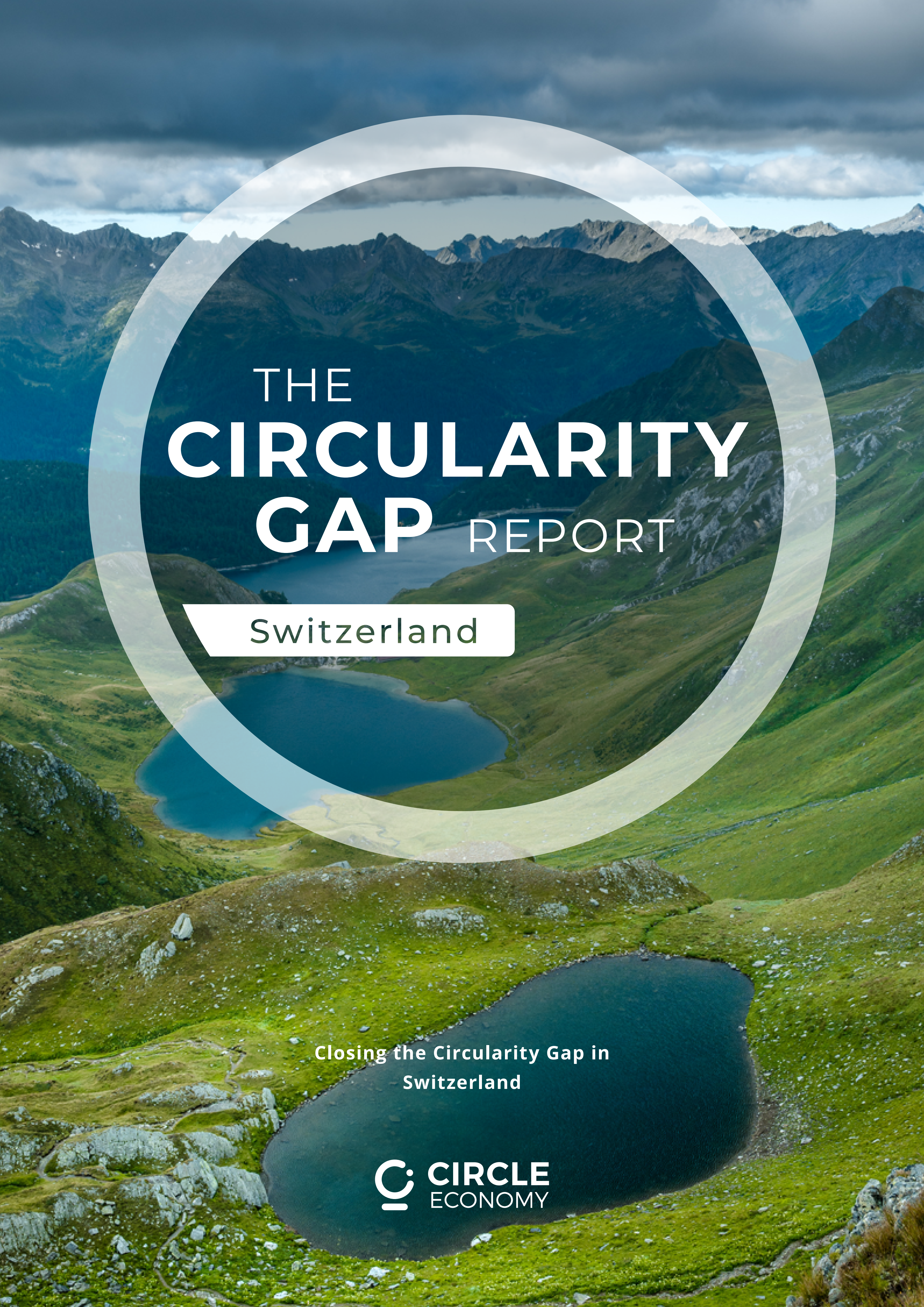


THE CIRCULARITY GAP REPORT

Switzerland

Closing the Circularity Gap in Switzerland

CIRCLE ECONOMY

CIRCLE ECONOMY

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

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

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

BEHIND THE COVER

Switzerland's iconic Lake Ritom in Val Piora, with pools formed one after the other in a line, may remind us of the linear economy—but their circular shape also nods to the path forward. On this cover, the three circular lakes emphasise the urgency of the transition to a circular economy for the country, to both preserve nature and maintain a high quality of life for all.

Deloitte.

Deloitte Switzerland is part of a global professional services network that provides integrated services including audit and assurance, consulting, financial advisory, risk advisory, tax and related services to our clients. With nearly 2,700 employees at six locations across Switzerland, including our headquarters in Zurich, Deloitte serves companies and organisations of all legal forms and sizes in all industries.

Driven by our purpose to make an impact that matters, we understand the necessity of bringing the public and private sectors, and civil society together to work on sustainable solutions that benefit businesses, society and the planet.

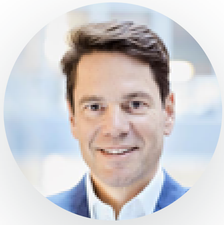
Circular Economy Switzerland

IMPACT HUB Switzerland · kick start · MINERVA STIFTUNG

Circular Economy Switzerland pursues the vision of a Switzerland that has completed the transition from a linear economy to a circular economy. By connecting enthusiastic circular economy actors from the private sector, civil society, politics and administration and promoting cooperation and knowledge exchange across all sectors and areas, Circular Economy Switzerland acts as a catalyst for a broad and strong circular economy movement in Switzerland.

To achieve this goal, we are facilitating a national multi-stakeholder roadmap through a participatory process in conjunction with the *Circularity Gap Report Switzerland*, supported by the Minerva Foundation. Impact Hub Switzerland and Kickstart Innovation are our implementation partners.

IN SUPPORT *OF THE CIRCULARITY GAP REPORT SWITZERLAND*

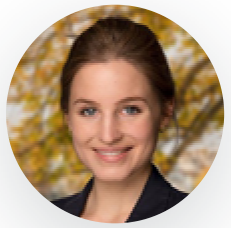


DR STEFAN BRUPBACHER
DIrector at Swissmem

'Circular economy is both an imminent opportunity and challenge for the manufacturing industry. The world is increasingly consuming more: this requires more energy- and resource-efficient machines, new technologies and business models to mitigate. Herein lies an opportunity for the Swiss manufacturing industry, which thanks to its exports, can help contribute to circular solutions worldwide.'

DR SEBASTIAN FRIESS
President at the Bern Economic Development Agency

'The *Circularity Gap Report* shows us that we've reached a turning point in economic growth and development: linear value chains can no longer be the holy grail. Future-oriented growth must be based on circular economy principles and closed resource and energy loops. The Canton of Bern has embraced this through a clear government's vision and several support programmes for companies. More will follow.'



KATHRIN FUCHS
Co-Lead at Circular Economy Switzerland

'The *Circularity Gap Report Switzerland* shows the potential of a circular economy in Switzerland, highlighting how it can address the root causes of climate change while offering an economic and social opportunity to do better. To realise this potential, we need collaboration, a shared national roadmap and joint action between stakeholders.'

ADÈLE THORENS GOUMAZ
State Councillor and President of the Committee on the Environment, Regional Planning and Energy

'This *Circularity Gap Report* is a milestone for Switzerland. It gives us an overview of the current situation and shows us how far we still have to go. The time is right, as our country is about to finally include sustainable resource management in our Environmental Protection Act. Switzerland has been a pioneer in the field of recycling, but there is still a lot to do. We must begin with action from the product design stage, to effectively reduce material consumption and make our economy more efficient, resilient and sustainable. To do this, we need to mobilise our capacity for innovation and develop new business models. The circular economy must be understood as an opportunity, for our companies as well as for our environment.'

MARINA CAROBBIO GUSCETTI
State Councillor at the Canton of Ticino

'The circular economy is central to tackling climate change and can have a major impact on sustainability. The effects of climate change are evident in our region, from a lack of rainfall south of the Alps to the subsequent water shortage. Water, the cornerstone of life on our planet, must be used with care and waste must be minimised. A concerted transition towards a circular economy would allow us to better protect essential resources such as water, and reduce waste and pollution.'

ANDRÉ HOFFMANN
Vice-Chairman at Roche Holding Ltd.

'This report makes a strong case for us to rethink how we stay within our planetary boundaries. It provides valuable insights on the crucial role the circular economy must play in the systems change we urgently need. The *Circularity Gap Report Switzerland* may serve as a blueprint for those driving circularity in their fields of work.'

ALEXANDER KEBERLE
Head of Infrastructure, Energy & Environment and Member of the Executive Board at economiesuisse

'The circular economy is both a responsibility and an opportunity for Switzerland. As a high-income country, Switzerland uses a great deal of resources—but it also has a strong, innovative and sustainable economy that can leverage the potential of the circular economy. Swiss businesses must play an important role, pioneering cutting-edge technology and thus contributing to the global implementation of the Sustainable Development Goals. To fully tap into the potential of the circular economy, however, businesses need a conducive ecosystem and enabling framework conditions.'

KATKA LETZING
Co-Founder & CEO at Kickstart Innovation, Spinoff of Impact Hub Zurich

'The *Circularity Gap Report* shines a light on the industries in Switzerland where current systems must be rethought. We still have the potential to pivot, to shape a thriving climate and economy. The report gives recommendations and inspires stakeholders to collaborate and embrace the change that needs to come.'

IN SUPPORT *OF THE CIRCULARITY GAP REPORT SWITZERLAND*

IRENE MARTINETTI
Manager of Circular Economy at the World Business Council for Sustainable Development (WBCSD)

'Moving to a circular economy is about generating value for both people and planet. Along with economic value, well-managed circular solutions preserve resources, reduce environmental impacts, and increase health and wellbeing. Switzerland is only 6.9% circular: there is ample room for improvement. Its track record for innovation and a population increasingly conscious of ecological footprints and social issues mean that the country is well placed to transform consumption patterns to meet its needs, and bolster competitiveness and long-term resilience.'

DAVID QUASS
Senior Director of Sustainability at VF Corporation

'Doing less harm will certainly not resolve the climate and societal crises we face—our decision-making processes need to shift. The principles of circularity fundamentally challenge how we're operating as businesses and individuals. The *Circularity Gap Report* helps connect global challenges to our local context here in Switzerland. The report shows how we're doing as a country, gives pragmatic recommendations for innovation and collaboration, and suggests essential changes to our business and daily lives. Let's get to work!'

DR REGINE SAUTER
DIrector at the Zurich Chamber of Commerce

'Our natural resources are finite: we must take care of them. The production of goods and the construction of buildings and infrastructure are energy-intensive and may have detrimental effects on the environment. It's imperative that we succeed in using materials a second, third or multiple times. Due to their innovative strength, Swiss companies already make important contributions in this area, developing technologies that enable the recycling of valuable materials, textiles and building materials. This is environmentally beneficial and economically attractive. Switzerland must rely on its innovative strength and our companies can make an important contribution worldwide to achieving sustainability goals.'

RETO SAVOIA
CEO at Deloitte Switzerland

'The first Swiss *Circularity Gap Report* underscores the challenges and highlights the opportunities we have as a country to transition to more circular methods, materials and mindsets. Our prosperity and stability provide a strong foundation for change, yet also means we run the risk of complacency. Change will require us to rethink business models, value chains and our own behaviours. We all have a role to play in this transition, and we will only succeed by working together. Harnessing technology and accelerating innovation will also be crucial to implement the strategies highlighted in this report, to help Switzerland build a more resilient, and circular, future.'

CHRISTIAN VITTA
Director of the Department of Finance and the Economy at the Canton of Ticino

'Circular economy is an important topic for the Canton of Ticino and is of particular interest to the Department of Finance and Economy. Circular business models offer companies considerable economic advantages, and can strengthen competitiveness and open up new commercial opportunities. This transformation also stimulates innovation and the search for optimal solutions for sustainable consumption and production. The principles and benefits of the circular economy are perfectly aligned with the economic development strategy implemented by our Canton. The latter aims to stimulate innovation, entrepreneurship and corporate social responsibility, while creating attractive jobs and continuing sustainable economic growth.'

CHRISTINE WIEDERKEHR-LUTHER
Head of Sustainability at Migros Group

'Circular economy allows us to indetify solutions to the challenges of climate change. It also allows us to gain more independence in raw material procurement and to build up resilience in an interconnected world. Even so, pioneering work is still needed, not only technically and in terms of processes, but also in terms of behavioural change. This will require heart and soul, perseverance and investing in good partnerships. The *Circularity Gap Report* encourages us to continue on our chosen path and clearly shows that there is still a lot of potential to close the loop in Switzerland.'

EXECUTIVE SUMMARY

Supporting the shift to a circular economy in Switzerland can help shape a more resilient, sustainable country. The circular economy is a system in which waste is minimised, products and materials are kept in use at the highest value possible, and natural systems are regenerated. By following fundamental tenets of circularity—using less, using longer, using again and making clean—Switzerland has the opportunity to rethink its status quo and progress towards its various environmental goals. This report acts as the first step in service of this goal: before we can manage, we must measure. To this end, this analysis examines the current state of the circular economy in Switzerland, examining how it uses materials and at which quantities. Doing so allows us to sketch a way forward: a vision for a Swiss economy that does more with less, tackles material and energy use and works towards its strategic environmental goals. To ensure our data is in line with the reality of Switzerland, we worked with Deloitte Switzerland and Circular Economy Switzerland, primarily using data from the Federal Statistics Office (FSO) and the Federal Office for the Environment (FOEN).

Switzerland's Circularity Metric is 6.9%—leaving a Circularity Gap of just over 93%. This means that the vast majority of material inputs to the Swiss economy—used to satisfy residents' needs and wants—come from virgin sources. This is slightly below the Circularity Metric for the global economy, measured at 7.2%.[1] The country consumes 163 million tonnes of virgin materials per year: 19 tonnes per capita—higher than the European average, at 17.8 tonnes per capita. While a high rate of consumption is common for a high-income nation such as Switzerland, its material footprint is more than double the estimated sustainable level, at 8 tonnes per capita.[2, 3] As a small nation with tight restrictions on forestry[4] and relatively little to mine or quarry, Switzerland boasts very low levels of extraction—around 7 tonnes per capita. However, this means that the country is fulfilling its demand for materials through extraction taking place abroad, contributing to waste and emissions elsewhere. In all, reducing material consumption is the imperative of our changing era: globally, the extraction and processing of materials is responsible for 70% of greenhouse gas emissions,[5] and more than 90% of biodiversity loss and water stress.[6] By tackling its consumption patterns, Switzerland can address the root causes of climate change and environmental degradation—both at home and abroad. To this end, this report analyses how materials—metal ores, non-metallic minerals, biomass and fossil fuels—are used to meet Switzerland's societal needs, from Housing and Nutrition to Transport and Manufacturing.

Switzerland has high material and carbon footprints—but much of its impact takes place abroad. Switzerland imports an abundance of materials and finished products from abroad, fulfilling only one-tenth of its material demand through domestic extraction. High-impact materials—such as fossil fuels and metal ores—are almost entirely imported, which can have substantial environmental impacts on other parts of the world: the mining of metals, for example, is a highly wasteful process that generates large volumes of by-products called tailings. Other imports, such as fertiliser (material-intensive and polluting) and electronics and textiles are similarly high-impact. Opportunities for change, however, are abundant: for example, halted imports of Russian gas following recent EU sanctions, as well as nuclear power accidents in recent decades, have further prompted Switzerland to rethink its energy supply. Numerous circular solutions, applied across sectors, could be employed to cut imports, bolster resilience and retain the value of resources in the economy for longer.

The three biggest sectors contributing to Switzerland's material and carbon footprint are manufacturing, construction and agrifood. Combined, these top three sectors represent 73% of the material footprint, and 63% of the carbon footprint. Switzerland's manufacturing sector is one of the largest and most innovative in Europe.[7] It's also a sector of high impact: manufacturing industries, both those within Switzerland and those abroad that feed Swiss consumption, contribute 41% of the country's material footprint, and represent 36% of the carbon footprint. Switzerland's construction sector consumes vast quantities of materials, energy and water, comprising 18% of the total material footprint and 14% of the total carbon footprint—largely due to the high prevalence of inefficient older buildings. Lastly, Swiss residents' nutritional needs account for 14% of the total material footprint and 13% of the carbon footprint: the majority of this is made up of processed foods and crop cultivation for both animal and human consumption. While these three sectors are highly material- and carbon-intensive, Switzerland is well-positioned to make improvements. Innovation is strongly present within Swiss culture, with the country ranking third worldwide for both innovation and research and development (primarily funded privately).[8] Although these characteristics have long-served a largely linear way of working, they now have the potential to work in favour of a different goal: the circular transition. A behavioural change among consumers may also spark a shift in industrial practices: Swiss residents may demand more circular products whilst also minimising their consumption.

Examining the Circularity Gap helps paint a picture of the Swiss economy. While Switzerland is just 6.9% circular, this doesn't mean that the other 93.1% of the materials flowing through its economy go to waste. The Circularity Gap is made up of five different elements:

1. **10.7%** of Switzerland's material consumption is represented by **renewable, carbon-neutral biomass** with the *potential* for cycling: food crops, timber and wood products, for example.
2. **Non-renewable biomass** is biomass that is not carbon neutral. Switzerland, although uncommon, has negative land use and land cover change (LULCC) emissions:[9] it sequesters more carbon than it 'consumes' through its use of biomass. For this reason, the country has no Non-renewable biomass.
3. Inherently **Non-circular inputs**, such as fossil fuels used to power industry, heat homes and fuel transport, represent **9.2%** of material use.
4. **Non-renewable inputs**—such as metals, rocks, chemicals, glass and plastics—represent the largest share of material inputs, at **40%**. These materials *could* be cycled, but currently are not. 28% of this comes from net extraction abroad, revealing the significant contribution of international trade flows and supply chains to the Swiss material footprint.
5. More than **33%** of Switzerland's material use is locked into **stock** in the form of often-crucial buildings and infrastructure: plenty of materials are used to upgrade and expand the railway system, for example.[10] As these materials won't become available for reuse or recycling for many decades, it's crucial that circular elements like design for durability, adaptation, repairability and cyclability are considered now to enable positive outcomes further down the road.

Switzerland must focus on reducing Non-circular inputs and Non-renewable inputs, while ensuring that additions to stock are made as circular as possible and that biomass is cycled back into nature.

Circular strategies across five areas could nearly double the Circularity Metric and cut material use by one-third. To bridge the Circularity Gap, this report explores five 'what-if', non-time-specific scenarios, each applying multiple strategies that bolster circularity, cut material use and emissions, and provide a wealth of other co-benefits. These scenarios are: 1) Embrace a circular lifestyle, 2) Advance circular manufacturing, 3) Rethink transport and mobility, 4) Build a circular built environment and 5) Nurture a circular food system. Together, they have the power to increase the Metric from 6.9% to 12.1%, reduce the material footprint by 33% and cut the carbon footprint by 43%. This would equate to a material footprint of 12.8 tonnes per capita, bringing it almost on par with the global average, and closer to the estimated sustainable level. With a more circular economy, Switzerland could also enjoy many other benefits: improved health and wellbeing from more sustainable food and more resilient communities, protection of the country's natural landscapes and strengthened biodiversity, to name a few.

There are limitations as to how much the Circularity Metric can grow—but this doesn't downplay the Swiss economy's potential for improvement. The five scenarios presented could deliver transformative results. But why, then, does the Metric 'only' rise to 12.1%? Firstly, it's not technically feasible to achieve 100% circularity: materials cannot be cycled infinitely due to quality degradation. Secondly, circularity can be difficult to control within a single country. As we've seen, Switzerland is particularly involved in world trade: it's a massive importer of materials, driving extraction and waste abroad, and manufactures a wide range of products for export. Measures to control the circularity of imports that are consumed domestically—or to reduce the need for them—shouldn't be overlooked. Ensuring that Swiss industry designs for circularity, benefitting both domestic consumers and export markets, will also be crucial. Thirdly, large amounts of materials will always be needed to a degree to sustain Swiss residents—in terms of housing and infrastructure, for example, although these needs can be provided for in a far more efficient way. Despite these limitations, even a small improvement in the Metric can have a big impact: so Switzerland's potential to boost its Metric to 12.1% is an opportunity to seize. And while it's important to ensure closed loops, engaging in higher value strategies—using less, using longer and using cleaner resources—will be crucial. As such, potential big wins for Switzerland are exemplified by the possible reductions in the material and carbon footprints, which represent a true metamorphosis for the Swiss economy.

The foundation for transformational change has been built. In many areas of sustainability, Switzerland is ahead of the curve: it's among the world's best recyclers of municipal solid waste,[11] and has succeeded in decarbonising its electricity sector.[12] It also boasts a number of plans and initiatives to meet its ambitious climate targets. The foundation for change already exists: it's widely recognised that action has already begun from all stakeholders, from policymakers and businesses to members of civil society.[13] Circular economy strategies can meet needs with fewer materials and less environmental impact, and therefore offer a toolbox for Switzerland to achieve its goals. While the country still has a way to go in cutting its material footprint and reducing its reliance on imports, it is well poised to take on the challenge. In the scenarios, our analysis identifies the key levers to tackle the crucial challenges of how (i) residents can embrace a less materialistic lifestyle, (ii) the lifespans of industrial equipment and consumer goods can be prolonged and (iii) the expansion of housing stock can be regulated.

This report lays the path forward for a more circular Switzerland. Achieving a more circular economy requires more than technical solutions and will require action on four recommendations:

1. **Increased coordination and collaboration among stakeholders.** For Switzerland to deliver on its environmental goals it must take the cross-cutting, holistic approach whilst considering its decentralised governance structure. Stakeholders from the private and public sectors, civil society organisations and academia alike must join forces to drive meaningful change. To this end, a **multi-stakeholder roadmap** will be developed and launched in conjunction with this report to develop a vision for a circular economy, rounded out by concrete activities and targets.
2. **Policies that promote and accelerate the circular economy—while disincentivising the linear economy.** A fit-for-purpose policy framework would encourage circular initiatives, such as tax breaks for repair services, whilst simultaneously discouraging linear practices, such as a ban on single-use products with the more sustainable alternatives that are available. Some cantons are already taking action—Zürich, for example, has enshrined the circular economy in its constitution.[14]
3. **Business models and investment strategies with circularity at their core.** There must be a shift from business models and investment strategies based solely on economic growth to models that centre on additional factors: the preservation of materials and their value, reduced environmental impacts and the creation of innovative, future-orientated jobs, for example. Understanding of the necessity of a broader range of considerations has been growing in Switzerland for decades but is yet to truly become the norm.
4. **A circular economy vision backed by a comprehensive measurement framework.** To effectively track progress, material-related indicators could be aligned with broader environmental goals such as climate neutrality, biodiversity protection and pollution reduction. These indicators can also be coupled with targets to lower material use, extend resource lifetimes and increase the share of secondary material consumption. The monitoring and evaluation of progress will also require more extensive data gathering at both the sectoral and business level.

Switzerland must focus on reducing Non-circular inputs and Non-renewable inputs, while that ensuring additions to stock are made as circular as possible and that biomass is cycled back into nature.

If approached holistically and designed well, the circular economy can provide far-reaching environmental, social and economic benefits. This report envisions a new economic system, with wellbeing and a high quality of life for all Swiss residents at its core.

