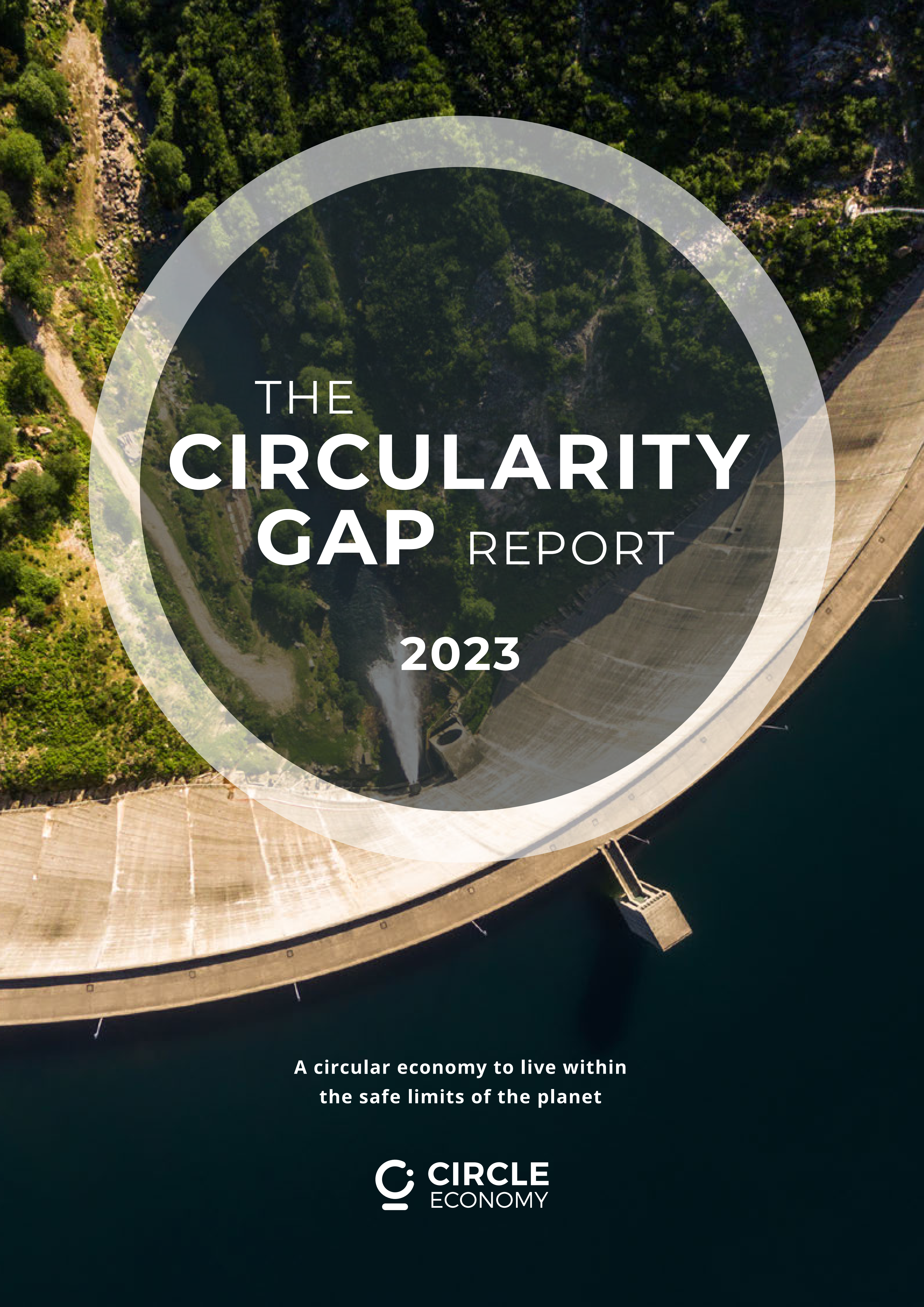


THE CIRCULARITY GAP REPORT

2023

A circular economy to live within the safe limits of the planet

CIRCLE ECONOMY

BEHIND THE COVER

The image on the cover carries a strong message: we're putting far too much pressure on our planet, and the metaphorical dam is about to break. We are currently overshooting five of the nine boundaries crucial to the health of our planet—continuing along this path will mean putting people and planet increasingly in harm's way. Through a circular economy, we can relieve these pressures, bringing humanity back within a safe operating space.

CIRCLE ECONOMY

We are a global impact organisation with an international team of passionate experts based in Amsterdam.

We empower businesses, cities and nations with practical and scalable solutions to put the circular economy into action. Our vision is an economic system that ensures the planet and all people can thrive.

To avoid climate breakdown, our goal is to double global circularity by 2032.

In collaboration with:

Deloitte.

We are an international professional services network comprising over 333,000 specialists who provide audit and assurance, consulting, financial advisory, risk advisory, tax, and related services to clients in over 150 countries. Our purpose is to make an impact that matters.

To build the sustainable future we need, at the speed we need to build it, we have to work together in new, more ambitious and impactful ways. Our goal is to convene the private sector, public sector and society to inform and enable actionable strategies that will improve circularity, in a way that benefits businesses, society, and the planet.

IN SUPPORT OF THE *CIRCULARITY GAP REPORT*

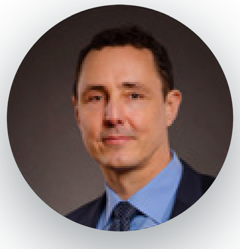
FRANS TIMMERMANS
Vice President at the European Commission

'Humanity has to learn to live within planetary boundaries. When we decouple economic growth from material use, prevent and reduce waste, use recycled materials instead of primary raw materials and boost circular business models, we can do it. By making our economy fully circular, we create new jobs, accelerate innovation, and at the same time fight the climate and biodiversity crises. With the Green Deal, Europe is now leading the circularity transition. But we challenge others to beat us: in the race to save the future of humanity there can only be winners. The *Circularity Gap Report 2023* is a call to action for all parts of the world and a great source of inspiration for everyone who's ready to build the economy of tomorrow. The future economy is circular!'

CHRISTOPH HEINRICH
CEO at WWF Germany

'Global circulariy at 7.2% is a stark reminder that we are overusing our planet's resources and that we urgently need to transform our economies. The *Circularity Gap Report* delivers solutions and shows that a circular economy can make a significant contribution to climate change adaptation, protection of biodiversity and better living conditions.'

STEPHEN SICARS
Director, Division of Circular Economy and Environmental Protection UNIDO



'Circular practices make business sense, and improve competitiveness of firms and resilience of economies. Everyone, from citizens to businesses, has to get on board with circularity to remain within the carrying capacity of our planet. Governments need to create the conditions for whole-of-government and whole-of-society engagement towards a just transition to circular economies. As a starting point on this journey, the *Circularity Gap Report 2023* offers differentiated strategies and useful insights for low-, middle- and high-income economies.'

CARLOS MANUEL RODRIGUEZ
CEO and Chair at the Global Environment Facility

'As the circular economy has become a widely accepted political aspiration, the annual *Circularity Gap Report* has also become a go-to resource for public and private world leaders. At GEF, we view the circular economy as one of the critical levers in mitigating climate change and increasingly use this lens in deploying resources. This year's Report not only calls for the need to globally boost the circular economy, it also highlights which circular strategies are best applicable for different regions of the world and how to best use scarce resources for key societal needs.'

KATE RAWORTH
Co-founder of the Doughnut Economics Action Lab and author of Doughnut Economics

'Each year the *Circularity Gap Report* further clarifies the concepts and metrics that are needed to make the circular economy visible, irresistible and inevitable. This year it crucially identifies different strategies for countries with different responsibilities and capacities to act. It confirms that high-income nations must massively reduce their material throughflow—a challenge that they all must rise to, but none are yet on track to meet. Transformative times ahead.'

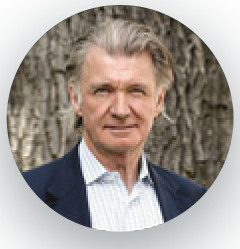
MARK WATTS
CEO at C40

'A 1.5-degree world will be a circular world. Now is the time for action to mitigate climate breakdown and cities have a crucial role to play here. Circle Economy's *Circularity Gap Report 2023* shows us solid solutions and actions that cities can adopt to continue leading the circular transition.'

KATRIN LEY
Managing Director at Fashion for Good

'The entire lifecycle of consumer goods has a huge environmental impact. It is so important that circularity permeates every level: from design, processing and consumption to the end-of-use possibilities. It's great to see that the circular solutions in this report are based on what is realistic and possible within the planetary boundaries: a vital framework for our future.'

ANDERS WIJKMAN
Chairman at Circular Sweden and Climate-KIC



'Our societies use resources like there is no tomorrow, causing climate change and ecosystem destruction along the way. This report shows how we need to act fast in meeting human needs in more intelligent ways and, above all, reduce wasteful consumption. The circular economy holds deep potential to be an essential part of the necessary systemic change.'

IN SUPPORT OF THE *CIRCULARITY GAP REPORT*

MAAYKE DAMEN
Director Circular Economy at the World Business Council for Sustainable Development

‘Tracking the global material metabolism is no easy feat—but the *Circularity Gap Report* has improved how we can report on this year after year. We know that business-as-usual is not an option, and this report highlights how varied circular economy solutions are: from innovations to common-sense behavioural shifts.’

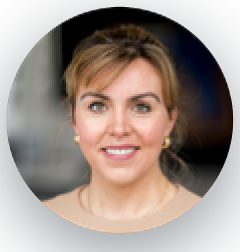
JANEZ POTOČNIK
Former European Commissioner for the Environment and Co-chair at the UNEP International Resource Panel

‘Our material consumption is driving the triple planetary crisis of climate change, biodiversity loss, and pollution. We need to end overconsumption: we can do this by embracing all circularity principles, especially the imperative to “Use Less”. The *Circularity Gap Report 2023* describes transformations in crucial resource systems—our challenge now is to make them a reality.’

KRISTIN HUGHES
Resource Circularity Director, Executive Committee Member at the World Economic Forum

‘Circularity is a critical enabler to decrease our greenhouse gas emissions and address material scarcity, while building a growing and resilient economy. Businesses are increasingly realising the symbiotic opportunities of circular operating and business models for growth while building resilience in their supply chains. The *Circularity Gap Report* provides valuable insights on how we are progressing circular transformation to achieve our wider growth and sustainability goals.’

VIVIANNE HEIJNEN
Minister of Environment, the Netherlands



‘There is broad recognition of the enormous benefits that a circular economy offers. More than ever before, we need to align our common actions towards circularity.’

ROY JAKOBS
CEO at Royal Philips and Platform for Accelerating the Circular Economy Board Member

‘This year’s *Circularity Gap Report* shows a further decline in global circularity. This is truly alarming. Both companies and governments alike need to do what they can to help reverse this trend if we’re to stay within our planetary limits. At Philips, our circular strategy is underpinned by EcoDesign, refurbishment and digitalisation, with the goal being to help make healthcare better, more convenient and more sustainable.’

STIENTJE VAN VELDHOVEN
Co-chair at the Platform for Accelerating the Circular Economy

‘The potential for circularity goes well beyond recycling and waste management to the heart of extraction and consumption of materials. Circularity is key to addressing the triple planetary challenges of biodiversity loss, pollution and climate. Governments and companies should adopt circularity within their core targets for these areas.’

JYRKI KATAINEN
President at the Finnish Innovation Fund Sitra

‘Indicators, including the mobilising *Circularity Gap Report*, are essential to move the needle in the right direction. I hope this report will inspire you to take bolder steps that will accelerate the transition.’

AMBROISE FAYOLLE
Vice President at the European Investment Bank

‘Building a circular economy is imperative to reduce our environmental footprint, achieve climate neutrality and pass on a healthy planet to future generations. Yet, the *Circularity Gap Report 2023* shows the world is still largely linear. We hope that this important report, and its analysis of circular solutions for four key sectors, will serve both as a wake-up call and a guide for all relevant actors on how we can shift away from ever increasing material extraction and wastage. The European Investment Bank, through its finance and advisory services, is ready and well placed to support the scale up of the circular economy.’

DR. PATRICK SCHROEDER
Senior Research Fellow at Chatham House

‘The Circularity Metric has become key for measuring progress of the global circular economy transition. But despite the multitude of corporate circular strategies and government policies that are being applied across the world, the global economy remains stubbornly linear—raising ambition and accelerating implementation is urgently needed.’

JENNIFER STEINMANN
Global Sustainability and Climate Practice Leader at Deloitte

‘Sustainability and climate strategists from both businesses and governments are looking to circular economy practices for tangible solutions. The opportunity for innovation is great, but largely unrealised to date. The *Circularity Gap Report* provides valuable insights in our collective progress towards these solutions. What is essential now? Further interconnectivity between organisations, governments and societies to accelerate the impact we make.’

EXECUTIVE SUMMARY

The global economy is now only 7.2% circular; and it's getting worse year on year—driven by rising material extraction and use. The global economy increasingly relies on materials from virgin sources. In the six years of the *Circularity Gap Report*, the global economy extracted and used more than in the entire 20th century[1]—improving people's living standards, but at the same time breaking through the safe environmental limits of the planet. The first edition of our *Report* in 2018 was the first ever to measure global circularity, finding it was 9.1%. It dropped to 8.6% in 2020 and has now fallen to 7.2%. Comparing these figures can be difficult,[2] however, we can assert that circularity goes down as the general rate of global material extraction rises. This is coupled with the fact that more and more materials are going into stocks such as roads, homes and durable goods, thus leaving fewer materials to cycle back into the economy. A circular economy focused on cycling alone cannot keep up with virgin material use rising to unprecedented heights—we cannot recycle our way out of this one.

With a circular economy, we can fulfil people's needs* with just 70% of the materials we currently use—within the safe limits of the planet. Our current economic model is smashing through the planet's safe limits. Today, five of the nine key 'planetary boundaries' that measure environmental health across land, sea and air have been broken—largely due to the impacts of the linear 'take-make-waste' economy. It is, therefore, critical that we transform our relationship with materials to maximise benefits for people and to minimise the pressure on the planet's life support systems. Essentially, this study finds that adopting a circular economy could not only reverse the overshoot of planetary boundaries, but it could slash the global need for material extraction by about one-third. This reduction is rooted in removing fossil fuels from the global equation—especially coal—and lowering demand for high volume minerals, such as sand and gravel, largely for housing and infrastructure.

Use less, use longer, use again and make clean. These four key circular economy principles underpin the solutions presented in this report, highlighting how there is much more to a circular economy than just recycling. The 16 circular solutions identified in this report centre on principles that can lead to a sharp decline in virgin material extraction (use less) and to using the materials that we do have better and for longer (use longer), as well as swapping out fossil fuels for renewable energy and toxic materials for regenerative ones (make clean). They also boost the use of secondary materials (use again). The circular economy as we present it aims to optimise how materials are used for the wellbeing of all. It focuses on circular materials management and minimising consumption towards sufficiency levels—where appropriate—to reduce environmental impact.

Circular solutions for only four global systems will address the lion's share of environmental pressures. This report's analysis considers the impact of circular materials management on air and water pollution, waste, nature degradation and loss, and more—basing our projections on the Planetary Boundaries framework. It finds that unleashing just 16 transformational circular solutions across four key systems—Food systems, the Built environment, Manufactured goods and consumables, and Mobility and transport—can reverse the current overshoot of five of the nine key planetary boundaries, thereby maintaining thriving ecosystems for water, land and air, and limiting the global temperature rise to within 2-degrees. Our analysis is unconstrained from political, economic and social dynamics: the findings, therefore, serve as an inspiration—providing us with a snapshot of what an alternative world could look like.

