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ESG investment: understanding system changes

Key takeaways

- Environmental constraints mean that system changes will be necessary to meet four key human demands – for energy, food, manufacturing (including housing) and mobility.
- Technology will both enable and limit system change, as will social/political acceptance. We look at the key challenges involved in meet these four key demands.
- Priorities include electrification (energy), production resilience and waste reduction (food), circular economy principles (manufacturing) and smart emissions-free mobility.

01 Introduction

For understandable reasons, the global approach to environmental, social and governance (ESG) issues has often been to set broad **targets** – e.g. limits to global temperature gains. Such targets have the merit of focusing political attention and (in theory) economic resources on a specific challenge.

Effective ESG investment, however, requires going beyond targets and thinking in more depth about the required **system changes**. Investors need to understand where we are now (in terms of our demands and how corporates currently respond to them), as well as the likely opportunities and constraints in future during the transformation to a more sustainable economic model.

The **Triple Planetary Crisis (climate change, biodiversity loss and pollution)** is the most obvious driver of system change. Concern about the so-called "planetary boundaries" – what the planet can take before we face irreversible disintegration – has prompted continuing national and international environmental regulation, along with initiatives to encourage investment in more sustainable technologies and a greater appreciation of the importance of **natural capital** – the most important current market failure.

Our environmental predicament is largely the result of meeting four key human demands – for **energy, food, manufacturing** (including housing) and **mobility**. We focus on these four demands specifically because they have the highest double materiality towards nature. Double materiality considers both what corporate activity does to the environment, and what a changing environment means for corporate activity. For example, our food system is the biggest driver of biodiversity loss while being strongly dependent on biodiversity richness.[1] So these four key demands are both significantly contributing for the planetary crisis and – potentially – the solution to a sustainable future.

Mankind's desire to fulfil its four basic needs has given rise to our current economic system. Therefore, we refer to this as a market-demand structure. In the past, corporates have responded to these four key demands by increasing supply – without consideration of the impact on natural capital or other environmental factors. As a result, we now have complex corporate and economic structures in place to meet these demands which appear increasingly inappropriate. But these supply structures cannot immediately be dismantled as the global population's demands must continue to be met. The emphasis therefore needs to be on changing the way we meet these four demands as part of a process of transformation to a more sustainable model.

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Our ability to meet these four basic needs during such a process of system change will not just be determined by environmental priorities. **Technology**, for example, will play a key role in the transformation and how individual sectors will respond. But what are its limitations? In addition, are proposed changes to energy, food, manufacturing output or mobility feasible in a **social/political context**? While environmental concerns are the key driver of change, and technology will likely provide a widening fan of ways to address them, social/political issues may put boundaries on what we can do.

We highlight below some key challenges for meeting these four basic needs in the future in a sustainable manner. There will not be simple answers to these challenges. In fact, progress is likely to through a process of **guided evolution** where policy, corporate and investor approaches zigzag forward as society's understanding of environmental issues, and how to approach them, continues to improve. Crucial to this process will be the development of a greater understanding of **key value chains** in the global economy. There is also likely to be an increasing focus on "**double materiality**" – the notion that we need to consider both how corporate activity affects the environment, and what a changing environment means for corporate activity. The process of change will create opportunities for investors but also risks around established industries and sectors linked to them.

