shared ways of measuring circularity**

Ways to measure circularity and its impacts are still very underdeveloped. While there are already some tools for measuring circularity in organisations, there is a lack of common denominators and ways to create comparable information on the status of different organisations and their operations. Fortunately, there are already organisations and solutions that are looking to further tackle the issue. Supporting the uptake of circularity measurements in organisations could contribute to improved understanding and communication of the impacts of circular business. This in turn could help build stakeholder expectations on circularity in society, and further encourage organisations to make the transition.

## Aspects of circular business development

Business has had and will continue to have a central role in driving the circularity transition. Circularity has become a major source of innovation globally and new circular economy solutions are emerging at an accelerating rate all over the world. While the motivations of different organisations to emphasise circular thinking and the pathways to circular innovation vary, based on this study, there are some common themes as to how businesses can successfully advance the circular economy in their operations.

By building on the understanding of the inspiring global solutions studied for this report, the following recommendations are aimed at helping organisations on their journey to become more circular and to untap the business benefits while future-proofing their business.

## Understand your solution's value to customers

Based on this study, many circular innovations stem from scientific curiosity, a passion to find more sustainable solutions or seeing an opportunity to improve on one's own or a customer's processes. A vital component of scaling up from pilot projects to commercial solutions lies in putting effort into understanding the customer's existing and potential future needs and priorities and building for the market, rather than solely aiming for a technologically improved solution. A significant number of major global businesses have set tangible environmental and climate targets (such as zero waste or climate neutrality), and circular innovations will have a crucial role to play in helping these companies meet the objectives.

Without a strong customer value proposition, the potential societal impacts are not achieved. By putting the client at the core of circular innovation, organisations can find

ways to develop a business model that generates positive impact as well as being commercially viable. The most viable circular economy solutions have found a way to improve their customer's operations or life through circularity so profoundly that making the leap of faith of transitioning to a more circular way has become easy for the client.

## Communicate your impact

Circular economy solutions often generate positive systemic impacts that support the transition to an environmentally and socially sustainable society. An ability to account for and communicate the direct and indirect positive impacts, as well as to be transparent about any negative impacts or risks, creates awareness and legitimacy around the circularity themes. This in turn contributes to stronger stakeholder relationships and may help in attracting investment and demand. Furthermore, communication about the impacts supports creating a general awareness of the circular economy and its benefits and importance for society. Identification and communication of qualitative impacts is a starting point for organisations, and as a next step, organisations can move towards a more quantitative approach.

In this study we have found that many organisations are striving to develop quantitative measures for impact and circularity. However, starting to model the impact on a "best-effort basis" is something that can be learned from the leading global solutions. It is important that organisations transparently communicate their efforts and underlying methodology for impact measurement, including the challenges and potential biases or flaws. Organisations can find support for their efforts to communicate their impact by collaborating with universities and research institutions, which are often happy to participate.

### **Integrate into circular ecosystems early**

Engaging with potential clients as well as testing and co-developing with possible key partners in an early phase of development helps to ensure that a solution is designed to suit existing industrial or societal processes and infrastructures. It also helps to respond to customers' goals and contributes positively to society in the long run. Building key partnerships with those less well represented in traditional business operations – partnering with NGOs, local community organisations, research institutions and charities, for example – gives valuable external insight into configuring operations for success.

### **Support your approach with data**

Measuring and analysing data helps understand how and in which direction to further develop circular economy solutions. Digital solutions can help organisations to measure circularity impact, find new business opportunities and optimise resource use – thus improving their own internal operations and profitability. Moreover, supporting digital services are often key to ensuring adequate awareness and suitable space for the circular economy solution to succeed in. Data and its applications thus appear to be integral to many circular economy solutions. The data economy should be a central consideration when developing circular economy solutions, as it supports collaboration and connectivity. Leading solutions maximise the use of data to optimise their own operations, but data can also be a source of business.

*"The data economy should be a central consideration when developing circular economy solutions."*

**Figure 3: 39 inspiring solutions from around the globe.**

| Name of the solution                             | Circular business model               | Brief description of solution   |
|--|---------------------------------------|---|
| <b>Anandipad by Aakar Innovations</b>            | Resource efficiency and recyclability | Anandipad sanitary pads are produced in rural communities using local and natural resources. When the pads are disposed of, they can be recycled or made into manure through the composting process.  |
| <b>ACCIONA</b>                                   | Resource efficiency and recyclability | In large infrastructure projects, applying circular economy principles requires a holistic approach in establishing circular solutions. ACCIONA does this, and also utilises a communication platform to gain a solid understanding of the problems to be tackled and to identify the best available technologies that are adapted.         |
| <b>BC Materials</b>                              | Renewability                          | Building construction is responsible for 40 per cent of CO <sub>2</sub> emissions globally. BC Materials recovers surplus earth-mass from construction sites and transforms it into construction materials.   |
| <b>Blendhub</b>                                  | Product-as-a-service                  | About a third of all produced food goes to waste before even reaching consumers. Blendhub's food powder solution extends the life of food items and facilitates industrial production and transportation of food.   |
| <b>BlueMovement</b>                              | Product-as-a-service                  | Traditionally, a broken washing machine is a consumer's expensive burden. BlueMovement introduces an alternative business model where more appliances are repaired and consumers save money.  |
| <b>BRING by JEPLAN</b>                           | Resource efficiency and recyclability | The current fashion industry supports unsustainable consumption behaviours and excessive natural resource use. BRING by JEPLAN enables textile recycling and a behavioural change for the better.   |
| <b>Carbons</b>                                   | Resource efficiency and recyclability | Impurities and excess nutrients washing from agriculture and urban areas reduce the quality of natural waterbeds. Carbons Finland has developed a hybrid biofilter that both filters the impurities and enables the reuse of excess nutrients back to their natural cycle.  |
| <b>CCI Bioenergy</b>                             | Renewability                          | A novel technology transforms organic waste into biogas and digestate. In North America, the transformation of waste organics into usable products can equate to 120 million tonnes of greenhouse gas emission reductions annually.   |
| <b>Circular Transitions Indicators, CTI Tool</b> | Circular data management              | With the CTI Tool, businesses can measure the level of circularity in their operations. With the metrics produced by the tool, businesses are able to identify the possibilities circular business models provide.  |
| <b>Circular</b>                                  | Circular data management              | The use of lithium-ion batteries is increasing as mobility becomes electric. Traditional sourcing of battery raw materials is challenging and not sustainable. Circular supports the circulation of materials by their traceability platform that enables businesses to identify material cycle possibilities throughout their value chain. |
| <b>Covestro</b>                                  | Resource efficiency and recyclability | Covestro's salt recycling process keeps the salt needed in plastic production in circulation. It also reduces water consumption in production and lowers the amount of salt ending up in natural waterbeds.   |
| <b>DSM-Niaga</b>                                 | Resource efficiency and recyclability | Designing for circularity is in the core of DSM-Niaga's approach. Together with their production partners DSM-Niaga redesigns products with simple combinations of non-toxic materials that are safe and durable but also easy to disassemble for material recovery.  |
| <b>EcoVolt By Cambrian Innovations</b>           | Resource efficiency and recyclability | Industrial water use poses diverse resource and pollution risks. The EcoVolt water treatment utility creates a closed loop for production that overcomes these global challenges.   |
| <b>Excess Materials Exchange</b>                 | Sharing platforms                     | Across industries, the lack of data and transparency of materials hinders the high-value reuse of businesses' excess materials. Excess Materials Exchange (EME) platform overcomes the challenges in sharing these materials securely and efficiently.  |
| <b>FLOOW2</b>                                    | Sharing platforms                     | Many companies' materials and machines stand idle for most of their lifespans. FLOOW2 facilitates the circulation of such resources between or within businesses through a trustworthy platform.  |
| <b>Foodrescue.ca by Second Harvest</b>           | Sharing platforms                     | Annually, almost 60 per cent of all food produced in Canada is lost or wasted. The Second Harvest mobile app FoodRescue.ca redirects this unsold surplus food to people in need and builds more resilient communities.  |
| <b>Green Standards</b>                           | Product-life extension                | The decommissioning of office furniture prematurely ends the lifecycle of valuable resources. Green Standards prevents unnecessary waste by redistributing surplus furniture to non-profits in need.  |
| <b>Green4Good by Compugen Finance</b>            | Product-life extension                | Green4Good tackles the e-waste issue by offering a technology disposal service which is sustainable.  |
| <b>The Blue Connection by Inchainge</b>          | Circular communications               | A lack of practical training makes adopting circular practices difficult. The Blue Connection is an educational game that guides users through the transition to circular business models.  |

Figure 3 continues

| Name of the solution           | Circular business model               | Brief description of solution   |
|--------------------------------|---------------------------------------|---|
| <b>Kotkamills</b>              | Renewability                          | Plastic barriers in food packaging improve food safety but complicate recycling. Kotkamills' water-based barrier is easier to recycle and reduces the stress on non-renewable virgin raw materials.   |
| <b>Li-Cycle</b>                | Resource efficiency and recyclability | Lithium-ion batteries have traditionally been impractical to recycle, leading to disposal as hazardous waste and the loss of valuable materials. Li-Cycle's solution creates a circular supply chain for the previously challenging process.  |
| <b>Live Love Recycle</b>       | Resource efficiency and recyclability | Lack of recycling means that waste ends up dumped, in landfills or incinerated without treatment. The Live Love Recycle platform improves harmful waste management with communication and collaboration.  |
| <b>Magnomer</b>                | Resource efficiency and recyclability | Packaging often includes elements that hinder recycling. Magnomer's magnetisable ink can remove impurities to allow more complete recycling.  |
| <b>Odakyu Electric Railway</b> | Product-life extension                | Urbanisation leaves suburban communities with demographic changes and under-utilised residential spaces. Circular lifestyles can fit well into these valuable infrastructures.  |
| <b>OLIO</b>                    | Sharing platforms                     | A third of the world's food gets thrown away. OLIO is a platform fighting to save more food.  |
| <b>Optel Group</b>             | Circular data management              | The circular economy is slowed down by invisible material flows. The Intelligent Supply Chain platform enables circular innovation by granting companies greater visibility over their supply chains.   |
| <b>Project Zero</b>            | Circular communications               | With its educational content and workshop material, Project Zero prepares a generation of circular economy leaders.   |
| <b>Renewcell</b>               | Resource efficiency and recyclability | Only one per cent of global textiles are recycled, and that percentage is difficult to reuse. Renewcell's recycling process enables a longer life for valuable cotton and viscose material.   |
| <b>Rubicon</b>                 | Circular data management              | The linear economy is full of waste streams that contaminate ecosystems and hide valuable resources that could be recycled and reused. Rubicon makes these streams visible and available for better management.   |
| <b>Rype Office</b>             | Product-life extension                | Office furniture has a surprisingly wasteful and short lifespan in the linear economy. Rype Office saves furniture from landfill and incineration and gives it a second life.   |
| <b>Safi Organics</b>           | Renewability                          | Common fertilisers in Kenya are poorly suited for local soils and can do more harm than good. Safi Organics has an alternative which uses crop residues into customisable, carbon-negative fertilisers.   |
| <b>Soilfood</b>                | Renewability                          | A tenth of the EU's total greenhouse gas emissions comes from agriculture. By recycling industrial by-products into soil improvers, fertilisers, and agricultural lime, Soilfood reduces greenhouse gas emissions.  |
| <b>SunCrafter</b>              | Product-life extension                | Almost 1 billion people globally don't have sufficient access to electricity. At the same time solar panel waste lacks an effective recycling system. Rehabilitated and reconfigured solar modules offer affordable grid-independent electricity for remote areas and take advantage of the increasing amount of solar panel waste. |
| <b>SundaHus</b>                | Circular data management              | Reusing construction materials is challenging and most material ends up downcycled or wasted. SundaHus helps actors in the construction sector choose materials without unwanted substances and ultimately re-use or recycle them.  |
| <b>SusGlobal Energy</b>        | Renewability                          | Organic waste is seldom sorted from other types of waste in North America. SusGlobal Energy helps municipalities turn the waste into a high-quality dry compost and liquid bio-fertiliser.  |
| <b>Tamturbo</b>                | Product-as-a-service                  | Industrial facilities often have old compressed air technology which requires oil and service and breaks easily. Tamturbo offers compressed air as-a-service that is completely oil-free and low maintenance.   |
| <b>TECO<sup>2</sup></b>        | Resource efficiency and recyclability | Eco-composite material reduces the unsustainable use of wood and raises awareness of the plastic waste issue.   |
| <b>Teemill</b>                 | Renewability                          | The clothing industry is known for a large environmental footprint and human rights issues across its value chain. Teemill offers a free platform for entrepreneurs including in developing countries to sell t-shirts designed with circularity in mind.   |
| <b>Waste Not Why Not</b>       | Circular communications               | The circular economy is still largely unknown in many parts of the globe. This podcast aims to fill the circularity knowledge gap among millennials.  |

# References

Ellen MacArthur Foundation (2020), Circulytics tool.

Forslund T. (2020), Has 2020 changed the direction of the circular economy?

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES (2020), Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating'.

International Resources Panel (2019), Global Resources Outlook 2019.

Lacey P., Long J. and Spindler W. (2020), The Circular Economy Handbook – Realizing the Circular Advantage, Palgrave MacMillan UK.

Material Economics Sverige AB (2018) The circular economy – a powerful force for climate mitigation

Orasmaa A., Laurila L. and Liimatainen H. (2020), Rethinking ownership, Sitra studies 176

Padilla-Rivera A., Russo-Garrido S. and Merveille N. (2020), "Addressing the Social Aspects of a Circular Economy – A Systematic Literature Review", in Sustainability.

Schroeder P., Anggraeni K. and Weber U. (2018), "The Relevance of Circular Economy Practices to the Sustainable Development Goals", in Journal of Industrial Ecology 2018.

Sitra, the Technology Industries of Finland and Accenture (2018). Circular economy business models for the manufacturing industry

The International Institute for Sustainable Development (IISD) and Sitra (2020), Effects of the Circular Economy on Jobs

UN, Sustainable Development Goals.

# Annex 1: Overview of study results

Overall, 203 solutions responded to the sign-up survey. This was a versatile group of circular economy solutions with different target sectors, business models, innovation methods and organisational structures, as well as goals and aspirations. What they all had in common, however, was that they in one way or another contributed to changing the linear economic practices of our society. While the sample size is not large enough on all continents to make conclusions about the global status of a circular economy, the data gathered from all the responses give some valuable insight into the circular economy space.

## Types of circular economy solutions

In our study, we identified two types of organisations behind the circular economy solutions. The division between the two is based on whether circularity was part of their operational model at the dawn of their business. There are the circular “natives”, who have based their business idea on the concepts of a circular economy, and the circular “adapters”, whose core business is founded in a more traditional, linear setting, but who have later found ways to apply circular economy principles to a part or all of their operations. Despite the name, the “adapters” are active in driving systemic circularity, and not merely adapting to a changing operating environment.

