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From 'greening' the present system to real transformation – transforming resource use for human wellbeing and planetary stability

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Summary

- **Introduction:** Learning from *The Limits to Growth* 50 years later: natural resource use is driving the world's environmental challenges, and will drastically increase without action.
- **Earth4All** follows up on *The Limits to Growth* by recommending five key turnarounds for planetary stability and human wellbeing in the 21st century.
- **Doing more with less:** the world must learn to deliver human wellbeing without transgressing planetary boundaries.
- **Go beyond 'greening' our current system:** unlock system solutions through targeting resource use to human needs (in addition to 'greening' energy and material supply).
- **Human needs can be provided for much more intelligently:** optimising material-intensive provisioning systems should be the first step towards minimising environmental impacts and social disadvantages.
- **Overlooking resource management and circular economy solutions:** current climate and biodiversity plans could be more effective by incorporating science-based resource solutions.
- **A better vision of resource-sustainable economic ecosystems:** we should optimise human needs, not traditional economic success, and update metrics accordingly.
- **Developed vs developing countries:** almost all countries must be looked on as "developing", and all need to change resource-use trajectories. Low- and middle-income countries have huge opportunities to leapfrog current high-income countries, and high-income countries have a historic responsibility to lower their huge resource use and its impacts.
- **Better global governance of material flows and resource use:** we need dedicated, science-based mechanisms for global resource governance. Such mechanisms will enable shifts towards human needs approaches and sustainable economic systems.
- **Conclusion:** for "the future we want" the world has a collective responsibility to build a "new normal" based on wellbeing-focused ethics and values.

Introduction

This year marks 50 years since the publication of The Club of Rome report *The Limits to Growth*. The report was a sharp critique of the notion of material growth as eternal. The report predicted increasing problems as a consequence of rapidly growing populations and economies. The forecast then was that the world economy would face the risk of a collapse within 50–100 years as a result of resource depletion, increasing volumes of waste and pollution, and the degradation of vital ecosystems.

The *Limits* report was heavily criticised, not least by conventional economists. According to them, a combination of innovations and technology fixes would solve emerging problems along the way. Alternatively, it was claimed, there is always the possibility of substitution.

However, while it is possible to exchange different materials for one another – such as wood for steel or plastic – the possibilities of substituting nature's services are radically different. Regardless of how much money is being mobilised, it cannot compensate for extinct species, the variety of ecosystem services that humans benefit from or a stable climate system. And with regard to the notion that financial capital would be able to substitute for natural capital, investing in even the most modern fishing vessel cannot catch fish in an empty sea.

In the 50 years that have passed since The Club of Rome report to The Limits to Growth, resource use in the world has more than tripled (Global Resources Outlook, 2019).

In the 50 years that have passed since The Club of Rome report, resource use in the world has more than tripled (Global Resources Outlook(GRO), 2019). The benefits have been obvious, in the form of vast improvements in the standard of living of billions of people around the world, first and foremost in the industrialised countries. But the downsides in the form of resource depletion and overuse are becoming all too evident. Increasing degradation of land and marine ecosystems, accumulation of waste and the rapid growth of greenhouse gases (GHGs) in our atmosphere have turned into global emergencies. Six of the planetary boundaries have been overshot: climate change, biodiversity loss, nitrogen and phosphorous loading, freshwater change and land-system change. If nothing radical is done, resource use will at least double again by 2060 (GRO, 2019). The consequences for the climate, vital ecosystems and biodiversity will be devastating.

Earth4All

There have been a number of follow-up reports over the years to the *Limits* report. The most recent one is *Earth for All: A Survival Guide for Humanity*, compiled by the project Earth4All and launched in September 2022. *Earth for All* is the result of joint efforts by researchers from the Potsdam Institute, Stockholm Resilience Centre, Norwegian Business School and The Club of Rome, and a great number of alternative economists and thought leaders from around the world, working together in the Transformational Economics Commission (at the invitation of The Club of Rome).

In *Earth for All*, different scenarios are explored to understand what it will take to bounce back strongly from the pandemic in order to eliminate poverty, reduce inequality, address both climate change and the eco-system crises effectively and overall reduce the risk of Earth system shocks. Five key pathways, or "turnarounds", are suggested to support the necessary transformation of our economies to meet the Sustainable Development Goals and allow wellbeing for all within the planetary boundaries. In summary the turnarounds are aiming at:

1. ***Energy transformation*** **to halve emissions of GHGs every decade: from fossil fuels and energy wastefulness to clean and efficient energy designs that run on renewable power.**
2. ***Food-system transformation*** **to become nature positive by 2030: from extensive, extractive agriculture to low red-meat diets and regenerative agriculture.**
3. ***Widespread adoption of new economic models:*** **from debt and poverty traps in low-income areas to instigating fair and green growth models.**
4. ***Reduced inequality*** **to achieve a goal of ensuring the wealthiest 10% of the global population have less than 40% of the global wealth: from inequality to inclusiveness, that is, lift the bottom 40% paid by taxing extraction of the commons.**
5. ***Empower women*** **and invest in education for all: from discrimination to education and empowerment of women everywhere.**

These turnarounds need to be underpinned by a number of cross-cutting policies. The most important one will be a radically different approach from those used hitherto regarding the management of natural resources. This is due to the fact that extraction and processing of materials (everything extracted from the earth) is responsible for all aspects of the triple planetary crisis of climate change, biodiversity loss, and pollution and waste. With regard to global climate change, 50% is caused by the refinery of fossil fuel products such as petrol or plastics, the extraction of biomass in agriculture and forestry, and the production of steel and cement. The remaining 50% is caused by economic activity downstream of extraction and processing, and by households (GRO, 2019).