02 Energy

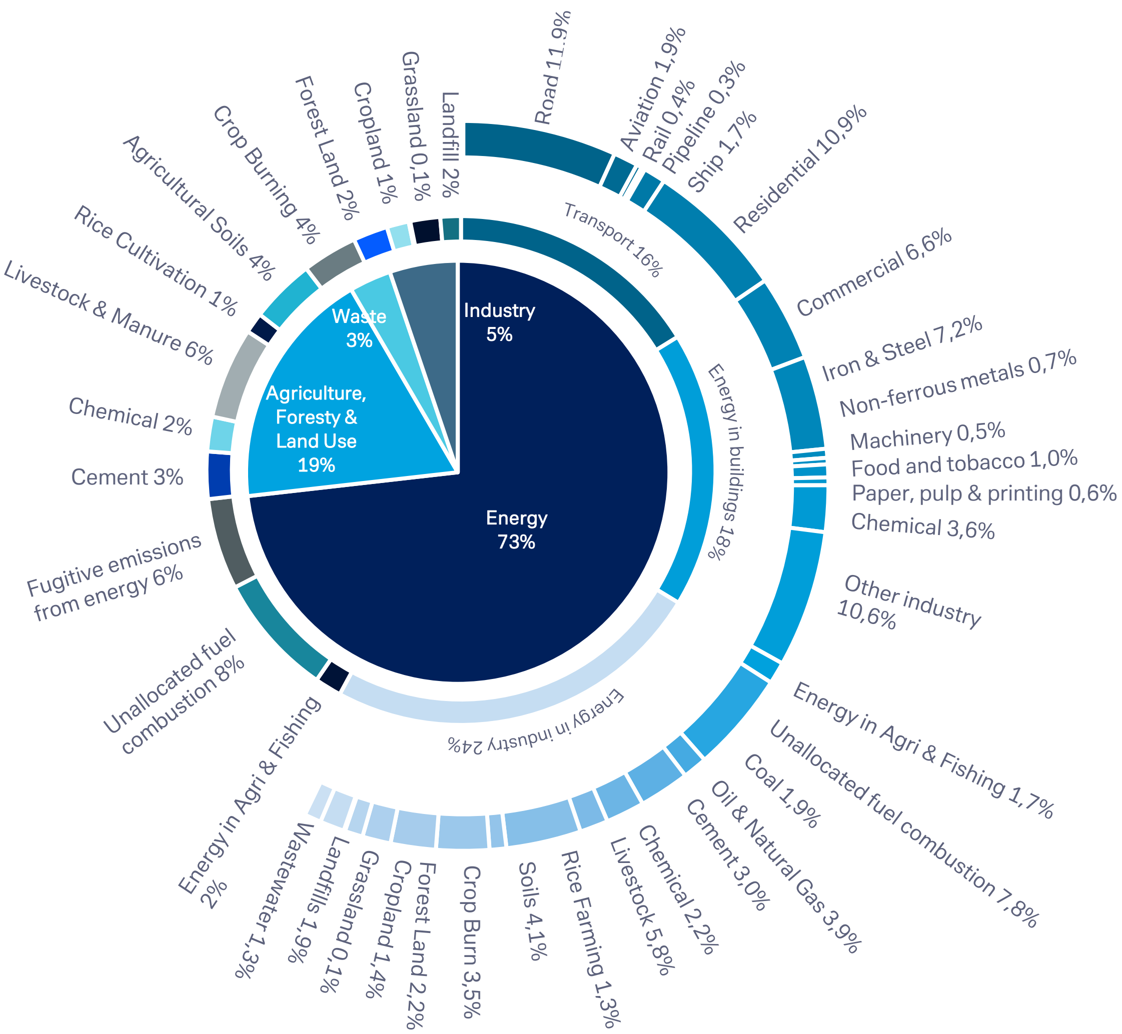
System change: electrification without greenhouse gas emissions

Challenge: On the energy supply side, we need to increase the output of carbon-free renewable energy. But we also need to find a more sustainable way of consuming energy – most obviously through electrification. Despite efficiency initiatives, we should work on the assumption that economic growth will continue to boost energy use. (See for example the IEA energy forecasts to 2050[2].)

Key GICS sectors affected: Although all sectors are dependent on energy, albeit at varying levels, the energy, utilities and capital goods sectors are likely to be subject to the greatest and most direct changes.

Environment: Energy currently accounts for three-quarters of global greenhouse gas emissions (Figure 1). This is largely due to our continuing dependence on fossil fuels: for example, these still account for around two-thirds of all electricity generated worldwide[3]. (Coal on its own accounts for over 60% of energy generated in both China and India.) Less environmentally-damaging sources exist, although they are not completely problem free (e.g. via complications associated with metal and

Figure 1: Global greenhouse gas emissions by sector



Source: Climate Watch, World Resources Institute, Deutsche Bank AG. Data as of 2020.

minerals extraction for electrification, social disruption from hydropower).

Technology: Increased **electrification** is the most obvious technological solution. However, this only makes sense if we can produce electricity in ways that are carbon-free, reliable and sufficient. We are making progress here, increasing renewable electricity capacity by 130% over the last decade, compared to 24% for non-renewables[4]. Technological advances and implementation scale have been accompanied by falling costs: the cost of solar PV electricity has fallen by 80% or more over the last decade, and wind energy costs have fallen by 50%[5].

