Safeguarding the Global Commons for human prosperity and environmental sustainability

May 2022

The Global Commons Stewardship Framework

A discussion paper

CENTER FOR GLOBAL COMMONS

Endorsements

The preservation and restoration of the Global Commons on which our shared prosperity depends is a monumental task - one which we can only achieve, if businesses become a force for good and being a force for good is good for business. While the 'Race to Zero' on carbon emissions is well underway, it is difficult for business leaders and other decisionmakers to grasp the complex interconnections and tradeoffs between different Global Commons, like the climate system and land biosphere. The framework in this report cuts through this complexity and provides a tangible, science-based action agenda for decisionmakers to bring about the transformations required to preserve our Global Commons.

Paul Polman, business leader, campaigner and co-author of "Net Positive"

The Global Commons are the foundation for our continued prosperity on this planet. To preserve the health and resilience of these Earth systems, deep transformations of our economic and social systems are required. This framework builds on the scientific evidence and lessons from international progress on decarbonization to outline four system transformations, alongside the action levers that can unlock the economic, political and social change needed to achieve sustainable development within planetary boundaries.

Nick Stern, Professor of Economics, Chair of the Grantham Research Institute on Climate Change and the Environment, London School of Economics

The challenges of economic development, social inclusion, and the health of Earth systems are intimately linked, as are the sustainable development solutions. Economic wellbeing and environmental sustainability must not be in conflict. The Global Commons Stewardship Framework recognizes this core truth and establishes an action plan for a just and sustainable transition that benefits all parts of society and helps to reduce inequalities both within and among nations.

Jeffrey D. Sachs, Director of the Center for Sustainable Development at Columbia University

This report provides a compelling overview of the way in which human activity, and resource consumption in particular, are shaping the Global Commons. Spillover impacts from consumption and trade are driven by rich countries, while much of the damage and most vulnerable populations are concentrated in less developed regions. To avoid a global 'tragedy of the commons', we need coordinated management across countries, with a particular responsibility falling to high-income countries. The framework points toward the transformations and actions stakeholders need to take to achieve this, including demand-side measures that can reduce environmental destruction without undermining human wellbeing.

Izabella Teixeira, Co-Chair, UN International Resource Panel

Companies are transitioning toward a zero-emissions economy by setting science-based targets, reallocating capital, driving innovation and investing in new business models. This process has been accelerated by the Paris Agreement and resulted in an impressive array of multistakeholder coalitions that are transforming industries. While successful decarbonization is far from assured, this report highlights that we need to learn from these promising successes to develop effective governance mechanisms to safeguard the Global Commons on which our continued health, prosperity and security depend.

Nigel Topping, High Level Champion for Climate Action for COP26

Today, many business leaders understand the clear scientific evidence for potentially calamitous environmental risks. The art is however how link the business goals and core competencies to it. In other words: how to do well (business-wise/ financially) by doing good (for society). By outlining system transformations as well as action levers, the framework described helps to translate the science into concrete actions for business. The private sector will be essential to financing and driving these transformations to preserve the health and resilience of our Global Commons. Understanding the real costs and opportunities for purpose-driven business models should be near the top of board agendas.

Feike Sijbesma, former CEO Royal DSM, co-chair Global Climate Adaptation Centers, Board Philips and Unilever

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Foreword

The scientific evidence is now overwhelming: we are on a collision course with the stable and resilient Earth systems on which human wellbeing, prosperity and safety depend. On current trends, the world is rapidly depleting the stability and resilience of interdependent Earth systems—our Global Commons. We need to transform our economic and social systems to safeguard these Global Commons or risk exceeding tipping points beyond which change may become self-reinforcing and irreversible. And we need to make these changes urgently.

It might seem far-fetched to advocate for a stronger focus on the Global Commons at a time when the world's attention is focused on the war in Ukraine and the terrible human suffering that is unfolding as a result. Countries are racing to increase their military spending. Fissures in the international community and divisions between major powers are growing wider. The war threatens to generate shortages and crises for the many countries that depend on imports of energy, food and fertilizer.

These are precisely the types of dislocations that the unchecked degradation of our Global Commons will exacerbate. There is growing evidence that destabilized Global Commons function as a threat multiplier: they amplify displacement, migration and conflict. We now need to realize that healthy and resilient Earth systems—our Global Commons—are at the heart of our health, security and prosperity, and work together to manage them responsibly.

Another casualty of the war in Ukraine could be international cooperation to safeguard the climate system and other Global Commons. Similarly, the global economic system has shown itself to be highly fragile because of its dependence on fossil fuels, which are frequently sourced from totalitarian regimes. It is impossible to tackle these challenges without greater international cooperation—a point that is reinforced every day by the ongoing COVID-19 pandemic. The war must end quickly to end the human suffering in Ukraine. This is also essential to prevent another food crisis and rebuild our capacity for cooperative approaches to safeguard the Global Commons. Countries need security from outside aggression and from the degradation of our critical Earth systems. This will require new governance mechanisms for Global Commons stewardship that can facilitate effective collaboration toward this shared purpose.

To succeed, we need a shared framework for action that can bring together stakeholders, guide transformations and inform deft diplomacy in support of security and the Global Commons. We need clarity on the direction and levers of change at the local, national and global levels.

Drawing on the latest science, we outline a framework for Global Commons stewardship organized around four system transformations:

- decarbonization of energy, industry and transport;
- sustainable cities and communities;
- sustainable production and consumption; and
- sustainable food, forests, land, water and oceans.

These transformations are feasible and can chart a path toward a prosperous future that promotes peace and prosperity. Rich countries must take responsibility. The Global Commons Stewardship Index, published by the United Nations Sustainable Development Solutions Network and Yale University, shows that rich countries generate high negative spillovers that drive adverse impacts on Global Commons in less developed countries. Now is the time for rich countries to take the lead and work together with all countries to develop equal and mutually beneficial partnerships built on diplomacy, investment and trade that value, preserve and restore the Global Commons.

This report has benefited from extensive consultations with stakeholders and experts from around the world. We are grateful for their advice and guidance.

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Key messages

Science has made clear that in the age of the Anthropocene, human actions are undermining the stable and resilient Earth systems which are the very foundation of human development and prosperity. We refer to these systems collectively as the "Global Commons." The Global Commons comprise key biophysical systems with nine planetary boundaries, some of which we are transgressing, putting our shared health and prosperity at risk.

Destabilized Global Commons function as a threat multiplier: an amplifier of displacement, migration and conflict. The Global Commons are central to current global disruptions, from the zoonotic COVID-19 pandemic to the climate emergency and biodiversity loss. Even Russia's invasion of Ukraine illustrates the risks of not considering or valuing the resilience and sustainability of energy, food and land use systems. We must now realize that healthy and resilient Earth systems—our Global Commons—are at the heart of our health, security and prosperity, and work together to manage them responsibly.

The breach of the planetary boundaries and the destruction of the Global Commons are deeply rooted in the prevailing economic system, which is based on linear production, consumption and disposal patterns, without adequate pricing of externalities. The fundamental solution for humanity to achieve sustainable development within the planetary boundaries is thus to transform our current economic and social systems. This will involve four system transformations:

- decarbonizing our use of energy;
- adopting circular production and consumption;
- making cities and communities more sustainable; and
- transforming food, land and ocean use systems.

Bringing about these profound transformations will involve a set of action levers. Through a review of the literature and expert consultations, we characterize these as:

- advances in target setting, governance and institutions;
- a reset of economics, finance and incentives;
- inclusive and fair consensus building; and
- harnessing innovation, technologies and data.

This report presents a comprehensive framework to safeguard the Global Commons organized around four systems to be transformed, with four common sets of action levers to catalyze system transformation. While safeguarding the Global Commons requires a comprehensive approach and collaboration by diverse stakeholders, we also present an action agenda that translates these levers for governments, business and finance, civil society and international organizations.

We hope this 4x4 matrix will help stakeholders take meaningful action to safeguard the Global Commons by cutting through the complexity. However, we recognize that the world is failing to take action at a scale and speed which are commensurate with the magnitude and urgency of the challenge. We lack an effective mechanism to govern the Global Commons; and as yet, it is not widely recognized that the health and stability of the Global Commons are essential to our continued prosperity and security. Time is not on our side.

The complementarity of intergovernmental mechanisms and multistakeholder coalitions in the global fight against climate change may be the most promising mechanism for effective governance of the Global Commons.

Ensuring the health and resilience of the Global Commons is in the interests of all nations, but some countries bear a disproportionate responsibility. In other words, the prosperity of rich countries is secured through the imposition of the burden of unsustainable production on developing countries. These spillover effects are made strikingly clear by the Global Commons Stewardship Index, discussed further in this report. Developed countries thus have both the responsibility and the resources to lead the system transformations needed to safeguard the Global Commons. All countries must work together by developing equal and mutually beneficial partnerships built around diplomacy, investment and trade that value, preserve and restore the Global Commons.

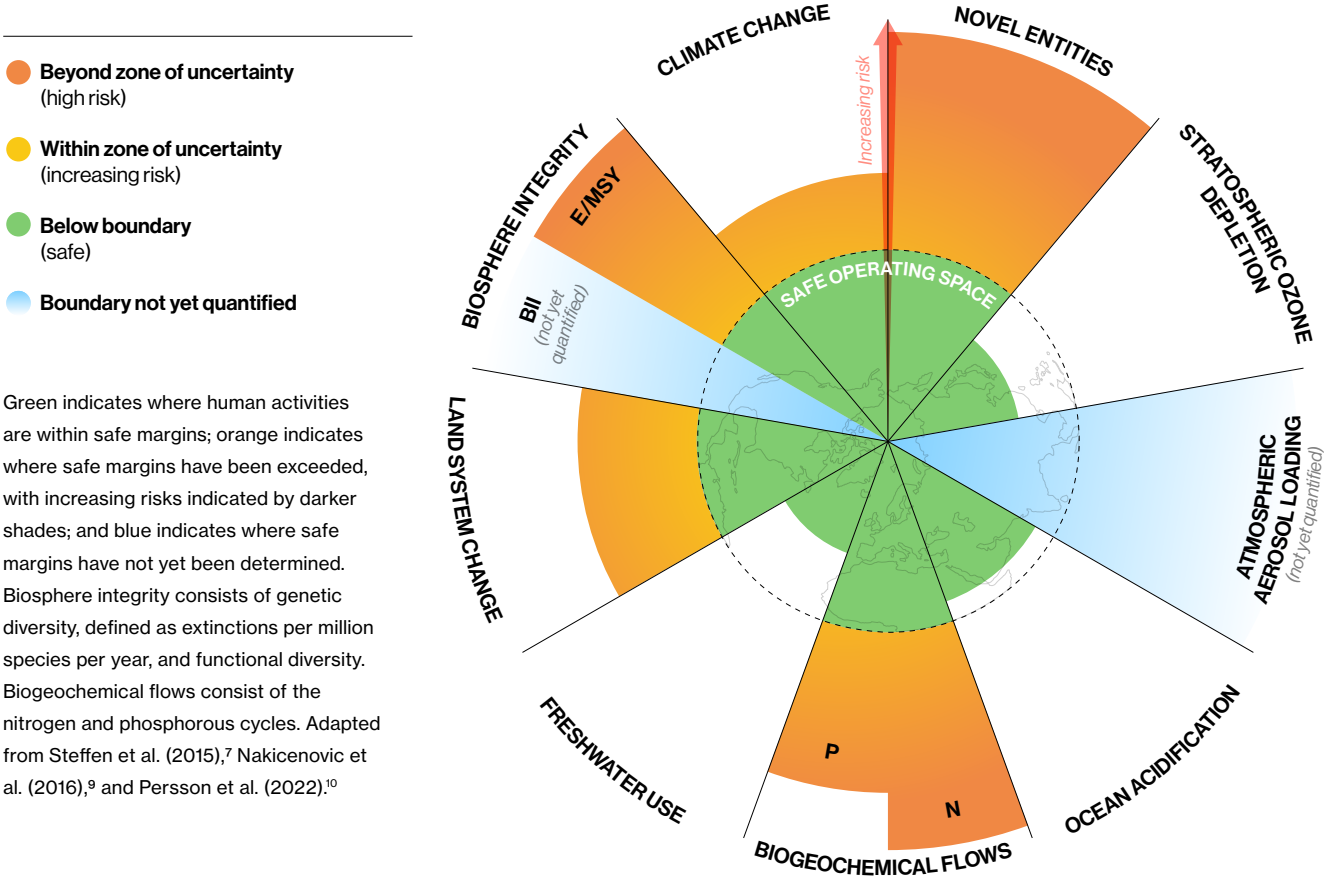
A Summary for decision makers

It is now abundantly clear to all: our unsustainable resource use, linear production and consumption patterns, and destruction of nature are changing the climate and disturbing stable and resilient Earth systems. We are witnessing more frequent droughts and heatwaves; more severe hurricanes and typhoons; accelerating sea level rise; major disturbances to agriculture; unprecedented coral bleaching; and the collapse of major fisheries. Humanity is now undermining all life on Earth.[1] The sixth Intergovernmental Panel on Climate Change (IPCC) Assessment Report underlines the urgency of achieving deep emission reductions,[2] but prevailing economic trends risk putting the achievement of the UN Sustainable Development Goals (SDGs) and the objectives of the Paris Agreement out of reach.

We are now in a new geological epoch shaped by human degradation of critical Earth systems—the Anthropocene.[3] Over the last 12,000 years, modern humans have enjoyed the Holocene: a uniquely stable epoch that enabled the rise of the world's great civilizations. Since 1900, however, the world's population has increased almost fivefold and world gross product has risen eightyfold.[4] Humans are consuming ever-larger shares of the world's renewable and non-renewable resources, and emitting unsustainable volumes of waste and pollutants.

As a result, humanity is at risk of exceeding the scientifically estimated safe operating thresholds for people and the planet. Scientists have estimated the carrying capacity of the Earth, or "planetary

FIGURE 1
Planetary boundaries



Green indicates where human activities are within safe margins; orange indicates where safe margins have been exceeded, with increasing risks indicated by darker shades; and blue indicates where safe margins have not yet been determined. Biosphere integrity consists of genetic diversity, defined as extinctions per million species per year, and functional diversity. Biogeochemical flows consist of the nitrogen and phosphorous cycles. Adapted from Steffen et al. (2015),[7] Nakicenovic et al. (2016),[9] and Persson et al. (2022).[10]

boundaries,"[5,6] which must be respected to preserve critical Earth systems and ensure a safe operating space for humanity (Figure 1). Several of these boundaries have already been transgressed; some are within a zone of uncertainty; and for others, we lack adequate data. Under business as usual, many planetary boundaries are projected to be transgressed in the near future, which would threaten human civilization and survival.[7]

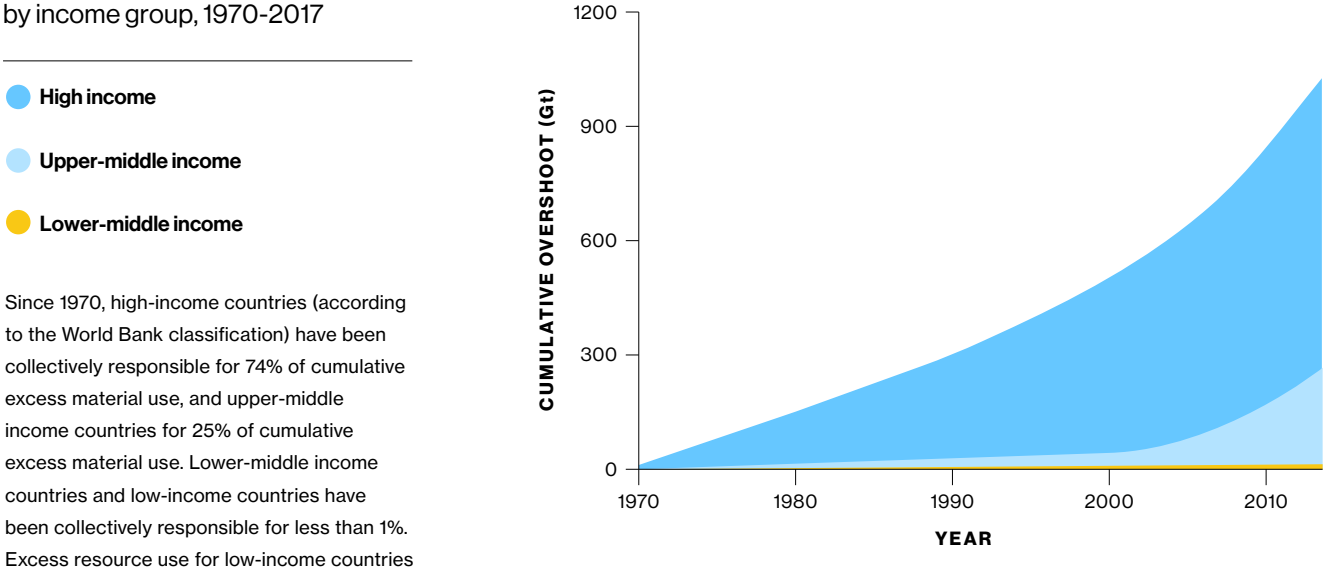
A major course correction is needed to provide a safe and just corridor for people and the planet. Clearly, the prevailing trends are unsustainable. Transformations of key economic systems are needed to promote human prosperity and wellbeing for all without breaching the planetary boundaries. As we discuss below, successful strategies to stabilize the Earth system must also take account of inequalities. Rich countries, and the wealthy within each country, account for a disproportionate share of the resource use and pollution that are driving global environmental change (Figure 2). For these reasons, a global perspective is needed on these challenges; and strategies must be integrated across biophysical, technological and social drivers of change.

