Climate Governance Commission

Reflections on Governance for a Circular Economy

ANDERS WIJKMAN

Anders Wijkman. 2021. *Reflections on Governance for a Circular Economy.* A GCF Report. Stockholm: Global Challenges Foundation.

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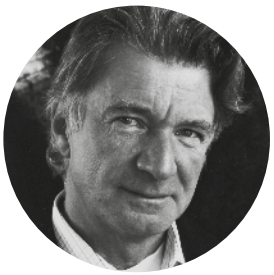
ABOUT THE AUTHOR



Anders Wijkman, Honorary President of the Club of Rome, Chairman Climate-KIC

Anders Wijkman is an opinion maker and author. Anders is a former member of the European Parliament, honorary president of the Club of Rome, member of the IRP (International Resource Panel) – a UN expert-body "to build and share the knowledge needed to improve the use of our resources worldwide". He is, as well, chair of Circular Sweden, a platform for producers, retailers and recycling companies to advance the circular economy. He is a member of the Royal Swedish Academy of Sciences, the World Academy of Art and Science and the World Future Council.

“The circular economy is, and has always been, how marginalized societies have had to view their interactions with the resources available to them through their environment for their survival — it is a natural reality for them.”

Kule Chitepo, Development Practitioner, Expert on Integrated Natural Resource Management, South Africa.

Executive Summary

Welcome to the world of the circular economy – an emergent way of looking at the economy. The backdrop is the rapidly increasing throughput of energy and materials, not least the growing use of disposable products, and the threat it constitutes to planet Earth. The International Resource Panel (IRP)[1] is estimating that the extraction and processing of materials, fuels and food make up more than half of global carbon emissions and 90% of the loss of biodiversity. To continue business as usual would endanger planetary life-support systems, whether referring to climate change, ecosystem decline or resource depletion.

The circular economy should be everybody's business. By moving from linear to circular production models the pressure on natural systems would lessen considerably. Nothing is 100% circular, however. All materials degrade and disperse over time and with use. What's more, collecting end-of-life products and materials and restoring them to a re-usable state itself requires energy inputs and new materials. Obviously, the circular economy is no panacea. Still, a lot of studies confirm that there are huge gains to be made – economically, socially and environmentally – by moving from linear to circular material flows and by keeping products and materials in use as long as possible.

The objective of this paper is first to present the rationale for a circular economy – including a discussion on its limitations – and, second to discuss the barriers to change and how to overcome them through a combination of different governance initiatives.

One particular challenge is that there does not exist a generally agreed upon definition. To date the circular economy is seen by many as a metaphor for a variety of measures aiming at enhancing resource efficiency. A commonly used definition from the Ellen Mac Arthur Foundation goes as follows:

> *"Looking beyond the current take-make-waste extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three main principles:*
>
> *i) Design out waste and pollution, ii) Keep products and materials in use, and iii) Regenerate natural systems."*

In order for society to move from a linear to a circular production model there is a strong need for a robust and generally accepted definition. The positive thing is that the International Organization for Standardization (ISO) in 2019 took the initiative, urged by many governments, to work on a definition. A proposal is expected in the spring of 2023.

Decoupling

The concept of decoupling economic activity from resource use – the ability of an economy to grow without corresponding increases in energy and resource use and in environmental pressure – has been a central theme in the sustainability debate for decades. Absolute decoupling occurs when the relevant environmental pressure is stable or decreasing while the economy is growing. Decoupling is relative when the rate of environment degradation is still positive, but less than the growth rate of the economy.[2]

While relative decoupling has been happening – and is happening – the gains made have most often been eaten up by a combination of economic growth and the so-called rebound effect, i. e. that the resources freed up by increased efficiency are used up very soon through increased consumption. Looking at the global economy as a whole, the fact is that material use in recent years increases faster than the growth of GDP – a consequence primarily of rapid infrastructure development in the emerging economies.[3]

Although progress on decoupling overall has been disappointing, efforts must continue. A combination of technology innovation, policy measures, behavior change and redistribution of wealth – primarily between industrialized countries and low-income countries – stand out as the main vehicles for change. But for that to happen we need policy frameworks that provide the right incentives for a different kind of economy.

So far most climate change mitigation strategies have been sector-based, with a primary focus on energy use. The general level of material use in society, and the fact that demand for materials has been increasing rapidly, was until recently mostly neglected – in spite of the fact that the climate benefits from using products longer and from enhanced rates of reuse, refurbishment and recycling of materials ought to be obvious. Numerous studies have confirmed that enhanced efficiency in the use of key materials leads to a significant reduction in carbon emissions.[4]

Strong rationale for a circular economy

The rationale for enhancing resource efficiency is compelling. It is multidimensional – encompassing economic, ecological as well as social considerations. However, enhanced resource efficiency alone will not result in a sustainable economy. Energy and material use in the Global South will have to grow significantly to make eradication of poverty possible. In industrialized countries, the combination of economic growth and rebound effects are likely to more than balance out the resource savings made over time. Hence, demand for virgin materials is expected to continue to increase globally for several decades. The question is by how much?

Here is where a move to a circular economy could play a crucial role. Moving away from today's utterly wasteful production model – from "take-make-dispose" linear production – toward a circular production model, where goods are designed and produced for extended use, reuse, reconditioning and recycling from the outset will no doubt help reduce the pressure on natural systems. It is important to emphasize that a move from a Linear to a Circular Production Model will be enhanced by the mushrooming of digital technologies – such as the Internet of Things (IT), big data, and data analytics. Such technologies are looked upon as "enablers" of a variety of new services that have the potential to radically reduce material use.

A move from a linear to a circular production model represents an economy-wide transformation. All major stakeholders have to be committed and engaged – national governments, cities, the business community, researchers as well as consumers. The international dimension is crucial. International and global governance that facilitates the transition to a circular economy is very much needed.

Many barriers to change

Even if a circular economy appears obvious it will not happen by itself. The barriers to change are plentiful. Policy frameworks have to be reconsidered at international, regional, national and city levels. Business models, consumer preferences and lifestyles have to be changed. There are, indeed, a number of reasons why the "take-make-dispose" model continues to dominate the economy. The most important ones are:

- During much of history natural resources were perceived as both abundant and cheap; likewise, the capacity of nature to absorb waste and residues was perceived as infinitely large.
- Producers have rarely paid the full costs of production; the use of nature has been more or less free of cost – resulting in a huge market failure.
- Many products include toxic substances and hence are difficult to reuse or recycle.
- Modern products are composed of a variety of materials, which are both difficult to decompose and reuse and recycle.
- Supply chains are global in nature which make it difficult to close the loops; moreover, trade agreements are free from references to circularity.
- Most business models have favored high material throughput and short product lives.
- Consumer patterns were developed without considering sustainability.
- We measure the wrong things; GDP growth is a useless metrics when it comes to everything that is connected to qualitative development.

To overcome all these barriers, a number of things have to happen – both in politics, business and with regard to consumer preferences. At the top of the list will be policy initiatives – at global, regional, national and city levels – to correct for market failures and provide the necessary incentives to move the economy in the right direction.The transition towards a circular economy is taking place in an increasingly globalized economy. The linkages with international trade are crucial. In spite of the importance of trade, existing research is presently limited. Policy action in most countries give priority to achieving circular material flows at the domestic level, yet international trade occurs at various levels along the product value chain.

The EU has presently around 80 Free-Trade Agreements (FTAs). While all these agreements include Sustainability Impact Assessments and various environmental safeguards, the circular economy is rarely referred to. Trade in secondary raw materials will be an important part of a transition to a circular economy. Just as natural resources are unequally distributed geographically, the same can be said about secondary raw materials. What is lacking, however, are internationally accepted quality standards for such materials.

Governance

The question of how to overcome the barriers to a circular economy is multifaceted. The role of policy is central on many levels – international, regional, national and city – but other stakeholders play a crucial role as well, the most important being business organizations, science and technology and civil society.

The 2030 Agenda reflects a global consensus that economic, social and environmental aspects of development are interlinked and mutually dependent. Governments all over the world have agreed to work together to meet the Sustainable Development Goals (SDGs). The circular economy must be discussed and framed within the context of the SDGs and a systemic approach is necessary. The seventeen goals are interconnected and progress towards one target will influence the others.

Adherence to lofty goals is one thing. Meeting the goals in practice is a different matter. Regretfully, there is no governance system at the international level that guarantees that the SDGs in general or the circular economy more specifically are being pursued. The implementation is up to each and every government and varies greatly.

Rethink economic policy frameworks

When examining the hurdles on the road to a circular economy, most are closely related to shortcomings and failures in policy frameworks, not least the flawed incentives structure of the economy. This can only be addressed by policy change. Ideally at the international level. Recent initiatives in the EU demonstrate that European markets are likely to undergo major changes with regard to resource efficiency and circularity in the near future. Policy measures at EU level will then have to be complemented at the level of Member States. Crucially important, as well, will be for the EU and it's Member-States to prepare for follow-up initiatives at the level of UN, WTO, OECD, G7 and G20 to make sure that the transformation to a CE will be compatible with rules-making at the international level.

Regarding policy change the most important measures ought to be:

- Initiate a tax shift – lowering taxes on labor and increasing taxes on resource use.
- Stop subsidizing fossil fuels production and consumption.
- Products should be designed for reuse, refurbishment, remanufacturing and recycling.
- Remove VAT on all reused materials. This would give a boost to reuse and recycling.
- Use Public Procurement proactively in the advancement of the circular economy.
- Make material use a priority in climate mitigation strategies.
- Give cities greater authority in decision-making on circularity.
- Complement today's flow-based metrics, such as GDP, with measures of a country's stock of assets to account for the restoration and regeneration of natural capital.

European Green Deal

The European Green Deal was launched in 2019. It is meant to transform the Union into "a modern, resource-efficient and competitive economy, where i) there are no net emissions of GHG emissions by 2050, ii) where economic growth is decoupled from resource use, and iii) no person and no place is left behind."[5] Several of the policy proposals referred to above are likely to be addressed in the implementation of the Green Deal.

A cross-cutting issue of crucial importance is the Circular Economy Action Plan.[6] It includes a Sustainable Products Initiative[7] and will have particular focus on resource intense sectors such as textiles, vehicles and batteries, construction, electronics, plastics and packaging. Legislative proposals are prepared to support a "Right to Repair" and Mandatory Sustainability Standards for Public Procurement.

Global action

The European Union makes clear in its Action Plan for the Circular Economy that it cannot deliver the goals of the Green Deal alone. Global cooperation is indispensable and the European Commission "has confirmed that it will lead the way to a circular economy at the global level and use its influence, expertise and financial resources to implement the 2030 Agenda for Sustainable Development in the EU and beyond."[8] The actions under consideration are wide-ranging, such as:

- Lead efforts at the international level to reach a global agreement on plastics.
- Propose a Global Alliance on Circular Economy and Resource Efficiency.
- Initiating discussions on an international agreement on the management of natural resources.
- Build a stronger partnership with Africa to maximize the benefits of the green transition and the circular economy.
- Promoting the circular economy in the context of bilateral, regional and multilateral policy dialogues.
- Ensure that Free Trade Agreements reflect the enhanced objectives of the circular economy.

In the absence of an international organization that can mobilize the world community to adopt legislation that not only helps meeting the SDGs in general, but – more specifically – promotes and incentivizes a vastly more resource-efficient and circular economy, the actions initiated by the European Union are promising.

The role of the business community

The European Green Deal will significantly change the business environment. The Circular Economy Action Plan will aim at an economy-wide transition which gets to the heart of industrial production – from design to manufacturing to consumption, repair, reuse, recycling and bringing resources back into the economy. This is in stark contrast to today's linear production model. There is only one possible conclusion to be drawn from this: production and business models must change. Disruption is inevitable. Businesses that do not adapt to the principles of circularity will have a difficult future.

Given the urgency with regard to climate change and ecosystem decline, a natural question emerges: Where to start? The answer is quite simple. Any attempt to promote circularity in all its aspects should give priority to areas in the economy where energy and material throughput is particularly large, such as: Energy, Construction and Building, Batteries and Vehicles, Electronics, Textiles, Plastics, Packaging and Food.

The business community is to a large extent dependent on policy-makers to be able to make the necessary shift to a circular economy. The current economic system is geared towards the demand of the linear economy. Circular entrepreneurship is thus at a disadvantage. Another hurdle is the need to reconsider value chains. Production and consumption often take place in many different countries with inputs from multiple suppliers. In a circular economy, supply chains will have to be reorganized so that information and materials flow in both directions to facilitate reuse, refurbishment and recycling.

One business model that is rapidly gaining ground is Products as a Service (PaaS). Leasing products instead of selling them has benefits both for businesses and consumers. But for that to happen finance models have to change. PaaS means that revenues will be generated over time and not once a product is ready to be brought on the market. Investments will be needed upfront, while returns are uncertain.