However, there remain valid questions about how much further this process can go. In particular, how we deal with the problem of **intermittency**. As we know, the sun and the wind are intermittent sources but the need for power is not. One possible answer here is increased energy storage, helped by (for example) falling battery costs and other new technologies, such as hydrogen-based storage.

However, electrification may also require a broader rethink of **electrical distribution systems**. Greater coordination will be needed between users, producers, and networks to tackle intermittency and other problems. The historical preference for putting energy plants close to cities may also have to be abandoned, as renewable energy needs to be generated close to source.

Social/political: Governments have been ramping up Net Zero efforts through tax credits, subsidies, renewable project tenders and so on. Such initiatives are relatively uncontroversial when they relate to provision of renewable energy and have been broadly supported, particularly when they improve perceived **energy security**. However, mandating switches in energy sources to reduce energy use (or to make it less environmentally-destructive) may prove much more controversial. This is not just in relation to transport: measures to change the sources of domestic heating are also causing political difficulties in several European economies.

The energy transition could also increase **international political stresses**, for example in relation to the supply of metals necessary for electrification technology. Regional taxation regimes intended to reduce carbon emissions will also have an international dimension.

03 Food

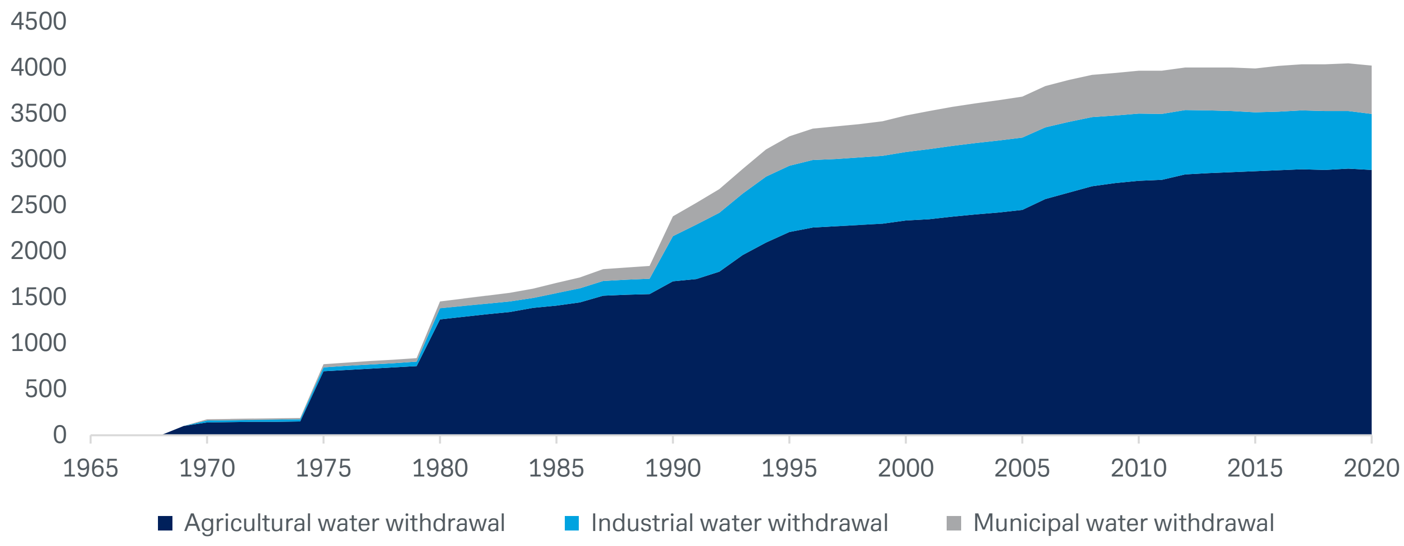
System change needed: food production and trade resilience, less waste

Challenge: The world population is growing, implying higher calorie consumption. Increasing urbanization will also require changes in the way that food is bought. On the supply side, food production will involve increased competition for land, energy, and water. The focus here is not on reducing demand, but on supplying it in a more efficient, sustainable and predictable way, needing improvements at each stage of the food industry: production, processing, transport, and consumption. This will require consideration of structural issues, e.g. the appropriate balance between local and global food production.

Key GICS sectors affected: Consequently, the biggest changes are likely to take place in the consumer staples sector, while the materials sector should be partially affected due to, for example, fertilisers.

