PBL Netherlands Environmental Assessment Agency

SCENARIOS FOR THE SEVENTH GLOBAL ENVIRONMENT OUTLOOK

A Future we Choose

The seventh edition of the Global Environmental Outlook (GEO-7), the flagship publication of the United Nations Environment Programme (UNEP), provides a comprehensive assessment of the state and future of the global environment. The report concludes that, despite global efforts and calls for action, our planet is facing global environmental crises of climate change, biodiversity loss, land degradation and desertification, and pollution and waste. The world is not on track to achieve internationally agreed goals and targets related to these crises, resulting in substantial social and economic damages. Despite a rapidly closing window of opportunity, achieving these goals and targets is still possible with strong benefits for both people and planet. There are multiple pathways to do so, though all requiring unprecedented and coordinated action across sectors and stakeholders.

To help envision these plausible pathways, GEO-7 provides a comprehensive and tailored analysis of new scenarios, coordinated and co-produced by PBL Netherlands Environmental Assessment Agency. The *Current Trends Scenario* shows a future characterised by a continuation of current socio-economic trends and a scale-back of climate and environmental policies. Two *Transformation Pathways* show alternative routes to achieving globally agreed goals and targets, built around contrasting narratives of societal and technological transformation. This note presents a synthesis of the key insights of these scenarios as formulated in GEO-7.

Future developments under continuation of current trends

The world is not on track to achieve globally agreed environmental goals and targets

Under the *Current Trends Scenario* most environmental pressures are expected to intensify towards 2050. This includes a further increase of emissions of greenhouse gases and pollution, ongoing land-use changes, and escalated resource use and exploitation. Major drivers include population growth, increasing urbanisation, further economic growth, and resource-intensive lifestyles (see Figure 1). Consequently, the global environmental crises are expected to worsen:

- Current climate policies and Nationally Determined Contributions (NDCs) fall short of meeting the Paris Agreement temperature goal, with a global mean temperature rise likely to exceed 1.5 °C above pre-industrial levels around 2030. The high-emissions *Current Trends Scenario* projects a further increase to just over 2 °C by 2050. In a scenario that assumes continuation of the mitigation effort implied by current policies, global mean temperature increases to around 2.9 °C this century.
- Biodiversity loss, in the scenario analysis measured as loss of Mean Species Abundance, is projected to continue along historic rates, thereby moving further away from the targets set in the Kunming-Montreal Global Biodiversity Framework.
- Land-use change and soil degradation are projected to continue, undermining progress towards the land-degradation neutrality target of the United Nations Convention to Combat Desertification.
- Finally, air and water nutrient pollution are projected to remain high, with an increasing number of people exposed to levels above World Health Organisation (WHO) guidelines.

