THE CIRCULARITY GAP REPORT

2021

Solutions for a linear world that consumes over 100 billion tonnes of materials and has warmed by 1-degree

CIRCLE ECONOMY

BEHIND THE COVER

The image shows the ripple effects of even the smallest of actions: while a single piece of gum clinging to a wall is trivial, the accumulation of billions has a massive impact. The same can be said for our individual ecological footprints, which have merged to spark a climate emergency. This image reminds us that the power to enact change is within all of us and that we are even more powerful if we come together. Collaborative circular climate action is within our reach.

WHO WE ARE

We work to accelerate the transition to a circular economy. As an impact organisation, we identify opportunities to turn circular economy principles into practical reality.

With nature as our mentor, we combine practical insights with scalable responses to humanity's greatest challenges.

Our vision is economic, social and environmental prosperity, without compromising the future of our planet.

Our mission is to connect and empower a global community in business, cities and governments to create the conditions for systemic transformation.

The Platform for Accelerating the Circular Economy (PACE): This report is published as part of the Platform for Accelerating the Circular Economy (PACE). PACE is a public-private collaboration mechanism and project accelerator dedicated to bringing about the circular economy at speed and scale. It brings together a coalition of more than 70 leaders and is co chaired by the heads of Royal Philips and the Global Environment Facility. It was initiated at the World Economic Forum and is currently hosted by the World Resources Institute.

IN SUPPORT OF THE *CIRCULARITY GAP REPORT*

STIENTJE VAN VELDHOVEN
Minister for the Environment, Netherlands

'The *Circularity Gap Reports* show the circular economy's enormous emission mitigation potential and key role in achieving our climate goals, as well as the need for national and global action. We need systemic change in how we use our resources, that goes beyond recycling and incorporates new business models, design and metrics. In order to fully understand our progress and identify specific action areas, we need a variety of coordinated metrics, including the *Circularity Gap Report*.'

BORGE BRENDE
President of the World Economic Forum

'The *Circularity Gap Report* offers not only a sober warning of the danger of climate inaction, but a clear map forward. Collaborative effort among government, business and civil society is necessary to scale the circular economy and drive down emissions. Only through collective investment in and commitment to circular practices can we shape a more sustainable, resilient future.'

FRANS VAN HOUTEN
CEO of Royal Philips & Co-Chair of PACE

'The *Circularity Gap Report 2021* provides a clear and alarming view on the insufficient progress towards a circular economy. Decoupling economic growth from resource use is critical to mitigate climate change. I urge the global community to step up efforts and to adopt circular practices with urgency.'

KATE RAWORTH
Author of the book Doughnut Economics & Senior Visiting Research Associate at ECI, University of Oxford

'If humanity is to meet the needs of all people within the means of this delicately balanced living planet, it is essential for the linear, degenerative industrial systems that we have inherited to become circular and regenerative by design. Last century's economic theories, models and policies were not designed to bring about this transformation: it is a challenge that belongs to our own generation. The *Circularity Gap Report 2021* plays a key role here by providing highly valuable analysis, data, guidance and examples that build the necessary momentum for circularity in this critical decade ahead.'

CARLOS EDUARDO CORREA
Minister of the Environment & Sustainable Development ,Colombia

'The National Strategy for Circular Economy involves the joint work of producers, suppliers, consumers and other actors in production and consumption systems to develop and implement new business models that incorporate waste management, efficient handling of materials and changes in the lifestyles of citizens.'

CARLOS MANUEL RODRIGUEZ
CEO of 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. This year's report articulates the critical linkages between the circular economy and climate change, connecting two major priority areas. With countries currently working to build back better from the covid-19 pandemic and submit updated climate pledges in the 2021 COP26, this report's insights are particularly timely.'

DIMITRI DEVREEZE
Co-CEO of Royal DSM

'More than half of all greenhouse gas emissions are caused by the use of our planet's resources, such as minerals, metals and biomass. If the world economy is to be successfully sustainable and resilient, then circularity must be built in from the start as we endeavor to design out waste and pollution. This report rightly stresses the role of business and how important it is that we address the interconnected issues of climate change and resource use together, hand-in-hand.'

MARTIN FRICK
Senior Director of the United Nations Framework Convention on Climate Change (UNFCCC) & Deputy to the Special Envoy for the UN Food System Summit 2021

'For billions of years, our home planet operated in a perfect cycle: new life emerged from the same carbon that existed as life before. We are running out of time to restore this balance and achieve carbon neutrality. For that, we need to eliminate waste and create products that last, can be repaired and ultimately be transformed into new products.'

GABRIEL QUIJANDRIA
Minister of the Environment, Peru

'The economic recovery the world is facing represents a unique opportunity to build back better. The circular economy offers an integrated approach that reinforces the need to incorporate collaborative and low-carbon economic models.
The *Circularity Gap Report* and its close link with emissions reduction targets is not only necessary but essential if we want to rebuild sustainable, harmonious economies that guarantee the well-being of people.'

PAVAN SUKHDEV
President of WWF International

'The *Circularity Gap Report 2021* shines a light on the elephant in the room: that we can only achieve the goals of the Paris Agreement by managing and consuming materials in a more circular way. This report gives all nations practical and innovative policy guidance and strategies that can be included in their updated Nationally Determined Contributions.'

ANDRE HOFFMANN
Environmentalist, Philanthropist & Vice-Chairman of Roche

'Climate change is undeniably the biggest market failure of the 20th century. Our current system, based on the assumption of infinite growth on a finite planet is both obsolete and incomplete. The time has come to take a step back and rethink human activity on our planet. This report offers a toolkit to equip governments, businesses, academia and civil society at large to implement sustainable and circular policies.'

JYRKI KATAINEN
President of the Finnish
Innovation Fund Sitra

'As we begin to recover from a difficult year, we now have a chance to solve multiple crises at once, from resource scarcity to biodiversity loss and climate change. The *Circularity Gap Report 2021* presents an important contribution for how we can tackle both overconsumption and climate change through smarter management of the world's resources. For the upcoming COP26, the circular economy needs to be at the heart of the conference.'

FEIKE SIJBESMA
Honorary Chairman
of Royal DSM

'In these unprecedented times, a compass that helps businesses steer action and sets realistic targets to make our economy more circular is crucial. Doubling our global circularity rate is by no means easy, but with the support of the *Circularity Gap Report*, we can start measuring and monitoring our progress to redesign our value chains and treat waste as a renewable input.'

JANEZ POTOČNIK
Former European Commissioner
for the Environment &
Co-Chair of the UNEP
International Resource Panel

'Circular economy is becoming a widely recognised and accepted concept. But to make it real, as the *Report* shows, will require many efforts and a system change, also in our understanding of the circular economy and its relation to climate change. We need to embrace dematerialisation, rethink concepts of ownership and move from resource efficiency to resource sufficiency.'

PAUL KLYMENKO
CEO of Planet Ark

'When will we know that we are truly sustainable? I have come to the conclusion that this will occur when we have transitioned to a carbon neutral circular economy. Zero-carbon energy is a crucial part of the transformation, but it is not enough. The *Circularity Gap Report 2021* quantifies the essential role that a more circular economy will have in meeting global societal needs, without exceeding our available carbon budget. In a time of post-covid-19 economic reconstruction, it highlights the way forward in building sustainable society.'

EBERHARD BRANDES
CEO of WWF Germany

'To fight climate breakdown our system needs a major overhaul. A truly circular economy mimics nature and can ensure the restoration of our environment and reconnect humans with the natural world. In order to achieve this, we need a better understanding of how circularity can live up to its potential. The *Circularity Gap Report 2021* provides a decisive first step in that direction.'

ABOUT THE *CIRCULARITY GAP REPORT*

The first *Circularity Gap Report* presented the alarming statistic that our world economy was only 9.1% circular, leaving a massive Circularity Gap. The Report, launched in January 2018 during the World Economic Forum in Davos, has since been updated and published on an annual basis. This iteration marks the fourth edition. The Reports provide high-level insights into the global metabolism and key levers for transitioning to circularity, as well as supporting decision-makers by communicating metrics and better measurement of the circular economy to guide their action. Yet, updating the Circularity Metric is not feasible on an annual basis due to the limited availability of data. Since 2020, the *Circularity Gap Reporting Initiative* also explores how data to inform stakeholder decision-making can best be collected, communicated and made globally accessible. For updates and contact details we encourage you to visit our website: circularity-gap.world

EXECUTIVE **SUMMARY**

Enacted globally, a circular economy can close the Emissions Gap. This study shows that combining the twin agendas of circular economy and climate mitigation gets us on a path to a well below 2-degree world by 2032. In adopting a roadmap packed with circular strategies, we can pave the way for the systemic transformations needed to course-correct the global economy—going far beyond the limitations of current policy and national climate pledges. The current pledges bring us over 15% of the way; the circular economy delivers the other 85%. If the coming decade is the decisive one for humanity's future on earth, then 2021 is the year to ramp up our efforts to bring our goals into realistic reach and prevent the worst effects of climate breakdown. Our current economy is only 8.6% circular, leaving a massive Circularity Gap. The good news is that we only need to close the Gap by a further 8.4%—or roughly double the current global figure of 8.6%—to get there.

However, circularity in our 8.6% world is trending down, not up. Whilst the *Circularity Gap Report 2020* revealed that the global economy was only 8.6% circular, just two years earlier it was 9.1%—things have got worse. So, although we only need to almost double circularity to close the Emissions Gap by 2032, the globe remains shackled by outdated 'take-make-waste' practices. Humanity has now also breached two major milestones: the world is consuming 100 billion tonnes (Gt) of materials and it is 1-degree warmer. Due to data unavailability, the Circularity Metric was not updated for this year, yet all indicators point to the reality that the globe remains engulfed by the linear economy and its unsustainable practices, processes and behaviours. However, when the covid-19 pandemic swept the world in 2020, we saw empty skies and roads, as entire populations were placed under national lockdown. Temporary as the resulting drop in annual global emissions may be, it has shown us what is possible: from governments to citizens, we are now armed with the knowledge that transformational change is doable.

And time is running out. Even if all countries that pledged climate action as part of the Paris Agreement fulfil their emissions-cutting promises, the rise in temperatures is still forecast to hit 3.2-degrees this century.[1] Global warming shows no signs of slowing and the reality is that certain vulnerable cities and countries will face catastrophes that threaten much of the population.[2] And in a cruel irony, lower-income nations who contribute the fewest emissions are also most vulnerable to the impacts of climate breakdown. We are already past the point of minor amends. Course-correction will require a major, transformational gear-change in systemic thinking. This big shift is the circular economy.

Climate breakdown demands more than current climate pledges can deliver. This *Circularity Gap Report* quantitatively maps how greenhouse gas (GHG) emissions and resources move through our economy, from extraction to end-of-use. What we find is that material handling and use[3] accounts for the vast majority (70%) of GHGs[4] emitted. This proves how vital it is to look beyond the narrow energy focus of the current climate pledges to make a real impact. By applying circular strategies at the intersection of materials and emissions hotspots, we can increase value-retention and cut excessive consumption, thereby slashing GHGs. This is how narrowing the Circularity Gap, in turn, closes the Emissions Gap.

A circular economy can satisfy societal needs and wants by doing more with less. We need materials to fuel our lifestyles; this produces emissions. However, the circular economy ensures that with less material input and fewer emissions, we can still deliver the same, or better, output. Through smart strategies and reduced material consumption, we find that the circular economy has the power to shrink global GHG emissions by **39%** and cut virgin resource use by **28%**. Within this, the societal need of Housing delivers half of the impact, while Mobility and Nutrition account for much of the rest. To get to our end goal of a socially just and ecologically safe space[5], we need intelligent resource management to stem consumption and cut emissions, so their impact falls within planetary boundaries.

Countries: another year lost in the race to get it right. No country is firmly on the path to achieving our goal of a socially just and ecologically safe space.[6] They do, though, wield power—especially now. Economic stimulus packages to pull countries out of their post-pandemic slumps are rolling out and the crunch UN summit, the COP26, has been postponed to Autumn 2021. This means we have lost valuable time to accelerate action, especially as the majority of countries were not on track to update their already 'woefully inadequate'[7] climate pledges by the end of 2020.[8] To guide this process, we examine the common challenges and opportunities for three overarching country profiles and present blueprints for action tailored to each context and set of unique climate pledges. For countries, this truly is their time.

This is the real year of truth. With 2020 struck by covid-19, lockdowns around the globe not only contributed to a sharp decline in emissions, but also accelerated decommissioning of fossil assets.[9] Despite this progress being unintended and arguably temporary, it can teach us valuable lessons to translate into structural change—and now, the world seems to be listening. Emboldened by universal uptake of renewables, governments are making decisions that will positively shape our climate future. The events of 2020 also served to hold a magnifying glass to the flaws in our system—an unsustainably linear system reliant on the exploitation of nature and people—and there is no environmental justice, without social justice. Destructive and instructive as the pandemic proved, it is ultimately climate breakdown that will be the biggest global health-threat of the century.[10] In a time of building back better, the circular economy has never been more relevant.

BRIDGE THE GAPS THROUGH LEADERSHIP AND ACTION

1. **Build a coalition for action that is both diverse and inclusive.** Bringing a diverse community of businesses, governments, NGOs and academics together to boost capacity and capability will accelerate collective action toward circularity, serving the betterment of societal needs and global ecological health. This will enable action toward reaching the Paris Agreement's goals before it's too late and begin to build the necessary infrastructure and alliances to collect, retrieve and share circular knowledge on a global level.

2. **Integrate plans for leveraging the circular economy into national climate pledges.** Circular strategies suited to different country profiles can get nations back on a well below 2-degree pathway. Integrating tailored plans can also enable better goal-setting, measurement and benchmarking for countries in the NDC revision process, and ensure that each nation can address global issues in a way that aligns to their local context, incentives and mandates. This can also support key industries that need to shoulder the change.

3. **Create an enabling environment to facilitate the circular transition.** Market and regulatory failures that inhibit the enabling conditions needed for circular initiatives to reach scale can be addressed by policymakers; including steering away from financial models that only support linear projects. Capital must also be mobilised toward circular initiatives to unlock the potential of 'building back better'.

Photo by Ivan Bandura

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1. INTRODUCTION

Humanity is living beyond the means of Planet Earth. Our use of finite resources continues to spiral upward; greenhouse gas (GHG) emissions continue to disperse into the air. The earth continues to heat up. It is becoming clear that we're running out of time to course-correct. Yet, in light of rapid global change, since the covid-19 pandemic struck in March 2020, the world is finally waking up. Covid-19 has disrupted business-as-usual. Climate breakdown, resource scarcity and ecological collapse have moved from the horizon to the now, as shocks and crises have exposed the fragility of our current, linear system. Calls to 'build back better' with a green recovery—thereby mending the impacts of the pandemic in a way that also addresses climate breakdown—are strong. This 2021 edition of the *Circularity Gap Report* quantifies the huge synergistic and transformational power the circular economy holds for the climate mitigation agenda—just in time for this year's crunch UN summit that will pave our future climate pathways. In getting smarter about our global resource use and consumption, we can close the globe's widening Circularity and Emissions Gaps. Closing both Gaps together will put us firmly back on a path toward the goal of the Paris Agreement: limiting warming to well below 2-degrees.

1 BILLION TONNES, 1-DEGREE GLOBAL WARMING

In our 2020 *Circularity Gap Report*, we recorded a bleak, first-time milestone: 100 billion tonnes of materials enter the global economy every year. These materials are funnelled through our economy and allow us to continue our way of life. However, of this massive amount, only 8.6% is cycled back into the economy. For the past 200 years at least, the hallmark of global consumption and resource use can be aptly described as 'take-make-waste': a linear economy. Whilst this model has enabled vast growth, a defining characteristic has unfortunately been huge overconsumption to the detriment of planetary health. Furthermore, despite bringing prosperity to some of the population, some of the time, global social equity has also been negatively impacted. In many parts of the world, linear over-consumption has effectively become the norm, whilst elsewhere, minimum living standards are not even being reached.

In 2017, we passed another bleak milestone: the threshold of human activities causing 1-degree global warming.[11] In 2020, we reached 1.1-degrees.[12] To date, the last five years have broken successive weather records and—even if the current climate pledges, the Nationally Determined Contributions (NDCs), are followed—the global rise in temperatures is still forecast to hit 3.2-degrees this century.[13] This is an alarming number; the Intergovernmental Panel on Climate Change (IPCC) has warned that going beyond 1.5-degrees alone will increase the frequency and intensity of climate impacts. In a 3-degree warming situation, the globe risks being drowned by climate extremes such as floods, droughts and wildfires, all of which displace populations and increase food insecurity. Global GHG emissions reached record highs in 2018, and despite dips following lockdown-lifestyles due to covid-19, we are still far off track. This difference between 'where we are likely to be and where we need to be' has become known as the Emissions Gap.

FIVE YEARS SINCE THE PARIS AGREEMENT

There has been, however, globally coordinated action on climate breakdown. According to United Nations Climate Change, in 2015; 196 countries signed the Paris Agreement. Worldwide climate action was set out: mitigation of climate change by limiting the average global temperature rise this century to well below 2-degrees; support for lower-income nations and transparent reporting of climate goals. Things could only get better—or so was the presumption. It is now clear, though, that the blueprints mapped out for the globe in the form of national climate promises—NDCs—were never powerful enough to fulfil the Agreement's well below 2-degree goal. With a prevailing focus on renewable energy and an incremental focus on industries, they will not get us where we need to be. And in the five years that have passed since Paris, large gaps between promises and implementation have emerged. With every year of slow progress, the challenge grows. More extreme action is necessary. However, what should have been a pivotal moment for updating and strengthening the NDCs was missed: the COP26 in 2020 was cancelled and postponed to November 2021 due to the covid-19 pandemic. As a result, 2021 has become a pivotal year for climate action—the decisions we make this year will shape our future climate.