The framework presented in this report provides a science-based foundation for decision makers that cuts through the complexity to provide comprehensive measures for Global Commons stewardship. The scale of the required transformations of our economic, social and geopolitical systems is daunting; the transformation is complex; and inertia and vested interests in incumbent systems

prevent decisive action from being taken simultaneously at all scales. The mission to avoid transgressing dangerous tipping points in the Global Commons can succeed only by triggering and accelerating change across socio-technical, ecological and market/economic systems.

Tentative progress in the global fight against climate change provides some hope and lessons on more effective mechanisms to govern the Global Commons. Despite the deficiencies in official negotiation deals, COP26 in Glasgow revealed growing momentum in key transitions, which in turn provides both grounds for optimism and practical lessons to accelerate progress. The global fight against climate change has shown how intergovernmental mechanisms complemented by multistakeholder coalitions can accelerate ambition, action and advances in technology. This combination of intergovernmental and multistakeholder coalitions may present the best possible option to govern the Global Commons. Meanwhile, investors and regulators are increasingly recognizing previously hidden costs and risks of unsustainable business practices. In response, they are shifting investments to enhance their resilience and seize the multitrillion-dollar business opportunities of contributing to the fulfillment of the SDGs and the transformation to a regenerative economy. In contrast to the potential costs of planetary disruption—such as the estimated $22 trillion loss to the global economy from the COVID-19 pandemic—the investments required to seize these opportunities are entirely manageable. As governments, regulators, investors, customers and employees increasingly demand that businesses take responsibility, laggards face existential risks.

FIGURE 2
Cumulative excess resource use of countries by income group, 1970-2017



Since 1970, high-income countries (according to the World Bank classification) have been collectively responsible for 74% of cumulative excess material use, and upper-middle income countries for 25% of cumulative excess material use. Lower-middle income countries and low-income countries have been collectively responsible for less than 1%. Excess resource use for low-income countries is close to zero and thus not visible in this figure. Adapted from Hickel et al. (2022).[8]

Staying within the planetary boundaries requires a global perspective on the preservation of five Global Commons domains:

- the climate system;
- the ozone layer;
- the land biosphere;
- oceans; and
- the cryosphere (i.e., polar ice sheets and glaciers).

Each of these domains consists of numerous biophysical Global Commons systems. For example, the cryosphere is made up of the following Global Commons systems:

- Arctic sea ice;
- the East and West Antarctic Ice Sheets;
- the Greenland Ice Sheet; and
- inland glaciers.

Several of these Global Commons systems constitute "tipping elements"—that is, they not only contribute to the regulation of the Earth system, but can also undergo major changes past dangerous tipping points. If they are pushed too far (e.g,. through greenhouse gas (GHG) emissions, deforestation or pollution) and these tipping points are exceeded, this can lead to irreversible changes due to shifts in feedbacks (e.g., from buffering/cooling to self-amplifying/warming). Each Global Commons is a biophysical system that affects the stability of the Earth system as a whole and can be preserved only through coordinated management across countries. The Global Commons are highly interdependent and must be secured through integrated strategies at the local, national, regional and global levels.

The **Global Commons Stewardship Framework** we outline provides a powerful, science-based guide for decision makers to understand what needs to be done to safeguard the Global Commons and align actions with their preservation and restoration. It is organized around four systems to be transformed, with four common sets of action levers.

The following system transformations are critical to safeguard the Global Commons:

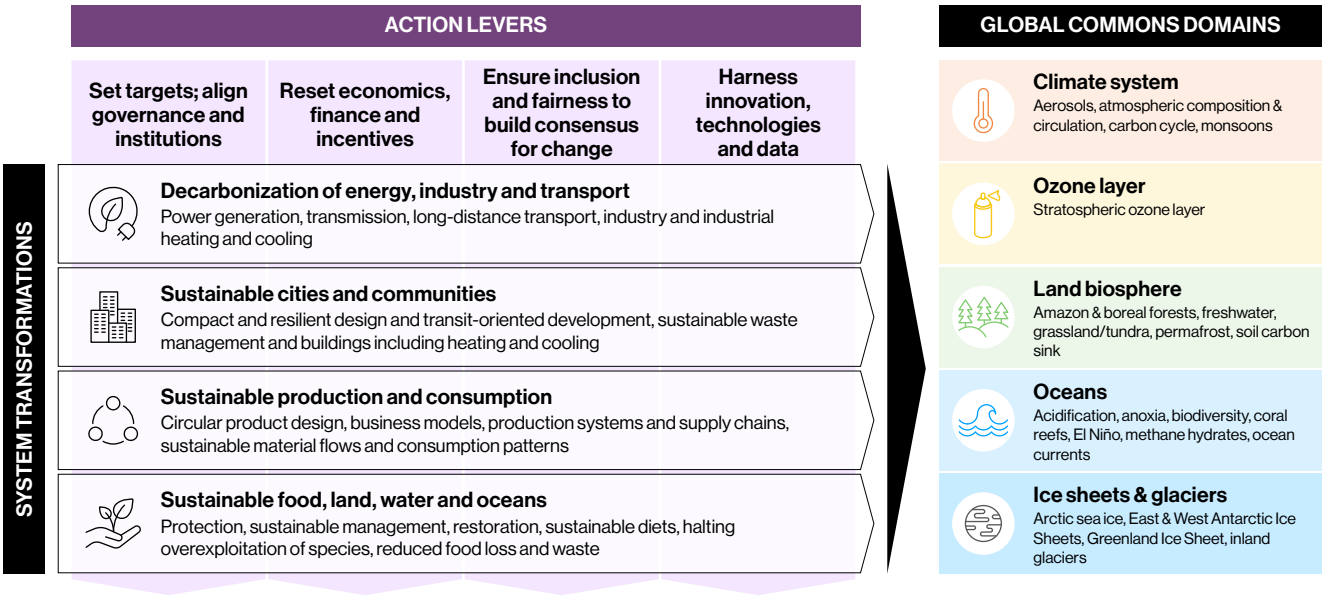
- **Decarbonized energy, industry and transport:** The decarbonization of power generation, transmission, long-distance transport, industrial heating and industry through measures such as enhanced efficiency, increased electrification, the phaseout of fossil fuels, modal shifts and the development of new fuels and solutions for hard-to-abate sectors—all while ensuring universal access to clean energy.

- **Sustainable cities and communities:** Including through access to compact and resilient urban design and transit-oriented development, sustainable buildings, heating and cooling of buildings and waste management.

- **Sustainable production and consumption:** Including through circular product design, production systems and supply chains, sustainable material flows and shifting consumption patterns.

- **Sustainable food, forests, land, water and oceans:** Including through protection, sustainable production and

FIGURE 3
The Global Commons Stewardship Framework



For a detailed list of the transformations and their critical components, see Table 3.

management, restoration, sustainable healthy diets, reduced food loss and waste, halted overexploitation of species and greater efficiencies in supply chains.

To activate these system transformations, there are four common sets of action levers which governments, businesses and other stakeholders can pursue. Together with the system transformations, these form the Global Commons Stewardship Framework, which can motivate, guide and accelerate actions and international cooperation among governments, civil society and businesses to safeguard the Global Commons and promote human wellbeing worldwide:

- **Set targets and align governance and institutions** to provide a clear ambition and pathway for change, strengthen multistakeholder coalitions and social movements, and reconfigure national governance and international cooperation for the Anthropocene. The most promising mechanism for effective governance of the Global Commons may be strong new multistakeholder coalitions that complement improved intergovernmental and national mechanisms.

- **Reset economics, finance and incentives** for the Global Commons by putting a price on carbon and natural capital, aligning economic policies and regulations toward Global Commons stewardship, redefining government and business accounting, and catalyzing private, public and blended finance.

- **Ensure inclusion and fairness to build consensus for change** by developing strategies for just transitions, including participatory design, fair incomes and investment in health, education and social safety nets to provide the foundation for these transformations; and valuing and

championing Indigenous Peoples and local communities as stewards of the Global Commons.

- **Harness innovation, technologies and data** to advance our understanding of the Global Commons and accelerate the transformations to safeguard them, paying special attention to the governance of the cybersphere.

In this report, we draw on a review of the literature on the enablers of climate action conducted by the World Resources Institute (WRI),[11] emerging lessons from energy decarbonization, major policy initiatives such as the European Green Deal and a vast number of multistakeholder coalitions around the world to identify practical steps for catalyzing the action levers for Global Commons stewardship. The specific actions that we encourage governments, business and finance, civil society organizations and international organizations and financing institutions to take are outlined at the end of this section. However, none of these actors can solve the challenges ahead in isolation; close collaboration between all stakeholders is essential and siloed approaches are likely to fail.

Action Lever 1: Set targets; align governance and institutions

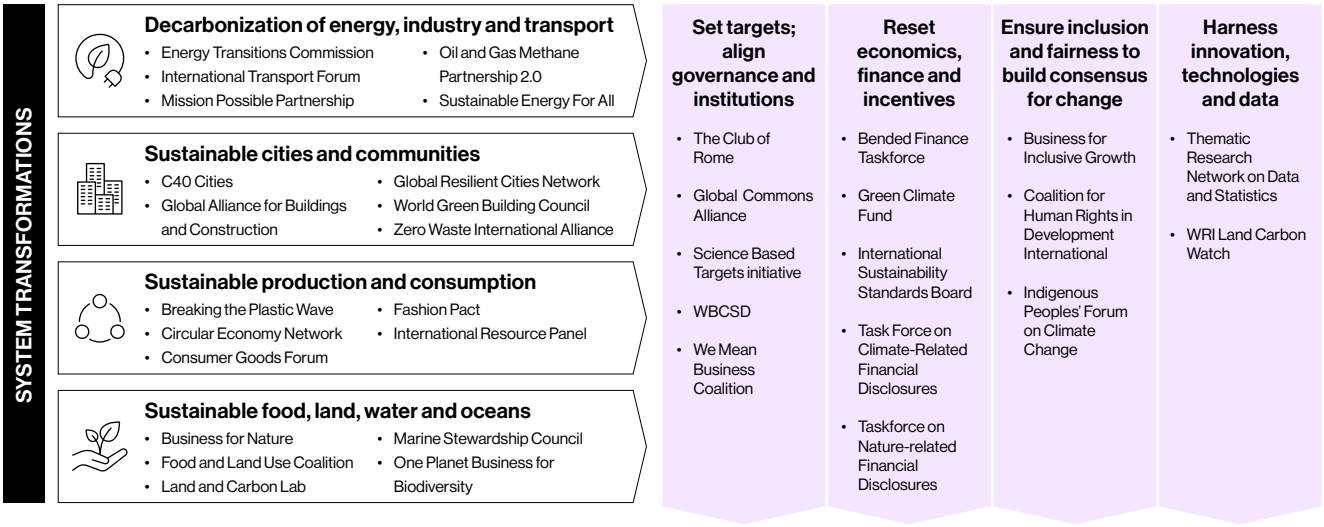
- **Set clear targets and promote pathways as a method for problem solving**. This builds on the initial success of the Paris Agreement and the emerging post-2020 global Biodiversity Framework. Targets should draw on advanced system modeling to focus attention on the task at hand and serve as management tools. Sector pathways—as promoted by the Energy Transitions Commission (ETC) and the Food and Land-Use Coalition (FOLU)—can demonstrate the feasibility of rapid progress, sharpen our understanding of how to solve the challenges and mobilize all stakeholders around a shared vision for Global Commons stewardship that helps ensure a just transition.

- **Strengthen multistakeholder coalitions and social movements** to complement the actions of international bodies and government-to-government cooperation by promoting problem solving, bottom-up experimentation, advocacy, coordination and implementation support across stakeholder groups and domains of expertise.

- **Make domestic policies and international cooperation fit for the Anthropocene.** Countries need institutions and processes to ensure science-based policymaking and measurement of progress, as well as new ways to balance political priorities.

FIGURE 4

Selected multistakeholder coalitions advancing elements of Global Commons stewardship



Countries—particularly the richest ones—must track and reduce negative spillovers on other nations and the Global Commons. On the international stage, countries should consider "Green Deal diplomacy" that frames bilateral and multilateral relationships under the overall objective of advancing sustainable development, including by setting a credible example and following up with diplomacy, trade policy, development support and other external policies.[12] There is a need for new international governance mechanisms for Global Commons stewardship.

- **Address illegal acts that harm the environment** by upholding and enforcing high legal standards domestically, respecting other countries' laws, strengthening transparency in supply chains and promoting efforts by multistakeholder coalitions. This includes extending the scope of illegal activities to ensure accountability and responsibility for environmental harms.

Action Lever 2: Reset economics, finance and incentives

- **Align fiscal policies with Global Commons stewardship.** This includes accounting for harm to the Global Commons through the adequate pricing of carbon and other pollutants; phasing out and repurposing harmful subsidies; facilitating the strategic use of public procurement; and preventing base erosion and profit shifting to ensure that countries have the fiscal means to invest in Global Commons stewardship.

- **Invest in safeguarding the Global Commons.** Each of the four transformations will require substantial public and private investments. National development banks and multilateral financial institutions play a critical role in directing long-term capital, alongside other public investment mechanisms, such as publicly supported pension funds. These institutions should ensure

their portfolios meet sustainability impact assessments and use blended finance to leverage and help direct private investments toward Global Commons stewardship. Payments for ecosystem services can raise funds and create markets for the regeneration of nature.

- **Align business and financial sector incentives with Global Commons stewardship**. To mobilize private capital for the four system transformations, countries and the international community must reform financial regulation and business accounting standards (including obligations to measure, disclose and manage risks); broaden national accounts to include natural capital; and introduce metrics for sustainable development that complement the use of gross domestic product (GDP) as a measure for a nation's wellbeing. Corporate leaders need to recognize that private gain at public expense is no longer acceptable and commit to net-positive business strategies. Financial institutions should shift their portfolios and develop instruments to raise funds for transformations based on science-based, externally verifiable decarbonization targets and other sustainability goals.

Action Lever 3: Ensure inclusion and fairness to build consensus for change

- **Design transformations in fair, transparent and participatory ways**. Globalization has brought prosperity to billions of people; but many still cannot meet basic needs and the COVID-19 pandemic has pushed millions into extreme poverty. Many of the poorest countries are particularly vulnerable to the collapse of the Global Commons. As rich countries take responsibility for reducing their global environmental footprints, they should establish equal and mutually beneficial partnerships that support countries in pursuing green, resilient and inclusive development. In embarking on transformations, countries should draw on emerging lessons from energy decarbonization on how to engage workers, trade unions and other stakeholders in the design and implementation of pathways that promote a just transition. Measures like transition funds and large-scale investments in education, skills and retraining can help reverse some of the regressive effects of decarbonization policies. High ambitions and solidarity within and across countries must go hand in hand.

- **Value and champion Indigenous Peoples and local communities as stewards of the Global Commons.** These are at the heart of managing critical habitats, particularly in the land and ocean biospheres. Valuing Indigenous Peoples and local communities means recognizing and upholding their substantive rights (e.g., to their land) as well as their procedural rights (e.g., to free, prior and informed consent; to information; to justice). Businesses and governments should not only respect these rights, but actively seek to consult and integrate the skills and expertise of Indigenous Peoples while ensuring inclusive and equitable decision making for the benefit of the local and Global Commons.

Action Lever 4: Harness innovation, technologies and data

- **Focus national innovation systems and industrial strategies** to align them with the technology needs of the four system transformations and harness them for prosperity—for example, by launching innovation challenges to identify promising technology-based solutions for Global Commons stewardship.

- **Promote trackers and measure progress, fill data gaps and make data useful for Global Commons stewardship**. To strengthen accountability and mobilize attention, stakeholders should focus initially on making direct and indirect impacts transparent (e.g., using the Global Commons Stewardship (GCS) Index); monitoring the progress of system transformations (e.g., through the Systems Change Lab); and supporting national policy action trackers (e.g., drawing on lessons from the Climate Action Tracker (CAT) for the energy transformation). Major data gaps still exist (e.g., on chemical pollutants/ novel entities, biodiversity, aerosols and oceans) at various scales, from corporate and global to local, but can now be closed at modest cost; and real-time data portals and artificial intelligence can drive data impact.

- **Enhance the cybersphere** by promoting shared and transparent management of the Internet and other digital technologies as critical levers for Global Commons stewardship.

The Global Commons Stewardship Framework, and its core thinking and implementation, are supported by several instruments, such as modeling, measuring and tracking systems change. Together, we call this entire body of work the **Global Commons Stewardship Initiative (GCSI).**

All components of the GCSI—the GCS Index, the PIK/Earth Commission modeling exercise and the results of the Systems Change Lab—herald the same message: **the speed and scale of progress on system transformation are grossly insufficient for us to achieve sustainable development within the planetary boundaries**. We urgently need to accelerate this process through the action levers outlined in this framework.