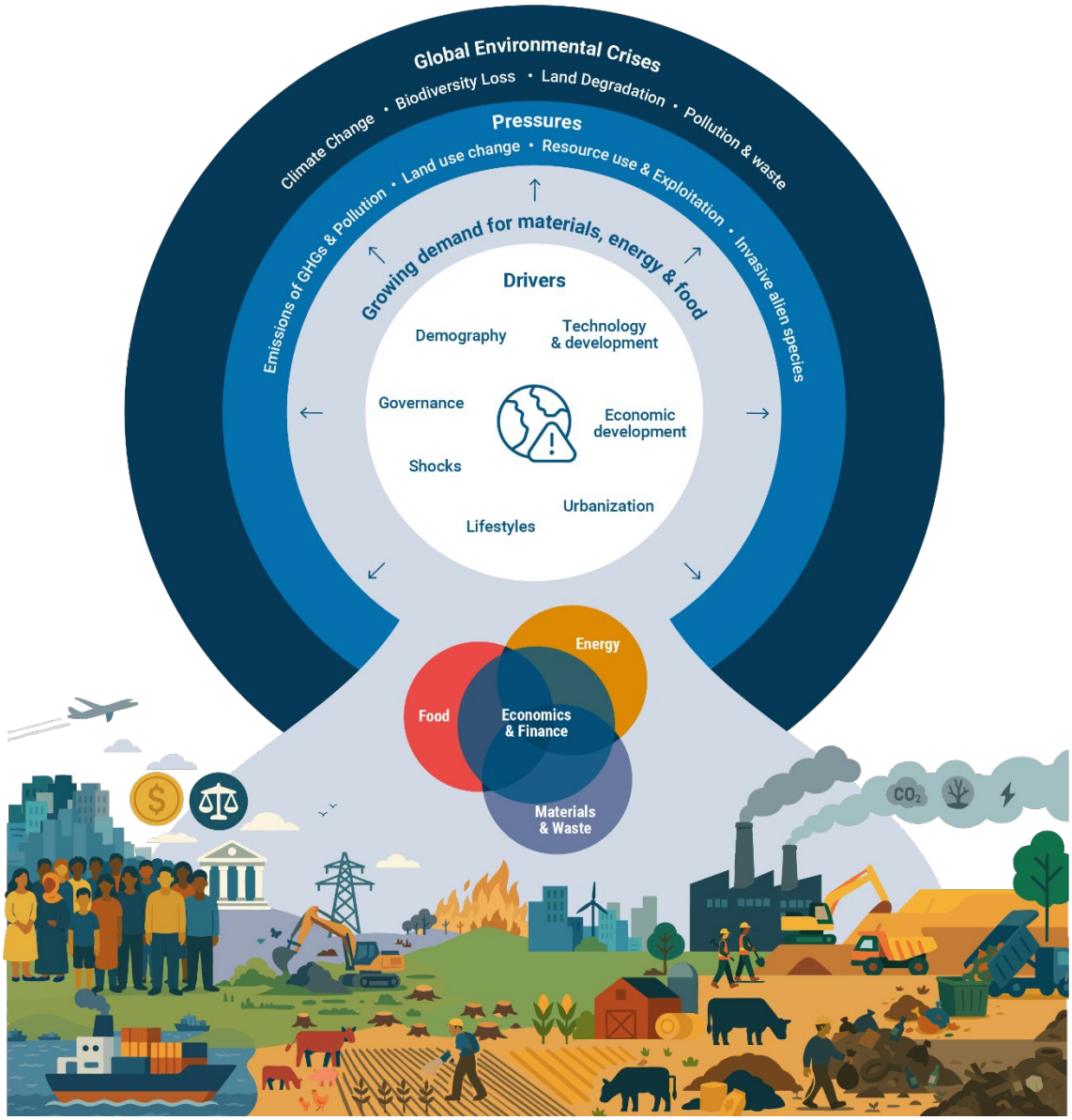
Human well-being is increasingly threatened by these global environmental crises

In the *Current Trends Scenario,* access to safe drinking water, adequate sanitation, and clean energy are projected to improve over time, and poverty, hunger, and child mortality to reduce. However, these improvements will not be sufficient to achieve related targets set by the Sustainable Development Goals (SDGs) by 2030 and for some not even before 2050. Vulnerable and marginalised groups are most likely to stay behind. The intensification of climate change, biodiversity loss, land degradation, and pollution can even undermine hard-won gains. By 2050, climate change significantly increases the amount of people exposed to extreme events like heatwaves, heavy rainfall, and droughts. Furthermore, climate change, increased air and soil pollution, land degradation, and decreasing pollination and natural pest control driven by biodiversity loss, all negatively affect crop yields, thereby undermining food security. Additionally, the economic consequences of global environmental crises may slow poverty reduction and widen inequality between and within countries.

The costs of inaction are substantial and will only increase over time

Although there is ample evidence that the escalating global environmental crises will lead to increased economic damage, only damages from climate change have been thoroughly researched. These studies estimate damages from reduced agricultural yields, damages to assets located in coastal or flood-prone areas, and a decline in labour productivity, among other impacts. Under the high-emissions *Current Trends Scenario*, the median estimate of economic impacts from climate change is projected around 4% of the global gross domestic product (GDP) in 2050, increasing to 22% in 2100. Even in a scenario in line with continuation of the mitigation effort implied by current policies, the climate-related damage costs are still estimated around 10% of global GDP in 2100, while limiting global temperature rise to 1.5 °C above pre-industrial levels could keep these losses below 2% throughout the century. As these estimates do not include all climate change-related damages, the risks of tipping points, and impacts from the other global environmental crises, the actual cost of inaction could well be larger.