THE CIRCULAR ECONOMY AS A MEANS TO AN END

Society now finds itself at a historic economic and cultural crossroads. Do we continue to tweak and tamper with our broken linear model, cognisant of the consequences and liable by default? Or, do we pivot to a new model—such as the circular economy—with fresh minds and new tools to pursue a desirable and deliverable paradigm shift?

The circular economy holds the promise for systemic transformation of our society, as its core tenants design out waste and pollution, keep products and materials in use and regenerate natural systems.[14] However, the circular economy is also an action agenda with impact that extends beyond resource efficiency. As a multi-stakeholder model, its systems-thinking approach boosts capacity and capability to serve universal societal needs. This circular framework aligns with a vision of a more resource-aligned, people-centric future. But getting there will not be easy. A full circular transition calls for creative innovation in systems design and rigorous collaboration across and within value-chains, plus among multiple stakeholders. Change may be difficult, but it is necessary. Closing the Circularity Gap serves the higher objective of preventing further and accelerated environmental degradation and social inequality. In moving the globe toward an ecologically safe and socially just operating space for humankind, the circular economy is a critical pathway.[15]

In our analysis, we have found that the vast majority (70%) of emissions[16] are associated with material handling and use, demonstrating the clear and necessary role for circular economy strategies—which look to do more with less—in emissions reduction. The aim of this report is to provide a quantified link between the circular economy and climate mitigation agenda. We create an x-ray of global emissions to unpack the blinking lights of climate breakdown and locate where emissions-material hotspots are to be found in our economy. Building on this analysis, we set out both global and regional treatment plans to get us back on a well below 2-degree and circular path.

THE REAL YEAR OF TRUTH

2020 was struck by covid-19. The pandemic served to unite the global population in one sentiment: vulnerability—the vulnerability of our economy, of our environment and, ultimately, our future on earth.[17]

Calls for a green recovery in alignment with other global challenges have never been louder, and many see a rare opportunity like no other to build a resilient and low-carbon economic future. The circular economy, as a tangible way of achieving this vision, is now more relevant than ever.

Governments around the world are now making huge decisions that will shape our climate future. Firstly, as a result of the impacts of the pandemic, stimulus packages designed to pull us out of economic slumps mean governments are now making decisions on how to spend capital that could build back better and help set new goals for resilience and preparedness. Alternatively, in thrall to business-as-usual, they might instead leave us vulnerable, divided and susceptible. These stimulus packages could, for example, drive a huge uptake in renewable energy, which in turn would spur jobs. *The 2020 Emissions Gap report*, which calls for a green recovery, notes that around one-quarter of G20 members have dedicated shares of their spending, up to 3% of GDP, to low-carbon measures. For most others, spending has mostly been high-carbon or neutral.[18] Moreover, high hopes were being pinned by many on the COP26 UN summit supposed to take place in 2020, but rescheduled for Autumn 2021. Therefore, how countries move forward with their NDCs following the events of the past year—and how governments take action to implement their pledges—can and will shape the future of our climate for years to come.

A GLOBAL COALITION TOWARD DECARBONISATION?

The encouraging announcements from a number of countries calling for a green recovery in 2020 largely placed net-zero at the heart of action. Capital funds enforced significant divestments in the fossil industry.[19] So, are we seeing a global coalition toward decarbonisation? Sweden, the UK, France, Denmark, New Zealand, Hungary, China (which alone is responsible for 28% of global emissions), South Korea and Japan all have a net-zero target in place by law (albeit with different goal years). The recent election success of the Biden administration means the US will also rejoin the Paris Agreement and the new President promises to delivery net-zero emissions by 2050. Also, the European Green Deal has stated the ambition to be the first zero emissions continent by 2050 with a specific Circular Economy Action Plan as part of the roadmap. These recent emissions-reduction pledges, especially from the US and China, could potentially bring the world on a 2.1-degree pathway—according to recent estimates—if backed up with long-term action.We see momentum building. There are also many facilitating factors that make now a perfect time for action.[20] Renewable energy prices are dropping and if China and the EU continue to invest in wind, solar and batteries, they will fall further, while climate legislation may see the price of carbon-intensive materials rise.

THE POWER OF COUNTRIES

In making these future-shaping decisions, countries clearly have potential—and potential is power. From determining the focus of each country's NDC to funnelling capital toward future-oriented innovation, their role is massive. The NDCs now largely focus on energy efficiency and renewable energy, as well as curbing emissions from land use, land-use change and forestry. Looking ahead, circular economy strategies could be employed to support countries in identifying and developing mitigation options which go beyond current pledges, both in scope and ambition.
But different countries should take different paths. Different country profiles, although operating under similar overarching global trends, need to problem-solve very differently and the implementation of circular strategies will, therefore, differ between localities. Higher-income nations, that are responsible for the overwhelming majority of historical emissions, need to shift away from current linear paradigms that fuel overconsumption of the earth's resources—and fast. Economies that are still growing, or rapidly building, can navigate away from linearity now so that they don't face the same challenges in the future. With this in mind, this *Circularity Gap Report* tailors its global roadmap for different country profiles in Chapter Six to deliver actionable roadmaps. In Chapter Seven, we dive into the on-the-ground barriers to the circular transition, and recommend points of change for countries' NDCs. With the pandemic, we have lost a valuable year to accelerate action. But the urgency is now more apparent and the collective attitude more accepting of fundamental change. This report can guide countries in this process of making the course-correction we so desperately need. For countries, this truly is their time.

SAME GLOBAL NEEDS, RADICALLY FEWER MATERIALS AND EMISSIONS

What this report will ultimately do is show the power of the circular economy to fulfil our global needs and wants, but with radically fewer materials and emissions. The circular economy ensures that with less input, we can deliver improved prosperity. This will require more than just a focus on renewable energy: it calls for transformational course-correction that not only encourages behavioural changes, but prompts a total overhaul of linear activities. In this report, we are also careful to examine ethical considerations and trade-offs that could potentially arise in the transition to circularity. The circular economy must not perpetuate the same mistakes of the linear economy, which relies on the continued exploitation of both people and planet. We therefore pinpoint the seven core societal needs and wants that guide our research: Housing, Nutrition, Mobility, Communications, Services, Consumables and Healthcare. Central to our proposition is ensuring that our roadmap for a well below 2-degree world is built upon scenarios that are resource efficient, but also people-centric; the impact of one circular strategy could have vastly different repercussions on communities in different localities and this must be taken into account. There is no environmental justice without social justice.

The Circularity Gap Report approach shows the potential benefits of circular economy solutions to trigger government and company action with 'what if' scenarios. Consider this when interpreting the figures we use in our roadmap (detailed in Chapter Four), such as 'cutting virgin resource use by 28%'. This is important because ours is not a dynamic modelling analysis (as used in the Emissions Gap Reports): material extraction and emissions are not forecasted to 2030 or 2050, nor do our interventions and scenarios account for technological or socio-economic trends occurring in that period.

AIMS OF THE *CIRCULARITY GAP REPORT* 2021

1. Illustrate and quantify the mutually reinforcing relationship of the circular economy and the climate mitigation agenda.
2. Demonstrate the power of circular economy strategies to close the Circularity Gap and the Emissions Gap and help us reach the goals of the Paris Agreement.
3. Accordingly, identify key interventions for impact, based on the needs of society, that are resource-smart and low-emission.
4. Identify how our scenarios can be tailored to national levels to inform goal-setting and NDC revision.
5. Identify key pathways for three distinct country profiles to transition towards the safe and just space.

Photo by Yogendra Singh

SEVEN SOCIETAL NEEDS & WANTS

HOUSING

The need that represents the largest resource and emissions footprint is for construction and maintenance of residential houses, especially in lower-income nations.

NUTRITION

Also with a large footprint is the need for nutrition, which includes agricultural products such as crops and livestock. Food products have short lifecycles in our economy, being consumed quickly after production.

MOBILITY

A considerable resource and emissions footprint is taken up by our need for mobility. In particular, two resource types are used: the materials to build transport technologies and vehicles like cars, trains and aeroplanes; plus, predominantly, the fossil fuels burned to power them.

CONSUMABLES

Consumables are a diverse and complex group of products—such as refrigerators, clothing, cleaning agents and paints—that generally have short to medium lifetimes. Textiles, including clothing, also consume different kinds of resources such as cotton, synthetic materials like polyester, dye pigments, and chemicals.

SERVICES

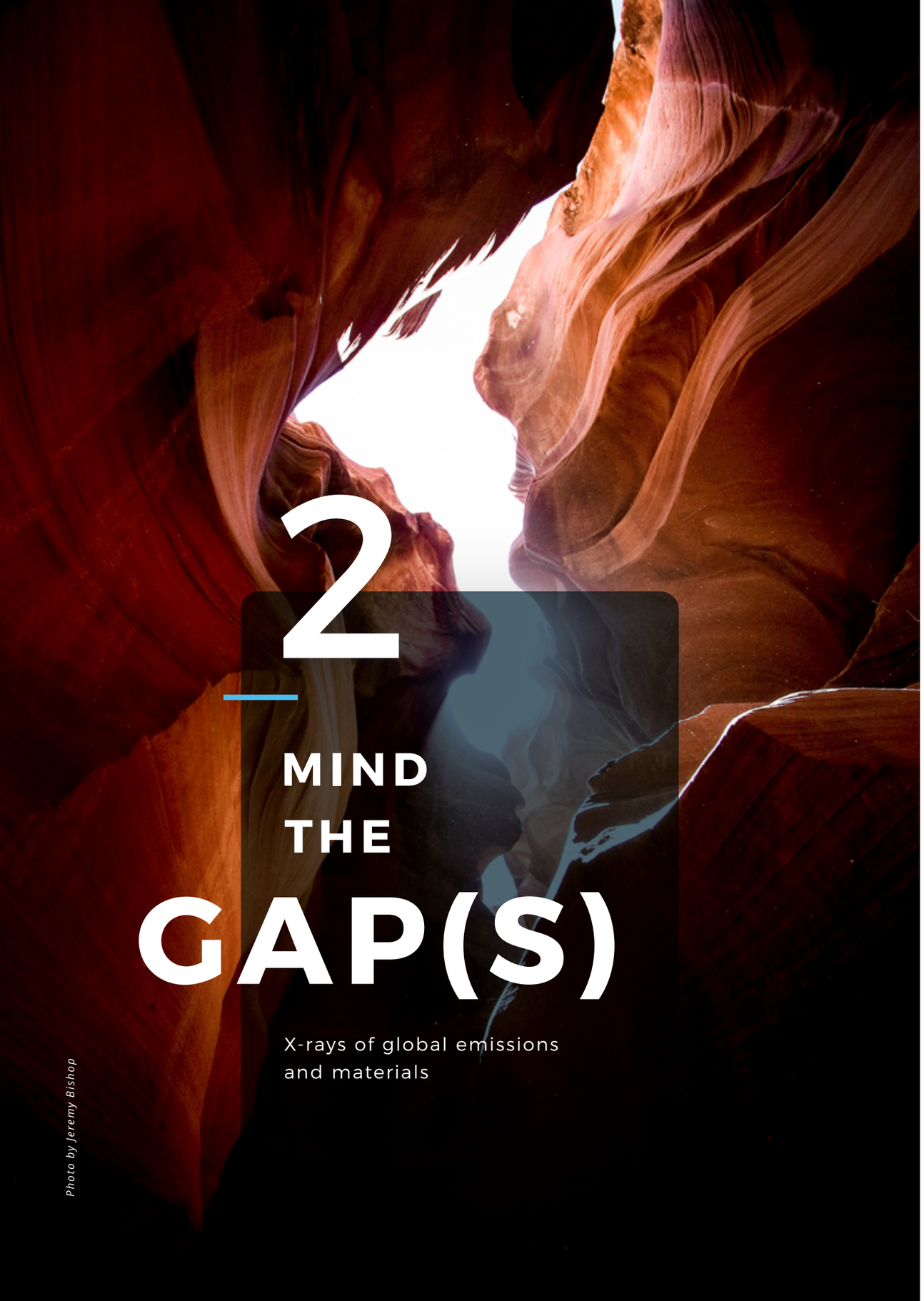
The delivery of services to society ranges from education and public services to commercial services like banking and insurance. The material and emissions footprint is modest in total and typically involves the use of professional equipment, office furniture, computers and other infrastructure.

HEALTHCARE

With an expanding, ageing and, on average, more prosperous population, healthcare services are increasing globally. Buildings aside, typical resource groups include use of capital equipment such as x-ray machines, pharmaceuticals, hospital outfittings (beds), disposables and homecare equipment.

COMMUNICATION

Communication is becoming an ever-more important aspect of today's society, provided by a mix of equipment and technology ranging from personal mobile devices to data centres. Increased connectivity is also an enabler of the circular economy, where digitisation can make physical products obsolete, or enable far better use of existing assets, including consumables, building stock or infrastructure.



2

MIND THE GAP(S)

X-rays of global emissions and materials

Photo by Jeremy Bishop

Circularity is in reverse: our 2020 report communicated that the global economy is 8.6% circular, while our 2018 edition reported 9.1%. Alongside our widening Circularity Gap, the world is heating up. In 2017, for the first time, humanity consumed more than 100 billion tonnes of materials and increased the mean global temperature by more than 1-degree above pre-industrial level.[21] We need to course-correct. Therefore, this year we—in a first for the *Circularity Gap Report*—have created an x-ray of how global greenhouse gas emissions flow along through different value-adding stages of the economy. By taking an approach to global resource use that considers both mass and carbon, we can consume fewer materials, increase value-retention and increase cycling back into the economy, whilst simultaneously slashing emissions. In the face of mounting urgency, the solutions we apply to our situation must also be multidimensional.

X-RAY OF OUR GLOBAL ECONOMY

In the first edition of the *Circularity Gap Report* released in 2018, we asked ourselves: how circular is the global economy today? Supplying an answer to that question, as well as insights into key global levers to move us toward circularity, are crucial for us to plan our path forward. Three consecutive reports have contributed to developing these insights, as well as bolstering metrics for circularity as a discipline. We now know how circular the globe is and what we need to do to close the Gap.

It soon became clear how the circular economy has to do more than look at material flows alone. In our 2019 report, we introduced the Mass-Value-Carbon (MVC) nexus, a concept that looks at how much greenhouse gas (GHG) emissions (Carbon) and value-created (Value) get distributed through meeting our key societal needs and wants with materials (Mass). Building on our MVC nexus concept and profoundly deepening our exploration, this report will scrutinise how global GHG emissions arise from the extraction, processing and use of resources. Following our signature style of providing one single visual that gives an overview of the entire global economy's material flows, we will now present one for global GHG emissions: our x-ray of global GHG emissions.

THE EMISSIONS **X-RAY** BEHIND GLOBAL SOCIETAL NEEDS

Energy carriers such as oil, gas, coal and fuelwood travel through the economy

Key points in the value-chain (from **Process** to **Provide**) where emissions embodied in energy carriers and materials shift and eventually switch

To satisfy all global needs and wants, we emitted 59.1 billion tonnes of GHGs in 2019, including land use, land-use change and forestry (LULUCF).[22] This is the amount that is dispersed into our atmosphere every year and it is the mammoth tonnage that we seek to strip back[23]. But first, we need to know where these emissions stem from to reduce them. Our emissions x-ray, Figure One, shows us how the vast majority of GHG emissions (70%) are ultimately generated through material handling and use (at the **Provide** level)—whether for the clothes we wear, the phones we own, or the meals we eat. In illustrating how 59.1 billion tonnes of emissions flow along and across global value-chains, Figure One allows us to gain a deeper understanding of the upstream drivers of those emissions. In doing so, the necessity for integrated policies that address embodied emissions becomes clear.[24 25]

Beginning from the left-hand side, we see how four types of resources—fossil fuels, minerals, ores and biomass—are extracted (**Take**) and put to use in the global economy. Fossil fuels are responsible for by far the most global embodied emissions (65%), with petroleum fueling much of the globe's transportation, plus coal and natural gas providing inputs for electricity, heat and industrial processes. The second-largest source of embodied emissions is the production of biomass through agricultural and forestry processes, with significant emissions (26%) related to LULUCF. This delivers us food products, timber and fuelwood, as well as fibres for the textiles industry. The extraction, basic processing and use of both ores and minerals (together with waste handling) have the smallest emissions contribution, in relative terms (8%), with calcination of cement kiln being the most emissions-intensive non-combustion process.

It is interesting to observe how the switch between the emissions related to materials and energy occurs. Notice that before energy carriers such as oil, gas, coal and fuelwood undergo transformation (**Process**) into refined materials, and energy and heat, they represent the majority of the emissions (70%); while, at this stage, materials are only responsible for 30%[26 27] (broken down into 23% material processing and 7% waste management and LULUCF). These materials for industry and construction then enter manufacturing and industrial processes in the form of plastic, rubber, iron, cement and wood products.