In spite of the many uncertainties important segments of the business community have been among the main proponents of leaving behind the linear production model. Corporations like IKEA, H&M, Unilever, Philips, Renault, Tarkett and Solvay have all been in the frontline with regard to the circular transition. Just as important has been a great number of medium-size companies and start-ups. The Finnish Innovation Fund Sitra – a pioneer when it comes to the circular economy – has compiled a list of altogether 39 circular inspiring solutions from all over the world.[9]

The World Economic Forum (WEF) has taken on a proactive role in the promotion of circularity. WEF's Circular Economy Initiative brings together private, public, civil society and expert stakeholders to accelerate the circular economy transition by advancing four key pillars or work:

- The Platform for Accelerating the circular economy (PACE) was launched in 2017 as a platform for public and private sector leaders to take commitments and accelerate collective action towards the Circular Economy.

- Transforming Material Value Chains. The WEF hosts a series of major value chain action partnerships that work with partners along global material value chains to advance circular models – from plastics, electronics, batteries, cars, to fashion/ textiles.

- Scaling Innovation and the 4IR. **Scale360°** is an emerging initiative which aims to mobilize action among innovators, governments, civil society, and private sector stakeholders to grow the ecosystem for circular 4IR technology innovation (Fourth Industrial Revolution) — with a focus on plastics, electronics, food and fashion/textiles.

- The Circular Economy for Net-Zero Industry Transition. This initiative is designed to raise the decarbonization ambition for harder-to-abate materials (steel, cement, chemicals, and aluminum) and help those industries realize a 1.5° pathway by catalyzing scalable circular economy solutions.

Initiatives like the ones taken by WEF will have great importance to help companies prepare for a transformation to a circular economy. One challenge, though, will be how to involve small– and medium-sized companies (SMEs) in the process. It is one thing for large companies to engage in sustainability-related matters but quite another for small and medium-sized companies. Here governments have to help put in place support schemes, preferably in close cooperation with business organizations.

In conclusion

The move towards a circular economy seems unstoppable. While nothing is fully circular, the benefits of moving from a Linear to a Circular Production Model are obvious both from purely economic as well as environmental and social points of view. The reductions in terms of carbon emissions, as well as other forms of pollution are striking. It is therefore somewhat of a mystery that societies have done so little until recently to promote resource efficiency in general and circularity more specifically. It is important, though, to remind the reader of the rebound effects. Neither resource efficiency in itself, nor circularity, will be sufficient to bring about "absolute decoupling."

Of crucial importance in the years ahead will be the policies enacted at global, EU, national government and city levels. The linear production model is dominating today because of massive market failures – the negative externalities in relation to both the extraction, production and use of all kinds of natural resources are not reflected in market prices. Business models are built upon high throughput of energy and materials. There is a strong need for more explicit and focused intergovernmental discussions about governance. Key issues will be how to align global supply chains with the objectives of a circular economy.

What will be needed urgently, as well, is a value shift – replacing, or at least complementing, material consumption as the main objective in life. Quality of Life has many components, such as a purposeful life, health care, healthy ecosystems and a stable climate, personal safety, conditions in the workplace, education, access to and participation in cultural activities and family life. It is abundantly clear from a lot of research that the priority given in contemporary society to material consumption is exaggerated, both from the point of view of nature protection and wellbeing and happiness for the individual.

The information technology revolution, no doubt, offers opportunities for people – not least among the young – to increasingly favour experiences over possessions.

Main report

Welcome to the world of the circular economy – an emergent way of looking at the economy, a topic of growing importance and a subject on many people's mind. The backdrop is the rapidly increasing throughput of energy and materials, not least the growing use of disposable products, and the threat it constitutes to planet Earth and its resources. It is increasingly clear that the linear economic model, driven by a "take-make-dispose" philosophy, is unable to manage the rapidly growing levels of resource consumption in the world. To continue business as usual would endanger planetary life-support systems, whether referring to a stable climate system or healthy ecosystems.

The circular economy has yet to achieve a generally agreed upon definition. To date it is seen by many as a metaphor for a variety of measures aiming at enhancing resource efficiency. Among the many attempts to define or describe the concept, the European Parliament version is both comprehensive and clear:

> *"The circular economy is a model of consumption and production, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.*
>
> *In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible. These can be productively used again and again, thereby creating further value.*
>
> *This is a departure from the traditional, linear economic model, which is based on a take-make-consume-throw away pattern. This model relies on large quantities of cheap, easily accessible materials and energy. Also part of this model is planned obsolescence."*[10]

The circular economy should be everybody's business. By moving from linear to circular production models the pressure on natural systems would lessen considerably. Nothing is 100% circular, however. All materials degrade and disperse over time and with use. What's more, collecting end-of-life products and materials and restoring them to a re-usable state itself requires energy inputs and new materials. Obviously, the circular economy is no panacea. Still, a lot of studies confirm that there are huge gains to be made – economically, socially and environmentally – by moving from linear to circular material flows and by keeping products and materials in use as long as possible.

The excessive use of natural resources – both energy and materials – is putting increasing pressure on natural systems. The International Resource Panel (IRP)[11] is estimating that the extraction and processing of materials, fuels and food – up to ready to use ("cradle to gate") – make up more than half of global carbon emissions and 90% of the loss of biodiversity. By moving from linear to circular production models – aiming to design out waste and pollution, keeping products and materials in use, and regenerating natural systems by the use of renewable materials end energy the pressure on natural systems would lessen considerably. The objective of this paper is first to present the rationale for a circular economy – including a discussion on its limitations – and, second, to discuss the barriers to change and how to overcome them through a combination of different governance initiatives.

Circular economy pioneers used insights from living systems to imagine effective industrial systems which are "regenerative, accessible and abundant by design." The natural world offers powerful lessons on how to build a circular economy. Dr Enric Sala explains this in The Nature of Nature: "Everything is reused or repurposed in nonhuman ecosystems. The natural world is the perfect circular economy, where everything, even after its lifetime, becomes a source for something else."[12]

This paper will deal primarily with the techno-sphere. This does in no way imply a neglect for the biosphere. On the contrary. A primary objective of the circular economy is to preserve and regenerate natural capital. Hence, the interplay between the techno-sphere and the biosphere is of crucial importance. But the paper does not deal specifically with the bio-economy, i.e. primarily the management of forests and agriculture. The reason is not that those sectors would be problem-free. On the contrary. Today's industrial farming systems are far from circular and are in dire need of reform and transformation. Furthermore, forest management systems in many parts of the world leave a lot to be desired. Yet, the focus chosen for this paper is broad enough, i.e. the massive throughput of materials in the techno-sphere.

The origins of the circular economy

1. THERE ARE LIMITS

Almost fifty years have passed since the launch of "Limits to Growth"[13], a report to the Club of Rome based on a study by MIT. Its key message was that a combination of resource depletion and pollution, if un-checked, would ultimately bring the global economy down.

The background was the rapidly increasing ecological footprint of humanity, driven by the growth in population as well as the resources used and pollution generated per person. The report tracked industrialization, population, food, resource use and pollution and developed a number of scenarios, all dependent on various degrees of human action on environmental and resource issues. The model used predicted that "overshoot and collapse" was inevitable before 2070 with continued "business as usual", that is, without significant changes to economic activity.

The approach presented in the Limits Report was both novel and controversial at the time. It challenged the notion that infinite material growth is possible on a finite planet and applied a systemic approach, i.e. taking into account a number of factors such as population, renewable resources, non-renewable resources, food production, pollution, industrial output as well as services output and their interactions.

Limits to Growth reverberated around the world and the book sold many million copies. One misconception already at the time of publication was the perception by many that the report predicted "overshoot and collapse" in the immediate future. However, that was never the case. The time perspective was the next fifty to hundred years.

The publication was followed by massive critiques, not least by conventional economists. One of the most fervent critics was William Nordhaus, the winner of the Riksbank Prize in Economics in Memory of Alfred Nobel in 2018 (popularly referred to as the Nobel Prize of Economics). The main critique was that the report had not factored in 'the ingenuity of man'. Furthermore, economists claimed that resource scarcity is primarily a question of pricing.

In hindsight, critics were partially right: the treatment of innovation was too static in Limits to Growth. The World3 computer model used in the MIT study was rather inflexible and could not predict the stunning advances in pollution control, which permitted many countries to partially escape from the tragedies of polluted air, water and soils.

With regard to resource scarcity the picture is mixed. Renewable resources tend to be heavily overexploited through overfishing, soil erosion, groundwater depletion or deforestation, as well as ecosystem degradation and pollution. In the case of non-renewable resources, the picture is even more complex. Some materials, like iron ore, remain abundant. For others, like certain metals and phosphorus, the risk of scarcity is tangible. A common problem is that once the richest ores are exploited, further extraction will require increasingly more energy and generate more pollutants.

Despite some shortcomings in the World3 computer model used, it was a serious mistake by conventional economists to dismiss the warnings of the report. The understanding among most economists about the functioning of the natural world was – and still is – limited. Most of them seem to make no distinction between financial and industrial capital on the one hand and natural capital on the other. 'As long as financial capital is increasing, we are fine' – so goes the thinking. But we cannot eat money and money cannot generate more orangutans, fertile soils or a stable climate, once overuse or pollution has gone too far.

Moreover, conventional economic models, linear in nature, are still today incapable of addressing and guiding society with regard to the nonlinearity of natural systems, such as the climate system. Scientists keep reminding us of 'tipping points' in relation both to the climate system and vital ecosystems like rainforests, soils or lakes. Once such tipping points are crossed, the original ecosystem can flip or the climate system can be severely destabilized, and the damage made may be irreversible.

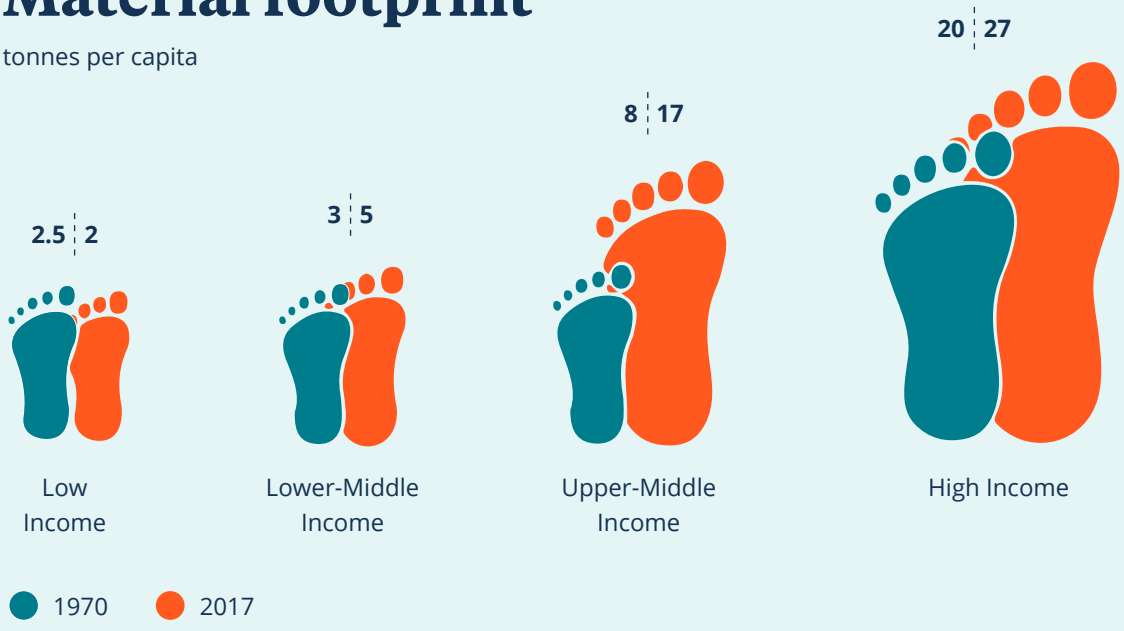
The reader may ask: why spend significant time and space on a fifty-year old report by the Club of Rome? The reason is simple. The concerns of the Limits Report are still as relevant today and hence provide a natural backdrop for any discussion on resource use. We have learned a lot since 1972 and are now in the possession of both the knowledge and the technologies necessary to address the challenges emphasized in the report. However, the necessary transformations in terms of values, thinking, economic organization and technologies – all related to the existence of adequate governance systems – are still missing.

Proof of this can be found in the already referred to Global Resources Outlook 2019 (GRO 2019).[14] The report shows that the forecasts made by Limits to Growth had a great degree of accuracy. "Over the past fifty years, the population has more than doubled and global domestic product has increased by more than four times." The report finds that, in the same period, "annual global extraction of materials grew from 27 billion tons to 92 billion tons (by 2017). This is likely to double again by 2060, given current trends." An OECD report published in February 2019 – "Global Material Resources Outlook to 2060"[15] – came to roughly the same conclusions.

GRO 2019 states that our throw-away model of consumption has devastating impacts on the planet. The report also emphasizes that the benefits of this type of resource use remain limited to but a few. Differences in the material footprint between countries remain stark. "High-income countries maintain per capita levels of material consumption that are more than 13 times the level of low-income countries."