Both types were represented in the solutions we studied. However, a clear majority of the selected 39 solutions (75%) are circular adapters. This may be due to

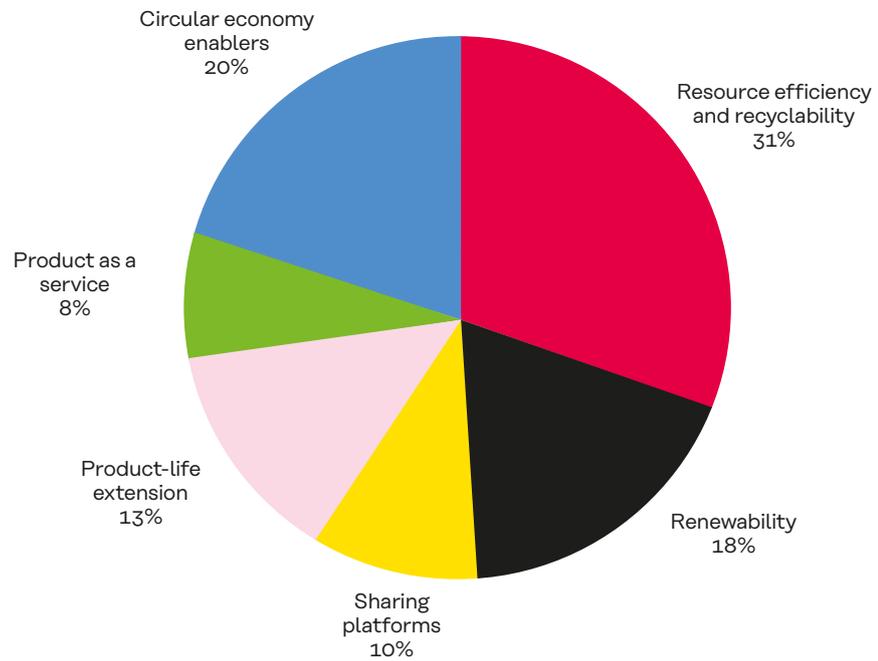
the assessment framework and methodology used, which required the solutions to have reached a certain economic and technical maturity to qualify for the interview round, disqualifying many “circular natives” that are often start-ups still under development. Mature organisations with established traditional businesses supporting exploration of new concepts may have better financial opportunities to bring their circular ideas to life. However, we also discovered that, possibly because both the “native” and “adapter” solutions are relatively young, many of the solutions have yet to fully scale up their operations around the solution.

Our analysis against the framework also showed that the solutions are tackling large, important and complex environmental and social problems with their circular economy solutions. As a result, there is a clear emphasis on purposeful circularity vision, greenhouse gas emission reductions and other environmental impacts of the solution.

## Circular economy business models

The organisations responding to the sign-up were asked to categorise the business model of their solution, as either one of the core business models or as “other” with additional details. The categorisation was checked to follow the definition of circular business models and adjustments were made if necessary. Both in the sign-up and among the selected 39 solutions, resource efficiency and recyclability was clearly the most dominant business model category.

**Figure 3: The division of the solutions' business models. Data is based on selected solutions, n=39.**



However, while conducting the study, it became evident that because of the strong interconnectedness of the circular economy business models, it is not always easy to make a distinction between the different business models. It was also discovered that not every solution or organisation operate simply under one business model.

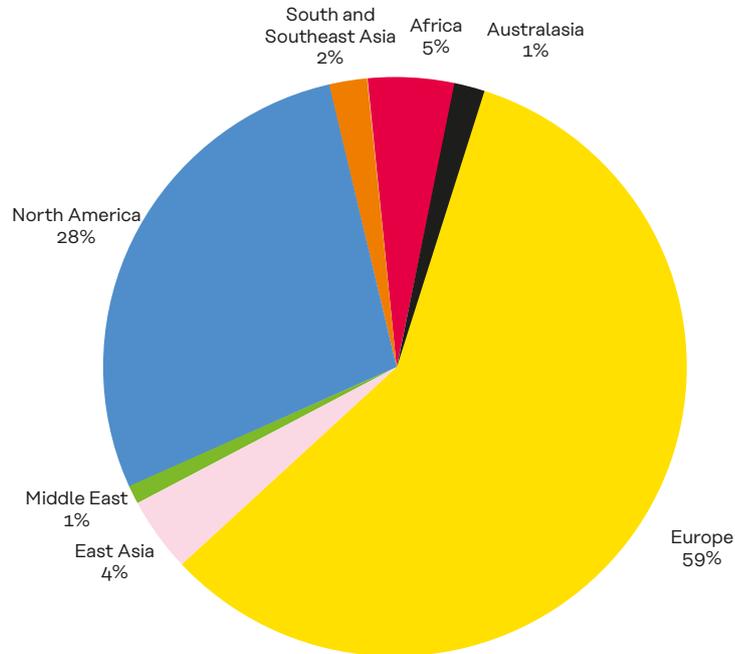
### **Geographic diversity**

A clear majority of the organisations that signed up their solutions originated from Europe or North America. While there are some very inspiring circular economy

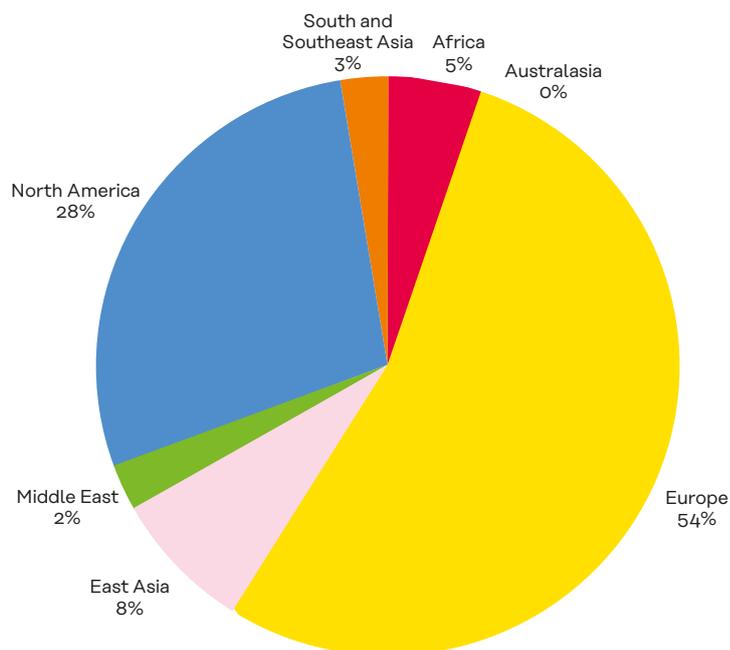
solutions in Africa, East Asia, South and South East Asia, Australasia and the Middle East, the areas are clearly underrepresented in the data. There were no sign-ups from Central or South America or Russia and Central Asia at all, despite efforts to reach those areas.

Ultimately, 39 inspiring solutions were selected to be presented in this report in more detail. Of this group of solutions, 82% were based in Europe or North America. The geographical representation of the final list of solutions is very similar to that in the sign-up phase.

**Figure 4: The geographic split of the original data from the sign-ups shows clear predominance of European and North American solutions. While it may partially be an artefact of the study methodology, it is also representative of the current status of the circular economy. Data is from the sign-up phase, n=203.**



**Figure 5: The geographic split of the data from final list of solutions is close to the one from the sign-ups (Figure 4). Data from the final list of selected solutions, n=39.**



## Maturity of solutions

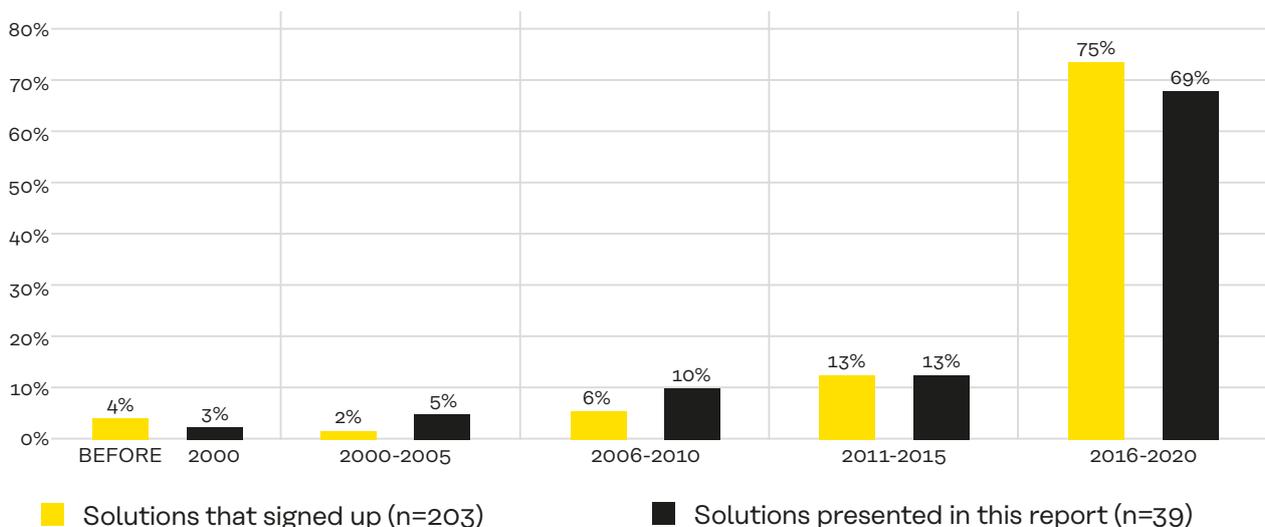
The past five years have seen a rapid expansion in the creation of circular economy solutions. 75% of the solutions that signed up had been launched after 2015. Additionally, 1% of the solutions that signed up are still under development and are to be launched soon. This represents the fact that a circular economy is a relatively novel economic model that has only started to gain momentum in recent years.

The solutions presented in this report have also been mostly launched in the last five years. Only one of the solutions was launched before the turn of the century, and just a few prior to 2015.

The novelty of the solutions can also be seen somewhat in the size of the organisations – many are still very much in their initial stages of growth. However, the solutions include both organisations that strive for aggressive growth and those that have no

plans to expand further. About half of the organisations behind the solutions have a turnover of under one million euros. Clearly, there are also larger players involved: roughly a quarter of the organisations have a turnover of one to 50 million euros, with 10% of the organisations already having an annual turnover of over 50 million euros. It is noteworthy that 15% of the organisations behind the solutions are not-for-profit in nature. This shows that the non-profit sector recognises that a circular economy can largely benefit the environment and society but may also be an indication of the relative activeness of the non-profit sector in the circular economy space. As the selected 39 inspiring solutions were assessed for financial viability and maturity, they also represent more mature organisations. More than half of the solutions are from organisations with a turnover of more than one million euros.

**Figure 6: Original launch years of the solutions, assembled into five time periods. As the concept of a circular economy only emerged after the turn of the century, the majority of the solutions have been developed only within the past five years.**



## Annex 2: Solution profiles

### A fully compostable and biodegradable sanitary napkin

Anandipad sanitary pads are produced in rural communities using local and natural resources. When the pads are disposed of, they can be recycled or made into manure through the composting process.

Anandipad is the only sanitary pad in the world that is fully compostable and biodegradable. Increased access to sanitary napkins has important social relevance for women's inclusion in society, and the biodegradable design eliminates the huge environmental impact of commercial plastic pads. Women are also empowered through the product's manufacturing process, which happens in villages throughout India and Sub-Saharan Africa.

Knowing that people in rural villages must use unclean clothing during menstruation, the founder conducted field work in India and Afghanistan with the Aga Khan Foundation to identify a solution. The founder learned that an affordable safe and environmentally friendly design is key to increasing the use rate of sanitary napkins. With a local vendor they conducted R&D to find a natural replacement for plastic and expensive imported materials.

#### Problem

In India, only 36 per cent (121 million) of menstruating women use sanitary pads, but 12.3 billion sanitary pads go to landfills annually, which takes 500+ years to degrade. At the moment, most sanitary pads are made of plastics and harmful chemical polymers. When burnt, the product releases toxic fumes and gases that pollute the ecosystem and negatively affect human health.

#### Solution

Anandipad sanitary pads are mainly produced in mini-factories involving village women as entrepreneurs and workers. This enables them to earn a sustainable livelihood and become financially independent. The production process uses local and natural resources, as the bioplastic used is made from cotton starch.

After disposal, the product can be recycled or used as fertiliser, which can be utilised for agricultural purposes. Currently the company has 30+ units across India and Nepal and 10 in African countries, partnering with local entrepreneurs and NGOs. The company is currently expanding sales to urban consumers by promoting its high quality, healthy and eco-friendly aspects.

Beyond compostable aspects, the solution incorporates circularity in its innovative use of raw materials. The solution uses local resources coming from natural plants and agricultural waste materials, even outside of its main market in India. For instance, in Kenya the company produces pads out of the invasive plant species water hyacinth.

## Environmental impact

With 150,000 users currently, the solution helps reduce the sanitary pads that are disposed of in landfills annually in India. The use of natural plant-based resources, including invasive species of plants, also has a significant positive impact compared to plastic or monoculture crops.

## Social impact

The solution improves impoverished women's health and promotes employment. Over one million women have been reached with the compostable pads. There are over 600 women employed in production units, and 300+ women engaged in sales activities. Over 100,000 girls and women have been reached through a menstrual health awareness program and 600 workshops have been organised with women, girls and boys as part of the behavioural change program.

## Key information

- Geographical origin of the organisation: South and Southeast Asia
- Circular economy business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: Africa, South and Southeast Asia
- <https://aakarinnovations.com/anandi/>

# Turning large infrastructure projects circular

In large infrastructure projects, applying circular economy principles requires a holistic approach in establishing circular solutions. ACCIONA does this, and also utilises a communication platform to gain a solid understanding of the problems to be tackled and to identify the best available technologies that are adapted.

The circular economy encompasses many different concepts, and there is no one way to apply them. ACCIONA strives to apply circular economy principles throughout their large infrastructure projects. These projects include multi-billion-dollar renewable energy, transportation and construction jobs.

The synergies between the different divisions of the company have been crucial for developing circular economy practices at ACCIONA. The organisation has worked to establish a company-wide symbiosis, where different divisions support each other. This allows each division to cooperate, learn and benefit from others, enabling innovative circular solutions across various industries.

## Problem

The construction of large-scale projects such as transportation or energy infrastructure has many negative environmental impacts. The projects may require a lot of materials that are energy-intensive and are not used efficiently and recycled properly. The planning and design phases do not often consider impact on local ecosystems and biodiversity.

## Solution

ACCIONA is dedicated to circular economy and sustainable business across their many infrastructure solutions. Each of their divisions work closely to offer a holistic circular solution, including in energy supply and efficiency, water supply and treatment, waste management, restoration of degraded spaces, and eco-design in construction materials. Each division integrates technologies, business models and innovative approaches for the design, building and management of infrastructure throughout each structure's whole lifecycle.

The organisation applies a holistic approach in establishing circular solutions in infrastructure that involves the participation of local governments and communities. Therefore, the organisation has developed and applied a communication platform, both internally and externally, to gain a solid understanding of the problems to be tackled, and to identify the best available technologies that are adapted according to the nature of the problems. With input from governments and communities various tailor-made solutions can be put forward that will adapt to circularity needs, as well as to time frames and public budgets.

## Environmental impact

The environmental impact depends on the nature of the infrastructure project. Overall, through their holistic approach, the company achieves significant savings in material use, valorisation of waste (e.g. use of extracted soil from metro excavation work for the restoration of mines and quarries), and emission reductions of GHG and other atmospheric pollutants, which allows the company to keep its pledge of staying carbon neutral.

## Social impact

The company considers the social impacts of their infrastructure projects through consultations with local governments and communities at the design phase of the projects. The main social impacts are associated with the creation of jobs both directly (e.g. employed in the infrastructure project during and after completion) and indirectly (e.g. enhance mobility in communities located away from transportation hubs).