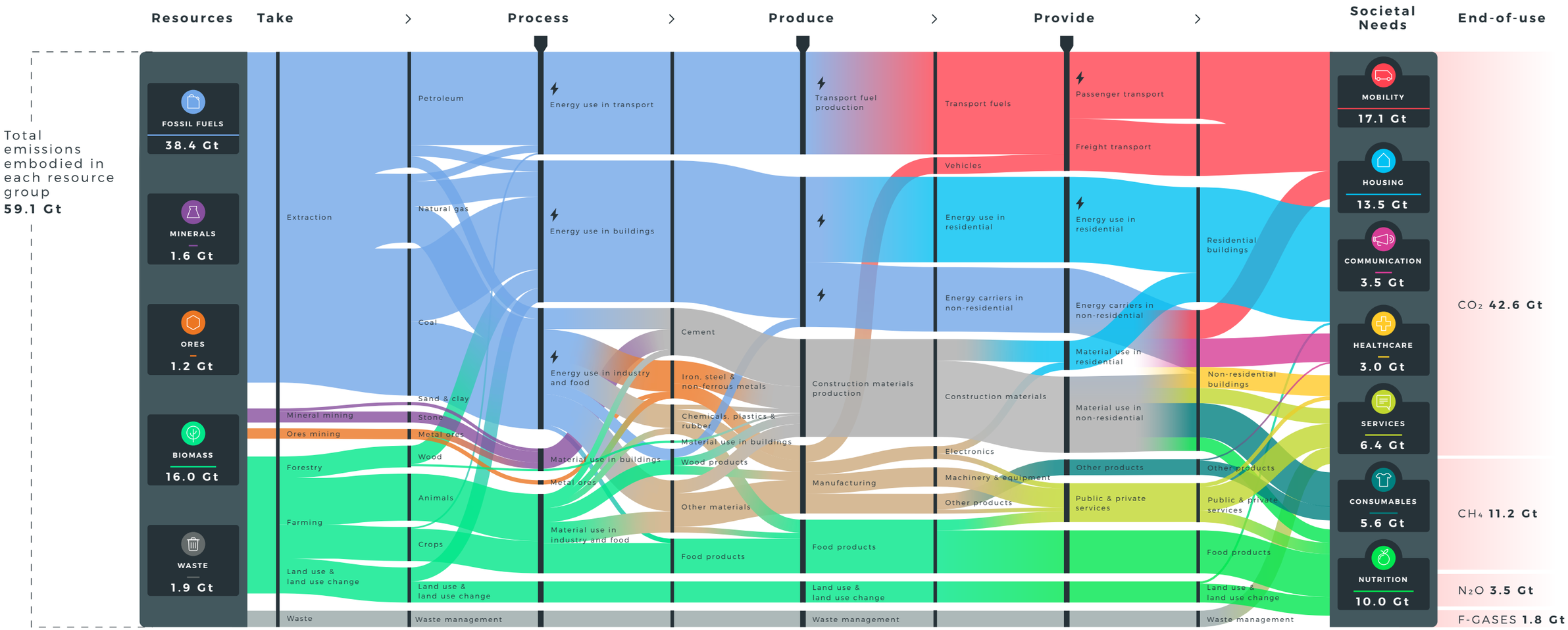


Figure One X-ray of global greenhouse gas emissions behind meeting key societal needs and wants in billion tonnes (Gt).

Added to these materials is process heat and electricity, as well as energy carriers such as oil derivatives, gas and coal.

They are then transformed (**Produce**) into products such as electronics, capital equipment, construction materials and food. At this point, the balance between emissions related to energy versus materials has shifted to be almost fifty-fifty. Materials together represent 51% of all emissions, while the energy used to heat and cool buildings, light our homes and workspaces, as well as the energy that is used for personal and freight transport, represents the remaining 49%. However, ultimately—at the point of final consumption (**Provide**)—both freight transport and the lighting, heating and cooling of non-residential buildings also serve material purposes: the emissions related to energy become 30% and materials, 70%. Now, a huge proportion of the emissions that were at first associated with energy carriers have gradually become embodied into finished goods and services which, in turn, satisfy the seven societal needs.

EMISSIONS-INTENSIVE HOUSING, MOBILITY AND NUTRITION

Providing **Mobility**, **Housing** and **Nutrition** to the world accounts for almost 70% of global emissions. **Mobility** leads the way with an emissions footprint of 17.1 billion tonnes. This is primarily the result of fossil fuel combustion across passenger and freight transport. The production of automobiles, trucks, trains and aeroplanes is relatively limited in emissions contributions. Responsible for the second-largest footprint is **Housing**, at 13.5 billion tonnes of emissions. **Housing's** hefty footprint comes down to the vast extraction, transport and construction activities it entails, as well as the energy used to light, heat and cool dwellings. Third in line is the provision of food for **Nutrition** with 10 billion tonnes of emissions. LULUCF associated with the production of food, but also fibres and clearing for expansion of urban centres, is responsible for about 4 billion tonnes of emissions (high uncertainty).

The remaining 30% of emissions flow into satisfying **Communications**, **Services**, **Consumables** and **Healthcare**. At 6.4 billion tonnes of emissions, **Services** is the biggest of the smaller needs. The footprint for service provision includes the buildings and energy required for educational institutions, museums and other public-service properties, as well as the material needs for their functioning. **Communication** is responsible for 3.5 billion tonnes of emissions. These largely fuel communication infrastructure as well data storage and communication devices. The broad group of **Consumables** accounts for 5.6 billion tonnes of emissions for the production of clothing, personal health products and consumer electronics. With the smallest footprint of all the societal needs and wants, **Healthcare's** footprint of 3 billion tonnes is mostly related to hospital buildings, healthcare equipment such as MRI scanners and the production of medical disposables and pharmaceuticals.

DEVISING A TREATMENT PLAN THROUGH A MASS-CARBON LENS

We now want to complement the insights the emissions x-ray has given us with the reality of material use in our global economy. Material transformation offers the prospect of adding value at each step of the supply chain—from simple raw materials, through to complex products. As part of the same process, however, emissions and waste are generated. Therefore, when considering our economic activity more holistically, we need to adopt different lenses—here Mass-Carbon—to scrutinise the combined inputs and outputs from these steps and understand fully how these activities contribute to meeting our societal needs. In combining the material and emissions footprints in Figure Two, we can see the multiple avenues that hold the most impact from a Mass-Carbon perspective.

By revealing how both materials and emissions flow through the economy, Figure Two shows us that for some societal needs, the focus areas where we can close the Emissions Gap overlap with the focus areas to close the Circularity Gap. Yet for other societal needs, there is no overlap, and we must adapt our approach accordingly. From a material (Mass) perspective, **Minerals** represent by far the largest share (51%), while they only make a minor contribution from an GHG emissions (Carbon) perspective (2.8%). That said, there are still 'hot spots' along the mineral value-chain that are exceptionally emissions-intensive, which we should aim to bypass by applying circular strategies (as in the case of cement clinker production). The opposite is true for **fossil fuels**: in terms of materials they represent a modest share of 15%, yet they are responsible for 65% of emissions. These resources are almost entirely used for combustion purposes.

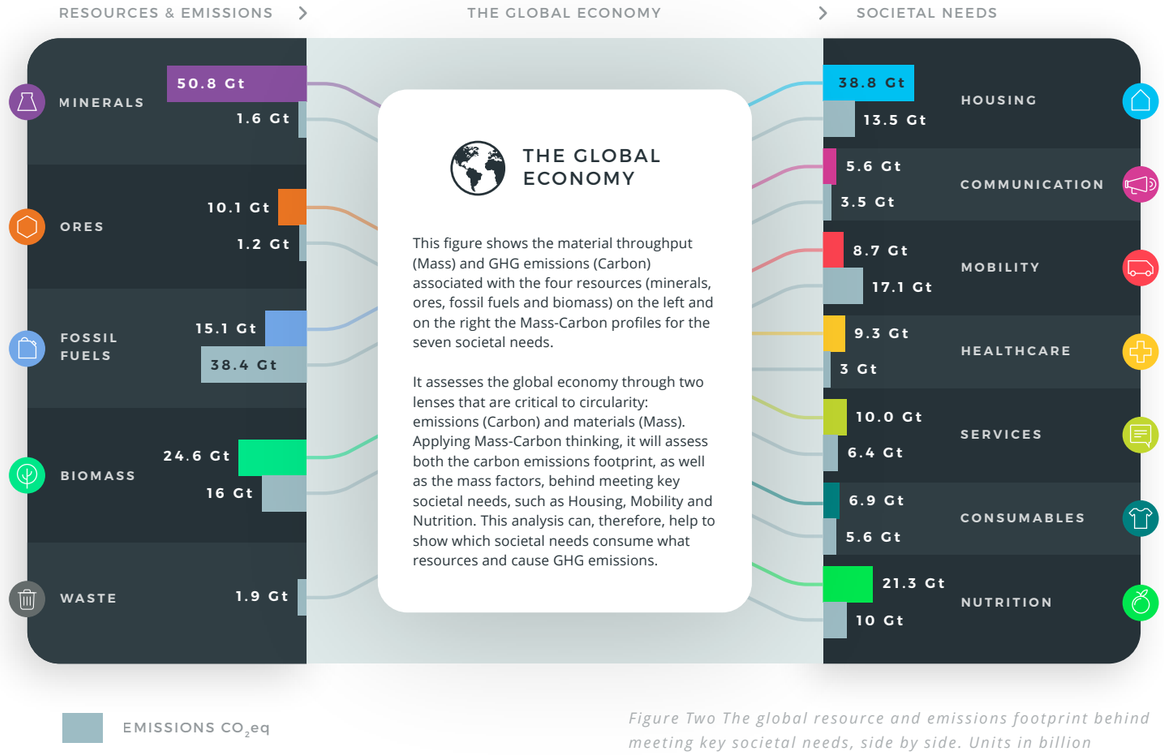


Figure Two The global resource and emissions footprint behind meeting key societal needs, side by side. Units in billion tonnes (Gt).

The energy-density properties of fossil carriers make them very lucrative as a commodity, but it is impossible to bypass any steps in the value-chain due to the very nature of their use. This is why we see fossil fuels as having no place in the circular economy. Biomass is responsible for around 25% of materials and 27% of emissions, yet as a resource it represents an interesting case: biomass captures carbon from the atmosphere during its growth, but again is often used as an energy carrier, thereby eventually producing emissions. In applying circular strategies, we would promote the increase of carbon storage in biomass (through, for example, the use of wooden construction materials), while bypassing the emissions-producing steps in the value-chain.

In using circular strategies, we can reconfigure these supply chains to 'bypass' the emissions hot-spots. By swapping out emission-intensive processes such as smelting and remanufacturing for metals, for example, with processes that extend the lifespan of the material, such as repair, we would reduce the need for excess virgin material extraction and emit fewer GHGs. We put this to the test in our roadmap to a well below 2-degree world, which is presented in Chapter Four.

**Land use, land-use change and forestry (LULUCF) is defined by the United Nations Climate Change Secretariat as a 'greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use such as settlements and commercial uses, land-use change, and forestry activities.' We include LULUCF because it is included in the Emissions Gap and because they are important in the estimation of sustainably sourced (carbon-neutral)—and thus circular—biomass.*

3

METRICS BEHIND THE GAPS

Global circularity & the Emissions Gap

Measurements are critical to understanding the world around us. Consistent measurement frameworks should inform governments and businesses alike to engage in uniform goal-setting and guide future action toward circularity and climate mitigation in the most impactful way. In last year's *Circularity Gap Report*, we saw the global Circularity Metric go from 9.1% to 8.6%, demonstrating the power of having a single, overarching metric to track progress and change. And now in this fourth edition of the Report, we present robust, quantified evidence to show how the circular economy and climate mitigation agenda are mutually reinforcing by using both the Circularity Gap and the Emissions Gap to illustrate our case. What the findings tell us is that governments wanting to satisfy our societal needs and wants within healthy planetary boundaries need a roadmap and fresh strategies.

WHY THE CIRCULAR TRANSITIONS NEEDS METRICS

We need metrics and measurements to search for and identify solutions and to help monitor and report our progress in alleviating problems. Our Circularity Metric measures the circularity of the globe, and in providing an initial assessment of how wide the Circularity Gap is, the analysis provides an insight into where circular opportunities and priorities lie in material flows. By measuring circularity in this way, businesses and governments can track their circular performance over time and put trends into context, as well as engage in uniform goal-setting and guide future action in the most impactful way.

THE CIRCULARITY METRIC AND GAP

The circular economy is a big picture and holistic idea. Ultimately, it is a means to an end—a socially just and ecologically safe space. Exactly how the circular transition can deliver more beneficial social and environmental outcomes is not a question with just one right answer however. There is no simple straight-line solution and the feedback loops in the system run in all directions.[28] In particular, three connected spheres need to be taken into account: how resources are put to work to deliver social outcomes via provisioning systems. Provisioning systems comprise of physical systems such as road infrastructure, technologies, and their efficiencies[29] and social systems, which include government institutions, businesses, communities and markets.[30]

Provisioning systems are the essential link between biophysical resource use and social outcomes. For example, different forms of transportation infrastructure (railways versus motorways or car-sharing versus car ownership) can generate similar social outcomes, but at very different levels of material use.

In capturing one overarching measurement of circularity, we need to reduce this complexity somewhat. So, we take the metabolism of the globe—how materials flow through the economy and are in long-term use—as the starting point. This approach builds on and is inspired by the work of Haas et al.[31] (2015). Taking the x-ray of the globe's material use, we consider six fundamental dynamics of what the circular economy transition aims to establish and how it can do so. This translates into two objectives and four strategies, which we base on the work of Bocken et al. (2016):[32]

- **Objective one:** Resource extraction from the lithosphere is minimised and biomass production and extraction is regenerative.
- **Objective two:** The dispersion and loss of materials is minimised, meaning all technical materials have high recovery opportunities, ideally without degradation and quality loss; emissions to air and dispersion to water or land is prevented; and biomass is optimally cascaded.

The four strategies we can use to achieve these objectives are:

- **Narrow flows—Use less**: The amount of material used or greenhouse gases (GHGs) emitted in the making of a product or in the delivery of a service are decreased. This is through circular design or increasing the usage rates of materials and products. In practice: Sharing and rental models, material lightweighting, multifunctional products or buildings, energy efficiency, digitisation.
- **Slow flows—Use longer**: Resource use is optimised as the functional lifetime of goods is extended. Durable design, materials and service loops that extend life, such as repair and remanufacturing, both contribute to slowing rates of extraction and use. In practice: Durable material use, modular design, design for disassembly, repair, remanufacturing, refurbishing, renovation, remodelling.

- **Regenerate flows—Make clean**: Fossil fuels, pollutants and toxic materials are replaced with regenerative sources, thereby increasing and maintaining value in natural ecosystems. In practice: Regenerative material use, renewable energy, regenerative agriculture.
- **Cycle flows—Use again**: The reuse of materials or products at end-of-life is optimised, facilitating a circular flow of resources. This is enhanced with improved collection and reprocessing of materials and optimal cascading by creating value in each stage of reuse. In practice: Design for recyclability (both technical and biological), design for disassembly, recycling, waste-to-energy.

If we effectively deploy strategies focused on **slowing**, **narrowing**, **cycling** and **regenerating** the flow of materials, we will ultimately require fewer materials to provide for similar needs. Because of this, fewer materials will be used by the economy, they will have a longer lifespan and can be reused more effectively and with less harm caused to the environment. For our Circularity Metric to capture this crucial process, we measure the share of cycled materials as part of the total material inputs into a global economy. As such, it illustrates the current progress towards achieving the circular economy's ultimate goal of designing out waste through the four listed strategies.

THE EMISSIONS GAP

For a decade, the United Nations Environment Programme (UNEP) has highlighted the Emissions Gap every year. The Emissions Gap assesses the level of GHGs emitted if we continue to plunder along a business-as-usual scenario that includes current Nationally Determined Contributions (NDCs), compared to the level we must emit to stay on track to keep rising global temperature to 2-degrees, and ideally 1.5-degrees. In the 2020 edition of the *Report*, launched in December 2020, seven scenarios are outlined specifying the Gap under different policy settings (2010 policies, current policies, Unconditional NDCs, Conditional NDCs) and under different goals (2-degree goal, a 1.8-degree goal and a 1.5-degree goal).[33]

THE EMISSIONS GAP IN THE *CIRCULARITY GAP REPORT*

It was in 2017 that we at Circle Economy took inspiration from the *Emissions Gap Report* and felt an equivalent for the use of materials was needed on a global stage. Then the *Circularity Gap Report* was born. The Emissions Gap that is referred to in this *Circularity Gap Report* is defined in reference to a **1.75-degree trajectory to be achieved by 2032**, thereby meeting the goal of staying well below 2-degree of warming as specified in the Paris Agreement. Where the NDCs and current policies end, this Emissions Gap begins.

THE EMISSIONS GAP 2020

According to the latest *Emissions Gap Report*, based on a scenario of current Unconditional NDCs, global temperatures are estimated to rise by about 3.2-degrees above pre-industrial levels by 2100.[34] Carbon dioxide emissions are predicted to fall by up to 7% (between 2% and 12%) compared to 2019 emission levels as a result of the pandemic slowdown. However, atmospheric concentrations of GHGs continue to rise. This is because the NDCs are 'woefully inadequate', states the report. UNEP also looks at ways to bridge the Gap—with the latest report summarising the scale of emerging net-zero emissions pledges made by countries and exploring the potential of the lifestyle, aviation and shipping sectors.

It also states that if we were to continue on a business-as-usual pathway, emissions could reach 65 billion tonnes CO_2 equivalents by 2030[35] (see Figure Three on page 38 for more information). In this scenario, we would be faced with dangerous climate breakdown. The climate policies already in place can deliver a reduction of 11 to 13 billion tonnes CO_2 equivalents. Of the remaining emissions, previous Circle Economy research estimated that circular economy strategies could further close the Emissions Gap by about half.[36] This report finds it delivers a huge reduction of 28.8 billion tonnes and closes the Gap by more than 70%.

To read more about our methodologies, visit our website circularity-gap.world.