Other components of the Global Commons Stewardship Initiative

In addition to the Global Commons Stewardship Framework, the GCSI is pursuing the following initiatives (each work is also presented in a separate document):

- **The GCS Index—compiled by the Sustainable Development Solutions Network (SDSN), the Yale Center for Environmental Law & Policy and the Center for Global Commons at the University of Tokyo—assesses both domestic impacts on the Global Commons and the wider impacts of trade and consumption (so-called "international spillovers").**[13] Rich countries generate the largest share of international spillovers. Even if the domestic impacts of these countries look reasonable, once international spillovers are included, it becomes clear that their footprint is unsustainable. Trade is an important source of income and prosperity; but unsustainable production of food and manufactured goods is driving environmental degradation such as deforestation, rising GHG emissions and other adverse effects. In absolute terms, G20 countries bear a special responsibility to accelerate the transformation toward sustainable consumption and production systems, and therefore to reform the governance of the Global Commons. The next iteration of the Index will improve both the quality and the granularity of the data; and the GCSI will assess practices and policies that could effectively mitigate spillovers and assure Global Commons stewardship. We will use these insights to propose concrete steps to expand effective governance.

- **The Potsdam Institute for Climate Impact Research (PIK) and the Earth Commission are undertaking interdisciplinary modeling of transformation pathways** that will allow humanity to stay within planetary boundaries and achieve the SDGs by 2030, 2050 and beyond. While existing modeling and resulting pathways largely focus on achieving a given climate stabilization target, this work will capture the interactions across the four system transformations and two Global Commons domains: the climate system and the land biosphere. The goal is to determine the level of system transformation which is needed to maximize wellbeing within the planetary boundaries.

- **The Systems Change Lab, sponsored by WRI and the Bezos Earth Fund, tracks progress in implementing system transformations, as well as enablers of change.** Its State of Climate Action 2021 report assesses progress toward the transformational change needed to limit warming to 1.5°C, which is aligned with many of the system transformations identified here.[11] The report reveals that the transitions required to avoid the worst climate impacts are not happening fast enough. Of the 40 indicators assessed, none is on track to reach the 2030 targets. Change is heading in the right direction at a promising but insufficient speed for eight; and in the right direction but well below the required pace for 17. The remaining transformations are either stalled, heading in the wrong direction or lacking data. The report also identifies underlying conditions that enable change: supportive policies, innovations, strong institutions, leadership and shifts in social norms. For example, annual increases in finance for climate action must accelerate thirteenfold to meet the estimated need in 2030.

From the Paris Effect to the Spirit of Glasgow

Russia's invasion of Ukraine is both a challenge to and an opportunity for the notion of peaceful international collaboration. Putin's "might-is-right" military invasion, founded on baseless propaganda, aims to deal a death blow to an already weakened rules-based international order. At the same time, it has resulted in unprecedented unity and resolve across much of the world. It could yet provide a lesson for the ability of countries to work together in the pursuit of shared interests. Given the recent escalation of the Ukraine situation, we now need to realize that healthy and resilient Earth systems—our Global Commons—are at the heart of our health, security and prosperity, and work together to manage them responsibly. To this end, we need a robust new governing mechanism.

The present moment offers unprecedented opportunities to advance Global Commons stewardship. In the five years since the Paris Agreement was adopted, countries and regions accounting for more than 50% of global GDP have put net-zero targets in place;[14] although more is needed to keep global warming within 1.5°C, such as credible pathways to net zero that include ambitious near-term targets for 2030. These initiatives are also creating the conditions for companies to follow suit. Clear long-term goals, innovation and public support for emerging technologies (e.g., renewable feed-in tariffs) have enabled much faster technological progress than anticipated by most analysts—what we call the "Paris Effect."[14] Renewable energy is now cheaper than fossil fuel-based power in most markets; electric vehicles are replacing the internal combustion engine; hydrogen aircraft are in development; and industries are organizing around decarbonization. As climate change increasingly becomes a lived reality, public awareness of the need for mitigation and adaptation is at an all-time high.

Even if the pieces are falling into place for the decarbonization of energy systems, much greater efforts are needed to achieve the objectives of the Paris Agreement. Global emissions continue to rise and national ambitions—albeit growing—remain insufficient.[15] The clear message from COP26 in Glasgow was the need to move from talk to action. While the government-to-government negotiations produced only modest results, what was truly remarkable about the gathering was the array of other forces aligning with the need for deep decarbonization. For instance, the Glasgow Financial Alliance for Net Zero united existing initiatives and over 450 financial firms across 45 countries responsible for assets of more than $130 trillion to drive science-based decarbonization in finance and the real economy. Many events brought into sharp focus the pathways to deep decarbonization country by country, sector by sector and even company by company. Fulfilling this "Spirit of Glasgow" will require creativity and courage from policymakers and business leaders, backed by strong advocacy from citizens and youth, to take on vested interests that are beholden to polluting technologies. Safeguarding the Global Commons requires transformations of our entire economic system, which must be pursued with the same vigor.

The challenges to development, inequality and the health of critical Earth systems are intimately linked; and the same is true of their solutions. All countries must strive to meet the needs of their populations while staying within the planetary boundaries. Development and sustainability must not be in conflict. The SDGs rightly include social

development alongside environmental sustainability. Without social inclusion and human wellbeing, it will be impossible for societies to undertake and sustain the transformations needed to stay within the planetary boundaries. This need for new, equitable solutions also has a strong international dimension, as spillover impacts are driven by international trade. To succeed, we require clear paths toward a just transition that benefits all parts of society and helps reduce inequalities both globally and nationally. Demand-side measures that eliminate unnecessary resource use can play an important role in reducing pressures on the Global Commons, while helping to improve basic wellbeing for all.

International cooperation can mobilize countries around shared approaches to safeguarding the Global Commons. For example, the Organisation for Economic Co-operation and Development (OECD) has been instrumental in brokering a global agreement to reform taxation and has proposed a harmonized assessment framework for carbon pricing.

New multistakeholder coalitions—involving business, civil society organizations, consumers and investors—are building powerful movements that complement multilateral cooperation. These can help break the impasses that sometimes paralyze multilateral mechanisms. In particular, civil society organizations can drive increased accountability, effective communication and stakeholder engagement. We need more of this mobilization; and we need to amplify the voices of youth to focus minds and spur us to try harder to tackle the challenges ahead.

Companies must also play an important role in safeguarding the planetary boundaries, as their long-term success depends on the health of people and the planet. Contributing to the fulfillment of the SDGs and the transformation to a regenerative economy is a multitrillion-dollar business opportunity. Every major company should commit itself to science-based targets. There simply is no longer social license for companies that do not combine the profit motive with active participation in realizing the system transformations toward Global Commons stewardship.

Education fulfills multiple critical roles in enabling and sustaining the transformation to a global economy that operates within the safe and just corridor. Universal access to education provides a necessary foundation for scientific understanding and innovation. Universities and research organizations have a special responsibility in training the next generation of leaders and promoting practical problem solving for sustainable development.

The time is now to bring humanity's impact on the Earth in line with the planetary boundaries. We are conscious of the catastrophic costs that inaction will incur for all people on this planet. We also know how painfully slow and difficult international cooperation can be—particularly when major powers compete for global leadership. But having studied the issues carefully, we are convinced of the feasibility of rapid progress in securing the Global Commons. This requires a step change in action across all stakeholders and all sectors of the economy. We are inspired by the Paris Effect and the advances that have occurred in recent years. When we put our minds to the four system transformations, human ingenuity and cooperation will prevail. There can be no more bystanders; so we call on everyone to join the fight for a better future.

A.1 Action items for governments

Disclaimer: Governments, businesses and international or civil society organizations cannot solve the challenge of Global Commons stewardship in isolation. Close collaboration between stakeholders at all levels is essential and siloed approaches are likely to fail. We therefore call on all actors to join forces and engage in effective multistakeholder coalitions.

Set targets; align governance and institutions

- **Commit to targets and pathways:** Translate strategies into concrete national goals for both the medium and long term (e.g., 2030 and 2050) across the four system transformations. These targets should then be translated into action through long-term pathways.

- **Align policymaking processes and ensure oversight:** Integrate policymaking across key ministries and agencies in order to operationalize the transformations. For example, food and biodiversity strategies should be integrated to secure the Global Commons. Legislatures and judiciaries play important roles in ensuring oversight and accountability. Countries may also establish independent statutory advisory bodies, such as the Climate Change Committee in the UK.

- **Address international spillovers:** Routinely incorporate international spillovers into policymaking processes (e.g., statistics, cost-benefit evaluations, trade agreements).

- **Conduct Global Commons diplomacy:** Implement Global Commons stewardship as a central framework for 21st century diplomacy that considers cooperation on clean technologies, financing, shared management of transboundary resources, an end to environmental crime and much more.

- **Strengthen governance for Global Commons:** Strengthen existing institutions and establish new international governance mechanisms (e.g., international legal frameworks) to manage important issues of Global Commons use and preservation, and provide legitimate venues to mediate potential areas of conflict. These should recognize the risks of unilateral action in interfering with the Global Commons, and emphasize the global interest in preserving and restoring the healthy functioning of these critical Earth systems.

Reset economics and finance

- **Consider inclusive wealth measures:** Expand national accounting frameworks to include natural capital using the UN System of Environmental-Economic Accounting and consider new indicators of human wellbeing, such as the OECD's Better Life Index or New Zealand's Living Standards Framework.

- **Restructure fiscal incentives:** Apply the social costs of natural capital degradation (e.g., through carbon and resource taxes and the repurposing of harmful subsidies), and promote payments for

ecosystem services. To ensure a healthy tax base, governments should support international efforts to curb base erosion and profit shifting.

- **Align investment:** Align public procurement and all investments by public institutions (e.g., national investment banks, official development assistance (ODA), publicly supported pension funds) with Global Commons stewardship in order to accelerate technological shifts and build new markets for clean technologies.

- **Direct blended finance:** Implement structures and strategies to mobilize co-financing for the investments that activate the four system transformations, such as streamlining regulatory restrictions, building pipelines of bankable projects and mainstreaming and scaling blended finance instruments.

- **Reform the financial system:** Improve financial standards and regulation to direct capital markets away from financing activities that undermine environmental, social and governance objectives (e.g., EU Taxonomy, Taskforce on Climate-related Financial Disclosures (TCFD), Taskforce on Nature-related Financial Disclosures (TNFD), prudential and business accounting standards).

Strengthen social inclusion and equity

- **Design transformations in fair, transparent and participatory ways:** Ensure legitimacy (e.g., through participatory and transparent decision-making processes) and fair distribution of cost and benefits (e.g., through just transition funds). This must be part of the *ex ante* strategic planning to ensure buy-in and maintain progress.

- **Protect, value and engage Indigenous Peoples and local communities:** Promote inclusive and equitable decision making for the benefit of local and Global Commons. Not only can these groups provide important knowledge; they can also play a key role in managing natural systems responsibly. The starting point must be to recognize and uphold their substantive rights (e.g., to their land) and procedural rights (e.g., to free, prior and informed consent; to information; to justice).
- **Engage in international cooperation:** ODA is critical to promoting Global Commons stewardship and ensuring that less developed countries escape extreme poverty by 2030.[16] In addition to increasing the level of financial and technical assistance, harnessing the full potential of ODA will require clear standards and measurements.

Harness innovation, technologies and data

- **Promote mission-oriented innovation:** Develop evidence-based, mission-oriented innovation and industrial strategies to provide the long-term funding and direction needed to facilitate innovation and its deployment at scale (e.g., through innovation challenges, real-world laboratories, research networks).

- **Innovate through education on the Global Commons:** Universal access to education provides a necessary foundation for innovation. Promoting scientific literacy, including an understanding of environmental challenges, can create consensus for action and safeguard against misinformation.

- **Harness new data for accountability:** Harness the power of new data technologies, such as remote sensing, to increase accountability and improve our understanding of the state of the Global Commons.

- **Ensure a safe cybersphere:** Combat cybercrime and fake news by strengthening international mechanisms of cooperation and accountability for technology companies.

A.2 Action items for business and finance

Disclaimer: Governments, businesses and international or civil society organizations cannot solve the challenge of Global Commons stewardship in isolation. Close collaboration between stakeholders at all levels is essential and siloed approaches are likely to fail. We therefore call on all actors to join forces and engage in effective multistakeholder coalitions.

Set targets; align governance and institutions

- **Set science-based targets:** Embrace Global Commons stewardship and set science-based targets across entire supply chains.

- **Turn targets into action:** Develop detailed net-zero GHG strategies that specify the business model transformation to be undertaken, capital commitments and other investments planned to support the transformation, as well as metrics, interim targets and reporting plans. Identify material contributions to the four system transformations. The World Business Council for Sustainable Development's (WBCSD) Vision 2050 details nine transformation pathways which provide business leaders with further details on key transitions and action areas.

- **Advocate for and drive system transformations:** Participate actively in driving the system transformations instead of lobbying to maintain the status quo. Helping policymakers design policies that effectively achieve desired behaviors and outcomes can avoid the costs of bad regulation and uncertainty. Participation in multistakeholder coalitions can drive system change within countries and across key industries—for example, by solving common challenges and overcoming first-mover disadvantages.

Reset economics and finance

- **Reinvent models of value creation:** Transition to net-positive business models that generate long-term value, rather than extract value, by recognizing and internalizing their impacts on diverse stakeholders and over time. Take a lead in aligning internal and external reporting and strategic decision-making processes to take accountability for direct and indirect impacts of operations (e.g., TCFD, TNFD, International Sustainability Standards Board (ISSB), European Taxonomy), and transition to more resilient and regenerative business models.

- **Mobilize finance:** Financial institutions should not only direct their portfolios to green activities, but also create instruments that mobilize investment in science-based transition paths for polluting industries (e.g., transition bonds).

Strengthen social inclusion and equity

- **Proactively work toward a just transition:** Participate in proactive conversations to ensure that consideration is given to the sectors, regions and workers that are negatively affected by transformations. Their interests should be safeguarded in creating just transition strategies—for example, by providing security, training and investment to mitigate negative impacts and share gains.

- **Respect Indigenous Peoples and local communities:** Firms should recognize and uphold the substantive rights (e.g., to their land) and procedural rights (e.g., to free, prior and informed consent; to information; to justice) of Indigenous Peoples and local communities. They should protect, value and engage Indigenous Peoples and local communities that are directly or indirectly affected by their operations, and promote inclusive and equitable decision making for the benefit of local and Global Commons.

Harness innovation, technologies and data

- **Align innovation:** Focus on innovation and investment in areas that advance the four sector transformations—including through public-private partnerships, innovation challenges and multistakeholder coalitions—to rapidly test, refine and scale solutions.

- **Take accountability:** Invest in initiatives to generate and integrate data on the Global Commons to ensure transparency and accountability across supply chains by providing early demand for solutions; and combine this with internal data and make it publicly available to highlight and prove environmental, social and governance impacts.

- **Drive data collaboration:** Engage in international, sectoral and multistakeholder coalitions to improve the availability, quality and use of data and novel governance approaches to bolster Global Commons stewardship and responsible governance of the cybersphere.

- **Strengthen the cybersphere:** Collaborate through legitimized international efforts, including novel governance mechanisms, to counter and minimize detrimental impacts of the cybersphere that may be a byproduct of current operations (e.g., cybercrime, fake news).

A.3 Action items for civil society and multistakeholder coalitions

Disclaimer: Governments, businesses and international or civil society organizations cannot solve the challenge of Global Commons stewardship in isolation. Close collaboration between stakeholders at all levels is essential and siloed approaches are likely to fail. We therefore call on all actors to join forces and engage in effective multistakeholder coalitions.

Set targets; align governance and institutions

- **Advocate for Global Commons stewardship and drive accountability:** Advocate for the need to set targets and take ambitious action to preserve the Global Commons at the international, national, regional and local scales. Civil society plays a critical role in ensuring accountability and transparency among governments and business.

- **Educate and mobilize:** Use science-based arguments and evocative narratives to make the significance of the Global Commons and their responsible stewardship accessible to the public and relevant stakeholder groups. Contribute to shaping the public discourse and debunking misinformation.

- **Build consensus for action:** Make targets relevant and tangible to sectors, regions and businesses. Broker consensus views (e.g., on sector transformations) and concrete demands for other actors (e.g., enabling conditions to be provided by government).

- **Monitor greenwashing:** Maintain vigilance and exert pressure to prevent and expose greenwashing by business and governments.

- **Support inclusive wealth approaches:** Advocate, develop and pilot approaches that extend key measures of accounting for progress with natural and social wellbeing.

Strengthen social inclusion and equity

- **Ensure the legitimate participation of critical stakeholders:** Provide a voice to all relevant stakeholders—particularly those frequently excluded, such as the young and future generations, Indigenous Peoples, local communities and the poor. Promote inclusive and equitable decision making and the upholding of groups' substantive rights (e.g., to their land) and procedural rights (e.g., to free, prior and informed consent).