Each country has a different starting point and will progress at a different pace towards the shared global goal of reversing environmental overshoot, while fulfilling people's needs. Bringing these circular solutions to life requires an understanding of local, national and trading contexts. Transformational change does not look the same across the world: some countries need to radically reduce material extraction and use, while others need to stabilise or even grow it. This study considers these nuances. The world's highest-income *(Shift)* countries deliver high standards of living, but consume the majority of the world's materials and massively overshoot many planetary boundaries. These countries must focus on reducing overconsumption and lightening their impact on the environment. Middle-income *(Grow)* countries are rapidly industrialising and have a growing middle class—their material consumption has increased in tandem but some are now reaching saturation points. These countries should now focus on new ways to stabilise and optimise their material consumption to maximise societal wellbeing. Finally, *Build* countries house the majority of the world's population but use less than a tenth of the materials of *Shift* countries. These countries should focus on the building up of infrastructure and the provision of wellbeing, even if this requires that they increase their material footprint.

To reverse the overshoot and achieve wellbeing within safe limits, purpose-driven collaboration between the public and private sectors is essential—only then can we scale the transition to a circular economy. Chapter five highlights the crucial role of public-private collaboration in achieving this bold vision for the future. Circular business models can deliver huge material savings, such as Mobility-as-a-Service for material-intensive cars that sit unused for 95% of their lifetimes in the *Shift* countries. Policy can greatly magnify such business efforts and manage potential rebound effects by setting ambitious targets for active mobility in cities, and mandating Extended Producer Responsibility. Policy is also crucial to enable a just transition to a circular economy. There will certainly be several big shifts from linear to circular industries, and potentially rebound effects from increased material efficiency, but policy makers can uphold the importance of wellbeing for its citizens and workers. The shift from linear to circular industries will see a seismic shift from business-as-usual, leading to rebound effects resulting from increased material efficiency. This is why policy makers are essential changemakers in upholding the rights of citizens and workers in the transition. Policy, along with the entire economic system, needs to shed business-as-usual: embracing long-term vision and interests over short-term rewards.

A circular economy offers solutions on how to reduce, regenerate and redistribute vital materials use, for both the planet and all its living beings. In order to achieve the bold ambitions of a circular economy as laid out in this report, we need a shared vision. The following three principles can help bring a shared focus to business leaders and policy makers:

- **Reduce: from efficiency to sufficiency, resilience and adaptiveness.** The economy is embedded in nature and nature has limits. We must, therefore, also place boundaries on material use and prioritise the transformation of material use into societal benefits. This means a circular economy must push for a cultural shift to prioritise immaterial ways to fulfil needs, and invest in health, wellbeing and education and decent jobs, rather than material accumulation—as does the predominant economic model in many parts of the world.
- **Regenerate: from extraction to regeneration.** About one-quarter of all materials consumed by the global economy every year come from regenerative sources. The regenerative capacity of the planet is a gift—so we must respect and support its capacity to regenerate, also for future generations. Many regenerative solutions already exist today that show that we can move from humanity being net-negative to net-positive on Earth's life support system.
- **Redistribute: from accumulation to distribution.** There is currently enough wealth and materials in the world to provide a good quality of life to every single human being on this planet.[3] The challenge is ensuring that we can distribute the access to materials to an increasingly expanding group of people, requiring redistribution, different lifestyles, better technologies and social innovations.[4] By moving away from ownership and accumulation and towards models of access that distribute resources more equally, we can move towards a system that provides high standards of living to all.

**The Circularity Gap Report* typically bases its analysis on seven key 'societal needs and wants', recognising that materials are increasingly used to fulfil many non-essential 'wants'. Our analysis does not fully deliberate the threshold point at which a 'need' becomes a 'want across all needs and wants.*

CONTENTS

1 INTRODUCTION

The year that has elapsed between the *Circularity Gap Report 2022*'s publication and this one has been like no other. Many have suffered through the impacts of a global pandemic, droughts, wildfires, geopolitical instability and more. Not one continent was untouched by the dangerous impacts of climate breakdown. The issues that we must collaborate on to solve have long been known—poverty, unsustainable lifestyles, an economic system that prioritises GDP over human and planetary wellbeing and more—and the urgency is building. Life shouldn't be determined by the cards that you were dealt, but by how you play your hand. Our systems have been wildly degenerative for the past centuries, but why should they continue to be? This report lays out some hard truths about how our linear economic model has pushed a range of planetary boundaries to dangerous and unpredictable limits. But it also presents solutions: showing how people's needs and wants—such as nutrition, mobility, housing, and basic goods—can be satisfied within crucial planetary boundaries. The key to these solutions is circular principles: some so simple that you'd wonder why we haven't always done things this way. Others will require radical collaboration between a variety of actors from industry and government and a radical shift in the lifestyles of the world's wealthiest. But all should inspire us to create an economy that emulates nature: naturally circular and supporting life. We have a strong hand.

MATERIALS ARE CENTRAL TO THE STORY OF HUMAN PROSPERITY

Materials have long propelled human affluence, driving rising living standards over the past (at least) 100 years, enhancing life expectancy and employment, as well as basic education levels. However, this progress has also come at a tremendous cost: the modern industrial economy is inherently linear—characterised by 'take-make-waste' processes in practice. It is also powered by fossil fuels, a finite and polluting energy source. Meanwhile, injustice has also become central to the story of the global economy's relationship with materials: in many parts of the world, overconsumption has effectively become the norm, whilst elsewhere, minimum living standards are not even met.

YET THE LINEAR ECONOMY HAS EXCEEDED THE SAFE AND HEALTHY LIMITS OF THE PLANET

Much of the environmental impact that has occurred in the past 100 years can be attributed to rising greenhouse gas (GHG) emissions—and our *Circularity Gap Report 2021* found that 70% of global GHG emissions are tied to material handling and use.[5] But the impacts go far beyond emissions. Ultimately, material extraction and use is a strong proxy for environmental damage[6]—driving over 90% of total global biodiversity loss and water stress, for example.[7] In fulfilling societal needs—and many wants—we are now transgressing five of nine planetary boundaries that are crucial to planetary health: climate change, biodiversity loss, land system change, chemical pollution, and cycles of nitrogen and phosphorus. Ocean acidification—also driven by spiralling carbon emissions—is dangerously close to its tipping point. Clearly, our relationship with materials requires balance. The pursuit of a circular economy—a means to the end goal of relieving environmental pressures and shaping a thriving society for people—requires more efficient, and sometimes less, material use. Now, we're consuming and wasting too much, dragging down our global circularity.

RISING MATERIAL USE DOES DRIVE BETTER GLOBAL LIVING STANDARDS—BUT ONLY UP TO A POINT

While instrumental to raising living standards, research shows that after a certain level of material consumption, wellbeing ceases to increase.[8,9] And we cannot fully blame rising material use on the ballooning population: in the past 50 years, the global population has doubled, yet material extraction has more than tripled. Ultimately, the bulk of this has been largely concentrated in wealthy countries (especially in a few hotspots, such as North America and Europe), and we now see material extraction rising in rapidly growing middle-income nations (*Grow* countries)—China, for example, is thought to be responsible for 75% of the growth in material consumption since the year 2000.[10] Affluence, overconsumption and waste are the real accelerators of global material demand. And such affluence has been unequally distributed for far too long: over the past 40 years, for example, more than one-quarter of the new income from global GDP growth has gone straight to the world's richest

1%.[11,12] Similarly, just eight nations (France, Germany, Italy, Japan, the UK, the US, Canada and Russia) were responsible for 85% of GHG emissions in 2015, while many *Build* nations still live within planetary boundaries. The question of how richer nations—which have largely been responsible for climate-related disasters—can help poorer, more vulnerable nations was front and centre at COP27 in November 2022.

IS A NEW BLUEPRINT FOR A SUSTAINABLE FUTURE FINALLY EMERGING?

Much of the world's coordinated climate action has focused on GHG emission reduction: 196 countries signed the Paris Agreement in 2015, committing to limiting average global temperature rise to 1.5-degrees. However, we're slowly beginning to see action that extends beyond decarbonisation: China's Nationally Determined Contribution (NDC) to the Paris Agreement, for example, details plans to build up recycling infrastructure, scale eco-industrial parks and ramp up the reuse of organic waste,[13] while the Japanese Government has bold aims to reach 'full circularity' by 2050—with a focus on regenerative business that helps—rather than hurts—nature.[14] Many other governments have also zoomed in to the local level, co-developing policy roadmaps for circular cities that centre on reducing soaring material demand by better-managing urban spaces and rolling out green active transport options—strategies that also tend to improve wellbeing.[15] As circular solutions continue to make their way into climate targets around the world, it's crucial that holistic measures that systemically cut consumption and extend materials' value take centre stage along with cycling efforts. Meanwhile, transforming economic systems to embrace circularity and low-carbon systems will lead to job gains as well as losses—as fossil fuels plants are decommissioned in favour of solar and wind farms, for example. Fortunately, research and policy increasingly anticipates and addresses the future negative impacts on workers, industries and regions. Indeed, support measures, such as reskilling programmes for workers, and economic diversification policies for regions, are crucial to a just transition.

Interesting debates targeting the heart of dominant global economics have also reached new heights this year: growth at all costs versus green growth or degrowth, for example. Meanwhile, countries are experimenting with and sharing knowledge on innovative policy approaches for 'wellbeing economies'—the Wellbeing Economy Governments partnership (WEGo), for example, currently comprises New Zealand, Scotland, Iceland, Wales and Finland.[16] Iceland has a range of indicators for wellbeing that guide its government in decision making, for example. Furthermore, the concept of the Doughnut Economy[17] is being explored in cities such as Amsterdam, Brussels, Melbourne, Berlin and Sydney,[18] and even in industries such as the British fashion industry.[19] Based on a combination of the Planetary Boundaries framework and the UN Sustainable Development Goals, the Doughnut aims to reprioritise traditional economics towards the goal of ensuring the needs of all are met within the means of the planet. This goal is aligned with a circular economy: one that is regenerative by design and retains materials' maximum value in society for as long as possible.

A CIRCULAR ECONOMY—IN ITS FULL BREADTH—IS THE FOUNDATION FOR A MORE SUSTAINABLE FUTURE

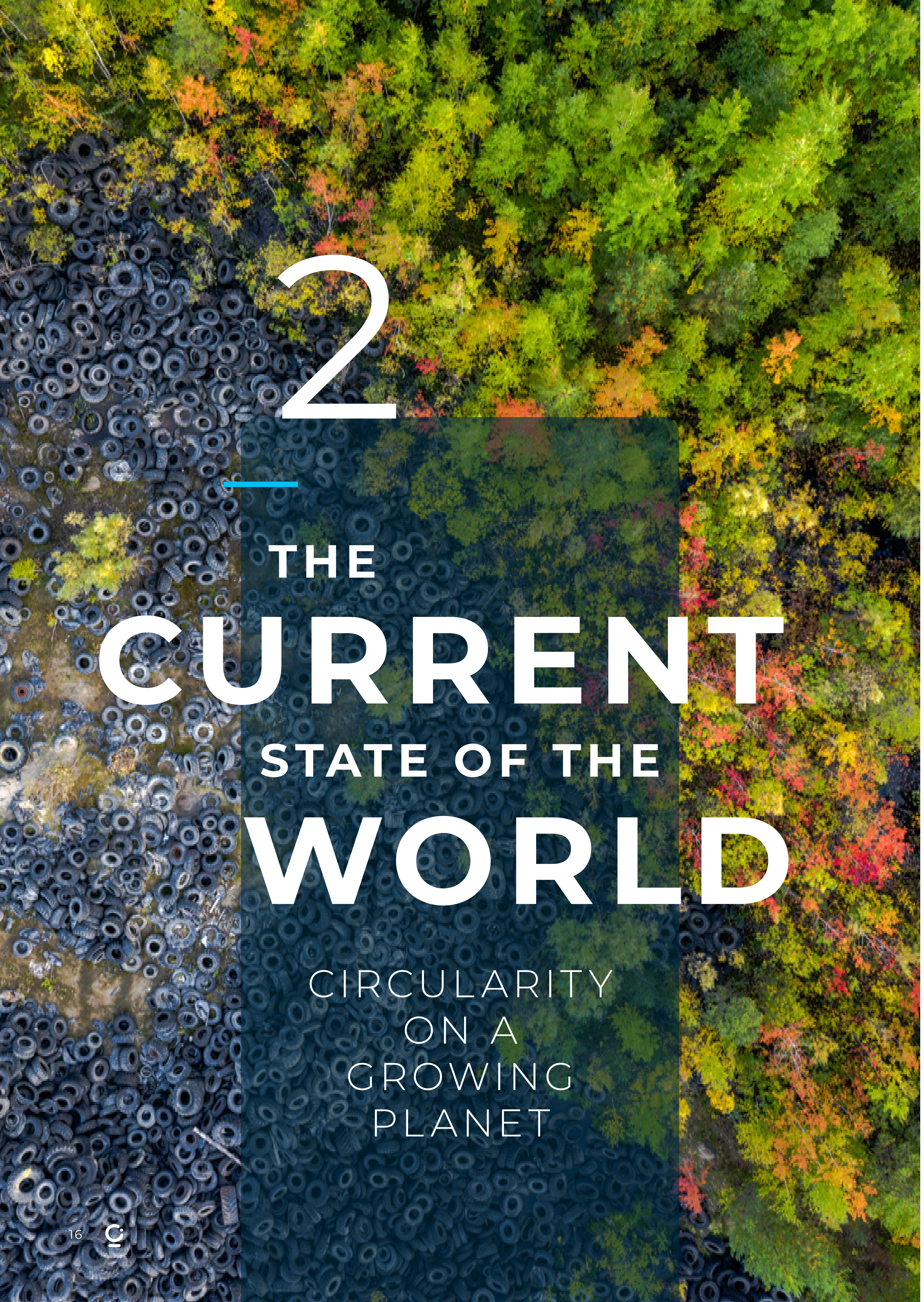
Current trends are alarming: over the last 30 years, we've lost an area close to the size of Iraq (420 million hectares) to deforestation.[20] Close to half of the Earth's soil is seriously degraded, roughly 85% of global fish stocks are facing collapse, and wildlife populations have plunged by 70%[21] in the last half-century. It's high time to turn the tide. Adopting circular solutions across key systems could fulfil our needs with just 70% of the materials we currently use—and crucially, could bring the vital signs of the planet back within safe limits. A circular economy does this by prioritising systemic solutions that help us use less, use longer, use again and make clean. A circular economy has a key role in striking a safe and fair balance between human life and ecological limits: the ultimate goal of the 21st century.

This report will allow you—as a policy maker or a business leader—to embrace systems thinking: rethinking the entire system and understanding that one small change in a single place can impact the whole. We must think along with the planet and draw inspiration from nature to create a more balanced world: reduce, regenerate and redistribute.

We have a strong hand—let's play our cards right.

AIMS OF THE *CIRCULARITY GAP REPORT 2023*:

1. **Quantify** the current circular state of the world: update the Circularity Metric and a range of other crucial indicators concerning global material flows.
2. **Identify** key circular solutions within key systems that are based on the needs of society and impactful on a range of planetary boundaries for healthy air, water and land.
3. **Demonstrate** the power that these circular economy solutions can have in reversing the overshoot on multiple planetary boundaries.
4. **Illustrate** which circular solutions are most suitable for different country profiles, based on economic, social and environmental differences, in order for them to reach their goals.



2 THE CURRENT STATE OF THE WORLD

CIRCULARITY ON A GROWING PLANET

The planet is now home to 8 billion people—and in sheltering, feeding, transporting and clothing these billions, the global economy consumes a landmark 100 billion tonnes of materials per year. By 2050 material extraction and use is expected to double relative to 2015 levels, threatening a total breakdown of Earth's life support systems, which are already at a breaking point.[22] Without material management strategies that keep us within planetary boundaries, the UN has warned of 'total societal collapse', driven by concurrent climate change disasters, economic vulnerabilities, political instabilities and ecosystem failures.[23] A crucial solution to address this challenge is a circular economy: more than just recycling, increases in secondary material use must be matched by a systemic approach to smart material management that enables doing more with less, using for longer and substituting with sustainably managed regenerative materials. By upgrading to a model that maximises the value that we extract from our precious materials, we can better ensure the wellbeing of present and future generations, while respecting the boundaries of our planet.