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GLOSSARY

Consumption refers to the use or consumption of products and services meeting (domestic) demand. *Absolute consumption* refers to the total volume of either physical or monetary consumption of an economy as a whole. In this report, *consumption* refers to absolute consumption.

Cycling refers to the process of converting a material into a material or product of a higher (upcycling), same (recycling) or lower (downcycling) embodied value and/or complexity than it originally was.

Domestic Extraction (DE) is an environmental indicator that measures, in physical weight, the amount of raw materials extracted from the natural environment for use in any economy. It excludes water and air. [Source]

Domestic processed output refers to 'the total mass of materials which have been used in the national economy, before flowing into the environment. These flows occur at the processing, manufacturing, use, and final disposal stages of the economic production-consumption chain.' [Source]

Domestic Material Consumption (DMC) is an environmental indicator that covers the flows of both products and raw materials by accounting for their mass. It can take an 'apparent consumption' perspective—the mathematical sum of domestic production and imports, minus exports—without considering changes in stocks. It can also take a 'direct consumption' perspective, in that products for import and export do not account for the inputs—be they raw materials or other products—used in their production. [Own elaboration based on Source]

Economy-wide material flow accounts (EW-MFA) are a 'statistical accounting framework describing the physical interaction of the economy with the natural environment and with the rest of the world economy in terms of flows of materials.' [Source]

Environmental stressor, in Input-Output Analysis, is defined as the environmental impact occurring within the region subject to analysis. There is therefore an overlap between the stressor and the footprint, as they both include the share of impact occurring within a region as a result of domestic consumption. This is how they differ: while the rest of the stressor is made up of impacts occurring within a region as a result of consumption abroad (embodied in exports), the footprint includes impacts occurring abroad as a result of domestic consumption (embodied in imports).

Greenhouse gases (GHG) refers to a group of gases contributing to global warming and climate breakdown. The term covers seven greenhouse gases divided into two categories. Converting them to **carbon dioxide equivalents** (CO_2e) through the application of characterisation factors makes it possible to compare them and to determine their individual and total contributions to Global Warming Potential (see below). [Source]

High-value recycling refers to the extent to which, through the recycling chain, the distinct characteristics of a material (the polymer, the glass or the paper fibre, for example) are preserved or recovered so as to maximise their potential to be re-used in a circular economy. [Source]

Materials, substances or compounds are used as inputs to production or manufacturing because of their properties. A material can be defined at different stages of its life cycle: unprocessed (or raw) materials, intermediate materials and finished materials. For example, iron ore is mined and processed into crude iron, which in turn is refined and processed into steel. Each of these can be referred to as materials. [Source]

Material footprint, also referred to as Raw Material Consumption (RMC), is the attribution of global material extraction to the domestic final demand of a country. In this sense, the material footprint represents the total volume of materials (in Raw Material Equivalents) embodied within the whole supply chain to meet final demand. The total material footprint, as referred to in this report, is the sum of the material footprints for biomass, fossil fuels, metal ores and non-metallic minerals. [Source]

Material flows represent the amounts of materials in physical weight that are available to an economy. These material flows comprise the extraction of materials within the economy as well as the physical imports and exports (such as the mass of goods imported or exported). Air and water are generally excluded. [Source]

Net Extraction Abroad (NEA) represents the difference between the trade balance of products and that of the raw materials needed to produce them. The difference between the two represents the 'actual' or net quantity of raw materials that have been extracted abroad to satisfy domestic consumption.

Planetary boundaries define the 'safe operating space' for humanity, based on the planet's key biophysical processes. Originally developed by Rockström et al. (2009), the framework quantifies nine 'limits': 1. Climate change, 2. Novel entities,[15] 3. Stratospheric ozone depletion, 4. Atmospheric aerosol loading, 5. Ocean acidification, 6. Biogeochemical flows (nitrogen and phosphorus), 7. Freshwater use, 8. Land-system change, and 9. Biosphere integrity.[16] Five of nine boundaries have now been transgressed. [Source]

Raw Material Equivalent (RME) is a virtual unit that measures how much of a material was extracted from the environment, domestically or abroad, to produce the product for final use. Imports and exports in RME are usually much higher than their corresponding physical weight, especially for finished and semi-finished products. For example, traded goods are converted into their RME to obtain a more comprehensive picture of the 'material footprints'; the amounts of raw materials required to provide the respective traded goods. [Source]

Raw Material Consumption (RMC) represents the final domestic use of products in terms of RME. RMC, referred to in this report as the 'material footprint', captures the total amount of raw materials required to produce the goods used by the economy. In other words, the material extraction necessary to enable the final use of products. [Source]

Resources include, for example, arable land, fresh water, and materials. They are seen as parts of the natural world that can be used for economic activities that produce goods and services. Material resources are biomass (like crops for food, energy and bio-based materials, as well as wood for energy and industrial uses), fossil fuels (in particular coal, gas and oil for energy), metals (such as iron, aluminium and copper used in construction and electronics manufacturing) and non-metallic minerals (used for construction, notably sand, gravel and limestone). [Source]

Secondary materials are materials that have been used once and are recovered and reprocessed for subsequent use. This refers to the amount of the outflow which can be recovered to be re-used or refined to re-enter the production stream. One aim of dematerialisation is to increase the amount of secondary materials used in production and consumption to create a more circular economy. [Source]

Sector describes any collective of economic actors involved in creating, delivering and capturing value for consumers, tied to their respective economic activity. We apply different levels of aggregation here—aligned with classifications as used in Exiobase V3. These relate closely to the European sector classification framework NACE Rev. 2.

Socioeconomic cycling is the technical term for the Circularity Metric. It comprises all types of recycled and downcycled end-of-life waste, which is fed back into production as secondary materials. Recycled waste from material processing and manufacturing (such as recycled steel scrap from autobody manufacturing, for example) is considered an internal industry flow and is not counted as a secondary material. In the underlying model of the physical economy used in this report, secondary materials originate from discarded material stocks only. The outflows from the dissipative use of materials and combusted materials (energy use) can, by definition, not be recycled. Biological materials that are returned back to the environment (for example, through spreading on land) as opposed to recirculated in technical cycles (for example, recycled wood) are not included as part of socioeconomic cycling. Energy recovery (electricity, district heat) from the incineration of fossil or biomass waste is also not considered to be socioeconomic cycling, as it does not generate secondary materials.

Socioeconomic metabolism describes how societies metabolise energy and materials to remain operational. Just as our bodies undergo complex chemical reactions to keep our cells healthy and functioning, a nation (or the globe) undergoes a similar process—energy and material flows are metabolised to express functions that serve humans and the reproduction of structures. Socioeconomic metabolism focuses on the biophysical processes that allow for the production and consumption of goods and services that serve humanity: namely, what and how goods are produced (and for which reason), and by whom they are consumed. [Source]

Territorial-based carbon footprint is based on the traditional accounting method for GHG emissions, with a focus on domestic emissions, mainly coming from final energy consumption. A **consumption-based carbon footprint** uses input–output modelling to not only account for domestic emissions but also consider those that occur along the supply chain of consumption (for example, accounting for the embodied carbon of imported products).

Total material consumption is calculated by adding Raw Material Consumption (material footprint) and secondary material consumption (cycled materials).

1. INTRODUCTION

The planet we live on today has largely been shaped by our globe's dominant linear economy: the extraction, transport, processing, use and disposal of materials to satisfy societal needs and wants has hugely contributed to the overshoot of many of the planetary boundaries that support life on this planet.[17, 18] Material extraction and use, which has more than tripled globally since 1970 to 100 billion tonnes a year,[19, 20] has largely driven this overshoot. What's more, our global *Circularity Gap Report 2023*[21] found that the global economy is only 7.2% circular—meaning that more than 90% of the resources we consume come from virgin sources. This report finds that Switzerland's overall Circularity Metric is 6.9%, sitting slightly below the global average. At 19 tonnes per person, per year, its material footprint is well above the global average of 11.9 tonnes per capita[22] and more than double the estimated sustainable level of 8 tonnes per capita. Our analysis provides an avenue for change: one that can maintain Swiss residents' high standard of living while reducing pressure on materials and preserving its forests, alpine glaciers and clean air and water. This big shift is the circular economy: a toolbox to combat ecological and climate breakdown by rethinking our relationship with materials, using less and designing out waste.

THE RISKS OF LINEARITY IN SWITZERLAND

With increasing biodiversity loss, resource depletion and extreme weather events, we are now feeling the daily effects of Earth's boundaries being pushed to its limits. A healthy planet is essential for human beings to not only survive, but thrive. Although the impacts of waste and emissions vary by material, and can be softened through technological developments, a clear link remains between overall material consumption and ecological impact.[23] Material use is thus a good proxy for measuring environmental degradation: 70% of global greenhouse gas (GHG) emissions stem from material handling and use,[24] as well as over 90% of biodiversity loss and water stress,[25] for example. Globally, material extraction has exploded over the past fifty years, more than tripling from 27 billion tonnes in 1970 to 92 billion tonnes in 2017.[26] While this has stimulated economic development, it is becoming increasingly clear that it has come at an environmental cost, resulting in six of nine planetary boundaries being crossed.[27] As global material use reached new heights, the Circularity Metric has decreased from 9.1% to 7.2% within six years.[28]

Within the broader global context, Switzerland is exceeding what is already classified as an 'excessive' level of material consumption: our current global level of consumption already technically requires 1.75 Earths to sustain.[29] Looking at the analysis in the global *Circularity Gap Report 2020*,* we can see that Switzerland exemplifies the *Shift* country profile, alongside most other high-income countries in the global North. This means that it scores very highly on the United Nations' Human Development Index (HDI), between 0.8 and 1, but its Ecological Footprint—an indicator that accounts for human demand for biological sources—reflects its high level of consumption. If everyone on Earth were to live like the average Swiss resident we would require the resources of almost 2.75 planets.[30] *Shift* countries account for around two-thirds of global GDP, yet house just one-fifth of the global population.

Like much of the globe, Switzerland's prosperity is tightly linked to its material use: GDP doubled between 2000 and 2020,[31] while raw material consumption has continued to outpace—and cancel out— material efficiency improvements. And although Switzerland has achieved relative decoupling[32] as its GDP has grown at a higher rate than its resource use, efficiency gains won't have an impact if they're met by ever-rising extraction and consumption, both domestically and abroad. Steady population growth[33] poses an extra challenge: how can Switzerland meet the needs of its residents while continuing to decrease its material use?

Currently, at 163.3 million tonnes, Switzerland's material consumption is putting disproportionate pressure on natural ecosystems worldwide. While the country is well on its way to becoming carbon neutral, its economy still relies heavily on virgin resource extraction and creates vast amounts of waste. The bulk of this extraction isn't taking place domestically, however: as the country is quite small—both in terms of population and area—approximately 83% of its material footprint is owed to raw materials extracted abroad and then imported, with only 7 tonnes of materials per capita (out of 19) extracted domestically each year. Slightly less than half of this domestic extraction is used within Switzerland, while slightly more than half is exported. Switzerland's high material footprint is tightly linked to its prominent manufacturing sector: nearly half of the material footprint can be attributed to advanced manufacturing industries—and yet only 2% of these materials are extracted within the country.

The imperative is clear: to combat the breakdown of our climate and other ecological systems, we must bring our economic activity back within planetary boundaries. This will require a transformation of the way in which we relate to materials: a downscaling of consumption while maintaining—or even raising—standards of wellbeing. By enlisting a holistic circular economy approach—using less, using longer, making clean and using again—Switzerland can continue to shape a prosperous society that does more with less, tackles material and energy use and contributes to its strategic environmental goals.[34]

** Find out more about how Circle Economy categorises countries as Build, Grow or Shift in the global* Circularity Gap Report 2023,[35] *on pages 42–43.*

THE ROAD TO CIRCULARITY: MORE THAN JUST CYCLING

While Switzerland's Circularity Metric is higher than other European countries, such as Sweden (3.4%) and Scotland (1.3%), the road to circularity ahead will require a true societal transformation. This has already begun: in recent years, the stage has been set to an extent, by the adoption of numerous measures relating to food waste, sustainability in the agriculture sector, raw material efficiency, waste avoidance, plastic recycling and the use of the energy potential of wood.[36] To make the most efficient impact, Switzerland is now supporting the development of the *Green economy—federal measures for a resource-saving, sustainable Switzerland* report, which is updated every four years and reflects upon the status of resource use and the need for action, as well as reporting on whether measures from the previous period were implemented or not.[37] Likewise, the canton of Zürich has enshrined the circular economy in its constitution, providing a legal base for the shift away from linearity.[38] The foundation for change has been built: it is clear that the government recognises that action is needed from all stakeholders, from policy makers and businesses to members of civil society.

A SOCIAL, ENVIRONMENTAL AND ECONOMIC OPPORTUNITY

The circular economy is a means to an end: the end goal being an economy where societal needs are met for current and future generations, within the ecological limits of the planet. By lowering material consumption and boosting its circularity, Switzerland can reduce environmental pressures, both domestically and abroad, without lowering its residents' quality of life. A holistic circular economy must put people at its core, and endeavour to provide greater access to—and distribution of—resources. Social considerations, such as quality work opportunities and leveraging the skills of the existing workforce, should be front and centre. For example, with the majority of the workforce employed in the service sector,[39] Switzerland must carefully consider how it can leverage its labour capacity and skills to successfully transition to a circular economy, for which many strategies rely on manual labour. Some studies predict that economies dominated by material-intensive sectors will experience significant employment losses, while those with less dependence on extraction—like Switzerland—will experience a smoother transition.[40]

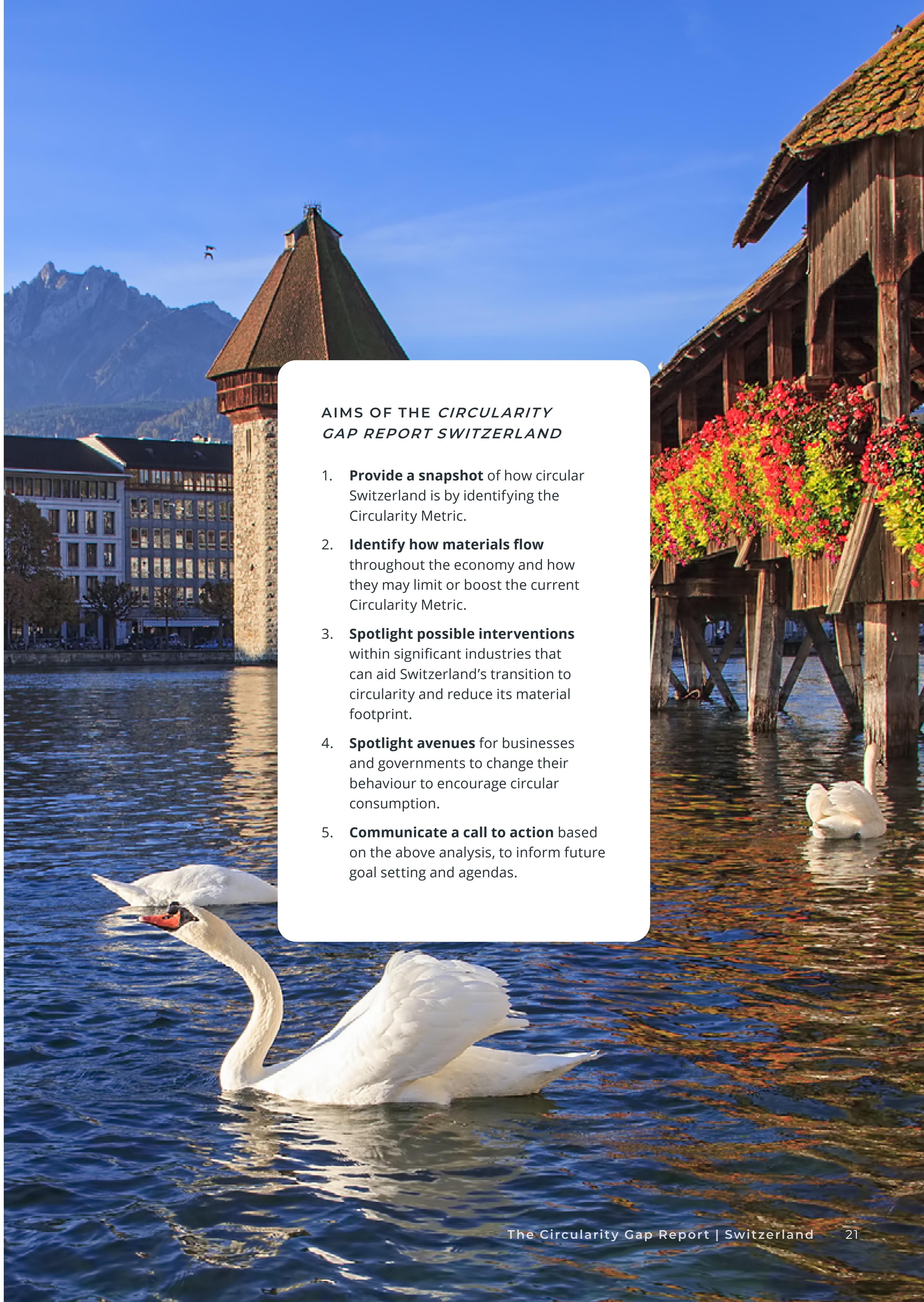
To decouple economic growth from material use, we need solutions for systemic inefficiencies. Think of the average car, for example, which sits unused around 95% of the time:[41] the materials extracted to produce such vehicles are not used as optimally as they could be. Similarly, food consumption in Switzerland generates 330 kilograms of avoidable food waste per person per year, with approximately 38% of food waste occurring in households.[42] By redesigning systems of production and consumption to tackle these inefficiencies, a circular economy allows us to decouple material consumption and their associated impacts from the essential service that is delivered, be it transport or nutrition. Let's consider the vehicle example again: an electric vehicle, powered by renewable energy, designed for efficient repair and reuse, and shared amongst several people, can deliver the same—or even better—outcomes as a privately-owned motor vehicle, yet with a fraction of the environmental cost from its production, use and end-of-life (including the battery).[43, 44] A head-on approach to the circular economy will require Switzerland to unlock its massive potential for innovation and leverage its highly skilled workforce to increase economic competitiveness. With the circular economy comes opportunity: economic value for businesses, new services for consumers and potential for the creation of new—and if potential shortcomings are addressed—future-orientated jobs.[45]

AN ECONOMY FULL OF POTENTIAL: CLEAN ENERGY IS JUST THE BEGINNING

In certain arenas of sustainability, Switzerland is ahead of the curve: it boasts the lowest carbon intensity among International Energy Agency (IEA) countries, owing to a carbon-free electricity sector dominated by nuclear and hydropower, for example.[46] The Environmental Performance Index ranked Switzerland as the ninth most sustainable country in the world, taking indicators on ecosystem vitality like biodiversity, climate change and ecosystem services into account; as well as health indicators like air quality, sanitation, drinking water and waste management.[47] But Switzerland has work to do in bringing its overall material consumption down to sustainable levels. Because 70% of global emissions stem from material use and handling, the circular economy is instrumental for countries to achieve their climate goals and cut emissions both at home and abroad.[48] While Switzerland has set domestic climate targets—halving emissions by 2030 and going net-zero by 2050—there are so far no plans to tackle consumption-based emissions. Overall, the foreign share in the carbon footprint of Switzerland was 71% (67.7 million tonnes of carbon dioxide equivalent (CO_2e)) in 2019. The domestic share accounted for only 29% (45.7 million tonnes of CO_2e).

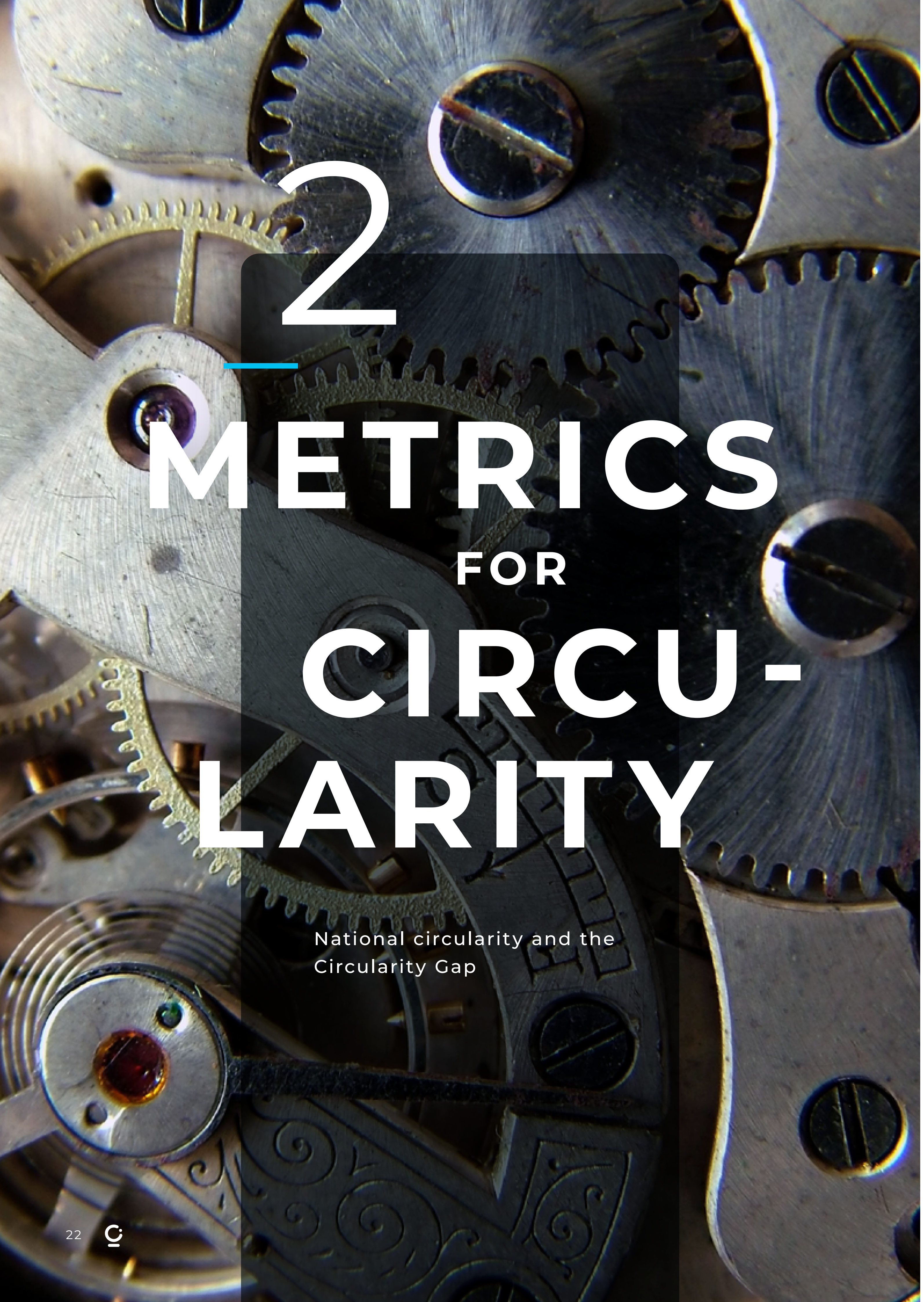
In our highly globalised economy, the production of goods abroad, such as personal electronics, can involve hundreds of components sourced from all over the world. Extensive transport must occur—alongside heavy packaging production—to get raw materials from one place to another for production, in addition to the finished product being packaged and transported to Switzerland. Reducing the sheer scale of these processes by encouraging practices such as reuse, remanufacturing and recycling domestically can significantly cut emissions, material use and waste. It also lessens the environmental impact abroad caused by extraction, serving to reduce Switzerland's overall material and carbon footprint. A similar story emerges when returning to Switzerland's food waste statistics: as noted, almost one-third (2.8 million tonnes) of food produced is thrown away (both in Switzerland and abroad), amounting to about 330 kilograms of avoidable food loss per capita per year.[49] Much of this waste could be avoided through better management to prevent losses, damage and spoilage, with more mindful practices on the part of retailers and consumers. The effect would be significant: around one-quarter of Switzerland's food-related environmental impact is caused by 'avoidable' food waste—that which could have been eaten.[50] The cost of this also amounts to around EUR 609 (CHF 658) per person per year—a waste of more than EUR 5.1 billion (CHF 5.5 billion) in total.[51, 52] So while Switzerland may rank high in sustainability, future goals must consider the nation's overall material footprint rather than focusing solely on easier-to-control domestic emissions.