Environment: Unsustainable food production can be caused by a variety of disparate factors that are either directly environmental (e.g. lack of water, erosion) or caused in other ways by human activity (e.g. overfishing). But the process is two-way: not only does climate have an impact on food production, food production itself adds to concerns around biodiversity loss, water scarcity and greenhouse gas emissions. As highlighted in Figure 2, agriculture is one of the biggest contributors to the world's freshwater withdrawals, with 70% of the overall share[6].

Figure 2: Global water use* by sector



* in 10^9 m3/year. Source: FAO, EEA, Deutsche Bank AG. Data as of September 2023.

Technology: Progress will be through using a wide range of technologies in each stage of the food chain. Farmers have been adopting new technologies for millennia to boost output. But the desire to boost output is now accompanied by a need to reduce associated environmental damage. There are many ways that this can be done, e.g. through developments in aquaculture, sustainable agroforestry, lab based meat and meat culture, waste management technologies, bio fertilizers, sustainable farm equipment, to name but a few possible areas for development.

Social/political: Those most impacted by food insecurity are those with least wealth, lower and more unstable incomes and less access to essential basic services. Failure to ensure reliable supplies of food can therefore have drastic consequences. Often, supply problems have a major international dimension: for example, it is estimated that 80% of food imports in Africa come from outside the region[7], making it vulnerable to unconnected events elsewhere – as has been shown the impact of the Russian/Ukraine war on global grain production. Even where there is no immediate disruption, food supply will likely depend on complex global collaboration, often under uncertain regulatory regimes (e.g. fishing).

For richer societies, **switching food sources** can help reduce the environmental impact. As is well-known, meat can have a much higher carbon footprint than plant-based high protein alternatives[8]. Eliminating dairy and beef accounts for the majority of carbon emissions reductions.

Another politically less-controversial approach to satisfy demand is to **reduce food loss and waste**. Around one-quarter of calories in food produced today are wasted, not just in consumption (35% of total wastage) but also production and storage (24% each)[9]. North America and Oceania on average lose around 1,500 kcal per person per day from “farm to fork”.

Measures to reduce waste can range from the provision of better physical food storage facilities to changing consumer behaviour (e.g. via consumer education campaigns).

04 Manufacturing

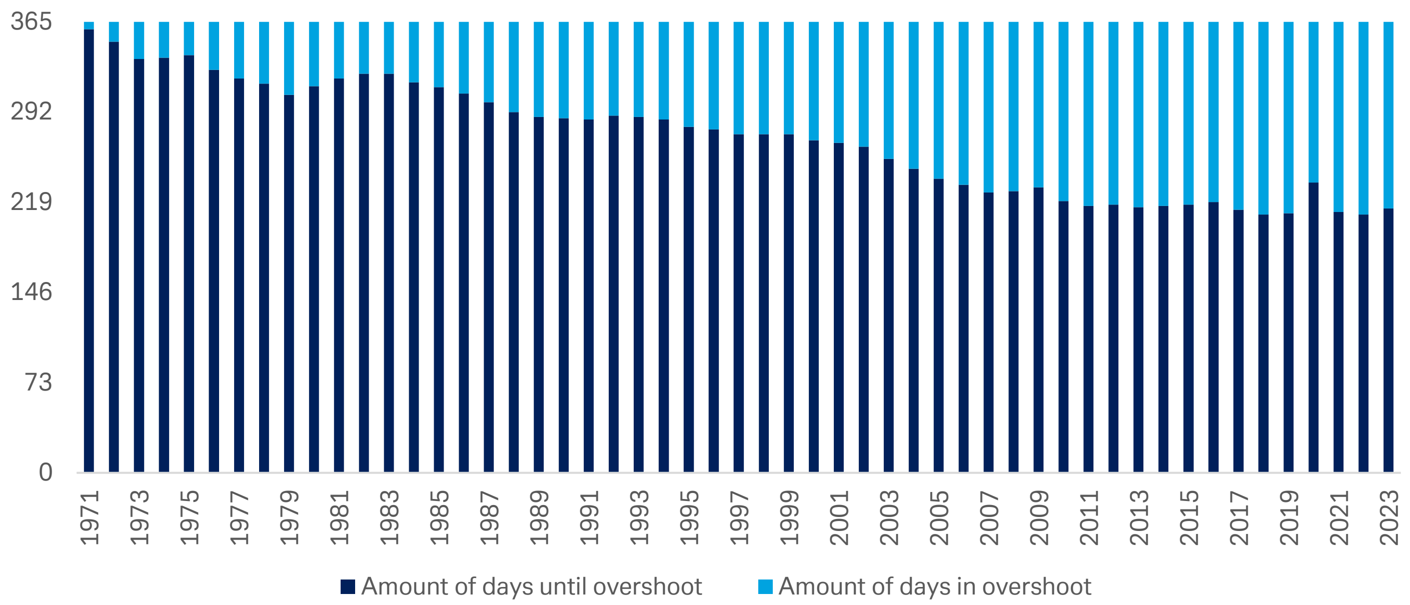
System change needed: move to circular economy principles