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: resource efficiency and recyclability
- Number of employees: over 250
- Share of the circular economy solution of total business or operations: between 10% - 49%
- Current geographical scope: Australasia, Central and South America, Europe, Middle East, North America
- <https://www.acciona.com/sustainability/>

# Re-using locally excavated earth to make environmentally friendly building materials

Building construction is responsible for 40 per cent of CO<sub>2</sub> emissions globally. BC Materials recovers surplus earth-mass from construction sites and transforms it into construction materials.

Construction is one of the most material- and carbon-intensive industries globally. BC Materials transforms excavated earth into building materials to help jumpstart a circular construction industry. BC Materials' ambition is to help the building sector lower its carbon emissions, reduce waste and create healthy and qualitative environments for working and living.

The innovation is rooted in an African architectural experience where earth-based building materials are still very much used. In the EU, the innovation is closely linked to the interpretation of regulations regarding excavated land.

## Problem

Building construction is one of the most polluting industries in the world. Excavated earth eventually ends up transported far away and dumped into mines, quarries or artificial hills.

This inefficient activity of digging, transporting and dumping creates superfluous transport, air pollution and CO<sub>2</sub> emissions as well as stimulates the intensive extraction of other resources.

## Solution

BC Materials collaborates with architects, construction companies and transporters of excavated earth to recover earth-mass from construction sites. Without chemical processes, the company transforms the surplus mass into construction materials, such as clay plasters, rammed earth and compressed earth blocks, and sells it directly to building companies, architects, contractors and private customers.

BC Materials links together stakeholders in the building construction's value chain: BC materials' strength is that they use already available raw materials and transform the excavated earth-mass to provide it to building companies, architects and home owners in a virtuous closed loop. Construction companies reduce their CO<sub>2</sub> emissions and landfilling costs, the real estate owners benefit from alternative local and carbon neutral solutions, and the end users (inhabitants) appreciate better acoustic performance, better air quality inside and out, and better thermal insulation as the buildings are cooler in summer and warmer in winter.

## Environmental impact

Re-using locally excavated earth contributes to less transportation and air pollution, as well as preservation of biodiversity, because the solution sources its secondary materials within the Brussels area. Another important point is the improved efficiency of resources, as the production process requires less water and electricity and thus results in less CO<sub>2</sub> emissions, even compared to classic fired brick made from virgin raw materials – up to 90 per cent reduction.

## Social impact

Re-using locally excavated earth into circular building materials helps strengthen the local networks and the local economy as well as the cohesion in the region. In fact, through the solution, BC Materials has a close partnership with local building companies and architects, who both produce this kind of waste and are willing to have an alternative solution that uses less carbon for end-consumers. Also, BC Materials collaborates with universities to share knowledge about resilient building.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: renewability
- Number of employees: Under 10
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Europe
- [www.bcmaterials.org](http://www.bcmaterials.org)

# The world's first food-as-a-service platform for sustainable nutrition globally

About a third of all produced food goes to waste before even reaching consumers. Blendhub's food powder solution extends the life of food items and facilitates industrial production and transportation of food.

Blendhub's food-as-a-service platform, which combines a portable factory unit and cloud-based software, brings product-as-a-service principles to a less explored sector: food production. Blendhub tackles the globally relevant issue of food waste by enabling smarter nutritional supply chains and local production and distribution of food.

The founders of the company are entrepreneurs with experience in technology companies and the food industry. Blendhub built its first factory in 2004 in Spain. By 2009, the company was able to develop a prototype for a portable factory. The first portable factory was implemented in India in 2011.

## Problem

About a third of all produced food goes to waste before even reaching consumers. Wasted food means not only lost nutritional content but also the loss of the energy and resource inputs that went into producing the food, such as land, fertiliser and water. With many more mouths to feed globally each year, a more flexible way of locally producing and distributing food products is badly needed.

## Solution

As a company, Blendhub has been developing food products for over two decades, focusing mostly on food powder production which extends the life of food items and facilitates industrial production and transportation of food. This experience has helped them develop their food-as-a-service platform.

Blendhub's solution consists of two components: first, they have created a container-sized modular factory for food processing that can be deployed anywhere in the world at a fraction of the cost of traditional production methods; and second, they have developed a cloud-based software suite that enables online quality control of food production and supply chain monitoring.

The use of food powders is only one of the factors to achieve a circular economy in food production and distribution. The ability to replicate systems and processes quickly and efficiently is crucial to make a long-lasting impact at a global scale.

In addition to traditional business partnerships, the company has also built partnerships with circular economy advocacy groups and charities. They hope to increase resilience in the global food supply chain, enable local startups in developing countries to mature and go to market, and improve food access to areas in crisis.

## **Environmental impact**

By streamlining the food supply chain, Blendhub reduces greenhouse gas emissions in the transportation of food items. The shelf-life of food powders is significantly longer than that of fresh food items, which supports food waste reduction. The company also takes inputs from food items that were unsold or overproduced that would otherwise go to waste.

## **Social impact**

In addition to the jobs they create, the company provides food powders to communities in need and makes nutrition affordable. They also localise food production instead of having long production chains, which increases community resilience.

## **Key information**

- Geographical origin of the organisation: Europe
- Circular economy business model: product-as-a-service
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: Central and South America, Europe, North America, South and Southeast Asia
- <https://www.blendhub.com/> <https://www.chemometricbrain.io/>

# Home appliances-as-a-service to promote reuse, repair and extended lifecycles

Traditionally, a broken washing machine is a consumer's expensive burden. BlueMovement introduces an alternative business model where more appliances are repaired and consumers save money.

As part of BSH Hausgeräte – with leading home appliance brands such as Bosch, Siemens, Neff and Gaggenau – BlueMovement is a clear example of how large companies can take responsibility and move towards a circular economy with their product-as-a-service business model. The lifespan of appliances is also extended thanks to included repair services.

BSH will gradually add circular elements to their business to reduce their dependence on resources and reduce waste generation. BlueMovement helps the company to learn fast in the circular economy, while also tapping into new customer segments and ensuring new revenue streams.

## Problem

In the electronics sector, broken appliances are rarely repaired or refurbished and instead end up in landfills while being replaced by new appliances. This cycle stresses scarce resources and contributes to climate change by increased production. The gradual implementation of a circular economy reduces both the need for resources as well as the waste produced, but requires companies to rethink their businesses in order to be successful in the future.

## Solution

With BlueMovement, BSH goes beyond selling home appliances and instead offers them as a service. BSH delivers, installs, repairs, moves, adjusts and picks the appliances up again at the end of the contract.

After their use, appliances are repaired and reused, and working components of broken appliances are reinstalled in a new loop if the appliance itself is not repairable. BlueMovement also facilitates initiatives within BSH to redesign appliances so that they are easier to disassemble and repair.

BlueMovement adds circular elements to the linear economic model of production, use and disposal and forces competitors to do the same. For example, Bosch, which has already taken some real steps towards sustainability, is widely promoted on this platform due to their eco-efficient appliances.

BSH Hausgeräte's initiative may further encourage customers to ask for similar services in other appliance groups and with other brands. In addition to offering affordable household appliances, BlueMovement is a good way to educate consumers on waste and induce behavioural change.

## Environmental impact

Using a refurbished or repaired appliance instead of buying a new one saves resources and reduces the reliance on virgin resources. BlueMovement leases appliances with high environmental ratings, so customers reduce their energy, water and detergent consumption throughout the use of the appliance compared to traditional models.

## Social impact

BlueMovement makes sustainable home appliances more affordable. In fact, they have observed that customers who used to do their laundry by hand can now afford a resource-efficient washing machine through the initiative. Repair costs are automatically included in the cost of the service, which makes it safe and accessible also for low-income groups.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: product-as-a-service
- Number of employees: over 250
- Share of the circular economy solution of total business or operations: under 10%
- Current geographical scope: Europe
- <https://www.bluemovement.nl/>

# Technology-based “direct-to-customer” solution for a circular fashion industry

The current fashion industry supports unsustainable consumption behaviours and excessive natural resource use. BRING by JEPLAN enables textile recycling and a behavioural change for the better.

JEPLAN strives to create a circular ecosystem for the fashion industry by developing recycling technology and constructing circular supply chains, with special focus on changing consumer behaviour. Specifically, they collect old clothes from consumers, recycle them chemically and sell the material back to their partners. Various mega players are participating in the supply chain in Japan and the solution is currently being piloted France, which demonstrates its high scalability potential.

JEPLAN invested 25 million euros in 2017 to complete its pilot plant specialised in polyester. Three years later, with various clothing brands and technology owners, BRING by JEPLAN flexibly incorporates various technologies and continues development and commercial production.

## Problem

The value chain of textiles in the fashion industry is still linear and only a fraction of used textiles is recycled globally. The use of recycled materials in fashion is increasing, but new recycling technology is needed to close the loop and to decrease the negative environmental and social impacts of the industry. Additionally, consumers do not often have enough motivation to bring used clothes to collection points for recycling.

## Solution

JEPLAN currently recycles polyester and cotton and sells the recycled materials back to its partners. Through this, the solution reduces the use of fossil fuel-based resources and the amount of textile waste, fostering circular behaviour both on a corporate and consumer level.

JEPLAN's project BRING calls on consumers to return their old clothing back to stores. The project has been established in collaboration with several major fashion brands. These partners take back used garments at their stores and JEPLAN provides them a service for recycling these items.

The biggest contribution to circularity is triggering the creation of a new consumption culture. JEPLAN fosters circularity and transitioning away from the current linear textile industry by creating incentives for consumers to return used clothes to retail stores.

The technology itself supports the transition to an oil-free textile industry by making the existing manufacturing process for petroleum-based products obsolete.

## Environmental impact

With collecting 3,000 tonnes of used clothes since the launch of BRING, JEPLAN realises reductions in the use of virgin and fossil fuel-based raw materials by producing recycled raw materials. Also, the solution enables a reduction of waste streams to incineration or landfill by providing the collection system for retailers.

## Social impact

JEPLAN improves access to sustainable consumption choices for their customers, and the company strives to increase people's awareness of circular fashion. They have contributed positively to health and wellbeing of local communities by decreasing the impacts associated with incinerating textiles.

## Key information

- Geographical origin of the organisation: East Asia
- Circular economy business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: East Asia
- <https://www.jeplan.co.jp/en/service/bring/>

# Affordable bio-based solution for recycling nutrients from agriculture

Impurities and excess nutrients washing from agriculture and urban areas reduce the quality of natural waterbeds. Carbons Finland has developed a hybrid biofilter that both filters the impurities and enables the reuse of excess nutrients back to their natural cycle.

Carbons Finland's hybrid biofilter is a natural and highly scalable solution that prevents nutrient leakage from fields and thereby improves local water quality. At their end-of-life, the biofilters can then be reused in several applications to release the captured nutrients back to their natural cycle.

The development of the solution started from a research program from the Finnish Ministry of the Environment to identify a way to reduce nutrient leakage from the agricultural sector. The subsidy system and environmental regulation for the agricultural sector requires limiting nutrient leakage and there is a need for solutions that are easily accessible.

## Problem

Controlling excess nutrients from manure, sludge and biomass as well as impurities from urban stormwater is currently inadequate. The nutrients from agricultural fields and other impurities from urban areas end up in rivers, lakes and seas, where they cause eutrophication and degrade water quality. With increasing heavy rains, the impurities washed into natural waters will increase and further worsen the negative impacts on water quality and ecosystems.

## Solution

Carbons Finland's hybrid biofilter is composed of biochar and woodchips. The mechanism is simple: the biofilter is placed in a waterway, for example a ditch where it captures excess nutrients and other impurities that have dissolved into the waterway. The biofilter offers an affordable and easy solution to decrease the environmental impact of, for example, agricultural operations.

The nutrients caught in the biofilter can be recycled back to soils, decreasing the need for chemical fertilisers, or added to compost to make it more productive and less odorous. The used biofilters can be used as an integrative factor to combine water, nutrients and microbes in soil. The solution generates raw materials that can be used as recycled inputs instead of virgin raw materials, which exposes more people to the circular economy.

## Environmental impact

Carbons Finland's solution significantly reduces nutrient leakage to waterways, thus reducing eutrophication and biodiversity loss. The used biofilters can reduce soil degradation and increase carbon content of the soil which fosters plant growth and can help to restore ecosystem services. When applied in green infrastructure, biochar can help to reduce impurities leaking from urban stormwaters to waterbodies.

## Social impact

The solution improves community resilience and social wellbeing as it contributes to cleaner and healthier waterbodies and supports ecosystems both on land and under water.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: resource efficiency and recyclability
- Number of employees: under 10
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: Europe
- <https://carbons.fi/en/home/>

# Transforming organic waste into renewable energy and soil amendment products

A novel technology transforms organic waste into biogas and digestate. In North America, the transformation of waste organics into usable products can equate to 120 million tonnes of greenhouse gas emission reductions annually.

CCI's technology (the BTA Process) solves two problems: the need for renewable energy and the requirement for managing organic waste in a sustainable manner. The City of Toronto utilises the BTA Process to transform residential source separated organics (SSO) into biogas and digestate.

The founder of the company learned about anaerobic digestion in the 1990s. His aim was to build anaerobic digestion (AD) facilities throughout North America to produce renewable energy from organic waste. In the year 2000 he built Canada's first AD facility.

Through trial and error, the facility improved its operations and gained recognition. CCI built and operated an AD facility for the City of Toronto and their technology was then selected again for the city's second anaerobic digestion facility as well.

## Problem

SSO is a resource that is often wasted. When SSO is disposed of in a landfill, methane, a greenhouse gas that is 80 times more potent than carbon dioxide, escapes. In North America, the transformation of waste organics into usable products can equate to 120 million tonnes of greenhouse gas emission reductions annually. Despite the potential, the move towards organics diversion in most cities in North America has been slow. Solution providers need to be innovative and creative, and clients need to be forward-thinking.

## Solution

The process generates biogas 24/7 from SSO that is sorted by residents and collected by the city. The SSO is cleaned and then fed into the AD process. The generated biogas can be used for process heat and also has the potential to be upgraded to renewable natural gas (RNG). Over 90 per cent of the biogas produced at one of the plants will soon be turned into compressed RNG and used to power City of Toronto fleet vehicles and heat city buildings.

In addition to large-scale projects, CCI has also developed in conjunction with Qube Renewables from the UK, a small scale micro digestion product called the BioQube. The large-scale and small-scale solutions were developed to transform organic waste into value-added products, thus contributing to a circular economy. CCI has established several pilot projects with large food processing companies to harness the energy and value remaining in their organic materials. CCI is also collaborating with First Nations groups in Canada with the objective to develop pilots in their communities. These innovative partnerships serve to advance the circular economy and communicate its benefits in multiple locations.

## Environmental impact

Currently, approximately 75,000 tonnes of the City of Toronto's organic waste is processed every year with CCI's BTA Process which produces biogas. The production and use of biogas results in avoiding methane emissions of up to 50,000 tonnes per year. The biogas is usable renewable energy and the generation of digestate is further processed into soil amendment products to improve soil health.

## Social impact

CCI's solution creates jobs and develops community resilience benefits through the creation of renewable energy and regenerative soil amendment products. Furthermore, CCI's solution establishes links to with for example the First Nation communities. CCI is also active in the area of student education programs through one of its clients, the Ontario Water Centre, where the objective is to provide hundreds of students the opportunity to learn about the circular economy, energy, water and waste management.