THE CURRENT STATE OF CIRCULARITY

Worldwide, total material extraction is on the rise: it more than tripled since 1970, but almost doubled since the year 2000—reaching 100 billion tonnes today. This growth is not solely due to the global population doubling since 1970, as per-person material use has only increased by a factor of 1.7. For instance, while virgin material demand in 1970 was around 7.4 tonnes per person, far below today's approximately 12 tonnes,[24] this growth in per-person material demand has not been evenly distributed across countries. Material use may outpace population growth in high-income countries, while the opposite is true for lower-income countries—generating a global average that doesn't show the full picture. Ultimately, the metabolic rate of the global economy is accelerating: material extraction and consumption are growing at almost unprecedented rates, comparable to the 'Great Acceleration' occuring in the period after the Second World War.[25] This is revealed by the fact that virgin material use is not set to slow down anytime soon: without urgent action, it is expected to reach 190 billion tonnes by 2060.[26]

How can a circular economy change this picture? We measure circularity by looking at what is flowing into the economy. Today, the global economy consumes 100 billion tonnes of materials, and a portion of that consumption every year comes from secondary materials. The Circularity Metric, introduced in 2018, was the first approximation of how 'circular' the global economy was. In this year's edition of the *Circularity Gap Report*, we present a more holistic view on the circularity of the economy, by looking deeper into the linear consumption that makes up the 'Circularity Gap'.

CIRCULAR INPUTS

Secondary materials that are cycled back into the global economy, otherwise known as circular inputs, account for **7.2%** of all material inputs into the economy—this is the Circularity Metric.

Circular inputs measure the share of secondary materials that are cycled back into the economy from waste. In just the past five years, the world's circularity has shrunk from 9.1% to 7.2% of total material inputs. This isn't simply because we're failing to *cycle* more—it's also due to increasing virgin extraction and the fact that we are putting more and more materials into stocks like roads, homes and durable goods. This means that the global economy cannot cycle enough to create a truly closed-loop of consumption: without significantly reducing material use, it's inevitable that the Circularity Metric will continue to fall.

RENEWABLE INPUTS

The potential share of renewable materials put into the economy are measured as renewable inputs. These are divided into *Ecological cycling potential* **(21.2%)**—carbon neutral biomass—and *Non-renewable biomass* **(3.8%)**—biomass that is not carbon neutral. Together, these represent approximately 25% of all material inputs.

Biomass use has grown by a factor of 2.7 in the past fifty years, now representing about 27% of total material consumption today, or 25 billion tonnes per year. Biomass includes everything that is harvested from the ground—from food and feed crops, to natural fibres and timber products. While biomass is largely considered renewable, some is considered non-renewable due to the imbalance in the carbon cycle.[27] The ways in which biomass is cultivated is precarious, with land system change often linked to deforestation, soil depletion and the draining of wetlands, which have all served to damage biodiversity while damaging carbon sinks—the latter also causing an increase in emissions.

While carbon neutrality is a necessary condition for biomass to be considered sustainable, it is not sufficient in itself: other nutrients such as nitrogen and phosphorus should be fully circulated back into the economy or the environment as well. As of yet, methodological limitations exist in determining nutrient cycling. To this end, in line with past *Circularity Gap Reports*, we have excluded ecological cycling in our calculation of the global Circularity Metric. For example, we cannot track biomass to its final end-of-life stage, so it isn't easy to ensure that the nutrient cycle has closed. If this were the case, however—and if sustainable biomass management were to become the norm—circularity could significantly increase.

NON-RENEWABLE INPUTS

These materials represent about **15%** of total inputs to the global economy and are composed of metals and non-metallic minerals.

Metal ores have increased by more than 3.5 times in fifty years, to 9.4 billion tonnes, while still representing just one-tenth of total extraction. This relatively sharp increase is due to the expansion of the built environment and manufacturing sectors, as well as the transition to clean energy—a necessary but material-intensive process, particularly for metals. The mining of metals, as well as non-metallic minerals, has spurred biodiversity loss, in addition to pollution of water, air and soil, and toxic waste generation.

Non-metallic minerals have seen the steepest growth: their extraction has increased nearly five times over the last 50 years, and now represents almost half of total material extraction, at 42.8 billion tonnes. This is primarily due to a booming construction industry and the need to house, provide infrastructure and cater for rising populations in many parts of the world.

NON-CIRCULAR INPUTS

Referring exclusively to fossil fuel energy carriers, these materials represent **14.6%** of total inputs in the global economy.

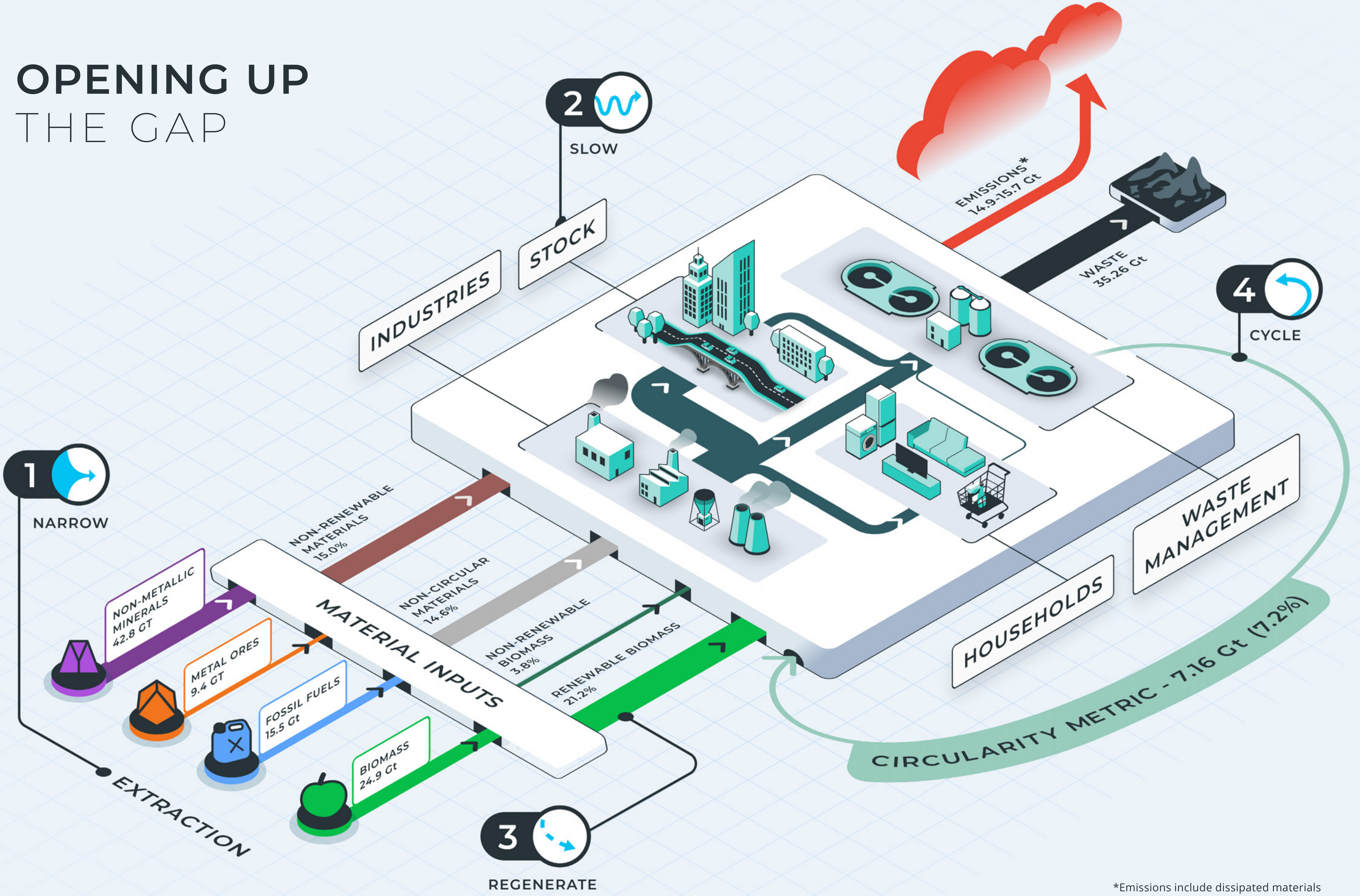
Fossil fuels used for energy consumption are highly impactful from an environmental perspective and inherently non-circular—when combusted—as they result in dispersed emissions in the atmosphere. Fossil fuel consumption has grown about 2.6 times over the last 50 years—and represents a substantially smaller share of the total: we now consume about 15.5 billion tonnes of these materials per year. This is likely due to fossil fuels' lighter weight compared to heavy materials like minerals. However, they're certainly not without impact: the global economy has scaled up their use to, for example, build and power buildings and industries, transport people and goods around the world, produce synthetic fertilisers and manufacture a whole host of basic goods—leading to soaring greenhouse gas (GHG) emissions and driving climate change, among other environmental issues.

STOCK BUILD UP

Representing a massive **38%** of total material input into the global economy, stock build up is composed of circular, non-renewable and renewable materials—as described above—most notably non-metallic minerals in the form of construction materials, such as concrete going into buildings, as well as metal ores such as steel, aluminium and copper going mainly into buildings, infrastructure, and machinery.

Stocks have grown 23-fold in the 21st century. This has mainly been in the form of large, long-lasting structures such as buildings, infrastructure and roads (these account for the largest portion of materials), as well as vehicles, machinery, and the equipment and appliances we use day-to-day. In 2018, approximately 43.6 billion tonnes of materials were added to stocks, while almost 12 billion tonnes were depleted from stocks in the form of end-of-life waste. Net additions to stock thus amounted to 38.2 billion tonnes. As global material extraction and use has surged, a clear pattern has emerged: almost two-thirds of net stock addition occurs in *Grow* countries (see country profile descriptions on page 42), while *Build* countries contribute to fewer than one-tenth (9%) of total global stock additions.

OPENING UP
THE GAP



*Emissions include dissipated materials

Figure one illustrates how key materials flow into different parts of the economy—including additions to stock and waste—and highlights where circular strategies (narrow, slow, regenerate and cycle) may be most appropriate.

THE KEY LEVERS TO TRANSITION TOWARDS A CIRCULAR ECONOMY

Now that we have explored the different types of materials that enter the economy every year, we can begin to see where the different principles of circular economy can be applied in our socioeconomic metabolism: we can design **stocks** like buildings, infrastructure, machinery and vehicles to be rich resource mines for the future, and design manufactured goods and consumables to be **cycled** and made **regenerative**. Furthermore, the focus must also centre on getting more value out of **fewer** materials. Achieving the aims of a circular economy—minimising material use, regenerating the Earth and preventing material losses—can be done through four key strategies, based on the work of Bocken et al. (2016):

1. **NARROW:** USE LESS

Narrow strategies reduce material and energy use. Currently, material use is highly inefficient and ineffective; we can deliver similar social outcomes by using much less and phasing out fossil fuels, for example. This doesn't mean being worse off, but rather focussing on using materials efficiently: think in terms of riding a bike instead of driving a car, eating less meat and living in a space that suits your needs. Using less is a core tenet of the circular economy—yet currently, the threshold for sustainable consumption, 8 tonnes per person,[28] is being surpassed by 1.5 times.

2. **SLOW:** USE LONGER

Slow strategies aim to keep materials in use for as long as possible, for example through design for durability and repairability. A more circular economy is also a slower one: materials, components and products—and even buildings and infrastructure—that we lock in **stocks** are made to last. This will lower material demand in the long run, in essence also serving to *narrow* resource flows.

3. **REGENERATE:** MAKE CLEAN

Regenerate strategies phase out hazardous or toxic materials and processes, and substitute them with regenerative biomass resources. A circular economy aims to mimic natural cycles—by shifting to more regenerative farming practices, for example—while also maximising the share of circular biomass that enters the economy.[29] Regeneration can happen both at the systems level (by designing regenerative processes) as well as at the product level (by switching synthetic to organic fertilisers, for example).

4. **CYCLE:** USE AGAIN

Cycle strategies aim to cycle and reuse materials at their highest value: they maximise the volume of secondary materials re-entering the economy, ultimately minimising the need for virgin material inputs and therefore also *narrowing* flows. Of course, virgin materials will always be needed to a degree: all materials degrade and can't be cycled infinitely, use energy, and require blending with virgin materials to maintain strength and functionality.

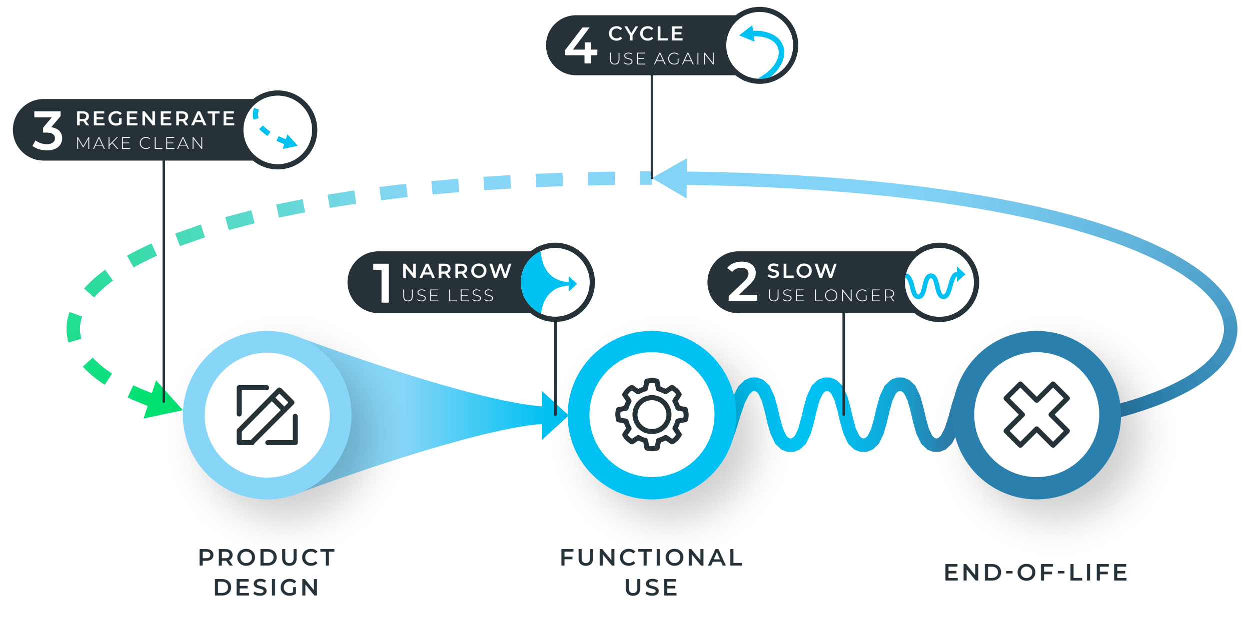


Figure two depicts the four flows to achieve circular objectives: narrow, slow, regenerate and cycle.