Challenge: The traditional linear economy manufacturing model of **take, make, and waste** has resulted in a depletion of natural resources, pollution and a significant increase in carbon emissions. But how can we move towards sustainable manufacturing inputs and processes? Four materials in particular – plastics, aluminum, steel and cement – have a heavy environmental footprint but underpin our current society. They need to be a focus for change.

Key GICS sectors affected: The system change for manufacturing probably covers the most sectors among all system changes. The materials sector is expected to be the most directly affected. While sectors such as industrials, information technology, consumer discretionary and health care are likely to be also affected.

Environment: The environmental impact of manufacturing is not limited to CO_2 emissions. Chemical reactions during manufacturing processes also contribute to **other emissions**, for example of nitrous oxide (N2O), which has a global warming potential that is roughly 300 times higher than CO_2. Waste disposal via landfills can also result in the release of other potent greenhouse gases such as chlorofluorocarbons (CFCs). **Resource depletion** is also an issue: the manufacturing sector is estimated to be responsible for around 20% of total water consumption globally[10] and is the largest consumer of minerals

Figure 3: Days until Earth Overshoot Day was reached



Source: Earth Overshoot Organisation: “Earth Overshoot Day marks the date when humanity’s demand for ecological resources and services in a given year exceeds what Earth can regenerate in that year.” Data as of October 2023.

globally (about 50%). For instance, production of steel requires iron ore and coal, cement similarly requires limestone, clay, and other minerals, while plastic production requires petroleum.

Manufacturing can have an impact on land, water and air pollution and can also contribute to biodiversity loss, including via the destruction of natural habitats (e.g. via deforestation for the production of palm oil). Toxic chemicals emitted by manufacturing processes can also persist in the environment for long periods of time and have been linked to declines in wildlife populations, including amphibians, birds, and fish[11].

Technology: Multiple technologies will be required to move to circular economy principles. These will encompass a spectrum ranging from product design (for durability and usability) to the use of recycled and waste materials as inputs through closed loop manufacturing processes. They will also involve different approaches to how a manufactured product is supplied and used (e.g. via rental/sharing rather than ownership).

Technology, for example, is likely to impact the way we use and dispose of **plastics** – recycling where possible and reducing their overall use. We may be able to substitute more sustainable materials in other processes – e.g. using ammonia as a refrigerant instead of CFCs (chlorofluorocarbon) and HCFCs (hydrochlorofluorocarbons). Changing building processes provides another way to improve sustainability, for example by using more sustainable materials (e.g. as alternatives to cement), changing construction methods or via energy efficiency.

Major technological challenges include **steel production** (an energy-intensive process that also generates significant waste) and increasing the usage of **biobased materials**. Increased use of data, new and advanced materials (e.g. graphene, metal alloys) and new processes (additive manufacturing, advanced robotics etc.) however offer the prospect of major change in many sectors.

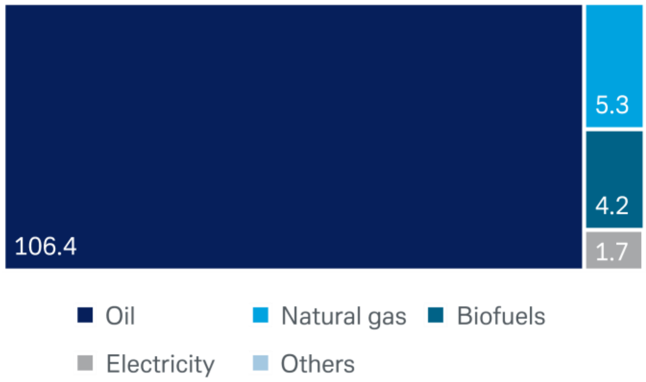
Social/political: Countries have been legislating for changes in manufacturing processes for more than a century, initially for social reasons and more recently increasingly due to environmental concerns. However, implicit social acceptance of such measures should not be taken for granted, particularly if they threaten to reduce employment levels or to increase prices. The politics of manufacturing also has an international dimension, particularly when developed economies are seen as imposing unjustified **new standards** on emerging market manufacturers (or simply offshoring high polluting processes to them), providing a pretext for global trade restrictions.