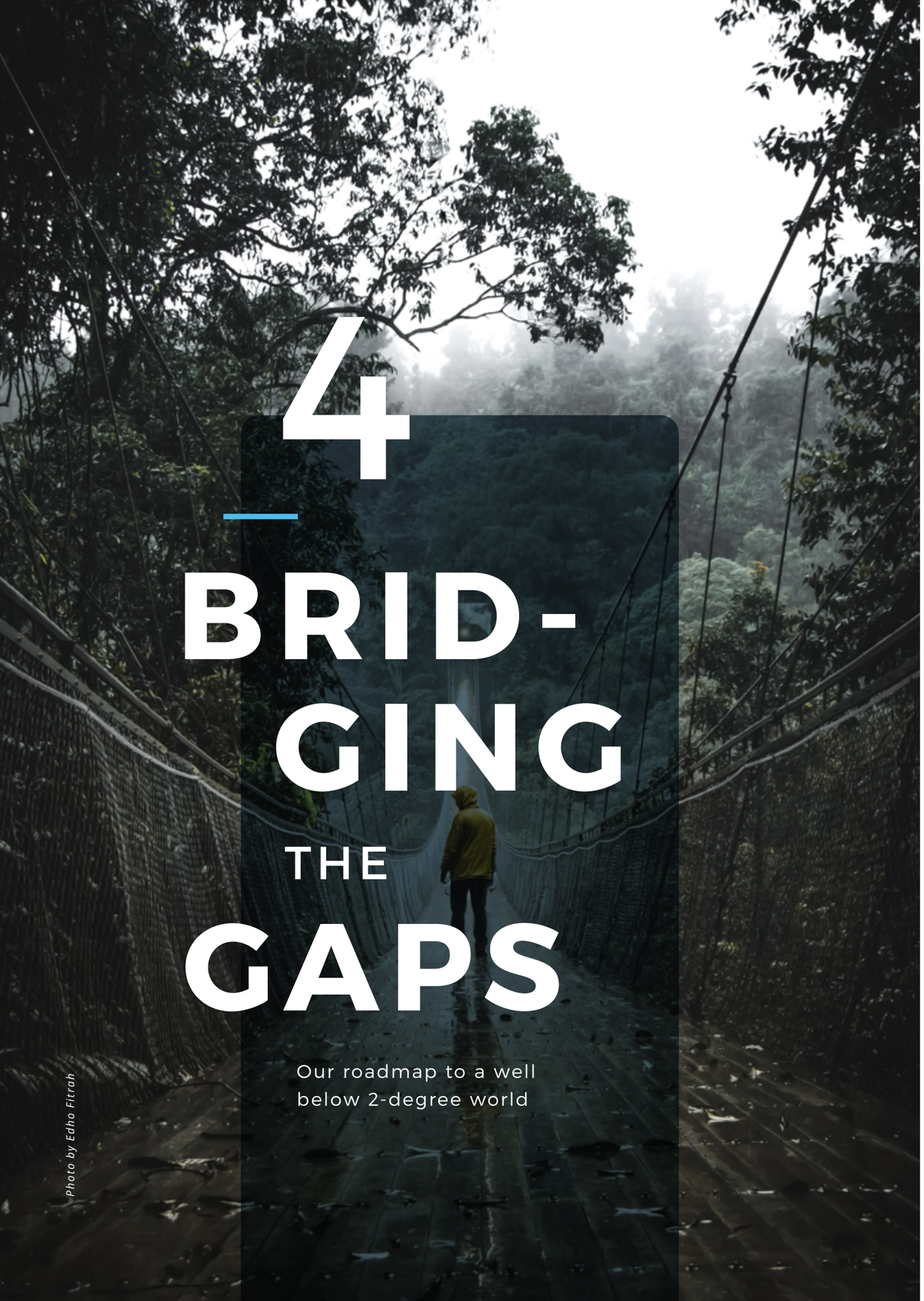
WHERE DOES OUR DATA COME FROM?

Our study draws upon an increasingly broad research stream that makes use of Environmentally-extended Multi-regional Input-Output Analysis (EE-MRIOA) to model the potential environmental impacts and benefits of the circular economy from a macroeconomic perspective. Relying on the EE-MRIO database Exiobase v3.7, our methodology and underlying model is based on the same equation set of two other prominent studies—Wood et al. (2017)[37] and Donati et al. (2020)[38]—with the exclusion of rebound effects.

The key features of our assessment are its life-cycle and consumption-based perspective as well as the use of modelling blueprints that revolve around changes in consumption patterns (demand), production recipes (supply) and adoption rates in the form of either a partial increase, reduction or substitution, of products or services. The scope and data for our scenarios and interventions (displayed in Chapter Four as the roadmap) build upon the work of Ivanova et al. (2020)[39], Vita et al. (2019)[40], Moran et al. (2018)[41] and Hertwich et al. (2018)[42], among others.

Our input-output assessment measures the impact of chosen interventions and scenarios on the material and carbon footprints of the globe, which we divided into three country profiles, namely: Grow, Build and Shift. A separate modelling is carried out for quantifying flows of waste and secondary materials based on a 'light update' of the hybrid Exiobase v3.3.17 IOTs. Bringing this information together, the Circularity Gap measures the share of virgin materials in the total material consumption, while the Emissions Gap gauges how much of the global GHG footprint still needs to be reduced in order to stay within the 1.5 and 2-degrees emissions pathways set by the IPCC.

Photo by Matthew Devries



4

BRIDGING THE GAPS

Our roadmap to a well below 2-degree world

Photo by Edho Fitrah

Now that we have presented the current state of the globe's emissions and vast resource use, it is time to analyse the findings and suggest a remedy. In this chapter, we explore the transformative power of circular economy strategies to ensure intelligent material use, tackle overconsumption and slash greenhouse gas (GHG) emissions. They go further than the current policies and national climate pledges dare to go. Moving beyond renewable and efficient energy, they draw from a deeper body of circular interventions; calling for systemic transformation coupled with behavioural change. Nested within our roadmap are 'what-if' scenarios, which have been based on strategies that ultimately narrow, slow, regenerate or cycle material flows across societal needs and wants. They ultimately have a major effect on managing climate and world resource use, such that the impact trends fall back within planetary boundaries. The broader ambition is that these directions facilitate and trigger concerted action and the formation of global and local coalitions to advance ideas across sectors, supply chains, cities and regions.

SCENARIOS FOR THE WORLD

There is a long history of sketching scenarios to reform the global economy, with the Club of Rome's report, *Limits to Growth*, in 1972 providing a landmark in this tradition. The message of this book still rings true today: the earth's resources cannot sustain current rates of economic and population growth much beyond the year 2100. We've witnessed the publication of scenarios in this field since then. They've ranged from considering the near-term and incremental change, which is symptomatic of many of the Nationally Determined Contributions (NDCs), while others take a more transformational approach with an eye on systemic change. This includes the approach our *Circularity Gap Reports* take. With scenarios rooted in the circular economy, there is a clear need for urgent transformation of how we produce, design and consume within our economies.

NO COUNTRY IS FINISHED DEVELOPING

How could we not call for transformational and systemic change? Last year, our report posited that when it comes to reaching the ecologically safe[43] and socially just[44] space, all countries are failing. We are all developing countries. On the global stage, we continue to consume too much and to drive climate breakdown with increasing levels of GHG emissions from our activities. Marking a turning point in 2020, the International Energy Agency's (IEA) flagship *World Energy Outlook* report[45]—which typically set the tone of the climate debate—laid out an aggressive action plan for countries. For the first time, it went beyond focusing on the renewable energy transition and called for behavioural overhauls across all populations that enjoy access to modern energy. Clearly, from production to consumption, the alarm is heard: we need to change.

SOCIAL AND ETHICAL CONSIDERATIONS

Of course, 2020 was a year like no other for many of us. As the pandemic threatened the livelihoods of billions, calls for systemic transformation were everywhere, while narratives around 'building back better' and 'the great reset' ushered in a real sense of opportunity. This time, our responses must match the scale of the climate, social and economic emergency—in a way that reduces global and local inequality and protects against climate breakdown. Therefore it is imperative to add strings to our bow and incorporate social and ethical considerations in the circular economy transition. Any successful economic model must meet the needs of the society it serves while responsibly stewarding the natural systems upon which it is reliant. It is a matter of striking a harmonious balance between people and planet.

It's also imperative to remember who will drive the circular transition on the ground: human capital. Initially, the circular economy transition is expected to be labour-intensive. This is because the core pillars behind preserving a material's maximum value, for as long as possible (reuse, repair, remanufacture and recycling), hinge on processes that typically require more labour than in the linear economy where resources are often wasted and incinerated [46][47]. With the introduction of new design strategies, production processes and business models, the type of work that will be undertaken will be reshaped, thereby creating new jobs, transforming existing ones and phasing out others. This change will require skills from across the spectrum, where we need to pay equal attention to practically- and theoretically-skilled workers and ensure that workers are protected and don't fall foul to the same explotiations as in the linear economy. A circular economy transition that is mindful of social and ethical issues is one for which we should all strive.

SOCIETY CENTRAL, RESOURCE SMART, CLIMATE-SAFE SCENARIOS

In creating a roadmap to a well below 2-degree reality for the globe, its complexity needs to be taken into account. The nine planetary boundaries framework, which includes biodiversity loss, climate change and land system change[48], provides guidance here. In our analysis, however, we spotlight two aspects in one strategy: climate mitigation through the intelligent management of the globe's resources. In this way, we don't explicitly engage with the other planetary boundaries, but this allows us to focus on scenarios that can point us in the direction of a safe and just space. We use the Circularity Gap and the Emissions Gap as goals to guide us in building our scenarios for the roadmap.

To construct our roadmap and the scenarios it holds, we look at the seven societal needs and wants (see page 17). Taking this consumption approach, we are able to examine ethical considerations and trade-offs that could potentially arise in the transition to circularity. We are aware that resources are increasingly used to not only satisfy societal needs, but also wants.[49] Consider this: although a healthy diet requires 2,000 kcal per day for a typical female, the intake in some countries may be far higher, while malnutrition persists in others. The more calorie intensive diets could consist of out-of-season, imported foods that have travelled across the globe, or high levels of animal protein. Calling to reduce consumption here may be appropriate and even ethical, but less so in cases where access to basic nutritious food is limited. The circular economy is also about achieving a structural and cultural shift where we can all satisfy universal needs—so there are important differences to take into consideration. In being a means to an end of a safe and just space, the circular economy must consider that different approaches or tactics must prevail in different contexts to ensure local needs are met and that a reduction in overconsumption, for example, is encouraged. We apply this thinking in Chapter Six and Seven when we consider our three country profiles: Build, Grow and Shift.

It's worth noting that the scenarios within our roadmap are 'what-if' scenarios: they serve as an ambitious exploration of a potential path forward and sketch which type of interventions and levers are most impactful. They are not, however, grounded in political realities. They do provide a qualitative assessment of the implementation timeframe, but they are not quantitatively modelled year-by-year.

A POWERFUL STARTING POINT: THE NDCS

Following three decades—since the Earth Summit in Rio de Janeiro in 1992—of global coordination on climate change, the majority of nations have put forward plans to get our planet back on a safe trajectory: the NDCs. These targets are not static, one-off commitments; they are long-term and require investment, time and tracking. However, multiple reports and progress-checks[50] have found that these plans will not only probably be missed but that they—even at the onset—never went far enough to keep us on a below 2-degree path. This highlights the need for interventions that go far beyond the NDCs, and encapsulates the drivers behind our research: the transition to a circular economy can contribute further to climate change mitigation than the strategies countries are currently employing.

For this reason, we have excluded circular interventions that were commonly mentioned in countries' first NDCs. While only the transition to renewable energy was mentioned in the majority (57%) of NDCs—albeit at varying degrees of detail—other interventions such as 'energy efficient appliances' and 'shift to public transport' also appeared fairly frequently. For this reason, none of these strategies have been directly included in our analysis. By prioritising in this way, we hope to demonstrate the additional potential and impact our scenarios will have in keeping us on track to meet the goals of the Paris Agreement.

WHY

In developing circular interventions to transform how we fulfil our societal needs and wants, we use the four circular flow strategies as a base (see 25). But how do they tackle both GHG emissions and material footprints?

NARROW,

By minimising the overall material inputs into an economy, the emissions present in resources and, therefore, end products will be lower. This can be strengthened if priority is given to the flows with the highest embodied emissions.

REGENERATE,

In using regenerative resources, the high levels of emissions in fossil fuels and unsustainable biomass are cut from the economy

SLOW,

In extending the functional lifetime of resources, the emissions attached to individual material flows are spread out and therefore minimised over time.

CYCLE?

Depending on the energy used and emissions released during cycling, this strategy has the potential to eliminate embodied emissions from inputs.

HOUSING

Housing leads the way in guzzling resources and producing emissions to satisfy our need for shelter. When it comes to the environmental impact of a sector as economically and socially significant as Housing, we must use less, by narrowing flows. This can be achieved through ultimately **building fewer, but better**, new houses and multi-occupancy dwellings, to **reduce overall floor space** and optimise resource efficiency. However, before we build new buildings, we should **prioritise extending the lifetime of existing stock.**

Core interventions include **banning building with virgin materials** and simultaneously introducing policies to cap residential stock expansion in line with available Construction and Demolition Waste (C&DW). This strategy assumes all C&DW is diverted as a secondary material for residential construction, but only half is fit for purpose (high uncertainty). It also factors in the rate of demolition as a determinant of material flow volumes. In short, **new construction is constrained by the secondary materials that become available.**

In slowing flows, more **co-housing, increased renovation, refurbishment, modular design** that can easily adapt to needs over time is needed, and **re-occupancy of underused and disused buildings** to meet housing demand within global stock limits. Optimising **flexible and multi-functional space** for non-residential purposes also frees up existing stock for (redesignation as) housing. In addition, the reduction in total floorspace delivers proportional savings on heating and cooling; while this is enhanced with avenues to cut energy consumption, such as lower room temperatures, smart metering and improved thermal insulation. **Retrofitting existing housing stock** will both slow flows by extending the lifespan and in some cases cycle flows through reuse of materials in renovation and refurbishment on-site (as does the specification of recycled or circular materials in general construction).

Nature-inspired solutions can also lower material and energy demand by **narrowing** and **regenerating** flows. Low-energy approaches such as Passivhaus design (minimising requirements for mechanical space heating, cooling and ventilation) can narrow flows, while applying **renewable technologies** such as **solar photovoltaic or thermal, air-source and geothermal heat pumps**, can regenerate flows and shrink the carbon footprint of a property. The use of low-carbon construction materials, lightweighting and local sourcing all help to cut embodied energy. **Natural or renewable building materials**, such as wood, straw and hemp, help regenerate flows as well. Green roofs and living walls are all examples of interventions with regenerative benefits, at least in terms of thermal performance, water management, biodiversity and air quality.

Finally, other impactful interventions that can cycle flows include **modern methods of construction** such as modular and offsite design, plus **design for manufacture and assembly**. As well as carrying the potential for deconstruction, relocation and reuse of elements (or even whole buildings), factory-built options boost resource efficiency in production and performance.

NUTRITION

In such a resource- and emissions-intensive need, tackling food shortages and scarcity starts first with optimising how we use the food we already have at our disposal, before looking to increase production. Here, the notion of 'sustainable biomass'—which is produced and sourced sustainably (meaning carbon-neutral)[51], and therefore circular—is also very important as food constitutes a large proportion of it globally.

Cutting excess consumption is a critical means to narrow flows. Interventions around food sufficiency—for instance, via reductions in per capita caloric and protein daily uptake rates in Shift countries, bringing them down to match Grow country levels (see more on page 50)—can also result in secondary benefits such as less packaging. In our roadmap, slashing excess consumption implies keeping caloric supply (not consumption) under 3,000 kcal per person, per day, reducing packaging in the food supply chain by 55%, and reducing food waste (household) and losses (supply chain). Further narrow interventions include **footprint-per-calorie reductions** which can be achieved through **changes in diet**; largely the uptake of **vegan** and **healthier** options. Given a focus on constant caloric and protein intake, a move away from foods with low nutritional value, such as sugary beverages and refined, heavily processed food can be impactful. **Unprocessed food** is championed, alongside an ongoing decrease in consumption of all meat, fish and dairy, with a target of 100% eradication of unhealthy high-sugar, high-salt products.

Sustainable food production represents another significant avenue. Fresh, regional, local and seasonal options on the menu mean less need for hot-housing vegetables, which equates to a reduction in fuel inputs, plus fewer food miles and lower transportation impacts. **Urban, organic** and **precision farming** models would also eliminate synthetic fertiliser use.

Backed by carbon-neutral biomass certification, substituting **food waste and losses** for **fodder crops** will support growth of secondary markets, helping to cycle flows.

Improvements to food preparation resources and practices would bring benefits to public health, as well as energy consumption. Key interventions include the replacement of polluting traditional biomass and black-carbon-producing stoves with **clean cooking** apparatuses, including advanced solar-electric stoves, that would regenerate flows.

MOBILITY

With its mammoth footprint, Mobility is commonly associated in the minds of both policymakers and the public with GHG emissions reduction. From driving to flying, opportunities for change are plentiful. As evidenced during the global pandemic's regional lockdowns, the obvious way to narrow flows is simply to **reduce travel**. This reduction can be achieved through a range of interventions, including the **provision of regional and local hubs, shared and virtual offices, telecommuting** and **working from home**. The optimisation of supply chain logistics also represents an opportunity for multiple resource-efficiency wins in terms of **waste minimisation, cargo miles** and **infrastructure cost**. **Vehicle design improvements** are another more incremental way to narrow flows, with lightweighting and smaller sizes of mobility vehicles such as cars and scooters, resulting in a reduced requirement for steel and aluminium production, as well as lower fuel consumption and embodied energy. **Autonomous vehicles** (driverless cars), as well as **electric bicycles** promise Mass-Carbon savings, too. When it comes to prioritising **durable design** and material selection, plus **optimising repairability and maximising maintenance**, we can also slow flows, thereby extending the lifetime of vehicles.