Figure 1
Drivers and pressures of the interlinked globally environmental crises



Transforming key systems to meet environmental and well-being goals

Multiple pathways exist to achieve internationally agreed goals and targets

The two *Transformation Pathways* combine alternative sets of solutions across the interlinked Energy, Food, Environment, Materials & Waste, and Economics & Finance systems. They are designed to achieve internationally agreed environmental and well-being goals and targets from the Paris Agreement, the Kunming-Montreal Global Biodiversity Framework, the United Nations Convention to Combat Desertification, and the Sustainable Development Goals (SDGs). The pathways do, however, emphasise different combinations of behavioural and technological change on the way towards these goals:

- The **behaviour-focused** *Transformation Pathway* is driven by changes in societal values and norms towards sufficiency, accompanied by a significant decrease in unsustainable consumption (see Figure 2).
- The **technology-focused** *Transformation Pathway* is driven by efficiency and clean-technology gains in an economically globalised world (see Figure 3).

The two pathways highlight the magnitude of the necessary transformations as well as the interactions across the five systems and across the environmental and human well-being goals. They are not predictions or an endorsement of specific solutions, nor are they mutually exclusive. Instead, they are meant to foster discussion, among multiple stakeholders and actors at different levels, about possible pathways towards more sustainable futures.

These pathways all require unprecedented action, combining a range of transformative solutions across systems

While the two *Transformation Pathways* have different approaches to transforming production and consumption patterns, as well as different perspectives on environmental management (see Figures 2 and 3), both include major transformations of the Energy, Food, Environment, Materials & Waste, and Economics & Finance systems (see Figure 4). In the Energy system, both pathways include the decarbonisation of the energy supply, electrification of end-uses, and demand-side management. In the Food system, they include dietary changes, reducing food losses and waste, improving agricultural practices, and providing for sustainable intensification. In the Environment system, both pathways include the protection and sustainable use of ecosystems, as well as restoration of degraded land and forests. These transformations are supported by a circular economy that reduces the dependence on extractive activities and related environmental pressures. Finally, changes in the Economics & Financial systems help to enable these transformations by proper pricing of negative externalities, reforming harmful subsidies, unlocking private financial capital, and using non-price instruments to promote behavioural change. The *behaviour-focused pathway* shows much stronger reductions in primary energy demand, water withdrawal, and extraction of metals and material, while the *technology-focused pathways* shows much higher increases in renewable energy production, crop yields and mineral recycling rates (see Figure 4).