05 Mobility

System change: smart emissions-free mobility

Challenge: The structural challenge is to transport people and goods in different, less environmentally and socially damaging ways. In recent decades, **higher incomes** have allowed both more personalized day-to-day mobility (e.g. cars), discretionary consumption of mobility (e.g. tourism) and increased volumes of goods traded by land and sea, boosting both energy use and emissions. Increased **urbanization** has also increased demand for personal and shared local transport systems.

Figure 4: Energy consumption in transport in exajoule

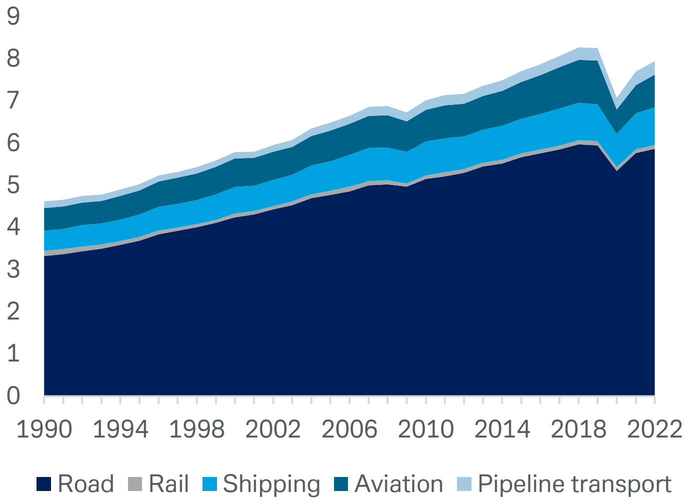


Source. IEA, OECD, Deutsche Bank AG. Data as of October 2023.

Key GICS sectors affected: Consumer discretionary and industrials are among the affected sectors.

Environment: Due to the high dependency on fossil fuels (as shown in Figure 4), Mobility was responsible for around 37% of global end-use CO_2 emissions in 2021[12], with other environmental impacts through the manufacture and use of transport systems. One focus, particularly in congested urban areas, has been on the direct negative impacts of transport on **human health**.

Figure 5: Global CO_2 emissions from transport by sub-sector in Gt CO2



Source: IEA, Deutsche Bank AG. Data as of October 2023.

Technology: Areas currently in focus include alternative vehicle powertrains (e.g. not dependent on an internal combustion engine) and the broad concept of smart mobility (improving mobility through autonomous driving, car sharing and other organizational improvements etc.). Both will require the construction of a large-public infrastructure and have apparent technical limits (electrification might work well for cars, for example, but seems more problematic for long-distance aviation and freight).

Mobility offers the possibility for significant gains through **mixing old and new technologies.** One route to reducing carbon emissions from the global maritime fleet and aviation, for example, is to combine the new (biofuels) with the old (oil and petrol) in propulsion systems. (There is a need to do this – global maritime carbon emissions are roughly the same as from the entire German economy[13].) However, such initiatives will further work on reducing cost differentials on new fuels, associated technological development (e.g. of emissions filters for biofuel-based vehicles) and regulatory incentives.

Social/political: Transport can prove a highly political issue because the impact on individual behaviour may be immediate and the impact on taxation is very visible at a local and personal level. Restricting demand will involve both measures that are not particularly politically difficult (e.g. car pooling), but there will also be more controversial initiatives (e.g. through vehicle use levies or through the banning of older vehicles). As we have already seen in some cities, such measures can be seen as unfair and prompt significant political reaction. As always, there will also be an international political dimension, particularly for longer-distance travel such as shipping or aviation.

06 Conclusion

It is very likely that the necessary system changes are going to be defined by a process of guided evolution with approaches constantly readjusting as our understanding of environmental issues continues to improve.

However, system changes will need to address general structural problems of our current economy structure as well as narrow technological challenges in a way that is both politically and socially acceptable.