- **Work toward a just transition:** Play a role in advocating for and developing just transition strategies—for example, by mediating stakeholder

discussions and making proposals.

- **Advance human development:** Focus on advancing human development through the SDGs—including universal access to social services and basic infrastructure—as an important precondition for long-term sustainable transformations.

- **Build capacity:** Support capacity building, technology transfer and pilot programs to assist less developed countries, which can be crucial for crowding-in private investment.

Harness innovation, technologies and data

- **Drive innovation:** Fund critical innovations that help advance the four system transformations to secure Global Commons stewardship (e.g., through innovation challenges). Convene and join initiatives to drive innovation.

- **Innovate through education for the Global Commons:** Universal access to education provides a necessary foundation for innovation. Promoting scientific literacy, including an understanding of environmental challenges, can create consensus for action and safeguard against misinformation. Use the SDGs or the Global Commons as a framework for teaching, research and problem solving, which can break down academic silos and guide practical research.

- **Make data available and usable:** Ensure that data is freely available online in real time and make it usable and relevant for other stakeholders—particularly to expose greenwashing.

- **Drive collaboration:** Engage in international, sectoral and multistakeholder coalitions to improve the availability, quality and use of data and novel governance approaches to bolster Global Commons stewardship and responsible governance of the cybersphere.

A.4 Action items for international organizations and financing institutions

Disclaimer: Governments, businesses and international or civil society organizations cannot solve the challenge of Global Commons stewardship in isolation. Close collaboration between stakeholders at all levels is essential and siloed approaches are likely to fail. We therefore call on all actors to join forces and engage in effective multistakeholder coalitions.

Set targets; align governance and institutions

- **Align priorities with Global Commons stewardship:** Align work and processes with safeguarding the Global Commons and realizing the four system transformations.
- **Strengthen international law:** Pursue and support legal approaches to managing the Global Commons—such as efforts to combat environmental crime, boost transparency in trade and improve the global legal framework for the environment (e.g., recognizing ecocide as an international crime)—to help establish and strengthen international standards.
- **Promote regional collaboration:** Serve as a mediator and enabler for some of the toughest policy and financing challenges arising from the need for regional collaboration, such as shared biomes and watersheds or shared infrastructure, like power pools.

Reset economics and finance

- **Align financing with transformation pathways:** Align international finance around national pathways toward Global Commons stewardship, such as ensuring energy finance is consistent with national decarbonization pathways. Undertake sustainability impact assessments, including a focus on impacts on the Global Commons, before any substantial commitment of funding or other major action.

Strengthen social inclusion and equity

- **Advance human development:** Focus on advancing human development through the SDGs—including universal access to social services and basic infrastructure—as an important precondition for long-term sustainable transformations.
- **Mobilize development assistance and climate finance:** Meet ODA and climate finance obligations, which remain critical to help poorer countries achieve the SDGs and ensure global fairness.

Harnessing the full potential of ODA will require clear standards and measurements. Without a fair international "deal" on financing, it will be impossible to safeguard the Global Commons.

- **Build capacity:** Support capacity building, technology transfer and pilot programs to assist less developed countries, which can be crucial for crowding-in private investment.
- **Respect Indigenous Peoples and local communities:** Ensure that all projects protect, value and empower Indigenous Peoples and local communities at the regional and local levels.

Harness innovation, technologies and data

- **Drive innovation:** Fund critical innovations that help to advance the four system transformations to secure Global Commons stewardship (e.g., through innovation challenges). Convene and join international initiatives to drive innovation.
- **Set standards for data quality and availability:** Promote transparency and harness the power of new technologies to track the state of the Global Commons, including through international standards set by the UN Statistical Commission, the OECD and many other bodies.

B Safeguarding the Global Commons

Over the last 12,000 years, modern humans have enjoyed the Holocene: a uniquely stable epoch that enabled the rise of the world's great civilizations. But we are now in a new geological epoch—the Anthropocene, which is shaped by human degradation of critical Earth systems.[3] Since 1900, the world's population has increased almost fivefold and world gross product has risen eightyfold.[4] Humans are consuming ever-larger shares of the world's renewable and non-renewable resources, and emitting unsustainable volumes of waste and pollutants. Indeed, human actions have begun to shape the carbon cycle, the nitrogen cycle, the oceans, the cryosphere and other Earth systems.

Scientists have estimated the carrying capacity of the Earth, or "planetary boundaries,"[5,6] which must be respected to preserve critical Earth systems and ensure a safe operating space for humanity. These planetary boundaries cover nine control variables:

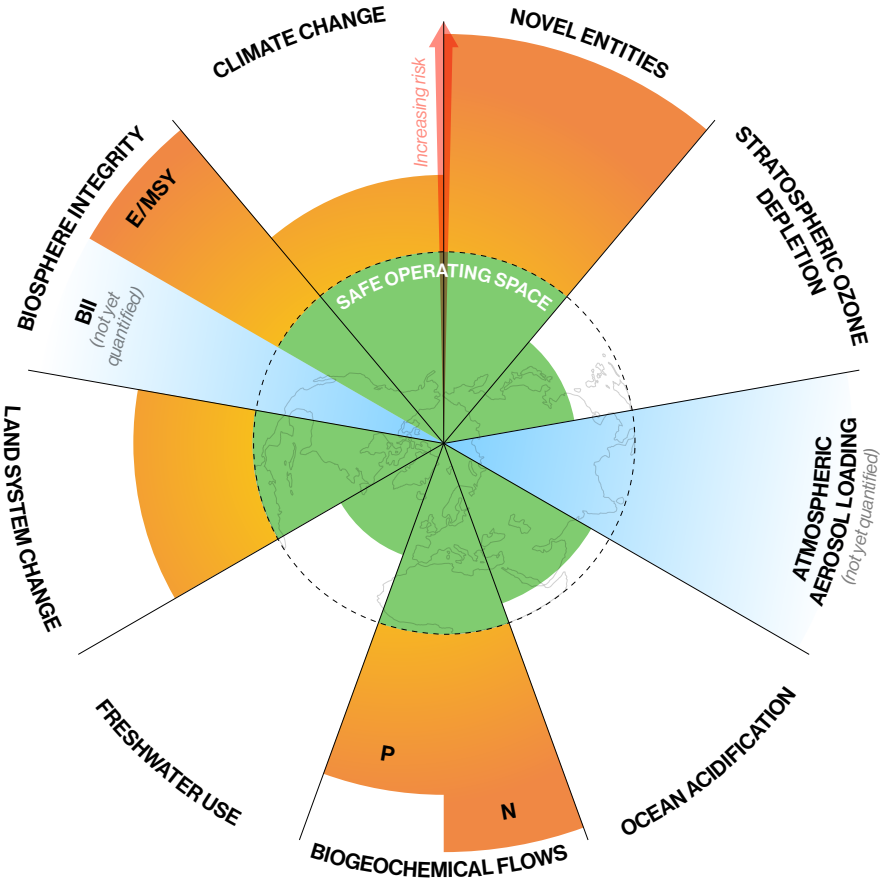
- climate change;
- biosphere integrity;
- land system change;
- freshwater use;
- biogeochemical flows;
- ocean acidification;
- atmospheric aerosol loading;
- stratospheric ozone depletion; and
- novel entities (Figure 5).

Several of these boundaries have already been transgressed; some are within a zone of uncertainty; and for others, we lack adequate data. Under business as usual, many planetary boundaries are projected to be transgressed in the near future, which would threaten human civilization and survival.[7]

FIGURE 5
Planetary boundaries

- **Beyond zone of uncertainty** (high risk)
- **Within zone of uncertainty** (increasing risk)
- **Below boundary** (safe)
- **Boundary not yet quantified**

Green indicates where human activities are within safe margins; orange indicates where safe margins have been exceeded, with increasing risks indicated by darker shades; and blue indicates where safe margins have not yet been determined. Biosphere integrity consists of genetic diversity, defined as extinctions per million species per year, and functional diversity. Biogeochemical flows consist of the nitrogen and phosphorous cycles. Adapted from Steffen et al. (2015),[7] Nakicenovic et al. (2016),[9] and Persson et al. (2022).[10]



Clearly, these trends are unsustainable. A major course correction is needed to safeguard the Earth system. Major changes are needed to promote human prosperity and wellbeing for all without breaching the planetary boundaries. However, as we discuss below, successful strategies to stabilize the Earth system must also take account of inequalities. Rich countries, and the wealthy within each country, account for a disproportionate share of the resource use and pollution that are driving global environmental change. For these reasons, a global perspective is needed on these challenges; and strategies must be integrated across biophysical, technological and social drivers of change.

Moreover, strategies to meet the planetary boundaries must consider socio-economic development needs. To this end, Kate Raworth and others have augmented the planetary boundaries with social floors for income and social protection; health, education and other social services; and access to basic infrastructure services.[17] This "doughnut framework" is starting to be used by decision makers around the world.

As trade and supply chains now span the globe, business leaders play an important role in safeguarding the Global Commons. This is no longer optional or altruistic. At a fundamental level, the long-term success of businesses and the economy depends on the health of people and the planet. The COVID-19 pandemic has starkly illustrated the potential costs of planetary disruption, with the projected cumulative output loss from 2020 to 2025 standing at $22 trillion.[18]

In contrast, the transformations required to achieve the SDGs, and thereby safeguard the Global Commons, could open up economic opportunities worth up to $12 trillion and increase employment by up to 380 million jobs by 2030.[19] Seizing these opportunities will require significant investments and fundamental shifts in how businesses operate.

Meanwhile, governments, regulators and investors are increasingly demanding greater responsibility and transparency. In addition, a growing share of customers and employees are refusing to engage with companies that do not live up to their environmental and social responsibilities. Paul Polman, the former CEO of Unilever, argues that companies must become net positive; and that "those who miss this seismic shift will face a raft of existential risks. The economics of business as usual will not favor them, society won't accept them, and younger generations won't work for them."[20] A "net-positive" company is one that "improves well-being for everyone it impacts and at all scales—every product, every operation, every region and country, and for every stakeholder, including employees, suppliers, communities, customers, and even future generations and the planet itself." This is an aspiration that no company has yet achieved; but many have embarked on the journey and those which ultimately succeed will stand to be more resilient, attractive and profitable.

B.1 Understanding the Global Commons

In Elinor Ostrom's famous definition, "common-pool resources" are finite resources whose use by members inside or outside a group must be carefully managed.[21] Failure to do so can lead to the "tragedy of the commons," where everyone loses from the exhaustion or destruction of common-pool resources. Ostrom and others focused on commons at the local level, such as shared irrigation systems, communal forests, grazing grounds and clean water. But the concept of common-pool resources, or commons, is also helpful for understanding the challenges of maintaining Earth system stability in the Anthropocene; and for devising appropriate response strategies at local, national, regional and global scales.

We use two criteria to define the "Global Commons." First, "Global Commons" describes the biophysical systems that must be safeguarded for the Earth system as a whole to remain resilient and stable within Holocene-like conditions that can support human development. This means that the planetary boundaries are set to keep the Global Commons in a healthy functioning state. Second, "Global Commons," as distinct from local or regional-scale commons, are common-pool resources that require coordinated management across countries in order to avoid the tragedy of the commons. As we will see below, this science-based definition of the biophysical Global Commons complements international law, which focuses on the high seas, the atmosphere, Antarctica and outer space.[a]

a The Global Commons Stewardship Framework focuses on Earth systems, so we exclude outer space.[22]

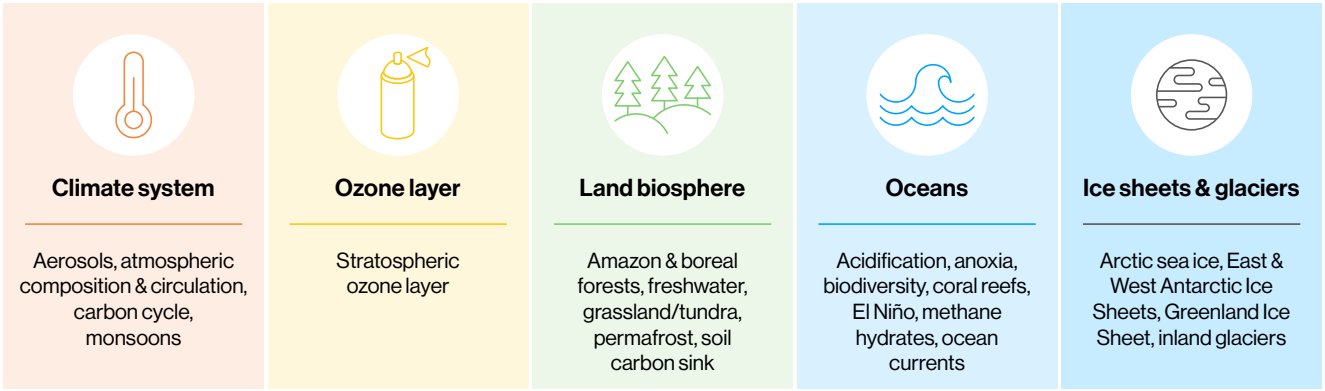
We focus here on the biophysical Global Commons and also briefly consider digital systems or the cybersphere, which is becoming inseparable from the biophysical world (Section D.4.3). We note that there are several social, economic and cultural commons at a global scale. They include public health surveillance and disease control; UNESCO World Heritage Sites; the United Nations and international conventions; the internet; international research cooperation; technology exchange; and many others. These are of critical importance to human wellbeing and underpin strategies to secure the biophysical Global Commons.

Nakicenovic et al.[9] were the first to apply planetary boundaries to identify key biophysical Global Commons. We build on their work in identifying five domains of the Global Commons (Figure 6) that must be preserved to stay within the planetary boundaries:

- **Climate system:** The Earth's "greenhouse effect" and associated processes have maintained a stable temperature range during the Holocene, which has enabled the rise of human civilization. The climate system is largely driven by greenhouse gas (GHG) concentrations in the atmosphere, which in turn are affected by the carbon cycle and other feedbacks. These and other air pollutants generate aerosols, which can contribute to climate change and drive regional weather patterns (e.g., monsoons); so we include clean air as part of the climate system. A stable climate system is critical for directly securing the planetary boundaries on climate change and ocean acidification, as the latter are driven by increased concentrations of carbon dioxide (CO_2) in the atmosphere. Indirectly, the climate system also drives changes to other planetary boundaries, including land use

FIGURE 6
Five Global Commons domains

The five Global Commons domains are made up of a number of biophysical Global Commons systems.



Each Global Commons is a biophysical system that affects the stability of the Earth system and can only be preserved through coordinated management across countries. The Global Commons are highly interdependent and must be secured through integrated strategies at the local, national, regional and global levels.

change (e.g., through desertification); biosphere integrity (e.g., through changes in species ranges); and freshwater use (e.g., through increased evapotranspiration).

- **Ozone layer:** The thin layer of ozone in the upper stratosphere absorbs ultraviolet radiation from the sun that is harmful to humans and other living organisms. As the emergence of the "ozone hole" has shown, the ozone layer is highly vulnerable to human perturbations, which can breach the planetary boundary of stratospheric ozone depletion. Indirectly, the ozone layer affects biosphere diversity, in terms of both functional and genetic diversity. To this end, the Montreal Protocol has banned the production and use of chemicals, such as chlorofluorocarbons (CFCs), that can harm the ozone layer. As a result, the ozone layer is the one planetary boundary where human pressures have abated over the last 20 years; though there are now growing concerns about increased illegal use of CFCs in some countries.

- **Land biosphere:** The land biosphere comprises various forms of land, including wilderness, agricultural, urban and industrial land. It includes major biomes of global significance, such as boreal and tropical forests. Changes to the land biosphere directly affect the planetary boundaries of land system change, as well as freshwater quality and use.[b] The latter are driven primarily by land use and land use change, including for agriculture. Indirectly, the land biosphere affects multiple planetary boundaries, including biosphere integrity (e.g., through changes in habitat ranges); climate change (e.g., through changes to carbon sinks and the Earth's albedo); atmospheric aerosol loading (e.g., through desertification and sand storms); ocean acidification (e.g., through changes in the carbon cycle); and biogeochemical flows (e.g., through the release of reactive nitrogen and phosphorous).

- **Oceans:** The ocean biosphere comprises the high seas and coastal marine waters. It is home to a large share of biodiversity. Ocean currents and carbon sinks are major drivers of the Earth's climate system and cryosphere. Most reactive nitrogen and phosphorous released through human activities end up in the ocean, where they foster anoxic zones that are lethal to most forms of life. A stable ocean biosphere therefore directly contributes to respecting several planetary boundaries, including the climate system; biosphere integrity; ocean acidification; and biogeochemical flows.

- **Cryosphere:** A final Global Commons is the cryosphere, which comprises polar ice sheets and glaciers. The cryosphere directly affects climate change, including through changes to the Earth's albedo. Melting ice sheets are chiefly responsible for sea level rise, which can have profound implications for land system change and biosphere integrity. Thawing glaciers

b Major perturbations of the hydrological cycle that affect planetary boundaries are driven by changes to evapotranspiration due to modifications of land biomes.[23] For this reason, we do not include the hydrological cycle or other freshwater systems as a separate Global Commons.

alter seasonal freshwater flows that drive agriculture in many parts of the world.