## Key information

- Geographical origin of the organisation: North America
- CE business model: renewability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: North America
- <https://www.ccibioenergy.com/>

# Empowering businesses to measure and improve their circular performance

With the CTI Tool, businesses can measure the level of circularity in their operations. With the metrics produced by the tool, businesses are able to identify the possibilities circular business models provide.

Circular IQ's digital platform CTI Tool enables businesses to understand the impact of their product components throughout their entire lifecycle. The CTI Tool was developed in partnership with the World Business Council for Sustainable Development (WBCSD) to support the Circular Transition Indicators (CTI) Framework. The data-driven metrics generated through the platform help organisations develop clear targets to improve their circularity alongside their value chain partners. Those metrics support companies on their path towards the circular economy.

There has been a gap between standards and the actual needs of businesses, including engaging their supply chains in a democratic way. With experience in helping businesses strengthen their sustainability performance, the company noted that, though well-intentioned, businesses often find it very challenging to navigate, adopt and achieve the numerous sustainability standards and goals that exist. In partnership with the WBCSD Circular IQ is able to engage with and be heard by the global circular economy community.

## Problem

Resource depletion is a global problem of immense magnitude. It has been estimated that of generated waste only a small proportion is recovered, while waste generation will increase by 70 per cent by 2050. Businesses are directly affected, facing massive impacts on profitability and resilience while confronting pressures from increasing legislation on waste recovery, taxation and bans. Without knowledge on what a product is made of and how to reuse and recycle it, all its components become waste.

## Solution

Circular IQ's CTI Tool enables businesses to measure circularity, report on it and identify improvement potential in a safe, transparent and third-party-verifiable way, helping organisations align circular goals with understandable metrics. The basis of the solution is the tool, which shows the use of secondary and/or renewable resources and recyclability as well as the practical considerations for reusability. Clear and actionable reports and dashboards support businesses in decision making and setting circularity goals throughout the value chain.

By democratising its platform for all members of a customers' value chain, Circular IQ contributes to systemic circularity. In this way, circularity is not assessed or measured in silos of the supply chain, but rather all supply chain partners are incentivised to use the CTI Tool. The platform also enables users to benefit from the knowledge and data gathered about the product components to simplify the process and ensure uniform data about components is used.

## **Environmental impact**

With the CTI Tool, businesses are able to measure the environmental impacts of their value chains through various lenses, including greenhouse gas emissions at the product or material level, waste tonnage and water use. Industry leaders gain full transparency to their environmental impacts and set goals against those baselines to achieve greater circularity. If each leader shifts from non-renewable to recycled content in their products, the impacts on greenhouse gas reductions are enormous.

## **Social impact**

Businesses can measure the social impacts of their value chains with the CTI Tool, assessing factors such as forced labour practices, fair wages and health and safety. All the data gathered in the accounts can be verified by independent third parties and used for sustainability reporting. The platform provides results that inspire customers to shift their procurement processes towards sourcing from ethical and certified suppliers.

## **Key information**

- Geographical origin of the organisation: Europe
- Circular economy business model: circular economy enabler / circular data management
- Number of employees: under 10
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Central and South America, Europe, North America
- <https://ctitool.com/>

# Traceability-as-a-service to enable responsible, closed-loop supply chains

The use of lithium-ion batteries is increasing as mobility becomes electric. Traditional sourcing of battery raw materials is challenging and not sustainable. Circular supports the circulation of materials by their traceability platform that enables businesses to identify material cycle possibilities throughout their value chain.

The Circular platform supports the development of circularity in sectors such as lithium-ion battery manufacturing, through enhanced traceability. By letting customers trace raw materials throughout the value chain, the platform can confirm that recycled materials are used over virgin supplies, all while ensuring respect for human rights and tracking embedded carbon throughout the supply chain.

The founders of Circular had a vision: technologies such as blockchain, machine learning and the Internet of Things could be applied to solve known challenges in supply chains. Car manufacturers and consumers are increasingly aware of the social and environmental risks associated with sourcing the raw materials needed for lithium-ion batteries. Circular was born to be the technological backbone that manages these risks through responsible sourcing and sustainability improvements.

## Problem

Lithium-ion batteries are expected to power our shift towards electric mobility. Fundamental to the success of the energy transition is supply chain transparency and effective recycling of materials used in batteries. However, traditional sourcing of battery raw materials for electric vehicles is not socially or environmentally responsible, and the technology and infrastructure for recycling lithium batteries are still in early stages.

## Solution

Circular is a software solution that enables customers to track the flow of materials throughout their supply chains. It allows customers to, for example, determine securely whether batteries can be safely reused in a secondary application at their end of life, or whether they need to be recycled. Circular also helps businesses capture and communicate information about the carbon footprint of their battery production. Beyond this, Circular enables producers to verify and communicate about responsible sourcing throughout their supply chain.

By partnering with major mobility companies such as Volvo, Daimler and Boeing, Circulor has already begun demonstrating systemic change towards responsible and circular sourcing in the lithium-ion battery sector. They have proven it is possible to track raw materials through the supply chain, which will improve the transparency and circularity of the electric mobility industry's value chain. Circulor has already begun expanding its application to the recycled plastics sector.

## Environmental impact

The Circulor platform enables participants in the electric vehicle value chain to significantly reduce their carbon footprint. Over 70 per cent of the carbon footprint of an electric vehicle comes from its manufacturing and sourcing, with 50 per cent of that footprint from the battery. By providing a platform to assess, measure and ensure responsible sourcing of lithium-ion batteries, Circulor indirectly reduces the greenhouse gas emissions of a carbon intensive value chain.

## Social impact

Ciculor supports its customers to create a fully responsible value chain where producers can monitor their sourcing decisions. The Circulor platform encourages value chain participants to stop sourcing from places that rely on unacceptable labour conditions or child labour for sorting hazardous waste streams.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: circular economy enabler / circular data management
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Africa, Europe, Russia and Central Asia, South and South-east Asia
- <https://www.ciculor.com/about>

# A closed-loop process to recover and reuse salts from industrial wastewater

Covestro's salt recycling process keeps the salt needed in plastic production in circulation. It also reduces water consumption in production and lowers the amount of salt ending up in natural waterbeds.

Covestro's solution closes the loop on salt needed in the production of plastics and other polymers, thereby taking a step towards circularity in the materials science industry. The scalable solution is applicable to a variety of industries and provides a threefold environmental benefit: saving nonrenewable resources, saving water and reducing water pollution.

Covestro has adopted sustainability goals related to the UN's Sustainable Development Goal 6, "Clean water and sanitation." The salt recycling process fits into a long-term R&D strategy on finding ways to close water-related loops in high-tech polymer production, partly funded by the German government.

## Problem

The production of common plastics and other polymers requires large amounts of salt, which ends up highly concentrated in the resulting waste water. This salty waste water can pollute aquatic ecosystems, negatively affecting biodiversity and even harming drinking water production for cities downstream of the polymer production plants. The sourcing and production of virgin salts also requires intensive exploitation of non-renewable resources, with further negative effects on the environment.

## Solution

Covestro has developed a technology that recycles salty discharge from polymer production waste water into chlorine. This creates a closed-loop process as chlorine is an essential raw material for further polymer production. After a purification process containing several steps a sufficient level of purity is achieved and the recycled salt is directed into a chlorine-alkali electrolysis. New salt is added to reach the needed concentration for chlorine production, thus closing the loop from waste water to a valuable resource.

The research and development done by Covestro is the basis of a new joint project "Re-Salt" (recycling of salt-laden industrial process water), initiated by the German Water Center, Donau Carbon GmbH, EnviroChemie GmbH and a number of universities. The project was funded by the German Ministry for Education and Research.

## Environmental impact

The solution reduces the need of virgin raw materials (salt, NaCl), water consumption and salt discharges into bodies of water. The solution has significantly reduced the amount of salt used in chlorine-alkali electrolysis and the amount of desalinated water used. Finally, the solution saves 1,000 tonnes of CO<sub>2</sub> emissions annually thanks to increased resource efficiency.

## Social impact

Most of the surface waters downstream of chemical industry plants are impacted by salt discharges. By recycling the salt in their waste water, the solution ensures communities' access to clean water in the proximity on the plant.

## Key information

- Geographical origin area of the organisation: Europe
- Circular economy business model: resource efficiency and recyclability
- Number of employees: Over 250
- Share of the circular economy solution of total business or operations: under 10%
- Current geographical scope: Europe, East Asia
- <https://report.covestro.com/annual-report-2019/management-report/covestro-group-at-a-glance/responsibility-along-the-value-chain/circular-economy.html>

# Redesigning everyday products to design out waste and keep materials in the circular economy

Designing for circularity is in the core of DSM-Niaga's approach. Together with their production partners DSM-Niaga redesigns products with simple combinations of non-toxic materials that are safe and durable but also easy to disassemble for material recovery.

The DSM-Niaga approach unlocks circular design for everyday products, such as carpets, mattresses, and furniture panels. The solution is based on designing these products with the simplest combination of non-toxic materials, which makes them safe and durable but also easy to disassemble for product-to-product recycling. Niaga® carpets, mattresses and furniture panels are already available on the market and further redesigns are underway.

Niaga started with a sense of urgency to address the vast amounts of global carpeting waste. Chris Reutelingsperger, Niaga's founder, set out to design everyday products that could fully become the same product again. Hence the name Niaga – “again” spelled backwards. By joining forces with DSM and making use of their materials expertise, DSM-Niaga was able to develop a polyester “click-unclick” adhesive. Using this innovation, DSM-Niaga unveiled its first product, a mono-polyester carpet which can be 100 per cent recycled, again and again.

## Problem

Around 4.5 billion m<sup>2</sup> of carpet, 35 million mattresses and 10 million tons of furniture are thrown away each year. These waste streams pile up in landfills or end up in waste incineration plants, causing the loss of precious resources and materials, increased CO<sub>2</sub> emissions and the accumulation of hazardous toxins in the air, water, soil and living organisms.

## Solution

DSM-Niaga's circular design approach aims at reducing the massive waste of everyday products they design by rethinking their products from the ground up. Their technology, product designs and material innovations are offered to producers. Products made with the DSM-Niaga technology generally use less material, allow for lower transportation emissions due to less weight, use less energy in production and can easily be recycled for product-to-product reuse. Each product is marked with a “Niaga” tag, which includes a material passport to guarantee transparency on the materials used and to facilitate recycling.

Circularity is a central part of the venture's identity, and the company raises awareness of circular economy principles throughout the industries they operate in. DSM-Niaga seeks likeminded value chain partners that want to collaborate on transparency, clean materials and material recovery. By adopting several different business models for distributing the technology, DSM-Niaga's solution can be used throughout different value chains and industries and is easily scalable.

## Environmental impact

Carpets, mattresses and furniture are among the top 10 most voluminous waste streams, which often contain hazardous volatile organic compounds. DSM-Niaga's solution reduces both the enormous amount of waste headed to landfills and incineration plants and the need for virgin resource extraction. DSM-Niaga production machines do not use water and they require, on average, 80 per cent less energy than traditional methods.

## Social impact

DSM-Niaga has an indirect impact on improved health and thus quality of life for consumers. Carpets, mattresses and furniture panels that are designed for reuse according to Niaga's principles do not include any added chemicals, preserve indoor air quality and reduce the risk for respiratory problems and allergies.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Europe, North America
- <https://www.dsm-niaga.com/>

# Wastewater treatment and resource extraction as a service

Industrial water use poses diverse resource and pollution risks. The EcoVolt water treatment utility creates a closed loop for production that overcomes these global challenges.

EcoVolt, from the company Cambrian Innovation, addresses the issue of water scarcity and safety with the world's first bioelectrically-enhanced waste water treatment solution, converting waste water to renewable energy and reducing greenhouse gas emissions.

This innovation comes from work commissioned by NASA for the International Space Station. The objective was to build a closed loop life support system, generating mass and energy savings as well as decreasing the cost associated with carbon dioxide reduction. The spinoff of the solution was scaled up by the original research team from Cambridge, MA to turn it into an industrial solution.

## Problem

A growing number of manufacturers report water-related risk in their supply chain operations. As companies expand, they face increasing resource challenges, including water, energy and waste water treatment needs. With drought intensity increasing, water shortages are predicted to become more frequent than ever.

## Solution

Cambrian provides waste water treatment and resource extraction as a service by creating renewable EcoVolt micro-utilities at a partner's site. Their flagship solution efficiently treats waste water while extracting clean energy and generating clean water.

Notable users of EcoVolt include the food and beverage, textiles and pharmaceuticals industries as well as municipalities. By turning to water reuse, any type of industry with waste water streams can expand their production capacity and boost revenue streams without exceeding their consumption ceiling.

Though clients are first and foremost attracted by the economic rationale behind the solution, EcoVolt helps foster circular economy and adopt and integrate better environmental practices. Cambrian Innovation also works closely with the research sector and publishes in scientific journals, therefore supporting the whole circular economy community.

## Environmental impact

EcoVolt has a significant positive impact on reducing water use and eliminating water pollutants, whilst reducing greenhouse gas emissions related to energy production. It also supports the wellbeing of local ecosystems through potential water, air and soil remediation.

## Social impact

Cambrian's technology improves social wellbeing and community resilience by safely managing waste water and eliminating potential contamination of the surrounding environment. The technology can improve access to affordable clean water and renewable energy, which is important for underdeveloped areas that suffer from water scarcity.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: North America
- <https://cambrianinnovation.com/>

# **B2B matchmaking platform to find high-value reuse options for materials and products**

Across industries, the lack of data and transparency of materials hinders the high-value reuse of businesses' excess materials. Excess Materials Exchange (EME) platform overcomes the challenges in sharing these materials securely and efficiently.

Combining technology, human intelligence and powerful tools, EME provides a cross-sectoral matchmaking platform for materials and products while ensuring traceability and transparency. The platform aims to find the highest added-value matches, with regards to the environmental and socio-economic impacts.

EME was originally a resource passport. However, after development, the founders realised that a passive marketplace will not be sufficient to find high-value reuse options. They started to develop a “dating” platform for excess materials that would utilise new digital technologies to automatically match supply and demand of excess materials with their highest value reuse options.

## **Problem**

The growth and scale of circular initiatives are hindered by lack of transparency, timing and availability of resources, quality and quantity of resource flows, and inefficient internal resource cycles. Organisations lack tools for efficient collaboration that allow them to redistribute excess resources and utilise other organisations' waste flows.

## **Solution**

The matchmaking platform helps businesses across sectors find high-value reuse options for materials and (waste) products, enabled by artificial intelligence, Hyperledger blockchain and smart contracts.

The matchmaking is supported by Resources passports which restore information of the materials' properties such as composition, deconstruction, quality and toxicity. Other features enable tracking and tracing of material flows exchanged and the evaluation of the financial, environmental and social impacts of circular matches.

Companies that use the platform can reduce or eliminate their material disposal costs and generate extra revenue from exchanged materials, whilst reaching their sustainability targets.

EME helps companies globally to overcome the barriers of materials exchange and helps to transform current coincidental and relatively small-scale circular economy practices to a highly scalable and structural exchange of materials across industries.

## Environmental impact

Material exchange facilitated on the platform reduces greenhouse gas emissions, energy use and the use of virgin raw material by increasing the use of secondary materials and decreasing the amount of materials sent to landfills or incineration. The company's large-scale pilot including 17 materials from 8 multinational companies in 2018 suggested a 54 million euro environmental cost reduction and a 64 million euro financial value creation.