The circular economy could present a huge opportunity for the Swiss economy with regard to recovered resource value, access to new markets and green investment funds, as well as the value created through new circular products and services. Simultaneously, such circular approaches can offset resource, market, operational, business and legal risks associated with the current linear 'take-make-waste' model. Our analysis finds several avenues to cut Switzerland's material and carbon footprints, advance resource efficiency and substantially increase material circulation in the economy, progress towards the Sustainable Development Goals, and bring the country from theory to action: the kind of systemic shift needed to realise a circular economy. Combined, the strategies laid out in this report could cut material consumption by 33%, bringing it down to 110 million tonnes, and reduce the carbon footprint by 43%, bringing it down to 65 million tonnes of CO_2e. By transforming the way it provides for Swiss residents' societal needs and wants, the country can boost its Metric from 6.9% to 12.1%.



AIMS OF THE *CIRCULARITY GAP REPORT SWITZERLAND*

1. **Provide a snapshot** of how circular Switzerland is by identifying the Circularity Metric.
2. **Identify how materials flow** throughout the economy and how they may limit or boost the current Circularity Metric.
3. **Spotlight possible interventions** within significant industries that can aid Switzerland's transition to circularity and reduce its material footprint.
4. **Spotlight avenues** for businesses and governments to change their behaviour to encourage circular consumption.
5. **Communicate a call to action** based on the above analysis, to inform future goal setting and agendas.



2 METRICS FOR CIRCULARITY

National circularity and the Circularity Gap

Measurements are critical to understanding the world around us. As it becomes more urgent for us to adapt our socioeconomic system and become more circular, we need to provide a tactical approach for measuring the transition. In 2018, Circle Economy launched the Circularity Metric for the global economy for the first time. This analysis adapts the concept of the Circularity Metric to suit a national profile. This chapter explains how Switzerland's circularity has been assessed and introduces a set of indicators that help us understand the significant material flows that contribute to the country's large Circularity Gap. These insights allow us to formulate a plan for moving toward greater circularity: they provide an initial assessment by locating circular opportunities and priorities in material flows. By measuring circularity in this way, both businesses and governments can track their circular performance over time as well as engage in uniform goal-setting and guide future action in the most impactful way.

THE CIRCULARITY METRIC EXPLAINED

In order to capture a single metric for circularity in an economy, it is necessary to reduce the complexity of material flows. This analysis takes the metabolism of a national economy—the way in which materials flow through the economy and are used over the long-term—as the starting point. This approach builds on and is inspired by the work of Haas et al.[53] (2015), and continues the approach applied in all other national *Circularity Gap Reports*. Taking an 'X-ray' of the economy's resource and 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, based on the work of Bocken et al. (2016).[54]

The core objectives are:

- **Objective one:** Resource extraction from the Earth's crust 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 with optimal value retention; emissions to air and dispersion to water or land are prevented; and biomass is optimally cascaded.

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

- **Narrow flows—Use less:** The amount of materials (including fossil fuels) used 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 (mass reduction), multifunctional products or buildings, energy efficiency, digitisation.
- **Slow flows—Use longer:** Resource use is optimised as the functional lifetime of goods is extended. Robust, long-lasting 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, reuse, repair, remanufacturing, refurbishing, renovation and remodelling over building new structures.
- **Regenerate flows—Make clean:** Fossil fuels, pollutants and toxic materials are replaced with regenerative alternatives, thereby increasing and maintaining value in natural ecosystems. In practice: Regenerative and non-toxic material use, renewable energy, regenerative agriculture and aquaculture.
- **Cycle flows—Use again:** The reuse of materials and 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 and recycling. In practice: Design for recyclability (both technical and biological), design for disassembly, reuse and recycling.

While each of these four strategies are important, their deployment may lead to potential overlaps or even anti-synergetic effects. For more information on how these strategies affect each other in practice, refer to Appendix A on page 82.

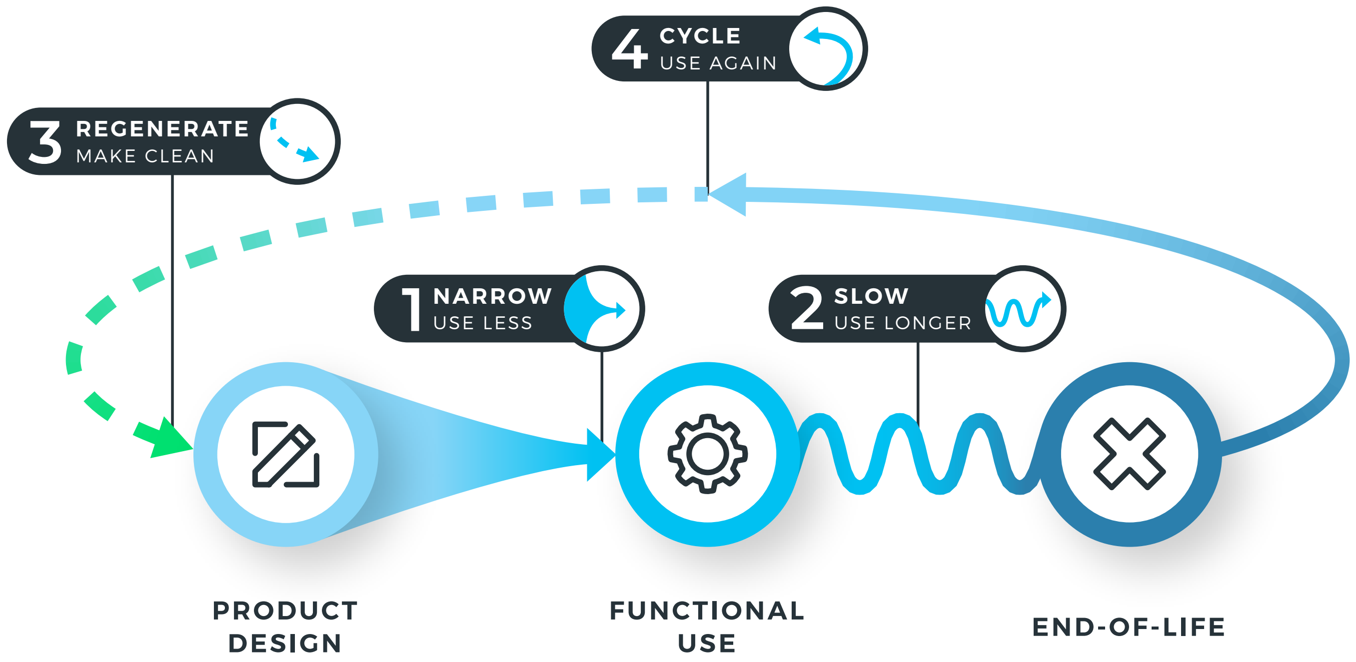


Figure one depicts the four flows to achieve circular objectives: narrow, slow, regenerate and cycle.

While all four flows are crucial to the success of a circular economy, our Circularity Metric captures circularity in one figure, based on cycling: it measures the share of cycled materials as part of the total material consumption into an 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.

Communicated as a percentage, our input-focused Metric it is a relative indicator of how well global or national economies balance sustaining material-based societal needs and wants with materials that already exist in the economy. The value of this approach is that it allows us to track changes over time, measure progress and engage in uniform goal-setting, as well as benchmark countries' circularity against each other as well as at the global level. Additionally, it should provide direction as to how Switzerland can embrace its circular potential. Since its launch in 2018 at the World Economic Forum, the Circularity Metric has formed a milestone for global discourse on the circular economy.

DYNAMICS INFLUENCING THE CIRCULARITY METRIC

Applying the Circularity Metric to the global economy is relatively simple, largely because there are no exchanges of materials in and outside of planet Earth. For countries, however, the dynamics of trade introduce complexities to which we must adapt our metric, resulting in certain methodological choices.[55] These are:

1. **We take a consumption-based perspective.** This means that we only consider materials consumed domestically, and exclude exports from our accounting.
2. **We use demand-based indicators.** This allows for a re-allocation of environmental stressors from producers to final consumers, which ensures that resource depletion is allocated to countries based on their roles in driving production through their consumption. This ensures transparency for countries with high import levels and highlights the importance of reducing consumer demand.
3. **We consider imports and exports in terms of their Raw Material Equivalents (RME).** This allows us to more accurately interpret the true impact of finished and semi-finished products. Learn more about RMEs on page 29.

For a more detailed explanation of these choices, please refer to Appendix B, on pages 82–83.

INSIDE THE CIRCULARITY GAP

The Circularity Metric is one thing—but what about all the other indicators that make up the 'Gap'? In our Circularity Metric Indicator Set, we consider 100% of inputs into the economy: circular inputs such as cycled technical materials and carbon neutral biomass, non-circular inputs and non-renewable inputs, and inputs that add to stocks. This allows us to further refine our approach to closing the Circularity Gap in a particular context, and answer more detailed and interesting questions: how much biomass is Switzerland extracting domestically, and is it sustainable? How dependent is Switzerland on imports to satisfy the basic societal needs of the population? How much material is being added to Switzerland's stock like buildings and roads every year? These categories are based on the work of Haas et al. (2020).[56]

CIRCULAR INPUTS

Socioeconomic cycling rate (6.9%)

This refers to the share of secondary materials in the total consumption of an economy: this is the Circularity Metric. These materials are items that were formerly waste, but now are cycled back into use, including recycled materials from both the technical (such as recycled cement and metals) and biological cycles (such as food, paper and wood). In Switzerland, this number falls just below the global average of 7.2%, totalling 6.9% of total material input.

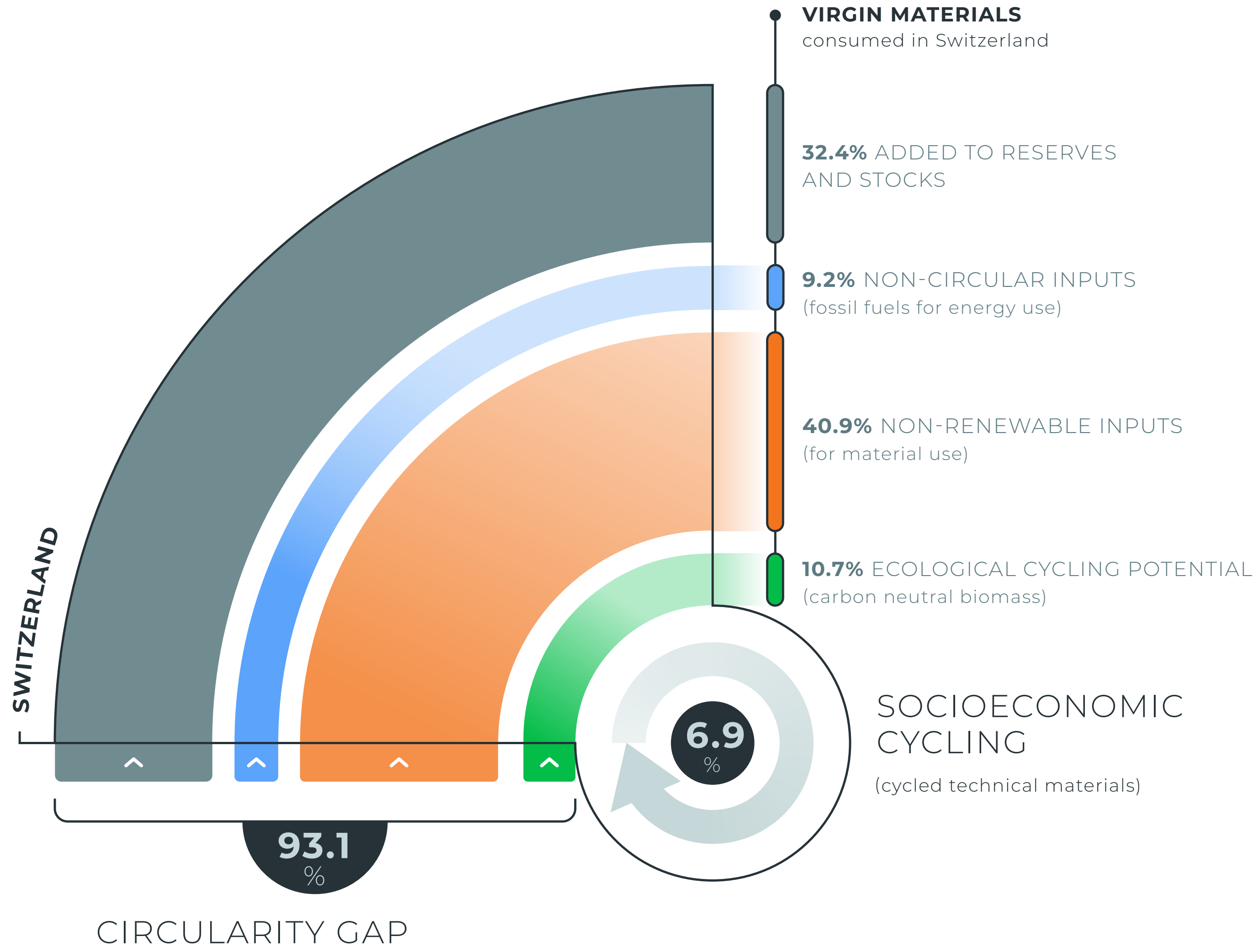


Figure two shows the full picture of circular and non-circular materials that make up Switzerland's Circularity Gap.

Ecological cycling potential (10.7%)

Ecological cycling concerns biomass, such as wood, manure, food crops or agricultural residues. To be considered ecologically cycled, biomass should be wholly sustainable and circular: this means it must, **at the very least**, guarantee full nutrient cycling—allowing the ecosystem biocapacity to remain the same—and be carbon neutral. Because detailed data on the sustainability of primary biomass is not available, the estimation of the ecological cycling potential needs to rely on a broader approach: if the amount of elemental carbon from Land Use and Land Cover Change (LULCC)[57] emissions are at least the same as the carbon content of primary biomass in the total consumption of an economy, then all the consumed biomass can be considered carbon neutral. This condition is met in Switzerland: we can consider its biomass to be carbon neutral.

WHY DON'T WE INCLUDE ECOLOGICAL CYCLING POTENTIAL IN THE CIRCULARITY METRIC?

While carbon neutrality is a necessary condition for biomass to be considered sustainable, it is not sufficient in itself: other nutrients such as nitrogen and phosphorus should be fully circulated back into the economy or the environment as well. As of yet, methodological limitations exist in determining nutrient cycling. To this end, in line with past *Circularity Gap Reports*, we have excluded ecological cycling in our calculation of Switzerland's Circularity Metric, even though this could potentially boost the country's circularity rate to 18%. For all nations, we take a precautionary stance with its exclusion, with the knowledge that its impact on the Metric may not be accurate. For example, we cannot track biomass extracted in Switzerland to its final end-of-life stage, so it isn't easy to ensure that the nutrient cycle has closed. If this were the case, however—and if sustainable biomass management were to become the norm—circularity could significantly increase.

LINEAR INPUTS

Non-renewable biomass inputs (0%)

This metric indicates a biomass input rate that is not carbon neutral. When LULCC emissions are positive, there is a share of biomass that is not carbon neutral because not all CO_2 will be 'sequestered' through consumption (CO_2 embedded in biomass in Domestic Material Consumption). However, for Switzerland this figure represents 0% of the total material footprint since LULCC emissions are negative: the country's biomass can be considered carbon neutral because CO_2 sequestration outweighs CO_2 loss.

Non-circular inputs (9.2%)

This category centres on fossil fuels for energy use. Fossil-based energy carriers, such as gasoline, diesel and natural gas that are burned for energy purposes and dispersed as GHG emissions in our atmosphere are inherently non-circular. Here, circular economy strategies such as cycling are not applicable as the loop cannot be closed on fossil fuels—although the circular transition will inherently reduce emissions through 'narrow' and 'regenerate' strategies. At just over 9% (or 16.1 million tonnes), Switzerland's rate of Non-circular inputs is moderate, highlighting the fossil-fuel-dependent nature of the economy, especially for space heating and to power transport and industry. This is in spite of a decarbonised electricity mix.

Non-renewable inputs (40%)

Non-renewable inputs into the economy that are neither fossil fuels nor non-cyclable ecological materials include materials that we use to satisfy our lifestyles such as the metals, plastics and glass embodied in consumer products. These are materials that potentially *can* be cycled, but are not. Switzerland's Non-renewable input rate stands at a rather high 40% (or 70.1 million tonnes). However, it should be noted that the majority of this stems from extraction happening abroad for materials and goods imported into Switzerland, of which all is allocated under Non-renewable inputs.[58, 59]

STOCK BUILD-UP

Net additions to stock (33.3%)

The vast majority of materials that are 'added' to the reserves of an economy are Net additions to stock. Countries are continually investing in new buildings and infrastructure to ensure that the local populations have access to basic services, as well as build up infrastructure globally to support renewable energy generation, distribution and storage capacity. These resources do, however, remain locked away and not available for cycling and therefore weigh down the Circularity Metric. At just above 33% of total material consumption (or 58.4 million tonnes), Switzerland's **stocking rate** appears to be average compared to other countries for which this was estimated so far. To compare, in absolute terms, net stock additions per capita in Switzerland are 7.4, compared to 4.5 tonnes per person per year in Scotland and 10 tonnes per person per year in Sweden. Both Scotland and Sweden have much lower population densities than Switzerland—which tends to yield a higher net stock addition per capita. However, Switzerland's rate still exceeds that of Scotland, suggesting that more development is taking place.

For a more exhaustive look into the methodology behind the Circularity Gap, you can visit our website: www.circularity-gap.world/methodology

PRACTICAL CHALLENGES IN QUANTIFYING CIRCULARITY

Providing a baseline measurement a country's circularity offers many advantages, not least that it can be used as a call to action. As the circular economy is full of intricacies, simplifications are necessary, which result in limitations that must be considered.

1. There is more to circularity than (mass-based) cycling: using less, using longer and regenerating natural systems. These are captured in other ways: using less, for example, is captured by decreases in the material footprint.
2. The Metric focuses on one aspect of circularity. We focus only on material use, without examining other factors such as biodiversity loss, pollution, toxicity and so on.
3. We consider relative, not absolute, numbers. This means that if cycling increases at a faster rate than material consumption, the Metric will improve—even if the ultimate goal is for consumption to decrease.
4. Achieving 100% circularity isn't feasible. There are technical and practical limits to cycling, and some materials will always be required for stock build-up. Some materials, like fossil fuels, are also inherently non-circular and cannot be cycled.

For more detail on each of these points, please refer to Appendix C, on page 83.

NATION	SOCIOECONOMIC CYCLING	ECOLOGICAL CYCLING POTENTIAL	NON-RENEWABLE BIOMASS INPUTS	NON-CIRCULAR INPUTS	NON-RENEWABLE INPUTS	NET ADDITIONS TO STOCK
Sweden	3.4%	36.3%	-	7.4%	13.1%	39.8%
Scotland	1.3%	16.6%	1.6%	15.0%	45.1%	20.4%
Northern Ireland	7.9%	22.9%	0.9%	16.6%	17.9%	33.7%
Poland	10.2%	13.8%	1.4%	18.7%	20.7%	35.2%
UK	6.9%	10.7%	0%	9.2%	40%	33.3%
Switzerland	6.9%	10.7%	0%	9.2%	40.9%	32.4%

Table one provides comparisons between countries for which we have derived a Circularity Metric Indicator Set.

** Note: Any discrepancies in the sum of these figures is due to rounding.*

3 SIZING SWITZERLAND'S GAP

The resource reality of meeting societal needs

Switzerland is 6.9% circular. This means that the vast majority of materials flowing through its economy come from virgin sources. This chapter dives into the country's socioeconomic metabolism, exploring how materials are used—and at which proportions—to meet various societal needs and wants, from housing and nutrition to mobility and manufactured goods. Our analysis reveals Switzerland's large material footprint, and explores why this is the case. Key themes have emerged that illustrate the country's resource use: Switzerland presents a material- and carbon-intensive profile, primarily driven by heavy material extraction taking place abroad to meet Swiss demand. On a sectoral level, the construction, manufacturing and agri-food sectors comprise the largest portions of the country's material flows.

MEASURING SWITZERLAND'S METABOLISM

This analysis takes the socioeconomic metabolism of Switzerland—the way in which materials **flow** through the economy and are kept in long-term use—as the starting point for measuring its level of circularity. To ensure our data is in line with the reality of Switzerland, we worked with Deloitte Switzerland and Circular Economy Switzerland primarily using data from the Federal Statistics Office (FSO) and the Federal Office for the Environment (FOEN).

Figure three provides a schematic depiction of Switzerland's socioeconomic metabolism. It depicts the amounts of materials (clustered into four key resource groups) concentrated in the inputs and outputs of highly aggregated industry groups.[60] Because the majority of materials flow through just a handful of sectors in an economy, we have limited our visualisation to show these. The left side shows the four resource groups: non-metallic minerals (sand, gravel and limestone, for example), metal ores (iron, aluminium and copper, for example), fossil fuels (petroleum and coal, for example) and biomass (food crops and forestry products, for example, but not livestock).

On the left, we also see the volume of resources entering the national economy through **imports**. These are represented in terms of Raw Material Equivalents (RMEs)—the amount of material extraction needed, anywhere in the world, to produce a product. A motor vehicle, for example, may weigh 1 tonne when imported, but all the materials used to produce and transport it across global value chains can be as much as 3.4 tonnes; while 1 kilogramme of beef for consumption has a total material footprint of 46.2 kilogrammes. RMEs are a useful means for showing the impact of a good by showcasing the strong link between material extraction and environmental impact. Together, the domestic extraction and the **RME of imports** comprise the total inputs (raw material input, which does not include secondary material inputs) of a national economy: this is the **material footprint**.