The five Global Commons domains define the broad categories of biophysical systems that must be safeguarded through global action in order to ensure a stable and resilient Earth system. The planetary boundaries are set to safeguard the Global Commons, providing both resilience and services to humanity through a stable and manageable Earth system. In short, we all depend on them both for our own wellbeing and for that of future generations. The five domains integrate the original (legal) definition of "Global Commons" (high seas, the atmosphere, Antarctica) except outer space, which is not part of the biosphere that regulates the state of the planet.

Each of the five Global Commons domains consists of numerous biophysical Global Commons systems. For example, the cryosphere domain is made up of five Global Commons systems:

- Arctic sea ice;
- the East and West Antarctic Ice Sheets;
- the Greenland Ice Sheet; and
- inland glaciers.

This hierarchy of the Global Commons is useful, as it can inform more concrete governance measures.

Several of these Global Commons domains are scientifically identified as "tipping elements"—that is, they not only contribute to the regulation of the Earth system, but can also undergo major changes past dangerous tipping points. If these biophysical systems are pushed too far (e.g,. through GHG emissions, deforestation or pollution) and these tipping points are exceeded, this can lead to irreversible changes due to shifts in feedbacks (e.g., from buffering/cooling to self-amplifying/warming). These changes may affect the overall stability of the Earth system.

B.2 Goals for safeguarding the Global Commons

Fortunately, governments have ratified the Paris Agreement and adopted the SDGs. Together, these provide a useful goal-setting mechanism to safeguard the Global Commons. The Paris Agreement commits the world to net-zero GHG emissions by the middle of the century and net-negative emissions beyond.[1,24] Meeting this objective will stabilize the climate system, curb ocean acidification, drastically cut air pollution and safeguard "the integrity of all ecosystems, including oceans, and the protection of biodiversity."[25] In this way, meeting the Paris Agreement targets will also help preserve terrestrial and marine biodiversity.

The SDGs, contained in the 2030 Agenda for Sustainable Development, set out quantitative goals for economic prosperity, social inclusion, environmental sustainability and the Global Partnership for Effective Development Co-operation. They underscore the central importance of sound stewardship of the "biological support systems of the Planet."[26] Critically, the SDGs emphasize the need to reduce extreme poverty in all its forms and promote social inclusion.

We are beginning to get a clearer sense of how countries are contributing to the degradation and stewardship of the Global Commons. The SDSN, Yale University and the Center for Global Commons at Tokyo University have compiled the GCS Index, which assesses both countries' domestic impacts on the Global Commons and the impacts embodied in trade and consumption (so-called "international spillovers").[13] The 2021 GCS Index helps identify those countries with the greatest per-capita and absolute negative impacts on the Global Commons (Annex 1).

Table 1 lists 50 countries and their per-capita impacts on the Global Commons; and Table 2 lists the 20 countries with the greatest absolute impacts on the Global Commons—generally the relatively large countries, by population or wealth. The five entities with the worst impacts are China, the United States, the EU27, Japan and India. Eighteen of the 20 top contributors are part of the G20, which bears a special responsibility in safeguarding the Global Commons, as its member countries represent two-thirds of the world's population and 85% of global GDP. These spillovers are largely driven by global resource extraction, which has increased dramatically over the past half-century. Quantifying national responsibility for ecological breakdown by assessing nations' cumulative material use in excess of equitable and sustainable boundaries also points to the disproportionate responsibility of high-income countries (Figure 7, p36).[8]

Demand-side measures to reduce wastage (i.e., demands superfluous to human needs and wants) are an important lever to reduce spillovers. According to the latest Intergovernmental Panel on Climate Change (IPCC) report,[27] such measures could reduce GHG emissions in end-use sectors by between 40% and 70% by 2050 without undermining human wellbeing. Such demand-side approaches require a mix of political leadership and ambitious policy, innovation in business models and technologies, and cultural interventions.

TABLE 1

Global Commons Stewardship Index 2021 results in proportional terms

COUNTRY	OVERALL		DOMESTIC			SPILLOVER	
Albania		→	52.0		→	69.6	→
Algeria		→	40.1		→	74.5	→
Argentina		→	40.0		→	62.8	↓
Armenia		→	62.1		↓	69.6	→
Australia		→	15.8		→	17.0	→
Austria		→	47.9		→	17.8	→
Azerbaijan		→	37.3		→	72.2	→
Bahrain		→	35.0		→	35.1	→
Bangladesh		→	67.9		→	93.3	→
Belarus		↓	50.7		→	99.9	↓
Belgium		→	66.4		→	18.2	→
Bosnia & Herzegovina		→	39.3		→	73.9	↗
Botswana		→	42.2		→	28.1	→
Brazil		→	44.5		→	69.7	↗
Brunei Darussalam		→	10.3		→	32.0	→
Bulgaria		→	46.8		→	60.7	→
Canada		→	22.0		→	16.4	→
Chile		→	43.8		→	42.7	→
China		→	34.3		→	75.5	↓
Colombia		→	35.5		→	66.8	→
Costa Rica		→	63.6		→	55.9	→
Croatia		→	52.1		→	48.0	→
Cuba		→	58.5		→	74.6	→
Cyprus		→	58.0		→	27.9	→
Czech Republic		→	46.0		→	32.6	→
Denmark		→	67.1		→	19.9	→
Dominican Republic		→	65.9		→	71.0	↗
Ecuador		→	60.0		→	74.7	→
Egypt, Arab Rep.		↗	39.3		→	85.9	↗
Estonia		→	51.3		→	28.5	→
Ethiopia		↗	77.1		→	99.9	↑
European Union		→	23.9		→	26.5	→
Finland		→	68.0		→	24.3	→
France		→	62.9		→	24.1	→
Gabon		→	41.7		↗	64.2	→
Germany		→	53.0		→	20.5	→
Greece		→	44.5		→	27.1	→
Guatemala		↗	61.2		→	78.7	↗
Hungary		→	51.8		→	53.7	→
Iceland		→	40.5		↗	17.5	→
India		→	40.4		→	88.7	↗
Indonesia		→	31.3		↓	79.7	↗
Iran, Islamic Rep.		→	33.4		→	68.1	→
Iraq		→	39.3		→	78.7	→
Ireland		→	61.2		→	22.1	→
Israel		→	35.8		→	29.8	→
Italy		→	54.5		→	27.4	→
Jamaica		→	62.0		→	62.4	→
Japan		→	60.7		→	18.3	→
Jordan		↗	62.5		↗	57.7	→

COUNTRY	OVERALL		DOMESTIC			SPILLOVER	
Kazakhstan		→	15.5		→	54.2	→
Korea, Rep.		→	52.7		→	23.8	→
Kuwait		→	20.9		→	3.6	→
Latvia		→	77.1		→	33.1	→
Lebanon		→	52.5		→	46.7	→
Libya		→	21.7		→	66.6	↓
Lithuania		→	67.4		→	26.5	→
Luxembourg		→	52.6		→	1.8	→
Malaysia		→	36.1		→	33.1	→
Malta		→	52.3		→	25.0	→
Mauritius		→	40.2		→	6.3	→
Mexico		→	39.1		→	59.7	→
Montenegro		→	35.0		→	12.8	↗
Namibia		→	46.1		→	44.2	→
Netherlands		→	57.6		→	13.6	→
New Zealand		→	27.4		→	25.7	→
Nigeria		→	50.9		→	91.1	→
North Macedonia		→	53.3		→	59.7	↗
Norway		→	30.9		→	10.4	→
Oman		→	20.3		→	26.2	→
Pakistan		↗	45.6		→	99.8	↑
Panama		→	53.9		→	51.7	→
Paraguay		→	50.5		→	59.5	→
Peru		→	50.1		→	73.0	→
Philippines		→	54.5		→	81.5	→
Poland		→	46.7		→	52.3	→
Portugal		→	52.0		→	26.6	→
Qatar		→	7.9		→	23.3	→
Romania		→	66.8		→	59.7	→
Russian Federation		→	33.3		→	51.5	→
Saudi Arabia		→	18.4		→	22.5	→
Serbia		→	40.6		→	36.4	↗
Singapore		→	42.7		→	1.3	→
Slovak Republic		→	58.4		→	26.5	→
Slovenia		→	55.4		→	27.6	→
South Africa		→	29.7		→	66.2	↗
Spain		→	40.5		→	25.8	→
Sri Lanka		→	64.3		→	76.8	→
Sweden		→	75.0		→	21.4	→
Switzerland		→	78.2		↗	5.8	→
Thailand		→	50.8		→	58.8	→
Trinidad & Tobago		→	11.3		→	38.3	→
Turkey		→	40.7		→	57.2	↗
Turkmenistan		→	22.0		↓	51.8	→
United Arab Emirates		→	10.6		→	1.8	↓
United Kingdom		→	55.3		↗	21.7	→
United States		→	31.5		→	25.8	→
Uruguay		→	44.0		→	39.4	→
Venezuela, RB		→	65.7		↗	61.4	↓
Vietnam		→	40.9		↓	82.9	→

LEGEND		
DASHBOARD	SCORE	LABEL
	95–100	No or limited negative impacts on the GC
	90–95	Low negative impacts on the GC
	80–90	Medium-low negative impacts on the GC
	70–80	Medium-high negative impacts on the GC
	50–70	High negative impacts on the GC
	30–50	Very high negative impact on the GC
	0–30	Extreme negative impacts on the GC

LEGEND	
ARROW	MEANING
↑	Projected to meet 2050 target
↗	Projected to meet only 2030 target
→	Insufficient progress toward target
↓	Trajectory headed in wrong direction

Notes: Indicators are standardized to allow comparison across countries. Countries listed in alphabetical order. The GCS Index calculations include all Global Commons except the ozone layer due to lack of available data.

TABLE 2

Global Commons Stewardship Index bottom 20 countries in absolute terms

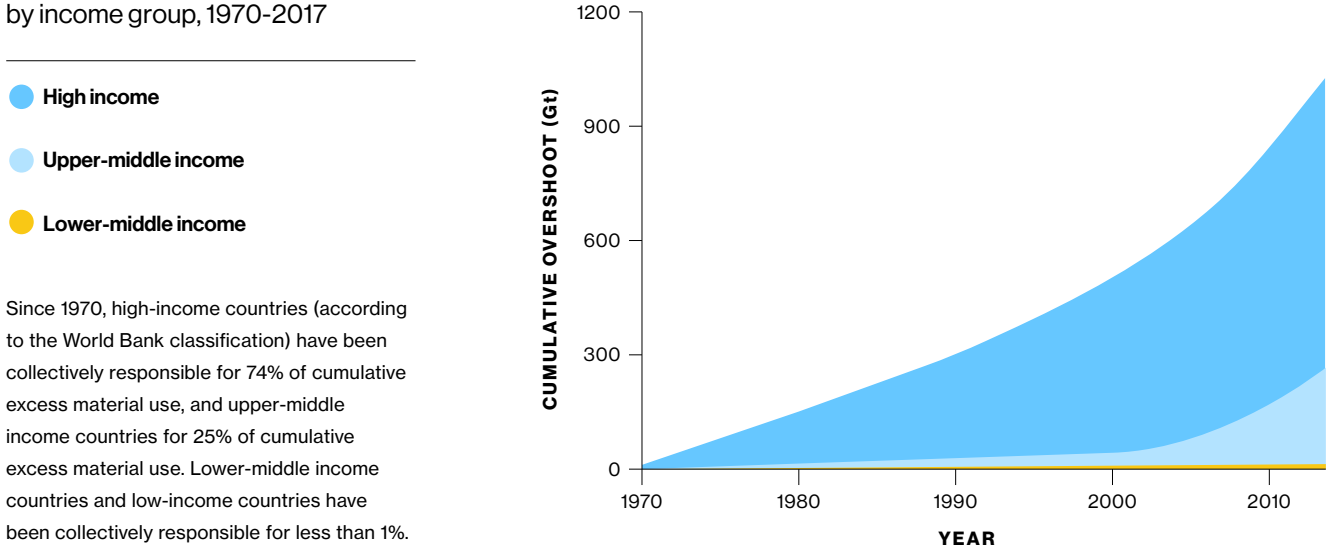
COUNTRY	OVERALL		DOMESTIC			SPILLOVER	
Iran		→	33.4		→	58.7	→
Turkey		→	36.1		→	47.8	→
Spain		→	44.0		→	37.6	→
Korean Republic		→	49.3		→	32.5	→
Italy		→	48.2		→	31.2	→
France		→	55.5		→	25.6	→
Mexico		→	29.6		→	47.1	→
Saudi Arabia		→	34.4		→	38.5	→
Canada		→	36.7		→	35.1	→
Australia		→	23.0		→	50.6	→
United Kingdom		→	48.7		→	23.0	→
Brazil		→	24.1		→	43.2	→
Indonesia		→	12.1		↓	52.8	→
Germany		→	45.4		→	11.6	→
Russian Federation		→	16.3		→	26.3	→
India		→	4.4		↓	30.6	→
Japan		→	46.2		→	1.3	→
European Union		→	9.1		↓	1.0	→
United States		→	7.8		→	1.0	→
China		↓	4.5		↓	1.0	↓

LEGEND		
DASHBOARD	SCORE	LABEL
	95–100	No or limited negative impacts on the GC
	90–95	Low negative impacts on the GC
	80–90	Medium-low negative impacts on the GC
	70–80	Medium-high negative impacts on the GC
	50–70	High negative impacts on the GC
	30–50	Very high negative impact on the GC
	0–30	Extreme negative impacts on the GC

ARROW	MEANING
↑	Projected to meet 2050 target
↗	Projected to meet only 2030 target
→	Insufficient progress toward target
↓	Trajectory headed in wrong direction

FIGURE 7

Cumulative excess resource use of countries by income group, 1970-2017



Since 1970, high-income countries (according to the World Bank classification) have been collectively responsible for 74% of cumulative excess material use, and upper-middle income countries for 25% of cumulative excess material use. Lower-middle income countries and low-income countries have been collectively responsible for less than 1%. Excess resource use for low-income countries is close to zero and thus not visible in this figure. Adapted from Hickel et al. (2022).[8]

C The Global Commons Stewardship Framework

In the words of Pope Francis, "What is needed...is an agreement on systems of governance for the whole range of so-called 'global commons'."[28] Sound management of the Global Commons requires determined action at the local, national, regional and global levels. Communities must reduce the resource intensity of their development models. Countries must decarbonize their energy systems and curb international spillovers. Key biomes—such as the Amazon, the Congo Basin and some marine areas—must be managed at regional levels. And global frameworks such as the United Nations Framework Convention on Climate Change (UNFCCC) and the UN Convention on Biological Diversity (CBD) must help ensure that national actions aim to respect the planetary boundaries. Across all levels, stakeholders must organize around shared goals, redesign markets, improve technologies, strengthen inclusive governance and mobilize the power of data.

Fortunately, we are witnessing profound changes in awareness of the Global Commons and a movement toward achieving planetary sustainability. The necessary change is happening across four broad transformations that are critical for safeguarding the Global Commons, and is being tracked by the Systems Change Lab:[c]

c These four transformations are aligned with transformations to achieve the SDGs and the objectives of the Paris Agreement, as reviewed in the scientific and policy literature,[29–31] and as increasingly applied to policies. For example, the European Green Deal focuses on critical SDG transformations.[32]

- **Decarbonized energy, industry and transport:** The decarbonization of power generation, transmission, long-distance transport, industrial heating and cooling, and industry through measures such as enhanced efficiency, increased electrification, the phaseout of fossil fuels, modal shifts and the development of new fuels and solutions for hard-to-abate sectors—all while ensuring universal access to clean energy.

- **Sustainable cities and communities:** Including through access to compact and resilient urban design and transit-oriented development, sustainable buildings, heating and cooling of buildings and waste management.

- **Sustainable production and consumption:** Including through circular product design, production systems and supply chains, sustainable material flows and shifting consumption patterns.

- **Sustainable food, forests, land, water and oceans:** Including through protection, sustainable production and management, restoration, sustainable healthy diets,[d] reduced food loss and waste, halted overexploitation of species and greater efficiencies in supply chains.

In addition—and as reviewed in Section D—countries must transform health, education and other social systems to promote human wellbeing, expand human capital and reduce inequalities. These investments are a vital enabler of Global Commons stewardship. Without social inclusion and human wellbeing, it will be impossible to undertake and sustain the transformations needed to safeguard the Global Commons.

Each system transformation is critical for safeguarding multiple Global Commons. With the exception of the ozone layer, each Global Common similarly requires contributions from more than one system transformation. This shows that countries cannot prioritize one transformation over another; all transformations work synergistically and must be pursued in harmony with each other.