PRACTICAL CHALLENGES IN QUANTIFYING CIRCULARITY

Measuring a baseline for global circularity offers many advantages, not least that it can be used as a compelling call to action. After all, the figures are clear—circularity is in reverse. The circular economy, however, is an intricate and holistic concept, and representing it through one single Metric requires certain simplifications. The limitations stemming from these simplifications are:

THERE IS MORE TO CIRCULARITY THAN (MASS-BASED) CYCLING

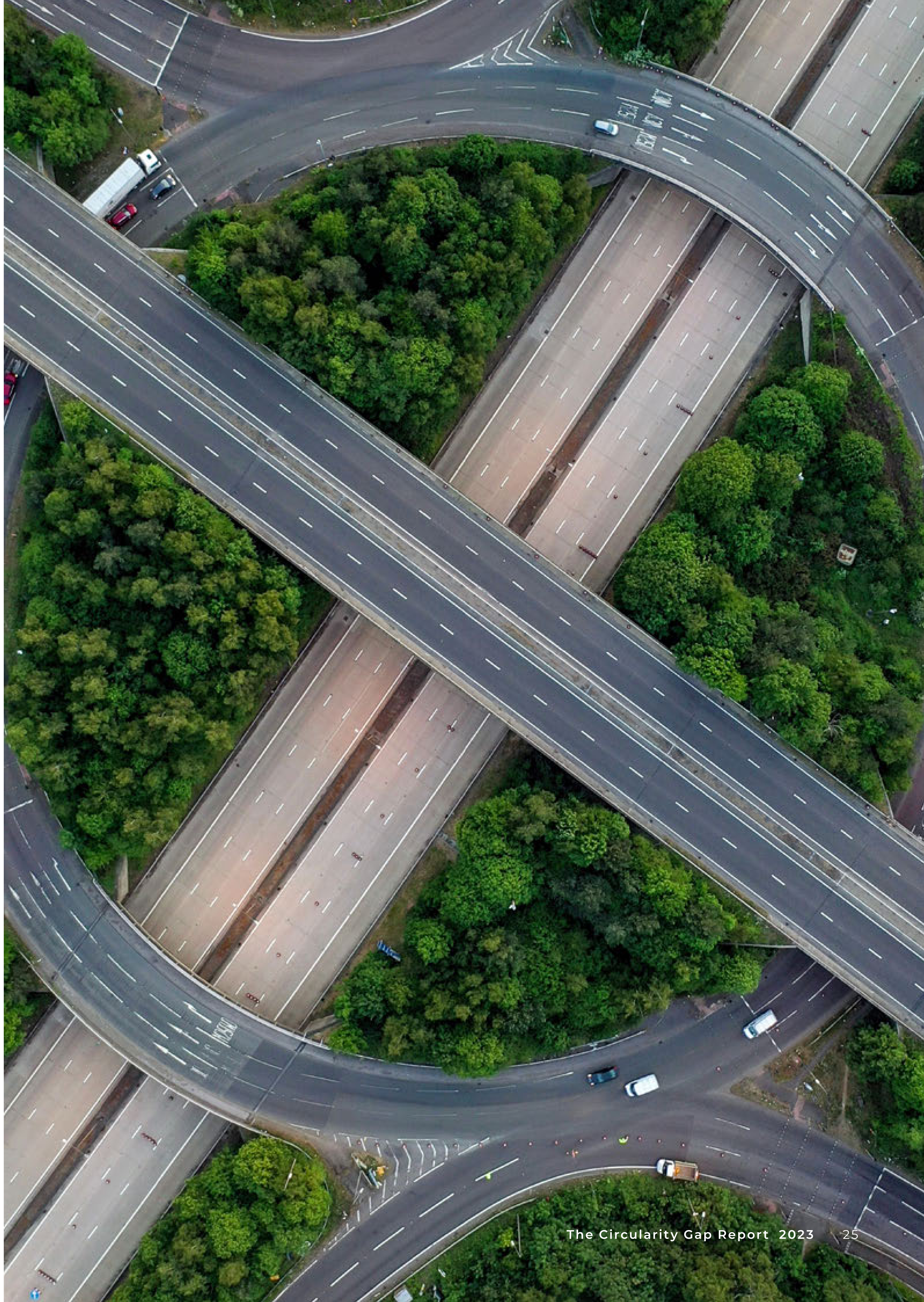
The circular economy has multiple aims: keeping materials in use, at the highest value possible, while decreasing material extraction and use. Our Circularity Metric only measures the mass-based cycling of materials that re-enter the economy and does not consider their composition, value or level of quality. *Slow* strategies—making things last—and *narrow* strategies—using less—also aren't fully captured. While the introduction of the full Indicator Framework (see pages 18–19) is a solid starting point for measuring elements of circularity beyond cycling, such as performance in material use, at least for the baseline assessment—the inclusion of Net additions to stock is a first step towards capturing *slow* strategies, for example—there are still limitations. For instance, due to methodological challenges as well as a lack of standardised metrics and data gaps, reflecting such changes is not entirely possible—in spite of these loops being absolutely crucial for obtaining a rounded understanding of the circular economy.

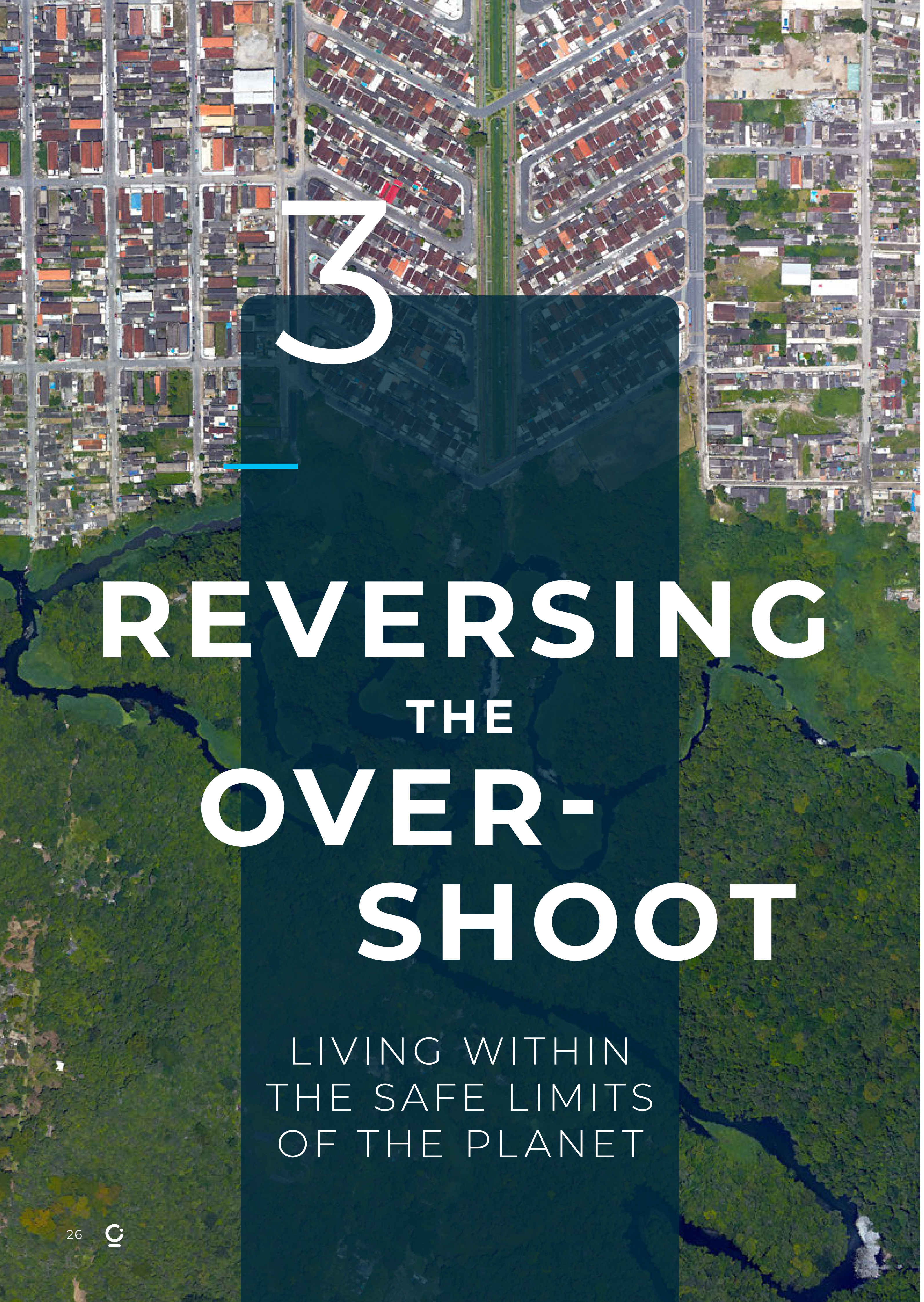
ACHIEVING 100% CIRCULARITY IS NOT FEASIBLE

While our objective may seem to be reaching a 'fully circular' economy, this is technically not possible: there's a practical limit to the volume of materials that can be recirculated. This is partially due to technical constraints, but also because some materials are combusted through their use (think fossil fuels) while others are locked into long-term stocks for many years, making them unavailable for cycling. What's more: materials that can be cycled, such as metal, plastic and glass, may only be cycled a few times, as each cycle degrades quality and will require at least some virgin inputs. The sheer volume of materials we use also poses a challenge: it would take a very slow economy to downsize our material use to match our capacity for recycling.[30] There are also trade-offs to consider: fossil fuels have no place in a circular economy, for example, yet the energy transition will be highly material-intensive. In essence, decarbonising the world will cause material extraction and consumption to spike—a phenomenon that will inevitably drag down the Metric. Our model, which analyses the rate at which circularity *could* grow, makes estimates based on one snapshot in time, rather than a dynamic analysis of these future trade-offs.

A CIRCULAR ECONOMY ISN'T SOCIALLY JUST BY DEFAULT

Ensuring that the circular transition forges a safe space in which all people can thrive will require a systems redesign: in essence, we need to ensure that we minimise the resource use associated with meeting human needs. Circular strategies can help us achieve this, but the social lens must be taken into account: current understandings of the circular economy focus on material use and do not consider issues of global social equity, and are threatening to exacerbate the divide between high- and lower-income countries,[31] as well as within countries. National and supranational policies and commitments in higher-income countries can be short-sighted in practice: often formed to reach local targets, with no thought of the adverse impact they may have beyond borders, which can include exacerbating global power imbalances in lower-income countries, such as exploitative labour practices.[32]





3

REVERSING THE OVER-SHOOT

LIVING WITHIN THE SAFE LIMITS OF THE PLANET

The challenge of the 21st century must be to regain balance between satisfying people's needs and planetary health. Excessive and wasteful consumption is outdated—the planet is humanity's life support system and it should be treated as such. The circular economy offers a deep pool of solutions that are key to solving this challenge—using fewer materials where possible and squeezing out as much value as possible from the materials we use. Achieving more with less. To achieve this, we have developed a series of global scenarios that model impacts against the Planetary Boundaries framework.[33] This chapter displays the results of this comprehensive approach: a global circular economy that can reverse the overshoot, regenerate systems and achieve wellbeing for people within planetary boundaries. The scenarios that we have developed are designed to explore the 'what if?' and provide a glimpse into a world where we do things differently.[34] Read on for the guide, split between four key systems, based on the societal needs for housing, nutrition, the manufacturing of basic goods, and mobility.

MAPPING PLANETARY HEALTH: A COMPLEX AND INTERRELATED PICTURE

This analysis relies on the Planetary Boundaries framework to provide a holistic and in-depth understanding of planetary health. The framework was conceived in 2009 by Johan Rockström, former director of the Stockholm Resilience Centre at Stockholm University, together with 28 world-renowned scientists, to identify the processes that regulate the stability and resilience of the Earth's systems. They proposed nine quantifiable and interrelated planetary boundaries within which humanity can safely continue to thrive: crossing these boundaries increases the risk of causing irreversible environmental changes, threatening human life on Earth.[35] Today, five of the nine planetary boundaries have been crossed,[36] and we are now functioning beyond a sustainable operating space and are in the 'danger zone' of irreversible change to Earth's natural life-supporting system.[37]

AN APPROACH BASED ON PEOPLE'S NEEDS—AND SOME WANTS

Certain actions of the linear economy, from its throwaway culture to its heavy use of fossil fuels, lead to huge rises in greenhouse gas (GHG) emissions, contributing to climate change. But 'climate change' is only one of the nine boundaries. These boundaries laid out in the framework indicate different—but inherently interrelated—components of planetary health[48] that current human activities cross in many different ways (see page 29). If managed correctly, the circular economy is a means to address the root causes of each of the planetary boundaries—truly allowing this generation to reverse the overshoot era. But how?

Our *Circularity Gap Reports* have always grounded their perspectives through the seven societal needs and wants: materials have a vital role to play in fulfilling people's needs for housing, nutrition, mobility, manufacturing, healthcare, education and communication. A circular economy approach allows us to change the way we meet these needs. Consider the need for mobility, which transports people from their homes to workplaces, friends and family. Private passenger vehicles require large volumes of materials and fuel to operate, spend nearly 95% of their lifetime parked and place heavy demands on road infrastructure—and yet often only carry one or two people at a time.[49] Taking a more circular approach, where public transport, car sharing and more active modes like cycling are prioritised, can dramatically reduce both material use and pressure on infrastructure. In essence: serving the same need, but with far less impact.

This report examines how four of these key needs and wants—nutrition, housing, mobility and manufacturing—connect to the Planetary Boundaries framework, finding that they contribute to the vast majority of overshoot. In these areas of the economy, feedback loops run wild: consider agriculture, for example, where excessive fertiliser use intended to maximise output harms soil health and biodiversity, which cuts yields, pushing us into even higher fertiliser use. Through circular strategies, we can reverse this: If we fundamentally reshape how we provide for needs by using less, using longer, using again and making clean, we can shrink our impact and land firmly back in a safe operating space.

STAYING WITHIN THE SAFE LIMITS OF THE PLANET

Our analysis explores how the global economy can meet people's needs for nutrition, housing, mobility, and manfuactured goods following circular economy principles. The result? A set of 16 circular solutions have been modelled across four global systems: Food systems, the Built environment, Manufactured goods and consumables, and Mobility and transport. The counterfactual scenarios that have been developed in this report are designed to explore 'what if?' and do not take into account the effects of transitions over time, such as the changes in resource extraction in the transition to renewable energy. Each of the solutions that have been modelled are summarised on pages 33, 35, 37 and 39.

For a more detailed description of the entire modelling exercise, please refer to the methodology document accompanying this report.*

The circular economy solutions belonging to each system typically only contribute a minor impact reduction across the planetary boundaries. But when we combine them, we can see the substantial impact that a circular economy can have at a global level.

**Find the full methodology document at circularity-gap.world/methodology*

FOUR KEY SYSTEMS TO REVERSE THE OVERSHOOT

FOOD SYSTEM

The full set of farm-to-fork-to-bin activities along the agrifood value chain, involving the production, processing, transport, consumption and disposal of food.[50 51] We do not consider activities upstream from agriculture, such as fertiliser or machinery production for farms.

MANUFACTURED GOODS AND CONSUMABLES

A collection of production and consumption activities related to durable manufactured goods (such as machinery, equipment, vehicles and furniture) as well as consumables (such as textiles, fast-moving consumer goods and electronics).

BUILT ENVIRONMENT

The construction, use and maintenance of common, man-made physical structures. These include residential and commercial buildings, as well as infrastructure such as roads, bridges and dams.

MOBILITY AND TRANSPORT

All of the activities (including fuels and vehicles) involved in moving goods and people from point A to B over land, water and air.

THE PLANETARY BOUNDARIES FRAMEWORK

Stratospheric ozone depletion

This means higher levels of UV radiation reach ground level. The appearance of the Antarctic ozone hole was proof that increased levels of man-made ozone-depleting chemical substances, interacting with polar stratospheric clouds, had passed a threshold. Fortunately, because of the actions taken as a result of the 1989 Montreal Protocol, we appear to be back on track to staying within this boundary.[38]

Biodiversity loss

Loss of biosphere integrity results in the loss of local and regional biodiversity, which makes ecosystems more vulnerable to changes in climate and ocean acidity. Currently, the extinction rate is used as a boundary measure for loss of biosphere integrity. Today, the global extinction rate far exceeds the rate of speciation.[39] If the current extinction rate is sustained, an undesired system change is highly likely.

Chemical pollution and release of novel entities

This includes microplastics, pesticides, heavy metal compounds and radioactive materials. Persistent organic pollution, for example, has caused dramatic reductions in bird populations and impaired reproduction and development in marine mammals.[40]

Climate change

This is measured by CO_2 concentration in the atmosphere, with a suggested boundary of 350 parts per million (ppm) above the pre-industrial level.[41] We've now surpassed 390 ppm CO_2 in the atmosphere. The loss of summer polar sea-ice is almost certainly irreversible. This is one example of a well-defined threshold that, when breached, gravely impacts the Earth system.[42]

Ocean acidification

This is a reduction in the ocean's PH due to CO_2 absorption: around one-quarter of our CO_2 emissions dissolve in the ocean.[43] This makes it difficult for essential marine life to survive. Unlike most other human impacts on the marine environment, which are often local in scale, this boundary has global ramifications. It is also an example of how tightly interconnected the boundaries are, as atmospheric CO_2 concentration is the underlying variable for both the climate change and ocean acidification boundaries.