## Social impact

By decreasing materials sent to landfills and incineration, EME has a positive impact on the health and wellbeing of local communities. As EME supports the development of secondary material markets, it strengthens the resilience of economies, supports the creation of jobs for maintenance, repair and refurbishment, and improves working conditions in primary resources extracting countries.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: sharing platforms
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Europe
- <https://platform.excessmaterialsexchange.com/>

# Customised asset sharing platforms for businesses and organisations

Many companies' materials and machines stand idle for most of their lifespans. FLOOW2 facilitates the circulation of such resources between or within businesses through a trustworthy platform.

FLOOW2 is a platform for creating online business-to-business marketplaces for asset sharing. This customisable and scalable solution enables companies from different sectors to boost the utilisation efficiency of their assets, materials, services, personnel and facilities.

The idea for FLOOW2 started from construction sites where surplus materials were laying around unused. However, competition issues and absence of information on the demand and supply between firms hindered any such exchange. FLOOW2 was able to overcome these issues by creating a "safe space" for sharing within a closed circle. From there, the service was broadened to other sectors, such as business parks, retail chains and healthcare districts, and continues to expand its scope.

## Problem

All organisations have devices, equipment and materials that are not in constant use. Items stand a majority of their life cycle, while other businesses and organisations keep buying new products and materials. This means overproduction, overconsumption, idle capacity and spillage, which depletes natural resources and wastes energy.

## Solution

Through the FLOOW2 marketplace platform, organisations can share, swap and sell underutilised assets. FLOOW2 utilises a subscription based internal service model and can be customised for individual organisations or communities that wish to better allocate their assets. With FLOOW2, organisations can achieve better visibility over their inventory and more efficient use of resources, which saves costs or even generates additional turnover.

Sharing assets is an integral part of the development towards a circular economy. FLOOW2 supports the creation of small circular sharing ecosystems and fosters circular action amongst participating organisations by tackling the lack of trust in asset sharing.

Such sharing models result in less products being bought, less materials going to waste, more accurate allocation of personnel and more efficient resource use overall. Fostering collaboration can also drive innovation and encourage the adaptation of more circular economy practices.

## Environmental impact

By helping companies find opportunities for their byproducts or other unwanted materials, FLOW2 reduces waste and increases resource recycling and reuse. This translates to a reduced consumption of virgin raw materials, reduced primary energy use and reduced use of fossil fuel-based raw materials.

## Social impact

If the economy is disrupted by events such as pandemics or natural disasters, companies can agilely direct spare personnel from one area to another and guarantee continued work through FLOW2. FLOW2 also makes sustainable production more accessible for companies, indirectly enabling access to sustainable consumption. Overall, sharing builds stronger communities that are more resilient and perhaps even more equal.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: sharing platforms
- Number of employees: under 10
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: Europe, North America
- <https://www.floow2.com/>

# Connecting food businesses and charities to capture surplus food

Annually, almost 60 per cent of all food produced in Canada is lost or wasted. The Second Harvest mobile app FoodRescue.ca redirects this unsold surplus food to people in need and builds more resilient communities.

FoodRescue.ca provides a logistical solution that helps businesses connect with their local communities to save good food which would otherwise go to waste. Their simple platform fights three major crises: food waste, climate change and food insecurity.

FoodRescue.ca is a program of Second Harvest, a nonprofit organisation dedicated to directing surplus healthy food to people in need. Despite the charity's best efforts, surplus food in the supply chain was still slipping through the cracks. FoodRescue.ca was developed in response, as Second Harvest management realised that a digital platform could capture even small amounts of surplus food and scale the initiative.

## Problem

Thirty-two per cent of Canadian food waste is avoidable, being edible food that could be redirected to support people in local communities. Food that ends up in landfills is a massive contributor to global greenhouse gas emissions.

## Solution

FoodRescue.ca is an online tool and mobile app that allows local businesses with surplus, unsold food to connect with nonprofit and social service organisations in their area. These organisations recover and redistribute the food for their clients.

The program utilises accessible technology to create a scalable business model to reduce food waste. By increasing access to safe food, FoodRescue.ca allows people to do more with existing food resources.

Second Harvest plays a leadership role in Canada's efforts to create a circular food supply chain. In addition to expanding the reach of their FoodRescue.ca program they work with every sector, including public authorities, to raise awareness and accelerate movement on the food loss and waste agenda.

Second Harvest is also part of global conversations around circular economies. Their leaders have for example participated in research for the World Bank around the challenges associated with food waste. They also share their research, models and tools to help international players develop similar platforms successfully.

## Environmental impact

Since their inception in May 2018, FoodRescue.ca has averted over 13,000 tonnes of greenhouse gases by rescuing food that would have otherwise gone to landfills and released harmful greenhouse gas emissions. FoodRescue.ca's donation KPIs also help food donors measure and manage their food loss and waste.

## Social impact

Supporting individuals who lack food security is a core component of FoodRescue.ca's dual social-environmental business model. By September 2020, the platform had more than 2,000 registered donor locations and more than 2,000 registered non-profits, with a total of over 1,800 tonnes of food rescued. This has provided nearly 4 million meals and more than 6.5 million euros worth of donated food to people in need.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: sharing platforms
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 50 %
- Current geographical scope: North America
- <https://www.foodrescue.ca/>

# Managing office furniture donation, resale and recycling while achieving a 98 % diversion rate

The decommissioning of office furniture prematurely ends the lifecycle of valuable resources. Green Standards prevents unnecessary waste by redistributing surplus furniture to non-profits in need.

Green Standards helps corporations resell, recycle or donate their furniture to local organisations in need, creating a positive environmental and social impact. In the process, Green Standards demonstrates to its partners the value that the circular economy can unlock.

Green Standards began as a service coordinated between non-profits and corporations with surplus office furniture. The company quickly learned that to scale, they needed to expand beyond charities into the recycling and resale channels. Green Standards has evolved into a solution that includes corporate project management, multi-channel asset redistribution, non-profit engagement and story-telling, and industry-leading environmental reporting.

## Problem

The Environmental Protection Agency estimates that 8.5 million tonnes of furniture and equipment are sent to landfills each year in the US alone. Corporations are paying up to 634 million euros annually in landfill tipping fees for office decommissions, while many non-profit organisations across North America lack access to quality office furniture and equipment.

## Solution

Green Standards manages the office furniture removal and redistribution process for companies with the goal of reselling, donating or recycling the assets so that they are saved from landfills. To ensure clients have the most redistribution options and cost-efficiencies possible, Green Standards has built a preferred network of resellers, strategic recyclers and over 17,000 non-profit partners across North America. A fully transparent social and environmental impact report is provided to customers at the end of the process.

Green Standards is building a web of participating organisations that might not otherwise contribute to or benefit from the circular economy. Green Standards aims to change corporations' mindsets to prioritise a circular impact from their office decommission projects rather than paying a fee to send the furniture to landfills. Partnerships through the furniture and waste recovery value chains are a critical part of this process, including with recycling facilities, hundreds of charities and furniture manufacturers who are under pressure to demonstrate the end-of-life impacts of their products.

## Environmental impact

Green Standards has diverted over 70,000 tonnes of workplace furniture and equipment from landfills at a 98.6 per cent diversion rate, offsetting over 171,033 tonnes of CO<sub>2</sub>-equivalent emissions. Green Standards coordinates with charities, recyclers and furniture resellers to ensure that almost all of a company's used office furniture finds a second life.

## Social impact

The essence of Green Standards' model is to extend the life of furniture by finding it a second home with social service organisations who would have otherwise invested programming dollars to purchase new furniture. By granting these 5,000 organisations the freedom to reallocate funding toward fair employment wages or serving community needs, Green Standards is contributing to building resilient communities.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: product-life extension
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: North America
- <https://greenstandardsltd.com/>

# Solving the end-of-first-life management of technology

Green4Good tackles the e-waste issue by offering a technology disposal service which is sustainable.

Green4Good helps organisations to manage the end-of-first-life IT assets and resell the used devices at competitive rates to the next user. The program ensures product life extension, reduces the need for manufacturing new equipment and generates verified carbon credits through technology resale and refurbishment.

CFI started Green4Good after years of seeing organisations' lack of awareness about how to properly manage e-waste in an environmentally responsible way. Simultaneously, these organisations were also missing out on generating revenue from their redundant IT assets. CFI also wanted to help companies quantify the impact they make through the program. This brought about the Green4Good CarbonBank initiative, offering companies carbon credits for their end-of-first-life IT assets and the ability to offset new IT equipment purchases to become carbon neutral.

## Problem

The majority of electronics' lifecycle greenhouse gas emissions occur during manufacturing and the energy consumption of daily use. Businesses must constantly replace their devices that are designed to become obsolete after a few years' use. Once obsolete and disposed of, 80 per cent of devices accumulate in landfills as toxic waste or contribute to the poor working conditions and rights of scrap labourers in developing societies.

## Solution

The Green4Good program offers organisations a sustainable IT asset disposal service along with verified carbon credits. Through Green4Good, organisations can refurbish, resell or donate a large variety of technologies which can help them reach their sustainability targets. The received technology is securely processed and 90 per cent is reused and sold into secondary markets. Green4Good has its own marketplace for the technology it has refurbished. The remaining 10 per cent of technology that has no resale value is responsibly recycled through local partners so nothing ends up in landfills.

Green4Good enables a mind shift towards the circular economy in companies that would otherwise not believe that it is possible to find significant value from their used IT assets.

## Environmental impact

To date, the Green4Good program has resold over 1.8 million end-of-first-life IT assets. Green4Good has averted over 500,000 tonnes of CO<sub>2</sub> emissions and as a result developed a similar number of carbon credits which organisations can use towards their carbon reduction goals.

## Social impact

Green4Good enables improved access to sustainable consumption choices by creating high-quality refurbished products at a significant discount. This model provides opportunities for people from diverse socio-economic backgrounds to access technology and enables everyone to contribute to the circular economy. Green4Good operates their entire value chain within North America to ensure all the processing takes place locally and safely, contributing to domestic employment rates. Green4Good supports communities by encouraging participating corporations to donate their technology resale revenue towards local charities and non-profits.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: product-life extension
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: North America
- <https://green4good.ca/>

# Disrupting packaging with plastic-free and moisture resistant food containers

Plastic barriers in food packaging improve food safety but complicate recycling. Kotkamills' water-based barrier is easier to recycle and reduces the stress on non-renewable virgin raw materials.

Kotkamills' solution improves the recyclability of packaging products that are irreplaceable for society yet highly problematic from an environmental perspective. The solution eases access to sustainable raw material use and helps realise the sustainability ambitions and targets of companies and consumers.

Previously, there was demand for sustainable plastic substitutes in the market by eco-front-runners, but no real commitment. Kotkamills has closely cooperated with converters, brand owners and the secondary market to ensure that stakeholders can use the solution for primary applications on the industrial scale.

## Problem

Food packaging is a necessity for safe and hygienic food services globally, and disposable food packaging seems like an inseparable part of our modern lifestyle. The use of plastic in fibre-based packaging makes these products grease and moisture resistant, but also hinders their recyclability. Therefore, these products often end up in landfills or incineration and can cause plastic accumulation in nature.

## Solution

Kotkamills has developed a barrier board for food packaging. The material is grease and moisture resistant, biodegradable and fully recyclable in the existing recycling processes. It can also be easily used in existing recycling and package converting processes.

The product's design enables easy industrial processing and the recycling of packaging materials into pulp and further into new paper and board products. The recycled fibre has a lower price than virgin pulp and therefore strengthens the secondary materials market.

The upcycling of sawmills' excess wood chips, the main fibre raw material of the product, improves resource efficiency of the forest industry and enables additional revenue creation. Kotkamills collaborates with other organisations to develop new methods for waste sorting to ensure the materials remain in the loop.

## Environmental impact

By replacing plastics, Kotkamills decreases the use of non-renewable raw materials and the greenhouse gas emissions of the packaging industry. The barrier board can be fully recycled but it is also biodegradable and can thus reduce plastic accumulation in nature, preventing microplastics and chemical pollution.

## Social impact

The new barrier board improves consumers' access to products with sustainable packaging, without risking food safety and hygiene or compromising consumer convenience. By reducing the amount of plastic waste accumulating in nature, Kotkamills also contributes positively to the health and wellbeing of communities.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: renewability
- Number of employees: over 250
- Share of the circular economy solution of total business or operations: between 10%-49%
- Current geographical scope: Global
- <https://kotkamills.com/>

# Advanced lithium-ion battery resource recovery for safer recycling and reuse

Lithium-ion batteries have traditionally been impractical to recycle, leading to disposal as hazardous waste and the loss of valuable materials. Li-Cycle's solution creates a circular supply chain for the previously challenging process.

Li-Cycle has developed a ground-breaking way to create a truly circular supply chain for lithium-ion batteries in a world where increased electrification is needed to combat climate change. This solution defies the common misconceptions about the recyclability of lithium batteries by doing so in a safe, sustainable and economically viable way.

Traditionally, recycling lithium batteries involved processes focused on nickel and cobalt, leaving other materials unrecovered. Attempts to capture all critical materials and produce recycled-content batteries proved too costly and not possible at scale. The founders of Li-Cycle wanted to prove that secondary materials from spent batteries can be used to develop new batteries in an economic and sustainable way.

## Problem

The world lacks a viable option for dealing with the rapidly growing volume of spent lithium-ion batteries. In North America, before Li-Cycle, processes for dealing with lithium-ion batteries were exporting the waste, sending it to landfill (often igniting fires), or burning the critical materials. This linear approach contributes to climate change, environmental degradation and social challenges.

## Solution

Li-Cycle uses its patented Hub and Spoke technology to recover between 80-100 per cent of materials within batteries. By the end of 2020, they had capacity to process 7,500 tonnes of lithium-ion batteries per year.

The recovery output becomes input materials for battery supply chains. Where materials are not of sufficient quality for batteries, other paths for returning them to the economy are found such as steel, plastic lumber and drywall.

Li-Cycle's participation in the broader circular economy conversation helps shift mindsets toward the possibilities of recovering materials that were deemed impossible to recover, and changing the paradigm by showing that electric vehicle (EV) batteries don't have to be harmful for the environment if recycled properly.

## Environmental impact

Producing one tonne of Li-Cycle's battery material emits 74 per cent less greenhouse gas emissions than producing one tonne of battery material from virgin sources. Li-Cycle's process also produces zero waste, as all materials that are not end products are recycled properly. Therefore, Li-Cycle's product will have a significant contribution to reducing the negative impacts of EVs.

## Social impact

Li-Cycle's solution indirectly reduces the number of people forced into inhumane labour practices that come with mining cobalt by replacing the need for virgin resources. Li-Cycle's process also creates safer waste streams for individuals working in waste management as it reduces the risk of fires by removing lithium-ion batteries from the traditional waste streams. From an employment perspective, Li-Cycle is creating more jobs as it grows quickly.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: North America
- <https://li-cycle.com/>

# Crowdsourced recycling platform that connects all the stakeholders of the recycling process

Lack of recycling means that waste ends up dumped, in landfills or incinerated without treatment. The Live Love Recycle platform improves harmful waste management with communication and collaboration.

LiveLoveRecycle makes the recycling process easier and accessible to everyone. It connects people and companies in possession of unwanted waste products with entities who can reuse these raw materials. The app has become an integral part of life in Beirut, with 20,000 people benefiting from it today.