As well as better vehicles, **better utilisation of all vehicles** will further narrow flows. With personal vehicle ownership no longer the dream it once seemed, interventions include **shared mobility**, via car clubs and pools, **ride-sharing**, as well as **public transport**, with park-and-ride provision to cut fuel consumption[52].

Finally, optimising **end-of-life vehicle management** is critical to cycle flows, with the recycling of metal and plastic components, and the use of recycled material, on the rise.

COMMUNICATION

Efficient design and use of communication equipment, especially by way of **digitalisation**, can narrow flows. Consider the large reduction in printed materials as the trends towards e-books and online news platforms gained ground. Interventions include the **sharing of equipment and tools**, plus cloud computing services, which help avoid a trade-off in terms of proliferation of impacts from personal computing and mobile electronic devices. Simply **buying smaller and lighter** laptops instead of desktop computers with LCD monitors can mean resource consumption is reduced and resource efficiency enhanced.

CONSUMABLES

With Consumables, such as paper, textiles, plastic, furniture and electronics, we need to use less, or narrow flows, which revolves around **efficient design and use of consumer products**. By shifting consumption choices and mainstreaming circular design, we can impact both usage and acquisition rates. Tangible interventions include: **increasing digitisation** to reduce paper use; **not making textiles from animals**; aiming to **eradicate single-use plastic**; **optimising usage of electronics** to minimise e-waste; specifying only **eco-labelled responsibly-sourced timber furniture**; and prioritising **local purchasing and sourcing**.

In slowing flows, which revolves around the design of **durable consumer products**, interventions include introducing and encouraging **repair, maintenance, sharing, re-manufacturing** and **take-back programmes for textiles, appliances, furniture** and **machinery**. Options such as the **elimination of planned or built-in obsolescence**, investment in **higher-quality production to extend life-expectancy** of goods, plus **design for disassembly**, **customisation** and **replacement parts** are all practical and marketable.

The use of sustainable material can also regenerate flows by **eliminating toxins and pollutants**, plus has the potential to support the provision of chemical-free choices to consumers. Interventions include improved efficiency and ongoing reduction of chemical use in consumer products through the **adoption of biobased alternatives, chemicals leasing** and **selection of natural fertilisers** and **organic compost in gardens**.

Facilitating reuse by cycling flows will maximise the uptake of circular materials in Consumables that **close loops and boost value in secondary markets**. Key interventions include **promoting recycling of plastics**, **synthetic fibres, paper, wood** and by-products; also specifying **recycled content obligations**, plus substituting where possible for virgin or raw material.

HEALTHCARE

Although the total potential impact of circular Healthcare interventions is small compared to some of the other societal needs and wants, there are nevertheless multiple benefits to be realised. For instance, **investment in longer-lasting medical equipment**, with planned **preventive maintenance regimes** in place, can not only extend asset lifetimes through cascading but also reduce the number of single-use plastic items in production and use—so serving to simultaneously narrow, slow and cycle flows.

The development of virtual healthcare service models is another avenue where interventions can narrow flows. Access to diagnosis and treatment can be improved, whilst concurrently reducing the need for physical consultation spaces and all the associated resource consumption costs, including travel impacts. Combining Healthcare and Communication interventions in this way delivers environmental, social, and economic sustainability benefits.

SERVICES

In our recommendations, we do not include interventions relating specifically to the societal need of Services, as the materials used and emissions released in performing such Services are included in other categories. For example, repair interventions—classified as a service—are addressed under most of the other needs and wants.

5 SET-TING A NEW COURSE

The transformational impact of circularity

Photo by Mike Erskine

To get the global economy on a pathway towards circularity and a well below 2-degree world, major course-corrections are needed. This section highlights the extent to which our roadmap (presented in Chapter Four) is able to mitigate climate breakdown and curb material use globally: in other words how effective they are in Mass-Carbon terms. This chapter also showcases some of the dominant climate mitigation narratives out there: an urgent timeframe and a clear temperature goal.

NO ROOM FOR BUSINESS-AS-USUAL

Material extraction has fuelled economic progress since the Industrial Revolution, at the same time causing human-made greenhouse gas (GHG) emissions. Over the last five decades, the global extraction of materials more than tripled, from 26.7 billion tonnes in 1970, to 92.1 billion tonnes in 2017.[53] And as we revealed in our 2020 report, more than 100 billion tonnes of materials now enter our economy. Material use is accelerating; and with this comes increased GHG emissions—now totaling 59.1 billion tonnes.[54]

Exceptionally in 2020, the covid-19 pandemic resulted in worldwide lockdowns. As people were restricted to their homes, a hefty dent was made in the annual emissions bill: at the lowest point global CO_2 was 7% (between 2% and 12%) lower than in 2019.[55] This was the lowest level since 2010. However, little has been done to prevent a rapid rebound in emissions as countries began opening up after both the first and second wave. To put emissions into a structural decline, large shifts in government policies will have to take place. The *Emissions Gap Report* 2020 found that a green pandemic recovery[56] could shave 25% off the emissions we would see with the current pre-covid policies in place. And now we are armed with new knowledge: faced with the necessary urgency we can rapidly change our behaviours almost overnight. And, ultimately, climate breakdown will be the biggest global health threat of the century.[57]

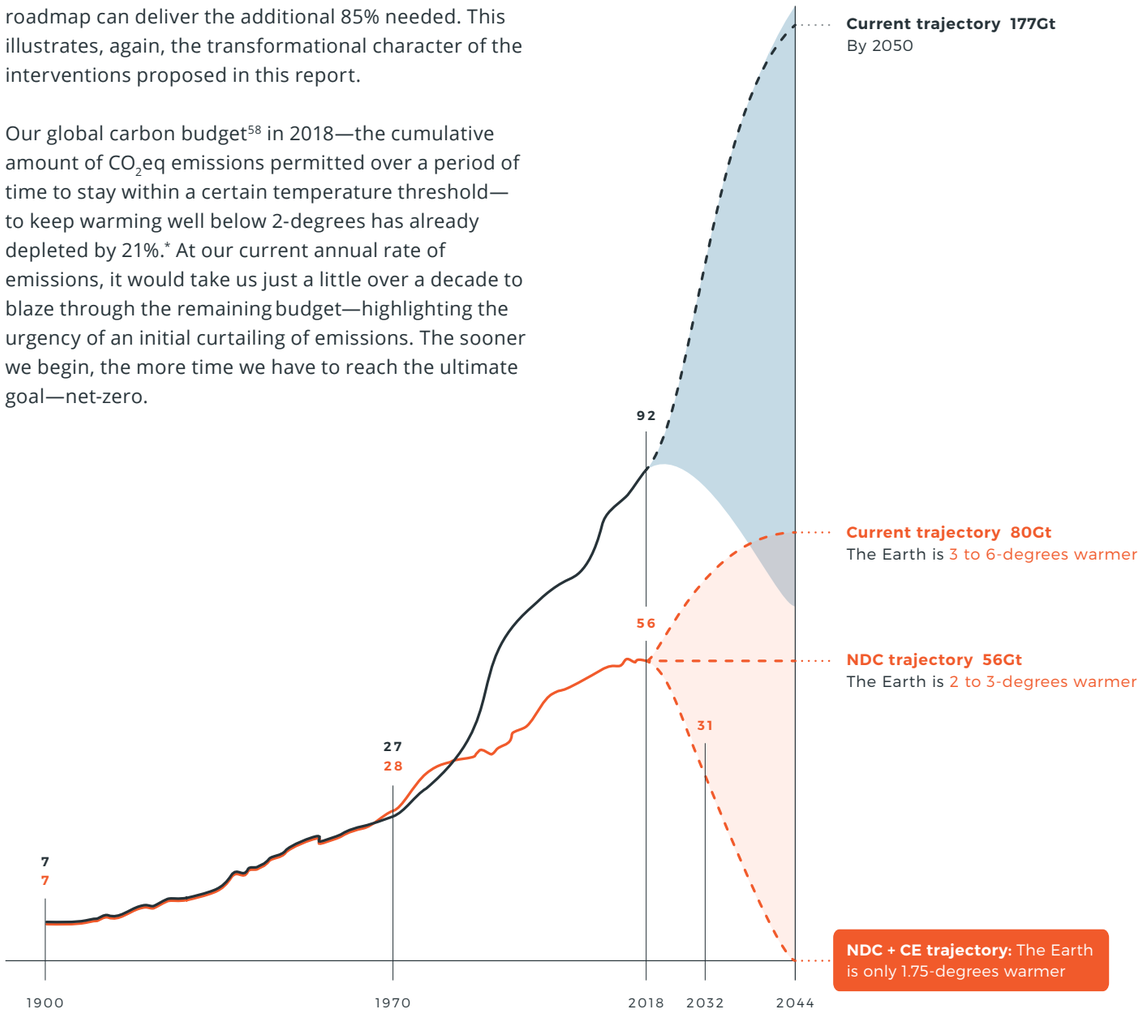
Making our economies more resource-efficient will, in turn, reduce GHG emissions along the value-chain— from the mines from which raw materials are sourced and the fields in which produce is grown, to manufacturing and retail via last-mile logistics. This exponential potential for a global reset crosses all borders which demarcate national climate commitments and favours intensifying cooperation along supply chains, thereby closing local material cycles.

MATERIAL EXTRACTION & GHG TRAJECTORY

Figure Three shows the trajectory that could be achieved if our roadmap is implemented and backed by strong action that honours NDC commitments. Under a 'current policies' scenario we will likely reach 60 billion tonnes of GHG emissions by 2030. With the adoption of the (unconditional) NDCs this will go down to 56 billion tonnes by 2030. Implementation of the interventions we suggest will bring this down further to reach 33.2 billion tonnes of CO_2eq by 2030, which is on trajectory towards net-zero by 2044. In short, between business-as-usual and our scenario by 2030, the NDCs could 15% of the solution whereas our roadmap can deliver the additional 85% needed. This illustrates, again, the transformational character of the interventions proposed in this report.

Our global carbon budget[58] in 2018—the cumulative amount of CO_2eq emissions permitted over a period of time to stay within a certain temperature threshold—to keep warming well below 2-degrees has already depleted by 21%.* At our current annual rate of emissions, it would take us just a little over a decade to blaze through the remaining budget—highlighting the urgency of an initial curtailing of emissions. The sooner we begin, the more time we have to reach the ultimate goal—net-zero.

If we assume that emissions will decline from 2021 onwards at a linear rate, we are given the gift of more time. Staying within the desired well below 2-degree limit will be possible in this scenario if we reach net-zero emissions by 2044, upping the previous deadline by more than a decade. To realise this scenario, though, we must implement all NDC pledgesand all proposed circular strategies in our roadmap by 2030—and then carry that momentum forward until 2044.



Even if countries meet all the targets laid out in NDCs—most of which have been deemed insufficient, highly insufficient or critically insufficient[59]—emissions will not drop, but rather stabilise up to 2030. This is where circular strategies come into play, carrying us the rest of the way to a net-zero world by 2050. Yet, at present, many countries are not on track to meet their climate goals; and the uptake of circular strategies is occurring at a slower pace than is needed.

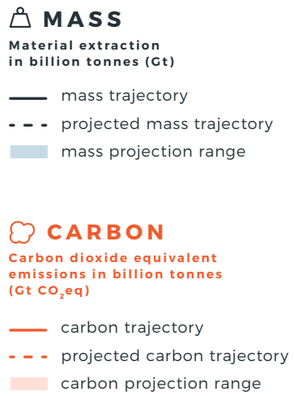


Figure Three shows the development for material extraction (Mass) in billion tonnes (Gt) and GHG emissions in carbon dioxide equivalents (Carbon) from 1900 to 2019 and projected to 2050, including the transformational impact of our circular roadmap.

IS A FULLY CIRCULAR ECONOMY POSSIBLE?

Huge dynamics at play across the globe represent barriers to us closing the Circularity Gap to the same extent we can close the Emissions Gap. These include:

Stock build-up and operation. Countries are continually investing in new buildings and infrastructure, such as to provide Mobility and Housing, as well as renewable energy. This stock build-up is not inherently bad; many countries need to invest to ensure that the local populations have access to basic services, particularly in Build and Grow countries (Chapter Six), as well as build-up infrastructure globally to support renewable energy generation, distribution and storage capacity. These resources would remain locked away and not available for cycling, and therefore weigh down the Circularity Metric.

Material quality loss. Even in an ideal circular system, some primary resource extraction would still exist. This is because there is always a loss of material quantity or quality in the process of cycling, which we need to compensate for by adding new virgin materials either directly or in the form of energy.

**The carbon budget was set at 800 billion tonnes of CO_2 equivalents. Assuming emissions remained equal for 2018-2020, this budget has been depleted by 167 billion tonnes CO_2 equivalents—leaving 633 billion tonnes CO_2 equivalents remaining. At our current annual rate of emissions, it would take us just a little over a decade to blaze through this 633 billion tonnes budget; highlighting how urgent an initial curtailing of emissions is. The sooner we begin, the more time we have to reach the ultimate goal—net-zero.*

THE SOLUTION SPACE SUMMARISED

Figure Four on the next page shows how our roadmap 21 interventions across six scenarios—one for each of the six societal needs we model—can mitigate climate impact by curbing GHG emissions. The roadmap sketches interventions that move beyond incremental action and provides solutions that will require behavioural change (dietary shifts towards less meat consumption, for example) and the adoption of state-of-the-art technologies in industry to mitigate emissions in hard to abate sectors (such as steel manufacturing). It illustrates how continued globalisation can benefit from the uptake of digital solutions. The combined interventions showcase the mitigation potential that begins where the current country pledges end; illustrating the additional impact our interventions can bring to the NDCs. In short, the interventions provide input for a more profound and fundamental transformation than the more current pathways that make up the vast majority of NDCs.

For each intervention, Figure Four shows its potential to reduce GHG emissions as the width of the intervention 'box', and the material footprint reduction by the height of the box. The image shows the contribution of each intervention separately, as well as for all interventions combined. What is visible is that some interventions overlap, which means that the total effect when we consider certain interventions overlapping is significantly less than when all individual interventions are combined, yet ignoring the overlap. This is because some interventions, when combined, will partially cancel each other out. For example, in 'Reduce floor space', we also reduce the volumes of construction and demolition waste (C&DW) that become available for recycling and repurposing. Another example is the overlap between various smart transport solutions ('Reduce travel', 'Circular vehicles', for example), whose impact is modelled to narrow the footprint of Mobility. The absolute impact of lightweighting the global car fleet in 'Vehicle design improvements' is directly moderated by the size of the said fleet, which in turn is reduced by, for instance, car sharing. This dynamic between interventions and the extent of their overlaps is visually depicted by the boxes.

The Figure shows the sheer difference in the emissions- and material-reduction power between interventions. Echoing our findings from the emissions x-ray presented in Chapter Two, it's clear that the societal needs that currently generate most emissions—Housing, Mobility and Nutrition—also show the biggest need, and in fact, opportunity, to reduce impacts.

Together, the combined interventions can almost double the current global Circularity Metric of 8.6%, bringing it to 17%. In temperature terms, we can stay below a 2-degrees warming scenario if we implement all segments of the roadmap, as well as conditional and unconditional NDCs by 2032, and then continue decreasing emissions at more or less the same pace to reach net-zero by 2050.

HEIGHT
expresses the **mass material** reduction in **Gt**

WIDTH
expresses the **emissions** reduction in **Gt CO_2eq**

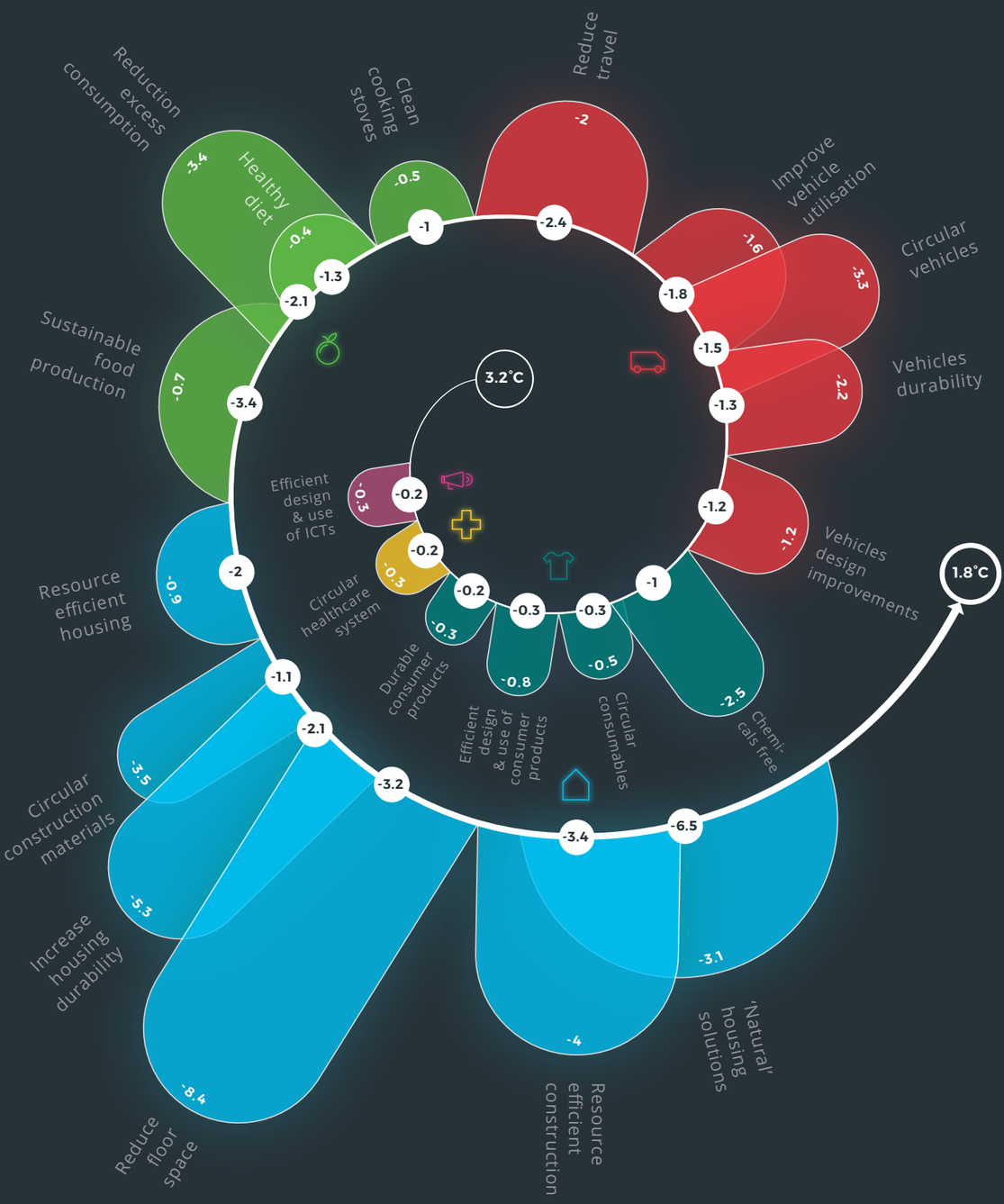
COLOUR
represents a societal need:

- CONSUMABLES
- COMMUNICATIONS
- HOUSING
- MOBILITY
- HEALTHCARE
- NUTRITION

TEMPERATURE
total mitigation of expected global temperature increase by 2050

INTERVENTIONS
VORTEX

Figure Four shows the impact of our interventions on the Circularity and Emissions Gaps



GLOBAL EMISSIONS SLASHED BY 39%

From a global warming perspective—and with the aim of closing the Emissions Gap—our circular scenarios have the potential to cut **39% of total global emissions**. Breaking this down, we see that the societal need for **Mobility** is the largest contributing 'consumption category', although **Housing** and **Nutrition** also have huge mitigation power.