Figure 2
The narrative of the behaviour-focused *Transformation Pathway*

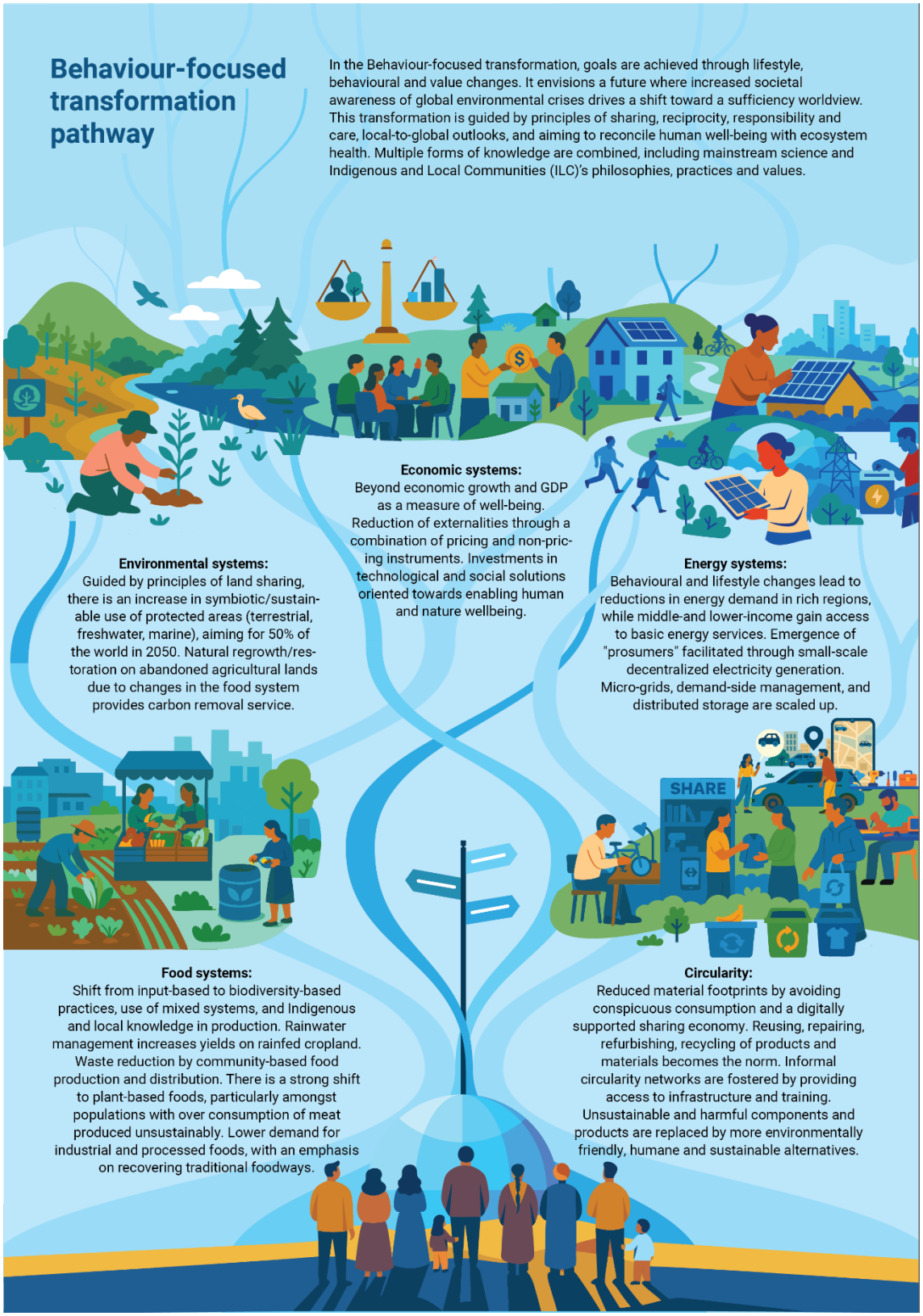
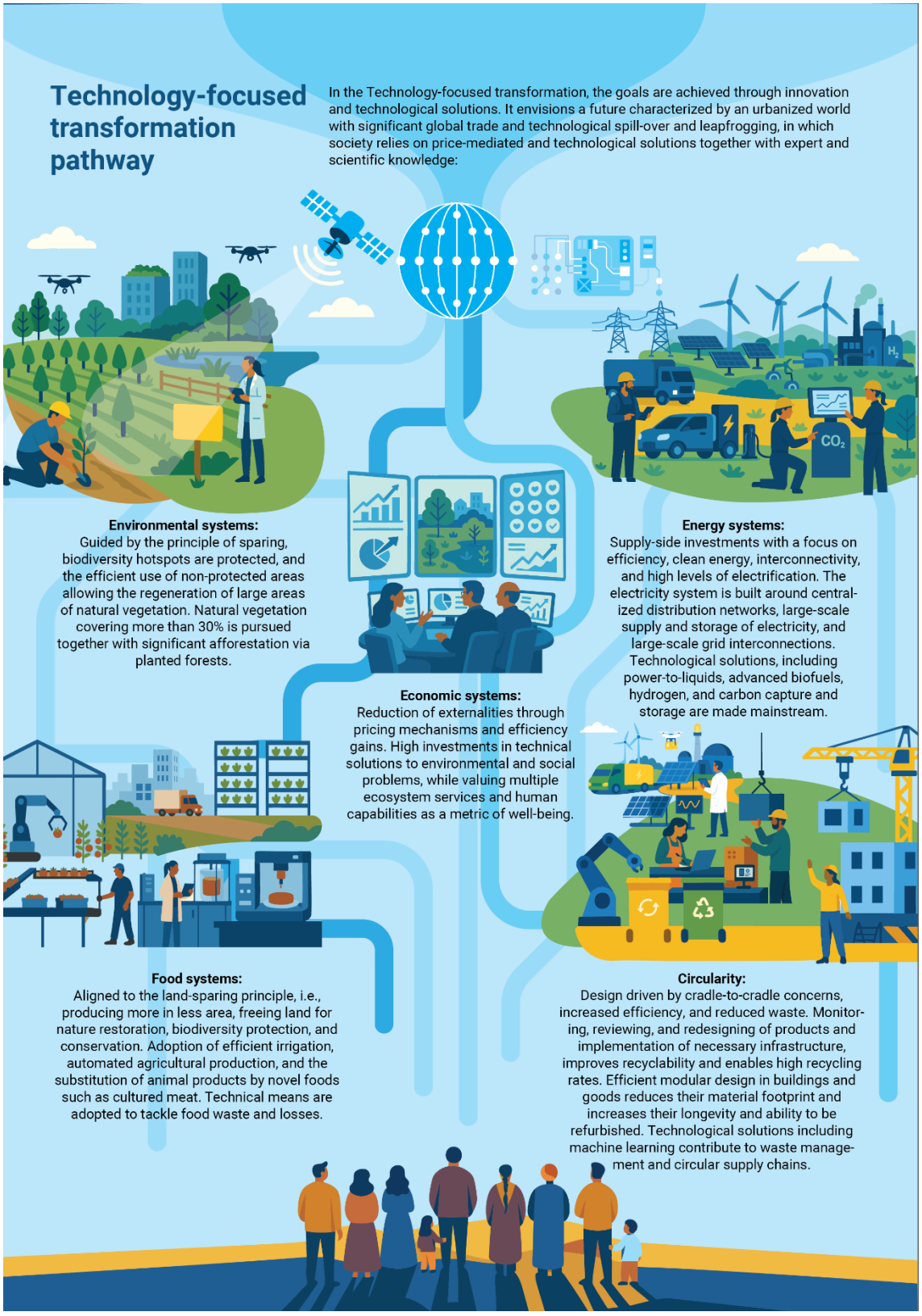