Live Love Recycle identified the garbage-recycling problem in 2015. They developed their own platform and started operating in 2018 thanks to the financial support they received from various national and multinational organisations.

## Problem

Three billion people in the world do not have access to a recycling service. This issue is especially apparent in underserved areas like much of Lebanon. Additionally, there is a lack of contact and communication between parties that generate waste and those that would like to reuse these materials or products. The root cause is a lack of communication and transparency.

## Solution

Live Love Recycle is a recycling application based on crowdsourcing that facilitates recycling and communal waste management for example in an area without a municipal waste collection scheme.

Through a crowdsourced platform, users can also take part in waste logistics: anyone with a bike or car can transport waste. For organisations scouting for reused materials, Live Love Recycle therefore reduces the costs related to waste logistics.

The organisation also provides users with waste data and assistance on recycling, while constantly supporting them in their waste management efforts. The platform is an efficient solution for fostering communal recycling and it benefits all parties involved.

By creating a platform that gathers information on available waste materials for people who could reuse them, the company contributes towards a circular economy.

## Environmental impact

Live Love Recycle helps to keep materials in circulation longer and reduces the use of virgin raw materials, which decreases the negative impacts of resource extraction, such as on biodiversity. Resource savings also reduce negative environmental impacts connected to waste incineration and landfilling, such as emissions and pollution to air, water and soil.

## Social impact

Live Love Recycle has created jobs in waste collection for 436 people from vulnerable communities. Assistance and advice provided by the application increases awareness of sustainable behaviours which result in improved recycling activity. This contributes positively to community resilience as well as the health and wellbeing of local communities. It also pushes officials to improve waste recycling schemes.

## Key information

- Geographical origin of the organisation: Middle East
- CE business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Middle East
- <http://liveloverecycle.tilda.ws/>

# Ink that can be magnetised for enhanced recycling

Packaging often includes elements that hinder recycling. Magnomer's magnetisable ink can remove impurities to allow more complete recycling.

Magnomer's Design2Recycle solution uses magnetic ink to eliminate a crucial obstacle to recycling plastic consumer packaging. The solution has already been piloted by brands like PepsiCo and American Fuji Seal.

The EU Single Use Plastic guidelines call for a minimum level of recycled plastic in packaging such as PET bottles. Similar regulation is coming in the US. Magnomer's ink technology allows consumer brands to design their packaging to meet these goals.

## Problem

Currently, 6 per cent of plastic bottles are recycled back into bottles. Packaging design elements hinder recycling as they cannot be separated from the plastic bottles they cover. This can make the whole bottle impossible to process or result in very poor-quality recycled plastic. Consumer brands face new regulations and consumer backlash and need plastic packaging recycling solutions that are compatible with their existing supply chains.

## Solution

As part of the industrial recycling process, packaging is ground into small flakes that can be melted down for further processing. Without Magnomer's magnetisable ink, the ground labels would cause impurities in the plastic flakes, making recycling much more difficult and inefficient.

With Magnomer's magnetisable ink, the labels can be removed using existing magnets, leaving only the pure packaging flakes. Magnomer's technology can be applied to a variety of resins and package types and can be integrated easily with existing printing processes.

Design2Recycle contributes towards closing the loop for plastics. They provide unique value to consumer brands and packaging manufacturers, ultimately enabling them to increase recycled content in packaging and offer consumers more sustainable products.

Magnomer's drop-in design lowers the threshold for switching for their clients, thus helping different supply chains in circular transition. With the solution, organisations can also meet and exceed regulatory requirements in the EU and US.

## Environmental impact

Virgin plastic production generates carbon emissions and toxins, as does their incineration at the end of their life. If used plastic packaging ends up in the environment, it degrades ecosystems both on land and in water which has adverse effects on wildlife and biodiversity. With Design2Recycle, these adverse environmental impacts of the plastic industry can be mitigated.

## Social impact

The solution contributes towards increased consumer plastic recycling which has a positive impact on local communities mainly through its environmental impacts: reducing plastic litter can be vital for the livelihoods, health and happiness of these communities.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: resource efficiency and recyclability
- Number of employees: under 10
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Europe, North America
- <https://www.magnumer.com/>

# Refurbishing old buildings into sustainable living residences with circular lifestyles

Urbanisation leaves suburban communities with demographic changes and under-utilised residential spaces. Circular lifestyles can fit well into these valuable infrastructures.

The rapid aging of Japanese society combined with the youth's migration to city centres have created a challenging housing situation where the elderly are left behind in suburban communities. The Odakyu Electric Railway has provided a new model for creating a circular community out of refurbished old buildings.

The company felt that their former company houses had strong potential value as residential real estate but needed a fresh approach for the revitalisation of the area. The idea of renovating the buildings to enable a circular lifestyle matched their needs well. By partnering with an architectural design company, the refurbished building attracts not only younger residents but also benefits the local housing market overall.

## Problem

With only the elderly remaining in the suburbs, it is difficult to maintain social services such as hospitals, public transportation and garbage collection. The Kanagawa area, a commuter community outside of Tokyo on the Odakyu Train Line, provides a clear example of this challenge, where the availability of social services and the effective use of vacant buildings are twin issues.

## Solution

The former company building of the Odakyu Electric Railway Company, located in the city of Zama in the Kanagawa area, has been renovated and turned into rental housing. A key point of the renovation has been “sharing spaces with limited resources”. For example, there is a common garden, urban farm lots for rent and common laundry, all of which support circular lifestyles.

The building has achieved an occupancy rate of 98 per cent. This has had a significant revitalisation effect on the surrounding area, while providing a model for other communities. Starting with the renovation, the company has plans to build a closed loop ecosystem and community in collaboration with the local city government.

The solution's key circular component is revitalising a community through the extension of an older building's lifecycle, while turning perceived weaknesses into strengths. For example, the limited space of some residential units has been turned into an attractive feature, as this encourages sharing economy practices among the residents.

As a result of this first project, the company has signed a circular economy agreement with the city of Zama to improve the circular economy in the local community by increasing the efficiency of waste management and conducting awareness raising campaigns.

## **Environmental impact**

As the lifespan of existing buildings is extended, there is reduced waste compared to complete demolition and new construction. Inside the rooms, eco-friendly materials from local suppliers are utilised. The encouragement of circular living also has a positive environmental impact, such as reduced use of cars due to limited parking space.

## **Social impact**

Besides fostering a community around circular principles, the circular residence has also improved the community resilience and social wellbeing by attracting people of child-raising age from outside the region. This has helped to maintain various social services in the area. The annual event “Hoshino Tani Market”, which aims to connect residents with local artisans and increase awareness of circularity, has also made the area more appealing to live in.

## **Key information**

- Geographical origin of the organisation: East Asia
- Circular economy business model: product-life extension
- Number of employees: over 250
- Share of the circular economy solution of total business or operations: between 10%-49%
- Current geographical scope: East Asia
- <https://www.odakyu.jp/english/about/>

# The world's first neighbour-to-neighbour food sharing application

A third of the world's food gets thrown away. OLIO is a platform fighting to save more food.

OLIO is a digital platform that lets users notify neighbours about extra food or ingredients, empowering communities to come together and prevent needless food waste. By reducing food waste from households, the scalable solution has a positive impact on the environment and social wellbeing, both on an individual and community level.

OLIO started when the founders were faced with having to throw away food despite hating to do so. The solution is built on research, testing and pilot programs, with food safety as a key focus area. Collaboration with consumers, businesses, communities and municipalities has also been crucial to ensure mobilisation around the issue.

## Problem

In the developed world, about half of all food waste happens at home. A lack of local community may mean residents do not know anyone to give excess food to. With more mouths to feed each year, the pressure on our food system will only continue to grow, meaning we need to transition to a more circular food economy.

## Solution

OLIO is the world's first neighbour-to-neighbour food sharing app. Apart from the peer-to-peer sharing component, OLIO also lets trained volunteers (known as "Food Waste Heroes") collect unsold food from local businesses to be distributed to other OLIO users for free.

For the individual users, OLIO gives a fun and easy way to decrease food waste and make a difference, whilst enjoying an empowering community experience. For the businesses, OLIO offers a cost-effective solution that enables them to achieve zero food waste locations.

OLIO's users and ambassadors advocate circular economy and awareness of the impacts of consumption. The platform's ideals match growing consumer interests such as sharing, community resilience and localism. The new partnerships created by OLIO help foster new hyper-local circular food networks.

## Environmental impact

So far 6.5 million portions of food have been shared worldwide via OLIO, which has reduced food waste sent to landfills. This is equivalent to taking over 30 million car kilometres off the road and saving over 1 billion litres of water in agricultural production. By optimising the use of resources in agriculture, the solution also contributes towards reducing the need for land occupied by agricultural activities.

## Social impact

The solution's key social impact is significantly improved consumer health and wellbeing, as OLIO can help reduce hunger in local communities. It also contributes towards improved community wellbeing by increasing social cohesion. The food that is distributed through OLIO is also inherently sustainable, as it would otherwise be wasted, which means it also improves access to sustainable consumption.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: sharing platforms
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Central and South America, Europe, North America
- <https://olioex.com/>

# End-to-end material traceability across global supply chains supports a circular economy

The circular economy is slowed down by invisible material flows. The Intelligent Supply Chain platform enables circular innovation by granting companies greater visibility over their supply chains.

Optel Group's Intelligent Supply Chain platform records the digital journey of any material flow from cradle to grave – from raw materials to the consumer and beyond. This enhanced visibility is used by companies to optimise their material flows and make more informed circular decisions related to product design.

Optel was founded in 1989 and began developing technology related to supply chain traceability. Over time, the company's solutions were applied to various sectors, allowing collaboration amongst different actors. As technology and processes evolved, the company was able to track a product's lifecycle all the way to end users. Key partnerships with universities and innovation organisations, as well as acquisitions of technology start-ups, have supported Optel's growth.

## Problem

A key obstacle to achieving circular economies is identifying materials used in production across supply chains. Without visibility over what kind of materials are used and to what extent, the environmental impacts of products and services are difficult to identify and the opportunities for improving their sustainability are limited. Lack of information also hinders the reuse and recycling of products.

## Solution

On the platform technologies such as mobile data collection apps, scanning systems, geographic information systems and artificial intelligence provide information on material flows such as their location, output and quality. Optel also uses gamification so system users are encouraged to engage in behavioural changes that support a circular economy.

Optel Group is part of a large network of actors. In addition to their customers, Optel's network consists of industry associations, recycling and waste organisations, universities, government agencies and charities.

## Environmental impact

Optel Group helps their clients to improve their sustainability performance with better materials management that fosters circular use of materials and reduces greenhouse gas emissions. Through their technology solutions, Optel Group facilitates the identification of materials for reuse and recycling, supporting the growth of the secondary market.

## Social impact

Optel Group solutions enable the creation of jobs from waste diversion and resource efficiency, which are also key components of a circular economy. The gamification systems create positive social impacts by incentivising users towards sustainable behavioural changes that may improve their health and well-being.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: circular economy enabler / circular data management
- Number of employees: over 250
- Share of the circular economy solution of total business or operations: under 10%
- Current geographical scope: Central and South America, Europe, North America, South and Southeast Asia
- <https://www.optelgroup.com/>

# Paving the way to a circular economy in British Columbia, Canada

With its educational content and workshop material, Project Zero prepares a generation of circular economy leaders.

Project Zero, an initiative by the non-profit Synergy Sustainability Foundation, aims to catalyse the shift to a circular economy in British Columbia. The project organises an incubator for businesses and roundtable events for policymakers and industry leaders to identify circular opportunities.

In the 2010s, the Province of British Columbia identified the circular economy as a focus area for regional sustainable development. The Foundation decided to launch an incubator for circular economy ideas in collaboration with the local government and partners such as Vancity Credit Union.

## Problem

Two major barriers to a circular economy are lack of awareness and a low sense of urgency. The negative aspects of a linear economy are not transparent, and recycled materials are often looked down upon by consumers. This makes it difficult for entrepreneurs in the circular economy to succeed in the marketplace, while also hindering the advancement of appropriate legislation.

## Solution

Project Zero has set out to raise awareness on Vancouver Island and beyond about the opportunities of a circular economy. The project hosts quarterly roundtables to identify ripe opportunities for circular collaboration and advocate for policy changes.

Through its network, the initiative works to build awareness of the circular economy among small- and medium-sized enterprises. Youth engagement events and workshops, as well as an eight-month-long incubator program, all work to support innovation around circular economy principles.

In addition to communication and awareness campaigns, the organisation's waste stream audit tool and green business certification program enable traditional businesses to improve their operations and join the transition towards a circular economy.

## Environmental impact

Through its awareness campaigns and its incubator program, Project Zero helps to reduce waste, virgin material extraction and greenhouse gas emissions. Their waste stream auditing tool for businesses also supports waste visibility, which enables smarter business decisions with lower footprints.

## Social impact

Project Zero supports especially young entrepreneurs and social entrepreneurs. In 2019, the incubator program helped launch six new business, four of which were founded by women. Together, these ventures created 23 new green jobs.

## Key information

- Geographical area of the organisation: North America
- Circular economy business model: circular economy enabler / circular communications
- Number of employees: under 10
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: North America
- <https://www.project-zero.ca/>

# Returning textile waste to the fashion cycle

Only one per cent of global textiles are recycled, and that percentage is difficult to reuse. Renewcell's recycling process enables a longer life for valuable cotton and viscose material.

Circulose is made by Renewcell in the world's first industrial-scale chemical recycling process for used cellulosic textiles. The solution has been developed through collaboration between various stakeholder groups, such as prominent fashion houses and research organisations, making it an excellent example of diverse parties coming together for circular innovation.

The work started at the KTH Royal Institute of Technology research centre. Scientists had originally been working to produce biofuels but instead discovered a method for decomposing the cellulose in textile materials like cotton and viscose. Growing demand for virgin man-made cellulosic fibres and the pressure on fashion brands to improve recycling led the research team forward.

## Problem

The textile industry is very water-intensive and harms local ecosystem with the use of pesticides. Globally, most used clothes often end up in landfills. Synthetic clothes also cause a significant amount of ocean microplastic pollution. The industry's emissions are expected to consume 25 per cent of the global carbon budget by 2050, partially due to the growing need for textile products and the lack of affordable new sustainable textiles.

## Solution

Renewcell's chemical recycling process turns used cotton and viscose textiles into biodegradable Circulose pulp. This product can be made into new textile fibres and fed into the textile production cycle again and again. The fibres made from Circulose are indistinguishable from virgin man-made cellulosic fibres and fabrics, making them a great alternative to cotton. This enables sustainable production for many brands. The solution can accelerate the use of recycled input also in fast fashion and make sustainable fashion more accessible.

Renewcell enables the production of sustainable raw materials from fashion industry's waste. The industrial-scale solution provides large brands with an opportunity to use recycled materials and reduce their environmental impact while maintaining a high product quality. The upstream partners who collect and sort the textile waste are compensated for their work, ensuring less textiles end up in landfills.

## Environmental impact

Renewcell reduces the use of virgin textile fibers, which means less water usage in stressed areas, less need for chemical pesticides and less energy usage for logistics. Using waste as the main input for the production process also directly decreases the amount of waste sent to incineration or landfills.