The technical scope of the four system transformations for Global Commons stewardship has been outlined by the Systems Change Lab, Sachs et al.,[29] The World in 2050 initiative[30] and others. Tremendous progress has been made in conceptualizing and operationalizing the transformations in recent years. Several coalitions support technical analyses, policy support and stakeholder engagement around the transformations. For example, the ETC and the Mission Possible Partnership are helping to drive the energy transformation. FOLU is dedicated to supporting countries and advancing global discussions on how to make land use and food systems sustainable, with the Food, Agriculture, Biodiversity, Land-Use and Energy (FABLE) Consortium supporting national pathways. The International Resource Panel (IRP) and partners are promoting sustainable industry and consumption. And the C40 Cities Climate Leadership Group, ICLEI - Local Governments for Sustainability, United Cities and Local Governments and many others are supporting the urban transformation. The WRI-led Systems Change Lab is tracking progress for each system transformation (Table 3).

d "Sustainable healthy diets" are dietary patterns that promote all dimensions of individuals' health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable.[33]

TABLE 3

Global Commons stewardship transformations and their components tracked by the Systems Change Lab

GCS TRANSFORMATION	SUB-TRANSFORMATION	CRITICAL SHIFTS
Decarbonization of power, industry and transport	**Power**	Phase out unabated coal and gas electricity generation
		Rapidly scale up renewable electricity generation
		Modernize grids, scale storage, manage demand
		Guarantee reliable access to electricity for all
	Industry	Reduce demand for steel, cement and plastics or replace with zero-carbon alternatives
		Electrify industry
		Develop new solutions for zero-carbon steel, cement and plastics
		Reduce methane emissions from oil and gas operations
	Transport	Guarantee reliable access to safe and modern mobility
		Reduce excessive travel by car and plane
		Shift to public, shared and non-motorized transport
		Transition to zero-carbon cars and trucks
		Transition to zero-carbon shipping and aviation
Sustainable cities and communities	**Cities and the built environment**	Adopt compact urban design
		Build only zero-carbon buildings
		Make all existing buildings zero carbon
		Guarantee access to safe, resilient transport and shelter
		Transition to zero-waste cities
Sustainable production and consumption	**Sustainable production and consumption**	Increase material efficiency in production
		Decrease consumption of materials
		Regenerate biological material flows
		Regenerate technical material flows
		Extend the useful life of products and materials
		Recycle and recover resources at their highest value
Sustainable food, forests, land, freshwater and oceans	**Forests**	Protect forests and other natural landscapes
		Restore degraded and deforested landscapes
		Sustainably manage forests and other natural landscapes
		Sharply reduce chemical pollution and litter
		Halt the overexploitation of terrestrial species
		Dramatically slow the spread of invasive, alien species
	Food	Increase crop yields sustainably and without expanding farmland
		Increase livestock productivity sustainably and without expanding pastureland
		Increase aquaculture productivity sustainably
		Reduce food loss and waste
		Shift to healthier, more sustainable diets for all
		Reduce GHG emissions and other harmful environmental impacts from agricultural production
	Freshwater management	Protect freshwater ecosystems
		Restore freshwater ecosystems
		Sustainably manage freshwater ecosystems
		Sharply reduce chemical pollution and litter
		Halt the overexploitation of freshwater species
		Dramatically slow the spread of invasive, alien species
		Ensure reliable, sustainable access to clean water for all
	Ocean management	Protect marine and coastal ecosystems
		Restore marine and coastal ecosystems
		Sustainably manage marine and coastal ecosystems
		Sharply reduce chemical pollution and litter, particularly from land-based activities
		Halt the overexploitation of marine species, particularly by sustainably managing wild fisheries
		Dramatically slow the spread of invasive, alien species

The Systems Change Lab will continue to refine this list to ensure it best captures all relevant transformations.

Success will require massive innovation and sharing of lessons. There is a lot to learn across the four system transformations for Global Commons stewardship. In particular, we can learn from some of the early successes of energy decarbonization following the Paris Agreement. Evidence suggests that a "Paris Effect" has occurred, whereby policy commitments on decarbonization have accelerated innovation, technologies and financing solutions that put full decarbonization by mid-century within reach.[14] While a lot more must be done to make our energy systems climate neutral, early lessons can be applied to the three other system transformations for Global Commons stewardship.

With others covering the technical and operational details of each system transformation, we focus in this report on the action levers for activating and realizing the transformations. We draw on a review of the literature on the enablers of climate action conducted by WRI,[11] emerging lessons from energy decarbonization, major policy initiatives such as the European Green Deal and a vast number of multistakeholder coalitions around the world to identify practical steps for catalyzing the action levers for Global Commons stewardship. Four action levers work across all system transformations (Figure 8) and are reviewed in the following section:

- **Set targets; align governance and institutions** to provide a clear ambition and pathway for change and strengthen multistakeholder coalitions and social movements, reconfiguring national governance and international cooperation for the Anthropocene. The most promising mechanism for effective governance of the Global Commons may be strong new multistakeholder coalitions that complement improved intergovernmental and national mechanisms.

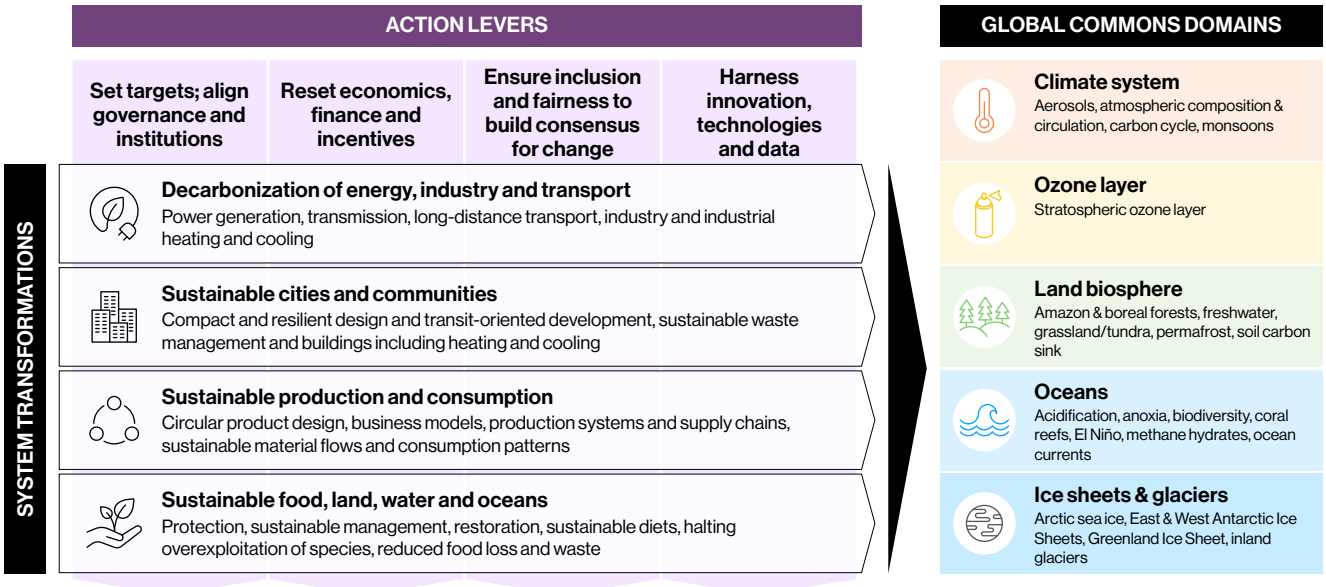
- **Reset economics, finance and incentives** for the Global Commons by putting a price on carbon and natural capital; aligning economic policies and regulations with the goal of Global Commons stewardship; redefining government and business accounting; and catalyzing private, public and blended finance.

- **Ensure inclusion and fairness to build consensus for change** through developing strategies for just transitions, including participatory design, fair incomes and investment in good health, education and social safety nets, to provide the foundation for these transformations. Value and champion Indigenous Peoples and local communities as stewards of the Global Commons.

- **Harness innovation, technologies and data** to advance our understanding of the Global Commons and accelerate the system transformations needed to safeguard them, paying special attention to the governance of the cybersphere.

In our experience, one of the most exciting opportunities today is to learn from what is working in one system transformation—say, energy decarbonization—and apply these lessons to other transformations that may be lagging behind. Such learning can be propagated both within countries and at the international level. The action levers are central to driving the system transformations for Global Commons stewardship, so the following section discusses them in detail.

FIGURE 8
The Global Commons Stewardship Framework



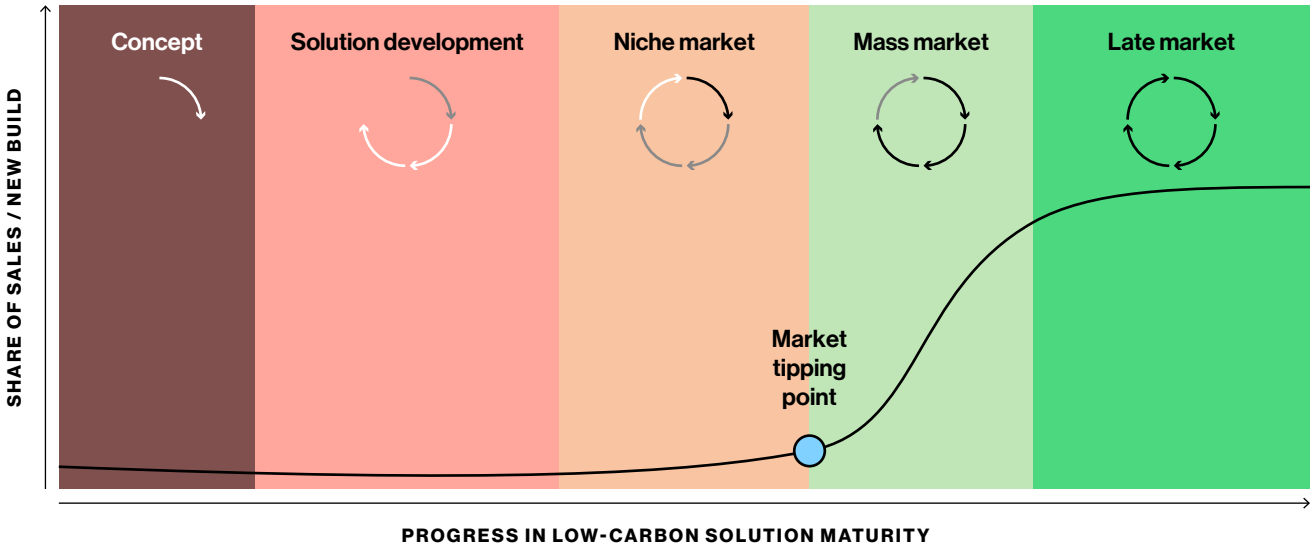
D Action levers for Global Commons stewardship

We are witnessing early signs of positive tipping points toward several system transformations for Global Commons stewardship (Section B). Such positive systemic tipping points (by contrast to the dangerous tipping points of the Global Commons discussed earlier in this report) occur when targeted interventions lead to large and long-term consequences for the evolution of that system, profoundly altering its modes of operation.[34] Interventions can foster the emergence of positive feedback loops and activate positive tipping points (see Figure 9) – as is already occurring in the energy and transport systems.

For example, the "Paris Effect" is making renewable power economically competitive with (often subsidized) fossil fuel power.[35] Countries are committing to reach net-zero emissions by 2050 and the financial system is integrating climate risk into its DNA. Multistakeholder movements — and particularly advocacy from youth leaders — are changing the global debate and making it increasingly difficult for policymakers and business leaders to dodge the question of how they will achieve net-zero emissions. Today, low-carbon solutions are competitive in one critical sector: electricity. With investment now flowing into low-carbon solutions of all stripes, we could reach market tipping points in sectors representing 90% of emissions by 2030 (see Figure 10).

FIGURE 9

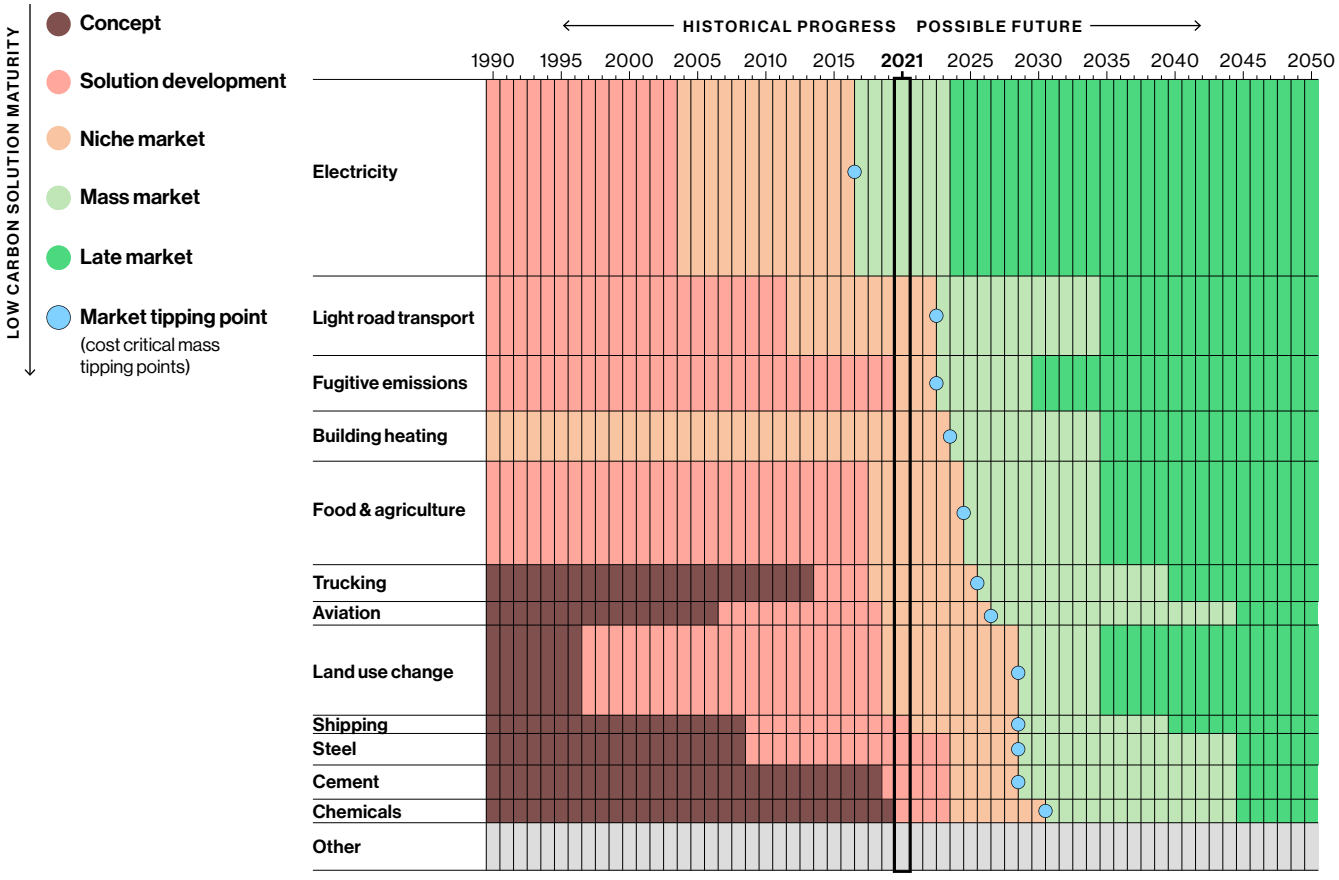
Progress in low-carbon solution maturity leads to market tipping point which triggers an S-curve scale-up in share of new sales / new build



Source: Adapted from *The Paris Effect - COP26 Edition*.[35]

FIGURE 10

Low-carbon solution maturity by sector—progress since 1990 and possible future to 2050



Note: Sectors sized according to 2019/20 emissions impact.
Source: Adapted from *The Paris Effect - COP26 Edition*.[35]

These profound changes have come about through advances in target setting, governance and institutions; economics, finance and incentives; inclusive and fair consensus building; and new innovations, technologies and data. Now it is time to apply these lessons systematically toward all system transformations for Global Commons stewardship. By activating the four action levers at local, national, regional and global levels, humanity can safeguard the Global Commons that underpin human wellbeing, prosperity and security. Together, these factors can bring about not only the system transformations, but also the changes in behavior, social norms and cultural values that are required to create consensus for a shared vision of the future, transformative policies and a shift in the goods and services we demand and consume.

D.1 Set targets; align governance and institutions

Perhaps our greatest challenge lies in making leadership and governance fit for Global Commons stewardship. Success will require more ambitious, better-integrated policies at all levels. But we must also look at the politics to see beyond what divides us as humans. As profound as differences might be between nations and peoples, the only path toward successful Global Commons stewardship lies in collaboration across and within countries. Another critical requirement is to mobilize stakeholders and secure buy-in across a broad range of policies, starting with shared targets. Without this societal buy-in, the four system transformations cannot be implemented. New governance models are therefore needed. The most promising mechanism for effective governance of the Global Commons may be strong new multistakeholder coalitions that complement improved intergovernmental and national mechanisms. We see four priorities for making governance fit for the Global Commons.

D.1.1 Set clear targets and promote pathways as a method for problem solving

As with every system change, clear targets and strategies for achieving them are critical starting points for Global Commons stewardship. As John F. Kennedy famously said, “By defining our goal more clearly, by making it seem more manageable and less remote, we can help all people to see it, to draw hope from it and to move irresistibly

toward it."[36] This is the essence of leadership for system change; and it is wonderful to see a growing list of countries adopting targets for net-zero emissions by the middle of the century.