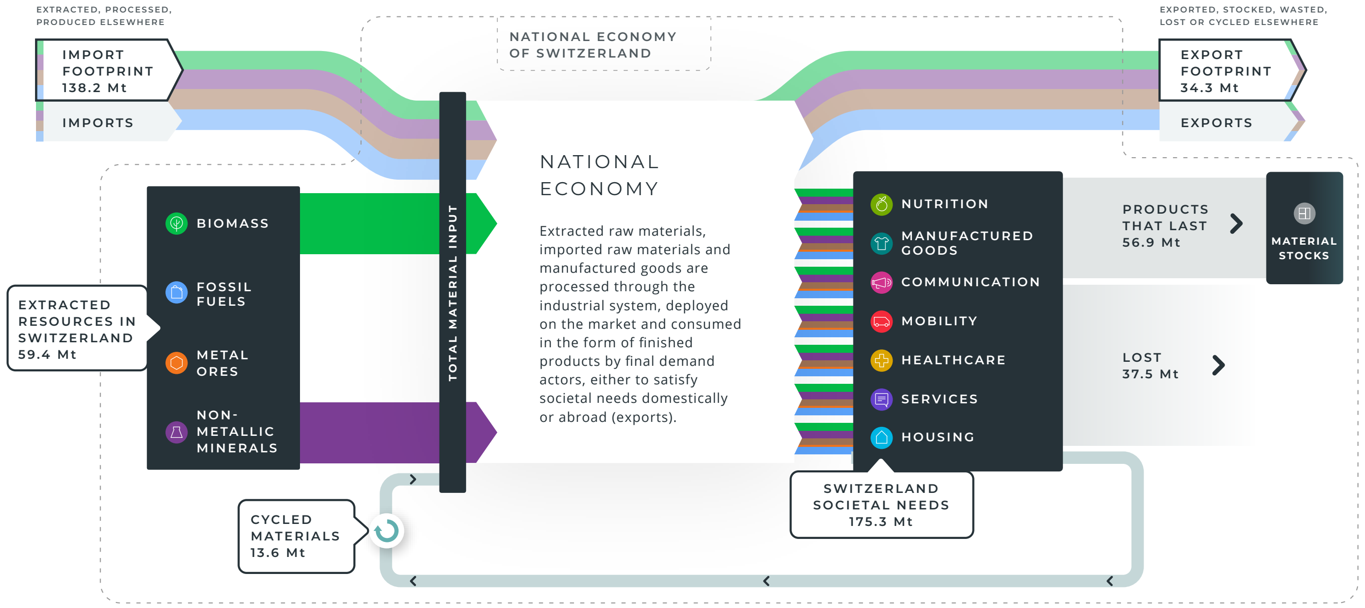


Figure three shows a schematic overview of the socioeconomic metabolism of Switzerland. Note: material stock and cycled material flows are not scaled to proportion.

** Figures may not sum to total due to rounding.*

Societies require materials to operate. In fulfilling people's needs, three connected dimensions need to be taken into account: 1) how resources are put to work, to 2) deliver social outcomes, via 3) provisioning systems. Provisioning systems comprise physical systems such as road infrastructure, technologies, and their efficiencies[61] and social systems, which include government institutions, businesses, communities and markets.[62] 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 outcomes, but at very different levels of material use: this is how the circular economy can allow us to thrive with minimal environmental impact.

On the next page, we describe the seven key societal needs and wants and which products and services they include, as well as the volume of materials it takes to fulfil them from Switzerland's total material consumption of 175.3 million tonnes. Since various products can be allocated differently, here we make choices explicit. For example, 'radio, television and communication equipment' can be classified either as part of Communication, or as Manufactured Goods. We decided to subsume it under 'Communication'. Since previous *Circularity Gap Reports*, we have also reallocated infrastructure to various appropriate societal needs: it is no longer purely allocated under 'Housing', meaning that comparisons with past analyses are no longer accurate.

SEVEN SOCIETAL NEEDS & WANTS

MANUFACTURED GOODS

39.5 million tonnes (23% of total material consumption)

Manufactured goods account for the greatest share of material consumption and consist of a diverse group of products—such as appliances, clothing, cleaning agents, personal-care products and paints—that generally have short to medium lifetimes in society. Textiles also consume many different kinds of resources such as cotton, synthetic materials like polyester, dye pigments and chemicals. Manufactured goods belonging to other societal needs—such as vehicles and capital equipment for healthcare—are not included in this category.

HOUSING

31.4 million tonnes (18% of total material consumption)

This includes the construction, maintenance and renovation of housing with materials such as concrete, steel and timber.

HEALTHCARE

27.6 million tonnes (16% of total material consumption)

With an expanding, ageing and, on average, more prosperous population, healthcare services are increasing globally. In addition to buildings, typical products used include capital equipment such as X-ray machines, pharmaceuticals, hospital outfittings (beds), disposables and homecare equipment. Similarly, the provision of education requires buildings and teaching tools, such as computers and projectors.

MOBILITY

27.5 million tonnes (16% of total material consumption)

A considerable share of total material consumption is taken up by the need for mobility. In particular, two material types are used: the ones used to build transport technologies and vehicles like cars, trains and airplanes, as well as infrastructure like roads and railways; plus, predominantly, the fossil fuels used to power them.

SERVICES

24.3 million tonnes (14% of total material consumption)

The delivery of services to society ranges from public services to commercial services like banking and insurance. This typically involves the use of commercial buildings, professional equipment, office furniture, computers and other infrastructure.

NUTRITION

19.7 million tonnes (11% of total material consumption)

Agricultural products such as crops and livestock are used to create food and drinks products. These tend to have short life cycles in our economy, being consumed quickly after production.

COMMUNICATION

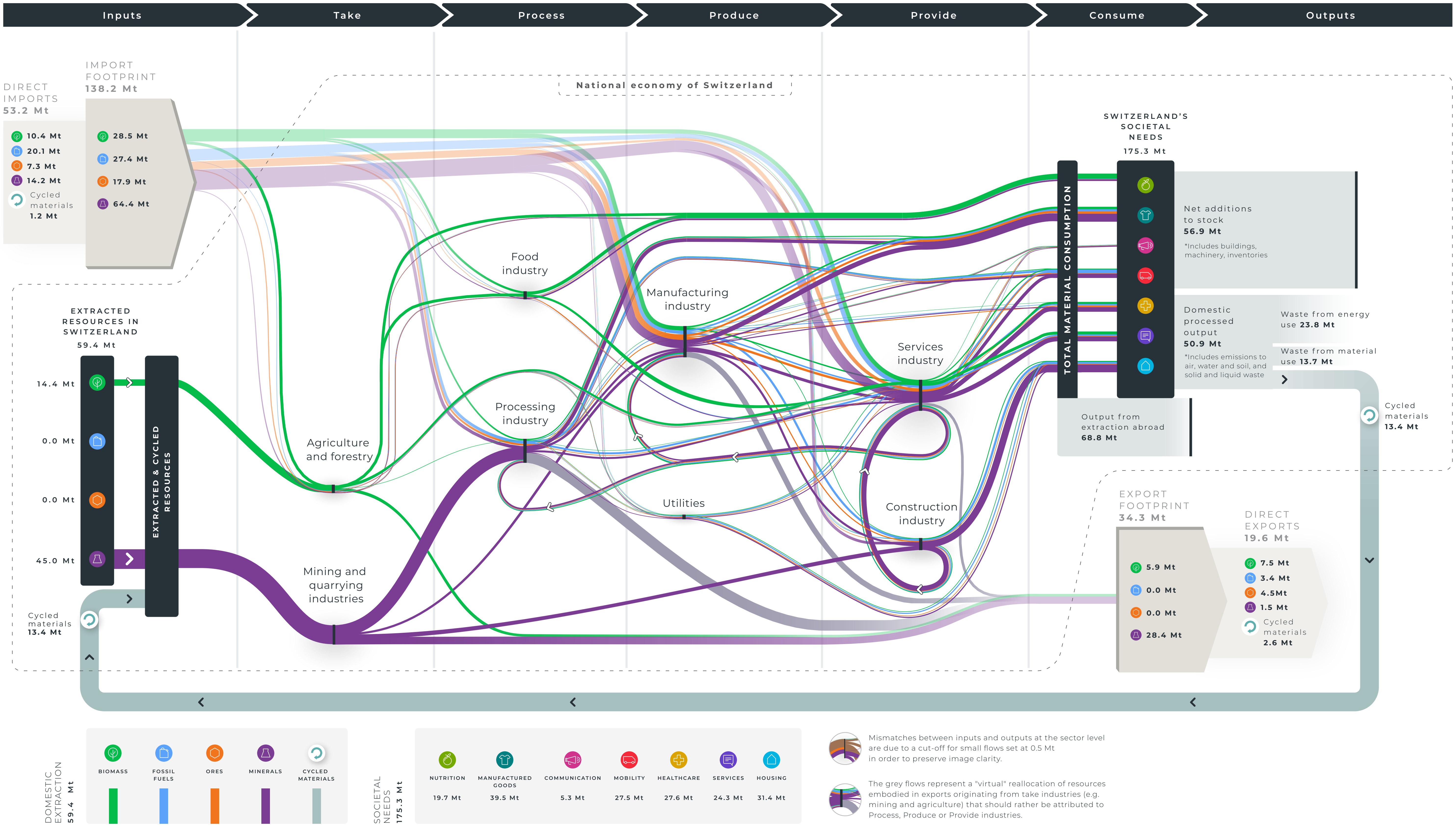
5.3 million tonnes (3% of total material consumption)

Communication is an increasingly important aspect of today's society, provided by a mix of equipment and technology ranging from personal mobiles 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—smart meters and teleconferencing instead of in-person meetings, for example.

** Figures may not sum to total due to rounding.*

X-RAY OF SWITZERLAND'S ECONOMY

Figure four shows an X-Ray of Switzerland's economy: the resources that feed into meeting key societal needs.



THE MATERIAL FOOTPRINT SATISFYING SOCIETAL NEEDS IN SWITZERLAND

The diagram on page 32–33 shows how materials move through the Swiss economy, from extraction to processing to production to the provision of goods and services. Finally, these reach their End-of-Life. Knowing what happens to products and materials after their functional use in our economy is essential for identifying and addressing opportunities for a more circular economy. For more detailed information on how our model classifies different waste types, and how this waste is processed, refer to Appendix D on pages 83–84.

So how are materials extracted, used, traded and managed at end-of-life in Switzerland?

- Domestic extraction amounts to **59.4 million tonnes** or **7 tonnes** per capita per year. This is largely non-metallic minerals such as sand and gravel. This is quite low compared to other European countries, as well as compared to EU and world averages.
- Directly imported products weigh 53.2 million tonnes. Considering RMEs (see on page 29) Switzerland's total import footprint is **138.2 million tonnes.**
- Exported products weigh 19.6 million tonnes. Its export footprint is **34.3 million tonnes.**
- Virgin material consumption sits at **163.3 million tonnes**, while total material consumption is **175.3 million tonnes.**
- Net consumption of secondary materials is **12 million tonnes.**
- Of the waste treated in Switzerland (including construction and demolition waste), around **49%** is 'technically' recycled,[63] while 14% is incinerated and 25% is landfilled. The remaining 12% is treated in wastewater treatment plants or spread on land, such as manure.
- Switzerland exports much more recyclable waste (2.6 million tonnes) than it imports (1.2 million tonnes).
- Five different waste streams, detailed in Table two, contribute to the Circularity Metric. Mineral waste and mixed ordinary waste are most prevalent, respectively claiming **61%** and **20%** of the total waste treated in Switzerland (by weight). Better recycling rates in particular for mixed ordinary waste, therefore, would be a key opportunity for Switzerland to boost its Metric.
- Switzerland has low recycling rates[64] for medical waste (7%), relatively low for chemical wastes (34%), relatively high for traditional recyclable waste[65] (61%), high rates for mineral waste (71%), and very high rates for animal and vegetal waste (98%), while no mixed ordinary waste is recycled,[66] but is rather incinerated for energy recovery. As Switzerland is a small, open economy, in the case of some special waste streams, it doesn't make sense for the country to have its own recycling facilities: for this reason, some potentially recyclable waste must be exported. Although exports destined for recycling are outside of the scope of this analysis, it should be noted that a proportion are likely recycled. Recycling rates for other countries that have undergone this analysis are summarised in Table two.

KEY THEMES OF THE SWISS ECONOMY

Switzerland's economy is import dependent and presents a material- and carbon-intensive profile. This can largely be attributed to: 1) high levels of per capita material consumption and 2) a large import footprint for all resource groups, but especially for minerals. Minerals are especially prevalent in the construction industry, for the production of building materials, and in the manufacturing sector, for the production of both building materials and equipment. On a sectoral level, the manufacturing, construction and agrifood sectors concentrate the largest shares of the country's material flows.

MATERIAL CONSUMPTION AND CARBON EMISSIONS STRONGLY EXCEED SUSTAINABLE LEVELS

While Swiss residents personally consume an above-average amount, the high material footprint can also be attributed to its advanced manufacturing industry, where there is a high level of machinery and equipment production and use.

Just over half of Switzerland's material use is represented by non-metallic minerals, with biomass claiming nearly one-quarter. At roughly 16% and 11%, respectively, fossil fuels and metal ores make up smaller portions of the footprint. Around half (53%) of Switzerland's material footprint can be attributed to its top ten industries, which use 86.72 tonnes of virgin materials. The construction sector claims the largest portion of this, at 16.7% of the total material footprint. This is followed by health and social work (7.7%), manufacture of machinery and equipment (7.5%), petroleum refinery (7.4%), chemicals (6.7%), manufacture of furniture (4.5%), manufacture of medical, precision and optical instruments, watches and clocks (3.9%), and hotels and restaurants (3.9%). The processing of food products, manufacture of electrical machinery and apparatus and manufacture of motor vehicles, trailers and semi-trailers all have smaller contributions to the material footprint.

Switzerland's carbon footprint is even larger—in terms of relation to the global average—than its material footprint. The global average of 5.6 tonnes of carbon dioxide equivalent (CO_2e) per person and EU average of 9.5 tonnes CO_2e per person are both surpassed by Switzerland, with a footprint of 13.1 tonnes of CO_2e per person, per year. Only one-third of the consumption-based emissions occur within the country—the rest takes place in other countries as the result of Swiss demand. This profile is similar to some other high-income nations for which we have completed this analysis. In Scotland, for example, around one-quarter of emissions originate within the country's borders;[68] in Sweden, this figure is nearly one-third. However, in contrast, 62% of Poland's consumption-based emissions occur domestically. Of the domestic carbon emissions produced in Switzerland, 24% are due to domestic consumption of Swiss residents and industries. The carbon footprint can be divided into 'direct emissions', accounting for 17% of the total footprint, and 'indirect emissions', accounting for 83% of the total footprint. Direct emissions, in our consumption-based approach, refer to emissions attributable to households, for example through activities such as household heating and private transport. Whereas indirect emissions refers to emissions attributable to industrial activities.

The majority of Switzerland's high carbon footprint can be attributed to its top ten industries, which produce 52.6 million tonnes of CO_2e, totalling 56% of national carbon emissions. The construction industry claims a large portion of this—around 12% of the total—followed by the manufacture of machinery and equipment (7%), health and social work (7%), petroleum refinery (6%), and manufacturing of furniture (5%). Air transport, food processing, hotels and restaurants, chemical production (including pharmaceuticals), and finally the manufacture of medical, precision and optical instruments, watches and clocks, all contribute smaller portions of the carbon footprint.

	SWITZERLAND	UNITED KINGDOM	POLAND	NORTHERN IRELAND	SCOTLAND
Chemical & medical waste	40%	0.6%	80.4%	50-60%	2%
Traditional recyclables	61%	13%	93.1%	62%	48%
Mixed ordinary waste	0%	14%	37.1%	13%	38.2%
Animal & vegetal waste	98%	3.4%	96.2%	100%	100%
Mineral waste	71%	68%	71.7%	65-73%	17.4%

Table two shows waste recycling rates for various countries for which we've completed this analysis.[67]

MUCH OF SWITZERLAND'S IMPACT IS TAKING PLACE ABROAD

While Switzerland's material footprint is relatively high, its domestic extraction is quite low. Owing to its small size, relatively limited and often-tightly managed natural resources, it takes just 59.4 million tonnes of materials from its territory within a year, equal to just **7 tonnes per capita**. This is below the EU average of 10.3 tonnes per capita and is slightly over half that of the world average: 12.3 tonnes per capita. Table three shows the breakdown of Switzerland's domestic extraction by material group.

As a strong manufacturing hub, Switzerland imports large volumes of materials from abroad to satisfy its own domestic demand. Only slightly more than one-tenth of the country's material demand is fulfilled by extraction within its own borders, with 82.5% stemming from imports in terms of RMEs. These imports are composed of four main materials, summarised in Table four.

The materials Switzerland imports from abroad are generally high-impact in nature, with import footprints far outweighing the direct import of materials. This shows the extent of material extraction outside of Switzerland's borders. Fossil fuels and metal ores, for example, aren't extracted at all in Switzerland, as seen in Table three. Vast quantities of crude oil and gas are imported—largely from the Asia and Pacific region—to power industry and transport and heat homes. While a substantial amount of gas used to come from Russia, imports have halted in the wake of Russia's invasion of Ukraine. Similarly, Switzerland is completely dependent on imports for metal ores, including an increasing amount of rare earth metals essential for the production of semiconductors and sustainable energy technologies—key components to achieving carbon neutrality goals. However, due to the sheer volume needed, non-metallic minerals—largely sand and gravel for construction—claim the largest share of the import footprint. Cereals and wood represent the largest portion of biomass' import footprint, while metal ore imports mainly comprise iron ore.

INEFFICIENT BUILT ENVIRONMENT DRAINS SWITZERLAND'S RESOURCES

The Swiss construction sector is resource-intensive, consuming large amounts of water, materials and energy. The sector has the highest carbon footprint of all Swiss industries: producing 13.3 million tonnes of CO_2e, 14% of the total carbon footprint. It also consumes massive amounts of materials: 29.7 million tonnes of virgin materials to be exact—18% of the total material footprint. These materials can be broken down into non-metallic minerals (23.6 million tonnes), fossil fuels (3.3 million tonnes), biomass (1.7 million tonnes) and metal ores (1.1 million tonnes). The majority of which are imported: of all the fossil fuels consumed by the construction industry, 65% come from Asia and the Pacific and 21% come from the EU, for example. The same is true for non-metallic minerals: almost 66% of the non-metallic minerals embodied in final goods imported are extracted abroad.

In line with its massive material footprint, this sector is particularly vulnerable to shocks and has indeed felt the effects of the pandemic and war: supply chain disruptions have resulted in material shortages and price spikes, especially owing to the energy-intensiveness of producing key building materials like cement, brick and concrete. Shifting to more regenerative, or secondary circular building materials—such as wood or recycled concrete—and production processes that favour clean energy over fossil fuels will be a key opportunity for Switzerland's transition to a circular economy. As long as new buildings are necessary to house the population, circular strategies will be crucial in ensuring that secondary, more efficient and less emissions-intensive materials are prioritised, along with design strategies and revitalisation practices such as renovation and retrofitting. This is discussed in further detail in Chapter four.

MANUFACTURING & PROCESSING ARE AT THE CORE OF THE SWISS ECONOMY

Advanced manufacturing and service sectors consist of industries that largely consume final or near-final products, often characterised by high footprints. Advanced manufacturing industries, for example, make up a large part of both the material and carbon footprints, representing **41% and 36%** of the totals, respectively. Manufacturing comprises resource-intensive industries that consume vast quantities of virgin materials and energy—generating emissions and waste in the process, largely abroad. Switzerland uses a total of **68.6 million tonnes** of virgin materials to feed its manufacturing sector, dominated by machinery, equipment and specific motor vehicles (**18% of the sector's material use**), chemicals, primarily for pharmaceuticals (16%), petroleum refinery (11%), furniture and equipment (11%), with the remainder of the industries making smaller contributions.

	NON-METALLIC MINERALS	BIOMASS	FOSSIL FUELS	METAL ORES
Share of total extraction (%)	76%	24%	0%	0%
Quantity extracted (million tonnes)	64.4%	28.5%	0%	0%
Key contributors	Sand and gravel (75%)	Animal grazing (48%) Sugar beet crops (10%) Wood for industrial consumption (10%)	0%	0%

Table three shows the key contributors to Switzerland's domestic extraction.

	NON-METALLIC MINERALS	BIOMASS	FOSSIL FUELS	METAL ORES
Share of total extraction (%)	47%	21%	20%	13%
Quantity extracted (million tonnes)	64.4%	28.5%	27.4%	17.9%
Key contributors	Asia and the Pacific	Asia and the Pacific	Asia and the Pacific	Asia, the Pacific and the Americas

Table four shows how imports are split between each of the four material groups.

As discussed, most of the materials feeding the sector come from abroad. More than half of these materials come from Asia and the Pacific, with the US and EU contributing roughly 15% each; Africa and the rest of Europe provide significantly smaller volumes of materials. Only 4% of the manufacturing sector's material footprint comes from within Swiss borders.

These industries have a similarly significant impact on Switzerland's carbon footprint, representing **34.3 million tonnes** of CO_2e: in this case, the manufacturing of machinery and equipment contributes the biggest portion (at **20% of the sector's carbon footprint**), closely followed by petroleum refineries (16%) and furniture and equipment (15%).

Although it represents just 8% of the sector's carbon footprint, chemicals and pharmaceuticals play a crucial role in terms of export value:[69] this industry makes up half of the country's yearly exports and contributes a substantial portion of GDP through its 1,000 industry operators. The machine, electrical engineering and metals industry has a similar stronghold on the Swiss economy, holding large economic significance and having firm footing as the second largest export industry. In absolute terms, Switzerland is among the world's top ten exporters of machinery[70]—ranking second in terms of per capita machinery exports. Innovation is at the heart of this industry's success: companies are accustomed to continuous improvement driven by significant investment in research and development. This—as well as this industry's position as Switzerland's largest employer in the manufacturing sector[71]—indicates substantial room for growth and potential openness to a transition to greater circularity. The watchmaking industry is third in terms of exports by value[72]—yet has the largest material footprint, thereby providing ample opportunity to improve its circularity.

4 BRIDGING SWITZERLAND'S CIRCULARITY GAP

Exploration of ‘what if’ scenarios for key sectors

Now that we have presented how Switzerland’s Circularity Metric and Indicator Set are derived and examined the country's material footprint, it’s time to suggest a remedy. For the chosen sectors, we have formulated scenarios that explore and entertain the ‘what-if’, allowing us to dream big and imagine a more circular, resource-light and low-carbon Switzerland. They serve as an exploration of a potential path forward but also sketch which type of sectors and interventions could be most impactful in terms of steering the Circularity Metric and material and carbon footprints.

BRIDGING THE CIRCULARITY GAP: 'WHAT IF' SCENARIOS

In our *Circularity Gap Reports*, our scenarios have been largely free from the constraints of law or political realities: deliberately non-time-specific and exploratory, the complexities of their real-life materialisation did not inform our analysis. Through this approach, we are able to freely imagine what our society could look like with truly transformational change: a close to fully circular economy. Below, we present an action plan that allows us to 'dream big' and outline which type of interventions and levers are most impactful in terms of improving the Circularity Metric, as well as impacting the material and carbon footprints.

To develop the ‘what-if’ scenarios, we focus on five material-intensive areas and industries that represent key leverage points for Switzerland's economy, using 2019 as the baseline year for our analysis. These scenarios are 1) Embrace a circular lifestyle, 2) Advance circular manufacturing, 3) Rethink transport & mobility, 4) Build a circular built environment and 5) Nurture a circular food system. The scenarios explore changes in the links between the economic and financial dimension (monetary flows, financial transactions and capital accumulation), the material and biophysical dimension (aggregate material throughput, infrastructure and stock expansion), and, lastly, the sociocultural dimension (desires, efficiency and productivity).