About two-thirds of the reduction in emissions is attributable to our interventions—detailed on pages 32 to 34 and in Figure Four—that tackle supply chain emissions (a reduction of 14.8 billion tonnes). These also serve to reduce overall consumption, for example through shared mobility concepts, or by reducing overall floorspace and increasing the durability of buildings. Only one-third of the emissions reduction is linked to reducing the direct emissions from **Mobility** (emissions released while driving) by reducing travel, lowering heating and cooling needs within **Housing** by applying green building strategies, for example, and avoiding all emissions associated with human activities in **Nutrition** that take place on agricultural land, forested land, wetland or peatland, such as cutting down forests or ploughing grasslands; land use, land-use change and forestry (LULUCF).

Despite the overarching impact of reducing global supply chain emissions as a whole, we see that the mitigation potential of each societal need and want varies. In providing **Housing** to the global population, 82% of emission reductions are related to the material side—the supply chain of construction materials—and to energy use in commercial and industrial buildings. Just 18% of the mitigation potential lies energy combustion for residential heating and hot water. Meanwhile, for **Mobility**, the majority (52%) of emission reductions relate to the supply chain and commercial fleet operation: design and manufacturing interventions, such as integrating circularity into vehicle design, as opposed to diffused emissions from driving.

For **Nutrition**, over 70% of mitigation potential can be attributed to how we use and value our land: LULUCF. The remaining 27% of emissions come from the supply chain—such as transporting crops from farms to traders. Our interventions can reduce LULUCF emissions by 75%—from 4.1 billion tonnes to only 1 billion tonne (high uncertainty). As global populations and appetites grow, more land is needed for crop cultivation—especially for livestock feed—and pasture land for raising animals. This drives deforestation which is hugely polluting, devastating for local biodiversity, and cuts the natural carbon absorption capacity of forests. Avoiding deforestation with sustainably farmed or managed biomass is a huge enabler, as our **Nutrition** scenario denotes, as is shrinking the footprint of our diets by reducing our consumption of meat proteins.

RESOURCE EXTRACTION DOWN BY 28%

When taking a mass perspective, clearly the most impactful interventions for closing the Circularity Gap come from **Housing**, but also **Nutrition**. Although it is a less impactful spatial need, **Consumables**' intervention 'Eliminate toxins and pollutants' scored an interesting contribution to the Circularity Gap. In general, for **Consumables**, it seems that the only product category that can have sizable impacts on emissions and circularity is related to the use of chemicals and chemical products.

The mitigation potential for **Housing** largely stems from the diversion of C&DW. Of all global waste in 2016, a massive 67.6% came from stocks: largely demolished buildings, infrastructure (and machinery, equipment and vehicles to a smaller extent). With the global average recovery rates of C&DW only standing at 35%, there is huge potential for impact here. As a result, fewer virgin materials would need to be extracted, which would alleviate the environmental impacts of mining and processing to produce materials such as cement and steel for construction. A further benefit would be that the amount of cycled materials in the economy would rise.

However there are limitations to how much we can close the Gap—primarily due to the non-synergistic relationship between some interventions. Some that focus on designing products and infrastructure to last means that stocks last longer, resulting in a further locking up of materials, which diminishes their potential for cycling. In the case of durable housing, this has a huge impact on the Circularity Gap, given the large critical mass of construction materials. We found a similar pattern for **Consumables** and **Mobility**: while durability interventions that extend product lifetime can slash material use by 2.5 billion tonnes, they also reduce the cycling potential of these goods, appearing less 'circular' in our assessment than they actually would be in reality. This doesn't negate the relevance of both interventions (slow and cycle); both have a crucial role to play in closing the Circularity Gap, which can only occur if all demand for construction materials is met by secondary materials, which is technically challenging. (For more information refer to the text box on page 39).

SYNERGISTIC INTERVENTIONS

The reality is that the fastest route to achieving climate change mitigation hinges on substantial reductions in our overall use of materials. In particular, those that have the highest embodied emissions—namely, fossil fuels and sustainably produced biomass. The logic follows that interventions that focus on using less have a substantial impact on closing both the Gaps.

Housing leads as the societal need with the most synergistic potential. There are a few main reasons behind this. Firstly, it has a gigantic contribution to resource extraction. Secondly, it makes abundant use of carbon-intensive materials such as cement and steel, heavily produces direct emissions from space heating and cooling (which can be diminished by a shift to renewable energy) and lastly is dominant in the generation of waste and potential for secondary material supply in the form of C&DW. With circular strategies, 9.5 billion tonnes of C&DW could be diverted from landfill. This is over four times the total global municipal solid waste (2.1 billion tonnes). The interventions we applied to the second most impactful societal need of **Nutrition** appear to have a slightly greater impact on the Emissions Gap. This is not entirely surprising, as most of the sector is related to ecological, rather than technical, cycling (biomass). Moving to clean cooking stoves and healthy diets has a softer impact, while reducing excess consumption and sustainable farming stand out for their strong effect on both the Circularity and Emissions Gap, respectively.

The remaining societal needs **Health, Communication** and **Consumables** have a noticeably lower impact on closing both Gaps. Consumables scenarios, defined by efficient product design and use, were less impactful on the whole, having a higher relative impact on circularity than emissions. As noted, the only product group to have a significant influence on both Gaps was that of chemicals and chemical products—while more common consumer items, from furniture and appliances to paper and plastic, had a more modest effect. However, this doesn't mean these categories should be ignored, as these interventions cover the products that final consumers can most easily engage with. Circular consumption models will inevitably have knock-on effects at a systems level, in addition to being within the reach of individuals to drive the change. However, in tailoring this treatment plan to country profiles we will move forward by focussing on **Nutrition, Mobility, Housing** and the enabling space of **waste management**.

6

TAIL-ORED TRANSITION PATH-WAYS

Country profile roadmaps

Photo by Tembela Bohle

2021 will be the year that many countries revise their NDCs. This report has now shown the massive potential of circular strategies to deliver at a global level. However, to influence the massive decisions that will impact our climate future for generations to come and see real-life results, the global roadmap must be tailored to national pathways. This chapter builds on the country profiles introduced in the *Circularity Gap Report 2020*; whilst recognising that no single country can ever be a perfect match for all the criteria of any one group, it is important to join the dots of our understanding. In this chapter, we consider the high-impact areas of Nutrition, Housing and Mobility, plus the enabling role of waste management in three distinct country profiles—so demonstrating the nuances of implementing our roadmap for a well below 2-degree world, in practice.

DIFFERENT COUNTRIES, COMMON NEEDS

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[60] and their ecological footprint[61] 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.

A key point here is severe carbon inequality at present and how it has driven our world into the midst of a climate emergency. Nearly half (48%) of cumulative CO_2 emissions over the last quarter century can be attributed to just the richest 10% of the globe, whilst the poorest 50% were responsible for only 7%.[62] In the past decades, our tight global carbon budget has been lavished on feeding the consumption of the rich while failing to lift the majority of the global population out of poverty. And in a cruel irony, the emissions inequality also has another side: lower-income nations who contribute the fewest emissions are also most vulnerable to the impacts of climate breakdown.[63]

The 2000s have seen a record number of natural disasters, rising sea levels and extreme weather events—all of which are connected to climate change and disproportionately impact lower-income nations.[64]

Aside from the statistics presented in the table on page 49, which clearly illustrates the physical, social and economic dimensions of the country profiles, it's also worth considering the emissions and material footprint of each profile. This helps us tailor their diagnoses and provide insights into how different country profiles can reduce the material and emissions footprint of their Nutrition, Housing, Mobility and waste management needs. It is clear that leveraging the climate change mitigation potential of a circular economy in Build countries means something different from doing so in a Grow or a Shift country.

COUNTRY PROFILES
REDUCING EMMISSIONS & RESOURCE USE

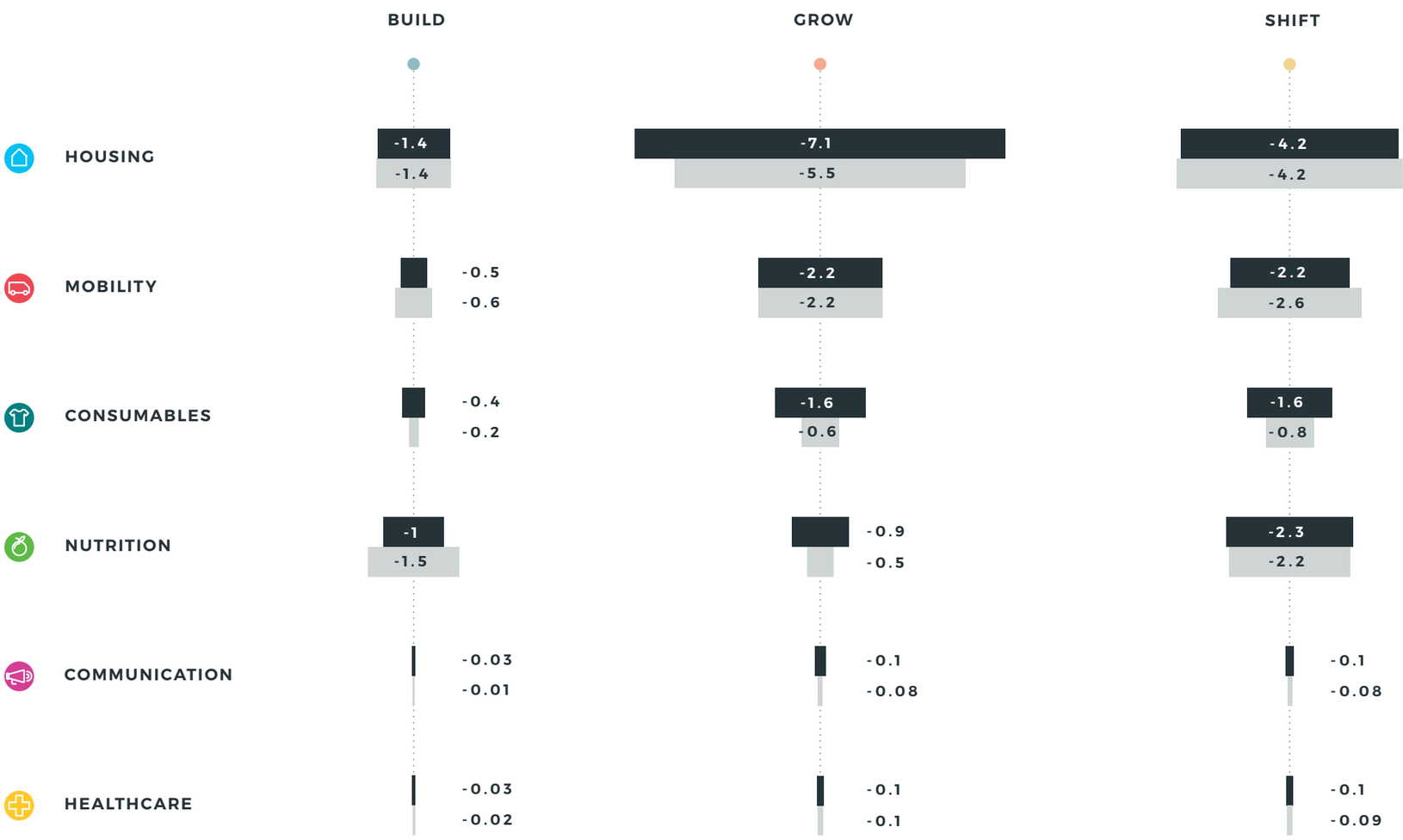


Figure Five shows which of our interventions have the most impact on the emissions and material footprint in absolute terms of each country profiles. All figures are in negative billion tonnes (Gt).

BUILD

A low rate of material consumption per capita means Build countries currently transgress few planetary boundaries, if any at all. They are responsible for the production of just 17% of global emissions and 19% of global resources in absolute terms, despite making up 48% of the global population. But these countries are struggling to meet their basic needs, including Human Development Index (HDI) indicators such as education and healthcare. They have biomass-oriented economies and are resource-rich, yet are net importers of fossil fuels, metal ores and non-metallic minerals in the form of finished and semi-finished products. As they continue to build their more basic infrastructure, Build countries have a uniqueposition in moving toward closing both the Circularity and Emissions Gaps.

When assessing the potential of Chapter Four's interventions, Figure Five shows that Housing and Nutrition have the largest impact in Build countries. As Build countries blaze ahead on improving the quality of life for their populations, four pathways in particular can aid the transition to a circular future that can also support limiting warming to well below 2-degrees. These relate to reforming agricultural practices away from monocropping and deforestation, applying circular thinking across their necessary construction, ensuring infrastructure for distributed and accessible mobility solutions in growing cities and combining informal and formal waste management infrastructure.

The Build profile is most relevant to countries in Sub-Saharan Africa, plus some small island states and Asian countries. The larger countries by population to which the profile may apply are India, Bangladesh, Ethiopia, Nigeria, Pakistan and the Philippines.

GROW

Grow countries are manufacturing hubs, hosting an expanding industrial sector and leading the way when it comes to building and economic growth. In facilitating rapid infrastructure expansion to lift a vast proportion of the population out of poverty and to accommodate a growing middle-class, they claim 47% of global emissions and 51% of global resource extraction from a consumption perspective, in absolute terms. They have the highest rate of non-metallic mineral extraction at 68%, are heavy metal ore users and are net-exporters of all four resource groups—they are the 'resource banks' of the global economy. The rapid industrialisation of these countries, and the expansion of the middle class, has occurred concurrently with improving living standards.

Figure Five highlights which societal needs require the heftiest emissions and material footprints, and guides us in narrowing our focus for impact. Four key transition arenas arise: prioritising sustainable agriculture, especially in products set for export, mainstreaming resource-efficient and low-carbon construction materials, satiating the growing appetite for energy with renewable sources where possible and establishing infrastructure for effective material cycling, including construction and demolition waste (C&DW).

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 Asian countries. The largest countries in this group are China, Indonesia, Brazil, Mexico, Vietnam and Egypt.

SHIFT

As leading emitters across all resource categories, Shift countries are at the centre of the transition towards a circular, low-carbon economy. Despite hosting a minority of the global population, they produce the majority of emissions (43%) and account for one-third (31%) of all global resource extraction. Their material consumption is 10 times greater than Build countries. Per capita, Shift countries are the largest consumers across all resource 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 resources.

Figure Five guides us in narrowing our focus for impact, and demonstrates how high impact Shift countries are. They are also highly responsible for reducing global emissions, particularly from an historical perspective, and are under pressure to do so—fast. In the high-impact areas of Nutrition, Mobility and Housing, Shift countries need to, first and foremost, take responsibility and reduce their consumption by integrating circular strategies across the board: from ownership to sharing models; to making the most of their goods—from buildings to vehicles—before, during and after their functional lifetimes and optimising how waste is valorised in the already mature waste management systems. To get there, they must mobilise all the technologies and funds that they have at their disposal.

The Shift profile fits best with the higher-income countries in the global North, in the Middle East and on the Australian continent. The larger ones are the United States of America, Japan, Argentina and member countries of the European Union.