Material footprint

tonnes per capita



Source: Global Resources Outlook, GRO 2019

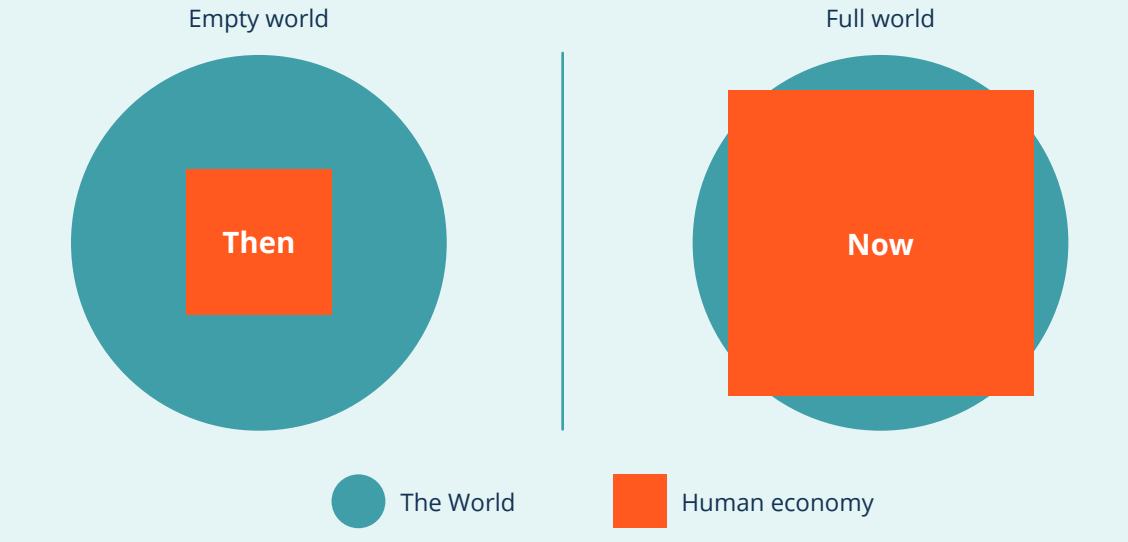
At the launch of the report the Acting Executive Director of UN Environment, Joyce Msuya, commented that "the Global Resources Outlook shows that we are ploughing through this planet's finite resources as if there is no tomorrow, causing climate change and biodiversity loss along the way. Frankly, there will be no tomorrow for many people unless we stop."

2. EMPTY WORLD VS FULL WORLD

There is disagreement among experts regarding what will be the main constraints for human development in the future – resource depletion or a combination of pollution, biodiversity loss and climate change? Judging by the GRO 2019 – and except for a few resources, such as healthy soils, phosphorus and rare earth metals – the limiting factor in the short and medium term will be the health and environmental consequences of our excessive and irresponsible use of resources.

In "Come On – Capitalism, Short-termism, Population and the Destruction of the Planet"[16], co-authored by Ernst von Weizsäcker and myself, we make the point that humans cannot become successful stewards of Planet Earth with development ideals, economic models and value sets that were shaped at a time of the empty world, when the global population ranged between one and two Billion people and when the bounty of natural resources on this Earth seemed endless. Today, actually since the mid of the 20th century, humanity exists within a full world where limitations are tangible in almost everything that we do.

Empty world and full world



Source: Club of Rome: Simplified after Herman Daly

While I do not want to underrate the incredible progress made since the Second World War in terms of human development, such as the reduction of poverty and improved access to education and health care, we are in the midst of a multi-faceted crisis. For decades there have been serious warnings about the serious risks building up in nature, in the social fabric, in the financial and economic system, around exponential technologies and the nuclear arms race. Yet such warnings have mostly not been heeded.

3. THE PREVAILING ECONOMIC MODEL IS NOT FIT FOR PURPOSE

Our current economic model is not fit for purpose. The COVID-19 pandemic has exposed the fragility of our health, social, economic, financial and political systems. It is important, now more than ever, to work together towards a more resilient economy focused on greater sustainability, wellbeing and regeneration with the aim to deliver a better balance between people, planet and prosperity. To achieve this, a shift in values is necessary.

A key prerequisite for a transformation to a sustainable society will also be a shift in the overall objectives of the business community. The main purpose of companies can no longer be to maximize short-term profits and shareholder value, but rather to broaden their objectives – which in some countries may require changes in the company law – and help contribute in a positive way to societal objectives in relevant areas.

Some people, like renowned economist Dennis Snower, go even further in their claim that current ways of thinking about the economy and economic behavior are inadequate. Snower writes– in a recent article in Evonomics[17] – that the dominating neo-classical system has had little success in addressing the great economic questions of our time, and raises a number of provocative questions:

If the free-market system is meant to satisfy our needs efficiently:

- why is it despoiling our environment?
- why is it generating inequalities and other inequities that threaten the social cohesion of our societies?
- why does it leave so many people economically insecure, vulnerable to unemployment and trapped in dead-end jobs?
- why does it not correct for the excesses of consumerism, workaholism and digital addictions, frequently leading to anxiety, depression, burnout, substance abuse and crime?
- why is it giving us so little guidance in promoting public compliance with social distancing rules during the COVID-19 pandemic, even though such compliance has economic causes and consequences?
- why does it keep so many businesses focused on short-term profit and shareholder value, even though so many business leaders are genuinely concerned about the environment and the wellbeing of their customers and employees?

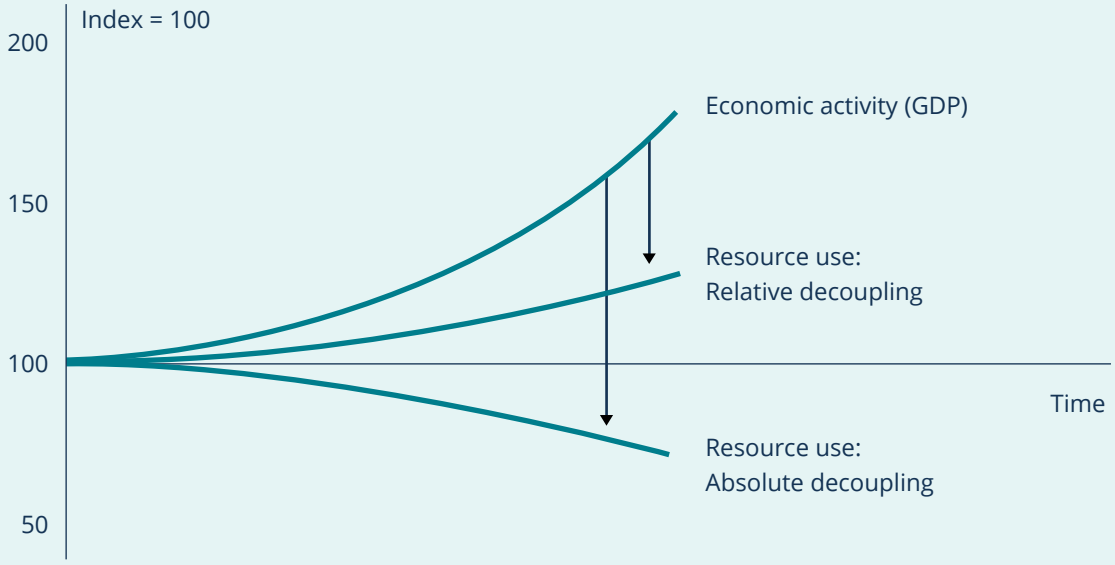
Whilst Snower raises crucially important questions, this is not the place to dwell into such queries. In response to some of the questions, ongoing efforts to make the economy more resource-efficient and circular – the main focus of this paper – provide at least part of the answer. But it is obvious we are at a turning point – in Snower's words, we are "close to a Copernican Moment." This is a moment when the shortcomings of the present economic system become so evident that political parties both at the center/right and the center/left ought to agree that a serious reform is needed. The ecological challenges are well-known and will require radically different policy frameworks. The same goes for the social challenges. As expressed by the Economics Prize winners Banerjee and Duflo: "when the benefits of growth are captured mainly by an elite, social disaster can be the result."[18]

The much-needed reform has to go far beyond a "yes or no" to conventional growth. That is not the main issue. The issue instead is prosperity, which goes much beyond production growth. The challenge will be to give priority to a wide range of indicators centered around human wellbeing, while recognizing that material consumption has its clear limits.

4. DECOUPLING

The concept of decoupling economic activity from resource use has been a central theme in the sustainability debate for decades. Decoupling refers to the ability of an economy to grow without corresponding increases in energy and resource use (source limits) and in environmental pressure (sink limits). A decoupled economy should ideally not negatively affect soil fertility and biodiversity, not diminish resource stocks and not lead to increased toxicity of land, water and air. (Decoupling Natural Resource Use and Environmental Impacts from Economic Growth, UNEP, International Resource Panel 2011).[19]

Resource decoupling

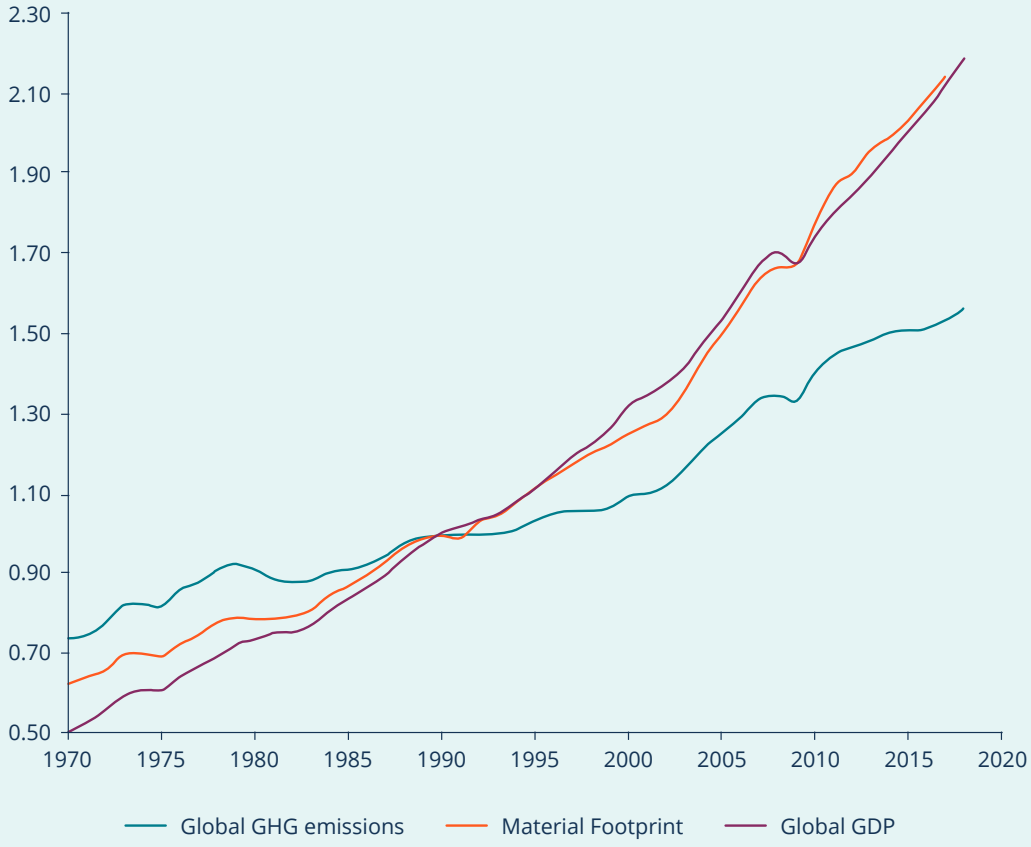


Decoupling can be either absolute or relative. Absolute decoupling occurs when the relevant environmental pressure is stable or decreasing while the economic driving force is growing. Decoupling is relative when the growth rate of the environmentally relevant variable is positive, but less than the growth rate of the economic variable.[20]

Relative decoupling will buy time, i.e. give the economy some extra time before it runs into resource constraints and/or excess pollution. Once the economy comes close to a boundary condition, absolute decoupling will be a requirement so as to enable the economy to continue to develop.

Unsustainable growth would inevitably lead to less development (growth) in the long run as the preconditions for growth and development – the sources and sinks referred to – are being depleted. This crucial interdependence between the economy and the life-supporting systems provided by planet Earth is well understood by most natural scientists. However, judging by the way society hitherto is managing resources, the relationship seems less clear for people in general, conventional economists included. A fact of the matter is that resource productivity has not been a priority in policy-making during most of industrial society.

Relative change in main global economic and environmental indicatiors from 1970 to 2018



Source: European Environment Agency (EEA), 2020

While relative decoupling has been happening – and is happening – the gains made have most often been rapidly eaten up by a combination of economic growth and the so-called rebound effect, i.e. that the resources freed up by increased efficiency are used up very soon afterwards through increased consumption. If we look at the global economy as a whole, the fact is that material use in recent years increases faster than the growth of GDP, primarily a consequence of rapid infrastructure development in the so-called emerging economies.