Most of these emissions are caused by high energy use in extraction and processing, while some are caused by chemical reactions. Therefore, even if energy use is at the core of carbon emission, we will not reach the goal of near-zero emissions unless we prioritise basic material use as well – everything from the possibilities of substitution (e.g. building with wood) to technology leapfrogging (e.g. using hydrogen instead of coal in steel-making) and meeting human needs in radically different ways.

Apart from the significant contribution to climate change, the extraction and processing of materials also cause 90% of global land-related biodiversity loss, mainly due to biomass production in agriculture, timber production or ocean resource use. Natural resource industries also cause one third of global air pollution, as well as water and land pollution, for example in coal or steel industries. Biodiversity hotspots are also threatened by localised specific pressures, such as mining.

As we mentioned earlier, global natural resource extraction has tripled since 1970. It is now at over 90 billion tonnes per year. The 2021 report by the Organisation for Economic Co-operation and Development (OECD) for the G20 reveals that G20 countries use over 70% of those resources.

The current market-economy-based policy frameworks that rule the world are incapable of both securing a fair distribution of resources and preventing further serious degradation of Earth's life-supporting systems.

Contrary to wide public perception, we have not managed to turn the alarming trends around. Global resource productivity, meaning the gross domestic product (GDP) produced per tonne of resource, has not improved since the year 2000. As the OECD report reveals, the consumption productivity in G20 countries – contrary to the belief among conventional economists – has also improved very little. High-income countries consume more than 10 times more of our planet's finite resources per capita than the lowest-income countries. Even with the tripling of natural resource use in the world since the 1970s, we still have a situation where 3–4 billion people live in poverty. This shows that the current market-economy-based policy frameworks that rule the world are incapable of both securing a fair distribution of resources and preventing further serious degradation of Earth's life-supporting systems.

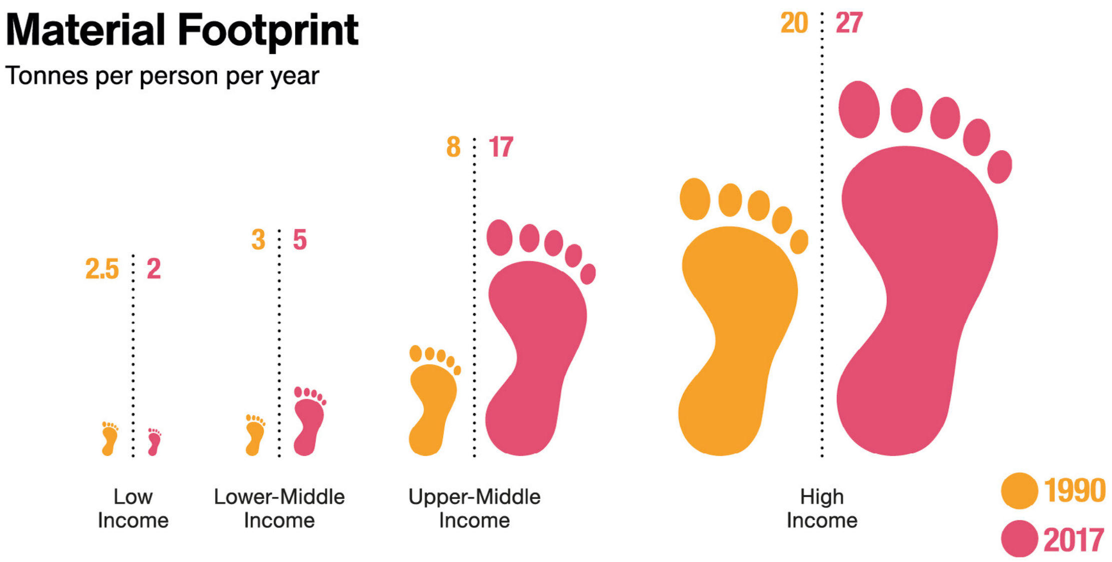

Figure 1. Material footprint by income group (Global Resources Outlook, 2019).

According to the United Nations' International Resource Panel (IRP), if we don't take transformative measures, material use will double again by 2060 (relative to 2015). Not only will the total amount of materials needed surpass planetary boundaries, due to their emissions in production and waste in use, but particular pressures will result from the spike in demand for certain metals and minerals for use with digital technology and for solar and wind energy, as well as for batteries or cleaner fuels such as hydrogen. Natural resource depletion is already alarming, and it is likely to affect vulnerable communities most severely. For example, roughly 39 million people depend on capture fisheries (i.e. catching wild fish rather than farming them in aquaculture systems) for their livelihoods, and the proportion of fish stocks extracted unsustainably has risen to nearly 35%. On land, increasingly intensive farming practices are accelerating soil destruction: if current rates of loss continue, the world's topsoil could become unproductive within 60 years (Maximillian et al., 2019).