Freshwater consumption

This is measured in terms of 'blue' and 'green' water. Blue water is the freshwater held in surface reservoirs. Green water is the fraction of rainfall that is absorbed by soil to feed plants. The freshwater cycle is closely linked to climate change and its boundary mirrors that of the climate boundary. A water boundary related to consumptive freshwater use and environmental flow requirements has been proposed to maintain the overall resilience of the Earth system.[44]

Land system change

This is driven primarily by agricultural expansion and intensification. Humanity may be reaching a point where further agricultural land expansion at a global scale may seriously threaten biodiversity and undermine the regulatory capacities of the Earth system. The Planetary Boundaries framework proposes that no more than 15% of global usable land should be converted to cropland.[45]

Biogeochemical flows: cycles of nitrogen and phosphorus

Nitrogen and phosphorus are both essential elements for plant growth, but activities like agriculture, poor wastewater management and fossil fuel use convert more atmospheric nitrogen into reactive forms than all of the Earth's terrestrial processes combined. A significant fraction of these nutrients make their way to the sea, and can push marine and aquatic systems across ecological thresholds of their own,[46] while impacting human health.

Atmospheric aerosol loading

This is impacted by GHG emissions and land-use change that releases dust and smoke into the air. Shifts in climate patterns and monsoon systems have already been seen in highly polluted environments, giving a quantifiable regional measure for an aerosol boundary.[47]

Legend

Safe | Close to overshooting | Overshot

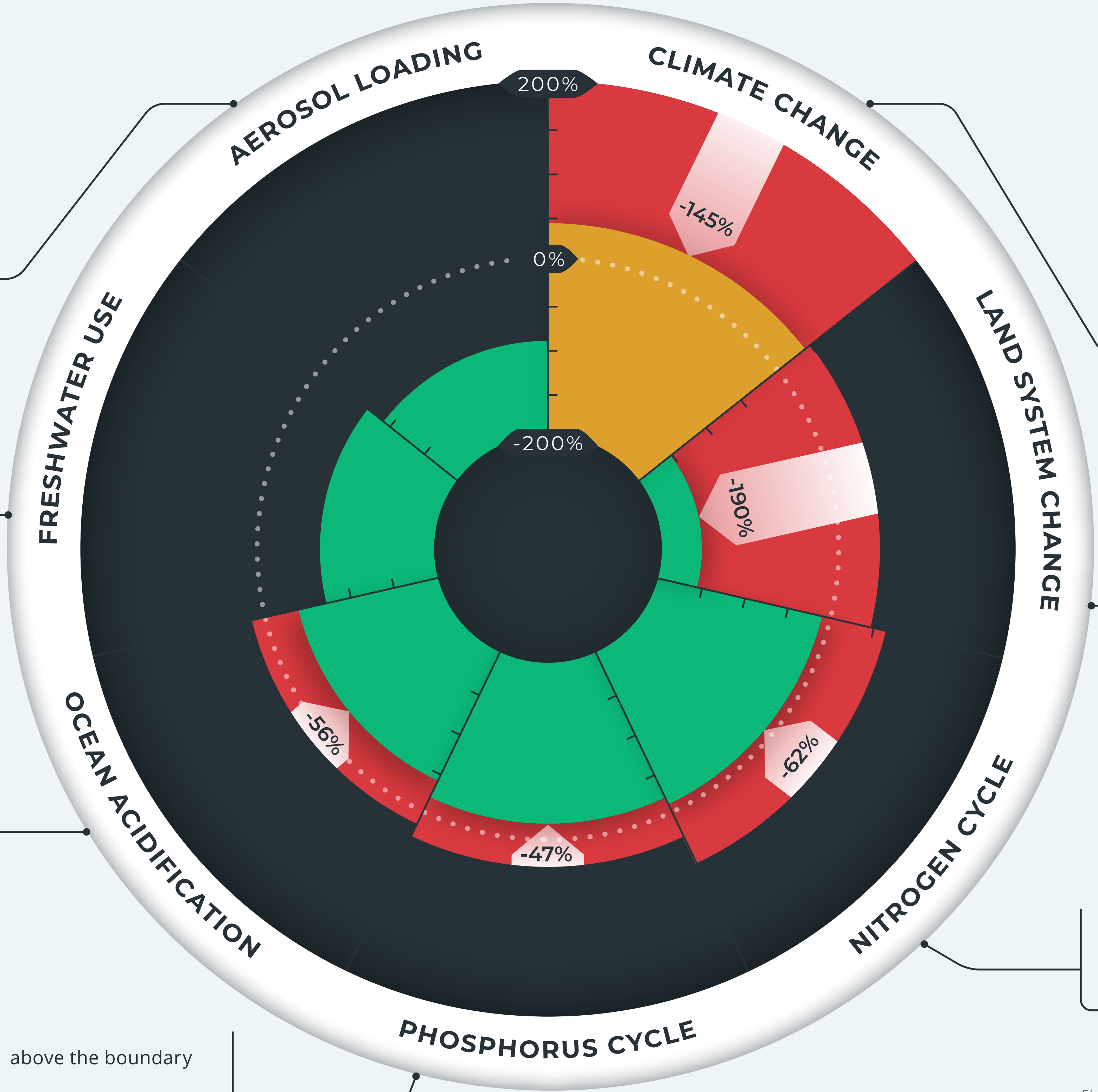
CIRCULAR SOLUTIONS HAVE THE POWER TO REVERSE THE OVERSHOOT

If a circular economy was implemented across these four global systems, virgin material extraction could drop by around one-third (**34%**)—from 92.7 billion tonnes to 61.2 billion tonnes.

GHG emissions could be reduced enough to **limit global temperature rise to 2-degrees.**[52] And crucially, the current overshoot of five planetary boundaries could be reversed.*

Underpinning our entire analysis is an assumption that the global economy **fully transitions to clean energy.** This would involve transforming the electricity mix so that 75% of the electricity currently powered by current fossil fuels (coal, natural gas and petroleum derivatives) is replaced by renewables, phasing out fossil fuel use for industrial purposes (heat and steam)—with the exception of hard to abate industries like steel production and fossil fuels extraction activities. Constraining material inputs, particularly for highly impactful fossil fuels, results in an 8% reduction in the material footprint.[54] In terms of emissions (the climate change planetary boundary), the largest reduction of all circular solutions comes from shifting to renewable electricity: a reduction of 77%. We do not examine this scenario in detail in the report.

**Although we were only able to model the transgression of six planetary boundaries (in the framework, phosphorus and nitrogen cycles are both contained within Biogeochemical flows), we added to the eight planetary boundaries known to have been previously quantified. Measuring stratospheric ozone layer depletion was not possible. According to Rockstrom and colleagues, this boundary is transgressed only temporarily in Antarctica each spring. Biodiversity loss and chemical pollution could also not be modelled. For more information, please refer to the [methodology document](#).*



From **87%** to **93%** below the boundary.

From **59%** to **62%** below the boundary.

From **13%** above the boundary to **43%** below the boundary.

From **33%** above the boundary to **14%** below the boundary.

From **191%** above the boundary to **46%** above the boundary —enough of a decrease to limit temperature rise to 2-degrees.

From **47%** above the boundary to **143%** below the boundary.[53]

From **59%** above the boundary to **3%** below the boundary.

Figure three shows the impact the 16 circular solutions have on reversing the overshoot of five planetary boundaries.

1 TRANSFORM THE GLOBAL FOOD SYSTEM

The need to sustainably fulfil the nutritional needs of around 10 billion people by 2050 is no small feat.[55 56] As global incomes also rise, so does food demand and production—and waste, if business-as-usual continues. And more often than not, where incomes rise consumers spend their extra money on meat: meat consumption has more than doubled since 1990.[57] Ultimately, future food demand could increase by 35 to 56% by 2050.[58]

However, food production cannot keep expanding indefinitely: it is the single largest driver of ecological impact and transgression of planetary boundaries.[59] While all food production comes with environmental costs, the bulk of these are partly due to the huge swathes of land dedicated to *industrially* growing what we—or livestock—eat: agricultural activities now occupy roughly half of the habitable surface of the planet and industrial practices decimate biodiversity, soil health and more. Livestock production is particularly impactful.[60 61] For example, it occupies around two-fifths of the planet's usable land surface. Fishing and aquaculture also generate significant environmental impacts on marine and freshwater ecosystems, water use and quality, and biodiversity loss, through activities such as overfishing, trawling, and chemical and plastic pollution, for example.[62 63] Further, huge amounts of consumer-ready food is wasted, marking a huge loss of not only nutritional resources but also energy, labour and land. Waste occurs both at the farm—14% of the world's food waste occurs during post-harvest production and processing phases[64]—and at the consumer end. Often, current food practices focus on maximising food production, rather than delivering healthy and nutrient-dense food—there are not only environmental, but also health costs to business-as-usual. Overall, food production practices are highly impactful on planetary boundaries:

THE FOOD SYSTEM IS BY FAR THE LARGEST DRIVER OF LAND-USE CHANGE GLOBALLY[65]

In terms of land footprint, agriculture is by far the most impactful: around 7% of global land use is allocated to crops,[66] which is equivalent to the size of East Asia, and livestock production alone occupies over one-quarter (27%) of global land use, equivalent to the size of the Americas.[67] The production of lost and wasted food globally accounts for 23% of global cropland.[68]

THE FOOD SYSTEM IS A MAJOR DRIVER OF CLIMATE CHANGE AND OCEAN ACIDIFICATION

It makes up one-third of GHG emissions,[69] while animal husbandry alone is linked to about 14.5% of global GHG emissions.[70] The production of lost and wasted food globally accounts for between 8 and 10% of global GHG emissions.[71]

THE FOOD SYSTEM IS RESPONSIBLE FOR 70% OF THE GLOBAL ACCESSIBLE FRESHWATER WITHDRAWALS THROUGH IRRIGATION[72]

Globally, water demand from agriculture has more than doubled between 1960 and 2000.[73] Food waste alone is responsible for 24% of total freshwater resources used in food production.

THE FOOD SYSTEM CONTRIBUTES TO THE VAST MAJORITY OF NUTRIENT OVERLOAD

Excessive use of synthetic fertilisers has resulted in an overload of the nutrients nitrogen and phosphorus. Livestock production alone is responsible for about one-third of global nitrogen mobilisation, enough to meet the entire 'planetary budget' for nutrient overload.[74] The production of lost and wasted food globally accounts for 23% of global fertiliser use.[75]

THE FOOD SYSTEM IS THE SINGLE LARGEST DRIVER OF BIODIVERSITY LOSS[76]

Human land use change for food production results in habitat loss and fragmentation, driving biodiversity loss and soil degradation.[77 78]

CIRCULAR SOLUTIONS FOR THE FOOD SYSTEM

The unique properties of the global food trade and the importance of food as a basic human need—and right—necessitate a systemic approach to sustainable food production and consumption for a planet of 8 billion people. This modelled scenario shows that global food production can be done in a circular manner; it is not necessary to sacrifice crop yields to reduce environmental impacts[79] if food systems are designed on closed nutrient cycling, water-nutrient management is improved, and symbiosis is ingrained within and between systems that are regenerative. Changing food consumption is also key: reducing high-impact foods, such as meat, as well as excessive caloric intake, and cutting food waste across the value chain (but particularly at the post consumer stage) are fundamental if the global food system is to remain within planetary boundaries.[80 81] According to our analysis, applying these four circular solutions to this system could help reverse the global overshoot of planetary boundaries:

1. PUT HEALTHIER, SATIATING FOODS FIRST

Healthy daily calorie intakes are averaged at around 2,600.[82] Prioritise satiating and healthy foods with a lower environmental impact—ideally shifting calories from meat, fish and dairy towards cereals, fruits, vegetables and nuts.

2. GO LOCAL, SEASONAL AND ORGANIC

Prioritise the production and consumption of local, seasonal and organic produce, which can lead to a reduced need for fertiliser, heating fuels, and transportation and processing services.

3. MAINSTREAM REGENERATIVE AGRICULTURE

Scale up regenerative and circular agricultural processes that encourage closed nutrient loops. This model supports healthy soils and ultimately keeps the land arable for far longer than typical farming processes. If meat remains in our diets, it should be reared within this model.

4. NO MORE AVOIDABLE FOOD WASTE

Abolish food waste along the supply chain and at the consumer level through better management of transport and storage, more refrigeration and smart planning, and technology at the consumer and food service levels.

2 BUILD A CIRCULAR BUILT ENVIRONMENT

Housing and providing services for the world's rapidly urbanising population—especially in *Build* and *Grow* countries—will inevitably require additional material use. Yet crucial construction materials are already becoming scarce due to overuse and rising incomes have shaped an appetite for bigger homes and ultimately more *space*—also driven by a rising trend for living alone in *Shift* countries.[83] The quick build-up of cities without smart urban planning has also contributed to urban sprawl, leading to high car dependency, air and noise pollution and excessive material use.[84] But it's not only about the material use involved in the construction of buildings: the way in which these are built will substantially influence material demand during their use phase, from energy efficiency to the lifetime extension of buildings themselves. Today, due to a lack of circular design and integrated planning, buildings already in use are major carbon emitters, claiming nearly one-third of global energy consumption.[85]

Our need for buildings and infrastructure is one of the most impactful: worldwide, construction and demolition drives nearly one-third of total material consumption, and generates a similar portion of waste.[86] Particularly over the past two decades, soaring demand from the construction industry has caused the extraction of non-metallic minerals—especially sand and gravel—to triple,[87] with sand being taken from the Earth more quickly than it can be replenished.[88] After clean water, sand is the world's most used resource. The (often unregulated) mining of these materials, production and transport of construction materials, and building operations and end-of-life waste management of the construction and demolition phase drive a range of climate-related disasters and planetary boundary impacts:

THE BUILT ENVIRONMENT IS RESPONSIBLE FOR ABOUT ONE-QUARTER OF LAND SYSTEM CHANGE

However, the built environment (including villages, towns, cities and infrastructure) is estimated to occupy just 1% of global land surface, or about 60 million hectares.[89] Through the extraction of the minerals necessary to produce construction materials and the emissions it generates, it is responsible for habitat destruction and consequently, biodiversity loss.[90 91 92]

THE BUILT ENVIRONMENT IS A MAJOR DRIVER OF CLIMATE CHANGE AND OCEAN ACIDIFICATION

Approximately 40% of global GHG emissions can be attributed to buildings' construction, use and demolition. Upstream activities, such as the production of building materials, are energy-intensive processes that generate vast amounts of GHG emissions: cement production alone contributes around 7% of global CO_2 emissions.[93] Buildings are also major energy consumers and thus emitters: building operations are responsible for approximately 55% of global electricity consumption, for example.[94]

THE BUILT ENVIRONMENT DRIVES WATER STRESS

Sand and gravel extraction disrupt water supplies, hydrological functions and river and coastal ecosystems.[95] The production of construction materials such as cement, steel and glass are water-intensive processes.[96 97]

CIRCULAR SOLUTIONS FOR THE BUILT ENVIRONMENT

The built environment is essential, yet the way we design our built-up spaces to deliver these needs determines the material demand to follow—thereby either greatly impacting or benefiting the environment. With circular economy design principles at the core, the circular solutions identified in this report show that we can create a modern and efficient built environment with significantly less impact on the crucial life support systems of the planet. According to our analysis, applying these four circular solutions to this system could help reverse the global overshoot of planetary boundaries:

5. BE AS ENERGY EFFICIENT AS POSSIBLE

From the design phase, utilise circular strategies to create material- and energy-efficient buildings, through the 'passivhaus' approach, for example. Couple these designs with a roll out of clean energy solutions: for example, low-carbon heating and cooling approaches such as heat pumps. Prioritise energy efficient appliances, wash at lower temperatures and lower thermostat settings by a few degrees. Overall, radically reduce energy and material demands.