The irony – and, indeed, positive thing – is that a decoupling between economic growth and carbon emissions seem to be in the cards. Renewable energy – primarily solar and wind – has made enormous progress in terms of learning curves and the lowering of costs in recent years. This means that an energy system free from carbon emissions ought to be a possibility within the next two to three decades. Whether it will happen in time to meet the Paris climate goals and avoid dangerous climate change is another issue.

Decoupling between economic growth and carbon emissions does not mean, however, decoupling from resource use in general and, in particular, from the hollowing out of vital ecosystems and loss of biodiversity. One important aspect of replacing fossil fuels with renewable energy sources – including the electrification of the economy – will be the rapidly increasing demand for a host of metals. For most of them linear production models dominate as of today. Unless resource efficiency – and circularity – is given utmost priority, it is difficult to see how supply will be able to meet demand.

Although progress on decoupling overall has been disappointing until now, efforts must continue. The International Resource Panel (IRP) projects that global material use may more than double by 2060 unless strong measures are undertaken to improve resource efficiency. Such a growth in resource use would result in substantial stress on resource supply systems and in radically higher levels of environmental pressures and impacts.[21]

A combination of technology innovation, policy measures, behavior change and redistribution of wealth – primarily between industrialized countries and low-income countries – stand out as the main vehicles for change, i.e. to help bring down the environmental impacts of energy and material use. Luckily, there are many opportunities that can be harnessed by improved technology, often complemented by behavior change. A host of exponential technologies should be able to lower the human footprint significantly. But for that to happen we need policy frameworks that provide the right incentives for a different kind of economy. In addition, we will need a shift in values, giving less priority to consumption of resource- and carbon-intensive goods in favor of spending time and money on activities that depend far less on material consumption. The rapid development of information technologies – offering opportunities for dematerialization, virtual reality, AI and machine learning – will hopefully help to bring about a much-needed shift in consumption patterns.

The information technology revolution, no doubt, offers opportunities for people – not least among the young – to increasingly favour experiences over possessions.

Strong rationale for a circular economy

5. MATERIALS, CARBON EMISSIONS AND JOBS

Most climate change mitigation strategies hitherto have been sector-based, with a primary focus on energy use. The general level of material use in society, and the fact that demand for materials has been increasing rapidly, was until recently mostly neglected – in spite of the fact that the climate benefits from using products longer and from enhanced rates of reuse, refurbishment and recycling of materials ought to be obvious. The energy saved when recycling metals, for instance, is significant. Climate change mitigation strategies must therefore become more holistic and consider material efficiency as a key objective.

Numerous studies have been done exploring how enhanced efficiency in the use of key materials can reduce carbon emissions. In the 2016 report "The Circular Economy and Benefits for Society"[22], The Club of Rome analyzed the overall societal effects of moving towards a circular economy for five European economies – Finland, France, the Netherlands, Spain and Sweden. The study looked at the likely effects on carbon emissions and job opportunities by enhancing energy efficiency, increasing the ratio of the renewable energy in the energy mix and organizing manufacturing along the lines of a material-efficient, circular/performance-based economy.

The target date for the changes was 2030. The results were clear: each of the three decoupling alternatives, in all the countries studied, would lead to a significant reduction in carbon emissions. In addition, the employment effects would be clearly positive. If the three decoupling strategies would be pursued together the results would be significant. Carbon emissions were estimated to be cut by two thirds or more, structurally. The number of additional jobs would be substantial. Most of the new jobs would be offered in activities like recycling, reuse, refurbishment, and renewable energy but – as well – in services, as an effect of turning products into services.

Another study on the European economy as a whole by Material Economics (2018)[23] assessed what the likely effects of making better use of already produced materials would be, and, by doing so, reducing the need for new production. The study examined key material flows, like steel, cement, aluminum, paper and plastics, and the corresponding value chains. It identified relevant circular economy approaches – like reducing waste in production, recirculating a larger share of materials, light-weighting products and structures, extending the life-time of products and deploying new business models based around the sharing of cars, buildings and the likes.

The study's main conclusion was that a more circular economy can make steep emission cuts from heavy industry: in an ambitious scenario for the EU, as much as 296 million tons CO2e per year could be cut by 2050, out of 530 million tons CO2e in total. Demand-side measures thus could take us more than halfway to net-zero emissions from EU industry and hold as much promise as measures on the supply side. In other words: "Much like improving energy efficiency is central to the EU's efforts to achieve a low-carbon energy system, a more circular economy will be key to developing European industry while cutting its carbon emissions."

6. MATERIAL VALUES THROWN AWAY

Up to now, discussions on resource use have mostly focused on factors like resource depletion, security of supply and the climate and environmental consequences of excessive use. Another factor to consider is the economic consequences of the prevailing linear production model. Several studies have shown that huge material values are being wasted after the first use cycle.

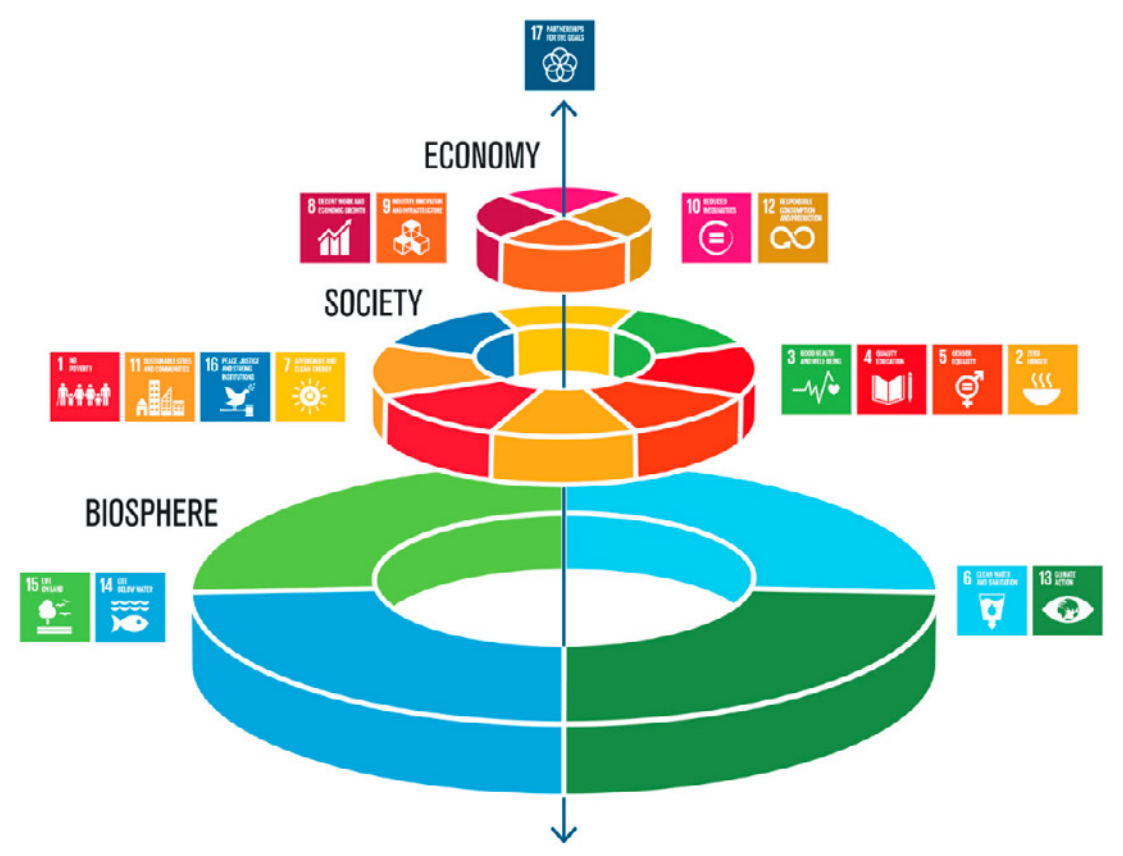
A major study in 2015 by the Ellen Mac Arthur Foundation – "Growth Within"[24] – estimated that "material reuse and recycling and waste-based energy captures only around 5% of the original material value in the European Economy as of today" – a colossal waste.

Another report by Material Economics in 2018[25] on material use in Sweden, showed that for material categories like steel, aluminum, concrete, paper and plastics on average only ¼ of the original material value was captured after first use cycle. Most of the value loss results from the physical loss of materials in combination with downgrading of quality. Plastics are the worst. Only about 13% of the original value is retained and almost half of that in the form of energy production. In the Swedish case this means that for the materials examined, billions of euros are lost annually as a result of poor design, flawed economic incentives and ineffective separation and recycling.

7. THE CASE FOR A CIRCULAR ECONOMY

The rationale for enhancing resource efficiency is compelling. It is multidimensional – encompassing economic, ecological, as well as social considerations. Reducing pressures on ecosystems and climate is uniformly aligned with economic benefits that, in addition, enhance social cohesion. The analytical foundations for action to conserve and use resources more efficiently have been established since many years. As seen from the pie chart by Stockholm Resilience Center, the natural resource base underpins all economic and social development and the overexploitation that is currently going on cannot continue.

SDGs pie chart



Source: Stockholm Resilience Center 2016 (Rockström – Sukdhev)
Credit: Azote images for Stockholm Resilience Centre

However, enhanced resource efficiency alone will not result in a sustainable economy. First, we have to keep in mind that economies in the global South will have to grow significantly in terms of energy and material use to make eradication of poverty possible. In industrialized countries, the combination of economic growth and rebound effects – when resources are freed up as a result of productivity gains and used to demand materials elsewhere in the economy – are likely to more than balance out the resource savings made over time. In fact, that is what has happened historically. Hence, demand for virgin materials is expected to continue to increase globally for several decades. The question is by how much?

Here is where a move to a circular economy could play a crucially important role. Moving away from today's linear and utterly wasteful production model – from "take-make-dispose" linear production – toward a circular production model – where goods are designed and produced for extended use, disassembly, reuse, reconditioning and recycling from the outset – ought to help reduce the pressure on natural systems.

The United Nation's Sustainable Development Goal number 12, "Responsible Consumption and Production," clearly addresses the need for a circular economy. The concept is specifically highlighted, as well, in the EU Commission's "European Green Deal" policy declaration in December 2019.[26]

More recently the Ellen MacArthur Foundation has given strong impetus to advancing the concept with a series of CE reports and initiatives. The Finnish Innovation Fund Sitra has been another strong actor in developing a Road Map to a CE for Finland in 2016[27] and in initiating and organizing the World Circular Economy Forum. Other significant developments are the proactive efforts by both the Dutch government and several Dutch cities, not least Amsterdam, as well as interest shown within the OECD, the G20 and the G7. OECD has organized numerous high-level conferences and round-table discussions on the circular economy in the city context. Another important initiative is the G7 Alliance on Resource Efficiency.

The issue of a circular economy has become increasingly prioritized not only in Europe. The Chinese Government introduced the concept as an important policy matter already in 2002. In 2009, a Circular Economy Promotion Law was adopted and different sector policies and strategies have been implemented. The concept has gained ground in India as well. Sector studies, such as e-Waste Management Rules, Plastic Waste Management Rules and a Metal Recycling Policy have been adopted.

Keeping products and materials in use as long as possible is one of the key premises of the circular economy. In slowing material flows, for example through repair and reconditioning, product life spans are extended and the production of new goods is postponed. Reference is often made to the six Re's: Reduce, Reuse, Refurbish, Repair, Recycle and Recover (in some contexts the concept of Remanufacturing is included, adding a seventh Re) and one D: De-linking materials to recover atoms and molecules for reuse. If the idea is to keep materials in use as long as possible, design and design principles become key issues. Moreover, concern should as well be paid to systemic issues such as to whether a product, a service and/or a packaging is at all needed, thereby making it possible to further reduce material throughput.

The potential for a change from a Linear to a Circular Production Model is greatly supported and underpinned by the mushrooming of digital technologies – such as the Internet of Things (IT), big data, and data analytics. Such technologies are looked upon as "enablers" of a variety of new services – and associated business models – that have the potential to radically reduce material use. One important aspect of this development is that digital solutions open up a host of opportunities for companies to bring their customers closer and let the use of technology improve and optimize customer experience.

8. NOTHING IS 100% CIRCULAR

Nothing is 100% circular, however. The second law of thermodynamics makes clear that quality is lost in all energy and material conversions. A comment made by the European Academies of Sciences Advisory Council (EASAC) – an advisory body to the European Institutions – in 2015 made the limitations of a circular economy clear:

"Recovery and recycling of materials that have been dispersed through pollution, waste and end-of-life product disposal require energy and resources, which increase in a nonlinear manner as the percentage of recycled material rises (owing to the second law of thermodynamics: entropy causing dispersion). Recovery can never be 100%.[28] The level of recycling that is appropriate may differ between materials."[29]

The key point here is that the handling and management of end-of-life products and waste materials – e. g. through reuse, refurbishment and recycling – does require significant energy inputs. Furthermore, all materials are subject to dissipation through friction and wear.