Doing more with less

The bitter truth is that the use of natural resources in general cannot continue to increase decade after decade. It must level off. Otherwise, there is no possibility of managing the wellbeing of 9–10 billion people in the long run within the planetary boundaries. The challenge is that the levelling off must take place at the same time as both energy and material use in low-income countries will – and have to – increase greatly. That is the only chance to acquire a decent standard of living.[1]

A critical question, therefore, will be to try to define the level of biophysical resource use that will meet the basic needs of all people on the planet without exceeding critical planetary boundaries. There is overshoot already – first and foremost in terms of GHG emissions – so the challenge will be to progressively modify overall natural resource use (through reductions and/or substitution) to make sure further overstepping of the planetary boundaries can be avoided.

Resource efficiency is part of the answer – both in terms of extended product life, reuse and recycling. But it is no panacea. Efficiency improvements happen all the time, but most of the gains have so far been cancelled out by the sheer increases in the volumes of consumption that take place when productivity increases free up resources. This means that technology advancements alone will not lead to the decoupling of production and consumption from environmental harms at the scale needed (Jackson, 2017). As expressed by Lewis Akenji: "Efficiency is blind to the limits of consumption and emissions – and so we can keep improving our efficiency even as we transgress the planetary boundaries."

The pathway to consider would be:

1. **vastly increased efficiency by which natural resources are used, coupled with substitution; combined with**
2. **a redistribution of wealth and hence access to resources between rich and poor countries and, indeed, rich and poor people; complemented by**
3. **policy measures that will address the rebound effects that we know will materialise when resource use will become more productive.**

The long-term goal has to be an economy where sufficiency is at the core. One important step in that direction will be the recognition that the present way of providing for human needs leaves a lot to be desired. The provisioning systems (resource-intensive systems delivering human needs) of today are most often wasteful – not only with regard to the way natural resources are used but also from a purely economic perspective. The main purpose of this article is to highlight the great potential to change these provisioning systems, to deliver human wellbeing while decoupling from resource use and its environmental impacts.

To make the Earth4All turnarounds real we must go beyond 'greening' our present system

Given that most of the impacts related to materials occur in the early stages of the production chain – for example, in mining, heavy industry and agriculture – a common strategy is to focus on the decarbonisation of the energy in production or on better methods of producing biomass. While the clean-up of production processes is certainly crucial, it is insufficient and can be harmful when pursued in isolation.

> Tackling the drivers of excessive resource consumption and focusing systems on what end-users fundamentally need will contribute to all five of Earth4All's proposed turnarounds.

The focus on energy production in most climate-mitigation strategies until now may be understandable: fossil fuels still make up more than 80% of the energy mix globally. However, undertaking the energy transition without a change in the drivers of excessive energy and material demand will never be enough to stay within planetary boundaries, and will incur massive trade-offs.

Tackling the drivers of excessive resource consumption and focusing systems on what end-users fundamentally need will contribute to all five of Earth4All's proposed turnarounds – increasing the chances over time of delivering human wellbeing within the planetary boundaries. We know that, in addition to driving ever-increasing environmental impacts, overconsumption of natural resources brings negative consequences for wellbeing: health impacts of food overconsumption are well known. Furthermore, mental health issues are prevalent in several high-consuming countries. As Earth4All's turnarounds recognise, inequality reduction is crucial for a sustainable future: those in the wealthiest countries are disproportionately responsible for the world's environmental impacts (Wiedmann et al., 2020).

Box 1. What are provisioning systems?

The current economic model maximises consumption, rather than optimising human and planetary health. Provisioning systems deliver essential societal needs: our homes, our food, the methods by which we get from A to B. By focusing our economies on optimising the systems that deliver our needs, we can achieve human health and wellbeing, while reducing the harmful environmental impacts that can lead to planetary boundaries being transgressed.

SYSTEMIQ and The Club of Rome's recent publication, *A System Change Compass*, identifies four major systems of resource use that deliver our everyday needs: nutrition (healthy food), mobility, housing (built environment) and consumer goods (SYSTEMIQ and The Club of Rome, 2020).

Looking at the economy through the lens of societal needs enables us to envisage a new kind of economic model: one that drives the development of certain activities over others and stimulates positive sustainable investment. Looking beyond traditional sectoral silos also enables an integrated systems approach, avoiding trade-offs and maximising co-benefits.

For example, focusing on greening the automotive sector by mass-producing electric cars will neither address the environmental impacts embedded in vehicle manufacture nor the wellbeing cost of hours spent in dense traffic. Instead, a choice could be made to focus on an integrated mobility system that minimises journey times with green communal options.

So why do we need resource efficiency in provisioning systems, in addition to greening their production processes and energy supply?

Trying to decarbonise current production and consumption patterns is a bit like trying to lose weight by increasing exercise while also eating more sugary snacks: it is inherently inefficient and costly.