6. MAKE THE MOST OF WHAT ALREADY EXISTS

There are already huge amounts of materials locked into existing buildings—make the most of them by reusing, repurposing and renovating with secondary materials. Where new builds are needed, be as efficient as possible with urban planning solutions that follow circular design principles so that buildings can be reused, repurposed or easily disassembled in the future.

7. PRIORITISE CIRCULAR MATERIALS AND APPROACHES

A huge range of circular approaches can cut the emissions and material intensity of buildings. Transition to using wood, timber or cross-laminated timber instead of steel and concrete, or move to other locally available materials. Utilise mainstream modular construction and prioritise lightweight frames and structures to reduce cement and steel use, as well as green roofs where possible.

8. REUSE WASTE

Maximise the high-value reuse of buildings and components where possible. Ideally, make construction and demolition waste a thing of the past, but where it cannot be avoided: ensure that as much of it as possible is recycled to avoid the need for virgin materials, such as sand and gravel.

3 ACHIEVE CIRCULAR MANUFACTURED GOODS AND CONSUMABLES

Heavy industry and manufacturing kick-started the Anthropocene: our current geological epoch, in which human activity is the main driver of Earth system changes. The impacts of the industrial system stem from two main factors: the scale of production (and consumption), and production processes themselves. The mechanisation of production—occurring during the Industrial Revolution—was and continues to be tightly linked with high energy use, particularly fossil fuels. It also enabled mass consumption, as consumption is both the driver and goal of the expansion of production. Therefore, the environmental impacts of industrial activities occur across the entire lifecycle: from material extraction to processing and end-of-life. Mining of the metals that are crucial for manufacturing has spurred serious environmental and social consequences. Mining processes create vast quantities of waste rock and toxic waste.[98] Industrial production processes are similarly important—since they determine system efficiency and thus influence energy and material use—and impactful: this analysis estimates that over one-quarter (28% or 9.8 billion tonnes) of global solid waste generation is industrial waste. Similarly, while industrial activities are highly energy-intensive (often fossil fuels), much of industry's vast energy consumption is lost as waste heat.[99]

The entire lifecycle of other product streams such as steel (and other metals), paper and cardboard, chemicals, textiles manufacturing, and plastics production are also highly impactful. The production of steel and other metals is highly energy- and material-intensive, representing around 10% of global primary energy demand,[100] and thus represents a significant amount of the share of the environmental footprint of industrial systems.[101] Similarly, textiles production and consumption has exploded during the last two decades: with production doubling between the years 2000 and 2014, and the average consumer buying many more pieces, yet each clothing item now being kept half as long.[102] This makes textiles responsible for substantial environmental impacts, including a hefty carbon footprint (up to 10% of GHG emissions[103]), chemical pollution, and waste generation.[104] Plastics are ubiquitous in modern society but they are also especially problematic: production has doubled since the year 2000, and waste and pollution are growing relentlessly,[105] with highly impactful environmental consequences on land and sea as well as with dire social consequences attached.[106 107] Some of this system's planetary boundary impacts include:

THE INDUSTRIAL SYSTEM IS RESPONSIBLE FOR LAND-SYSTEMS CHANGE

As heavy, material- and energy-intensive industrial activities that primarily consume metals and fossil fuels, manufacturing is linked to deforestation and land use change,[108 109 110 111] particularly in the tropics,[112] directly impacting ecosystem destruction[113] and biodiversity loss.[114]

THE INDUSTRIAL SYSTEM ACCOUNTS FOR APPROXIMATELY ONE-THIRD OF GLOBAL GHG EMISSIONS[115]

Because around three-quarters of its processes' energy demands are met by coal, steel production alone generates more emissions than all road freight,[116] for example.[117]

THE INDUSTRIAL SYSTEM DRIVES CHEMICAL POLLUTION OVERSHOOT AND THE RELEASE OF NOVEL ENTITIES[118]

Increased production and release of chemicals and plastics pollution present a wide range of adverse environmental impacts and on (other) biophysical processes, including water stress,[119 120] soil health and biosphere integrity, among others.[121]

CIRCULAR SOLUTIONS FOR MANUFACTURED GOODS AND CONSUMABLES

The manufacturing industry is rife with opportunity to do better by drawing on circular strategies that boost efficiency, get more from less, minimise pollution and consider social justice measures. Extractive and manufacturing industries will need to continue into the future to fuel our collective demand for materials and to support the large-scale deployment of renewable energy infrastructure. It is critical that, in addition to the adoption of sustainable practices, individual and community livelihoods are protected well into the future. Curbing material demand will be crucial to decarbonise hard-to-abate sectors—iron, steel and aluminium manufacturing, for example. According to our analysis, applying these four circular solutions to this system could help reverse the global overshoot of planetary boundaries:

9. MAINSTREAM INDUSTRIAL SYMBIOSIS AND EFFICIENCY

Achieve process improvements, scrap diversion and reduction in yield losses through greater industrial symbiosis and efficiency. Foster tighter collaboration within and between industries to deliver powerful material and emissions savings.

10. EXTEND THE LIFETIME OF MACHINERY, EQUIPMENT AND GOODS

Maximising the lifetime of goods that serve our daily needs can bring a number of environmental benefits. Decrease the costs to repair, remanufacture, upgrade and reuse through circular business models, material substitution, or regulations on the minimum guarantee of products.

11. BUY WHAT YOU NEED

Reduce the purchases of common electronic goods, appliances and other equipment to sufficiency levels. This shift is assumed to be supported by a combination of policies such as a raw material tax, but also service-based circular business models like sharing or pay-per-use.

12. ESCHEW FAST FASHION IN FAVOUR OF SUSTAINABLE TEXTILES

Prioritise natural and local textile manufacturing, as well as higher-quality and more durable garments. All used clothing should go on to be reused or, if needed, recycled appropriately. Industry shifts to encourage the large-scale deployment of sustainable production speed this process up.

4 DRIVE FORWARD CIRCULAR MOBILITY AND TRANSPORT

Transport systems are among the most impactful globally: heavily material-intensive and high consumers of fossil fuels, they fragment natural environments, often causing harm to ecosystem functions. These impacts aren't set to reverse: the demand for transport is trending strongly upwards all around the world,[122] and left unchecked, emissions from the transport system could grow by 60% by 2050.[123]

Transport is the single largest driver of oil demand worldwide, claiming around 60% of the total, and accounting for nearly one-third of final energy use.[124] Our oil and transport dependence is causing emissions to spiral. Passenger cars are the most common vehicle, and because most of them are powered with internal combustion engines, they are the largest source of emissions.[125] The number of vehicles worldwide has increased significantly during the last two decades, particularly passenger cars.[126] Similarly, aviation, despite representing a relatively smaller share of emissions for transport compared to road transport, is the fastest growing source of emissions within the system.[127] However, inequality within and between countries is vast. For example, the richest half of the world (high- and upper-middle income countries) are responsible for 90% of air travel emissions, while lower-middle income countries emit just 1%.[128] But transport and mobility networks, including not only the vehicles but the physical infrastructure that underpins them, generate significant environmental pressures. The bottom line: our need for transport—and our largely linear way of meeting this need—leads to:

THE TRANSPORT SYSTEM IS A MAJOR DRIVER OF CLIMATE CHANGE AND OCEAN ACIDIFICATION, ACCOUNTING FOR APPROXIMATELY 25% OF GHG EMISSIONS GLOBALLY

Road transport and air travel concentrate the bulk of emissions from the transport system: around 85% of the total.[129] Mainly—although not only—due to its high carbon footprint, transport and mobility are also major drivers of ocean acidification.[130]

THE TRANSPORT SYSTEM DRIVES LAND USE CHANGE AND BIODIVERSITY LOSS

For example, the development of land-based transportation infrastructure, particularly the construction and expansion of major road corridors, often leads to deforestation, landscape alteration, and biodiversity loss.[131 132 133] Transport, a core component of international trade, has also been found to increase deforestation.[134] Still, shipping and cruises that release harmful pollutants into the water lead to marine litter that severely impacts biodiversity.[135]

CIRCULAR SOLUTIONS FOR MOBILITY AND TRANSPORT

Transiting transport and mobility towards sustainability is a multidimensional process, and key to reducing environmental pressures globally.[136] It's crucial for emissions from transport and mobility to decrease sharply in the coming years, through decarbonisation and the higher uptake of active transport modes: walking and biking, where possible. The circular economy provides a wealth of opportunities to make all these aims a reality. With circular economy design principles at the core, our scenarios show that we can create healthy and efficient freight and transport systems for the future with significantly less impact on the planet. According to our analysis, applying these four circular solutions to this system could help reverse the global overshoot of planetary boundaries:

13. EMBRACE CAR-FREE LIFESTYLES AND ROADS

Swap car purchases for bikes and ride-sharing initiatives—especially in urban areas. A boost in virtual work reduces the number of kilometres travelled for commuting. This shift encourages better utilisation of spatial assets and former office spaces in urban settings.

14. INVEST IN HIGH-QUALITY PUBLIC TRANSPORT

Boost the use of public transport, including bus, tram and rail networks. In adapting our infrastructure, extra care can also be given to creating safer cycling routes and pedestrianised city centres—ultimately improving the liveability of regions and cities.

15. RETHINK AIR-TRAVEL

Minimise personal air travel, especially in regions with the most demand for long-haul air travel, such as North America, Europe and Asia.

16. ELECTRIFY REMAINING VEHICLES

Electrify public transport vehicles along with 50% of all privately owned cars.

4 DIFFERENT COUNTRIES, DIFFERENT CIRCULAR SOLUTIONS

TAILORED CIRCULAR PATHWAYS

Our modelling shows how just 16 circular solutions can bring global planetary boundaries back within safe limits. However, translating these theoretical solutions into widespread practice will require a comprehensive understanding of how solutions can be best adapted to local contexts around the world. This chapter builds on the country profiles introduced in the *Circularity Gap Report 2020*, which allow us to prioritise circular solutions based on countries' performance on human development and ecological impact.[137] Whilst recognising that no single country can ever be a perfect match for all the criteria of any one profile, it is important to present a wide range of circular solutions that can be adapted to optimise wellbeing within the country context, by combining technology, business and policy.

MYTH-BUSTING: POPULATION GROWTH DOES NOT LEAD TO OVERSHOOT

The previous chapter demonstrated the disconnect between human activity and the planet upon which we rely to live. As the global population grows and incomes rise—importantly lifting many out of poverty—consumption also rises. But increasing consumption beyond a point results in diminishing returns for wellbeing, and is detrimental to the planet, which further impacts the wellbeing of future generations. We need to think critically about how to strike a balance for the planet and all of its people, which urges us to redefine progress and look beyond only short-term impacts. As many have pointed out before, our current measuring stick of GDP for progress isn't always effective—it's sometimes even counterintuitive. The destruction of natural carbon sinks that are home to thousands of species is a good move for short-term economic growth, but not the environment, for example.

Our analysis locates numerous national examples where a spike in material use has been to the detriment of wellbeing indicators, such as life expectancy, nutrition, democratic quality, equality, education, access to energy and social support, among others. Singapore and Lithuania had the largest material footprint increase of the 148 countries studied[138] in the period 2005 to 2015, yet Lithuania recorded no average growth across wellbeing indicators (a small increase in life expectancy was compensated by a small decrease in life satisfaction) and Singapore achieved only a very small average increase (mostly by increasing employment). This starkly contrasts countries such as Angola, Eswatini, Togo, Nepal, The Gambia and South Africa, which marked strong progress on several wellbeing indicators yet had stable, and even declining, material footprints. This indicates that to better align increasingly scarce and competed for materials with the essential needs of people, additional materials should be directed towards countries where material scarcity hampers progress on basic wellbeing—rather than countries whose material needs are more than satisfied.

To this end, this report takes a similar approach. While it finds that circular solutions across key systems can cut global material demand by about one-third (34%) and reverse the overshoot, it is important to note that this reduction should not be equally shouldered across countries. *Shift* countries are responsible for most of the overshoot, and often carry a material footprint that is double or even triple the global average.[139]

BUILD, GROW, SHIFT: THREE COUNTRY PROFILES

Despite clear divergences between countries, we can still discern which circular economy interventions will be most suitable in certain contexts based on clear common needs and structural parallels. In our 2020 analysis, we took 176 countries and scored them on their social performance (measured by a Human Development Index score) and their ecological footprint[140] to assess how far they were from the end goal: a socially just and ecologically safe space. Our overarching finding was illuminating: no country resides within a safe and just space today. Some countries are close, others are far away; each starts from a different point on the map, but all have a distance to go. The position of each country in this analysis helps us form the three broad country profiles, which may exhibit some overlaps but overall allow us to highlight key common themes that are central to development pathways.

BUILD

Build countries live within planetary boundaries, but still need to build an economic system that satisfies their society's basic needs.They are home to 46% of the global population. They currently transgress few planetary boundaries, if any at all, but struggle to meet their basic needs, such as education and healthcare, and therefore score low on Human Development Index (HDI) indicators. Their economies are dominated by agriculture and forestry, and they are building basic infrastructure. **The *Build* profile is most relevant to countries in Sub-Saharan Africa, South Asian countries and some small island states. The larger countries by population to which the profile may apply are India, Bangladesh, Ethiopia, Nigeria, Pakistan and the Philippines.**

SHIFT

Higher-income *Shift* countries need to shift away from over-consuming the planet's materials in servicing their relatively affluent and comfortable lifestyles (although inequalities within *Shift* countries are rife). They are home to a minority of the world's population but consume 31% of materials and generate 43% of emissions. Per capita, Shift countries are the largest consumers across all material groups; their extraction of fossil fuels is relatively high, as is their participation in global trade. So, despite high HDI scores and comfortable lifestyles, these countries have a way to go to limit their consumption in line with our planet's boundaries. **The *Shift* profile fits best with the higher-income countries in the Global North, in the Gulf, Australia and Oceania. The larger ones include the US, Japan, Canada, Argentina and Member States of the European Union.**

GROW

Largely middle-income, *Grow* countries need to continue growing in a way that satisfies their societal needs, but within planetary boundaries. They are home to 37% of the world's population, and are industrialising rapidly and building infrastructure to lift their populations out of poverty and accommodate a growing middle class. They are global manufacturing hubs and the world's biggest agricultural producers. They use 51% of materials and generate 41% of emissions. **The *Grow* profile is most relevant to countries in Latin America and Northern Africa, as well as those with an economy in transition in Eastern Europe, the Caucasus and Central Asia, plus larger Southeast Asian countries. The largest countries in this group are China, Indonesia, Brazil, Mexico, Vietnam, Myanmar and Egypt.**

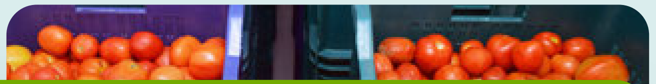
Figure four shows how 176 countries score on the Human Development Index (HDI) and the Ecological Footprint combined; three country profiles emerge with different distances to a safe and just operating space for humanity (the rectangular box on the bottom right).

BUILD

***Build* countries have the opportunity to dramatically lift wellbeing by balancing leapfrogging technologies with policies that support local skills and needs for material-smart growth.**

1. TRANSFORM THE FOOD SYSTEM

Build nations have predominantly agrarian, biomass-based economies where agriculture is central to the economy. Our analysis finds that over half of total material input to these economies is made up of biomass, and the vast majority of all waste generated is agricultural. Agriculture also makes up almost 60% of the total workforce, thereby holding an enormous potential to improve livelihoods.[141] The vast majority of farmers own small-scale operations or are pastoralists who depend on the food they can produce on their own. Malnutrition and poverty are key social challenges, largely due to poor soil conditions, climatic risks and lacking supply chain infrastructure.[142]
One of the key challenges for *Build* countries is to foster adaptive and regenerative food systems that build ecosystem health, and yield multiple sources of income for producers, while ensuring scalable infrastructure is in place to secure food supply to surrounding populations. Circular economy solutions can be strengthened by combining material-smart technologies with regenerative and adaptive principles for agricultural production, as well as taking into account low-tech, human-centred designs that are compatible with low material use and community preferences. ***Build* countries should focus on circular solution numbers: One, Two and Four (see page 33).**



One-acre farm is a highly profitable, mixed farm near Lake Victoria in Uganda

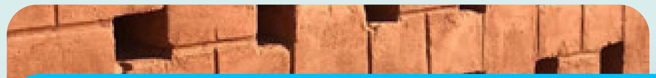
By reinforcing regenerative processes, the farm generates multiple revenue streams ***estimated at €95,000 per year***—more than ten times the average Ugandan salary. Beneficial exchanges of materials take place farm-wide: nothing goes to waste—maggots, for example, are grown on pig waste to feed to chicken and fish. The farm requires ***80% less feed and input costs,*** and produces multiple crops and by-products such as biogas.[143] Regenerative agriculture offers a ***powerful lever to boost local employment,*** while critically improving soil quality and ecosystem services, which protect the livelihoods of future generations.