The selection of the scenarios was based on quantitative and qualitative research, which allows us to paint a picture of what we're able to model based on methodological limitations. In calculating the total impact of the scenarios on Switzerland's economy, we measure the changes to the material footprint, carbon footprint and the Circularity Metric, taking a mass perspective. Additionally, under each scenario, we also report the environmental, social and economic co-benefits of the chosen circular strategies beyond their impact on material flows. Our modelling capacity is continuously evolving and improving: this is reflected by the approach in this report and will continue to improve for future editions. For more information on our scenario modelling, refer to our methodology document.

We are aware that measuring the effects of the suggested interventions in terms of their impact on the Circularity Metric and material and carbon footprints is a crude simplification, which ignores other relevant aspects such as additional ecological parameters: biodiversity or pollution, for example. However, we see the value of this analysis in contributing to the dynamic debate on where to focus our energy for enhanced circularity and reduced consumption in Switzerland and beyond.

Our scenarios are informed and developed by the ultimate aims of **slowing, narrowing, cycling and regenerating** resource flows, as described on page 29, which provide a starting point for the strategies needed to spur systemic changes. The following sections dive into the impact potential of each of the five scenarios in order of material footprint reduction potential, which is one of two key factors linking to the Circularity Metric (the other being cycling). All assumptions behind the modelling of these scenarios can be found in Appendix E, on pages 84–97.

1. EMBRACE A CIRCULAR LIFESTYLE

Our current linear economy is largely consumption driven—but excessive materialism has been found to damage individual wellbeing, as well as the environment.[73] Our dominant economic model has bred a damaging cycle: consumable goods are manufactured from raw materials, sold, used, and then discarded.[74] Like other wealthy countries, Switzerland's high standards of living are coupled with high material consumption. This results in high individual material footprints and waste generation: for the average consumer, with limited time or energy to look for less impactful alternatives, waste is inevitable for most products. The good news, however, is that unlike other sectors such as construction, individual consumers have a high, direct influence on reducing environmental impacts associated with consumer goods. Studies show that if everyone limited their household spending on consumable goods like the most climate-friendly, minimalistic quintile of the Swiss population, the share of GHG emissions under the direct influence of consumers (around half of the total) would diminish by about 31%.[75] Consumer decisions are therefore pivotal in transitioning to a circular economy—and what's more, there's a growing desire to 'live lighter' and declutter, with trends like minimalism and essentialism on the rise.[76, 77] To increase the extent to which consumers can tackle consumerism, the Government needs to simultaneously play a stronger role in shaping the environment in which the public acts, through appropriately sequenced measures including regulation, taxation and development of infrastructure. Businesses also have a critical role to play in enabling behavioural change through increasing the affordability and availability of more sustainable products and services, and engaging customers and employees.

Transitioning to a circular economy will require a better understanding of the relationship between society and materials,[78] as well as increased individual consciousness of what we're consuming and for how long. This 'what if' scenario explores the role of consumption in a circular economy,[79] examining the impact of a material 'sufficiency' lifestyle: having enough, but not too much. We analyse the impact of shifting to a more circular mindset for goods like clothing, food and its packaging, and household appliances and furniture, as well as activities like travel.

1.1 PROMOTE A MATERIAL SUFFICIENCY LIFESTYLE

This intervention explores a range of strategies to help Swiss residents adopt a lower-impact lifestyle that values minimalism and conscious living. Minimising the consumption of clothing, furniture, and electronic and electrical goods, whilst embracing community-based services, will narrow flows, while encouraging product repairs will stretch their lifetimes, thereby slowing flows. This scenario encourages a lifestyle of material sufficiency, characterised by consuming less and keeping products in the value chain for longer.[80]

Clothes and textiles

Current consumption patterns of household goods, such as clothing, furniture and household appliances generate significant environmental pressures across the globe.[81] In Switzerland, an analysis of clothing flows revealed an annual consumption of 16 kilograms and disposal of 11 kilograms of clothing per person. This is remarkably high compared to the rest of Europe, where the average for clothing consumption came in at 6 kilograms per capita in 2020—less than half that of Switzerland. What's more: of all clothing discarded in Switzerland, approximately 62% ends up in mixed municipal waste. About 27% of discarded clothes are collected and resold as secondhand clothes abroad, downcycled into rags or insulation, or incinerated. Only around 10% of discarded clothes are collected for reuse in Switzerland.[82]

Furniture

Furniture consumption poses a similar problem: most of the furniture disposed of in Switzerland is incinerated, for example. 17% of post-consumer furniture is collected for reuse via secondhand shops or online, but only around 5% of the discarded furniture is reused; the rest is disposed of in separate collections as bulky solid waste or directly disposed of at the incineration plant.[83] Furniture production and transportation generate the highest environmental impacts. Therefore, the best way to combat these impacts is by preventing the production of new furniture in the first place: this can be done by making more durable products (where the replacement of furniture components is provided for a minimum number of years), buying more local products (thus reducing the carbon emissions associated with transport), encouraging the reuse of furniture components through design, and lowering consumption in general.[84]

Electrical and electronic equipment

In addition to clothing and furniture, waste electrical and electronic equipment (WEEE) is also a big contributor to the Swiss environmental footprint: around 16 kilograms per capita are collected each year,[85] considerably higher than the EU average of 10 kilograms per capita.[86] Here, the higher generation of waste compared to the EU average implies that consumption is also likely to be higher.

In order to reduce the environmental impact of consumer goods, consumption must radically decrease. This can be achieved by using goods for longer through actively repairing and refurbishing products as much as possible, as well as being satisfied with owning fewer things, without compromising on quality of life or wellbeing.

Impact on Switzerland's circularity

This scenario delivers the largest material and carbon footprint reduction of all scenarios. By extending the life of goods, Switzerland could cut its material footprint by 15.4%, lowering it from 163.3 million tonnes to 138 million tonnes. The carbon footprint could also be reduced by 15.8%, from 113.4 million tonnes to 95.5 million tonnes of carbon dioxide equivalent (CO_2e). This is due to the highly energy-intensive nature and fossil fuel-based production of consumable goods—many of which are made with plastic, for example. Lastly, implementing these strategies could increase the Metric by 1 percentage point, bringing it up to 7.9%. This scenario could also bring a range of co-benefits: it could support local businesses with specialisations in repair or restoration. It may also reduce waste while enhancing Swiss residents' sense of community,[87] and increasing feelings of social connectivity and satisfaction.[88]

SWISS TEXTILE COMPANIES GOING CIRCULAR FOR ALL AGES

Swiss clothing brand FREITAG uses waste as a resource to cycle flows: it manufactures functional and fashionable bags, backpacks and accessories using old truck tarps in a bid to be fully circular by 2030. The company is rethinking its business model to incorporate circular principles along every step of its supply chain, from collection and disassembly to retail. FREITAG has developed a new, fully circular material using biodegradable textiles that it produces in-house to cut transport emissions, thereby **narrowing** flows.[89] Swiss brand Baby Come Back is also exploring circular opportunities for its business, with the aim of **narrowing, slowing**, and **cycling** material flows. It boasts a circular store for stylish second-hand clothes, accessories and toys for babies and children. The business model allows customers to return their previously used items to a Baby Come Back shop. To incentivise customers, the shop gives a part of the resell value to the customer who supplied the item. This reward can also be used by the customer to buy another second-hand item. When items are worn out completely, they are subject to repurposing and recycling.[90] Similarly, apparel retailer Timberland has launched its take back project 'TIMBERLOOP' in Switzerland. This allows anyone to send their used Timberland footwear, clothing or accessories back to the company for resale or—in cases where the condition is beyond repair—recycling. In return, customers receive a 10% discount off their next purchase coupled with updates on the status of their used items—fostering connection between people and their positive environmental efforts.[91] Keeping Timberland items in circulation for longer contributes to **cycling** flows, whilst allowing customers to purchase second-hand items reduces the production of new products, **narrowing** flows. Mountain clothing brand Muntagnard is also bringing circular economy principles to its brand, favouring renewable, recycled and biodegradable materials and ensuring its designs are easy to repair and recycle, **slowing** and **cycling** flows.[92]

2. ADVANCE CIRCULAR MANUFACTURING

The central tenets of the current linear system are 'take-make-waste,' which drive climate change and pollute air, land and water. Currently, approaches to waste management in Swiss manufacturing largely centre on end-of-the-pipe solutions such as incineration and downgraded recycling. In 2019 alone, Switzerland incinerated 210,000 tonnes of industrial and special waste.[93] Within Europe, Switzerland's manufacturing sector is one of the biggest and most innovative. In 2021, manufacturing made up nearly 19% of Switzerland's GDP, compared to the EU average of 15%.[94] Considering the size of its manufacturing sector, Switzerland surprisingly has only a few policies in place relating to industrial resource efficiency and waste reduction.[95] For example, the return, take-back and disposal of electrical and electronic equipment ordinance (*Ordonnance sur la restitution, la reprise et l'élimination des appareils électriques et électroniques* (OREA))[96] was revised in 2022 to include the separate collection and recovery of used appliances and valuable materials such as gold, copper, aluminium, iron, and recyclable plastics. Since the provisions of the ordinance now also apply to devices that can be extracted with reasonable ease from vehicles, buildings and other objects, the potential for recovery of recyclable materials has increased.[97]

We envision a circular manufacturing sector, where products and components are reused at their highest value, design optimises product lifetimes and current modes of production and sales radically change. This 'what if' scenario for Switzerland's manufacturing industry outlines opportunities to pivot away from linearity: we highlight how to advance resource efficiency by making better use of (metallic) waste in industrial processes, and how to extend product lifetimes through various R-strategies, from remanufacturing and refurbishment to repair and reuse.

2.1 IMPLEMENT RESOURCE-EFFICIENT, SYMBIOTIC MANUFACTURING

This intervention tackles several of Switzerland's high-impact manufacturing industries—such as mechanical and electrical engineering (MEM), chemical manufacturing and watchmaking. Gains in material efficiency should be integrated in early stages: cutting yield losses involves making the most of technological advancements to get more from less, **narrowing** flows. Further along the value chain, where materials are used to make a product process improvements will bring similar benefits. Reducing scrap material, a byproduct of standard procedure, would also boost efficiency and reduce the need for virgin material inputs, further **narrowing** flows. All unavoidable waste can also be reused, **cycling** flows.

Implementing more resource-efficient practices in Switzerland is crucial as it is a manufacturing hub, which exports many of its goods. In 2021, Switzerland placed third in the Bloomberg Innovation Index, which ranked the most innovative countries in the world, and ranked third globally for research and development.[98] Indeed, the country has some of the highest shares of GDP spent on Research and Innovation—two-thirds of which is financed by the private sector.[99] In 2019, 14% of the entire R&D expenditure of the Swiss private sector was invested in the MEM industry.[100]

To further boost Swiss industry, three industry associations launched the *Industrie 2025* initiative in 2015: a national platform for informing, networking and promoting Swiss companies around topics from Industry 4.0 in an effort to accelerate a transition toward digital technologies.[101] Similarly, Innosuisse (the Swiss Innovation Agency) is implementing the so-called *Manufacturing Technologies* impulse programme, which is part of the Federal Council's 2019–2020 action plan to promote digitalisation.[102] Its aim is to support innovation projects that promote new manufacturing technologies (realised in collaboration with research institutions) which will lead to the digital transition of the manufacturing sector.[103] Considering Switzerland's high levels of technological innovation, the great number of experts and highly-skilled workers, and the government's political and financial support for advanced technological innovation in the manufacturing sector, this intervention is well suited for Switzerland. Efforts should also be made to increase cycling in areas without technological barriers: metals like gold can be cycled in continuous loops, yet recycled gold is only used for between 25 and 30% of the total Swiss gold used to manufacture watches and jewellery.[104] As the country is a global leader in gold-refined products, boosting this figure could be a significant way to reduce environmental impact.

By implementing interventions that boost resource efficiency in manufacturing and cycle flows, Switzerland could cut its material footprint by 1.7%, lowering it from 163.3 million tonnes to 160.5 million tonnes. The carbon footprint can be reduced by 0.4%, from 113.4 million tonnes to 113 million tonnes; while the Metric could grow by 0.1 percentage points up to 7%.

2.2 EMPLOY R-STRATEGIES FOR MANUFACTURED GOODS

This scenario's second intervention employs various R-strategies[105] (see text box on page 47) for manufacturing machinery, equipment and vehicles. Remanufacturing and refurbishment practices can be used to extend product lifetimes, therefore **slowing** flows. Switzerland could also benefit from a shift to more circular supply chains, making use of leasing or other Product-as-a-Service (PaaS) systems as an alternative to ownership-based models. In a linear product-oriented system, the aim is to maximise the number of products sold; PaaS circumvents this and therefore contributes to **narrowing** flows.

Remanufacturing has the potential to not only minimise environmental impacts, but can also develop new market opportunities for entrepreneurs, create high-skilled jobs and offer products at lower prices for customers as a result of competition.[106] Switzerland has the potential to develop a large remanufacturing market, specifically in its pharmaceutical sector where biotech equipment is well suited to remanufacturing due to shorter replacement cycles and higher salvage value.[107] Despite this great potential, there are currently no programmes specific to pharmaceutical machinery remanufacturing.

Another of Switzerland's main manufacturing industries, the watch industry, has potential to become more circular. The reparability of watches and jewellery is key to slowing flows: it should be a priority in product design as well as in creating repair and refurbishment businesses.[108] Beyond repair, the reuse of jewellery and watches through rental programmes and second-hand sales shows great potential for reducing consumption and waste[109]—and this is on the rise. The pre-owned watch market, for example, is expected to grow from a current market size of EUR 18.5 billion (CHF 20 billion) to nearly EUR 32.4 billion (CHF 35 billion) by 2030 and comprise more than half of the primary market. Brands are also increasing their own 'pre-owned' sales channels,[110, 111] in addition to established platforms that offer second-hand watches.[112]

At the civilian level, there are some repair initiatives for other manufactured goods in Switzerland. To date, there are 203 repair cafés in Switzerland, where participants can repair broken items together with repair professionals: these free repair events provide an opportunity to take action against planned obsolescence and growing mountains of waste.[113] Similarly, online repair platform *Reparaturführer* helps individuals looking for repair professionals or guidelines on how to repair manufactured objects.

To model this intervention, we make a number of assumptions related to remanufacturing, refurbishment, repair and maintenance, and reuse. All together, this intervention could cut the material footprint by 5.3%, lowering it to 154.6 million tonnes, and the carbon footprint by 3.4%, bringing it down to 109.6 million tonnes of CO_2e. The Metric could be boosted by 0.4 percentage points, reaching 7.3%. This is one of the most impactful interventions across all sectors, which logically arises from the fact that the manufacturing of machinery and equipment is the largest single contributing industry to the material footprint.

Impact on Switzerland's circularity

Together, these interventions have the second-highest impact potential of the five scenarios, alongside the range of social and economic co-benefits they could bring. The country could boost its supply chain resilience against disruptions and volatility, lower material input by keeping materials in use for longer and cut waste generation. This could be further supported through collaboration with neighbouring countries: given Switzerland's small size, certain processes or the use of certain infrastructure may need to be outsourced. Scaling the uptake of R-strategies could also induce greater private sector involvement in the circular economy and boost industrial sectors, creating new opportunities for businesses, incentivising innovation and laying the groundwork for longer-term resilience and competitiveness. Scaling resource-efficient manufacturing processes and implementing various R-strategies across the sector could decrease Switzerland's material footprint by 6.4%, lowering it from 163.3 million tonnes to 152.8 million tonnes. This scenario would also result in emissions reduction of 3.7%, bringing total emissions to 109.2 million tonnes of CO_2e. The Metric would rise by 0.7 percentage points, to a total of 7.6%.

WHICH R-STRATEGIES DO WE CONSIDER—AND WHAT DO THEY MEAN?

- **Remanufacturing:** A procedure in which all components of a product are completely disassembled down to their smallest parts, are fully inspected and then reused for an entire new life cycle.
- **Refurbishment:** A procedure to improve the quality of a product up to a specified quality.
- **Repair:** The reparation of parts of a product that limit its performance and the maintenance of parts that can help to prolong its useful life. This can happen at the inter-industry level or be performed after consumers purchase a good. Similarly, upgrades can be carried out to improve a product's functionality and extend its useful lifetime: this goes beyond repair and implies an improvement to a product, for example, by increasing mechanical-, electrical- or ICT-related inputs, depending on the product.
- **Reuse:** The extension of a product's lifetime, that therefore displaces the sale of new goods. This assumption stems from the fact that products are often still usable—even without additional repair and maintenance—but reach their end-of-use early due to consumer attitudes and behaviours.

FROM STEEL TO ELECTRONICS: SWISS MANUFACTURERS ARE ALREADY GOING CIRCULAR

ID Watch has created an eco-watch made from recycled steel, with straps made from green waste from parks: its modular design is also built for repairability and the easy replacement of components.[114] Similarly, Panatere makes watch cases from fully upcycled and recyclable materials, such as steel scraps coming from neighbouring watch manufacturers. One company's waste becomes another's resource—both **cycling** flows and **narrowing** flows by reducing virgin material use. Through Panatere's solar metal processing, it produces stainless steel with 1/165th of the impact of conventional steel, in terms of CO_2e.[115]

Non-profit Swico Recycling is also doing its part to **cycle** flows of electronic waste: it offers a pick-up service for used IT & office equipment, communications, graphic design and medical technological devices—and then partners with qualified recycling companies to give these products a new life. In 2021, 43,000 tonnes of electrical and electronic equipment was disposed of through its service.[116]

Swiss company Logitech is bringing elements of circularity to its product design: it employs resource efficiency measures to **narrow** flows while prioritising recycled plastic to make its mice and keyboards—saving 8,000 tonnes of virgin plastic and cutting emissions by 19,000 tonnes of CO_2e.

Durability and cyclability are also key considerations in the design phase, to **slow** and **cycle** material flows, while much of its supply chain is powered by renewable energy, cutting carbon emissions by more than 94,000 tonnes of CO_2e and **regenerating** flows.[117]

Encouraging more circular product use also requires that customers are informed of their choices: global technology company ABB has developed a holistic circularity framework in order to assess the circular value of a product, covering the entire lifecycle from design and sourcing, to manufacturing and logistics, to an optimised use phase, to responsible end-of-life management. This approach covers both perspectives: ABB's ambition to make its own operation circular, as well as ensuring its products enable circular customer solutions (through material sourcing, product design, lifetime extension and takeback and recycling options). All of its products' environmental impacts are verified by independent bodies.[118]

3. RETHINK TRANSPORT & MOBILITY

Transporting people and products around the world releases emissions—and consumes vast quantities of materials to manufacture vehicles and build up infrastructure. In Switzerland, domestic transport is responsible for one-third of the country's carbon emissions[119]—the largest portion of which comes from passenger vehicles. Currently, road and air traffic in the country rely almost fully on fossil fuels, which are entirely imported from abroad. The reliance on fossil-based transport is one of the biggest sources of air pollution in the country,[120] despite significant improvements over the last 25 years.[121] New regulations already put restrictions on how much new passenger cars can emit per kilometre[122, 123]—albeit at a lower level than EU restrictions laid out in the *New European Driving Cycle*. Swapping combustion engines for electric vehicles represents a substantial opportunity for emissions reduction, especially as much of the Swiss electricity mix is based on renewables. Some progress in this arena is taking place: as of 2022, Switzerland ranks seventh in Europe for new registrations of electric vehicles.[124] Shifting to electric vehicles may vastly reduce emissions, but they also rely on hard-to-recycle batteries that contain scarce elements that put a strain on material demand, while so-called 'connected cars' generate lots of data about users and the car itself, consuming a substantial amount of energy.[125] In fact, one study suggests that the energy required to maintain the computer functions of autonomous electric vehicles may generate the same amount of emissions as all the world's data centres today.[126] These caveats must be considered in the electrification of the vehicle fleet, and also underscores why reducing the fleet size should be the top priority. From the materials perspective, *The Future of Swiss Mobility: Orientation Framework 2040* provides objectives to minimise natural resource use while maximising the benefits from materials already in use across the mobility sector over the next two decades. Policy, however, now largely centres on technological development and fails to address what's ultimately needed to reduce transport's impact: behavioural change among Swiss residents. And in spite of some goals on cutting the sector's impact, current efforts aren't enough: progress on reducing carbon emissions is running behind schedule and targets aren't being met, even with a drop in car travel during the pandemic.[127] In all: a shift to circular practices will be needed to get Switzerland back on track.

We suggest five interventions that can do just this—lowering the impact of Swiss transport while benefiting residents: reduce reliance on private vehicles, embrace flex work, pursue a modal shift for transport, improve vehicle design and reduce air travel. In general, the prioritisation of circular mobility strategies should take the approach of: reducing mobility demand, lightweighting vehicles and infrastructure and finally, electrifying the fleet and powering with clean energy.[128] Some of these strategies can be pursued on a city and national level, however, a strategy like lightweighting vehicles is a change that must be pursued on a sectoral level—with international cooperation. It's also worth noting that this scenario only measures the impact of changes to private mobility—passenger vehicles in particular. Ensuring that materials are used optimally for all transport across Switzerland—from buses to trains—will require broader and more systemic change.

3.1 REDUCE RELIANCE ON PRIVATE VEHICLES

This scenario's first intervention examines the impact of a modal shift among Swiss residents, with the ultimate aim of reducing overall car use to the lowest possible level. Reducing the need for private car ownership and fuel consumption can **narrow** flows, as both will result in less material use.

In Switzerland, vehicle emissions are very high—and are failing to achieve targets for emission reduction, in part due to the growing number of cars in the fleet and higher car ownership rates. The number of vehicles on the road has swelled by 39% over the last 20 years, while the number of cars per thousand inhabitants rose from 457 in 1995 to 537 in 2019 —a car-to-inhabitant ratio similar to the EU average.[129] Cars are also getting bigger: sport utility vehicles (SUVs) now make up half the total, a stark figure in comparison to the rest of the continent, for which the average is about one-third.[130] While private passenger cars are still the most popular way of getting around,[131] practices like carpooling and car sharing are becoming more mainstream, prompted by government incentives: as of 2023, carpoolers will be allowed to use bus lanes and some roads generally restricted to traffic.[132] Cycling is also on the rise—especially in urban centres—with around two-thirds of Swiss households owning at least one bicycle.[133] By examining data on car trips, we see huge potential for cycling: around half of car trips and the vast majority of bus or tram trips are less than 5 kilometres in length, equivalent to a 15 to 20-minute bike ride.[134] Policy is also increasingly supporting a switch to cycling, with the Federal Council enforcing legislation to embed biking in an article of the Swiss constitution.[135] Now, 23 of 26 cantons have launched departments to plan and roll out cycling infrastructure—yet indicators to measure progress are lacking, and the need for better and safer cycling lanes is still prominent.[136] With traffic levels on the rise,[137] a switch to more active transport modes (such as cycling and walking) will bring benefits beyond the environmental: lower noise pollution and better health, for example.