Let us start with a metaphor. Trying to decarbonise current production and consumption patterns is a bit like trying to lose weight by increasing exercise while also eating more sugary snacks: it is inherently inefficient and costly, and it will have many additional impacts on health and quality of life. Staying with the metaphor, what we need to do instead is replace the sugar consumption with more nutritious, healthy eating patterns, in combination with mitigating some calories through healthy exercise – all the while discovering great new flavour options and improved joint and muscle function.

To explain this logic for a key resource and provisioning system, let us look at a steel-intensive value chain. There is much current debate about decarbonising heavy industry such as steel production, with solutions including energy-efficient furnaces, the use of low-carbon hydrogen fuel, electrolysis, carbon capture and storage, and increased use of scrap metal instead of virgin iron. There is also a lot of debate about decarbonising private transport, and most debates focus on electrifying vehicles.

Several challenges come with decarbonising these heavy industries. For example, the production of low-carbon hydrogen requires a lot of solar and wind power, which in turn need metals for their technology. The technology for carbon capture is only in its infancy and is also material- and energy-intensive. Further, the electrification of a large and rising number of private vehicles will result in increased demand for batteries, which also need a lot of rare metals and pose an additional toxicity and waste challenge. Moreover, supposedly cleaner vehicles might boost demand for vehicles, which will increase the demand for batteries, as well as other car materials, such as steel. Also, we might still sit in traffic for hours and convert open spaces into infrastructure such as additional parking and roads, when people increasingly want access to nature and more convenient transport options instead.

No one actually needs steel, per se. What people need is simple: the mobility to get from A to B to see their friends, do their jobs and access all sorts of services – the functions that steel products enable. We need to optimise that mobility by (a) planning cities that are fairer, more compact and service-diverse to reduce the need for long trips; (b) offering the best cycling and walking options; and (c) offering public transport and pooled mobility options. At the same time, we need to use the modules and materials of that system in a more circular manner. Such systemic optimisation would save not only great amounts of steel, as well as other materials, but also large amounts of fuel and its related air pollution. Systemic improvement would improve quality of life for all.

The IRP calculated that, across G7 countries only, if 25% of journeys were shared rides the life-cycle emissions of the G7 private vehicle fleet could be reduced by up to 20% by 2050. Given that the average European car is parked 90–95% of the time, often on scarce inner-city land, benefits could extend far beyond the mobility system to urban greening and improved ecosystem service delivery. Combining this with circular material measures such as extended product life, better repair, remanufacturing and recycling, would increase the emissions savings potential to 40%. Furthermore, the supply challenges to electric car batteries can only be managed by a massive increase in utilisation per battery, meaning per vehicle, through prioritisation of buses and shared cars.

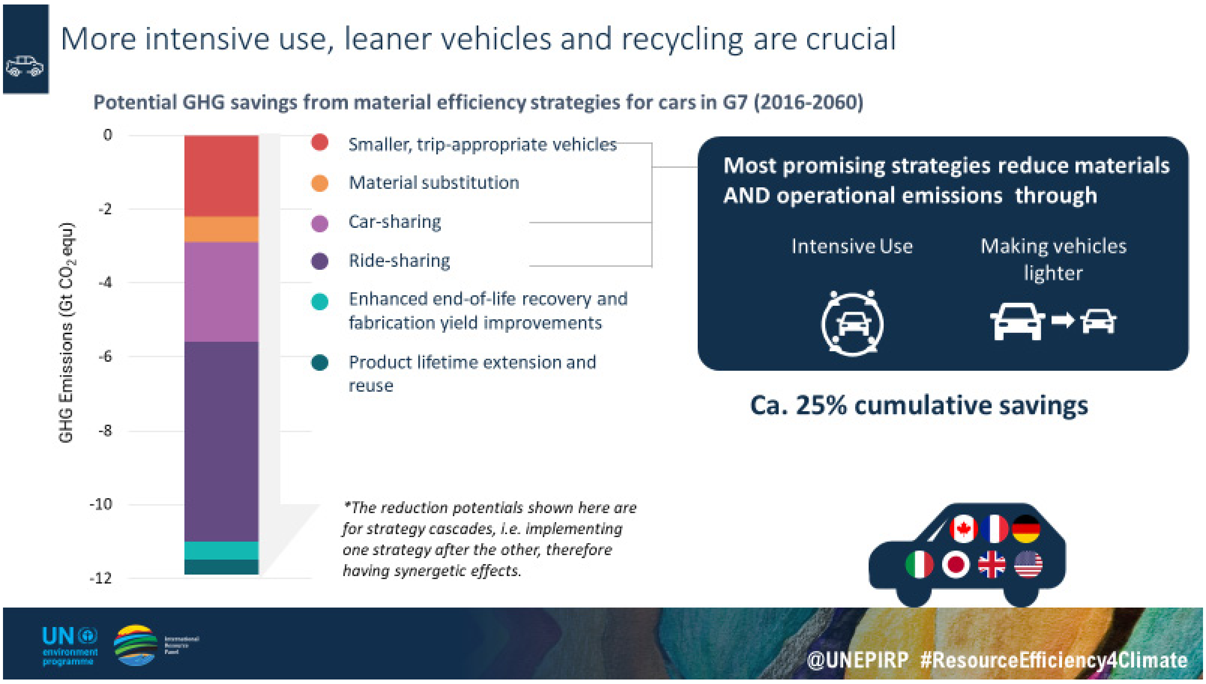

Figure 2. Potential for reducing life-cycle emissions in G7 car fleets through material efficiency strategies (International Resource Panel, 2020).