ColdHubs offers affordable subscription models that can boost access to cold chain solutions

To ensure that regenerative agricultural products reach consumers, adequate distribution infrastructure is needed: ColdHubs is a post-harvest, solar-powered, Cooling-as-Service solution in Nigeria. The 24 operational ColdHubs ***saved 20,400 tonnes of food from spoilage, increased the household income of over 3,500 smallholders, retailers and wholesalers by 50%, created 48 new jobs for women and mitigated 462 tonnes of CO_2 emissions***, with an annual energy consumption reduction of 547 kilowatt-hours. ColdHubs offers farmers a flexible pay-as-you-store subscription model at rates that they can afford, helping to tackle the barrier of access to financing for cold chain solutions.[144]

2. BUILD A CIRCULAR BUILT ENVIRONMENT

Build nations have fast growing and urbanising populations largely living in informal settlements with limited access to basic services. The majority of the 1.6 billion people that live without adequate shelter worldwide[145] live in *Build* nations.[146] This has ripple effects across the built environment: a lack of access to public transport, mounting waste and poor waste management, and increased air pollution.[147] At the same time, many *Build* nations house rich ecosystems, yet high levels of extraction of sand, gravel and limestone, and iron ores for use in the construction industry have majorly impacted the landscape and spurred biodiversity loss.[148] [149] For example, in The Gambia, 20% of all material use relates to construction, and over 50% of construction materials stem from non-renewable sources. The import of construction materials and metals constitute 24% of imported embodied carbon. Next to this, the extraction of sand and gravel to produce concrete threatens forest stock, including community-managed forests, which provide valuable livelihoods.[150] A key challenge for the built environment in *Build* countries is to develop efficient and adaptive infrastructure and housing systems while not undermining the ecosystems that provide essential resources. Circular economy principles can be applied throughout the built environment to deliver on these goals. ***Build* countries should focus on circular solution numbers: Five, Seven and Eight (see page 35).**



Earthwork is a local, low-impact building method

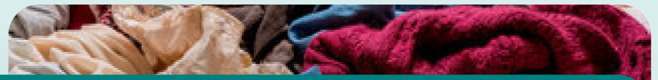
Compressed earth bricks—made from soil, natural fibres and clay—can last for centuries, are easy to repair and boast a very low carbon footprint.[151] Worofila, Earthwork Construction and Elementerre are companies in Africa that are reviving earth-based construction methods, and reaping the benefits.[152] One example of earthwork construction ***cut embodied energy by 95%*** compared to a similar traditional concrete block construction.[153]

Climate adaptive building must bring together local materials, labour and knowledge

The Friendship Hospital in Bangladesh was built to serve some of the most vulnerable populations. Its construction employed local craftsmen to make the most of local knowledge: the building process addressed many climate concerns, by utilising local building materials, using surrounding water as a passive cooling method, and harvesting rainwater for reuse, for example.[154] ***The building's environmental impact was minimised, while ensuring trust and legitimacy among the local population***—and shaping a beneficial environment for the mental and physical health of the hospital's patients.[155] Climate justice and unequal access to healthcare were central concerns, as was the use of sustainable, local building materials—serving to cut emissions and lower waste.[156]

3. ACHIEVE CIRCULAR MANUFACTURED GOODS AND CONSUMABLES

Build countries typically do not have extensive manufacturing industries.[157] As a result, energy and fossil fuel use is low. Material extraction and use and waste generated is also low—just 13% of the global material footprint and only 11% of global solid waste. However, they do incur disproportionate social impacts at the two ends of the supply chain: global extraction and waste management activities. Mining activities in *Build* countries have infamously led to the displacement of populations, violent conflict and human rights violations.[158] At the same time, once products from material streams such as textiles, plastics, and electronics reach their end-of-life, they are shipped from *Shift* countries—often illegally.[159 160 161] The majority of *Build* countries have highly informal waste management sectors that process very toxic consumer goods—often imported from abroad.[162] This leads to the disposal of harmful substances but also lost value since many products can be repaired.[163 164] A circular economy can help these countries leapfrog to sustainable industrial activities, particularly when capitalising on exponential technologies and system efficiencies. The formalisation and revamping of waste management holds important potential for improving labour conditions. At the same time, circular strategies can help unlock service-led development, particularly for highly-productive stages of the value chain such as technical services, including repair, remanufacture, and reuse activities for electronics, machinery and equipment, for example. ***Build* countries should focus on circular solution numbers: Eleven and Twelve (see page 37).**



WEEE centres in Kenya and Nigeria allow for the collection, repair and recycling of e-waste

Kenya established a WEEE centre that collects, repairs, resells and recycles electrical and electronic waste from over 8,000 clients. The centre ***employs 40 people***, and involves over 1,000 staff in collection. In Nigeria, E-waste Producer Responsibility Organisation Nigeria (EPRON) finances the collection and processing of e-waste by fees and levies charged to producers.[165] EPRON aims to ***reduce and safely recover the over 52,000 tonnes of brominated plastics***, 4,000 tonnes of lead, 80 tonnes of cadmium and over 300 kilograms of mercury which are otherwise burned or dumped in Nigeria every year[166] by an estimated 100,000 informal waste workers.[167]

The Circular Fashion Partnership accelerates a circular textiles industry in Bangladesh

The Partnership connects large suppliers, recyclers and brands operating in Bangladesh to build the necessary infrastructure to process post-production textile waste and unworn clothes.[168] To date, around ***1,500 tonnes of textile waste has been captured*** through the Partnership—which has also hosted more than one hundred summits, masterclasses and roundtables convening leaders to drive action and create opportunities for collaboration. If developed sufficiently, this collaboration can form the basis of a more permanent form of industrial symbiosis, closing the loop on textile waste and losses.[169]

4. DRIVE FORWARD CIRCULAR TRANSPORT

Build countries have contributed very little to the current overshoot, yet they often lack access to safe, affordable, efficient and sustainable transport and mobility.[170] However, this picture is changing with one of the fastest vehicle growth rates globally.[171] Driven by rapid population and economic growth coupled with urbanisation, Sub-Saharan Africa especially is going through a mobility revolution. Circular economy solutions and partnerships will be needed to ensure that transport systems can serve the needs of a rapidly growing economy, while leapfrogging the material-intensive mobility systems that exist today. ***Build* countries should focus on circular solution numbers: Thirteen and Fourteen (see page 39).**

Electric cargo bikes offer solutions for off-road freight transport in rural areas

Referred to as Steel Birds, these off-road cargo bikes are designed by Berlin-based company Anywhere, but are manufactured in microfactories in Africa. In urban areas, these bikes provide practical and ***cost-effective logistical 'last mile' services***, while in rural settings, they can reach remote areas to facilitate connection with villages. The solar panels and energy storage underpinning the bikes help establish a zero-cost microgrid, ***capable of providing electricity and running water cleaning units*** for remote populations.[172]

Glocal public-private partnerships roll out locally manufactured transport for rapidly urbanising cities

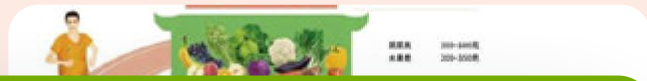
Safa Tempo are three-wheeled electric vehicles that became popular as alternatives to polluting Diesel-run Vikram tempos as 1990s Nepal was hit by rising air pollution and fuel scarcity. Introduced with the support of the Global Resources Institute (GRI) and the United States Agency of International Development (USAID), the transport solution provides ***clean, cost-effective, short-distance transport in urban areas***. It also boosted gender equality: it was a ***catalyst for getting women behind the wheel and in the driver's seat***, paving the way for their empowerment.[173 174]

GROW

Grow countries can prioritise material-efficient development pathways that maximise societal wellbeing for a growing population.

1. TRANSFORM THE FOOD SYSTEM

In *Grow* countries, rising incomes are paralleled by shifts in dietary patterns: particularly an increase in high impact foods like meat and rising food waste: all key drivers of overshoot and adverse health impacts. For instance, between 1990 to 2019, daily meat consumption per person doubled in Mexico and Brazil, and nearly tripled in China, while the share of plant-based proteins went down in all of them.[175] Today, China alone consumes 28% of the meat produced globally. Increasing affluence has also led to large-scale food waste. China, for instance, wastes 6% (or 35 million tonnes) of the country's total food production per year.[176] These two trends are a core challenge of *Grow* countries' food systems: how to ensure adequate nutrition for a rapidly growing population that can be decoupled from increasing environmental pressures from food production and waste. At the same time, many *Grow* countries are agricultural powerhouses and major agro exporters of commodities such as soybeans, poultry, pork and beef. Shifting towards more sustainable and circular production (farming practices) and consumption (diets) are key, particularly by downscaling most impactful processes (livestock production and consumption).[177] ***Grow* countries should focus on circular solution numbers: One, Two, Three and Four (see page 33).**



Alternative low-impact proteins can address the growing food waste challenge

Thai business Global Bugs produces cricket protein: a low-cost, complete source of protein and 'superfood' that ***requires one-sixth less feed, 1/1,000th the amount of water, and 1/20,000th the amount of land compared to the same amount of beef***. Insects also present a unique solution to heightening food waste challenges in *Grow* countries, as they consume low-value agricultural waste. Insect protein farm systems can, therefore, be designed in a circular way.[178]

New dietary guidelines to cut per capita meat consumption by 2030 have emerged in China

In 2022, China introduced new guidelines that aim to ***reduce per person meat consumption by half***, listing cultivated meats and other plant-based 'future foods' as suitable protein sources in its five-year plan. If effective, China's efforts to shift the messaging around healthy diets—with a focus on eating less meat and potentially avoiding red meat altogether, prioritising local products and reducing food waste—could inspire other countries to adopt a similar approach.[179 180]

2. BUILD A CIRCULAR BUILT ENVIRONMENT

A sharp increase in material use and waste generation[181] has been primarily linked to *Grow* countries experiencing GDP growth and an expanding built environment. Of net additions to stock in 2018, approximately two-thirds (65%) occurred in *Grow* countries. This stock build up is unprecedented in history and has been the main driver of global material demand growth in the last two decades.[182 183] Brazil, Russia, China and South Africa represent a significant portion of the increase in demand for sand and gravel, for example, while China alone accounts for roughly half of global cement production.[184 185] A circular built environment needs to address two core challenges: how to deliver high quality housing and infrastructure services for the world's fastest growing economies while leveraging the cutting edge of resource efficient solutions. ***Grow* countries should focus on circular solution numbers: Five, Seven and Eight (see page 35).**

Chiangmai Life Architects implement and scale circular construction strategies

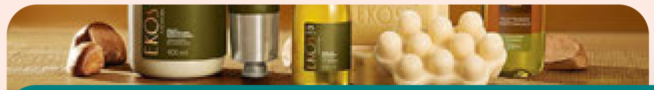
This Thailand-based company prioritises natural building materials to create homes, offices, schools and more: bamboo, rammed earth and adobe bricks, for example.[186] These carbon-absorbing materials can ***boast a negative carbon footprint***, in addition to other benefits: bamboo, for example, is quick-growing, lightweight, strong and flexible,[187] while rammed earth protects spaces from excessive heat and cold and is often locally available.[188] They also have a role to play in adaptation to climate change: bamboo has the ability to heal watersheds during extreme heat, while also mitigating floods.[189]

Mexico's EcoCasa Programme supports passive design and resource-efficient housing

The EcoCasa programme is managed by the state-run development bank Sociedad Hipotecaria Federal, and issues credits for houses with a 20% reduced energy consumption. The EU funded an extension to this programme, supporting houses with an 80% reduction in energy consumption and that meet the Passive House Standard.[190 191] ***Some EcoCasa buildings have more than 20% less embodied carbon***, while some with additional EDGE certification ***cut embodied carbon by as much as 44%***.[192] EcoCasa aims to bring more environmental concerns within scope as the programme develops, eventually hoping to target water use, transport and embodied energy. The programme is receiving recognition for its ability to transform the whole construction sector, as well as its replication potential.[193]

3. ACHIEVE CIRCULAR MANUFACTURED GOODS AND CONSUMABLES

Manufacturing is the beating heart of *Grow* countries, making up a substantial share of their economies and employment. The rapid economic development that has lifted the social foundation of many people in these countries has been predominantly led by the processing and manufacturing of steel, chemicals, textiles and cement. This presents an opportunity to improve livelihoods by developing innovative circular economy processes and business models for manufactured goods,[194] deploying low-carbon technologies and increasing shares of secondary production.[195] A key challenge in pursuing a circular model for manufacturing is ensuring that there are opportunities for highly skilled labour that drive global competitiveness over the long term, while also making significant gains in resource efficiency that mitigate crucial impacts to the environment. ***Grow* countries should focus on circular solution numbers: Ten, Eleven and Twelve (see page 37).**



Natura & Co paves the way to a circular and regenerative personal care industry

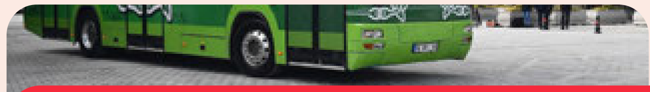
Brazil-based Natura & Co is a personal care subsidiary with bold circular economy targets, ***including 20% less packaging, 50% recycled content, and 100% reusable, recyclable or compostable packaging***. Plant-based ingredients are prioritised to create its soaps, creams and shampoos, and local traditional knowledge is used to supplement research and innovation. The company will deploy Life Cycle Assessments for all of its products to ensure lower environmental footprints, and supports regenerative agriculture to cut chemical use and create alternative revenue streams for farmers that are more economically attractive than deforestation. By doing so, Natura & Co protects the value of healthy rainforests, bolstering biodiversity.[196 197]

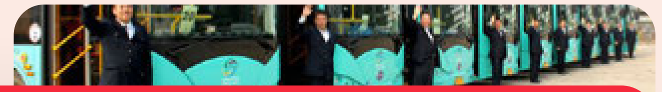
Eco-industrial parks are transforming the Vietnamese industrial sector

The Vietnamese government set up numerous industrial parks across the country, with the first established in 1991. Today, there are 326 in total. The implementation of just 12 industrial symbiosis opportunities could result in a ***70,000 tonne reduction in emissions, over 885,000 tonne reduction in freshwater use, and an 84,000 ton reduction in waste*** annually.[198] Eco-industrial parks have the potential to create jobs and improve working conditions.[199] In addition, they can provide an array of social infrastructures, such as vocational training centres and training centres for skills development, among other community services.[200]

4. DRIVE FORWARD CIRCULAR TRANSPORT

Grow countries are experiencing steep increases in demand for personal mobility and freight to serve economic expansion and rising consumption. For example, much of the urban expansion recently experienced in countries such as Mexico and Brazil took place in smaller cities with limited capacity to manage urbanisation and that are disconnected from major cities. Insufficient urban planning also drives environmentally unsustainable and costly mobility patterns,[201] especially personal vehicle dependency. Emissions are set to swell due to increases in vehicle sales across ASEAN and African countries: China and India alone are expected to account for nearly one-third of global passenger car-related CO_2 emissions by 2050.[202] Well-integrated public transportation networks will be essential in meeting the mobility demands of growing populations, yet they can often take decades to develop. More flexible solutions that rely on retrofitting vehicles and adapting roads for rapid transit can be a way of expanding access to mobility in an affordable and resource-efficient manner. A number of countries have already embedded circular economy principles in their mobility strategies to do just that. ***Grow* countries should focus on circular solution numbers: Thirteen, Fourteen, Fifteen and Sixteen (see page 39).**





Ankara continues to electrify old diesel buses

In Ankara, Turkey, diesel buses reaching their end-of-life are being given a new life as electric buses. The project promotes circular economy principles by extending the functional lifespan of 23 buses by the end of 2022. The buses are expected to gain an additional ***15 years of life, while using 25% less energy.*** The conversion is estimated to be approximately three times cheaper than purchasing a new EV bus.[203]

Shenzhen is set to be the first city in the world to electrify all public buses

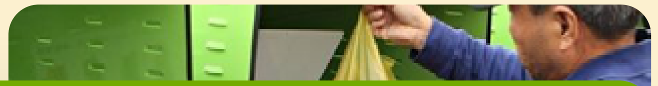
With the ambitious goal to cut emissions, reduce noise pollution and improve air quality, national- and city-level policy measures have created the enabling conditions for Shenzhen to deploy ***over 16,000 electric buses and more than 5,000 charging points***, incorporating new service models that incentivise component reuse and long-term value retention. This has allowed for Shenzhen to ***cut particulate matter by 4.3 million tonnes and carbon emissions by 6,000 tonnes***.[204]

SHIFT

Shift countries have largely achieved high levels of wellbeing, and can focus fully on minimising their impacts to the environment.