In a recent article in Harvard Business Review[30] the limitations with regard to a circular economy model are spelled out in quite some detail. The authors – Kieren Mayers, Tom David and Luuk N. Van Wassenhofe – are supporters of the circular economy. But while praising its objectives, they point at limitations in both its effectiveness and practicability:

> *"All materials degrade and disperse over time and with use. Textile and paper fibers, for example, are shortened by recycling; trace copper in steel prevents it being used in sheet metal; silicon in aluminum limits its use in cast alloys; and so on. Consequently, it is important to understand that materials can never progress through life purely in "lines" or "circles." Instead, they move through highly complex supply networks, and the popularly conceived repeating circular motion of reuse and recycling is in fact a downward spiral.*
>
> *What's more, collecting end-of-life products and materials and restoring them to a re-usable state itself requires energy inputs and new materials. In some cases, recycling and reuse can have even greater environmental impacts than production using virgin resources. For example, the use of recycled crushed concrete in cement can be better or worse for the environment, depending on the specifics of each situation (including where the materials are produced and where they are used).*
>
> *Given the limitless variety of products and materials in waste, scaling-up collection and recycling operations to deliver materials back for their original use and purpose can involve insurmountable complexity. The EU alone has identified 650 different types of waste, many of which themselves are complex mixes of different products from hundreds of producers, as in, for example, electronic equipment."*

The issues raised by Mayers et al are important, indeed. A move towards a circular economy is no panacea. There are many caveats, like efficiency vs resilience, thermodynamics, rebound effects, composite materials etc.

This being said, a lot of studies confirm that there are huge gains to be made by moving from linear to circular material flows and by keeping products and materials in use as long as possible. The social, environmental, as well as economic benefits have been amply demonstrated in numerous reports (European Commission, the Ellen MacArthur Foundation, Material Economics, International Resource Panel, Material Economics etc.).

9. RECYCLING - NO SILVER BULLET

To many people, the circular economy is being looked upon primarily as increased rates of recycling. Recycling has an important role to play. Material recycling saves a lot of energy and lessens pressure on fragile ecosystems. For instance, for each recycled ton of steel and iron scrap, there are 1.5 tons less that need to be mined as iron ore. Emissions are significantly reduced: with each ton of steel scrap, one ton of CO2 is saved. The efficiency of recycling of some other metals is almost just as high.[31]

Rare earth metals represent a special challenge. A recent report by CEWASTE "A Critical Contribution to Critical Materials Recycling"[32] underlines the importance of proper management of a large number of metals that are critical for electronics, renewable technologies but as well for the defense industries. This issue is of particular importance for Europe because of its high dependence on foreign supply. Despite recycling being one of the most important means to improve access to Critical Raw Materials (CRMs), recycling rates of such materials are close to zero due to the economic unattractiveness.

On a more general level, however, it is important to emphasize that recycling in itself is no silver bullet. Among the six (or seven) Re's (referred to above) recycling is the next to least effective from a resource efficiency point of view. More important than recycling would be to focus attention on keeping products and materials in use as long as possible. Despite this, the ongoing societal discussion on the circular economy most often refers to recycling as the principal concept.

As of today a significant part of all the materials being recycled are only suitable for downcycling into a lower-grade product. Moreover, while metals and glass can be recycled again and again, materials such as textiles, plastics and paper can only be recycled a few times. Last, but not least, even with high recycling rates – such as 60-70% – the loss of materials in the process is substantial. Consequently, a major issue when moving towards a circular economy will be to decide which materials to use in different situations – not least for short-lived products – to avoid a lot of waste in a system that is formally labeled as "circular".

10. DEFINITIONS AND INDICATORS

The beauty of GDP is its simplicity. It condenses into a single number a great number of human activities. It is understood by the majority as a proxy for welfare and wellbeing. But already in 1968 Robert F Kennedy criticized gross national product – a similar measure to GDP – by saying it "measures everything, in short, except that which makes life worthwhile."

This observation remains as true today. Sarah Arnold, at the New Economics Foundation(NEF), puts it the following way: "GDP is not a particularly useful measure in and of itself, because it doesn't tell us much about the direction of our economic activity or help us to determine how to govern it."[33] There are at least five indicators that GDP does not take into account, according to NEF, that could help measure national success more accurately: "job quality, wellbeing, carbon emissions, inequality, and physical health." I would add to the list ecosystem decline and biodiversity loss, leisure time, voluntary services, unpaid work at home, the value of technology, important aspects of the service economy etc. Furthermore, GDP fails to account for depreciation and depletion of assets.

Yet, after several decades of debate where the shortcomings of using GDP as a welfare indicator have been laid bare, most governments still refuse to change course. Gross Domestic Product is still almost universally used to gauge how well a society is doing. This is beyond understanding. GDP is a measure of market activity – nothing more.

Given the shortcomings of measuring welfare and wellbeing we should not be surprised that the way we measure the circular economy has serious limitations as well. The main problem is, as already mentioned, the lack of a generally agreed definition. The concept of the circular economy has been around for decades, partly under different terminologies. It synthesizes a number of schools of thought, such as:

- The Functional Service Economy (Performance Economy) of Walter Stahel.
- The Cradle-to-Cradle design philosophy of William McDonough and Michael Braungart.
- Biomimicry as articulated by Janine Benyus.
- The Industrial Ecology as a concept by Thomas Graedel.
- Natural Capitalism by Amory and Hunter Lovins and Paul Hawken.
- The Blue Economy systems approach as proposed by Gunter Pauli.

But despite these important contributions, still today there is no clear definition to go by.

While the general principles are relatively easy to understand there is, as was already stressed, no generally accepted definition. For many people the circular economy stands out as a metaphor for different aspects of resource efficiency. For others it is an almost overwhelming concept. Many businesses simply ask themselves what circularity means on a practical level?

A widely quoted definition of the circular economy – by the European Parliament – was referred to in the first section of this paper.

Another definition, by the Ellen MacArthur Foundation[34], is also worth mentioning:

> *"Looking beyond the current take-make-waste extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three main principles:*
>
> *i) Design our waste and pollution, ii) Keep products and materials in use, and iii) Regenerate natural systems."*

The fact that the concept is seen mainly as a metaphor for all kinds of activities promoting resource efficiency may not appear as a problem to most people. But, in fact, it is. Circularity has rapidly become one of the most embraced, but regretfully also vague, concepts in the field of sustainable development.

In a recent report to the Swedish Environment Protection Agency[35], sustainability consultant Dennis Pamlin brings attention to the risks posed by the absence of a clear-cut definition of the circular economy. The lack of a clear definition, according to Pamlin, makes it possible for different actors to continue their unsustainable practices under the disguise of circularity. Examples that come to mind are companies, based on unsustainable practices – like fast fashion, fast food, unsustainable tourism or consumer electronics and planned obsolescence – that are using initiatives within the circular economy realm as a way of diverting attention from their wasteful business models. For example, recycling and take-back schemes represent only marginal improvements in unsustainable business models.

The arguments in favor of a robust and generally agreed upon definition of a circular economy are very strong. There is simply no point in having circular economy principles agreed upon within an organization if the management does not have access to adequate indicators to measure the results of their decisions. The European Commission[36] highlights the importance of a monitoring framework that covers the various dimensions at all stages of the life cycle of resources, products, and services.

In 2019 the International Organization for Standardization (ISO) took the initiative, urged by many governments, to work on a definition of a circular economy. A technical committee ISO/TC 323 has been established with participation from more than 65 countries and growing.

The committee intends "to produce a set of internationally agreed principles, including terminology and a framework of what a circular economy is, and develop a management system standard. It also will work on alternative business models and methods for measuring and assessing circularity." Moreover, it "aims to cover all aspects of a circular economy including public procurement, production and distribution, end of life as well as wider areas such as behavioral change in society, and assessments, such as some kind of circularity footprint or index."

It should be added that progress, unfortunately, is relatively slow. A final proposal from the technical work is not expected until in the spring of 2023.

11. BARRIERS TO CHANGE

A move from a linear to a circular production model represents an economy-wide transformation. All major stakeholders have to be committed and engaged – national governments, cities, the business community, researchers as well as consumers. The global dimension is crucially important. International and global governance that facilitates the transition to a circular economy is very much needed.

We should not underestimate the barriers to change, however. Policy frameworks have to be reconsidered at international, regional, national and city levels. Business models – including across global supply chains – have to be rethought. The same goes for consumer preferences and lifestyles – for consumers around the world, not least in emerging markets.

Even if a circular economy appears both natural and appealing to many people, it is obvious that it will not happen by itself. A number of hurdles need to be overcome. After decades of increasingly intense discussion, not least in Europe, and a number of policy initiatives, what we have got so far are initiatives primarily aiming at enhanced waste management and recycling. These are steps in the right direction, but they must be complemented – or rather replaced – by a focus on upstream issues. The launch of the Green Deal – and the Circular Economy Action Plan – is meant to do exactly this but the implementation phase is only in its initial stages.

There are quite a number of reasons why the "take-make-dispose" model continues to dominate the economy:

- During much of history natural resources were perceived as both abundant and cheap; likewise, the capacity of nature to absorb waste and residues was perceived as infinitely large.
- Producers have rarely paid the full costs of production; the use of nature has been more or less free of cost.
- When companies source materials, secondary materials are most often more expensive than virgin materials; hence it does not pay to reuse, refurbish or recycle materials – a huge market failure.
- Many products include toxic substances and hence are difficult to reuse or recycle.
- There may be financial barriers to try on new business models – like moving from selling products to offering services.
- Supply chains are global in nature which make it difficult to close the loops; moreover, trade agreements are free from references to circularity.
- The productivity focus in the economy has been on labor costs and not on resource use.

- Most business models have favored high material throughput and short product lives.
- Thresholds in technological and infrastructure capacity.
- The fact that governments so far have paid limited attention to material efficiency unlike e. g. the priority given to energy efficiency.
- Consumer patterns in general have been developed without proper consideration of whether they are sustainable or not.
- The lacking of a generally accepted definition.
- Most importantly, we measure the wrong things. At societal level in the form of GDP growth, which says nothing about quality and at the level of materials where we measure flows but not stocks. In a circular economy, stocks are what matters.

To effectively overcome all these barriers, a number of things have to happen – both in politics, business and with regard to consumer preferences. At the top of the list will be policy initiatives – both at global, regional, national and city levels – to correct for market failures, to rethink how we measure and what we measure and to provide the necessary incentives to move the economy in the right direction.

12. CIRCULAR PRODUCT DESIGN - A CHALLENGE

Market failures, global supply chains, business models favoring high material throughput and too little focus on resource productivity are important reasons why circular economy principles have progressed slowly. But there are other causes as well. One of crucial importance is the fact that modern products are composed of a wide variety of materials, which are difficult both to decompose and to reuse and recycle. This is in stark contrast to the situation that prevailed before industrialization when almost everything was made from materials that were either decomposable – like wood, reeds, or hemp – or easy to recycle or re-use – like iron and bricks.

In a recent article in the Veolia Institute Review[37], Professor Tom Graedel at Yale University – by many referred to as the father of Industrial Ecology – discusses the preconditions for recycling and reuse in the economy. Graedel refers to a study some years ago by the International Resource Panel assessing the "best-estimate" end-of-life functional recycling rate of the elements of the periodic table. "Only fifteen to twenty elements had rates above 50%. Perhaps more dramatic are the more than thirty elements with essentially no functional recycling at all. Only a few elements were assigned values in between 0% and 50%. Thus, a majority of the elements employed in technology were used once and then lost to technology forever, a sad fate given the energy and effort expended to acquire them in the first place."

Graedel poses the question: "Why can't materials that are incorporated in products of various kinds be reused when the use of those products is finished?" He continues: "This seemingly obvious inquiry can be addressed, at least to some extent, by realizing that the forms of use of resources can be divided into four categories: 'in-use dissipated', 'currently unrecyclable', 'potentially recyclable', and 'unspecified' (generally small-scale uses whose low volumes do not justify tracking them)."

Graedel uses the medical device industry to demonstrate the scope of what a truly circular economy would demand. "As an example, the diversity of elements used by manufacturers of medical devices is thought to include at least seventy different elements for purposes of imaging, robotic surgery, artificial joints, and many more. Each element's use in medical devices or for electronics has a purpose, of course: better imaging of body organs, faster storage and retrieval of information, etc. A device maker adhering dogmatically to the circular economy vision would thus have to not only deal with contamination and sterilization issues, but also with the reprocessing of essentially the entire suite of the elements. This would be a major commitment for designers, product manufacturers, and executives, and suggests that dogmatism regarding advanced devices of all kinds so far as the circular economy is concerned is perhaps an unrealistic goal."