This example refers primarily to high-income countries where an intense debate on how best to reduce transport emissions has been ongoing for a number of years. But it also applies to middle-income and lower-income countries, which will be the main location of urban expansion in future, and the option to avoid repeating the mistakes of high-income countries clearly exists. These nations have the opportunity to plan for "smart mobility" and create urban environments not dominated by traffic-clogged highways, multiple car parks and poor air quality.

A similar logic applies beyond the mobility system: any energy-intensive materials, any output from nature-intrusive mining, and any output from biodiversity loss-intense agriculture and crop production ultimately goes through a value chain as part of a provisioning system that is supposed to meet society's need for a certain function.

Human needs can be provided for much more intelligently

Optimising currently material-intensive provisioning systems should therefore be the first step towards minimising unnecessary environmental impacts as well as social disadvantages, such as sitting in traffic, heating unused housing space or wasting food because of poor storage and wasteful fast-food systems. This approach applies to any material and the natural resources it depends on. Inefficient systems – for example, a built environment with underutilised, sprawling houses, or mobility systems primarily reliant on underutilised cars and roads – also consume excessive land and fuel resources in addition to materials.

In addition to improving the utilisation of systems, the value chains and production processes of their products and modules can be made more circular, ensuring that the materials and modules are being reused to the maximum extent. For example, the IRP calculated that a city – which is where most of the provisioning systems such as mobility, housing, food (consumption) and everyday goods (consumption) are concentrated – purposefully designed for fair compactness, circularity, nature-positivity, and active and public transport would need 10 times less energy (direct energy and embodied energy in materials) than a non-purposefully designed sprawling city matching the current trend. This significant improvement in productivity is the result of optimised use of space, leading to resource efficiency in buildings, fuel efficiency in heating, and accessibility of green transport options.

The term "efficient energy designs" usually sparks images of efficient light bulbs or fridges, or maybe more efficient industrial processes. It does not usually invoke visions and strategies for fundamentally redesigning our material-intensive provisioning systems and the circularity of value chains as a means to tackle the very driver of excessive energy demand.

The current Earth4All turnarounds partially capture this logic of systemic material efficiency. For example, the pathway for energy transformation includes a call for "efficient energy designs that run on renewable power", and the pathway for transforming food systems includes a call for a transition to nutrients that are less resource-intensive – ideally plant-based proteins instead of those provided by (red) meat or cattle dairy. However, the term "efficient energy designs" usually sparks images of efficient light bulbs or fridges, or maybe more efficient industrial processes. It does not usually invoke visions and strategies for fundamentally redesigning our material-intensive provisioning systems and the circularity of value chains as a means to tackle the very driver of excessive energy demand.

In technical modelling language, "energy efficiency", "energy productivity" and "energy demand management" usually include assumptions about provisioning systems of material functions, but this is often rather misleading for non-modellers. While the GHG emissions are caused by energy, optimisation to reduce energy demand can most often be found beyond the remit of the energy system and, instead, very much within the remit of those who shape the above-described provisioning systems – i.e. policymakers and business leaders such as transport ministers, housing ministers, infrastructure planners, urban planners, food and health departments, and product performance legislators. Including these relevant leaders in the discussion would make possible a truly systemic approach. But for that to happen, the often silo-based approaches to policymaking have to give way to more horizontal practices.

Therefore, it is important that any systemic models clearly explain the assumptions about energy demand, and the systems optimisations that will lead to change. It is thus even more essential that projects such as Earth4All clarify these approaches, through contextualisation of language, thought leadership and campaigning.

Systemic material efficiency should be seen as a cross-cutting theme that connects these turnarounds, especially the food, energy and poverty pathways, towards the necessary economic transformation.

Overlooking resource management and circular economy solutions

It is essential to be explicit about the system levers required to reduce resource demand (materials demand and their embodied emissions, i.e. the energy used to produce them; direct energy demand, e.g. in heating or vehicle fuels; land demand; water demand) because in current climate and biodiversity policies these levers are almost entirely missing. In many economic policies, systemic efficiency levers are not only missing, but – consciously or unintendedly – opposed.

For example, in the recently updated Nationally Determined Contributions (NDCs) and Long-Term Strategies submitted to the United Nations Framework Convention on Climate Change (UNFCCC), only a few of the most-emitting countries (based on a G20 analysis) mention energy or material demand management, efficiency or circular economy, and none include legally binding targets for reductions in material use. Material use is largely ignored, yet we know that it makes up a significant part of carbon emissions. No G20 countries include quantitative material efficiency targets in their NDCs. Likewise, National Biodiversity Strategies and Action Plans (NBSAPs) overlook the importance of resource management solutions, such as value chain transparency. We know most biodiversity loss results from unsustainable natural resource use, often through complex international value chains. However, despite a global biodiversity target on sustainable natural resource use, no NBSAP explicitly mentions supply or value chain transparency or impact (as determined using the Convention on Biological Diversity's NBSAP search tool).