Figure 3
The narrative of the technology-focused *Transformation Pathway*



Integrated planning is necessary to harness synergies …

The *Transformation Pathways* reveal strong synergies across systems and goals. For example, decarbonizing energy supply reduces both climate change and air pollution. Furthermore, both efficiency improvements (in the *technology-focused pathway*) and lifestyle changes (in the *behaviour-focused pathway*) reduce energy, land, and material demand, and thereby pressures on all environment crises. In the Energy system, reducing overall energy demand reduces the required renewable energy expansion and associated infrastructure development. Consequently, this also lowers the related demand for those minerals critical to the energy transition. In the Food system, dietary changes – present in both pathways but through different means – free up large areas currently dedicated to agriculture, enabling land to become a net carbon sink and allow the conservation of ecosystems. These solutions act as important enablers to simultaneously meeting climate, biodiversity, land degradation, and pollution goals.

… and navigate trade-offs

The *Transformation Pathways* also present important trade-offs. For example, large-scale afforestation and the use of bioenergy with carbon capture and storage – both important for meeting stringent climate goals, especially in the technology-focused pathway – could, if implemented incorrectly, lead to land competition, biodiversity threats, and the need for higher agricultural yields with associated pressures on water resources. By using agricultural and forestry residues for bioenergy, as well as using abandoned pasture lands for energy-crop production, significantly less land is required and competing land claims can be managed with more ease. Furthermore, carbon pricing and biodiversity protection may induce a rise in energy and food prices, which disproportionately affects poor households and indigenous and local communities. In order to strengthen human well-being, it is thus important to ensure adequate provisioning systems as part of the transformation. Finally, both pathways will inevitably challenge the status quo, presenting potential conflicts with existing interests. This calls for careful attention for both the winners and losers of the transformation.

Transforming key systems brings multiple benefits for human well-being

Both pathways generate significant health benefits, due to cleaner air from decarbonising the energy system, reduced water pollution from improvements in agricultural practices, and more sustainable diets, among other things. This contributes to avoiding over 9 million premature deaths by 2050. Furthermore, the reduced demand and competition for natural resources may make it easier to achieve universal access to safe drinking water, modern energy services, and food security, with significant subsequent benefits for human health, poverty reduction, and human security.