In all, this intervention could decrease Switzerland's material footprint by as much as 2.2% (primarily due to reduced fossil fuel demand), bringing it down to 159.7 million tonnes, while the carbon footprint would shrink by 4.4%, down to 108.5 million tonnes. The Metric could grow by 0.1 percentage points, to 7%.

3.2 EMBRACE FLEX WORK

The beginning of the covid-19 pandemic ushered in a 'new normal' for workers around the globe—and even as we've slowly returned to business-as-usual, for some, flex work is here to stay. This intervention explores how continuing to work from home where possible could positively impact Switzerland's Circularity Metric and material and carbon footprints: cutting the need for workers' commutes would lower transport demands, thereby **narrowing** flows.

In Switzerland more than one-third of the workforce worked from home—at least occasionally—in 2021.[138] This has increased sharply from under 7% in the early 2000s. However, most of these flex workers fall in the 'telework only occasionally' category, with only 4.3% spending more than half their working hours at home.[139] On the whole, Switzerland is still a 'country of commuters': most residents are working outside of the home, with an increasing number travelling beyond their canton for their jobs.[140] More than half of commuters get to their jobs by car, with around one-quarter using public transport: only around 17% use active forms of transport such as cycling and walking. So far, there's been little in the way of incentives for flex work: while remote workers will benefit from flexible social security rules until the end of 2022,[141] plans for other benefits or policies are lacking. However, Switzerland's *Long-Term Climate Strategy* has mentioned flex work as a means for cutting transport emissions, perhaps signalling more official recognition to come.

By implementing this intervention, Switzerland could reduce its material footprint by 0.7%, bringing it down to 162 million tonnes, and decrease its carbon footprint by 1%, bringing it down to 112.3 million tonnes. The Metric would increase by 0.05 percentage points, to 6.95%.

3.3 PURSUE A MODAL SHIFT FOR TRANSPORT

While our first intervention looked at sharply reducing car ownership and use, this intervention explores how this could be realised, examining the impact of a boost in public transport. Increasing the number of journeys taken by train and bus would cut the number of private cars on the road, thereby lowering material use and fuel consumption. This would **narrow** flows.

As seen in previous interventions, passenger vehicles are the predominant form of transport—and are even on the rise. In spite of this, residents' passenger kilometres travelled by car sit nearly 10 percentage points below the EU average, pointing to fairly solid public transport use. The system for public transport already in place is strong: positioning this as a key lever for realising a modal shift. There are also financial drivers: the country's varied terrain, often-severe winters, and high network complexity for roads mean that the construction of passenger car infrastructure is costly and maintenance is difficult.[142] Currently, the government's investments in passenger road infrastructure top those in rail infrastructure, although the latter still come in above the EU average.[143] Going forward, Switzerland can look at allocating more finances to these systems, while lowering investment in passenger car infrastructure—all while promoting behavioural change in residents. This will be most effective in densely populated, urban areas, which account for around three-quarters of the population.[144] Behavioural change could be encouraged by lowering the cost of using public transport: lowering fares for train travel, for example.

This intervention could cut Switzerland's material footprint by 0.9%, bringing it down to 161.7 million tonnes, and its carbon footprint by 1.9%, down to 111.3 million tonnes. The Metric would grow by 0.06 percentage points, to 6.96%.

3.4 IMPROVE VEHICLE DESIGN

While focus should ideally be placed on cutting transport by car, boosting public transport and electrifying the vehicle fleet, clean new technologies in vehicle design are also needed. This intervention therefore comprises a range of strategies that tackle the production and use phase of vehicles. Switzerland has an opportunity to **narrow** resource flows by prioritising small(er), more lightweight, fuel-efficient vehicles, thereby cutting material and fuel use. This could include private cars, public transport vehicles and freight transport.

Currently, in Switzerland, SUVs are among the most popular vehicle types: one survey found that Switzerland ranked first out of 15 European countries, with 19% of respondents owning an SUV. Large, off-road vehicles are often perceived as being safer for the mountainous terrain of Switzerland. These also carry a hefty price tag: tax rates—although set by individual cantons—are based on various criteria, including vehicle weight and CO_2 emissions. So while larger, heavier vehicles are far more expensive than lightweight vehicles—and tax-exempt electric ones—this hasn't hugely influenced purchasing decisions. As the Swiss franc is a powerful currency, Swiss residents can purchase larger, luxury vehicles from neighbouring European nations for use in Switzerland, although this practice is subject to import tax for both new and used cars.[145, 146]

By encouraging the further adoption of small, lightweight electric vehicles, Switzerland could cut its material footprint by 1.8%, bringing it down to 160.3 million tonnes. The carbon footprint would decrease by 3.5%. In all, the Metric could increase by 0.1 percentage points, reaching 7%.

3.5 REDUCE AIR TRAVEL

The aviation sector is heavily reliant on fossil fuels, making travelling by air a highly polluting mode of transport—an aeroplane's emissions per kilometre travelled are much higher than a bus or train.[147] Material flows in this intervention can be **narrowed** through a reduction in demand: this will reduce the materials needed to produce aeroplanes, while also lowering their associated fuel use.

The Swiss government is currently taking steps to discourage fossil fuel consumption in the aviation industry, but is not focussing on reducing the absolute demand for flights. Reducing demand is especially important given that the aviation sector is a difficult and slow sector to decarbonise. New plans focus more on regulation, such as obligating airlines to use more synthetic fuels. In addition, the government is pledging EUR 23–28 million (CHF 25–30 million) per year to fund the production of synthetic aviation fuel, often considered a more sustainable alternative.[148] Under these new policies, petrol and diesel importers would also be obliged to replace some of their fossil fuels with renewable alternatives. Companies will be exempt from CO_2 taxes if they can prove they are actively reducing their emissions. The proposed law will be submitted to parliament in the next year.[149] While air travel around the world has significantly reduced since 2020 due to covid-19, it may still return to pre-covid levels. In 2019, almost 60 million passengers arrived and departed Switzerland by plane.[150] Promoting alternative modes of transport and boosting local tourism could prevent a return to pre-pandemic rates of air travel. In Switzerland, trains are an especially favourable alternative to aeroplanes due to their connectivity to other European countries and often renewable energy supply.[151]

By reducing air travel, Switzerland could see a 0.4% reduction in its material footprint and 2.2% reduction in its carbon footprint, lowering them to 162.5 million tonnes and 90 million tonnes, respectively. The Metric would rise by 0.03 percentage points, to 6.93%.

Impact on Switzerland's circularity

By combining the four mobility-related interventions, Switzerland has the power to cut its material footprint down to 154.6 million tonnes, a 5.3% reduction. This relatively low reduction in the material footprint can be linked to the already-widespread use of public transportin Switzerland. Nevertheless, this intervention has the second highest carbon footprint reduction potential—largely due to a reduction in fossil fuel-reliant car use and aviation. By applying the measures suggested, Switzerland could lower its carbon footprint by 12.2%, bringing it down to 99.6 million tonnes. The Circularity Metric could grow by 0.3 percentage points, up to 7.3%. Switzerland would also likely enjoy a range of other environmental, social and economic **co-benefits** from implementing these strategies: less harmful air pollution, as noted, as well as lighter congestion in busy cities, less noise, and increased room for green spaces, for example.

FROM INFRASTRUCTURE TO VEHICLES, SWISS COMPANIES ARE PIONEERING CIRCULAR MOBILITY

SBB—Switzerland's public rail company—is looking to **narrow** and **cycle** material flows for transport infrastructure: it's working on cutting virgin material inputs, for example, by using recycled asphalt for 60% of the bottom layer and 40% of the top layer of pavements. It's also extending its trains' lifetimes (**slowing** flows), by renovating—rather than replacing—coaches, and protecting floors and walls against corrosion.[152] The Swiss public post office, *La Poste*, **regenerates** flows through its services: it distributes post and parcels using 16,000 electric scooters, featuring lithium-ion batteries recharged with renewable energy. *La Poste* knows that collaboration is key: it's working closely with the scooter manufacturing company to shape end-of-life reuse and recycling systems for the batteries. Currently, around 91% of each battery's materials are recycled through this collaboration.[153] Car sharing platform Swiss E-Car is also prioritising electric vehicles: its all-electric fleet is entirely powered through renewable energy, and is available to users all day every day, making it a quick and convenient alternative to private car ownership.[154]

4. BUILD A CIRCULAR BUILT ENVIRONMENT

Across the globe, the societal need for housing has a massive impact—and the case in Switzerland is no different. Buildings are responsible for around one-quarter of total GHG emissions, and claim around 40% of total energy consumption,[155] while housing alone consumes almost 17% of the total material footprint. Fossil fuels are still used to heat two-thirds of buildings, with only a little more than one-tenth heated through heat pumps.[156] This figure surges, however, when looking at new builds: around 59% of dwellings erected between 2016 and 2021 benefit from heat pumps, with oil and gas only servicing 15% of the houses built in this period.[157] On the other hand, the demand for new buildings is expected to increase, albeit slowly, creating a vicious cycle of inefficiency: average floor space per dwelling has increased over time, for example,[158] while the number of people per dwelling has fallen slightly over the last decades (on par with the EU average),[159] driving new construction which requires more land and resources. Financial turnover is also on the rise, increasing by a staggering EUR 1.8 billion (CHF 1.9) between 2018 and 2019.[160] The industry's growth has an impact, however: construction is Switzerland's largest waste source, generating 8.7 tonnes per capita—largely from excavation and demolition.[161] Going forward, it will be crucial to apply a circular lens to traditional building practices—one that looks beyond energy efficiency alone—to ensure the construction industry's impact doesn't continue to rise. Favouring circular principles like low-impact materials, using space more efficiently and ensuring cycling is in place could reverse this tide by reducing waste—and could spur innovation along the value chain, creating new skills, and job opportunities. All serving to stimulate economic development and provide a competitive edge to the Swiss economy, based on a more efficient use of materials.

To this end, this scenario comprises three interventions, exploring how Switzerland can optimise its housing stock expansion and increase its occupancy rates, shape an energy-efficient building stock, and scale resource-efficient building practices.

4.1 OPTIMISE HOUSING STOCK EXPANSION & INCREASE OCCUPANCY RATES

This scenario's first intervention comprises strategies to lower the Swiss construction industry's material footprint by **narrowing** and **cycling** flows. Construction and demolition waste, for example, can be put to good use for new residential construction and maintenance, while idle and unused commercial buildings can be better utilised to lower demand for new builds. We also envision a cap on new construction of residential, commercial and public buildings. This intervention also entails a range of strategies to boost building occupancy, which will also reduce the total number of buildings needed. As empty properties tend to remain empty, and therefore deteriorate more quickly due to insufficient maintenance, boosting occupancy can also make buildings last longer, **slowing** flows.

Housing stock expansion

Switzerland's housing stock is growing: the number of dwellings in the country increased from 3.6 million in 2000 to 4.7 million in 2021.[162] This may be, in part, to steady population growth.[163] Residents are also seeking out larger houses, with the average number of rooms per person on the rise,[164] matched by a decrease in overcrowding.[165] While growth in floor space has recently peaked and tapered off,[166] most new builds are substantially larger than those from a few decades ago. The rate of empty, uninhabited buildings has also risen steadily from 0.92% in 2010 to 1.72% in 2020, before slightly decreasing again,[167] showing that there's room to better utilise this space. A focus on circular strategies will be essential to ensure expansion of the housing stock makes the most of what's already available and is carried out in the most resource-efficient manner possible. Secondary material use will also have an important role to play here. Currently, construction and demolition waste is Switzerland's largest waste stream, representing 84% of the total—however, a fair share of this is already recycled: around two-thirds are recovered and used for construction, with around one-third landfilled or incinerated and a small portion exported.[168] This is still significant, with opportunities to further optimise building material recycling; especially as much of what is reused is used for backfilling, a lower-value application. While this does save on raw materials and cuts emissions, there's still room for higher value cycling. Circular strategies in this realm may be supported by the new

Federal Ordinance on Waste Avoidance and Disposal,[169] which outlines requirements for the nature, volume and (re)use of construction and demolition waste. The ordinance states that unpolluted and non-hazardous excavated material be recovered to the greatest extent possible.[170] Nonetheless, this regulation would be more effective if it indicated mandatory percentages of excavated waste to be recovered. It could also expand to include a mandatory percentage of secondary materials (i.e. recycled cement) required while building new houses. Zurich is leading the way in this realm: the city's public procurement policy for new buildings requires that cement is composed of 25% recycled aggregates.[171] This incentive has promoted the development of a market for recycled concrete in Zurich.[172]

Housing stock expansion

In the Swiss context, empty houses pose a number of problems: uninhabited buildings further tighten the already strained housing supply and drive up prices. Housing is increasingly seen as an investment asset, which can also negatively impact community lives and neighbourhoods.[173] Empty housing also fuels material use, as new building stock is needed to meet demand. Housing cooperatives and co-housing offer a way to use housing stock and building materials more efficiently, while also providing more socially and economically sustainable housing. Housing cooperatives are membership-based, with ownership shared equally amongst members, unlike co-housing, in which people own a share of the property and have both private and communal spaces. According to data from the Federal Office for Housing (BWO), in 2018, 5% of the population in Switzerland reside in cooperative housing schemes.[174] This figure is low due to a lack of focus on encouraging multi-functional spaces, cooperative housing and co-housing. Some action has been taken to encourage housing cooperatives with certain policies such as the *Fonds de roulement*,[175] which provides loans to non-profit housing suppliers and cooperatives, and *Aide a la pierre*,[176] which provides subsidies and grants. Based on various estimates, it is safe to assume there are around 2,000 housing cooperatives in Switzerland. The canton of Zurich has the most cooperative housing in Switzerland with almost 40% of all cooperative housing, followed by Bern with 10% and Lucerne with 8%.[177] These figures could increase with government incentives such as tax breaks, interest-free loans, or land use ordinances.

By applying these strategies, Switzerland could cut its material footprint by 2.6% and its carbon footprint by 3.5%. Its Circularity Metric could grow by 1.3 percentage points, up to 8.2%. This intervention is the most impactful of the built environment scenario. Due to the sheer volume of virgin materials the construction sector demands, limiting such demand proves a significant lever for material footprint reduction. Increasing the use of secondary building materials in new construction is the primary driver of growth for the Circularity Metric in the sector.

4.2 SHAPE AN ENERGY-EFFICIENT BUILDING STOCK

This intervention centres on improving dwellings already in the stock, rather than opting for demolition. To this end, we look at the impact of the deep retrofitting of buildings: this will **narrow** flows, by reducing the energy required to heat homes through significant improvements in building insulation. In doing so, secondary and non-toxic, regenerative materials should be prioritised to **cycle** and **regenerate** flows. Material choice is still crucial for retrofitting: it must be considered how embodied carbon in certain materials, such as concrete, may counteract efficiency gains.

On average, European building stock is quite old: in most EU countries, for example, around half of residential buildings were constructed more than 50 years ago, which is when early regulations on energy efficiency began to emerge on the continent. In Switzerland, the largest portion of dwellings were built between 1946 and 1980, with around one-quarter built prior to 1946.[178] These older houses are largely heated by fossil fuels like oil and gas.[179] Despite this older building stock, current retrofitting rates are low: only around 1% of total residential buildings undergo annual retrofitting for energy efficiency,[180] and more than 1 million residential buildings are poorly insulated or not insulated at all.

This can be attributed to the many barriers home-owners face in undertaking energy retrofits: a lack of knowledge regarding these activities and their economic long-term benefits among them.[181, 182] Switzerland is a country of tenants[183]—but its prevailing rental model means that neither tenants nor landlords are incentivised to make energy efficiency improvements to homes: landlords are often not responsible for energy bills, while such upgrades usually aren't economically viable or efficient for tenants.[184] The end of 2020 saw 2.3 million tenant households and only 1.4 million owner-occupied households: a home ownership rate of around 36%, ranking lowest in comparison to other European countries.[185] To meet the net-zero goals of the *Energy Strategy 2050*, however, the retrofitting rate will need to more than double—and heat pumps will need to be installed in older homes, as they're only featured in around 6% of houses built pre-1971.[186] Some progress is taking place in this realm: over nine years of activity, the Swiss *Building Programme* has provided a total of EUR 2.3 billion (CHF 2.5 billion) in funding, cutting CO_2 emissions by 16 million tonnes.[187] Demand for energy retrofitting is high, and significant amounts of money have already been funnelled into thermal insulation, assembly of domestic installations (ventilation systems with heat recovery and/or powered by renewable energy), and systemic building recovery (including improvements on the building envelope and in-house heating systems). By 2030, energy retrofitting will become mandatory for all buildings under the *Housing Stock 2050* vision from the Federal Energy Office.[188] It's crucial that realising this target is done in as circular a manner as possible through careful material selection—and that behavioural changes are monitored to prevent potential rebound effects, such as higher heating fuel consumption in spite of having a more energy efficient building.

By increasing retrofitting rates and boosting energy efficiency, Switzerland could cut its material footprint by 1.5% and its carbon footprint 6.6%. Its Circularity Metric could grow by 0.1 percentage points, up to 7%. This intervention stands out for its large potential for carbon footprint reduction, stemming from the fact that fossil fuels are widely used for building heating.

4.3 SCALE RESOURCE-EFFICIENT BUILDING PRACTICES

Our third intervention for the built environment comprises a range of strategies to improve the efficiency of residential buildings. We consider the impact of choosing lightweight materials, such as timber—**narrowing** flows—while also increasing the lifetime of bearing elements,**slowing** flows. We seek to **narrow** flows through improved construction processes, such as modularisation and off-site construction that can limit material losses, and through keeping the supply chain as local as possible.. At home, Swiss residents can make behavioural changes to narrow flows and ensure resource-efficiency as well: thinking twice before turning up the heat, making use of smart metres and using energy-efficient appliances, for example.

While data is limited on Swiss steel use, the nation is one of the biggest importers of steel products[189]—roughly half of which is used for construction.[190] Similarly, Switzerland is regularly among the world's top five consumers of concrete with over half a tonne of concrete used annually per capita.[191] However, Holcim continues to invest in research and development into reducing the material and CO_2 footprint of concrete through using carbon pre-stressed concrete and developing innovative mixes to produce low-carbon concrete products with its ECOPact.[192] What's more, in 2021, the proportion of 'timber structures' recorded in Switzerland's building permits was 6.2%, increasing from the 2011 levels of 2.6%. Considering the share of residential buildings with a partial or entire facade made of wood, there has been considerable growth: figures went from 9.8% to 20.3% of total house permits.[193] In Switzerland's case, shifting to more wood-based constructions will have a crucial role to play in cutting the building sector's impact: international studies show that the life cycle emissions of timber structures are up to 42% lower than their concrete counterparts,[194] while substituting concrete with cross-laminated timber can bring reductions of up to 60% at the individual building level. According to the *Swiss Wood Resource Policy 2030*, the country has huge potential when it comes to wood production. Indeed, Switzerland boasts large forests—covering almost one-third of the total territory. However, Swiss timber is not fully utilised and does not cover the booming local demand for wooden houses. This is due to high production costs, low demand for hardwood, little forest management intensity and the small-scale ownership structure of forests that determines small-scale supply behaviour.[195] As a result, it is cheaper to import finished timber products from neighbouring countries.[196] While it may be difficult to construct with 100% Swiss wood, building houses using local, sustainably-sourced timber is becoming more and more popular in Switzerland for its environmental benefits.[197] Here, strict policies around forest management will be crucial to maintain environmental integrity: sustainable harvests may be followed by additional tree planting of local varieties to ensure a biodiverse habitat.

External factors—from the covid-19 pandemic to recent geopolitical developments—have caused severe supply shortages of construction materials and sent prices soaring in Switzerland. Prices of construction materials have shot up across all regions of the country, increasing by nearly 5% as of April 2022 compared to the previous year. This inflation is specifically due to an increase in the price of concrete.[198] Shifting to more local and sustainable building materials could present a way to alleviate expenses and build resilience locally, cutting susceptibility to shocks from abroad—while also delivering material savings and slashing emissions. Modular construction is also an option to reduce material use. NEST (Next Evolution in Sustainable Building Technologies) is a modular research and innovation building from Empa & Eawag, two research institutions. Along with more than 150 partners, they are testing new, sustainable and circular materials, technologies and products and energy concepts to be used in the construction sector. Building energy efficiency measures into buildings themselves can also cut costs while having a huge impact on emissions. Switzerland is taking strong action with regards to building technology, and is home to many innovative technology suppliers. Since 2018, smart meters have been installed across Switzerland as part of the *Energy Supply Ordinance*. According to this regulation, 80% of all energy metres must be substituted with smart meters by the end of 2027. In 2020, the share of smart meters compared to conventional metres was 20.2%, while 2022 saw over 1 million smart meters installed. These figures continue to increase.[199]

By embracing more resource-efficient building practices, Switzerland could cut its material footprint by 1% and its carbon footprint 2.5%. Its Circularity Metric could grow by 0.1 percentage points, up to 78%.

Impact on Switzerland's circularity

Combining these three interventions for housing, Switzerland could cut its material footprint by 4.8%, lowering it from 163.3 million tonnes to 155.4 million tonnes. The carbon footprint could be reduced by 12.1%, from 113.4 million tonnes to 99.7 million tonnes. The Metric could grow by 1.4 percentage points, up to 8.3%. These results showcase a disproportionate link between material and carbon footprint reductions: there is much more room to reduce the carbon footprint for these interventions. This highlights the energy-intensive nature of the built environment while showing that circular economy strategies are crucial to tackling climate change. This scenario would also usher in a range of co-benefits for Switzerland: reduced household energy consumption, for example. Smart meters and deep retrofitting can also serve to boost consumers' awareness, as they encourage users to think more critically about how they power and heat their homes. Measures to reduce overall energy consumption will reduce fossil fuel use, thereby improving air quality and health. At the same time, creating a local market for secondary construction materials, coupled with the labour intensity of renovation and retrofitting activities, could bring new business and employment opportunities to the Swiss economy.

SWITZERLAND IS ALREADY SHAPING A LOW-IMPACT BUILT ENVIRONMENT

How? Circular strategies, such as **cycling** end-of-life construction and demolition waste, are already being implemented, reducing pressure on demand for virgin materials,**narrowing** flows. The national rail company, SBB, for example, is constructing train platforms with recycled asphalt—reducing the impact by one-quarter when compared to a conventional counterpart.[200] Holcim, a world leader in innovative and sustainable building solutions, is also advancing circular construction. Holcim launched Susteno, the world's first cement containing 20% recycled construction and demolition waste. Switzerland's policies promoting the upcycling of construction and demolition waste have made this innovative cement possible. In 2022, Holcim's Swiss operations recycled 1.2 million tonnes of waste, diverting valuable waste from landfill and preventing the consumption of virgin resources.[201] Choosing more **regenerative** materials with potential for reuse is also key to circular construction—and SBB aims to do just this by making future rail engineering buildings wood-based and easy-to-deconstruct, aiding future reuse and recycling. Putting these strategies into practice on the ground can be complicated; but online platforms or digital tools like material passports can help. SBB is working with Madaster to create a digital material registry for all their assets, which will include information on what kind of materials exist—and in which quantities. This way, older structures or buildings can act as a 'bank', providing secondary materials for use in further applications.[202]

5. NURTURE A CIRCULAR FOOD SYSTEM

Swiss agricultural practices—from growing crops and feed to grazing livestock—have substantial environmental impact. Such practices claim around 35.9% of the country's land.[203] The number of farms is decreasing, yet the average farm size has more than doubled since 1975:[204] a common trend pointing to the growing industrialisation of farming. Similar to the rest of the world, Swiss agriculture is putting increasing pressure on the country's natural landscapes: biodiversity is on the decline, with around 36% of wild species endangered and more than 60% of habitats classified as threatened or near threatened.[205] While agriculture can play an important role in maintaining habitats, changes in land and water management and a rise in intensive farming have influenced this decline. A lack of regenerative agricultural practices and relatively strong focus on animal products have also played a role: around half of agriculture's production value stems from livestock and dairy production, with crops playing a smaller role, contributing a little over one-third of financial value. Despite this, caps on livestock numbers are among the lowest in the world[206]—and much of the meat produced is used domestically: for animal products, the self-sufficiency rate is as high as 90%.[207] Organic farming is also on the rise—a trend which may further improve following the adoption of new measures rolled out in 2022 that will aim to cut pesticide use in half by 2027. The country's *Long-Term Climate Strategy* also provides a solid foundation for a shift to a more circular food system, underpinned by goals to reduce the agriculture sector's GHG emissions by 40% by 2050, as part of broader targets for carbon neutrality.[208] Similarly, the *2030 Sustainable Development Strategy* (2021) and related action plan outlines targets for the food system, including a shift to healthy, sustainable diets, a substantial drop in food waste and losses and an increase in the share of farms engaged in environment- and animal-friendly food production.