If we look at the EU, often heralded as a frontrunner and role model in a sustainable transition and circular economy, the rationale for systemic material efficiency isn't yet credibly included either. While the EU Green Deal communication from 2019 states the goal of "reaching net-zero emissions by 2050 and decoupling resource use from economic growth",[2] the policy packages put forward to implement the Green Deal show little decoupling potential. The EU's major energy package, called "Fit for 55", is mainly about decarbonising energy production and enabling industry to use cleaner energy. It does put forward a solid calculation of the absolute decrease in energy demand necessary to reach a 55% emissions reduction by 2030, showing that the EU must reduce total energy demand by 39%, compared with 1990 levels. That is a massive efficiency improvement to achieve in under 10 years, and its fulfilment should jump to the top of everyone's attention, yet it received little media coverage and little explanation within the Fit for 55 document itself about how it will be achieved.

In terms of recommendations for implementation, the document package refers to better housing insulation, transport efficiencies and industrial efficiencies, but it does not expand on the implications of reaching such a number. Staying with the example of energy efficiency in housing, the policy document proposed to realise that goal is the so-called Renovation Wave. While an extensive document with many good propositions, it only mentions the most systemic efficiency levers in passing: smarter space and house utilisation (see the **IRP analysis** mentioned above) through better urban design to prevent sprawl and improve affordability of more space-efficient inner-city flats (which would also be more energy efficient per person because of shared walls). Such design would enable downsizing for the elderly, and incentivise compact yet fairly spaced and high-quality neighbourhoods with shared-ownership models that incentivise long-term insulation and circularity.

In the policies for mobility systems in the **EU's mobility strategy**, we also see few systemic proposals to reach a significant reduction in energy or materials. Most of the focus is on electrification, with less emphasis on things such as smart urban design, improved public transport, mobility as a service or otherwise shared and circular transport systems. Let us leave no room for doubt: any strategy to clean up energy production, every measure to electrify industry, transportation or heating, and any measure to insulate houses is important and must be scaled – but they will be inefficient, and not fast enough, without complementary system optimisation to provide societal functions using fewer resources in the first place.

It is embarrassing that neither development banks nor development co-operation agencies have given priority to the management of natural resources and the opportunities offered to save resources at scale.

It is true that a major turnaround must happen in the supply and demand of energy, as the largest direct emitter of GHGs. But the turnaround action and policies do not come from energy-sector changes alone. They come from systemic changes in the use of energy in mobility, housing, consumer goods, food and social dynamics. Therefore, system turnarounds must be formulated for these kinds of societal needs, demonstrating how to save physical resources (both energy and materials) at scale.

If this is true for the EU and its member states, it is of course true for other parts of the world as well, not least for middle- and lower-income countries. There is an urgent need to share best practices in everything that concerns climate mitigation and adaptation and the prevention of biodiversity loss and ecosystem degradation. It is embarrassing that neither development banks nor development co-operation agencies have given priority to the management of natural resources and the opportunities offered to save resources at scale.

A better vision of resource-sustainable economic ecosystems

Based on this realisation, The Club of Rome and SYSTEMIQ wrote *A System Change Compass* in 2020, which was welcomed by European Commission President Ursula von der Leyen with a foreword, and with a strong endorsement by European Investment Bank President Werner Hoyer.

A System Change Compass puts forward a logic to economic policymaking that is directed at optimising the economy for the fulfilment of societal needs with the minimal, cleanest resource input, rather than with the goal of production itself. As explained in Box 1, the compass recommends looking at the economy as four provisioning systems that deliver resource-related essential needs to society: mobility, housing, food and everyday goods (such as electronic gadgets). Using this logic, energy, digital technology, circular infrastructure and (re) manufacturing, and nature-based solutions enable the development of economic ecosystems and would be the necessary components in the delivery of societal needs; they are not activities to be maximised for their own sake.

In addition to reminding us that the economy has a direct societal purpose beyond simply maximising itself, this logic also allows businesses, investors, policymakers and citizens to envision and innovate the economy of tomorrow. This means moving away from measuring progress in terms of GDP and towards measuring societal indicators alongside resource-use efficiency – throughout the whole value chain. Instead of trying to mend and mitigate old economic models, we need to innovate economic ecosystems that deliver functionality, as well as high-quality jobs, in ways that are fundamentally less resource-intensive, and with business models that offer function and save materials.

The idea of energy efficiency or energy demand reduction is abstract to most people, even to most business leaders and policymakers, and it often leads directly to scepticism and into conversations about "taking something away". The idea of a fundamentally more efficient, cleaner and convenient mobility system, however, is intuitive and attractive for most people (though maybe not yet to industry).

What we need is to create visions and movement towards those new systems, and the new jobs within them, working with stakeholders far beyond the energy sector and energy ministries.