COUNTRY PROFILES: PHYSICAL, SOCIAL & ECONOMIC DIMENSIONS

BUILD GROW SHIFT

	WORLD	
DEMOGRAPHIC INDICATORS		
Population[65]	**7.46**	billion people for all countries in each profile
Employment in agriculture[66]	**21**	percentage of total employment
ECONOMIC INDICATORS		
Gross domestic Product[67]	**60.3**	trillion € (Constant 2010) for all countries in each profile
Trade volume[68]	**33.7**	trillion € (Constant 2010) aggregate imports and exports for all countries in each profile
ENERGY INDICATORS		
Electricity access[69]	**89**	percentage of population with access to electricity
Energy usage[70]	**13.1**	billion tonnes of oil equivalent used per year
Renewable energy consumption[71]	**19.1**	percentage of renewable energy consumption based on overall energy consumption*
MATERIAL INDICATORS		
Material footprint[72]	**92.1**	billion tonnes of materials used by all countries in each profile
Material footprint per capita[73]	**12.3**	tonnes of materials used per capita per year
Material footprint of imports per capita[74]	**1.8**	tonnes of materials embodied in imports of all countries in each profile
Material footprint of exports per capita[75]	**1.8**	tonnes of materials embodied in exports of all countries in each profile
Stock build-up[76]	**28.7**	billion tonnes of non-metallic minerals used in all countries in each profile*
Waste generation[77]	**25.1**	billion tonnes of waste generated per year for all countries in each profile (excluding mining waste)
CARBON FOOTPRINT INDICATORS		
Carbon footprint[78]	**50.5**	billion tonnes of CO_2 equivalents for all countries in the profile (excluding LULUCF)
Carbon footprint per Capita[79]	**6.76**	tonnes of CO_2 equivalents per capita for all countries in the profile (excluding LULUCF)
Carbon footprint of imports per capita[80]	**0.62**	tonnes of CO_2 equivalents per capita embodied in imports of all countries in each profile
Carbon footprint of exports per capita[81]	**0.62**	tonnes of CO_2 equivalents per capita embodied in exports of all countries in each profile

DISRUPT: KEY ELEMENTS OF THE CIRCULAR ECONOMY

The circular economy assumes dynamic systems, a process of transformation rather than a specific end-point. The DISRUPT model gives it direction.

D **Design For the Future:** Adopt a systemic perspective during the design process, to employ the right materials for appropriate lifetime and extended future use.

I **Incorporate Digital Technology:** Track and optimise resource use and strengthen connections between supply-chain actors through digital, online platforms and technologies.

S **Sustain & Preserve What's Already There:** Maintain, repair and upgrade resources in use to maximise their lifetime and give them a second life through take-back strategies, where applicable.

R **Rethink the Business Model:** Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services.

U **Use Waste as a Resource:** Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

P **Prioritise Regenerative Resources:** Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way.

T **Team Up to Create Joint Value:** Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create shared value.

STRIVE FOR **SUSTAINABLE BIOMASS**

The production of biomass here refers to all living materials produced; in particular food crops, meat and dairy in agricultural activities and the production of timber in forestry. How we grow, source, process and transport our food—and what type of foods we eat—has a massive impact on both global emissions and material use. As agricultural production volumes rise and animal farming becomes more prevalent, land-use change (LUC) considerations in Build and Grow countries come to the fore. This is also due to the position of Grow countries as the largest agricultural producers in the world for virtually all commodities,[82] with almost one-quarter of the population employed in agriculture. Animal protein-intensive diets in Shift countries particularly affect agricultural emissions ascribed to Grow countries, with over 16% of the carbon footprint of the average EU diet attributable to deforestation.[83] As disposable incomes rise across the globe, the pressure to **safeguard our earth's natural carbon sinks**—forests—from deforestation in Build and Grow countries mounts, as well as moving **toward more regenerative agricultural practices**. Meanwhile, Shift countries should look at reducing **the impact of their often carbon-intensive diets**—from animal products to out-of-season products shipped around the globe abroad—and **high levels of food waste**.

To create a circular and low-carbon approach to agriculture, flows could first and foremost be **narrowed** in all country profiles, characterised by an efficient use of agricultural land. Across the board, the use of artificial fertilisers, pesticides and other pollutants should be eliminated to the extent possible to maintain healthy, fertile soils and safeguard biodiversity. Implementing a fully-fledged circular model of regenerative agriculture can drive the desired outcomes, whereby animal husbandry is balanced with crop cultivation, allowing waste products to be **cycled** into inputs: manure becomes fertiliser and crop trimmings and waste become fodder. In Build and Grow countries, resource-efficient practices that combine agriculture, forestry and livestock in community-managed systems are particularly relevant. In addition, efforts should be made in all country profiles to eliminate soil-degrading monocropping.

Rising levels of deforestation in Build and Grow countries—driven by practices such as feed-crop cultivation, expansion of pasture land and the planting of monocultures, to name a few—should be brought to a standstill. This can be done through a mixture of legislative action and **rethinking the business model**. In fact, research suggests that promoting a market for sustainably and responsibly produced goods in Shift countries, may, ultimately, be more effective than policy action.[84] This idea is strongly linked to the need for Shift countries to drastically reduce their consumption of animal products, which will have a sizable impact on both deforestation and other environmental indicators. Shift countries should also focus on **narrowing** flows by preventing the waste of edible food along the value chain. Innovative business models that **incorporate digital technology** can help prevent food waste at retail and household stages—which amounts to approximately 88 million tonnes per year in the EU, or 173 kilograms per person per year.[85] In Build and Grow countries, preventing losses at farm-stage, rather than household stage, is the primary challenge. In Brazil, for example, logistical issues hinder sufficient food storage—resulting in post-harvest losses of a mammoth 45%.[86] Losses can be mitigated with improved storage technology and infrastructure. On a global scale, food loss and waste are responsible for about 8% of GHG emissions[87]—and all countries have a role to play in minimising this figure.

REGENERATIVE AGRICULTURE: BRINGING LIFE BACK TO LAND

Niger, a country that historically battled desertification, has substantially increased its tree cover by transferring the **ownership rights of trees** from the government—which gave farmers little incentive to grow or protect them—to the people. In doing so, farmers can make money from their trees by selling branches, fruit and bark—a more lucrative opportunity than felling the trees for firewood. The result has been a **surge in community-managed forestry systems**, with the environmental co-benefits of healthier, more fertile and less dry soil.[88] [89] In Brazil, systems-thinking has influenced the Balbo Group to practice regenerative agriculture at scale—emulating natural processes and turning 'waste' into a resource.[90] The group developed a novel system for harvesting green cane: a machine splits cane into pieces, feeds the pieces into a hopper, strips the leaves, and returns the matter to the soil. While previous methods involved burning sugarcane straw pre-harvest, Balbo's Ecosystem Revitalisation Agriculture (ERA) feeds 20 tonnes of organic material per hectare back into the soil, forming a mulch that **replenishes nutrients, locks in moisture** and **hinders weed growth**. Along with reduced pesticide and fertiliser use, the system provides 20% higher yields than conventional sugarcane production. Across nations, Commonland is doing similar work. The initiative's drylands work in the water-scarce region of Altiplano Estepario region, Spain, tackles desertification and erosion.[91] Project members **planted 50,000 drought-resistant trees** native to the region, implemented measures to improve soil water retention, promoted biodiversity and engaged and mobilised local farmers and community members.

DESIGN CIRCULARITY INTO **STOCKS**

When it comes to the construction sector, the three country profiles are worlds apart. Build countries have the unique position where much of their infrastructure development has yet to happen. In stark contrast, in the Grow country of China, for example, more concrete was used in the past three years alone than the US in the entire 20th century.[82] Finally, the fact that Build and Grow countries are in the midst of building up crucial stock and infrastructure, while Shift countries should in theory have this available already, further aggravates the severe difference in consumption levels. We need to make strides in this hard-to-abate industry: by **designing circularity into new construction projects** in Build countries and ensuring that it also takes centre stage in infrastructure to accommodate Grow's swiftly growing middle-class—by means of **lightweighting and cycling**—we can yield significant reductions in their emissions and material footprints. Policy in Shift countries should **limit stock expansion**, require the **reuse of construction materials and extend the functional lifetime of buildings and infrastructure** to stem the impact of one of the globe's most polluting sectors.

The accelerating demand of urbanisation in Build and Grow countries necessitates new stock build-up—this is evident already. Looking ahead, the opportunity exists to **narrow** flows by **designing for the future**, and using locally-procured, lightweight materials (like wood, clay and loam) to replace emissions-intensive, traditionally linear alternatives such as cement, steel and glass.[93 94 95 96] Advances in architectural and engineering applications for **regenerative** wooden materials allow for broader use of locally-sourced and renewable timber, even in high-rise buildings. In Build countries, passive design and durable, climate-resilient design emerge as priorities. In the case that cement use is absolutely necessary, both Build and Grow country profiles could slash emissions by replacing carbon-intensive clinker with biological residuals like rice husk. An innovative production chain in Brazil, for example, uses açaí pits as a clinker substitute, both improving the sustainability of the energy matrix and providing local jobs in the process.[97 98]

In Shift countries, where stock buildup is at a relatively steady level, the focus should be placed on making the most of what already exists in the built environment—ultimately **slowing** flows to extend the functional lifetime of buildings through renovation rather than demolition. Flows can be narrowed by reducing the overall floorspace populations need, and by using space more efficiently: in the wake of covid-19, we have seen a decreased need for office space as the professional workforce have been confined to their homes, raising support for flexible location working and partial home-office arrangements post-pandemic. This opens up traditional office spaces to be retrofitted for a myriad of functions, from housing to community space—a practice that should be echoed in future design which can incorporate the principles of 'flex buildings'. In the case that new construction is necessary, Shift countries should anticipate the cycling and regenerating of flows for instance by leveraging the urban mine. Modular design and offsite construction, which can avoid glueing of components, both enable swift disassembly and reassembly of modules, extending the functional lifetime of parts. Combined with digital technology such as materials passports,[99] which catalogue the products used in a building and create documented 'storage units' of materials, Shift countries will have an arsenal of tactics to make the most of their buildings before, during and after their functional lifetimes.

BIO-MATERIALS: THE HOLY GRAIL OF CIRCULAR CONSTRUCTION

Innovations in bio-based construction materials have impacted lives and housing developments in Kenya, where research team Pamoja Projects has developed a **material sheet** made of **residual waste from corn and rice crops**. The technology is both low-cost and sustainable, and can be locally procured for use in construction projects across the continent—also boosting job creation in rural areas which prevents mass migration to urban areas unequipped to handle a population boom.[100] Build countries may continue to develop housing and infrastructure with circular strategies in mind—going beyond a sole focus on materials and additionally encompassing social wellbeing. Tsoga Environmental Centre, a community centre in one of Cape Town's informal settlements, encapsulates these principles: the project was shaped to **upskill and employ residents**, use **locally procured and sustainable materials** and improve quality of life for the neighborhood's residents.[101] Bamboo—which is fast growing and prevalent in tropical and subtropical regions—is another opportunity for building circularity into stocks. The Panyaden International School in Chiang Mai, Thailand, exemplifies the benefits of this beautiful and sustainable material: the school commissioned a **782 square metre sports hall, built from bamboo** without steel reinforcements or connections. The design meets modern safety standards while allowing for natural ventilation, and is entirely carbon-neutral: the CO_2 sequestered by the bamboo during growth was greater than emissions from transportation and construction.[102] In Shift countries, similar advances are being made in the development of novel building materials: for example, the innovative use of **seaweed** in Danish architecture provides a material that is naturally **rot and fire resistant, carbon negative** and **repels pests** due to its high salt content. The seaweed is used in building panels that can be easily prefabricated—and then disassembled at end-of-life—and acts as a natural temperature regulator that reduces the need for excessive heating and cooling.[103]

MAKE **MOBILITY CLEAN**

Mobility remains a dominant emitter, especially in Shift countries where commuting and global travel are frequent and car ownership is ubiquitous. But Build countries will see a greater need for passenger mobility and freight systems as their cities grow rapidly—often with limited urban planning or coordination. In Grow countries, meanwhile, meteoric urbanisation has already occurred and mobility systems are under immense strain. The need for **efficient and sustainable passenger and freight mobility** echoes across the profiles. But demand must not be fed with traditional mobility solutions based on fossil fuel combustion. Instead, **urban planning** which encourages fossil-free mobility and incorporates modern and **digital technologies** to **regenerate** flows should take centre stage. Shifting business models and behaviour from **ownership to sharing** and **incorporating durable design** into vehicles also emerge as impactful avenues—especially for Shift countries where the average European car is parked for 92% of the time.[104]

Fortunately, circular strategies can pave the way towards sustainable urban mobility. Firstly, all county profiles are able to **narrow** carbon and resource footprints by curbing the need for transportation. In Grow and Build countries, the rapid expansion of cities often coincides with the challenge of creating effective, well-distributed transportation networks. The UN estimates that by 2030, 43 'mega-cities' with upwards of 10 million inhabitants will span the globe—the majority located in Grow countries. Meanwhile, many urbanised Shift cities are now already busy with urban planning initiatives to encourage the de-motorisation of transport. **Rethinking the business model** and incorporating urban planning could create well-coordinated 'community villages', or neighbourhoods, where residents can easily satisfy their daily needs—school, work, retail and entertainment—by foot, or on bike. This, in turn, reduces traffic, congestion and consequential air pollution. Cities across all profiles may also work to reduce emissions by targeting freight mobility. Interventions like the creation of 'pick up points'—collection and distribution depots scattered throughout neighbourhoods—reduce the journeys delivery companies have to make, thereby reducing traffic congestion and emissions.[105]

Urban planners can also implement polycentric design, where several key districts can coexist and function as a self-contained 'city within a city,' thereby shortening commuting distances and increasing public transport use between the sub-centres.[106] Meanwhile, particularly in Shift countries, locked-down nations reduced their travel immensely in 2020 as many office-based professionals used **digital technologies** to move to online environments—proving that many of us don't need to commute every day.

While fewer opportunities exist to **regenerate** and electrify car transport in Build and Grow countries, owing to lower levels of vehicle ownership and less expansive charging infrastructure, they can still make a huge impact by electrifying their scooter fleet and public forms of transport. Although some Shift countries, such as Norway, boast an impressive number of electric vehicles, additional solutions such as sustainably generated hydrogen or biofuels represent interesting avenues for further innovation in combustion engines. It's not only the fuel for vehicles that makes Mobility in Shift countries very resource and emission-intensive, though. Firstly, a large amount of materials are funnelled into building transport technologies such as cars, trains, or ships in the first place. Also, vehicle ownership is very high; electric or not. Therefore, Shift countries should investigate the classic **slowing** strategy that is especially suited to countries that already have a substantial fleet of vehicles: **rethinking the business model** and encouraging car-sharing over ownership.

THE NEW MOBILITY: URBAN CONNECTIVITY, ELECTRIFICATION AND SHARING SYSTEMS

Actions to stimulate a modal shift are already occurring across Build countries, from the introduction of **high-speed electric trains** connecting cities in India,[107] to the revitalisation of colonial-era rail systems across Africa.[108] Currently, Africa's transportation capacity is fairly limited to road transport, with up to 90% of people moving from A to B with motorised vehicles, resulting in severe congestion in urban centres. **Revamping rail systems** will finally reconnect secondary cities to nationwide networks—presenting a crucial opportunity for both emissions reduction and improved urban planning. The importance of urban planning in inspiring modal shifts is clear: in Myanmar, for example, the past decades of urbanisation saw the **development of wide-laned rural roads in urban centres**, with no transitional public space and often susceptible to flooding. Changes in planning policy began to **accommodate cyclists and pedestrians** through narrowing lanes, eventually resulting in measurable reductions in emissions and air pollution.[109] Meanwhile, circular mobility in Grow countries can take the form of electrification and sharing systems. As scooters are the predominant form of transport in many countries across this profile, **sharing systems for electric scooters** are on the rise across Brazil, China, Malaysia, Mexico and South Africa,[110] allowing for more individualised mobility. In Shift countries, car sharing is enjoying a spike in success—especially as companies like Zipcar spread across the globe, establishing roots in over 500 cities. With the tagline 'Own the trip, not the car' the company works to change **established attitudes about ownership** by providing the convenience of car use without the hassleshassles of maintenance and repair.[111]

Photo by Vishal Shah

IMPROVE WASTE **MANAGEMENT**

Increasing affluence in Build and Grow countries—especially the swelling middle class in the latter—will see a concurrent increase in waste, not yet matched by sufficient waste management infrastructure. Waste management is a crucial enabler of the circular economy, as recovering materials or energy from waste is necessary to close loops and provides a continuous stream of resources. In the absence of waste management systems, or when they are overloaded with other countries' waste, unregulated open-fire burning—which emits black carbon and harmful toxins—has become an issue of mounting urgency for both environmental and human health. It is estimated that over 40% of the globe's solid waste is burned in open fires, with a significantly higher proportion in lower-income countries.[112] Without sufficient **infrastructure to collect, sort and process waste**, this rate is only set to increase. Linked to this issue is the rate of waste Shift countries export out to other countries, where there can be insufficient **valorisation of waste materials**. While waste infrastructure in Shift countries often runs smoothly, much work is yet to be done to fully **close material loops** and make the **most of what we consider waste**.

Waste management priorities vary widely between country profiles. In many cases, kerbside waste collection in Build countries is limited, and rarely reaches large unregistered settlements on the periphery of dense urban zones. In these areas, waste collection is largely organised and conducted through informal workers, also prevalent in some Grow countries, who can face significant social and health challenges in the absence of formalised unions. This demonstrates a need to **rethink the business model**, beginning with the empowerment, formalisation and eventual upskilling of waste pickers—before attempting to build up recycling or incineration plants. Build and Grow countries can endeavour to future waste flows by limiting the amount of waste produced in the first place—for example, through bans on single-use items, or measures to address the sachet economy prevalent in lower-income communities. Once sufficient infrastructure has been built for processing and segregating waste, flows can be **cycled** by finding alternative end-points for waste—such as the transformation of organic waste into biogas.

Ideal avenues for **cycling** in Grow countries may include industrial symbiosis approaches, where closely located industrial activities utilise each other's waste streams.