Electronics is another example of a sector where the issues of recovery and reuse pose many challenges. A recent study of the modular Fairphone 2[38] – a smartphone designed to be recyclable and have a longer lifespan – illustrates the many challenges involved. The study shows that the use of synthetic materials, microchips, and batteries makes closing the circle very difficult, if not impossible. Only 30% of the materials used in the present version of the Fairphone 2 can be recuperated. A study of LED lights had a similar result.

The results of the study led to improvements in how Fairphone pursues its recycling partnerships and processing methods in the future. The study shows that the success of different recycling processes is closely tied to the design of the original product, the materials it is made of and the ease of disassembly. The more complex a product, the more steps and processes it takes to recycle. In each step of this process, resources and energy are lost. Design for recycling must consider the combinations of metals, compounds, fillers, plastics and functional materials to minimize the loss of elements. Complex combinations with many different materials existing in mobile phones make this very challenging. The same goes of course for a variety of other products.

An important reason why progress in reuse and recycling is slow in the making, is that a significant part of all resources used – about a third of the total – are not easily reused or recycled in the short term: they are accumulated in buildings, infrastructure, and consumer goods. This situation can be referred to as the "delaying effect of stocks", a consequence of which is that in a world of increasing demand, even perfect recycling is not enough to meet supply. This is particularly true when referring to low-income countries where most of the urban infrastructure necessary in the years to come has not been built yet.[39]

Even at the end of the use cycle, some materials may not immediately undergo reprocessing and reuse. Personal electronics are famous for being retained in a bedroom drawer for as long as a decade – these are sometimes termed "hibernating stocks".

One issue not commonly discussed by circular economy advocates – and brought to the fore by Tom Graedel in the Veolia article – is where the reuse, remanufacturing, and recycling should or can happen. "In a technological world where diverse and complex products are often manufactured in a small number of specialized facilities, sold to users around the world, perhaps later resold or re-leased, and eventually discarded, product complexity and recycling technology cannot be assumed to exist everywhere in order to enable local remanufacturing and reuse. Ideally, one would capture the end-of-life products once they are obsolete but before they become degraded and disassembled and then ensure that they are transported to a facility fully capable of their remanufacture or recycling. For more complex products there will likely be few such facilities in the world, and the challenges of identification, transportation, and economics quickly become daunting."

13. TRADE CHALLENGES

The transition towards a more resource efficient and circular economy is taking place in an increasingly globalized economy. The linkages with international trade are crucial, through global value chains, as well as trade in second-hand goods, end-of-life products, secondary materials and waste. In spite of the importance of trade and trade regimes, existing research on these issues is limited. Policy action so far in most countries give priority to achieving circular material flows at the domestic level, yet international trade occurs at various levels along the product value chain. The challenges are many and varied, ranging from environmental standards, design criteria, fees and charges to the transboundary movements of waste and residue materials.

Supply chains of manufacturing industries have become global in last few decades. Products manufactured in developing nations like India and China are being sent to developed nations for consumption in higher volumes. Many low-income countries earn their main export revenues through trade in commodities. When industrialized countries – so far mainly the EU – start pursuing resource efficiency and circular material loops, it is by many Southern countries interpreted as a threat to their economies. Yet, as is clear from any serious global analysis, it should be in everybody's interest – at least over the long term – to transform today's utterly wasteful production and consumption system towards greater efficiency and effectiveness.

In a report by Jakhar, S. et al. 2018[40] the point is made that industrialized countries have the regulatory policies, technological knowhow and modern infrastructure to adopt circular supply chain models. Their counterpart is trailing in these aspects. In literature, limited research work has been performed on identifying the challenges of implementing circular supply chain management in developing nations and their contextual association.

The structural shift in European economies – keeping the value of products in the economy for longer and increasing the use of secondary raw materials, will naturally influence trade flows on many primary raw materials and will reduce imports to Europe. For other materials, however, such as particular metals, trade is likely to increase. The export of raw materials still plays a central role for many low-income countries and decline in exports may negatively impact their economic development. This being said, lessening the export of raw materials may generate opportunities to grow domestic markets in the developing economies, as the development of value-added processing is encouraged.

The need to look beyond domestic and/or EU borders was made obvious a few years ago when first China and then several other Asian countries banned waste imports for recycling. While such imports had been seen by many Asian countries as an economic opportunity, the associated health and pollution problems became increasingly difficult. This incident shows in a nutshell that a transition to a Circular Economy in the EU will have important implications for the rest of the world.

The EU has presently around 80 Free-Trade Agreements (FTAs) in place. While all these agreements include Sustainability Impact Assessments and various environmental safeguards – and make reference to resource use and waste management – the circular economy is rarely referred to.

Without any doubt there are ample opportunities to integrate aspects of the circular economy into FTA's in the future, both in general terms but, as well, with regard to specific sectors – like building and construction, electronics, textiles, vehicles and batteries and plastics. Of particular importance will be the harmonization of waste standards, with an emphasis of information regarding hazardous substances. The same goes for the harmonization of the rules of end-of-waste, i.e. to bring clarity of when waste becomes a secondary raw material.

Part of the challenge will be to try to limit and reduce illegal trade in waste, notably hazardous waste. Although legislation exists in the EU that mandates collection and recycling of e-waste, for example, we know that major parts are either exported, recycled through informal e-waste processing or simply discarded in waste bins. It often involves toxic emissions and dumping of waste acid without proper treatment which can lead to serious environmental and health consequences.

Trade in secondary raw materials will be an important part of a transition to a circular economy. Just like natural resources are unequally distributed geographically the same can be said about secondary raw materials as well. What is largely lacking, however, are internationally accepted quality standards for such materials. The European Green Deal, however, has helped to change the preconditions, not least for the waste management industry.

"Through constantly improved recycling technologies, more and more and especially high-quality secondary raw materials are being obtained" says Brigitte Reich, managing director of SECONTRADE[41], a company committed to recycling for years. "It is important that such materials arrive where they can be reused in the manufacture of new products. After all, the European Green Deal plans to increase the binding specification and quality standards of the proportion of recycled materials in new products (e. g. electrical appliances, batteries, building materials, etc.). This should further increase market demand for secondary raw materials and close the currently still prevailing recycling gap."

Improving the governance of trade in secondary materials goes beyond plastics. In December 2020, the WTO formed a working group on trade and environmental sustainability that is supported by over 50 members. It seeks to strengthen discussions around topics such as climate change, the circular economy and biodiversity protection in the run-up to the 12th WTO ministerial meeting scheduled for late 2021. It is to be hoped that this WTO initiative will produce quick results. Previous attempts to reconcile trade and environment objectives have most often led to nothing.

14. RESOURCE EFFICIENCY AND SOCIAL WELFARE

Maximizing resource efficiency gains for society as a whole cannot be seen in isolation. It must be linked to and primarily concerned with how well an economy can provide jobs and other forms of societal welfare gains. This area has received relatively little attention in academic studies and policy reviews thus far, even though many organizations recognize the key role a circular economy can play in the creation of high skilled jobs and social development. New Zealand is aiming at creating a "wellbeing economy", basing their national policy framework on the OECD framework for measuring wellbeing and progress. Zero Waste Scotland says that "there is a strong case" for including a balance of "employment, mental health and social cohesion" as elements of a sustainable economy.[42]

Companies facing choices between becoming more capital or labor intensive will analyze carefully the relative financial or market costs between labor and capital (the actual costs and relative prices they face). In both cases these costs are more or less distorted from a societal point of view. The economic costs for society of using natural capital are most often undervalued – on top of it often heavily subsidized – and no account is made for its depreciation. Furthermore, natural capital is also embedded in the usage of built capital (minerals, water, energy etc.), and that usage of natural resources and ecosystem services is most often underappreciated, often resulting in both misuse and over-use.

Labor is usually heavily taxed and limited account is taken of the positive externalities associated with employment. Under-usage of labor, i. e. unemployment, is actually a cost to society, as unemployment benefits will have to be paid out. Moreover, the person in question would rather work; by not working he or she is losing competence, human capital, making both the person and society worse off. There is also usually a social cost involved as unemployment very often is related to health issues and social problems like exclusion, not only affecting the unemployed person, but his/her family and even the wider community.

15. TECHNOLOGY REVOLUTION – HOW CAN IT HELP?

More digital data is being generated than ever before. Numerous digitally-enabled solutions are used to generate and collect new data, including for specific purposes such as a circular economy. For this data to be turned into information and gain value, it must be managed – that is, mined, systematized, processed and shared.

A recent discussion paper by the European Policy Centre (EPC)[43] – highlight the opportunities offered by disruptive technologies, notably digitalization. Data and digitally-enabled solutions like digital platforms, smart devices, artificial intelligence, the Internet of Things and blockchain are already contributing to the circular economy. They are used inter alia to improve resource efficiency, design, production, consumption, reuse, repair, remanufacturing, recycling and the overall waste management. They are also instrumental for the development of new business models, such as the sharing economy, products as services, smart mobility, etc.

Geospatial information is another sector where digital solutions can lead to increased support for the circular economy. When combined with asset tagging, eventually enabled and accelerated by smart devices, the above can provide visibility on the flow of materials, components, products and people, helping to identify optimal mobility routes, energy demand peaks and troughs, congestion and waste generation.

The EPC paper makes clear, however, that digitalization will not automatically lead to greater sustainability. In fact, there is a risk that if it is not guided well, it will result in unwanted rebound effects, such as an overdrive of a linear 'take-make-dispose' economy, and increase in greenhouse gas emissions."

The warnings are no doubt warranted. An article in Lombardier Odier in April, 2020[44] makes the observation that the digital industry's energy usage is increasing by 4% a year, which runs counter to the objective of the Paris Agreement.

The digital carbon footprint includes telecommunication networks, data centers, terminals (stationary and portable) and Internet of Things (IoT) sensors. Keeping the machines humming and providing redundancy so data and documents remain highly available and don't get lost comes at a high carbon cost — digital devices and back-end infrastructure consume a vast amount of electricity, even if digitalization enables greater energy efficiency in other industries.

The growth in demand for digital technologies is set to drive even greater energy usage. The direct energy footprint of information and communication technology also includes energy for the production and use of computer equipment (which is growing 9% per annum). As a result, the share of the information and communication technology sector in global greenhouse gas (GHGs) has grown from 2.5% in 2013 to 3.7% in 2019.

No doubt, a balance has to be struck between the need to reduce emissions from the technology sector and the opportunities offered by digitally-enabled solutions to boost the transition to a circular economy. They could help enhance connectivity and the sharing of information; make products, processes and services more circular; and empower citizens and consumers to contribute to the transition by increasing their awareness and enabling them to make sustainable choices and co-create knowledge.

In a study by the Digitalization Consultancy Industry in Sweden: "An Innovation Driven Roadmap for Fossil-Free Competitiveness and Global Sustainability"[45], the opportunities to use digital technologies for GHG emissions reductions are discussed. There are, according to the report, three different ways in which digital solutions can help reduce material throughput as well as GHG emissions.

First, existing systems can be optimized. Second, the uptake of sustainable solutions can be accelerated. Third, transformative changes can be achieved. A transformative change occurs when the impacts of digitization at various levels work together, i.e., when novel technical solutions, business models, economic incentives, new legislation, social planning, new financing models and methods for assessment and creating transparency, etc., are brought together.

Studies that mainly look into the optimization of current systems show that digital solutions can contribute to an estimated 20% reduction of global GHG emissions. But the potential for enhancing resource efficiency as well as cutting emissions is considerably larger if the focus would be on the transformative impact of digitization, having the potential to help meet society's needs in entirely new ways.

It seems obvious that many solutions powered by digitalization have great potential to both enhance material and energy efficiency and enable the reduction of GHG emissions. The EPC paper referred to above makes the point that Europe is currently engaged in two major transitions: "the creation of a more circular economy and the digital revolution." Major efforts are currently being taken by the EU and its Member-States to promote both transitions. "However, these efforts are not aligned."

The recommendation by the EPC is worth repeating. The EU should consider putting in place a policy framework, including economic incentives, aiming at releasing the power of digital technologies as enablers of the circular economy. As emphasized in the EPC paper, the policy framework has to "go beyond the traditional digital and environmental agendas; measures will need to be aligned with climate action and the wider sustainability agenda, and be supported by single market tools, industrial agenda, research and development, and social and consumer policy."

Governance

16. GOVERNANCE IS MULTIFACETED

Businesses cannot create and develop a circular economy on their own. Many stakeholders have important roles to play. Manufacturing companies will need to change their business models, regulatory authorities need to provide the right policy frameworks, science need to focus on technology and value chain innovation for circularity and consumers need to shift their mindset.

Governance remains somewhat of a contested concept. As expressed by Lisa-Maria Glass and Jens Newig[46]: "A common feature across the various definitions of governance is a distinction between government and governance, rejecting a view of the state as monolithic entity and the government as primary and unitary actor responsible for policy-making and implementation. Government can rather be understood as a central component of governance. According to new governance approaches, governance involves a plurality of public and private stakeholders, hybrid practices (administrative systems and quasi-market strategies) and is considered to be multi-jurisdictional, i.e. spanning different institutions, sectors and levels of government."