Developed vs developing countries

We also need to be open to learning from activities far beyond the usually discussed, often self-identified frontrunners. We must urgently shake the habit of calling countries that consume beyond their share of natural resources "developed". On the way to reaching wellbeing within planetary boundaries, almost all countries must be looked on as "developing".

Low-income countries have the opportunity not to follow the same damaging development pathways of today's high-income countries. Wellbeing in low- and middle-income countries could be increased further if these pathways were not followed. Instead, they must use the advantage of having less-entrenched industrial infrastructure and a vested interest to leapfrog to inherently

In contrast to a long-standing practice of so-called developed countries “helping” lower-income countries, we need to learn from the examples where countries have designed provisioning systems of societal needs that are both more resource-efficient and work along circular economy principles

more efficient systems at home, as well as dematerialised exports. In contrast to a long-standing practice of so-called developed countries “helping” lower-income countries, we need to learn from the examples where countries have designed provisioning systems of societal needs that are both more resource-efficient and work along circular economy principles. Often, lower-income countries should be able to perform better in this field, not least over time, if given access to the financial means to invest accordingly.

Circular economy principles are already being put into practice across low- and middle-income countries. For example, in Africa – Nairobi, Accra and Cape Town – open-source, local material flow data enables identification of circular economy opportunities. The built environment in Africa already embodies circular principles: a tradition of indigenous construction uses local building materials and local labour, while generating very little waste. USE-IT in South Africa and Worofila in Senegal are expanding the use of building blocks made from local earth. MycoTile in Kenya is producing construction bricks from fungi.

In the mobility system, cities in Asia are working to develop integrated circular transport systems: Jaipur is operationalising “smart intermodal mobility”, which includes integrating several modes of transport, implementing a fleet management system, frictionless ticketing, and real-time journey information. Given low rates of car ownership in India, implementation of high-functioning integrated transport systems could make private vehicle possession in cities irrelevant.

In Latin America, circular economy initiatives are improving neighbourhoods: for example, the informal settlement of Morro de Moravia in Medellin, Colombia, has undergone a green reconstruction project, with significant positive social and environmental impacts. Over 2,000 families now live in safer and more secure settlements, and the biodiversity of the local area has improved thanks to constructed wetlands. Two hundred jobs were created in community gardening and environmental restoration.

In these examples, levels of income and wellbeing still need to be improved, for example, in healthcare and energy security. However, it is essential that these wellbeing improvements are made utilising the parts of the system that already work, maintaining their resource-efficiency logic, for example by electrifying a shared transport system rather than redesigning a system based on the outdated models of prosperity found in many high-income countries. These old systems have by now shown all their negative side effects, such as waste, traffic jams and disconnected communities in sprawling cities and, of course, GHG emissions, and need not be emulated.

Better global governance of material flows and resource use

In order to enable a concerted global move towards realising resource efficiency in provisioning systems, we must plug a gap in our global governance structures. While several environmental agreements help with defining the planetary boundaries we cannot surpass, such as the 1.5oC goal for climate change, they do not help to steward the drivers that lead to climate change – as explained in the NDCs analysis above. In fact, the Paris Agreement does not even mention fossil fuels, let alone how material-consuming systems could reduce their fossil fuel dependency. Furthermore, current reporting under the UNFCCC only provides transparency on the emissions caused directly by a country's production, not on the emissions caused almost as directly by the consumption and imports of a country. Given global power structures, is it really mainly India's responsibility to decarbonise its steel sector, even though large parts of its production outcomes are used in Europe? Or should not all countries involved in dirty value chains have a responsibility to work together to innovate alternative, dematerialised, circular and cleaner value chains? If countries are serious in their efforts to move towards more resource-efficient production and consumption systems – where circular production is a crucial component – a shared responsibility will be necessary both for value chains and, indeed, for consumption patterns.

Global economic institutions, despite their ample use of the terminology of efficiency and productivity, are not giving priority to incentivising resource efficiency across systems either. For example, the World Economic Outlook has recently included content on GHG emissions and energy use, and it recognises climate shocks as severe economic risks, but there is no consideration about which parts of global production and consumption – measured in GDP – use energy and other resources particularly wastefully and inefficiently in the delivery of societal needs.

Several steps could be taken to upgrade global governance to help promote systemic resource efficiency, with the aim of delivering wellbeing to all within the planetary boundaries.

First, existing institutions should promote transparency and data sharing to link their activities and insights to resource use and materials flows. For example, the UNFCCC could add consumption-based impact reporting and encourage countries to make long-term plans to both decrease domestically produced emissions and initiate cooperation with major trade partners to decarbonise and dematerialise value chains. The World Economic Outlook could offer an overall view on the resource productivity of countries, from both a consumption and production perspective. It could also facilitate knowledge about which parts of GDP growth have been virgin-material dependent compared with those achieved through services or circular economy, and foster better understanding about how resource-dependent and "clean" GDP is distributed.