Our circular interventions for this scenario pave the way to realising these targets: if done well, agriculture can contribute to biodiversity conservation and protect soil health, bringing ecosystems back in balance, while nourishing a healthy population. To this end, this scenario proposes two circular interventions to cut Swiss food system's impacts: shift to more sustainable food production, and reduce food waste.

5.1 SHIFT TO MORE SUSTAINABLE FOOD PRODUCTION

This scenario's first intervention focuses on food production. We explore a range of strategies promoting farming methods that are less dependent on mineral fertilisers—such as regenerative and organic farming—to **regenerate** and **narrow** flows. Shifting to more seasonal and local food production will also serve to **narrow** flows by lessening dependence on greenhouse-grown foods[209] and lowering travel distances, thus cutting fuel consumption for heating and transport. Swiss farmers will have a crucial role to play in creating a more sustainable and low-waste food production system—one based on circular principles that works alongside nature, protects biodiversity and cuts emissions and chemical inputs.

Agriculture in Switzerland is already trending toward circularity. Today, more than 12.2% of all Swiss farms are organic, and organic products account for 7.7% of the entire Swiss food market.[210] Switzerland boasts more organic farms than the EU average, owing largely to its low levels of nitrogen fertiliser consumption: 5 kilograms per capita, compared to the EU average of 22.4 kilograms per capita.[211] However, the agricultural sector still accounts for the majority of Swiss GHG emissions.[212] Regenerative agricultural practices like no-till farming and nutrient cycling are more aligned with circular principles and actively work to reduce GHG emissions. In 2020, as a result of largely-linear agricultural practices, 93% of agriculture-related ammonia emissions—harmful pollutants that damage human health—were from livestock production.[213] Cattle caused the highest ammonia emissions in the sector, accounting for 77% of all emissions from livestock production and manure management. Ammonia emissions from agriculture have declined by nearly one-quarter in Switzerland since 1990; however, this drop occurred mainly before 2004, after which progress has largely halted. Currently, Switzerland's ceilings on livestock numbers are the lowest in the world.[214] Given the impact that livestock have on the environment, coupled with the Paris Agreement climate targets, the current ceilings may need to be reconsidered in the coming decade. Currently, the livestock industry (including dairy) represents more than 14% of the Agrifood sector's material footprint, and contributes more than 15% of its carbon footprint.

The Swiss *Climate Strategy for Agriculture* provides an overall view of the links between climate and agriculture and has already set goals for adapting to climate change and combatting GHG emissions. The strategy acknowledges that more than one-third of Switzerland's land area is used for agricultural production—which both contributes to and is affected by the consequences of climate change.[215] Circular strategies could aid Switzerland in reaching targets set by the Strategy, and indeed already feature in it: fertiliser production, for example, is a focus.

By shifting towards more organic, locally-sourced and seasonal food production, Switzerland could cut its material footprint by 1.2%, bringing it down from 163.3 million tonnes to 161.2 million tonnes, and its carbon footprint by 1.2%, from 113.4 million tonnes to 112.3 million tonnes. The Metric could increase by 0.1 percentage points, to 7%. By incorporating more regenerative practices guided by circular principles, Switzerland can sustain healthy land and people, while becoming a pioneer of sustainable food production in Europe.

5.2 REDUCE FOOD WASTE

This intervention revolves around cutting household-level organic waste. Preventable food waste—that which has spoiled in the refrigerator and then tossed in the bin post-expiry-date, or food bought in surplus only to be discarded—is limited, **narrowing** flows. Under this intervention, unavoidable food waste such as bones, peels, shells or other inedible components should be **cycled**. In addition this intervention involves residents limiting their caloric intake to a sufficiency level, in turn reducing waste along the value chain that was not necessary in the first place—subsequently **narrowing** flows.

The generation of food waste in Switzerland is aligned with the global average—with costs amounting to around EUR 609 (CHF 658) per person per year. This amounts to more than EUR 5.1 billion (CHF 5.5 billion) in total, not including losses taking place along the food value chain. For example, around 360,000 tonnes of food waste is generated abroad in the production of food. These losses are not recorded in the food disposal statistics within Switzerland, but should be considered when looking at the overall impact of Swiss material consumption.

Within Switzerland, 2.8 million tonnes of food waste is generated per year. Most of this avoidable food waste comes from food processing, followed by households—although household food waste has the biggest environmental impact: impact per tonne of food waste varies depending on where in the value chain the waste occurs.[216] In total, an estimated 25% of Switzerland's food-related environmental impact is caused by avoidable food waste—food that could have been eaten. This means that nearly half of all the agricultural land in Switzerland is used to grow food that ends up in the rubbish.[217] Currently, Switzerland's goal is to halve its food waste by 2030 through voluntary measures by the restaurant sector, the food processing industry and farmers organisations.[218] If this goal is to be met, action is needed to implement circular strategies at all stages of the food chain. Because the environmental impact of food loss is greater at the end of the food chain than at the beginning, measures in households, the catering industry and the retail trade are particularly effective in reducing environmental impacts. A holistic approach that combines community and business initiatives, public education and policy action to change the legal and financial framework in which the food industry operates will increase the likelihood of reducing Swiss food waste to a sustainable level.[219]

By eliminating all the avoidable post-consumer organic waste, Switzerland could cut its material footprint by 1.9%—bringing it down to 160.1 million tonnes, and its carbon footprint by 1.5%, from 113.4 million tonnes to 111.8 million tonnes. The Metric could increase by 0.6 percentage points, to 7.5%.

Impact on Switzerland's circularity

Altogether, this scenario could bring substantial benefits: Switzerland's material footprint could drop by 3.1%, bringing it from 163.3 million tonnes to 158.2 million tonnes, while the carbon footprint could drop by 2.4%, lowering it from 113.4 million tonnes to 110.7 million tonnes. The Metric could grow by 0.7 percentage points, to 7.6%. Although these impacts are modest compared to the other scenarios, their importance should not be overlooked. Embracing a circular food system could also bring a range of **co-benefits** to Switzerland, from the improved health of its residents to lower air pollution to healthier soil and flourishing biodiversity. Preventing food waste—in addition to helping the country meet its goal of halving it by 2030—will also benefit residents financially: after all, wasted food is wasted money. Producing food sustainably and locally could also help ensure greater resilience, protecting against future shocks—whether geopolitical, economic or health-related—while reducing import costs for import-dependent food groups, such as vegetables, fruits, nuts and fish.[220] This scenario can also help to stimulate new business models which capitalise on food waste, creating new employment opportunities and allowing for more collaboration with local farmers to increase the quality of their soil, provide biogas for energy and decrease dependency on imported fertilisers.

COMBINED INTERVENTIONS

Individual interventions across the economy have a limited impact on the Circularity Metric and the material and carbon footprints, but when combined, the benefits multiply. However, it is important to note here the difference in relative impacts between the material and carbon footprint reduction and the increases in the Circularity Metric. Firstly, as noted in Chapter two, the material and carbon footprints are absolute figures, while the Circularity Metric is relative. Secondly, because material consumption and GHG emissions are good proxies for environmental degradation, reducing them are primary goals for reducing environmental pressures. On the other hand, increasing the Circularity Metric is a result of lowering material consumption and GHG emissions. Increasing materials circularity in a socioeconomic system—replacing virgin with secondary materials—is just one way of reducing the overall material and carbon footprint (and thus environmental impacts). However, constraining the overall demand for materials has a much more significant effect on lowering the material and carbon footprints with fewer interventions needed. In this sense, the scenario analysis is very useful for exemplifying the limits to cycling relative to (material) consumption reduction.

In our broad 'what-if' vision for the economy that harnesses cross-intervention synergies, Switzerland's material footprint of consumption is lowered by a remarkable 33%, from 163.3 million tonnes to a mere 109.9 million tonnes. On a per capita basis, the material footprint could be reduced from 19 tonnes to around 12.8 tonnes per year, bringing the figure closer to what is suggested a sustainable level (8 tonnes per person per year[226, 227]). The combined scenarios also offer deep emissions reductions: the carbon footprint could be decreased by 43%, bringing it from 113.4 million tonnes of CO_2e down to 65.1 million tonnes of CO_2e. At the same time, the Circularity Metric could grow by 5.2 percentage points, increasing from 6.9% to 12.1%. Please refer to the following table for further detail on the impact of each scenario and specific interventions. For more information on the methodology behind the combined scenario results, refer to Appendix F on page 87.

FOOD FOR THE FUTURE: HOW SWISS COMPANIES ARE TACKLING WASTE, CHANGING MINDSETS AND LEVERAGING COLLABORATION

Switzerland is beginning to embrace more circular ideas regarding food consumption and is sharing these ideas through educational campaigns to reduce food waste and encourage high-quality, sustainable diets. The City of Lausanne, for example, is leveraging the power of public procurement, replacing ingredients in school and office canteens with more sustainable options; serving to **narrow** flows.

Across three years and 1.3 million meals, more than two-thirds of the food served had local origins.[221] Community-based initiatives to cut waste and shift mindsets are also on the rise: Save Food Fight Waste is inspiring people to shift their relationship with food by teaching people to reduce their waste and improve their consumption habits.[222] Save Food Fight Waste was initiated by the Pusch Foundation which helps local communities, schools and enterprises to preserve the environment. In addition to information days and educational campaigns, the foundation engages in small- to medium-scale projects across Switzerland. One project, for example, carried out in collaboration with the City of Lancy, initiated a process for the organic conversion of 55,000 plants grown in greenhouses. As a result of the project with Pusch, the City of Lancy obtained its Bio Suisse certification[223] in 2019.[224]

Food packaging waste is also being targeted: the new Institute of Packaging Sciences in Lausanne, for example, is experimenting with designs for environmentally-friendly packaging for Nestlé products.[225] **Regenerative**, bio-based, compostable materials are prioritised, as well as those that can be easily **cycled** through deposit return schemes and local recycling infrastructure. The initiative is also considering refillable packaging to **slow** flows.

PRS PET-Recycling Switzerland is an industry association that handles the collection and recycling of PET (polyethylene terephthalate) bottles. Switzerland was one of the first countries in the world to close the PET loop, bottle to bottle. PET bottles are collected, sorted based on colour, turned into granulate (PET flakes) and recycled into new PET bottles.

In addition to recycling PET bottles, Migros, a Swiss retailer, offers the public an uncomplicated way to collect plastic packaging at home using a dedicated plastic collection bag to be handed in for recycling at any Migros store. The collected plastic is sorted and recycled and is increasingly used in the packaging of Migros's own products.

SCENARIOS, INTERVENTIONS & STRATEGIES

Scenario	Interventions	Strategies	Impact
1. EMBRACE A CIRCULAR LIFESTYLE	**1.1 Promote a material sufficiency lifestyle**	• Minimise consumption of electronics, appliances, furniture and textiles • Encourage product repairs • Shop local	Reduction of material footprint by **15.4%**, decrease from 163.3 to **138 million tonnes**. Reduction of carbon footprint by **15.8%**, decrease from 113.4 to **95.5 million tonnes** of CO_2e. Circularity rises from 6.9% to **7.9%**. Co-benefits: support local businesses, reduce waste and household expenditure.
2. ADVANCE CIRCULAR MANUFACTURING	**2.1 Implement resource-efficient/ symbiotic manufacturing**	• Improve industrial processes to reduce virgin inputs for key manufacturing industries • Reduce yield losses • Divert scraps	Reduction of material footprint by **6.4%**, decrease from 163.3 to **152.8 million tonnes**. Reduction of carbon footprint by **3.7%**, decrease from 113.4 to **109.2 million tonnes** of CO_2e. Circularity rises from 6.9% to **7.4%**. Co-benefits: increased resilience to price volatility, reduced energy consumption and waste, reduced costs for waste disposal.
	2.2 Employ R-strategies for manufactured goods	• Increase the lifetime of machinery, equipment, and vehicles • Increase in remanufacturing, refurbishment, repair and maintenance, upgrade, and reuse services	

Scenario	Interventions	Strategies	Impact
3. RETHINK TRANSPORT AND MOBILITY	**3.1 Reduce reliance on private vehicles** **3.2 Embrace flex work** **3.3 Pursue a modal shift for transport** **3.4 Improve vehicle design** **3.5 Reduce air travel**	• Reduce car use and private ownership • Prioritise work-from-home to decrease commuter transport • Increase journeys by bus and train to cut car use • Prioritise small, lightweight, fuel-efficient vehicles • Reduce demand for passenger air travel	Reduction of material footprint by **5.3%**, decrease from 163.3 to **154.6 million tonnes**. Reduction of carbon footprint by **12.2%**, decrease from 113.4 to **99.6 million tonnes** of CO_2e. Circularity rises from 6.9% to **7.3%**. Co-benefits: improved air quality, less vehicle congestion, greater access to mobility through improved sharing and public transport systems, increased space for other purposes, such as green spaces.

Table five shows a summary of results for each scenario.

SCENARIOS, INTERVENTIONS & STRATEGIES

	INTERVENTIONS	STRATEGIES	IMPACT
4. BUILD A CIRCULAR BUILT ENVIRONMENT	**4.1 Optimise housing stock expansion & increase occupancy rates**	• Cycle construction and demolition waste • Utilise idle/unused commercial buildings • Decrease virgin material use for construction • Enforce incentives for co-housing and multifunctional spaces • Increase occupancy by taxing unoccupied spaces	Reduction of material footprint by **4.8%**, decrease from 163.3 to **155.4 million tonnes**. Reduction of carbon footprint by **12.1%**, decrease from 113.4 to **99.7 million tonnes** of CO_2e. Circularity rises from 6.9% to **8.3%**. Co-benefits: reduction in energy consumption and waste, new businesses and job opportunities, reduced fuel poverty and increased wellbeing at home.
	4.2 Shape an, energy-efficient building stock	• Carry out deep retrofits • Prioritise secondary, non-toxic materials for retrofitting	
	4.2 Scale resource-efficient building practices	• Choose lightweight building materials • Increase the lifetime of bearing elements • Prioritise modular and off-site construction • Keep supply chains as local as possible • Make behavioural changes in homes, like fewer and more efficient appliances	

	INTERVENTIONS	STRATEGIES	IMPACT
5. NURTURE A CIRCULAR FOOD SYSTEM	**5.1 Shift to more sustainable food production**	• Prioritise local, seasonal food production • Decrease synthetic fertiliser use	Reduction of material footprint by **3.1%**, decrease from 163.3 to **158.2 million tonnes**. Reduction of carbon footprint by **2.4%**, decrease from 113.4 to **110.7 million tonnes** of CO_2e. Circularity rises from 6.9% to **7.6%**. Co-benefits: health benefits, increase in biodiversity and soil health, reduced household expenditure on food, new
	5.2 Reduce food waste	• Cut household-level organic waste • Cycle unavoidable food waste • Reduce caloric intake	
COMBINED SCENARIOS	**The power of combined interventions**	**This row** presents the baseline result for enacting all scenarios in combination with each other.	Reduction of material footprint by **32.7%**, decrease from 163.3 to **110 million tonnes**. Reduction of carbon footprint by **42.6%**, decrease from 113.4 to **65.1 million tonnes** of CO_2e. Circularity rises from 6.9% to **12.1%**.

Table five shows a summary of results for each scenario.

5 THE WAY FORWARD

Switzerland has the potential to transform its economy: by doubling its circularity, it can halve the resources needed to fulfil its residents' needs and wants. This report illustrates how materials are allocated to meet Switzerland's needs and wants—and lays out guidelines for how the country can drive its circularity from 6.9% to 12.1%. This increase may not seem significant, but by integrating circular strategies, Switzerland could cut its material footprint by 33%, bringing substantial positive impact for the climate, biodiversity and pollution. This could have a transformative impact: our *Circularity Gap Report 2023*, which featured comparable scenarios to this report, found that a 34% reduction in the global material footprint could reverse the overshoot of five planetary boundaries, and limit global warming to 2-degrees.[228] The five scenarios presented in this report provide Switzerland with an opportunity to overhaul its economy, swap out material- and emissions-intensive linear processes for ones that make the most of materials' value, minimise waste and help regenerate natural systems: a transition to a circular economy. Boosting Switzerland's circularity to 12.1% should be an interim objective, and part of a larger trajectory to increasing circularity while decreasing material use and emissions to the greatest extent possible.

The transition to a circular economy will not be easy—nor will it take place overnight. While the strategies presented in Chapter four have transformative potential, their implementation will be met by numerous challenges. Adopting a 'material sufficiency' lifestyle offers the greatest opportunity for material footprint reduction: by shifting away from high levels of consumer consumption and extending the lifetimes of goods, Switzerland could cut its material footprint by 15.4%. Mobilising the Swiss population away from fast fashion, excessive consumption and prevailing models of ownership, however, will require large-scale behavioural change. Meanwhile, the scenarios with the second and third highest impact—manufacturing and mobility—must also be pursued. Interventions with comparatively lesser impact, such as those for food, must not be ignored—benefits should be viewed holistically and not just in the context of reductions in the material footprint and emissions, or gains for the Circularity Metric. All scenarios present their own unique co-benefits, from pollution mitigation to the protection of biodiversity to the creation of new circular jobs. There is no panacea to tackle ecological breakdown or the climate emergency, and while significant work has been done since 2019—the baseline year for this report—progress remains to be made. Everyone will have a role to play: the Government, businesses and society as a whole.

Going circular requires leadership and a proactive, innovative government approach. The Swiss Governments—of the communes, the cantons and the Confederation—need to do more. A strategic, integrated and comprehensive government approach with strengthened policy interconnectivity will be key to ensuring effective intra-government coordination. Swiss Governments must shift their focus from waste management (which has historically been good) to waste prevention: looking at the entire lifecycle of products and their impacts and ultimately creating coherent policies that are related to 'materials' rather than waste management alone. Similarly, targeted investment is needed. Switzerland needs more (and better) high-quality infrastructure to enable the improved management and high-value recovery of material resources. The government should not only invest, but also help businesses invest in advanced, high-value and competitive infrastructure that already exists, such as extended producer responsibility (EPR). In addition, the development of a 'pre-market responsibility framework'—based on indicators like repairability, the availability of spare parts and recyclability—would force new products placed on the Swiss market to meet minimum standards across these indicators. Despite recent improvements, concepts such as 'green' or 'circular' public procurement still remain vague. Adopting such models can help to lower risks for businesses developing circular services and products by creating a stable demand for their products. Finally, governments should work to increase transparency and access to information. This will be key to incentivising circular consumption by allowing consumers to make more informed choices regarding the origin, composition, repair and dismantling options, and energy consumption of the goods they purchase.[229]

Going circular requires a comprehensive set of indicators and targets. Ingraining material footprint reduction into targets and national policy-making will be fundamental to drive change at the scale, scope and speed needed. Strategies and roadmaps are already being developed in Switzerland, but links between these and reliable, robust indicators are still missing. Clear and agreed-upon metrics and indicators will be key for realising goals. Stakeholder dialogue within and across public and private entities is vital here to ensure good data is available and realistic, ambitious targets are set.[230] Aligning with the EU's ambitious circular economy targets and policies, for example—given how intertwined the economies and geography are—can serve as key guiding goals for government, businesses and citizens to work together towards. Switzerland can also move the climate discussion beyond territorial emissions and consider introducing more impactful indicators and legally binding targets to lower material use and consumption-based emissions. Regarding waste, targets could include zero industrial waste to landfill,[231] a reduction in the percentage of waste going to incineration, and, as noted, overall reductions in total waste generation. At the same time, sector-specific targets could be developed, ideally aligned with overarching national targets. Monitoring and evaluating progress will also require more extensive data gathering at the sectoral and business level. Sector-specific targets could also include indicators relating to circular employment activities that enable and support the transition, particularly those relating to the shortage of labour-intensive jobs. In developing such targets, collaboration between countries will be crucial: Switzerland can learn a lot from other countries' national journeys toward circularity, and vice versa. Peer-to-peer learning and knowledge transfer will increase the pace towards global circularity.

A significant opportunity for Switzerland—and the risk of missing out. While the country exhibits levels of consumption and extraction that far surpass the global average, it's well-positioned to take on the challenge of going circular. With well-formed goals for decarbonisation and the circular economy increasingly accepted as means for achieving environmental aims,[232] Switzerland has already taken its first steps to leave linear behind. Proactive stakeholder engagement will be key to the transition's success—and with plenty of collaboration programmes between business and academia that span sectors, Switzerland has the foundation needed for circularity to succeed. Through close collaboration and systemic changes that permeate government, the private sector and individuals, 'going circular' can become the country's new reality.

RECOMMENDATIONS AND NEXT STEPS TO BRIDGE THE CIRCULARITY GAP THROUGH LEADERSHIP AND ACTION

1. COORDINATION AND COLLABORATION IS ESSENTIAL TO ADVANCE CIRCULARITY

Multi-stakeholder networks can be an effective way to transfer knowledge and experience both across and within different stakeholder groups, such as industries, universities, schools and regional governments. Such networks can also be effective in enabling servitisation business models which require many different actors and types of infrastructure. These networks can be helpful in expanding and improving data collection and indicator measurement methodologies—one of the key challenges faced.

2. GOVERNMENT MUST FIRST LEAD THE WAY

The public sector can promote local, circular businesses through incorporating circular criteria into their public procurement strategies. This provides businesses with more long-term stability that is essential for many circular business models, especially those with high initial investment costs. Additionally, the Government can help to finance and facilitate cross value chain initiatives whilst communicating best practices and lessons learned to other businesses and civil society. The public sector can lead by example, showcasing that circularity is a viable way for Switzerland to achieve its societal and environmental goals.

3. CREATE THE RIGHT ENVIRONMENT WITH FIT-FOR-PURPOSE POLICIES

Circular businesses can thrive under suitable policy. For example, incentivising circular practices through tax breaks, with favorability towards those higher in the R-strategy hierarchy, helps to level the playing field with linear businesses. In general, a shift in tax from labour to materials could help accelerate practices that aim to keep materials in circulation for as long as possible. To complement incentives, appropriate regulations are also necessary. For example, enabling and expanding extended producer responsibility across different product groups, right-to-repair legislation and banning single-use products where appropriate. Finally, policy can provide clarity on what is deemed 'circular', aligning with the upcoming EU taxonomy—given the close trading links with Member States—whilst mandating adequate data collection for materials and products to make such classification possible.