Priorities include building reliable and sustainable systems for electrification - including distribution and storage (energy), more sustainable, resilient and efficient food production (food), the systematic introduction of circular economy principles (manufacturing) and smart, efficient and, above all, zero-emission mobility.

Not all companies will be affected by the system changes to the same extent. At the highest level, affected companies need to analyse their business model for risks and opportunities. To reduce these risks, companies need to adapt their supply chains and production processes and keep a close eye on the international regulation of their product/service. Capturing opportunities requires the identification of new business models as well as changes to existing business. This also involves rethinking product design in terms of life cycle.

Restructuring value chains and seizing opportunities inevitably go hand in hand with addressing societal issues. At the same time, appropriate governance structures are needed to introduce such changes. Finally, the companies need access to adequate financing. The companies that will have the most success will be those that not only reduce their negative double materiality towards nature, but can even better grasp the great opportunities involved in the sustainable transition.

Glossary

CFC and HCFC refers to chlorofluorocarbons and hydrochlorofluorocarbons respectively. Use of CFC is now restricted due to worries about their impact on the ozone layer, but HCFC also contribute to global warming.

Double materiality assesses both the material impact a company's activity can have on the environment (or the social and governance elements), and material impacts/risks that environmental change can have on a company.

ESG investing pursues environmental, social and corporate governance goals.

Greenhouse gases are the gases in the atmosphere that raise the surface temperature of planets such as the Earth. What distinguishes them from other gases is that they absorb the wavelengths of radiation that a planet emits, resulting in the greenhouse effect.

The International Energy Agency (IEA) is an intergovernmental agency studying energy-related issues

With the Inflation Reduction Act, the U.S. plans to invest USD374bn in climate protection and strengthening future industries.

The joule is the unit of energy in the International System of Units (SI). It is equal to the amount of work done when a force of 1 newton displaces a mass through a distance of 1 metre in the direction of the force applied. The SI prefix "exa" represents a factor of 10^18, or in exponential notation, 1E18.

Natural capital refers to the world's stock of natural resources, living and non-living, that have value (in the broadest sense) to society.

The Triple Planetary Crisis refers to the three interlinked issues of climate change, air pollution and biodiversity loss.

Value chains in the global economy are the networks and sequencies of processes necessary to deliver goods, services, trade and investment.

Bibliography

1. Keishamaza Rukikaire. (2021, Feb 3). Our global food system is the primary driver of biodiversity loss, unep.org. UNEP; Our global food system is the primary driver of biodiversity loss (unep.org)
2. IEA. (2022, Nov). World Energy Outlook 2022, iea.org. iea; World Energy Outlook 2022 (windows.net)
3. IEA. (2022, Nov). World Energy Outlook 2022, iea.org. iea; World Energy Outlook 2022 (windows.net), page 435
4. IRENA. (2022). Renewable Energy Capacity Statistics 2022. IRENA; Renewable Energy Capacity Statistics 2022 (irena.org)
5. IRENA. (2022). World Energy Transitions Outlook 2022. IRENA; World Energy Transitions Outlook 2022 (irena.org)
6. World Bank. (2022, Oct 05), Water in Agriculture, worldbank.org. worldbank.; Water in Agriculture (worldbank.org)
7. Paul Akiwumi. (2020, Aug 11). COVID-19: A threat to food security in Africa. UNCATD. unctad.org; https://unctad.org/news/covid-19-threat-food-security-africa
8. GFI. (2019). Plant-based meat for a growing world. GFI. gfi.org; Environmental benefits of plant-based meat products | GFI
9. Food and Agriculture Organization of the United Nations. (n.d). Food Loss and Waste Database. fao.org; Food and Agriculture Organization of the United Nations https://www.fao.org/3/i3347e/i3347e.pdf
10. GE. (2017, Aug 24). A Global Thirst: Water Use In Industry. GE. ge.com; A Global Thirst: Water Use In Industry | GE News
11. Gwynne Lyons. (2007). Wildlife impacts of chemicals. chemtrust.org; Wildlife impacts of chemicals (chemtrust.org)
12. Jacob Teter. IEA. (2023, July 11). Transport. Iea.org. iea; Transport - Energy System – IEA
13. BBC. Reality Check: Are ships more polluting than Germany?. (2018, April 12). BBC´. bbc.com; BBC Reality Check: Are ships more polluting than Germany? - BBC News

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