## Social impact

By targeting large fashion brands with wide consumer bases and affordable prices, Renewcell improves consumers' access to sustainable fashion. Additionally, the solution can lead to local and fair job creation in a circular economy, especially when operating on an industrial scale.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Central and South America, Europe, South and Southeast Asia
- <https://renewcell.com/>

# Waste-tracking software for smart waste and recycling solutions worldwide

The linear economy is full of waste streams that contaminate ecosystems and hide valuable resources that could be recycled and reused. Rubicon makes these streams visible and available for better management.

Rubicon enables worldwide traceability of material flows with its software-as-a-service and data analysis for waste, recycling and smart city solutions. These services are fundamental for responsible and sustainable waste management, helping businesses and communities to fully understand and track the composition, flows, scale, impacts and costs of their waste.

Rubicon was founded with a mission to end waste, in all of its forms. Through collaboration with renowned tech institutions and environmental organisations, the company has built innovative technology solutions that have been adopted by companies in North America, Europe and Asia.

## Problem

The linear economy creates waste at a great scale, which threatens the quality of our air, soil and water. Eliminating all waste streams would effectively change the linear economy into a circular one. The challenge is to create strong diversion processes and outlets for that material once it has been identified and separated.

## Solution

Rubicon's technology enables businesses and haulers to connect, schedule and track waste pick-ups and to analyse the data gathered from these activities. Companies gain visibility to how much waste there is, where it is created and how it is currently being handled.

Large Fortune 500 companies use the solution to identify opportunities for waste reduction and recycling as well as to comply with regulations. The platform measures important metrics such as diversion rate from landfills and carbon emissions avoided, which can also support sustainability reporting and impact measurement.

Rubicon improves its users' knowledge of their waste flows and can support their waste management processes design. Thus, it increases the capacity of these organisations to take further circular action, such as finding reuse opportunities for newly observed waste streams.

Rubicon collaborates with other organisations such as the Ellen MacArthur Foundation and Wharton initiative for global environmental leadership for knowledge transfer.

## Environmental benefits

Rubicon's focus is to increase their customers' diversion rate from landfills. Their solutions have a positive impact on reducing waste generation and the use of virgin raw materials, which translates to reduced greenhouse gas emissions and pollution from materials production and the landfilling or incineration of waste. Diverting organic matter from the landfill specifically can decrease methane emissions and pollution to air, water and soil.

## Social benefits

Rubicon's technologies across industries improve access to sustainable production. Contributing towards improved recycling may decrease landfill and incineration of waste and the risks associated with them, such as pollution which impacts the health and wellbeing of local communities. Rubicon has a positive social impact by creating quality jobs and is B-Corp certified. The organisation covers employee health premiums and ensures fair employment.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: circular economy enabler / circular data management
- Number of employees: over 250
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: Europe, North America, South and Southeast Asia
- <https://www.rubicon.com/>

# Beautiful, sustainable and affordable office furniture

Office furniture has a surprisingly wasteful and short lifespan in the linear economy. Rype Office saves furniture from landfill and incineration and gives it a second life.

Rype Office is a British office furniture remanufacturing and design company working to address the 300 tonnes of office furniture going to landfill every working day in the UK. They remanufacture unwanted office furniture to as-new condition using quality-controlled engineering processes.

## Problem

Though often overlooked, office furniture is a significant environmental problem. Research shows that over the 40-year lifespan of a commercial building furniture is a significant source of greenhouse gas emissions, accounting for 30 per cent of the total embodied carbon footprint of a building. This is due to the established process of buying furniture new and skipping after its first life.

## Solution

Rype Office offers their customers furniture with a reduced environmental footprint and a price tag less than half that of a new item. Rype Office sources used furniture from clients' existing stock and the UK's biggest clearance companies.

Their design service integrates remanufactured items along with furniture they have designed from waste materials into beautiful, sustainable and low cost workspaces. Every item of furniture sold comes with a take-back offer so it can be remanufactured for future lives.

The nature of Rype Office's business enables them to effectively close the loop and oversee the return and renewal of products, extending their economic life.

Rype Office creates awareness about the circular economy by telling clients the provenance of their products and demonstrating the environmental, economic and social benefits of a fully circular business model.

## Environmental impacts

When valuable material goes to landfills, not only does it occupy space and pollute ecosystems, but it also represents lost value and a lost opportunity for preventing the extraction of further virgin materials. Remanufacturing a piece of office furniture gives it an 80 per cent reduced environmental footprint compared to a new item.

## Social impacts

On large projects Rype Office tries to offer as many jobs to disadvantaged people living in close proximity to the project as possible. They have provided 6,500 hours of living wage employment to long-term unemployed or disabled people. When they design and manufacture new items they aim to work with partners with a shared commitment to social value creation. For example, Rype Office designs and manufactures a range of booths and soft seating with the Merthyr Tydfil Institute for the Blind.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: product-life extension
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Europe
- <https://www.rypeoffice.com/>

# Decentralised, customisable and resilient fertiliser for farmers in the developing world

Common fertilisers in Kenya are poorly suited for local soils and can do more harm than good. Safi Organics has an alternative which uses crop residues into customisable, carbon-negative fertilisers.

Safi Organics' solution turns the agricultural waste streams of Kenyan farmers into customised, carbon-negative fertilisers. With engineering know-how from MIT and intimate knowledge of the local environment, Safi Organics' highly scalable solution is well-researched and excellently suited for the Sub-Saharan African region.

The company's CEO grew up in rural Kenya and witnessed first-hand the challenges that local farmers faced related to long-term soil degradation. To develop the Safi Sarvi product, the team worked closely with local farmer co-operatives. Safi Organics partnered with the Kenyan Organic Research organisation to gather necessary data. Further technical knowledge was gained through enlisting a CTO specialised in biochar creation, pursuing partnerships with scientific experts and researchers, and winning research grants from institutions like MIT.

## Problem

Farmers in Kenya can often afford only the cheapest synthetic fertilisers. These one-size-fit-all fertilisers are poorly adapted for local soils, depleting their quality over time and decreasing the farmers' yields. As the land degrades, more synthetic fertilisers are needed to maintain crop productivity, and these chemicals often leak into waterways and pollute the environment. Use of synthetic fertilisers decreases soil organic matter which negatively affects the capacity of the soil to store carbon.

## Solution

Safi Organics turns crop residues, such as grain husks, into customisable, carbon-negative fertilisers. When used in place of synthetic fertilisers, Safi Organics' product helps increase the farmers' crop yield while sequestering carbon and restoring soil quality. The company's MIT-developed technology can be distributed for decentralised use, so that the fertiliser production can be carried out in villages using locally available resources and labour.

The company's product, Safi Sarvi, improves farmers' crop yields and income by up to 30 per cent, all for a price similar to imported synthetic fertilisers. The solution affords farmers an economical way to practice regenerative, carbon-negative and resilient agriculture.

The solution is a clear example of a circular business model, as an agricultural waste stream is turned into a valuable product with multiple environmental and social benefits.

## Environmental impact

The solution revitalises soil by helping to reverse soil acidification and degradation. The fertiliser also ensures that nutrients and moisture are retained for longer periods, reducing leaching and related pollution of waterways and the local environment. The fertiliser is carbon-rich, making it possible to capture and store carbon in soil. Locally produced fertilisers reduce the need for international transport logistics, which in turn decreases emissions. Finally, the conversion of locally available crop residues into valuable fertiliser reduces farmers' current practice of burning unneeded crop residues, which helps reduce air pollution.

## Social impact

The decentralised fertiliser production helps create jobs for underemployed youths in smaller farming communities. Rather than being forced to relocate to urban slums, these youths now can make a decent living in their home villages and are more likely to remain in the local agriculture industry to help strengthen its productivity. Another important point is that farmers are not dependent on imported fertilisers, which strengthens the local economy overall.

Additionally, stable, consistent design for the fertiliser manufacturing equipment has been important. From day one, the team has partnered with local manufacturers in rural villages. When parts break, the manufacturers need to be able to rely on local components and servicing.

## Key information

- Geographical origin of the organisation: Africa
- Circular economy business model: renewability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Africa
- <https://safiorganics.co.ke/>

# Harnessing industrial side streams to regenerative agricultural solutions

A tenth of the EU's total greenhouse gas emissions comes from agriculture. By recycling industrial by-products into soil improvers, fertilisers, and agricultural lime, Soilfood reduces greenhouse gas emissions.

Soilfood enables the circulation of materials between sectors that do not traditionally collaborate with each other. The solution utilises the by-products of one sector to produce a sustainable input alternative to another, working as a middleman that creates both monetary and ecological value for each party.

The founders of Soilfood had all been wanting to solve different agriculture-related problems, and eventually their collaboration created one interconnected solution. The Finnish waste regulation that came into force in 2013 demands that waste can only be disposed of in a landfill if it is not technically or economically possible to utilise it. This was an important guiding regulation that pushed actors across industries to view their side streams as a resource rather than waste.

## Problem

Conventional farming uses energy-intensive fertilisers and reservoirs and is responsible for a large portion of greenhouse gas emissions in the EU. Lack of organic material input and an excessive use of inorganic substances decrease the quality of soils and waterbodies and contribute to biodiversity loss. Simultaneously, many other industries generate by-products that already contain these valuable nutrients in an organic form, but instead of being utilised as a raw material, they are incinerated, disposed in landfill or otherwise treated as waste.

## Solution

Soilfood utilises industrial by-products from the forest, bioenergy, food, mining, chemical and environmental industries. The by-products are recycled into soil improvers, recycled fertilisers and agricultural lime, which significantly reduces the greenhouse gas emissions of both agriculture and industry. The use of soil improvers adds carbon to the soil, which increases the carbon sink and results in better soil fertility, crop performance and soil biodiversity. The solution adds value both to the industries and farmers. For industries, their previously valueless by-products are now acquired and spared from landfills. The farmers get a cost-efficient, reliable and sustainable agricultural input, many of which are suitable for organic farming.

Soilfood's operational model is to utilise side streams with reuse opportunities for added value, creating new regional value chains. For farmers, Soilfood offers holistic consultation services on regenerative agricultural practices. Additionally, 11 per cent of the budget is used for R&D activities which can further improve nutrient recycling and therefore circularity in agriculture and industry.

## Environmental impact

Soilfood Ltd improves the quality of soil and waterbodies by binding carbon and nutrients to soil. As the solution replaces energy-intensive virgin raw materials and mineral fertilisers with recycled nutrients, it reduces the use of fossil energy and non-renewable natural resources. In 2019 the solution saved 29,610 tonnes of carbon dioxide emissions, which is equivalent to 2,875 Finns' annual carbon footprints. The solution contributes to healthier soils that are more reliable in cultivation and crop production even in the changing climate.

## Social impact

The solution improves farmers' access to sustainable production practices by making the use of recycled input in agriculture more cost-efficient and supporting the farmers to change to regenerative agricultural practices.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: renewability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Europe
- <https://soilfood.fi/in-english/>

# Upcycled solar panels for renewable energy generation, anywhere

Almost 1 billion people globally don't have sufficient access to electricity. At the same time solar panel waste lacks an effective recycling system. Rehabilitated and reconfigured solar modules offer affordable grid-independent electricity for remote areas and take advantage of the increasing amount of solar panel waste.

SunCrafter's upcycled solar modules provide an agile solution for the global challenge of providing clean and affordable energy on-demand and wherever needed, whilst preserving materials and carbon emissions, which are caused by the production of new photovoltaic panels. The solution works wherever grid power is not easily available: from energy-poor regions to urban environments lacking adequate charging infrastructure for electric vehicles.

The idea behind SunCrafter originated when the founders were contracted to run quality controls on industrial solar farms. Triggered by the realisation that every year millions of functioning solar panels go to waste, they developed a first solution to provide a life for these modules: the EasyPanel technology. The solution required heavy initial R&D investments. SunCrafter then moved on to adapting its core product, standalone solar systems to various environments with varying needs of complexity and robustness.

## Problem

Accumulation of solar panel waste is escalating in the coming years without an economically and ecologically viable solution for disposal. Most decommissioned modules are not financially competitive in grid applications. At the same time sufficient access to electricity is lacking for many people around the world. Access to energy is crucial for low-income households to generate income and develop.

## Solution

SunCrafter offers a range of upcycled solar modules and other related components. By applying their own reconfiguration process onto decommissioned solar modules, they are upcycling them into uniquely robust plug & play solar generators for essential low voltage energy access. SunCrafter's urban e-mobility charging stations are more sophisticated, but work with the same second life resources.

SunCrafter extends the lifetime of solar panels and fosters access to renewable energy. The company has partnered with the EU to research and provide standardisation for the reuse of solar panels and is an advocate for circular renewable energy: for their urban e-mobility station they plan to deploy second life battery packs as to complete the circular concept of the product. SunCrafter harvests sunlight as an affordable energy source for everyone, wherever it is needed.

## Environmental impact

As the solution replaces diesel generators, SunCrafter's products save around 0.3kg of CO<sub>2</sub> per kWh of energy generated. Providing all currently unconnected habitats with solar generators would save 22 million tonnes of CO<sub>2</sub> annually. This could be achieved with 3 million tonnes of repurposed solar panels that avoid being incinerated or tossed to landfills, which is also a major environmental threat due to leaking toxins.

## Social impact

Lowering the upfront cost of solar power by reusing rehabilitated modules, increases the access to energy for remote or low-income households. When used to provide energy access to energy poor regions, the potential of positive social impact is particularly high. Access to electricity is a multiplier for other sustainable development goals such as improving health, education and economic development.

## Key information

- Geographical area of the organisation: Europe
- Circular economy business model: product-life extension
- Number of employees: under 10
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Africa, Central and South America, Europe, South and Southeast Asia
- <https://suncrafter.org/en/about/>

# Building the foundation for the future of circular construction

Reusing construction materials is challenging and most material ends up downcycled or wasted. SundaHus helps actors in the construction sector choose materials without unwanted substances and ultimately reuse or recycle them.

SundaHus provides an online platform, SundaHus Material Data, for managing construction materials throughout their lifecycle. The company has created what has already become a new standard procedure for many actors in the construction sector.

The environmental and health requirements for the building sector are constantly evolving. Building owners are increasingly interested in keeping track of what materials are in their building, often by necessity. The founders of SundaHus realised that it is most efficient to gather all the material and product information during construction, not later.

## Problem

Due to their material intensity, buildings are increasingly seen as potential urban mines. However, reusing and refurbishing used construction materials is challenging and most material ends up downcycled or wasted altogether. One issue hindering the potential for recycling is a lack of information about the material stock and content in buildings, preventing circular end-of-life use of the materials.

## Solution

SundaHus has created a web-based tool that helps actors in the construction sector choose, record and track materials and products that go into a building project. Over 5,000 real world construction projects with usual budget constraints have used the solution. The tool supports the selection of safe materials without unwanted substances in the design and construction phase, and information about the used materials is saved to a building-specific database, enabling automatic processing and decision-making. This makes it easier to manage and ultimately recycle the materials used in the building.

The solution enables circular end-of-life projects for buildings that are being constructed today. The solution encourages meaningful collaboration between different stakeholders in a construction project and helps them collaborate on gathering data from all participating entities. This can nudge the parties towards more sustainable choices along the whole construction value chain. SundaHus also collaborates with several building certification schemes.

## Environmental impact

Reducing the amount of hazardous substances in the building stock is SundaHus' most profound environmental impact. As the solution also creates visibility on the environmental impact of different building materials, it indirectly supports the reduction of greenhouse gas emissions and fossil fuel-based raw materials. Especially in the future, at the end of a building's life, the solution can significantly reduce the amount of waste sent to landfills and incineration by enabling reuse and recycling opportunities.