Setting goals is essential for social mobilization. Greta Thunberg and the youth movement she has inspired mobilize around the simple message of "getting to zero." Shared goals allow all people to agree on a shared direction and can elevate Global Commons stewardship above the noise. They also generate peer pressure and mobilize epistemic communities around shared problem solving, such as cutting the cost of renewable power or scaling up electric vehicles. The consensus target of "getting to zero" is demonstrating the power of clear goals in the energy sector.

The scientific understanding of the Global Commons and the planetary boundaries has improved significantly in recent years—particularly due to the IPCC, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services and the IRP. Yet important gaps remain—especially in relation to the tipping points of the Global Commons and the interdependencies between them. To this end, the Earth Commission, supported by Future Earth, is undertaking a global scientific assessment to refine the planetary boundaries and strengthen global Earth system targets as well as baseline data. This science will help to inform and motivate more ambitious and more rigorous numerical targets adopted by governments around the world.

The SDGs provide the international framework for clarifying the targets that can define success in managing other Global Commons. Two areas stand out where greater clarity and ambition are urgently needed in relation to policy targets at the global and national levels:

- **Terrestrial and marine biodiversity:** At the CBD COP15 in Kunming, governments must adopt an ambitious target for preserving and restoring terrestrial and marine biodiversity, including large tropical and boreal forests. The proposed "30 by 30" target[37] sets an important milestone; but science tells us that up to half of the Earth's land should be preserved for nature.[38]

- **Nutrient cycles:** The release of reactive nitrogen and phosphorous already exceeds planetary boundaries, yet we lack quantitative time-bound targets for curbing their release into the environment.[6] No international convention exists that is specifically mandated to tackle nitrogen and phosphorous, so this critical issue tends to fall through the cracks of international diplomacy and national action. We therefore call on the three Rio Conventions to explore how global science-based targets might be set, drawing in particular on upcoming findings of the Earth Commission.

Similar targets and baselines are needed for businesses. Starting with the Science-Based Targets Initiative (SBTi), the energy sector has pioneered science-based targets for sectors and individual companies. Almost

1,300 companies have adopted their own targets.[39] The SBTi and the Science-Based Target Network (SBTn) are now developing similar targets for other sources of GHG emissions, as well as for biodiversity, land, oceans and water. The SBTn aims to mobilize 1,000 companies and cities to set science-based targets across the Global Commons on a socially equitable basis, in advance of the launch of methodologies for 2022. This work is expected to contribute significantly toward making the Global Commons actionable by every company.

While this is an important trend, the vast majority of businesses lag behind in terms of disclosure and targets. While the 13,000-plus companies that disclosed through the Carbon Disclosure Project (CDP) represent 64% of global market capital, just 33% are developing a low-carbon transition plan and less than 9% have set targets validated by the SBTi.[40] Moreover, only 6% claim to have set a net-zero target; and a mere 1% reported on all key indicators that CDP associates with a credible climate transition plan. The silver lining is that this data exists, and both the number and the quality of plans are increasing. Corporate leaders bear a responsibility to ensure their firms develop credible and transparent plans to manage climate and wider environmental risks.

Through the Deep Decarbonization Pathways Project and the ETC, the energy community has also developed economy-wide and sector pathways to demonstrate the feasibility of "getting to zero"; identify the tough challenges that require more work; and mobilize all stakeholders around a common vision for decarbonization.[41, 42] Energy decarbonization pathways have thus become a tried-and-tested method for problem solving that has progressively allowed the sector to increase its ambitions. The Mission Possible Partnership mobilizes industry leaders to accelerate the translation of rigorous sector pathways into faster decarbonization efforts.

Thanks to these pathways, some sectors are now moving toward positive tipping points for decarbonization. Other "hard-to-abate" sectors are moving more slowly, but the combination of learning from others and peer pressure is nonetheless beginning to show effects. We now see more clearly that decarbonizing the industrial sectors will require greater material efficiency (i.e., reduced material inputs per unit of service provided); more efficient production processes; a switch to low-carbon energy carriers—in particular, electricity, hydrogen and synthetic fuels; and the deployment of carbon capture and utilization. These latter technologies reduce the need for mitigation, so they must be considered critically in terms of their realistic potential; otherwise, we risk delaying necessary mitigation action.

Similar pathways are needed for the other system transformations toward Global Commons stewardship. To this end, FOLU and its FABLE Consortium have promoted national decarbonization pathways toward sustainable land use and food systems in some 20 countries.[43] More work is needed to include oceans and to increase the spatial resolution of the pathways to better inform policies. FOLU has also developed a framework for triggering positive tipping points and applied

it to four critical transformations to transform food and land use.[34] Since food and land use systems account for up to 30% of GHG emissions,[44] every country must develop such pathways alongside energy pathways to map out the transformation toward net-zero GHG emissions. Together, these two sets of pathways can help to mobilize industry coalitions for practical problem solving, and inform countries' long-term low-emission development strategies and nationally determined contributions under the Paris Agreement.

Efforts to apply the concept of pathways and industry coalitions to sustainable consumption and production are also gathering pace. Yet, as underscored by the IRP, discrete analyses are required for major production and waste management systems.[45] *Breaking the Plastic Wave* presents such an approach for reducing plastic pollution and is beginning to mobilize governments, industry and civil society around the practicalities of curbing the release of plastic into nature.[46] The EU is promoting similar pathway assessments as part of its New Circular Economy Strategy.

Pathways for how cities and other human communities can transform to meet the SDGs represent a tremendous analytical and organizational challenge.

But we are encouraged by the progress made by C40, the Coalition for Urban Transitions and many others in conceptualizing pathways toward urban transformations and developing tools to activate them. More work is clearly needed—particularly to understand how pathways can be designed and implemented in cities around the world, which often face massive resource gaps and lack technical capacity. This is where new coalitions that harness new technologies and foster new modes of cooperation can perhaps add the greatest value (Section C.1.2).

Such pathways are necessary at the national level, to motivate and guide stakeholder coalitions and improve policies. But they are also required at the regional and global levels, to foster a science-based understanding of how systems and response strategies interact across the four system transformations for Global Commons stewardship and the SDGs more broadly. To this end, PIK and the Center for Global Commons at the University of Tokyo are facilitating an effort to model global and regional transformation pathways toward effective stewardship of the Global Commons. This work aims to improve our understanding of synergies and tradeoffs for governing the Global Commons under varied scenarios, which in turn could inform national policy pathways.

Box 1 | Modeling pathways toward Global Commons stewardship

PIK is conducting interdisciplinary modeling of transformation pathways that will allow humanity to stay within planetary boundaries and achieve the SDGs by 2030, 2050 and beyond. It is analyzing the synergies and tradeoffs in governing the Global Commons domains of atmosphere/climate and biosphere under various scenarios. This work will support international policymakers by offering evidence toward a shared vision, supporting problem solving and presenting viable pathways that contribute to the new economic paradigm. Its unique value will be in capturing the interactions across the four Global Commons Strategic Framework transformations, given that existing pathways largely focus on achieving a specific climate stabilization target. In particular, this research will take into account interdependencies between societal and environmental systems, and assess positive and negative synergies of policies and measures in different fields of action relevant for achieving the SDGs and safeguarding the Global Commons.[47–54]

D.1.2 Strengthen multistakeholder coalitions and social movements

Recent years have seen a sharp rise in the number of coalitions and movements aimed at promoting system transformations.[27] These have become critical drivers of problem solving, bottom-up experimentation, advocacy, coordination and implementation support across different stakeholder groups and domains of expertise. In all of these roles, they can accelerate progress toward positive tipping points—for example, by changing the feasibility and economics or shifting cultural and social norms. Such multistakeholder coalitions are an important complement to intergovernmental bodies and bilateral government cooperation. Compared with intergovernmental processes, coalitions can be faster off the ground and have greater freedom to develop and promote creative solutions. For example, WRI's broad experience in convening multistakeholder coalitions for the system transformations suggests that such movements can help to drive innovation, change behavior and norms, promote better policies and institutions, and facilitate response to exogenous change.[55]

Powerful examples of effective problem solving are the multistakeholder coalitions that contributed toward the global fight against AIDS, tuberculosis and malaria in the early 2000s.

Their shared problem solving focused on five core challenges:

- defined shared goals and metrics;
- pathways and policy standards for successful disease management;
- the development and financing of countries' capacity to design and implement complex disease control and treatment programs;[e]
- hard-headed, evidence-based advocacy; and
- applied research and technology development to fill gaps.[f, 57]

D.1.3 Make domestic governance and international cooperation fit for the Anthropocene

To achieve their science-based targets, national governments must develop detailed pathways and policies. Doing so successfully requires new ways of evaluating policies and measuring progress, as well as new ways to balance political priorities. Interdependencies across ministries can result in conflicts and tradeoffs beyond the traditional objectives of a ministry. For instance, a housing ministry will have historically focused on ensuring the delivery of (affordable) housing, rather than on decarbonizing the built environment or ensuring the sector does not deplete biodiversity excessively. Governments need strong institutions as well as mechanisms for alignment and coordination to manage difficult tradeoffs and develop solutions that are optimized across Global Commons stewardship and other legitimate priorities. The latest IPCC report highlights the need for independent and cross-institutional bodies to coordinate across sectors, scales and actors; build consensus for action among diverse interests; and inform strategy setting.[27] These functions are often accomplished through independent national expert bodies and high-level coordinating bodies that transcend departmental mandates.

Centralized approaches to managing such conflicts include cabinet committees that bring together the responsible political decision makers, convened by the head of government or finance minister. Some countries have set up "super-ministries" responsible for managing climate change. These can help; but they may struggle to influence decisions in other ministries and do not by default consider all Global Commons. At a working level, cross-ministry collaboration should be institutionalized by bringing together officials from various ministries to jointly resolve issues.

e A central actor in this regard was the Global Fund to Fight AIDS, Tuberculosis and Malaria. This promoted bottom-up innovation and helped build high-quality country demand for increased financing.[56]

f For example, the Bill and Melinda Gates Foundation, the World Health Organization, industry and many others initiated targeted programs to develop rapid-diagnostic tests for malaria, improve treatment for multi-drug-resistant tuberculosis, provide insecticide-treated bednets and explore effective methods for community engagement.

Governments also need effective institutions to provide backing and pressure for ambitious action. The judiciary can play an important role here. The highest courts of several countries have found domestic policies to be inadequate for achieving Global Commons stewardship. For example, in April 2021, Germany's Constitutional Court ruled that the country's climate law had to be revised to avoid placing an undue burden on young and future generations. In its ruling, the court explicitly acknowledged that Germany's remaining carbon budget must not be exceeded to remain in line with the global temperature goals set under the Paris Agreement.[58] This followed a series of court cases in the Netherlands, which led to a December 2019 Supreme Court decision ordering the government to implement more ambitious emissions reductions "due to the risk of dangerous climate change that could have a severe impact on the lives and welfare of the residents of the Netherlands."[59] These examples highlight the importance of judicial oversight over executive and legislative action in support of the Global Commons. In addition, the judiciary can play a role in holding companies to account for their impact. For example, in May 2021 the District Court of The Hague in the Netherlands ruled that Royal Dutch Shell must reduce its carbon emissions by at least 45% compared with 2019 levels by the end of 2030 to avoid environmental damage with respect to Dutch residents.[60]

However, while the judiciary can be powerful in setting precedent, its procedures are lengthy and reactive. Therefore, the establishment of institutions that can proactively scrutinize government policy is also crucial. For instance, the legislature can hold the executive to account in meeting national and international policy commitments relating to climate change and other Global Commons. As an example, the UK Committee on Climate Change and Denmark's Council on Climate Change were created by law to report regularly to Parliament on whether national policies are in line with commitments under the Paris Agreement. Crucially, the laws establishing these committees set out their independence and reporting duties, as well as the respective government's obligation to respond to all recommendations.[61]

Countries—particularly the richest ones—must further track and reduce negative spillovers on the Global Commons and on other countries. Such spillovers include emissions and biodiversity loss due to international trade, as well as exports of toxic waste. These spillovers are pervasive, as demonstrated by the GCS Index;[62] but they tend not to be measured by national statistical authorities. In recent years, data and analytical methods for estimating international spillovers have improved greatly—particularly in relation to the four system transformations for Global Commons stewardship. Every country can publish this data and should consider it in the process of policy formulation.[63] Eurostat, the statistical office of the EU, is preparing to incorporate spillover metrics into its official statistics and has urged other countries to follow its example. In April 2022, Sweden became the first country to announce its intention to set a target to reduce consumption-based GHGs generated abroad.[65]

Beyond measuring spillovers, countries must reform domestic policies to curb their

negative impact. As a first step, this requires the systematic assessment of the potential spillovers that domestic policies may generate on other countries. The transformation toward sustainable food, forests, land, water and oceans must address these spillovers. Famously, the US and the EU[64] failed to consider the impact of their biofuel mandates on tropical deforestation in Latin America and Southeast Asia. To increase policy coherence, all countries—and particularly rich countries—must screen their domestic policies for unintended international spillovers. These include bilateral and multilateral trade deals, which should align with Global Commons stewardship. As illustrated by the FABLE Consortium, analytical tools already exist to understand international spillovers and strengthen policy coherence.[43]

Countries must also reframe international relations in the age of the Anthropocene. In the last few years, tensions have risen between China, Russia, Europe, the US and many other regions. Russia has now invaded Ukraine, and there is a risk of a confrontation between Russia and NATO. We do not deny that there are deep-seated differences between countries; but a failure to come together to fight climate change and safeguard other Global Commons will literally spell the end of the world's great human civilizations.[66]

The China-US joint declaration at COP26 reiterated the countries' commitment to tackle climate change both individually and collaboratively. While this is commendable and necessary, the concurrent pursuit of cooperation and confrontation risks undermining trust and genuine collaboration. Thus, the world must hope that cooperation on the stewardship of the climate and other Global Commons will become central to relations between these two powers, deepening trust and enabling the constructive resolution of disagreements.

Indeed, Global Commons stewardship depends on effective international cooperation and diplomacy. For example, as part of its Green Deal, the EU is promoting the concept of "Green Deal diplomacy," which frames bilateral and multilateral relationships under the overall objective of advancing sustainable development, including by setting a credible example and following up with diplomacy, trade policy, development support and other external policies.[12] We strongly agree with the need for Green Deal diplomacy between all countries.

The recent agreement to reform international taxation rules to ensure the fairer distribution of tax revenues and a global minimum corporate tax rate further illustrates the potential for mutually beneficial international cooperation. The agreement was advanced by the OECD, and 136 countries and jurisdictions—representing more than 90% of global GDP—have joined the framework.[67] With respect to Global Commons stewardship, the OECD has also made progress toward a harmonized assessment of carbon pricing across 44 OECD and G20 countries.[68] This approach will be critical in facilitating cooperation and a fair comparison of emission pricing policies.

Meanwhile, existing intergovernmental bodies should be reconfigured to be better suited for

Global Commons stewardship. For example, while the G20 has emerged as a powerful and effective complement to the United Nations, it currently leaves out 96% of Africa's population and thus many of the regions and peoples most at risk of a collapse in the Global Commons. The economist Jeffrey Sachs argues that a simple remedy would be to expand the G20 by one member: the African Union.[69] The G21 would represent 54 more countries, 1.3 billion more people and $2.3 trillion more output. This would not only enhance the organization's ability to make better, more legitimate decisions, but also provide a crucial forum for African regional coordination.

The EU's Green Deal is the leading example of the vital role that regional institutions can play in driving action, collaboration and consensus. Regional collaboration is critical to ensure efficiency (e.g., interlinking energy grids, shared standards); strategic development of critical infrastructure (e.g., low-carbon transport and hydrogen networks); and appropriate stewardship of the Global Commons and ecosystems.

The prospect of experimental interventions that could directly alter global natural processes, such as geoengineering, poses significant challenges for both regional and international collaboration. While the potential to avoid—or even reverse—catastrophic tipping points should not be discounted, the risks and potential costs of these interventions are immense. Our understanding of natural processes is growing rapidly; but so too is our awareness of the complexity of and interactions between systems. A well-intentioned intervention could have severe and irreversible consequences. The fact that individual actors may be capable of deploying such interventions without the consent of affected stakeholders and the global community further underscores the need for new international governance mechanisms to manage the study and deployment of such unproven interventions in natural systems.

Some countries are also proposing stronger international legal frameworks for the Global Commons, including the Global Pact for the Environment. Other suggestions focus on expanding the Rome Statutes, which established the International Criminal Court (ICC). Currently, the ICC can hear cases relating to crimes against humanity, crimes of aggression, war crimes and genocide. Several campaigners have called for ecocide to be added as a fifth international crime. Efforts to establish new legal crimes or rights could make a significant contribution toward curbing environmental crime and protecting the Global Commons.