1. TRANSFORM THE FOOD SYSTEM

Shift counties are home to large-scale industrial agricultural systems, which deliver massive volumes of food—yet they also highly impact planetary boundaries such as GHG emissions, soil degradation and nutrient pollution.[205] Overconsumption of highly impactful foods, such as meat, a high dependence on imports, and soaring food waste are also signatures of most *Shift* countries. In the US, for example, almost 25% of all food supplied is wasted—going straight to landfill, incineration or down the drain. This is the equivalent of 90 billion meals, worth roughly 2% of GDP—all while one in eight US citizens are food insecure.[206] Most of this occurs at the points of retail and consumption. In the EU, over 50% of edible and inedible food waste comes from private households, the majority of which is 'avoidable' (around two-thirds), for example.[207] A circular food system can help *Shift* countries by introducing more regenerative models that build soil, sequester emissions and tackle food waste. This can be coupled by balancing caloric intake and investing in lower-impact sources of protein. These strategies combined can reduce the largest pressures on planetary boundary transgressions. ***Shift* countries should focus on circular solution numbers: One, Two, Three and Four (see page 33).**



Robotics and machine learning help scale regenerative agriculture

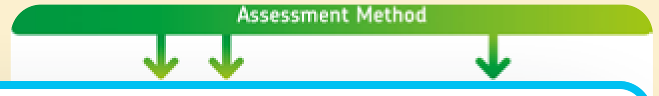
A wave of start-ups are combining biochemistry, genomics, machine learning and automated robotics technologies to develop new methods of precision agriculture, which ***can reduce the use of chemical inputs by up to 99%***. UK-based Small Robot Company provides solutions as a part of a farming-as-a-service model: robots that seed and care for individual plants in farmers' crops, ensuring each one gets the right amount of nutrients and water.[208] While still in an early phase, these technologies can support the scale up of regenerative agriculture practices such as multi cropping and cover cropping. Machine learning can ***help farmers anticipate problems, reduce waste and create adaptive strategies to maximise yields and profits over the growing season***.[209]

South Korea has transformed its food waste recovery process

In 1995, less than 2% of food waste was recycled—***a figure that increased to 95% by 2019 following a 2005 ban on landfilling food waste***.[210] This success is thanks to a comprehensive policy featuring a 'pay-per-use' scheme and bins for food waste disposal, which cost an average family around €6 per month to use.[211] This organic waste is then used to supplement animal feedstock and produce compost for urban farming initiatives.[212]

2. BUILD A CIRCULAR BUILT ENVIRONMENT

Historically, *Shift* countries have a high level of urbanisation as compared to the rest of the world, with 50 to 80% of the population already living in urban areas by the 1950s.[213] Today, almost three-quarters of the population in the EU lives in urban areas and more than 80% in the US and UK. However, population growth, urbanisation and growing affluence are driving an expansion of the built environment outside of highly compact urban areas into suburbs and countryside. Some key factors here are the increase of single households, as well as people buying bigger homes outside of highly dense urban areas, where costs are lower and floor space is greater.[214] This phenomenon is characterised by high personal vehicle dependency and bigger floor space on average, and is a major driver of adverse environmental consequences, such as landscape fragmentation, biodiversity loss, water, air and noise pollution.[215] Decreasing household size perversely drives up new housing demand. Smaller household size means lower efficiency, increased construction and increased land use—all of which add up to much more resource use and environmental impact. ***Shift* countries should focus on circular solution numbers: Five, Six, Seven and Eight (see page 35).**



Low-carbon materials, circular design and efficient manufacturing drives down impact

International architecture collective Superuse Studios tackles each stage of the construction process, with a focus on harvesting and reusing construction materials in its circular designs,[216] while UK-based Premier Modular specialises in fast-tracked and sustainable development of modular buildings.[217] Also based in the UK, TopHat Homes creates houses with significantly less embodied carbon: their homes ***save 61,000 kilograms of CO_2 over the life of a house, which is just 45% of the CO_2 produced by a traditional home***.[218]

The Dutch Environmental Performance of Buildings (MPG) method takes a lifecycle approach to prioritising sustainability

The Dutch government has the ambition to halve virgin material consumption by 2030[219]—necessitating an approach that minimises buildings' impacts across their entire lifecycles. Most regulations in the EU and beyond focus on the energy consumption of a building during its use phase, but the MPG ***brings the environmental impact of the materials used into scope.*** As such, it addresses the issue that as buildings become more energy-efficient, the climate impact of the materials they contain increases as a share of the buildings' total lifecycle impact.[220] In this way, the MPG addresses certain tradeoffs: that more energy-efficient buildings may come with a higher carbon footprint in terms of their materials.

3. ACHIEVE CIRCULAR MANUFACTURED GOODS AND CONSUMABLES

Since the development of a solid industrial economy in the late 19th and 20th centuries, *Shift* countries have become more service-oriented.[221] The ensuing process of 'deindustrialisation' resulted in offshoring many industrial and manufacturing activities—particularly the most energy- and material-intensive—to *Grow* countries, where social and environmental regulations are often laxer and less enforced. Despite this transition, the material footprint of consumption in *Shift* countries is more than 13 times higher than low-income countries.[222] Essentially, *Shift* countries have increased their reliance on the extraction and processing of materials from elsewhere in the world to fuel their excessive consumption of products such as textiles,[223] plastics[224] and electronics.[225] And inefficient practices prevail: many electronics have lifetimes that are 2.3 years shorter than their designed or desired lifetimes. Currently, the average EU citizen consumes 18 kilograms of electrical and electronic products per year—a high rate compounded by planned obsolescence and the lack of repairable designs. *Shift* countries should focus on drastically reducing material consumption and maximising the lifetime of impactful products. Regarding production processes: domestically, the focus should be on investing in cleaner, low-carbon and material-efficient technologies that reduce the environmental footprint of production activities. *Shift* countries should engage in technology- and knowledge-transfers, as well as providing access to finance to allow for the reduction of the environmental impacts of the international supply chains they rely on. ***Shift* countries should focus on circular solution numbers: Nine, Ten, Eleven and Twelve (see page 37).**

France launches a repairability rating for consumer electronics

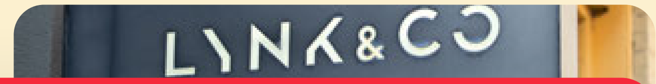
Released in 2021, the index will be further expanded to include durability criteria in 2024.[226] The rating has received positive public support, and is a crucial step in supporting France's objective to extend product lifetimes, mirroring the US *Right to Repair* bill and the EU *Sustainable Products Initiative*. Already, consumers are using the index to aid their purchasing decisions: around ***two-thirds of the shoppers provided with the ratings found it helpful for making choices***, suggesting that it could already be having a positive impact on consumer behaviour.[227]

IKEA commits to transforming its entire value-chain

IKEA has committed to becoming circular by 2030, taking a holistic approach to transform its entire supply chain while improving working conditions. It aims to use only renewable or recycled materials in its products: currently, ***55.8% of the materials it sources are renewable, while 17.3% are recycled.*** IKEA aims to provide circular product offerings by giving customers access to solutions and services that keep products in use, including a care and repair range, buyback and resell options, a circular hub, and the opportunity to purchase second-hand—with a furniture rental service being explored.[228 229]

4. DRIVE FORWARD CIRCULAR TRANSPORT

Shift countries have many systemic inefficiencies when it comes to transport and mobility, such as low utilisation and excessive vehicle weight. Although exact statistics vary from country to country, generally, private car ownership and use are very high, as is oil use per capita. In terms of air travel, the richest half of the world (high and upper-middle income countries) is responsible for 90% of aviation emissions.[230] Circular strategies should focus on avoiding or reducing the need to travel by cutting private vehicle use, especially those with combustion engines, designing car-free cities, and promoting rail over short-haul flights. Similarly, switching to more active and energy-efficient modes is imperative. This can be incentivised by investing in clean, reliable and affordable public transport while incentivising active transport, making lightweight shared electric vehicles one of the last options. ***Shift* countries should focus on circular solution numbers: Thirteen, Fourteen, Fifteen and Sixteen (see page 39).**



Dutch cycling culture emerged in response to resource scarcity

Enabled by safety concerns and an energy crisis in the 1970s, the Netherlands abolished major urban highway projects, and started prioritising policies that promote safe, healthy and clean mobility along with vibrant street life.[231] In the Netherlands today, 27% of all trips are made by bike—and with 17 million inhabitants, the country boasts ***23 million bikes***. Cycling benefits both physical and mental health, increases social interaction, allows for residents to cut transport costs and improves air quality.[232] Recent estimates showed that if everyone world-wide cycled as much as the Dutch, ***global emissions would drop by 686 million tonnes of CO_2 per year***.[233]

Lynk & Co offers a true opportunity for car sharing

With its flexible mobility memberships, Lynk & Co successfully turns mobility into a service. Its subscriptions and car-sharing platform offers a more sustainable alternative to traditional car ownership. Empowering customers to share their cars improves vehicle utilisation and makes better use of limited urban space. In 2021, Lynk & Co ***delivered 7,500 cars with almost 1,000 borrowers and lenders*** using the car-sharing platform. Among other sustainability actions, Lynk & Co dominantly focuses on encouraging sustainable car use, creating mobility inclusion, circulating materials and developing sustainable and electric cars.[234]

5

TAKE ACTION

NEXT STEPS FOR BUSINESSES, CITIES AND COUNTRIES

This report has focused on the important role that materials have on two deeply intertwined systems: people and planet. Enacting a global circular economy must be framed within the higher goal of bringing human activity within ecological ceilings and above social minimums. This analysis demonstrates how circular material management—doing more with less, using longer, and closing the loop—is an effective strategy to achieve this goal. A global transition to a circular economy means that we could deliver people's needs with just 70% of the current material demand, while bringing human activity back within the safe limits of the planet. Yet bringing about this systemic change will not only require a deep, large-scale transformation of consumption and production patterns, but an economy that is oriented towards new principles altogether. This final chapter provides three key goals to rally behind, and clear actions for policy makers and business leaders.

Delivering a good quality of life to a growing and dynamic population while respecting the limits of our planet will require a fundamental transformation of how we use material resources to fulfil needs. This report has identified four global systems where this transformation needs to happen, and has illustrated 16 bold solutions to deliver that change. But what is also needed is a shared vision that unites us towards a common purpose. We propose three key priorities to guide the implementation of a circular economy that will necessitate bold business strategies and institutional reform to fulfil the higher goal of wellbeing within boundaries. Without *reduction, regeneration and redistribution,* the circular economy is just an empty promise.[235]

REDUCE: FROM EFFICIENCY TO SUFFICIENCY, RESILIENCE AND ADAPTIVENESS

The economy is embedded in nature and nature has limits. We must, therefore, also prioritise the efficient transformation of materials into societal benefits. This means that a circular economy must push for lifestyles that shift away from overconsumption—and towards ones that invest in systems that support human thriving while systematically reducing waste and pollution, and use materials more efficiently.

ACTIONS FOR POLICY MAKERS

Prioritise wellbeing as a primary indicator of economic progress and incorporate wellbeing indicators in the policy making process. Furthermore, countries can establish consumption-based footprint reduction targets that aim to bring production and consumption within sustainable limits. Countries including Scotland, New Zealand, Iceland, Wales and Finland have begun to adopt wellbeing indicators in recent years.[236] Meanwhile, national governments can set a baseline for their material footprint and level of circularity using the *Circularity Gap Report* methodology, and follow Sweden's example by introducing the first consumption-based carbon footprint reduction target.[237 238]

ACTIONS FOR BUSINESS LEADERS

Explore a wide range of sufficiency-based business strategies that expand the value that your business can extend to your customers. Such strategies could include product lifetime extension services such as repair, customisation, or exchanges for products and services that better match customer needs. Simultaneously, transform your operations to optimise the resource efficiency of your products and production processes, and expand your capacity to repair and remanufacture goods that are already in use.[239] Follow the example of IKEA, which has set an ambitious circularity target and is working to transform its offerings and internal operations.[240]

REGENERATE: FROM EXTRACTION TO REGENERATION

The Earth's regenerative capacity is the cornerstone of all forms of life and a gift for human development. Regenerative systems support so many elements of human life, from nutrition and materials to the production of clean air and water. We must also respect and support its capacity to regenerate, by minimising pollution, protecting ecosystems, building soil health and strengthening biodiversity, for example. Many regenerative solutions already exist today that give us tremendous hope that we can move humanity from being net-negative to net-positive on Earth's life support system.

ACTIONS FOR POLICY MAKERS

Create financial incentives based on the inclusion of environmental impacts in the cost of goods and services. One well known example is the Ex'tax model, which proposes to shift the tax burden from labour to pollution, waste and natural resource depletion.[241 242] Governments can systematically measure and monitor natural capital and adjust tax incentives and subsidies to better support decarbonisation and natural resource management, ensuring that the regenerative capacity of its territories and natural assets are enhanced, not degraded.[243 244]

ACTIONS FOR BUSINESS LEADERS

Move away from non-renewable materials and practices that deplete ecosystems, and restructure your business models to actively strengthen the regenerative capacity of both people and planet. Follow the example of Patagonia, which has sourced many of its materials from regenerative farms while directly supporting, empowering and promoting the work of smallholder farmers.[245]

REDISTRIBUTE: FROM ACCUMULATION TO DISTRIBUTION

There is currently enough wealth and materials in the world to provide a good quality of life to every single human being on this planet.[246] The challenge is ensuring that we can distribute the access to materials to an increasingly expanding group of people, requiring redistribution, different lifestyles, better technologies and social innovations.[247] By moving away from ownership and accumulation and towards models of access that distribute resources more equally, we can move towards a system that provides high-quality services to all.

ACTIONS FOR POLICY MAKERS

Governments can invest in the commons: from public transport, parks and nature reserves, to public housing and renewable energy infrastructure, to healthcare and social services.[248] A strong backbone of public infrastructure and services means that everyone can have equal access to high-quality goods and services to meet their daily needs.

Governments can also steer the transition to a circular economy by enabling a just transition from inherently linear industries—like the fossil fuel industry—towards inherently circular industries like repair and waste management.[249] [250] Practical examples of existing policy tools range from energy taxes to carbon pricing.[251] These should be scaled to accelerate ongoing structural and distributional shifts, mirroring examples such as the use of carbon dividends[252] in Switzerland[253] and Canada.[254]

ACTIONS FOR BUSINESS LEADERS

Move towards service-based business models that deliver all the essential services that customers want. Manage the flow of goods and materials with circular production processes such as remanufacturing, repurposing and repairing. Leverage digital technologies to enable Product-as-a-Service (PaaS) such as TagItSmart, which has developed smart tags that allow manufacturers, consumers and recyclers to track every step of a product's lifecycle, and provides information on how to ensure circularity.[255]

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