Second, we need an additional multilateral institution, potentially through a United Nations convention, to at least steward a central database and provide reporting methods for resource use, as well as a methodology to allocate impacts to material flows across borders. The institution should also convene economic, social and environmental institutions to find pathways to stimulate systemic resource efficiency in a just transition (see our earlier point on visions and pathways in *Doing more with less*). In the mid-term, this multilateral institution on resource management should develop clear – yet nuanced – quantitative and qualitative targets for resource use and material flows, supported by a dedicated scientific panel similar to the Intergovernmental Panel on Climate Change (IPCC). The IRP has recently started research on the feasibility and potential use of such targets.

Third, informal governance leadership groups such as the G7 and G20 must make resource productivity (wellbeing per tonne of resource use) their North Star, even the new criterium for memberships – rather than just GDP.

Fourth, the World Bank, regional development banks and development cooperation agencies must help in the process of making systemic resource efficiency a reality. First and foremost, it is a question of capacity building. Lower-income countries need educational programmes at all levels to explain resource use in all its dimensions and, in particular, training programmes for its ministries, government agencies and private businesses in how to implement incentives for systemic resource efficiency.

Conclusion

Natural resources provide the foundation for the goods, services and infrastructure that make up our current socio-economic systems. The use of natural resources or materials sits at the very heart of the challenges we face. The way we (mis)manage them is the common cause of climate change, biodiversity loss, and pollution or health impacts. All these challenges are the consequences of drivers and pressures emerging from human behaviour, from the "old normal" and a still-prevailing economic system. It is essential to address these drivers in a systemic way.

Understanding these facts provides us with a clear hope that, by identifying the root causes of these crises, together we can deliver policy responses that tackle them effectively.

From the natural resource management point of view, the 21st century will be marked by two important parallel and complementary processes: *decarbonisation and systemic resource productivity or dematerialisation*. All our activities should be judged through a lens of whether they contribute to managing these trends.

What would that mean in policy terms?

- **Redefining consumption** from owning to using.
- **Redefining production** from mass sales to providing efficient functionalities.
- **Redefining core economic incentives** such as taxation, subsidies and public procurement.
- **Integrating wellbeing** as the objective across all policies.
- **Measuring sustainability** with a life-cycle perspective, harmonising across policy areas.
- **Activating existing financial potential** to enable transition.
- **Looking at innovation** in categories of economic ecosystems that provide societal functions, rather than in categories of production sectors.
- **Establishing science-based** resource governance mechanisms fit for the challenges of the 21st century. Innovative and effective governance will enable all other policy transitions.

According to economic theory, producers and consumers are behaving rationally. This is true, but only in the short-term, for market players maximising their wellbeing here and now. Since this rational behaviour is based on market signals that are not aligned with longer-term public interests, it does not lead to long-term sustainable solutions (economic, social and environmental). One can hardly claim that behaviour leading to the crises we face (climate, biodiversity, health or social) and resulting in imbalances (between humans and nature, and between current and future generations) is rational. It is thus essential to fix the market signals and align them with longer-term public needs.

There is a delusion in the assumption that by greening the existing systems and structures of production, which is important and needed in itself, we can deliver the necessary speed and scale and provide convincing and sufficient answers for fighting climate change, biodiversity loss, pollution and health implications.

To the current efforts to green the existing systems and structures of production, we must add a system-based approach, which will not only address the supply side of the current economic system, but also the demand side – existing (over)consumption and wasteful use of natural resources.

We need to move from efficiency to sufficiency concepts. As clearly indicated by the IRP, we must strive for the decoupling of wellbeing and economic development from natural resource or materials use and environmental impacts.

The circular economy could play an important role, if we define circular economy in a systemic manner to reduce not only waste but also space and material wastefulness within the systems. We can choose to see it as a chance to fundamentally improve the systems that deliver core material societal needs: mobility, housing, nutrition and everyday goods systems should directly focus on societal needs instead of just increasing outputs and profits for traditional sectors.

For the first time in human history, we face the emergence of a single, tightly coupled human social-ecological system of planetary scope. We are more interconnected and interdependent than ever. Our individual and collective responsibility has increased enormously. There is no way to escape the necessity for change. If we truly want “the future we want”, there is no way to escape the creation of a “new normal” based on different premises, ethics and values.

Footnotes

[1] GRO19 modelling showed that material use could be decreased by 25% (compared with BAU) if high-income countries decrease their resource use, while low- and middle-income countries' usage increases. The decrease in high-income countries gives "budget" for increases in low- and middle-income countries.

[2] **Note:** There is an ongoing discussion as to whether decoupling resource use from economic growth is possible; however, most of these discussions assume a traditional definition of growth that is largely based on material-intensive production and consumption. While not analysing the EU's definition of decoupling in this article, please note that any mentioning of decoupling by the authors of this piece refers to a decoupling of growing quality of life from resource use through provisioning-system optimisation and circular economy, not to a decoupling from traditional definitions of growth.

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Earth4All is an international initiative to accelerate the systems changes we need for an equitable future on a finite planet. Combining the best available science with new economic thinking, Earth4All was designed to identify the transformations we need to create prosperity for all. Earth4All was initiated by The Club of Rome, the Potsdam Institute for Climate Impact Research, the Stockholm Resilience Centre and the Norwegian Business School. It builds on the legacies of *The Limits to Growth* and the planetary boundaries frameworks.

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