The question of how to overcome the barriers to a circular economy is multifaceted. The role of politics is central on many levels – global, regional, national and city – but other stakeholders play a crucial role as well, the most important being business organizations, science and technology and civil society. Individual companies can set an example and pave the way for others.

Seen from the perspective of resource efficiency and circular economy, the governance model of today – across the board – is based the linear economy's long history. The focus has been on trying to limit externalities – both pollution, environment degradation and social ills – via regulation and control. This system worked relatively well to protect water, soils and air, at least in the OECD-countries. In most developing countries, however, policies have been lax or non-existing. The reasons for this state of affair are many, and include a lack of institutional capacity, opposition from vested interests and/or the notion being that "addressing poverty is more important than environment protection."

Over time issues of local pollution problems have been overtaken by global challenges like climate change, the decline of vital ecosystems, the pollution of the oceans and biodiversity loss. End of pipe control is not enough, no matter whether we refer to OECD or low-income countries. We need to find the building blocks for a resilient economy focused on wellbeing, sustainable resource use and regenerative development – the aim being a better balance between people, planet and prosperity.

The 2030 Agenda reflects a global consensus that economic, social and environmental aspects of development are interlinked and mutually dependent. Governments all over the world have agreed to work together to meet the Sustainable Development Goals (SDGs). The goals are no doubt ambitious.

The circular economy must be discussed and framed within the context of the SDGs and a truly systemic approach is necessary. The seventeen goals are interconnected and progress towards one target will influence the others. If for instance first-hand priority was given to goal 8 (decent work and economic growth), goals 13 (climate action), 14 (life below water) and 15 (life on land) would suffer badly. Hence, in the words of the Stockholm Environment Institute (SEI), "to deliver on the 2030 Agenda, governments, international organizations, businesses and other actors have to plan efficiently, exploiting the synergies, mitigating the trade-offs and treating the Agenda as an invisible whole."[47]

If the SDGs would be met by 2030, which is the objective, the world would have eradicated poverty, significantly improved health, education and social conditions around the world and obtained harmony between production and consumption systems and the environment. Resource efficiency and circular economy principles would without any doubt be at the core of the implementation. However, adherence to lofty goals is one thing. Meeting the goals in practice is a different matter. Regretfully, there is no governance system at the global level that guarantees that the SDGs in general or the circular economy more specifically are being systematically pursued and implemented. The implementation is up to each and every government and varies greatly.

The UN System is doing its best in terms of follow-up meetings. UN agencies such as UNEP, UNDP, UNICEF, UNCTAD and UNIDO assist member governments in the implementation of the SDGs. The World Bank and the IMF – as well as the regional development banks – are also actively engaged in the efforts to meet the SDGs. But all of them – maybe with the exception of the World Bank – lack the necessary resources and clout to make a real difference. Global governance leaves a lot to be desired.

17. RETHINK ECONOMIC POLICY FRAMEWORKS

The most important barrier to move towards a circular economy is the flawed incentives structure of the economy. This can only be addressed by policy change. Ideally at the international level, but that appears somewhat utopian today. However, recent initiatives in the EU demonstrate that European markets are likely to undergo major changes with regard to resource efficiency and circularity in the near future. Policy measures at EU level will then have to be complemented at the level of Member States. Crucially important, as well, will be for the EU and it's Member-States to prepare for follow-up initiatives at the level of UN, WTO, OECD, G7 and G20 to make sure that the transformation to a CE will be compatible with rules-making at the international level. The European Commission has already made clear that global action is an indispensable component of the Green Deal.

With regard to policy change some of the most important measures would be:

- A tax shift – lowering taxes on labor and increasing taxes on resource use (to account for unaccounted externalities in a linear production system – e.g. carbon emissions).
- Stop subsidizing fossil fuels production and consumption.
- Remove VAT on all reused materials. This would give a boost to reuse and recycling.
- Introduce design criteria across the board, i.e. products should be designed for reuse, refurbishment, remanufacturing and recycling.
- Use Public Procurement proactively in the advancement of CE (Circular Procurement).
- Recognize the importance of Cross-Cutting policy strategies: make material use a priority in climate mitigation and resilience strategies.
- Stimulate skills development – launch innovation programs to promote circularity.
- Explore the feasibility of introducing the Extended Producer Liability across the economy – i.e. moving from products to services. Or in the words of Walter Stahel in his seminal book "The Performance Economy": from selling products to selling performance.[48]
- Introduce a certification scheme for reused and repaired products to improve market conditions.
- Explore the possibilities to redefine the end-of-waste criteria in order to ease possibilities for reuse, repair and refurbishment.
- Introduce mandatory deposits for all short-lived consumer objects to provide incentives to consumers to be actively engaged in recycling and reuse activities.
- Explore policy measures to address the rebound effect. In his seminal work "Factor Five"[49], Ernst von Weizsäcker suggests a sort of "self-accelerating ping-pong" between resource productivity and related prices. Productivity increases would be matched by tax increases so as to make the real cost paid for energy and resource services unchanged over time.
- Recognize the need for Multi-Level policy interventions: In the EU, policy interventions at EU level need to be complemented by national policies with adaptations to local circumstances (the policy and economic starting point will be different for each country).
- Complement today's flow-based metrics such as GDP as a measure of economic progress with measures of a country's stock of assets to account for the restoration and regeneration of natural capital.
- Assist low-income countries to build capacity in issues related to CE.

Milan – NBS for urban regeneration

Source: Oppola (The EU Repository of Nature-Based Solutions)

18. EUROPE TAKES ON A LEAD ROLE

The European Green Deal was launched in 2019 as a response to the increasing climate and biodiversity crises. Striving to be the first climate-neutral continent, the Green Deal is meant to transform the Union into "a modern, resource-efficient and competitive economy, where i) there are no net emissions of GHG emissions by 2050, ii) where economic growth is decoupled from resource use, and iii) no person and no place is left behind."[50] Several of the policy proposals referred to above are likely to be addressed in the implementation of the Green Deal.

Most policy areas are affected by the Green Deal. It will cover issues like biodiversity, food production, clean energy, building and renovation, sustainable mobility, pollution control and climate action.

A cross-cutting issue of crucial importance is the Circular Economy Action Plan[51], presented in March 2020. It includes a Sustainable Products Initiative and will have particular focus on resource intense sectors such as textiles, vehicles and batteries, construction, electronics, plastics and packaging. Legislative proposals are prepared to support a "Right to Repair" and Mandatory Sustainability Standards for Public Procurement. The waste directives will be reviewed as well.

The Sustainable Products Initiative will be of particular importance. This initiative, which will revise the existing Eco-design Directive and propose additional legislative measures as appropriate, aims to make products placed on the EU market more sustainable. "Consumers, the environment and the climate will benefit from products that are more durable, reusable, repairable, recyclable, and energy-efficient. The initiative will also address the presence of harmful chemicals in products such as electronics and IT, textiles, furniture, steel, cement & chemicals."[52]

The Sustainable Products Initiative has been praised by a great number of stakeholders. As an example, the ZOE-Institute for future-fit economies in Germany, made the following comment: "To achieve the bold aim of ensuring that 'sustainable goods, services and business models become the norm' transformative changes are required that tilt the playing field. Rather than a 'race to the bottom of prices' a 'race to the top of sustainability' is needed. Incentives and regulations in the light of the Green Deal can contribute to put an end to the externalization of social and environmental costs by economic actors."

19. THE ROLE OF CITIES

The motives are very strong, indeed, for cities to embrace a circular economy. A circular approach to the way resources are managed will help address urban problems like waste disposal, air and water pollution, traffic congestion, carbon emissions and the like.

Cities have demonstrated high levels of ambition when it comes to climate action and have, indeed, become global governance actors in their own right, e.g. through various alliances and coordinated initiatives. In many parts of the world, action taken by cities have been by far more ambitious than by their national governments, demonstrating their potential to advance climate change mitigation and adaptation. Leading "by example" cities have aspired to raise the ambition of national and international climate governance and put action into practice via a growing number of 'climate change experiments' delivered on the ground. Networks of climate-active cities have emerged and most of these networks have made a point of making the circular economy part of their agenda as well. Organizations like the OECD and the European Commission have played an important role in organizing seminars and workshops highlighting different aspects of circularity and providing policy advice.

Hundreds of cities around the world have adopted circular economy strategies and road maps. City networks have been established to work together, to share best practices, to experiment and to explore different pathways to circularity. Initiatives by C40 Cities, Ellen MacArthur Foundation, Sitra, ICLEI, GEHL, Climate-KIC and many others have inspired cities to get actively engaged in circularity.

Two countries – Finland and the Netherlands – stand out as leaders with regard to the circular economy – both in terms of national strategies but, as well, when it comes to inspiring cities within and beyond their national context. Both countries adopted national road maps/strategies for the circular economy in 2016. The crucial role played by cities was stressed in both strategies and has resulted in cities like Amsterdam, Rotterdam, Utrecht, Helsinki and Turku to take on proactive roles in the transition. Many other cities in Europe come to mind. Cities like Berlin, Copenhagen, Malmö, Maribor, Milan, Madrid and the like have also made serious efforts to adopt policies promoting circularity.

It should be added that many cities may be pursuing circular strategies that were initiated under the label of "green cities" or "sustainable cities" but have over time been relabeled "circular". As already explained the definitions of "circular", "green" as well as "sustainable" are vague. Hence, clear boundaries between the different concepts and approaches do not exist.

A major risk so far concerning many of the efforts undertaken to promote the circular economy in cities is the fragmentation in terms of approach. There are exceptions but, in general, the impression when looking at city landscapes is one of plentiful vertical interventions, most often aiming at single-point solutions. While many of these efforts are worthy and do bring about improvements in material efficiency as well as reductions in pollution levels, such solutions rarely achieve systemic change, i.e. the transformation needed, and will not address climate change at the necessary speed and scale.

Based in particular on the work and experience of Climate-KIC, achieving quick and substantial reductions in GHG emissions will best happen by bringing different actors and systems thinking approaches together and by bridging multiple contexts rather than hoping for solutions generated in silos – i.e. through a systemic approach.[53] This definitely applies to innovation per se but, as well, to the exploration and development of solutions in general.

A "circular city" approach would build on the historic role of cities, noting that cities have the ability to incorporate ecological and social externalities into both business and consumer activities. Cities have the authority to decide on a lot of things related to city planning, energy and material use, infrastructure, building and construction, mobility and transport and waste management:

- Zoning and land-use plans can be adapted for example to assign (fewer) parking lots to new and existing developments, reroute public transport and by earmarking spaces for renewable energy capacity.
- Introducing building efficiency codes and standards; e.g. appliances, equipment, and lighting energy standards and labelling. Requiring building owners to install rainwater collection systems, improve the thermal envelope, or abandon fossil fuels for thermal energy generation are further examples.
- Lead by example: Acting on directly controlled services or assets through public procurement, for example by setting recycling shares for waste management, calling for new wastewater management systems (for example integrating heat recovery), making public transport and public lighting more energy efficient, adopting ambitious carbon neutrality targets for public buildings, public transport, and public lighting.
- Develop financial and non-financial incentives for industry and SMEs to develop circular supply chains by offering dedicated credit lines or other green financial vehicles.
- Working with utilities: decentralized energy generation and the phasing out of fossil fuels consumption will require new business models. Furthermore, energy grids will have to be retrofitted and made "smart" in order to cope with fluctuating renewable energy.
- Finally, but crucially: Engaging and connecting with citizens to explain the "circular city" approach through online and printed material, public discussions and events, and collaborative workshops where citizens are encouraged to provide ideas and engage in open design competitions.

20. CIRCULAR PROCUREMENT

Public procurement concerns a variety of goods and services, such as health or food services and building projects. In Europe, the volume of public procurements account for approximately 14 per cent of gross domestic product. In many developing countries the ratio is even higher. In the EU this translates to annual purchases of an estimated EUR 1,800 billion – made by over 250,000 European public sector actors. The Nordic Countries alone spend more than EUR 170 billion in public procurements every year.

Public procurements can help promote the development and scaling of sustainable products and services. By driving demand for circular products and services, public procurement will help accelerate circular business activities overall. Through responsible procurement, municipalities can serve as examples to others and spur each other towards more sustainable solutions.

Circular procurement can be defined as a process by which public authorities call for works, goods or services that seek to contribute to closed energy and material loops within supply chains, favoring high-quality services rather than the purchasing of products and giving priority to products designed in such a way that their lifetime can be extended. Another important aspect will be the choice of products and services whose negative environmental impacts across the lifecycle are negligible.