## Social impact

As the solution contributes to the selection of safer building materials both for people and the environment, it contributes positively to the health and safety of construction sector workers and the users of the buildings. Additionally, SundaHus makes it easier for the construction sector to make sustainable and safe material choices, increasing access to sustainable production.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: circular economy enabler / circular data management
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: Europe
- <https://www.sundahus.se/>

# Diverting organic waste streams from landfills

Organic waste is seldom sorted from other types of waste in North America. SusGlobal Energy helps municipalities turn the waste into a high-quality dry compost and liquid bio-fertiliser.

SusGlobal Energy's solution enables the production of both biogas and a high-quality fertiliser from organic waste streams. The scalable solution has significant environmental benefits, helping prevent harmful methane emissions from landfills while creating a renewable source of fuel and natural fertiliser.

The impending implementation of cap and trade systems and methane accounting for municipalities in Canada acted as catalyst. Growing public and academic recognition of the negative effects of landfilling organic waste have also facilitated the company's journey. The company has established strong relationships with municipalities, who purchase SusGlobal's services once the municipality initiates a biowaste sorting and collection system.

## Problem

Currently, organic waste is seldom sorted from other types of waste in North America. Implementing the necessary sorting infrastructure, such as organic waste bins, collection vehicles, composting facilities and anaerobic digestion machines, along with changing consumer behaviour, is a significant investment. In the meantime organic waste ends up in landfills across North America, where it releases methane, a potent greenhouse gas, as it breaks down. On top of this, the organic matter's embedded nutrients go to waste.

## Solution

SusGlobal Energy uses their proprietary technology to turn organic waste into a high-quality dry compost and liquid bio-fertiliser. The company works with municipalities that already have organic waste collection processes or are interested in implementing one. SusGlobal collects the organic waste stream from the municipalities and produces regenerated products, such as nutrient-rich organic compost or organic pathogen-free liquid fertilisers. The municipalities, who must normally pay a fee for sending the waste to landfill, instead pay SusGlobal to collect and process the organic waste, diverting it from the landfill.

Salvaging the value of a waste stream for use in another sector is a core tenet of circular economy thinking. To raise awareness about this approach, SusGlobal Energy is active in their relationships with local municipalities, who are their key partners. Large landfill companies also collaborate with the company when synergies are identified.

## Environmental impacts

This company supports the diversion of organic waste from landfills, which prevents emissions of methane, which is 28 times more potent a greenhouse gas than CO<sub>2</sub>. The resulting organic compost and pathogen-free liquid fertiliser provides nutrients to the environment, and the slurry produced helps optimise biogas production.

## Social impacts

In addition to the employment generated, the company supports communities living close to landfills by reducing the amount of organic waste in the area. Moreover, communities that participate in organic waste recycling systems become more conscious of sustainability matters. The company also supports small municipalities and subsidises bags or containers for collection when needed.

## Key information

- Geographical origin of the organisation: North America
- Circular economy business model: renewability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: North America
- <https://susglobalenergy.com/>

# Compressed air as-a-service for industrial facilities

Industrial facilities often have old compressed air technology which requires oil and service and breaks easily. Tamturbo offers compressed air as-a-service that is completely oil-free and low maintenance.

Tamturbo's compressed air as-a-service is the cheapest solution on the market in terms of lifecycle costs. The solution is an example of re-designing old technology with circular economy principles to create a product for a market where innovation has slowed.

The solution is technically complex, but all the technologies it uses have been around for decades. The founders had the vision of an oil-free and touch-free air compressor already in the 90s. They knew it could be done, but it took eight years of R&D to crack it.

## Problem

A tenth of industrial electricity consumption is used for compressed air, which is five per cent of total global electricity consumption. Traditional screw compressors have many parts and rely on oil, which has adverse environmental and health impacts. A huge proportion of the traditional manufacturers' business is from the market for spare parts, which drives unsustainable design and is costly to the client.

## Solution

Tamturbo offers compressed air as-a-service. The technology is nearly service- and maintenance-free because it minimises wear and tear, and it has fully remote monitoring and control capability. Thus, Tamturbo can keep the ownership of the technology at low risk. Clients save energy and reach their environmental targets, have a safer working environment due to the absence of oil, minimise the risk of failure of the device and save money at the same time.

With Tamturbo's technology and service model, industrial companies do not have to own their air compressor technology anymore or take care of its upkeep and maintenance. This can open up these companies to circular thinking and the service economy even more and foster change in industrial production practices. The compressor itself has been designed with circular economy principles of longevity and energy efficiency; for example, it does not have any touching parts which prevents wear and tear.

## Environmental impact

The solution reduces the greenhouse gas emissions emissions of industrial operations by reducing the primary energy use of air compressors and avoiding the use of oil. It also eliminates the risk of oil-contamination. As the technology is smaller in size than the traditional solution, almost maintenance-free and designed for refurbishing, it also has positive impact on materials use and reduces waste sent to landfills or incinerators.

## Social impact

Oil used in traditional air compressor technology poses a significant risk to employee health and wellbeing, as some oil always leaks out. Therefore, Tamturbo's solution has a positive impact on the health of industrial workers.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: product-as-a-service
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: between 10%-49%
- Current geographical scope: Europe, North America, South and Southeast Asia
- <https://www.tamturbo.com/>

# Plastic waste recycled into school furniture and ecological roofs

Eco-composite material reduces the unsustainable use of wood and raises awareness of the plastic waste issue.

The TECO<sup>2</sup> solution transforms plastic waste into eco-composite material used in classroom benches and ecological roofs. Currently operating in Burkina Faso, the solution has a highly positive environmental and social impact, addressing plastic waste, deforestation and education quality.

The solution was launched in 2013 with the aim to manufacture school and household furniture. The solution involved the collaboration of French and Burkinabe laboratories to substitute wood with a plastic waste as a raw material. The use of plastic waste reduces the cost of furniture.

## Problem

Many African cities lack sufficient plastic waste management infrastructure, meaning that plastic waste builds up in cities and enters the surrounding environment. Durable materials can be in short supply so communities turn to wood which is harvested unsustainably. Such deforestation can in turn contribute to local erosion, flash floods, biodiversity loss and desertification.

## Solution

TECO<sup>2</sup> has developed an eco-composite material that is manufactured using plastic waste and can replace wooden planks in classroom furniture and roofs. The end product is durable, waterproof and resistant to UV aging, while offering better thermal and acoustic insulation than other materials.

The material is composed of recycled plastic pellets, local plant fibres and other local resources. The residues of this process are used in other end products, such as paved roads. The technology was developed in collaboration with the LEMC laboratories of 2iE in Burkina Faso and PIMM of the ENSAM of Paris in France.

TECO<sup>2</sup> contributes towards closing the loop for plastics through its plastic-waste based material innovation. The company drives the transition to the circular economy by working with national and regional NGOs to raise awareness of the plastic waste issue. They also collaborate with government and research institutions to maximise their impact.

## Environmental impact

The solution enables the collection and recovery of plastic waste, currently about 15 tonnes monthly. Indirect impacts include the reduction of deforestation, erosion, flooding, biodiversity loss and droughts through the substitution of wood with recycled plastics.

## Social impact

TECO<sup>2</sup> trains local waste pickers as well as the workers involved in the manufacturing of the recycled pellets to enhance the collection and recycling process in a safe and efficient manner, resulting in the development of skills and raising awareness in the local community.

## Key information

- Geographical origin of the organisation: Africa
- Circular economy business model: resource efficiency and recyclability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: between 50%-99%
- Current geographical scope: Africa
- <https://teocarre.com/eco-tables-bancs-de-classe/#>

# A platform for anyone to start a circular t-shirt business

The clothing industry is known for a large environmental footprint and human rights issues across its value chain. Teemill offers a free platform for entrepreneurs including in developing countries to sell t-shirts designed with circularity in mind.

Teemill's online platform lets charities and other organisations create their own customised webstore for circularly designed clothing. Each t-shirt is designed to be durable and recyclable. They are printed and delivered on-demand from Teemill's UK-based factory. This helps reduce unnecessary production of "single use" clothing made under harsh working conditions with unsustainably sourced cotton.

The main innovation has been the combination of a fast and flexible manufacturing model with an integrated online store design and execution system. To help disrupt the current unsustainable t-shirt manufacturing process, the founders recognised that their platform must offer a superior user experience, meaning that a free access platform, complete with training resources, was prioritised.

## Problem

Over 100 billion items of clothing are made each year, and almost all are designed to be thrown away after being worn only a few times. From a production standpoint, factories are designed only for mass production, and the clothing sector is known to have human rights issues. As a result, clothing manufacturing is centralised, capital intensive and hard to disrupt.

## Solution

Teemill's web application includes everything a person needs to start their own brand for free online. Teemill makes the ordered products itself from organic cotton using renewable energy in the UK. The products are produced in real time as they are ordered, meaning that the company only produces what people need and unnecessary overproduction is avoided. Each article of clothing is also designed from the start to be returned once it is worn out (for example, with easily removable but more expensive ink used in prints), and the company makes new products from the recovered textiles.

Teemill's open platform allows countless organisations to sell their t-shirts and receive revenue for it in a circular way. Teemill is a clear cheerleader of circular business models, which can rub off on their large customer base. The solution provides a venue for entrepreneurs and small-scale businesses to grow and be part of a circular model and network.

## Environmental impact

The environmental benefits include lower emissions, less plastic pollution and saved water. Teemill displaces the production of mass-produced, single-use t-shirts made with unsustainably harvested cotton. The organisation reduces plastic waste by making their product and packaging plastic free. Their operations are powered by renewable energy and manufacturing robots support energy efficiency. The clothes are made with organic cotton that is meant to be returned by the customer when it is worn out, and then new clothing is created from the used material.

## Social impact

The Teemill platform creates jobs for people in developing countries. Since it is free to access, entrepreneurs in developing countries have utilised Teemill's platform to open clothing businesses online and sell their designs in developed countries, receiving foreign currencies that supports their local economy. The company has made it a priority for the manufacturing technology to be accessible without needing English language skills.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: renewability
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: 100%
- Current geographical scope: Europe
- <https://teemill.com/remill>

# Business game immerses participants in a realistic experience of circular transformation

A lack of practical training makes adopting circular practices difficult. The Blue Connection is an educational game that guides users through the transition to circular business models.

Inchainge's The Blue Connection is a browser-based educational tool that lets users, including businesses and students, experience the opportunities and challenges of the circular economy firsthand. Inchainge partners with companies and universities to distribute their cloud-based software as widely as possible, bringing practical circular economy knowledge to actors throughout global value chains.

Inchainge was already well established in the educational business simulation market before they worked closely with the Dutch bank ING and Windesheim University of Applied Sciences to develop The Blue Connection. Together they had the know-how and expertise to develop a powerful simulation combining circular training with finance, design, sales and supply chain management concepts.

## Problem

The circular economy has generated more discussion than action. This is due to widespread uncertainty on how to implement circular economy principles in a business context. There is a need for practical training on circular economy action and business design that can support the uptake of circular business practices.

## Solution

Inchainge provides a simulation game that gives a concrete and comprehensive overview of the circular strategies available, how they can be implemented, and which decisions must be taken. Users include different businesses and delivery partners such as consultancies and training entities, as well as universities.

In the game players collaborate to run a virtual circular manufacturer. They must make strategic and tactical decisions related to circular product design, recycled materials sourcing, financing and more. Users experience what collaborating to apply circular economy principles in a business environment entails and see how in-game decisions affect the company's circularity and profitability.

The product's gameplay lets users assume different roles within the value chain. This allows the users to build an understanding of circularity in their own business area, as well as cross-functionally within an organisation and across the whole value chain. The Blue Connection also allows international competitions and events to be held, where teams compete to create the best circular company.

## Environmental impact

Inchainge's main environmental impacts are indirect, coming from users' increased capability to transition to circular business models.

## Social impact

The largest social impact is increasing access to practical circular economy education. Inchainge's licensing model, cloud-based distribution and browser-based delivery allows universities and other large organisations to purchase licenses and then train their students or staff as much as needed.

## Key information

- Geographical origin of the organisation: Europe
- Circular economy business model: circular economy enabler / circular communications
- Number of employees: 10-250
- Share of the circular economy solution of total business or operations: between 10%-49%
- Current geographical scope: Europe, North America
- <https://theblueconnection.org/>

# A circular economy podcast on how not to save the environment

The circular economy is still largely unknown in many parts of the globe. This podcast aims to fill the circularity knowledge gap among millennials.

The *Waste Not Why Not* podcast from Ghost Island Media makes circular economy ideas accessible to the general public. Targeted at listeners without any specialised circular economy education, the podcast aims to spread optimism for a circular world with stories about problem-solvers who are already building our circular future.

During his work in waste management, the podcast host Nate realised that there was an awareness gap on consumption and waste management issues among the general public. The podcast was started after Nate met Ghost Island Media's producer. A tour of the West Coast of the US to interview scientists, organised in partnership with the American Association for the Advancement of Sciences, solidified the idea for the podcast.

## Problem

Awareness of circular economy is often limited to specialists, hindering the adoption of circular consumer goods and careers. To illustrate, in September 2020, searching “circular economy” on Instagram brings 343,000 posts, while the tag #plasticfree has over 2.4 million hits. The problem is not a lack of existing inspiring solutions but one of communication, as few media sources exist to amplify circular stories.

## Solution

The *Waste Not Why Not* podcast seeks to educate listeners on the best ways to help the environment with a specific focus on waste and the circular economy. The podcast team fills the circularity knowledge gap by making the science behind closing the loop fun and informative. The podcast hosts tell inspiring stories and feature scientists as guest speakers. The podcast currently has a few thousand listeners from Australia, New Zealand, Taiwan, the US, Hong Kong and the EU.

The solution's target audience is English-speaking millennials, especially in the Asia-Pacific region where the circular economy remains largely unknown as a concept. Higher education programs remain relatively underdeveloped, and there are few opportunities for people to gain a deeper understanding of the topic. Offering free and entertaining information on the circular economy online satisfies a growing interest among young people in circular economy, on a personal consumption and policy level.

## Environmental impact

There is a largely indirect positive environmental impact, stemming from behavioural change among consumers who listen to the podcast.

## Social impact

The solution can have a social impact by improving access to education and knowledge of sustainable consumption choices. Especially among millennials, concern about the state of the world, known as climate anxiety, has been shown to be widespread and serious, so a podcast that empowers young listeners with a message of optimism yields a positive social impact.

## Key information

- Geographical origin of the organisation: South and Southeast Asia
- Circular economy business model: circular economy enabler / circular economy communication
- Number of employees: under 10
- Share of the circular economy solution of total business or operations: between 10%-49%
- Current geographical scope: Australasia, Europe, North America, East Asia, South and Southeast Asia
- <https://podcasts.apple.com/ie/podcast/waste-not-why-not/id1459252325>, <https://ghostisland.media/>

**SITRA**

**SITRA STUDIES 182**

Sitra studies is a publication series which focuses on the conclusions and outcomes of Sitra's future-oriented work.

ISBN 978-952-347-215-0 (PDF) [www.sitra.fi](http://www.sitra.fi)  
ISSN 1796-7112 (PDF) [www.sitra.fi](http://www.sitra.fi)

**SITRA.FI**

Itämerenkatu 11–13  
PO Box 160  
FI-00181 Helsinki, Finland  
Tel: +358 294 618 991  
 @SitraFund