4. UNLOCK FINANCE FOR CIRCULAR BUSINESSES

Sufficient resources are essential to unlock new business models and transition from linear to circular. Seed capital for start-ups, as well as long-term funding options for small- and medium-sized enterprises (SMEs) and innovation projects, could be explored to ensure that financing is not inhibiting the transition. By leveraging public-private collaboration, mechanisms to de-risk and improve funding for the circular economy could be developed. For example, improving assessment methods so that high-impact circular projects can be identified and compared.

5. MEASURE, MONITOR AND EVALUATE PROGRESS AT ALL LEVELS

A collective vision between the Government, businesses and civil society of Switzerland's circular economy goals should underpin a roadmap and comprehensive measurement framework. Such a framework must be rooted in high-quality data and gaps should be identified, particularly for measuring indicators that concern high ranking R-strategies, such as repairability and product lifespans. Indicators should span beyond borders and account for entire value chains and ideally be comparable to other countries. The usefulness of these indicators can be greatly improved through sector-specific clustering, linking different levels of government (commune, canton and Confederation) and linking material-focussed indicators to impact indicators, such as job creation, greenhouse gas emissions and biodiversity loss.

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58. The Net Extraction Abroad indicator is calculated as the difference between the Raw Material Consumption (RMC) and Domestic Material Consumption (DMC). When the difference is positive, it means that the materials extracted abroad used to satisfy domestic final demand are larger than the domestic one used to satisfy demand abroad and vice versa.

59. We allocate all extraction abroad to Non-renewable inputs; while it could also be part of Non-circular inputs or Net additions to stocks, we don't have enough information to make this allocation. If we examine the indicator set based on Domestic Material Consumption instead of Raw Material Consumption, Socioeconomic cycling rises to 12.4%, Net additions to stock rise to 52.8% and Non-circular inputs rise to 14.9%, meaning that only 32.3% of all materials are available for recirculation. This figure can be considered more realistic, as it allows us to better allocate resources to the different indicators, in part due to a more complete data picture.

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64. Recycling rates are calculated as the recycled waste divided by the total waste treated for each waste category.

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66. This includes mixed household wastes and mixed and undifferentiated materials, but excludes traditional recyclable waste such as glass, plastic and metal.

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APPENDIX A: HOW THE FOUR CIRCULAR STRATEGIES WORK TOGETHER

There are potential overlaps between some of the four circular strategies: narrow, slow, regenerate and cycle. For example, slow and cycle interventions often work together. By harvesting spare parts to use again, we are both cycling—by reusing components—and slowing, by extending the lifetime of the product the components are used for. And ultimately, slowing flows can result in a narrowing of flows: by making products last longer, fewer new replacement products will be needed—resulting in decreased material use. There are also potential tradeoffs between the four strategies to be acknowledged. Fewer materials being used for manufacturing—narrow—means less scrap available for cycling. Similarly, if goods like appliances and vehicles are used for longer—slow—their energy efficiency falters in comparison with newer models, thus preventing narrowing. Using products for a long time—slowing flows—also decreases the volume of materials available for cycling: this can have a significant impact on material-intensive sectors like the built environment, where boosting the availability of secondary materials is particularly important. Some strategies to narrow flows, like material lightweighting, can result in decreased product quality and thus shorten lifetimes—making it more difficult to slow flows.

APPENDIX B: DYNAMICS INFLUENCING THE CIRCULARITY METRIC

Applying our Circularity Gap methodology to countries is complex and has required us to make a number of methodological choices. In a bid to generate actionable insights for national economies, and to enable comparison between countries, our Circularity Gap Reports take a consumption perspective: we consider only the materials that are consumed domestically, and allocate responsibility to consumers by excluding exports. However, the more 'open' an economy is, calculating the import content of exports becomes more difficult within the material flow analysis and input-output analysis frameworks, the latter in particular.

With our assessment approach, most production is ultimately driven by consumer demand for certain products or services. In an increasingly globalised world, the chain that connects production to consumption becomes more entangled across regions. Demand-based indicators—applied in this analysis—allow for a re-allocation of environmental stressors from producers to final consumers. This ensures transparency for countries with high import levels and also supports policies aimed at reducing or shifting consumer demand, at helping consumers understand the material implications of their choices, or at ensuring that costs of, and responsibilities for, resource depletion and material scarcity are allocated to entities and regions based on their roles in driving production processes through consumption.

Considering what residents of Switzerland consume to satisfy their needs, we must apply a nuanced lens to the direct imports; meaning we work out the full material footprints of the products. To account for the material footprint of raw materials is straightforward, but this is not the case with semi-finished and finished goods. To represent actual material footprints in imports and exports, we apply so-called RME (Raw Material Equivalents) coefficients in this study. As an open, high-income economy with trade equal to 131% of its GDP (2021),[233] doing so in the case of Switzerland is more complex than for a smaller, less integrated economy.

Finally, the Circularity Metric represents a country's efforts to use secondary materials; this includes waste collected in another country and later imported for domestic use. The total amount of waste recycled in treatment operations is therefore adjusted by adding waste imports to—and subtracting waste exports and by-products of recovery from—the amount of waste recycled in domestic recovery plants. When we adjust the volumes of recycled waste in treatment operations using imports and exports of secondary materials, 'credit' for saving virgin materials is ascribed to the country that uses that secondary material—recovered from former 'waste'. This perspective is similar to national accounts' logic, in which most re-attributions are directed at final use.

Whilst Switzerland's waste management sector has been investing heavily in domestic reuse and recycling infrastructure the market is not bound by geographical borders and materials can be transported wherever makes logistical, environmental and economic sense. Difficult-to-recycle materials and those that arise in smaller quantities can often be bulked and then transported for treatment in regional facilities. However, it's also possible to take a more 'production-oriented' approach, in which 'credit' for recycling efforts is given to the country that collects and prepares waste for future cycling. This is, for example, the perspective taken by Eurostat in its calculation of the Circular Material Use Rate. For more information on this, refer to the methodology document.

APPENDIX C: PRACTICAL CHALLENGES IN QUANTIFYING CIRCULARITY

The circular economy is full of intricacies: quantifying it in one number presents a number of limitations. These are:

- **There is more to circularity than (mass-based) cycling.** A circular economy strives to keep materials in use and retain value at the highest level possible, with the aim of decreasing material consumption. The cycling of materials measured by the Circularity Metric is only one component of circularity: we do not measure value retention, for example. The Metric focuses on the end-of-use and mass-based cycling of materials that re-enter the economy but does not consider in what composition, or to what level of quality. As such, any quality loss and degradation in processing goes unconsidered.
- **The Metric focuses on one aspect of sustainability.** Our Circularity Metric focuses only on material use: the share of cycled materials out of the total material input. It does not account for other crucial aspects of sustainability, such as impacts on biodiversity, pollution, toxicity, and so on.
- **Relative compared to absolute numbers.** The Circularity Metric considers the relative proportion of cycled materials as a share of the total material consumption: as long as the amount of cycled materials increases relative to the extraction of new materials, we see the statistic improving, despite the fact that more virgin materials are being extracted—which goes against the primary objective of a circular economy.
- **It is not feasible to achieve 100% circularity.** There is a practical limit to the volume of materials we can recirculate—in part due to technical constraints—and therefore also for the degree to which we can substitute virgin materials with secondary ones. Some products, like fossil fuels, are combusted through use and therefore can't be cycled back into the economy, while others are locked into stock like buildings or machinery and aren't available for cycling for many years. Products that can be cycled, such as metals, plastics and glass, may only be cycled a few times as every cycle results in lower quality and may still require some virgin material inputs. Because of this, reaching 100% circularity isn't feasible: this calls for a more nuanced approach to calculating circularity and setting targets.

APPENDIX D: WASTE MANAGEMENT

Under our system boundary definition, we quantified 27.1 million tonnes of end-of-life waste, including 2.8 million tonnes of manure, and 0.4 million tonnes of crop residues. Of the 27.1 million tonnes of waste that's treated, 49% is technical cycling of materials[234] (13.4 million tonnes, of which 10 million tonnes come from construction and demolition), while the remainder is lost indefinitely. Of the remaining 51%, 14% ends up incinerated (including energy recovery), 25% is landfilled, and 12% is lost, composed mainly of waste from energetic use in the form of excreta from human food consumption, which is treated in wastewater treatment plants or spread on land, and is not accounted for explicitly in the Circularity Metric. It is rather included as part of the Ecological cycling potential (see page 28=6 for more information). This difference explains the gap between the rate of domestically cycled materials (49%), which feeds into the Circularity Metric,[235] and the traditional recycling rate obtained from traditional waste statistics (56%).[236] When it comes to trade in waste, Switzerland's situation is underpinned by a highly negative trade balance in secondary materials: The country is exporting 2.6 million tonnes more recyclable waste than it is importing (1.2 million tonnes),[237] generating an import/export ratio as low as 46%. This, in turn, has a considerably negative effect on the Circularity Metric when a consumption-based perspective is taken, as less waste is re-entering the Swiss economy as secondary materials.

End-of-life waste is one element of a larger indicator called Domestic Processed Output (DPO), which can originate from both the material use and energetic use of products. DPO is the total mass of materials that have been used in the Swiss economy, before flowing into the environment—through landfilled waste or as emissions, for example. DPO from energetic use (including food and feed) stands at 23.8 million tonnes, and is composed mainly of emissions to air, as well as manure and combustion waste. These emissions can stem from biogenic sources (8.8 million tonnes) as well as fossil fuel origins (15.1 million tonnes). Together with 13.7 million tonnes of DPO from material use (end-of-life waste excluding recycled materials), this adds up to a total DPO of 37.6 million tonnes. A small part (3.7 million tonnes), which originates mostly from energetic use, but partially also from material use, are so called dissipative uses and losses: materials that are dispersed into the environment as a deliberate or unavoidable consequence of product use. This includes fertilisers and manure spread on fields, or salt.

Of the waste streams that *do* contribute to the Circularity Metric, and compared to other Northern European countries, Switzerland has low rates for the recycling of chemical and medical waste (3%), relatively low rates for traditional recyclables (9%), relatively low rates for animal and vegetal waste (10%), very high rates for mineral waste (77%), very low rates for equipment (1%) and no mixed ordinary waste recycled, but rather incinerated (0%). Of all these waste types, mineral waste and mixed ordinary waste are most prevalent, respectively claiming 61% and 20% of the total waste treated in Switzerland (by weight). Better recycling rates in particular for mixed ordinary waste, therefore, would be a key avenue for Switzerland to boost its Metric.

APPENDIX E: ASSUMPTIONS FOR THE SCENARIO MODELLING

Scenario one: Welcome a circular lifestyle

1.1 Embrace a 'material sufficiency' lifestyle
For this intervention, we have separately modelled a range of strategies. The consumption of new textile products is cut by 50%. For new textile purchases, items with recycled fibres or that are durable and high quality are preferred. We also assume that furniture purchases are minimal and done locally. Also, where possible, residents buy items designed for reparability (with replacement parts available in case of breakage) and made with reused and redesigned furniture components. Spending on electrical and electronic appliances such as radios, televisions and computers is cut by 80%. Paper use is heavily decreased, by printing only what's needed, buying recycled paper and toilet paper, and increasing digitalisation (through e-books, for example). We also assume that a material-sufficiency approach is applied to the service sector. Accordingly, we assume that a segment of the population becomes highly dependent on inter-community exchange and low use of commercial services. For example, people depend more on community members than commercial services for rental, repair, and reuse, and frequently work unpaid within their local community (for example, exchanging services through time banks). Finally, we assume that local cultural activities and home-based hobbies like gardening are preferred to long-distance travel.

Scenario two: Advance circular manufacturing

2.1 Implement resource-efficient manufacturing
In modelling this supply-side intervention, we consider a mix of strategies. We assume that metal inputs (all metals) for specific products are reduced by 28% due to process improvements. We also model the impact of implementing industrial symbiosis, which implies reducing yield losses and diverting scrap from the manufacturing industry, to other sectors, thereby reducing their virgin material use. We assume that Switzerland implements resource-efficient manufacturing techniques such as additive manufacturing and near-net shape manufacturing (NNS). Additive manufacturing, which uses data computer-aided-design software to deposit materials in the exact shapes needed, allows for flexible and highly material efficient production processes. This is particularly relevant for materials such as biochemicals, metals and ceramics in sectors such as aerospace, automotive and medical.[238] NNS allows for a product or component's initial production to be as close to the finished product as possible, thus reducing material inputs, waste material and (procurement, production, and waste disposal) costs.[239] Using waste as raw material could further increase cycling and reduce waste.

2.2 Employ R-strategies for manufactured goods
For this intervention, we first model a mix of supply-side measures. For remanufacturing and refurbishment, we assume that the overall volume of sales remains the same due to the redistribution and re-selling of the remanufactured/refurbished products, thereby creating a new life cycle. The displacement of new sales is therefore modelled as a net reduction in the inputs needed to produce the same volume of product output. When it comes to repair, upgrading and reuse, implementing both supply and demand-side measures would yield greater benefits. This could include new business models based on servitisation (renting and leasing, for example) and more flexible supply chain management (reverse logistics, for example), where manufacturing companies can capture value by returning goods to upstream operations. For instance, companies that sell machinery may decide to rent or lease it out to customers, eventually repairing and/or remanufacturing it to extend its lifetime. For repair, maintenance, upgrading and reuse, we assume a reduction in sales due to the life cycle extension of the repaired/maintained products) thus precluding the need for new purchases). Displacement of new sales can be modelled directly as a reduction in the product output volume. Two cases of repair are distinguished: repair and maintenance performed at the final demand level—where the repair action is carried out by households (leading to no need for extra repair services)—and repair and maintenance performed at the industry level—where the repair action is carried out by companies with extra repair services involved. We apply strategies at the same level across product categories, with the following split: 50% material inputs reduction due to remanufacturing and refurbishment, 25% reduction in material output due to reuse, and 12.5% material output reduction for repair and 12.5% for maintenance and upgrade.

Scenario three: Rethink transport & mobility

3.1 Reduce reliance on private vehicles
This intervention models the impact of several demand-side measures. This is modelled as the application of a lifestyle to part of the population, divided between urban (74%) and rural (26%) due to the different importance of owning a car in the two contexts. It assumed that 100% and 50% of the urban and rural populations respectively are targeted. This means that one-quarter of mobility by car is eliminated and reallocated to bicycle use (15%) and walking (10%). The remaining 75% of the total is reallocated to car sharing and carpooling. This results in an increase in average vehicle occupancy—up from 1.5 to 2.5. This is partially mitigated by greater 'wear and tear' for vehicles due to higher utilisation (+25%). It is also assumed that the elimination of the car by the target population extends to the elimination of the need for manufacturing and selling the car on top of the obvious reduction in fuel use.

3.2 Embrace flex work
This scenario envisions reducing the need for mobility by working from home, especially for hires living far from work. Energy rebound does not apply because the consumption is occurring at home rather than at the office, whereas the cost of ICT equipment is assumed to stay with the employer. In modelling this intervention, we assume that flex work increases by 50%, matched by a 20% reduction in commuter transport by car, bus and train. We also assume that demand for commercial real estate will drop as more workers stay at home.

3.3 Pursue a modal shift for transport
In modelling a modal shift, the population is divided into segments and their demand for mobility goods shifts towards other options. The main options represented in the model are buses and railways, respectively representing a relevant share of urban and extra-urban public transport. The shift towards walking and biking is represented by a reduction of passenger kilometres. This can be realistically modelled by considering the actual potential in the shift of passenger kilometres from private to public transport. In modelling this intervention, we assume that 45% of passenger kilometres currently travelled by car are redistributed to journeys by bus (5% of 45%) and urban rail (95% of 45%). In the medium term, this intervention will require spending on infrastructure to accommodate the increasing demand for public and shared mobility.

3.4 Improve vehicle design
We assume that vehicle design can reduce the demand for steel and aluminium components by 50% for private cars and vans, and steel, copper and aluminium by 17% for trains. A reduction in fuel and energy consumption stems from this improvement and it is modelled as ancillary change.

3.5 Reduce air travel
We assume a reduction in air traffic in congested regions with specified limits. Households' demand for air mobility services is reduced by capping the number of trips per capita per year from 3 to 1.5 for a net reduction of 50%. Also, a reduction of the average passenger kilometres per capita to 2,000 implies a reduction of demand for fuel from the air mobility sector. No reduction in tourism-related activity is modelled (for example, Hotels and Restaurants) as this is assumed to be offset through a rebound in spending on local tourism activities.

Scenario four: Build a circular built environment

4.1 Optimise building stock expansion & increase occupancy rates
In modelling this intervention, we examine a mix of supply and demand-side measures. To model housing stock regulation, we assume that throughout urban planning processes, fewer project approvals are given out that allow for construction with virgin materials. This could be achieved by regulatory and fiscal disincentives on virgin construction materials, thus supporting the uptake of secondary materials, for example. Accordingly, we assume a reduction of new construction by 13.6%. The restriction is applied to residential buildings only. The cap to the number of buildings is set using the fraction of Construction and Demolition Waste and other mineral waste that is not already recycled (which represents the volume of secondary construction material available) over a share of the net addition to stocks (which is used as a proxy for the material requirements of the housing demand in that year). Under such conditions, the cap is estimated at 87.5% of the residential building demand. Here, the assumption is that a cap based on the physical volume of materials is a good proxy for setting a cap on monetary investments. This scenario implicitly assumes max collection for recycling for construction and demolition waste and assumes 50% of it to be suitable for reuse.[240] Consequently, purchases of waste disposal services by the construction sector are set to 0. This could be enabled by incentivising the use of secondary materials, for example. In order to meet the demand for housing, we boost spending on housing renovation. This could be driven via targeted grants and tax breaks, for example. This is a static 'what-if' intervention that models the impact of long-term circular strategies—spanning 50 years or more—as if they would happen tomorrow without factoring in developments in the underlying socioeconomic trends, such as population changes or efficiency improvements. A combination of measures to increase average occupancy in both residential and commercial buildings was also modelled. For this, a maximum potential increase of 25% and 20% in the occupancy and proportional decrease in footprint of real estate services is modelled.[241] Additionally a reduction in electricity and heating fuels consumption due to increased residential occupancy and commercial space occupation is assumed to be proportional to the decrease in occupied space.

This scenario also comprises a range of strategies to increase building occupancy: these will reduce the total number of buildings needed. To assess this intervention's impact, we model a mix of measures. We assume that incentives for co-housing and multifunctional spaces—such as tax breaks—are enforced. For co-housing and multifunctional spaces, we assume a potential increase in occupancy of up to 25%, and a proportional decrease of 20% in the footprint of real estate services—along with cuts in electricity and heating fuel consumption as a result of increased occupancy. Increasing occupancy could be driven by levying a tax on unoccupied spaces.

4.2 Shape a low-carbon, energy-efficient building stock
Scenario one's second intervention focuses solely on the demand-side circular strategies. It models measures for maximising energy efficiency in the housing stock, such as deep retrofitting. All renovations (i.e. structural, light and medium energy) are carried out as deep energy renovations. This implies that the rate for deep energy renovations is raised from the current 0.2% to 11.3% (the sum of all the other renovation rates). According to EU data,[242] energy savings of 67%, 42%, 13% and 0% are assumed for deep, medium, light and structural renovations respectively. Based on this data, average energy savings from current renovations are estimated at around 11% and an overall reduction of the energy need of 55.6% is therefore applied. It's worth noting, however, that deep retrofitting will come at the cost of extra materials and embodied carbon: it's essential that circularity is prioritised in design and material choices to ensure outcomes are beneficial.

4.3 Shift to resource-efficient building practices
In modelling the impact of this intervention, we make a number of assumptions. For material use in construction, steel, aluminium and cement use is reduced—by 50%, 33% and 20%, respectively—while the use of regenerative materials like wood increases by 200% to offset the decrease in concrete; on-site material losses decrease by up to one-fifth while local supply chains are prioritised for material sourcing, reducing the overall transportation required. In households, we assume room temperatures drop by an average of 2-degrees, while smart metering decreases energy consumption by up to 4%. We also assume an increase in the use of energy-efficient washing machines, tumble dryers and irons.

Scenario five: Shift to a circular food system

5.1 Shift to more sustainable food production
This supply-side intervention assumes a shift toward locally produced food in households and in the restaurant sector with a policy focus on national food self-sufficiency. It envisions eliminating the need for chemical fertilisers, pesticides, hot-housing of fruit and vegetables (and thus heating fuels), and transportation services, due to changes in consumer choice towards organic and seasonal produce. In modelling this intervention, we assume a 100% cut in the use of mineral fertilisers, chemicals and medicines as inputs to food and hotel and restaurant products. We assume a boost in the proportion of local food on the market up to 50%, which is modelled as a 50% reduction of the transport needs of the food industries. Respectively, we assume an increase of 30% in the proportion of seasonal food in the market, which implies reducing the inputs of fuels and electricity to the vegetable sector by 30%. Due to the nature of our methodological approach, we were unable to provide a detailed assessment of changes in land-use management: increased regenerative farming practices, such as agroforestry, or the role of biorefining and the production of sustainable biofuels, for example. However, it's worth mentioning that these can undoubtedly play a key role in advancing circularity and diminishing environmental pressures.[243]

5.2 Cut food waste
For modelling the reduction of waste, the food supply from the FAOSTAT food balance sheets, which are based on purchases, was disaggregated into actual food intake and post-consumer waste. The latter was based on region-specific waste fraction per food group from FAO reports. This strategy assumes Swiss residents maintain the structure of their current diet but reduce their caloric intake to 2,700 kilocalories per person per day.[244, 245] Moreover, the elimination of avoidable post-consumer organic waste was also considered, up to 50%,[246] as per official targets in line with SDG 12.3.

APPENDIX F: MODELLING THE IMPACT OF COMBINED SCENARIOS

Overlaps between—and the sequentiality of—interventions mean that our combined scenario calculations, as laid out in Chapter four, yield different results than simply adding up the impacts of individually modelled interventions. In particular, the scenarios on repair, recycling, as well as fossil resource consumption, are applied across sectors, thereby also influencing industry-specific interventions on agriculture and construction, for example. Therefore, we prioritise interventions according to the principles of the circular economy. We begin with strategies that aim to reduce inputs, secondly applying repair and reuse-focused strategies, and only lastly applying those focused on recycling. We look at overlaps in terms of coherence, meaning that we exclude interventions that explicitly contradict each other. We also don't take anti-synergic effects into account: for instance, the reduced availability of waste for recycling as a results of improved manufacturing efficiency. The sequential application of interventions means that those applied further down will have a lower impact than earlier ones, targeting the same transactions between economic actors. For example: let's assume we model two interventions targeting investments in the construction services sector. The share of the investment to be reduced—as specified in the first intervention—will be applied to the original investment figures. In contrast, the second intervention will be applied to the reduced investment figure that has resulted from the application of the first intervention. It's worth noting that all scenarios are expected to have some rebound effects, yet for the most part we are unable to calculate these, aside from those outlined above.

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