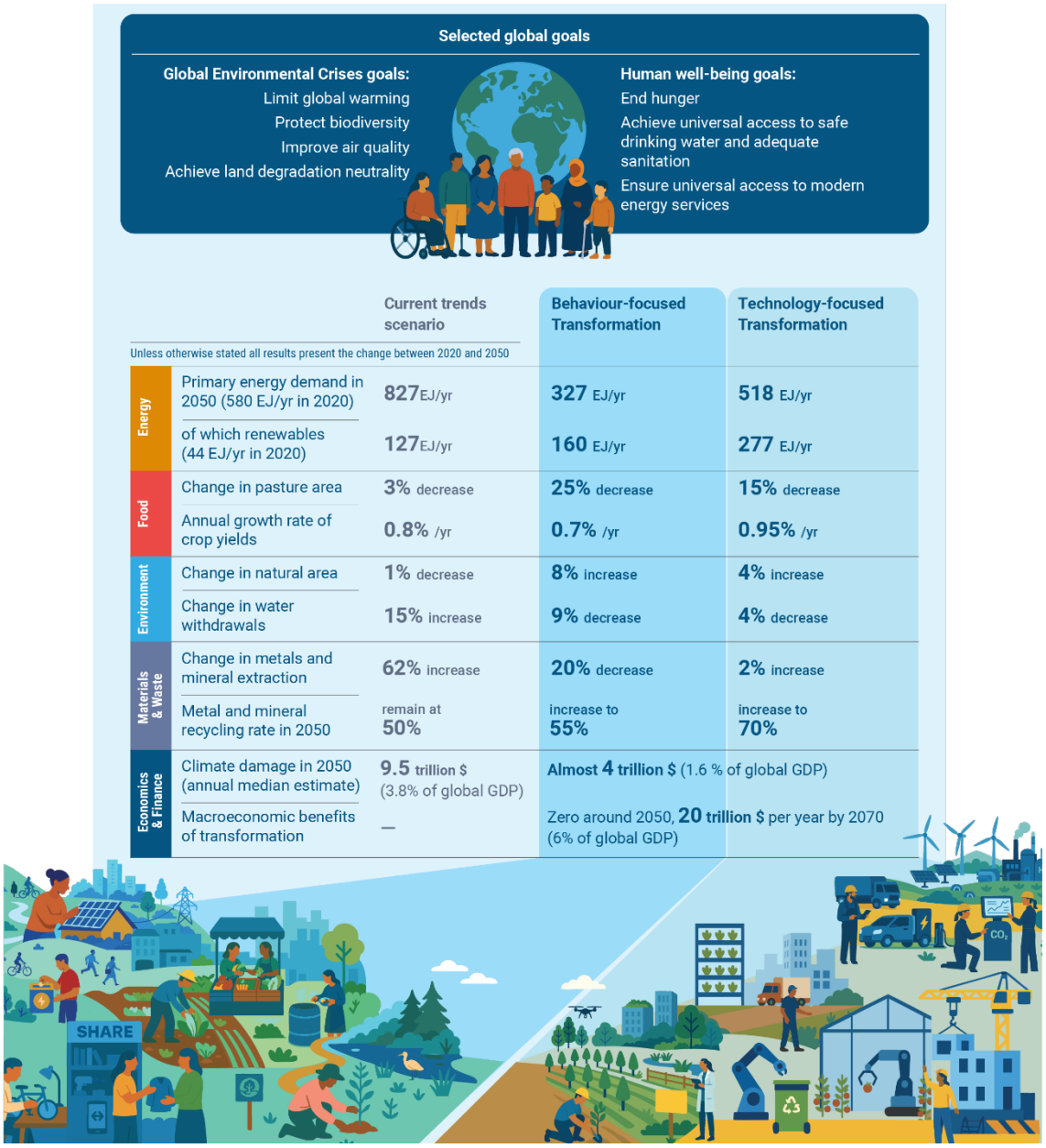
The long-term economic benefits of action outweigh the costs of the transformation

The macroeconomic costs implied in the *Transformation Pathways* peak at US$3 trillion per year around 2040 (approximately 1.5% of the projected global GDP). After 2050, these costs turn into benefits, as the avoided damages are also substantial and increase over time. Overall, the macroeconomic benefits are projected at US$20 trillion per year by 2070, contributing to 6% higher GDP, and continue increasing. These estimates depend on the reference scenario, here the high-emissions *Current Trends Scenario* which assumes no policies are implemented. Even compared to a scenario in line with a continuation of the mitigation effort implied by current policies, total macroeconomic benefits are estimated to increase to tens of trillions of dollars annually by 2100.

A future we choose

The global environmental crises can no longer be viewed as only environmental issues; they are also development, economic, and governance issues. Investing in a stable climate, healthy nature and land, and a pollution-free planet can avoid millions of deaths, help improve human well-being, and create long-term economic benefits. There are multiple pathways to do so, though all requiring unprecedented and coordinated action across systems and stakeholders.

Figure 4
Scenario results for key indicators of the five systems



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The scenario data can be explored here: https://geo7.apps.ece.iiasa.ac.at/.

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