For instance, the City of Amsterdam for instance has calculated the material savings and emission reductions that the city could achieve if it were to transition to circular building standards. In the value chain of buildings alone, material savings could be as high as 500,000 tons per year, representing a third of the city's annual material inflow. The enhanced material efficiency would mean a reduction of carbon emissions corresponding to 2.5% of the City's annual emissions.

If cities increase their demands specifically for circular solutions, it naturally becomes more attractive for designers and producers to offer circular products and services. However, procurers often lack the knowledge of how to incorporate relevant circular requirements for suppliers and how to design tender documents to promote circularity. In addition, procurers often lack knowledge of both the economic and the environmental benefits associated with circular solutions. The same is often true among market players like designers, manufacturers and retailers.

To increase the awareness among public procurers about the potentials of circular solutions – both with regard to cost savings, security of supply, job opportunities and environmental as well as climate benefits – a proposal would be to organize crash course on Circular Procurement for public procurement professionals within EU Member-States.

21. PRIORITY TO GLOBAL ACTION

The European Union makes clear in its Action Plan for the Circular Economy that it cannot deliver the goals of the Green Deal alone. International cooperation is indispensable and the European Commission "has confirmed that it will lead the way to a circular economy at the global level and use its influence, expertise and financial resources to implement the 2030 Agenda for Sustainable Development in the EU and beyond."[54] The actions under consideration are wide-ranging:

- Lead efforts at the international level to reach a global agreement on plastics in line with the objectives of the European Plastics Strategy.
- Propose a Global Alliance on Circular Economy and Resource Efficiency to identify knowledge and governance gaps in advancing a global circular economy and take forward partnership initiatives, including major economies.
- Explore the feasibility of defining a Safe Operating Space for natural resource use.
- Consider initiating discussions on an international agreement on the management of natural resources – something being considered in the work of the International Resource Panel.
- Build a stronger partnership with Africa to maximize the benefits of the green transition and the circular economy and continue promoting the circular economy in the accession process with the Western Balkans.
- Continue promoting the circular economy in the context of bilateral, regional and multilateral policy dialogues, for environmental agreements, as well as of pre-accession assistance and neighborhood, development and international cooperation programs, including the International Platform on Sustainable Finance.
- Ensure that Free Trade Agreements reflect the enhanced objectives of the circular economy.
- Step up outreach activities, including through the European Green Deal diplomacy and the Circular Economy Missions, and work with EU Member States to enhance coordination and join efforts for a global circular economy.

22. THE NEED FOR NEW PRODUCTION AND BUSINESS MODELS

The European Green Deal and the Sustainable Products Initiative will significantly change the business environment. While circular economy policies in the EU so far have been tinkering around the waste directives, the Green Deal and the Circular Economy Action Plan will aim at an economy-wide transition which gets to the heart of industrial production – from design to manufacturing to consumption, repair, reuse, recycling and bringing resources back into the economy. This is in stark contrast to today's linear production model.

The linear economy is based on the manufacture of short-lived products, planned obsolescence, economies of scale, and the consequent growing consumer demand for new products. The circular economy, on the other hand, is based on the consideration of the negative externalities that the consumption of resources originates. The application of circularity in the supply chain has two main objectives. One is based on the extension of the product life, the other one aims at increasing the amount of remanufacturing, repair, refurbishment, and recycling cycles.

There is only one possible conclusion to be drawn from this: production and business models have to change. Disruption is inevitable. Businesses that do not adapt to the principles of circularity will have a difficult future. This being said, the circular economy cannot be totally separated from the current linear one. The only way forward is a step-by-step approach.

One business model that is rapidly gaining ground is Products as a Service (PaaS). Leasing products instead of selling them has benefits both for businesses and consumers. But for that to happen the finance model has to change. PaaS means that revenues will be generated over time and not once a product is ready to be brought on the market. Investments will be needed upfront, while returns are uncertain. Such business models are not yet well-known to financing institutions and will require novel banking models as well as legislative support. As of today, no government has made specific attempts to support the development of new ownership models. This, no doubt, has to change. A move from products to services – whether in the form of leasing a product or buying of performance – is an essential part of moving from a linear to a circular economy.

Given the urgency with regard to climate change and ecosystem decline, a natural question emerges: Where to start? The answer is quite simple. Any attempt to promote circularity in all its aspects should give priority to areas in the economy where energy and material throughput is particularly large, such as: Energy, Construction and Building, Batteries and Vehicles, Electronics, Textiles, Plastics, Packaging and Food.

23. THE ROLE OF THE BUSINESS COMMUNITY

The business community is to a large extent dependent on policy-makers to be able to make the necessary shift to a circular economy. The current economic system is geared towards the demand of the linear economy. Circular entrepreneurship is thus at a disadvantage. Another hurdle is the need to reconsider value chains. Production and consumption often take place in different countries with inputs from multiple suppliers around the world. In a circular economy, supply chains will have to be reorganized so that information and materials flow in both directions to facilitate reuse, refurbishment and recycling. When customers acquire products, forward logistics can be organized to benefit from economies of scale. But taking products back from consumers may turn out to be a particularly difficult and cost-prohibitive problem.

In spite of the prevailing uncertainties in relation to a move towards a circular economy, important segments of the business community have been among the main proponents of leaving behind the linear production model. Corporations like IKEA, H&M, Unilever, Philips, Renault, Tarkett and Solvay have all been in the frontline with regard to the circular transition. Just as important has been a great number of medium-size companies and start-ups. The Finnish Innovation Fund Sitra – a pioneer when it comes to the circular economy – has compiled a list of altogether 39 circular inspiring solutions from all over the world.[55] With examples from six continents, these solutions range from circular fashion to magnetic ink and from upcycling solar panel waste to podcasts and games demonstrating a circular economy in practice.

IKEA is worthy of a special comment. Given its traditional business model the ongoing transformation is remarkable. In its new People & Planet Positive Strategy the company sets out a number of ambitious goals. In its Sustainability Report[56] it says: "The ambition for 2030 is to transform into a circular and climate-positive business. We will decouple material use from our growth and reduce more GHG emissions than the IKEA value chain emits, to contribute to limiting the global temperature increase to 1,5° C by the end of the Century."

Altogether nine design principles have been adopted, encompassing everything from designing for renewable and recycled materials, standardization, care (involving customers), repair, disassembly and reassembly, adaptability to remanufacturing and recyclability.

The company goals for 2030 are truly far-reaching:

- Designing every product from the very beginning to be reused, refurbished, remanufactured and eventually recycled, by applying our circular product design principles during the product development process.
- Aiming to only use renewable or recycled materials, by adapting and finding new sources and developing new materials.
- Finding circular solutions for existing and new customers to acquire, care for and pass on products.
- Taking the lead and joining forces with others through advocacy, collaboration, and business partnerships.

Philips is of particular interest since it has been one of the pioneers with regard to PaaS, i.e. turning products into services – or in the words of Walter Stahel "embracing the Performance Economy." Thinking of 'product as a service' means to embrace the complexity of production, consumption, environmental and social issues as well as market dynamics. Philips' 'light as a service' is a good example. It all started with Philips stopping selling lighting equipment to big customers and instead offering a lease. When developing this business innovation, Philips realized that the required electric service provision was not initially included in their offer to potential clients. By including energy as an aspect of their business model (leasing and maintaining lighting), Philips saw a chance to make more profit through energy efficiency and producing sustainable energy as a service.

Keeping products and materials in use as long as possible is one of the key premises of the circular economy. In slowing material flows, for example through repair, product life spans are extended, and the creation of new goods is postponed. Consumers, or users, need to support slow loops by treating their products carefully, cleaning them regularly and repairing them if necessary. A precondition for this is the development of a strong emotional relationship with the product that guarantees attachment and care. However, product care and attachment are hindered if businesses plan for obsolescence by artificially shortening product life spans or constantly introducing new models and products that urge consumers to replace old ones for the sake of following trends.

Instead, businesses could raise awareness through communications that boost the appeal of second-hand goods or actively shift from quick product releases to upgrades. The design of 'hassle-free' upgrades, for example, could reduce high product turnover rates and encourage consumers not to always go for the brand–new option. To increase consumer commitment to products, businesses could set up repair spots in their retail shops and to improve understanding, they could offer circular training. Outdoor retailer Patagonia, for example, partnered with iFixit to explain to users how they can repair their garments.[57]

Businesses can promote action and commitment by implementing online marketplaces or take back schemes that make the resale of used products as effortless as possible. On the policy level, material taxes — such as higher carbon pricing — will increase the price of virgin and carbon-intensive products, making secondary material-based goods more attractive for both businesses and consumers. In terms of recycling, private or public actors need to ensure that separated waste materials are collected and processed properly. They can further raise awareness of correct disposal practices through education and campaigns, such as a campaign launched recently by the municipality of Panaji, Goa's capital.[58] The campaign invites citizens and tourists to exchange dry waste such as PET bottles or cardboard through a barter system against daily use items like groceries.

The World Economic Forum (WEF) has taken on a proactive role in the promotion of circularity. WEF's Circular Economy Initiative brings together private, public, civil society and expert stakeholders to accelerate the circular economy transition by advancing four key pillars or work:

- The Platform for Accelerating the Circular Economy (PACE) was launched in 2017 as a platform for public and private sector leaders to take commitments and accelerate collective action towards the Circular Economy. The PACE community consists of 80 public, private, international and civil society executive leaders and over 200 members championing 18 projects across the globe.

- Transforming Material Value Chains. The WEF hosts a series of major value chain action partnerships that work with partners along global material value chains to advance circular models – from plastics, electronics, batteries, cars, to fashion/ textiles.

- Scaling Innovation and the 4IR. **Scale360°** is an emerging initiative which aims to mobilize action among innovators, governments, civil society, and private sector stakeholders to grow the ecosystem for circular 4IR technology innovation (Fourth Industrial Revolution) — with a focus on plastics, electronics, food and fashion/textiles. This work builds on a **report** launched in 2019 to explore the potential of the 4IR to fast-track the circular economy.[59]

- The Circular Economy for Net-Zero Industry Transition. This initiative is designed to raise the decarbonization ambition for harder-to-abate materials (steel, cement, chemicals, and aluminum) and help those industries realize a 1.5° pathway by catalyzing scalable circular economy solutions. The initiative convenes key stakeholders from the material supply side and key demand-side industries around dedicated Action Tracks, with the aim to facilitate industry collaborations along value chains on concrete circular economy solutions.

Initiatives like the ones taken by WEF will have great importance to help companies prepare for a transformation to a circular economy. One challenge, though, will be how to involve small– and medium-sized companies (SMEs) in the process. It is one thing for large companies to engage in sustainability-related matters but quite another for small and medium-sized companies. Here governments have to help put in place support schemes, preferably in close cooperation with business organizations.

Concluding remarks

The move towards a circular economy seems unstoppable. While nothing is fully circular, the benefits of moving from a Linear to a Circular Production Model are obvious both from purely economic as well as environmental and social points of view. The reductions in terms of carbon emissions, as well as other forms of pollution are striking. Against this backdrop is it somewhat of a mystery that societies have done so little until recently to promote resource efficiency in general and circularity more specifically. It is important, though, to remind the reader of the rebound effects. Neither resource efficiency in itself, nor circularity, will be sufficient to bring about "absolute decoupling".

While the main motive behind the move towards a CE is related to the effects on the environment – reducing the risk of resource depletion, lowering pollution and curbing GHG emissions – there are several strong co-benefits. The most obvious is the values to be captured and money saved. The waste in today's linear model is huge. In addition, there are a multitude of social objectives to be harnessed. Net employment will, according to a number of studies, be positive. Entrepreneurial activity is likely to flourish in areas like repair, maintenance, refurbishment and remanufacturing, in the sharing economy and in turning products into services. Social cohesion is likely to benefit. An economy built increasingly on the offering of services rather than products and on the concept of a sharing economy will result in a large number of interactions between citizens that are likely to enhance quality of life and, more specifically, the level of trust.

Of crucial importance in the years ahead will be the policies enacted at both global, EU, national and city levels. The linear production model is dominating today because of massive market failures – the negative externalities in relation to both the extraction, production and use of all kinds of natural resources are not reflected in market prices. Business models are built upon high throughput of energy and materials. The sourcing of virgin materials most often is less expensive than secondary materials. Furthermore, most products are not designed for reuse, refurbishment or recycling.

There is a need for more explicit and focused intergovernmental discussions about governance. Key issues will be how to align global supply chains with the objectives of a circular economy.

Finally, the importance of definitions must be stressed. The fact that the circular economy is mostly looked upon as a metaphor for a number of parallel features and concepts may not be seen as a problem at a glance. But it is. The interpretations range from narrow ones, focusing primarily on recycling, to very broad ones focusing on a thorough reform of the economy in support of ecological and social objectives. There is a strong need to narrow down the main features of a circular economy, not least to make it possible for regions, nations and cities as well as companies to benchmark against each other and, in particular, to measure progress.

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Global Challenges Foundation
Grev Turegatan 30, 114 38 Stockholm, Sweden
+46 (0) 709 54 74 27 | www.globalchallenges.org