Shift countries produce the highest levels of waste—11.6 billion tonnes per annum for all countries in the profile. As levels of collection and processing are relatively high, the priority here becomes reducing overall waste volumes. Countries can **design for the future**, eliminating excess resource use in packaging and product design, and **prioritise the use of regenerative resources**, for example by using biodegradable materials for packaging or certain product components. In managing the waste volumes that still arise, Shift countries must stop exporting their recyclable waste to Build and Grow countries, where processing facilities lack capacity. Policymakers and governments can also **team up to create value** and further roll-out schemes like Extended Producer Responsibility to hold corporations accountable for their waste. As technology is developed to process currently non-recyclable waste, landfills should be eliminated, with a view to remediating affected areas and restoring degraded ecosystems.

RAMPING UP RECYCLING: WASTE PICKERS, REUSE SOLUTIONS AND DIGITAL TECHNOLOGY

Technology-based solutions come into play in unifying the informal sector, as seen in the case of Kabadiwalla Connect. The Indian company provides **cost-effective and low-carbon solutions for waste collection, segregation and processing** through spatial mapping, digitalisation, sourcing and reverse logistics solutions that integrate informal workers into the system. For non-recyclable waste, other solutions emerge: community members can create 'eco-bricks' to use in construction, **using waste as a resource** by stuffing plastic bottles with non-recyclable waste, which are then used to form interlocking blocks. Port Elizabeth, South Africa, will boast the world's largest eco brick building: a school built entirely of the material, spearheaded by non-profit EcoBrick Exchange.[113] It should be noted that higher-value applications or recycling are preferable on the waste management hierarchy—but nonetheless, the project has already removed over 10 tonnes of waste from the community. Projects that increase accurate sorting, a crucial component of high-quality recycling, are also on the rise—as exemplified by UK-based pioneer project HolyGrail. The startup's approach is to tag recyclables with codes unique to their composition, using chemical tracers and digital watermarks. Preliminary results are promising, demonstrating that **digital watermark technology** can be applied in a myriad of situations and retrofitted into existing waste facilities—thus allowing for improved sorting rates, and consequently, higher levels of plastic recycling.

7

NATIONAL CLIMATE PLEDGES AND THE NDCs

Enabling a global circular economy

Photo by Luiz Clas

The rescheduling of 2020's COP26 and the far-reaching impact of covid-19 means that most countries were not on track to update their Nationally Determined Contributions (NDCs) by the end of 2020. This allows us to shape climate pledges for the globe guided by the lessons we have learnt over the last year. We live in a world that is only 8.6% circular and nowhere near limiting warming to below 2-degrees. This report can guide countries in making the course-correction we so desperately need: for the economy, ecology and society. This chapter details the barriers and enabling factors for a circular roadmap in the Build, Grow and Shift profiles, as well as assessing the efficacy of their current climate pledges: the NDCs. Across the board, current NDCs are overwhelmingly focused on the energy transition. Circular nations are not only more resource-efficient and low carbon, but there are many co-benefits to be enjoyed. For countries, this truly is their time.

ENABLING THE CIRCULAR TRANSITION IN BUILD COUNTRIES

Build countries have a number of contextual factors to consider in creating an enabling environment for the successful uptake of circular strategies. They are resource-rich and place a high focus on the extraction and sale of raw materials, but fall short in HDI indicators like education and healthcare. The good news: they have yet to build up much of their infrastructure, presenting a key opportunity to embed circularity in their practices and NDC pledges surrounding biomass, construction, mobility and waste management.

When it comes to legislation and policy, in Build countries, teaming up to create joint value is crucial in better-enforcing laws and in requiring multinationals—often from Shift countries—to take charge of their value-chain impacts across the world. While tackling deforestation is imperative, and often well-addressed in Build NDCs, the reality is politically fraught[114 115 116 117]—and well-articulated laws are often broken,[118] resulting in half of all tropical deforestation happening illegally.[104]

Similarly, lax regulations have allowed for the growth of unplanned urban 'sprawl' around the periphery of Build cities—whilst this housing is urgently needed, it must be sufficiently planned for—,[120] hindering the implementation of distributed mobility systems and efficient waste collection. The implementation of environmental regulation and planning can be stifled with structural enforcement issues and corruption; therefore, addressing these obstacles through increased transparency and control is imperative to facilitating sustainable growth and protection of natural capital in Build countries.

Build countries are also often characterised by a high prevalence of informal workers: in Africa, as much as 86% of the population is employed in the informal sector.[121] Teaming up to create joint value and aligning the role of the decentralised labour sector with waste management processes will be necessary to reduce footprints and material use from both construction and demolition waste (C&DW) and solid municipal waste. Burning—which can occur at major landfills, small dumpsites or households—may be spurred by a desire to uncover non-flammable materials like metals for scavenging. By introducing waste management infrastructure, halting waste-imports from Shift countries and formalising waste pickers—allowing them to work in safer conditions in processing facilities—these issues may be addressed.

Finally, actions taken across Build countries must be holistic in nature, and consider the complexities of the issues at hand. Previous efforts to address the waste problem, for example, have seen donors pouring financial resources into one big project, as results are easier to monitor.[122] Such projects may lack qualities necessary for and specific to localities, and because they do not take the wider context into consideration, often go out of business or lack economic viability.[123] Well-intentioned but misguided policies can backfire without a long-term approach and consideration of knock-on effects. The need for holistic action plans and participatory approaches—that consider the people these measures will affect—applies across sectors and geographies.

PRIORITIES FOR BUILD COUNTRIES' NDCS

Despite the United Nations Framework Convention on Climate Change's recognition of 'common but differentiated responsibilities', which acknowledges the comparatively minimal contribution of Build countries to climate breakdown, these countries' NDCs showcase strong ambitions and detailed action plans for climate change mitigation and adaptation. Their contributions, at times, detail the importance of shifting attitudes and habits as well as honing in on technology and finance.

India, for example, pledges to 'propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation', and notes that we 'must promote…sustainable lifestyles across the globe'.[124] Although it varies by country, circular strategies pop up within Build NDCs, especially in the realms of agriculture, forestry, energy efficiency and renewables expansion. In Ethiopia's NDC, for instance, agriculture and forestry are prioritised as they have the greatest emissions mitigation potential, while Kenya focuses on continuing to grow their already mostly clean energy mix by enhancing solar, wind and geothermal development. While these countries are generally on track regarding circularity and mitigation efforts, often with a strong additional focus on building resilience, there is room for growth.

Moving forward, Build countries can place a greater emphasis on developing circular construction and mobility systems, facilitated by cutting-edge urban planning and powered by renewables. Further challenges may arise in the implementation of the transition pathways already well-aligned with country NDCs; as corruption and political instability prevail, effective policy-making is vulnerable to manipulation from special interest groups.[125] For Build countries to successfully close both Gaps, well-intentioned legislation must be backed by strong political will and enforcement, and global markets must adapt to create room for sustainably produced goods and services from these regions.

ENABLING THE CIRCULAR TRANSITION IN GROW COUNTRIES

Grow countries have experienced rising levels of industrialisation, as well as higher living standards in recent years. This profile's resource use is characterised by fast economic growth—and material consumption increasing in tandem. Sustainable growth must, therefore, focus on using natural capital more efficiently, as well as further developing human capital. Key strategies for Grow countries in ramping up their NDCs will include incorporating circular design in construction, with a focus on public procurement, and safeguarding their biomass.

For our recommendations to be successfully incorporated in Grow countries, a number of enabling factors may be considered. Cultural elements once again come into play, as with Build countries: circular strategies must engage with those that they affect on a deep level, or the long-term uptake and success of those strategies will dwindle. Social co-benefits of the proposed interventions must be highlighted: for example, farmers are generally eager to use food waste as feed because it reduces their costs by up to 60%.[126] Initiatives focused on curtailing deforestation must similarly provide economic incentives to those on-the-ground to see success; research indicates that providing income-generating opportunities, which will impact the lives of those that take part in illegal logging, are considerably more effective than enforcement of law alone.[127] [128] Additionally, the formalisation of informal workers must place people at the fore, prioritising safety, health and respect.

Once again, stringent legislation related to multiple sectors—forestry and urban planning among them—is relevant to Grow countries' circular transition. Regulations must reflect circular goals: not allowing, for example, the construction of wide-laned rural roads in urban centres that fail to prioritise pedestrians, or urban sprawl that impedes walkability. Urban planning also encompasses the built environment, much of which is developed and operated under government authority in Grow countries—thus enabling public procurement to be a key driver of the circular construction transition, boosting demand for efficient and secondary material use. Incorporating digital technology and making the most of new recycling approaches for C&DW will be crucial, and should be done in tandem with the formalisation and eventual upskilling of the informal sector.

PRIORITIES FOR GROW COUNTRIES' NDCS

The NDCs of Grow countries are generally strong, characterised by a solid level of detail in their emissions mitigation plans. As the largest economy—and the biggest emitter—in the profile, China steps to the fore as the circular economy leader, exhibiting a range of interventions from building up recycling infrastructure and eco-industrial parks, to implementing low-carbon agriculture techniques and reusing organic waste.

While other Grow countries vary in their levels of detail and target mitigation areas, most NDCs would benefit from an increased focus on circularity in the construction sector—especially as urbanisation in these regions will continue to spur the expansion of the built environment. The importance of a functioning, future-focused waste management sector—that both collects and segregates waste at scale and produces high-quality secondary materials—is also generally overlooked. While the urgent need to halt deforestation and turn to more regenerative practices in agriculture is generally afforded attention in Grow NDCs, countries moving forward must align legislation with strong political action that enforces laws and punishes illegal logging and burning. In the future, Grow countries can create tangible routes for action by placing an even stronger emphasis on circular strategies, coupled with holistic plans for implementation that benefit the planet and people.

ENABLING THE CIRCULAR TRANSITION IN SHIFT COUNTRIES

Shift countries consume a vast volume of materials and, simultaneously, produce large amounts of waste, falling far outside of healthy planetary boundaries. A number of the social and environmental externalities that result from Shift countries' actions occur elsewhere—ultimately indicating that nations in this profile must further take responsibility for their consumption and emissions. The richest 1% of the global population account for more emissions than the poorest 50%.[129] As Shift countries further develop their national climate pledges, they will benefit from strong circular policies embedded across sectors. This will also reflect the rising activism in these nations which is an increasingly influential factor in social change.

In Shift countries, which have implemented much of their housing, infrastructure and mobility systems and are growing at a slower pace than Build and Grow, one priority emerges: governments must drive the transition as much as possible with legislation and policy. This is crucial in achieving what markets cannot: abolishing fossil fuel subsidies, regulating fertiliser and pesticide use, and enforcing stringent building efficiency requirements, amongst other measures. A second priority is shifting the attitudes and perceptions of populations. It will be crucial to tackle consumer beliefs that typically place object ownership on a pedestal over object sharing,[130] [131] as well as beliefs that enmesh success with materialism. Additional government focus may be placed on awareness and educational campaigns that work to shift cultural barriers, for example regarding perceptions of what constitutes a healthy diet. Currently in Shift countries, much of the onus for sustainability falls on the private sector; it will also likely rest with producers to create a greater market for ethically produced goods, and for architectural and engineering firms, infrastructure developers and construction companies to implement principles of circular design.

As with the other country profiles, all legislation or policy implemented must be holistic and address and support various actors teaming up to create joint value throughout the value-chain. To illustrate: consider the advent of laws that prevent supermarkets from destroying edible food. While well-intentioned, these did not address knock-on effects. For example, food banks without sufficient infrastructure for perishable goods were overwhelmed by massive influxes of donations, highlighting the necessity for collaboration among actors.[132] Furthermore, circular and sustainable public procurement is one of the most effective tools at governments' disposal to catalyse the transition, and is increasingly being recognised as a means of financing sustainable construction, for example. While collaboration is demonstrably crucial, it must go hand-in-hand with strong legislation that creates the conditions for circular or sustainable companies to flourish—while targeting those that do the opposite. To this end, Shift country governments must lead the way in taking responsibility and corporate accountability for the impact their lifestyles can have on other countries, especially due to their huge reach over supply chains. This must be done with strong political will that doesn't fall prey to the interests of lobbyists. In 2010, for example, the newly proposed American Clean Energy and Security Act was the 'most promising' piece of climate legislation in the US to date[133] [134] —yet private-sector companies expecting losses spent more than 575 million euros lobbying the bill, eventually driving its failure. Novel research shows that political opposition against cap-and-trade climate policy can be reduced by freely allocating subsets of permits to regulated firms, within the cap—reducing costs for regulated firms yet not impacting environmental goals.[135] This is particularly relevant to Shift countries, which often tout market-based climate solutions.

PRIORITIES FOR SHIFT COUNTRIES' NDCS

Most Shift countries are the highest global emitters and it is the opinion of many that the burden of climate mitigation should fall on their shoulders.[136] Despite this, Shift action plans are largely vague, and many countries in this profile are not on track to meet these loose goals. In the years directly succeeding the Paris Agreement, Shift countries' emissions have continued to climb, illuminating the breadth of work to be done

on overhauling the NDCs and working to implement strong policy. Rising frustration at the failure of Shift countries to commit to strong action has triggered powerful movements of climate activism in recent years, especially among young people—yet more work remains to be done as Shift countries review their NDCs and climate policies in the coming years.

Currently, most Shift NDCs have built-in high levels of flexibility, and often mention target areas for reduction without detailing specific mitigation measures. In this way, vague goals set by governments fail to translate the necessary clarity and ambition to key actors to drive the change together. This has resulted in market-based approaches like carbon pricing that are just too narrow and weak to meet our climate goals. As long as carbon remains underpriced and ambitious reduction targets are only given for the distant future, Shift NDCs cannot reflect the mitigation ambition required—massive, systemic change. Circular strategies are few and far between in this profile's action plans, with the exception of Japan and Chile—which do list detailed strategies under a broad range of mitigation areas and incorporate principles of circularity throughout.

On the whole, the transformation of energy supply, circular housing, mobility and sustainable food systems need more attention and speed—with these transformations requiring significant investment into infrastructure, policy and behavioural change, beyond the functional capacities of the private sector. Now, in 2021, the political climate leading up to the COP26 foreshadows promising change: the EU parliament has voted in favour of increasing the targets of Member States, aiming for a 60% reduction in emissions by 2030, while the Biden Presidency will see the US rejoin the Paris Agreement. Shift countries have an excellent opportunity to formulate more defined blueprints, supported by circular strategies, towards closing the Emissions Gap.

Photo by Sunyu Kim

8. THE WAY FORWARD

Tackling climate change calls for course-correction and a systemic-thinking approach. In looking beyond single variables, such as renewables or energy efficiency, we need a rounded understanding of our impact on the world. To achieve such a big shift, climate mitigation strategies must harness the transformative power of the circular economy. As our report illustrates, these twin agendas of change working in tandem can carry us down the road to a world that is well below 2-degrees warmer by 2032. And this massive impact will—on paper—only mean upping the circularity of the world by a further 8.4%.

Doubling circularity from its current figure of 8.6% will require us to pivot away from business-as-usual—for good. Yet, the take-make-waste habits of the linear economy are proving very hard to shake, and time is not on our side. Even if every one of the current Nationally Determined Contributions (NDCs) were fulfilled, temperatures could still rise to 3.2-degrees within this century.

Yet our report illustrates that transition pathways that are systemic and transformative are available. Whether from the perspective of a Build, Grow or Shift profile, countries can fulfil their societal needs in resource-efficient and low-carbon ways—by doing more with less. By applying circular strategies at the intersection of materials and emissions hotspots, countries can increase cycling and value-retention and cut excessive consumption, thereby slashing greenhouse gas emissions. This is how narrowing the Circularity Gap closes the Emissions Gap.

But, where do we begin? This big shift towards a more circular tomorrow starts by adopting strategic steps to bridge the gaps through leadership and action. These steps can embed circular economy principles and practices into the NDCs of individual countries, as well as facilitate policy and market frameworks that explicitly incentivise circular outcomes at all levels. These linkages serve to strengthen and align local actions with global aims.

The steps also bring people together and make connections across national, cultural, societal, sectoral and professional boundaries—to enable collaborative endeavours and engender collective responsibility.

From knowledge sharing to brand allyship, this coalition of the willing is a powerful agent for accelerating change. In the short term, our roadmap to a well below 2-degree world should leverage the policy-making platform provided by the upcoming COP26. It must, though, look beyond Glasgow, and towards longer-term climate legislation, too. Our vision for closing the Circularity Gap needs to be both ambitious and actionable.

If the events of 2020 taught us anything, it is that we can think the unthinkable and even do the undoable. Climate mitigation and a circular economy are undoubtedly difficult; but, together, they are not undoable.

BRIDGE THE GAPS THROUGH LEADERSHIP AND ACTION

1. **Build a coalition for action that is both diverse and inclusive.** Bringing a diverse community of businesses, governments, NGOs and academics together to boost capacity and capability will accelerate collective action toward circularity, serving the betterment of societal needs and global ecological health. This will enable action toward reaching the Paris Agreement's goals before it's too late and begin to build the necessary infrastructure and alliances to collect, retrieve and share circular knowledge on a global level.

2. **Integrate plans for leveraging the circular economy into national climate pledges.** Circular strategies suited to different country profiles can get nations back on a well below 2-degree pathway. Integrating tailored plans can also enable better goal-setting, measurement and benchmarking for countries in the NDC revision process, and ensure that each nation can address global issues in a way that aligns to their local context, incentives and mandates. This can also support key industries that need to shoulder the change.

3. **Create an enabling environment to facilitate the circular transition.** Market and regulatory failures that inhibit the enabling conditions needed for circular initiatives to reach scale can be addressed by policymakers; including steering away from financial models that only support linear projects. Capital must also be mobilised toward circular initiatives to unlock the potential of 'building back better'.

Photo by Denys Nevozhai

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