D.1.4 Address illegal acts that harm the environment

Most commonly, environmental crime consists of the theft, illegal appropriation or pollution of natural resources. Often, criminal networks exploit vulnerable people and ecosystems to engage in illegal deforestation, land grabs, fishing, logging, mining, wildlife trade and land conversion. Environmental crime is shockingly widespread, as the third most common illicit activity, after drug trafficking and trade in counterfeit goods. The long-term costs of environmental crime are estimated to be as high as $1-2 trillion per year,[70] and the annual tax revenue lost by governments due to environmental crime as high as $9-26 billion.[71] However, environmental crime is largely tolerated and is increasing at twice to three times the rate of the global economy.[72]

Countries must enforce and uphold high legal standards domestically while respecting other countries' laws, strengthening transparency in supply chains and promoting efforts by multistakeholder coalitions. For example, there is an opportunity to support a new Nature Crime Alliance which would combine the capacities of national law enforcement, Interpol and the United Nations Office on Drugs and Crime to crack down on environmental crime and human rights abuses in food and land use systems.[72] The proposed body, sponsored by Norway's International Climate and Forest Initiative, could recapture the illicit financing of environmental crime to finance Global Commons restoration and stewardship. The September 2020 Leaders' Pledge for Nature also included a commitment to ending environmental crime, which has since been endorsed by over 90 countries. These efforts should include extending the scope of illegal activities to ensure accountability and responsibility for environmental harms.

D.2 Reset economics, finance and incentives

The Stern Report,[73] the Dasgupta Review[74] and many other studies have shown that Global Commons stewardship makes good economic sense. It is far cheaper to curb negative human impacts than to bear the long-term consequences of inaction. Yet financial markets and businesses remain stacked against the Global Commons. For example, the global food system generates $12 trillion in hidden costs each year,[72] while its market value is $10 trillion. Radical changes to existing economic models are needed to curb unsustainable investments and redirect financing toward Global Commons stewardship. Shifting the economics can result in broad and efficient reinforcing

feedbacks that bring about the conditions for positive tipping points.

As one overarching challenge, it is widely acknowledged that GDP and national accounts present a misleading picture of countries' economic, social and environmental progress.[74–76] Countries should thus complement GDP with more direct measures of human wellbeing. New Zealand, for example, has replaced a focus on GDP with a Living Standards Framework that incorporates human, social and natural capital to guide decision making. To embed this thinking in policymaking, the Treasury has moved toward a "Wellbeing Budget" from 2019 and introduced a tool to consistently assess the monetary and non-monetary costs and benefits of policies. Other countries are considering different metrics, but the fundamental point remains the same: GDP is too narrow a gauge for progress in modern societies. The COVID-19 recovery both lends urgency and presents significant opportunity. If done well, the unprecedented government spending on post-COVID-19 recovery could turbocharge a shift toward Global Commons stewardship. If done poorly, however, these programs might entrench legacy sectors that undermine the system transformations.[77] We highlight four urgent priorities for action in this regard.

D.2.1 Align fiscal policies with Global Commons stewardship

National fiscal policies—on taxation and public spending—are critical tools for Global Commons stewardship and social inclusion. A first priority is to introduce an adequate carbon price that rises over time. According to the OECD, carbon prices will need to reach at least €120 per ton of CO_2 equivalent by 2030; but so far, most countries are falling woefully short of this target.[78] Effective carbon prices can be generated through carbon taxes and carbon market mechanisms, such as the EU Emissions Trading System. Together, these pricing mechanisms should cover all parts of the economy that drive GHG emissions. Similar pricing is necessary for other pollutants, such as nitrous oxide and sulfur dioxide. Increases in taxes on pollutants can in turn help to reduce the fiscal burden on labor, which can promote employment. Equity and distributional impacts of such carbon pricing instruments are critical to ensure they are widely accepted.[27] Carbon pricing is most effective if revenues are redistributed by returning them to taxpayers, supporting low-income households or ring-fencing them for green infrastructure (Section D.3.1).

Second, countries should phase out and repurpose harmful subsidies. The International Monetary Fund has estimated the potential revenue gains from charging efficient fossil fuel prices in 2025 at 3.8% of global GDP, which would also reduce global CO_2 emissions to 36% below baseline levels and prevent 0.9 million local air pollution deaths per year.[79] Well-designed energy

subsidies can help to meet critical societal needs and advance the achievement of the SDGs, but most energy subsidies are poorly designed: they encourage wasteful energy consumption; reduce investments in clean energy; exacerbate income inequalities;[g] and crowd out other critical public spending needs for infrastructure and social services. Fortunately, the toolbox for repurposing perverse energy subsidies is reasonably well known and backed up by country experiences.[80] The post-COVID-19 recovery and the disruptions in global energy systems following Russia's invasion of Ukraine present an opportunity to accelerate such subsidy reforms.

After energy, agriculture is the sector that receives the largest subsidies worldwide, to the tune of $700 billion annually. Many of these subsidies have net-negative social impacts on public health, the climate system, biodiversity, soil carbon storage and pollution.[72] Such subsidies should be redirected toward nature and human health-positive solutions, such as more sustainable agriculture, contributing to a food system transformation that could reap a societal return of over 15 times the investment costs required, which are estimated at less than 0.5% of global GDP. Such efforts would also reduce the estimated $12 trillion that our current food system generates each year in hidden costs to the environment, human health and development.[72]

A third priority for aligning fiscal policies with the four system transformations toward Global Commons stewardship is public procurement. Public procurement represents around 30% of total general government expenditure and 12% of GDP on average in OECD countries.[81] If aligned with the transformation pathways toward energy decarbonization, sustainable food systems and circularity, public procurement can accelerate technological shifts and set standards that will draw in more private finance. To this end, public authorities across the EU and the UK have already confirmed their intention to abide by the EU Taxonomy and equivalent standards in the UK. This is an important step and public procurement authorities elsewhere should consider similar approaches.

Fourth, countries must combat base erosion and profit shifting to sustain the fiscal base required to finance public investments in the four system transformations. This includes measures such as minimum corporate tax rates; greater tax transparency; fair taxation of technology companies, which can most easily shift profits to low-tax jurisdictions; transparent registers of beneficial company ownership; and enforcement of anti-money laundering standards. We are encouraged by the progress toward an agreement to reform international taxation rules that should curb base erosion and profit shifting, and hope that transparent minimum standards will soon be adopted by all major economies.[67] This will make a singular contribution to countries' ability to invest in achieving the SDGs, including Global Commons stewardship.

Fifth, to ensure better fiscal policies, countries must reflect natural capital in their national accounts to ensure that the destruction of natural capital is not disguised as economic

g One study concluded that the richest 20% of households receive six times more in fossil fuel subsidies than the poorest 20%.[80]

output and wellbeing. The UN System of Environmental-Economic Accounting (SEEA) has now matured to serve this purpose. It features methodologies for natural capital accounting for agriculture, forestry, fisheries, air pollution, energy, ecosystems, land, material flow, water and other environmental activities.

The SEEA considers both physical and monetary accounts that can be integrated with the standard System of National Accounts. We therefore call on countries to expand their national accounting frameworks to include natural capital and other dimensions critical for Global Commons stewardship.

D.2.2 Invest in safeguarding the Global Commons

In addition to fixing the rules of the game to make them compatible with Global Commons stewardship, countries must mobilize and direct more finance toward the Global Commons. The four system transformations will require an estimated increase in investment of $1.5-$2.5 trillion per year, or 1.5-2.5% of world gross product over the next 10 years.[h] Many of the necessary investments in energy systems, sustainable agriculture, environmental protection, the circular economy and other components of the transformation toward Global Commons stewardship are complex, and thus require public-private financing solutions at scale. At the moment, every public dollar spent mobilizes less than $1 in private funds. However, we are starting to understand the key success factors for mobilizing such blended finance.[87] They include streamlining regulatory restrictions, building pipelines of bankable projects and mainstreaming and scaling blended finance instruments.

National development banks and equivalent institutions are stepping up to finance energy decarbonization and the other system transformations. As one example, the European Investment Bank has become Europe's Climate Bank and is playing a central role in directing blended finance toward the objectives of the European Green Deal. Similarly, the missions of multilateral development banks—including regional development banks such as the Asian Development Bank and the Asian Infrastructure Investment Bank—should be aligned with the SDGs and equivalent standards, such as the EU Taxonomy. Concretely, multilateral lenders should not finance fossil fuel-based infrastructure that is inconsistent with achieving net-zero GHG emissions by 2050. The fact that many of the largest shareholders of multilateral finance institutions (China, the EU, Japan, South Korea, the UK and the US) have committed to full decarbonization by 2050 (before 2060 in the case of China) makes the shift away from financing unsustainable infrastructure a simple issue of policy coherence.

h Calculated by SYSTEMIQ from a range of sources.[72, 82–86]

Encouragingly, China, Japan, the EU, the US and other countries have all committed to phase out international financing for coal-fired power plants. International financial institutions should undertake sustainability impact assessments, including a focus on impacts on the Global Commons, before any substantial commitment of funding or other major action.[88] All national and multilateral financial institutions should focus their activities on mobilizing blended finance with the imperative of safeguarding the Global Commons. This includes the pension funds that many countries have amassed, estimated to stand at $56 trillion globally in 2020.[89] Given that many of these enjoy public sector support (e.g., favorable tax treatment), there is a case for making them subject to environmental, social and governance (ESG) criteria by default and using the funds to finance the transformation to a more sustainable and resilient economy. Countries like Denmark[90] and Sweden[91] have already implemented such approaches.

A more direct way of raising funding for restoring and preserving natural systems is to use the revenues from taxes on GHG emissions or other activities harmful to the Global Commons to fund payments for ecosystem services. This could stimulate and generate a competitive market for regenerating natural systems.

D.2.3 Align business and financial sector incentives with Global Commons stewardship

The private sector has a crucial role to play in making Global Commons stewardship a reality. Private banks and businesses must provide the drive, finance and resources to develop and scale the new technologies and operating models that are needed. This requires changes in how businesses measure costs and risks, as well as their success—that is, in everything from accounting standards to business models. But standards are not enough. Corporate leaders must recognize that private gain at public expense is no longer acceptable and commit to net positive business strategies (Box 2).

Box 2 | The need for net positive business strategies

Given the gravity and urgency of our environmental challenges, business models that are "less bad," doing marginally less damage or producing fewer emissions, are not good enough. Neither are "sustainable" business models that neither deplete nor replenish nature. Instead, former Unilever CEO Paul Polman calls for companies to think regenerative, restorative and reparative, so that they become "net positive." In his definition, net positive companies thrive by giving more to the environment and society than they take. His book outlines the implications for this approach,[92] centered on four steps that businesses can take to thrive today and win in the future.

First, move beyond shareholder primacy toward benefiting a broader set of stakeholders through responsible, long-term-oriented management. Focusing primarily on returns to shareholders often results in significant social and environmental harm; and it also leads to a myopic focus on short-term gains, which can undermine returns to investors. Long-term investor returns are the reward for serving a broad set of stakeholders well, rather than maximizing short-term financial profit.

Second, take responsibility for their full footprint, intended or not. Short-term profits have often been boosted by externalizing costs and internalizing profits.[93] However, the real costs of not taking ownership of negative impacts are now hitting home to managers and investors. Examples include child, low-wage and slave labor practices; the role of tech platforms in spreading divisive and false content; and catastrophic adverse environmental impacts ranging from local pollution to destabilization of the Global Commons. Increasingly, regulators, investors and customers expect firms to understand all the ways in which their operations affect people and the planet, and to mitigate and manage these responsibly. Innovations in data collection and sharing can help (see Section D.4.2).

Third, embrace deep partnerships and strengthen multistakeholder coalitions, including by working with critics (see Section C.1.2). When companies act together, they can tackle complex issues that will improve their own sustainability and resilience and those of the sectors in which they operate, and can often gain efficiencies that counter first-mover disadvantages. Such partnerships should also include constructive critics, such as civil society organizations, which can help identify problems and develop solutions.

Finally, shift toward a model of "net positive advocacy" with governments. Tackling complex systemic challenges requires fundamental changes in how the system is governed. Rather than exploiting government relations to resist regulations or demand preferential treatment, companies should consider how they can help policymakers improve the rules to solve problems for the benefit of all. This requires an open and transparent approach to government relations, including a clear understanding of the goals policymakers want to pursue. In proactively helping governments design policy that effectively achieves desired behaviors and outcomes, companies can avoid the costs of bad regulation and reduce uncertainty.

To mobilize private capital for the four system transformations, countries and the international community must align business and financial sector incentives with Global Commons stewardship, starting with financial regulation. The EU is seeking to direct capital markets away from financing activities that undermine ESG objectives, including the SDGs. Since the end of 2021, private investments must disclose whether they are consistent with the objectives of the Paris Agreement. In subsequent years, the EU Taxonomy will be expanded to cover other ESG topics that are broadly consistent with the four transformations for Global Commons stewardship. Joining many other central bankers convened under the Network for Greening the Financial System, Christine Lagarde has declared that climate change is a systemic threat to the world economy and is therefore critical to the mandate of central banks to ensure price stability and manage economic risks.[94]

Similarly, the UK is introducing tough financial regulations to push capital toward green investments, drawing in particular on the recommendations of the TCFD.[95] The US Securities and Exchange Commission has also proposed TCFD-inspired rules on climate-related financial disclosure.[96] China is preparing a raft of financial regulations to support its objective of achieving carbon neutrality by 2060.[97]

Investor pressure and regulation, as well as the self-interest of financial institutions, should increasingly lead to a rebalancing toward green investments. However, it is important that this does not merely become an exercise in labeling and funding activities that are already sustainable. This would risk cutting off industries that are most detrimental to the health and resilience of our planet from the funds needed to invest in transformation, and might push firms to continue operations in less well-monitored parts of the financial sector.[98] Instead, financial institutions and regulators must ensure the creation of instruments such as transition bonds that are linked to science-based, externally verifiable decarbonization targets and other sustainability goals.

The TCFD, the EU Taxonomy and similar standards for stress testing financial systems and redirecting investments away from environmentally harmful activities are vital tools for Global Commons stewardship. They are an important start and must now become more granular to support the transformation of energy and land use systems along the pathways identified by the ETC, FOLU and others (Section D.1.1). Crucially, over time, tools for financial stress testing and redirecting capital flows must look beyond GHGs to consider other attributes of the Global Commons and drivers of change.

In particular, a major gap exists in relation to national accounting for natural capital, as powerfully demonstrated by the Dasgupta Review.[74] Similarly, the World Economic Forum's New Nature Economy Report series reveals how key sectors contribute and are exposed to the degradation of natural capital.[99] Drawing on lessons from climate change, the TNFD has been established to systematically assess how the financial system can be reoriented toward sustaining a nature-positive economy.

We recommend that the TNFD also consider the vital but commonly overlooked issues of unsustainable releases of reactive nitrogen and phosphorous through agriculture, poor waste management and industrial activities. In this way, the TNFD can close two major gaps toward making the economy compatible with Global Commons stewardship.

As Larry Fink—chairman of BlackRock, the world's largest asset manager—highlighted in his 2021 letter to CEOs, climate change is a major risk for companies, but it is not reflected in corporate accounts.[100] Fortunately, key global actors are coming together to remedy this. The ISSB was launched at COP26 in November 2021 as an effort to consolidate the disclosure of financially material sustainability information by corporates and financial institutions within a globally accepted framework. It was initiated by the International Financial Reporting Standards Foundation, which already sets accounting standards that apply in about 140 countries. The ISSB is supported by a broad coalition, including the recently merged Value Reporting Foundation, which brings together the International Integrated Reporting Committee and the Sustainable Accounting Standards Board. This alignment of organizations suggests that emerging standards will soon move beyond voluntary standards that mobilize early adopters toward comprehensive adoption of better accounting standards. Regulatory authorities in every market should consider available proposals for rapid adoption.

D.3 Ensure inclusion and fairness to build consensus for change

All societies should strive to achieve social inclusion, equity and fairness, and to "leave no one behind," as called for by the 2030 Agenda for Sustainable Development. While income inequalities are rising across the board, many countries serve as models in this regard. For example, the Nordic states have maintained low levels of inequality through progressive taxation, income transfers and investments in human capital that disproportionately benefit the poor; and some countries in Latin America and elsewhere have shown how targeted policies can reduce inequality rates.

Social inclusion and equity are critical to build consensus for change and thus enable the four system transformations for Global Commons stewardship. The changes to economies and labor markets brought by the transformations will be acceptable and successful only if countries enjoy a high degree of social cohesion. Many of the transformations rely not only on changes in politics, technologies and business practices, but also on changes in behavior that require positive tipping points in cultural and social norms. The climate movement was perhaps the first to realize the critical importance of a just transition and these insights apply equally

to the other system transformations. While we fully recognize the importance of social inclusion to achieving the Global Commons, the scope of this framework does not include a comprehensive review of how countries can strengthen social inclusion and equity.[i] To promote Global Commons stewardship, countries should focus on the following issues.

D.3.1 Design transformations in fair, transparent and participatory ways

Globalization has brought prosperity to billions, but it is not delivering for many. Even before the COVID-19 pandemic, 8.4% of the world's population lived in extreme poverty (less than $1.90 a day).[103] The World Bank estimates that the pandemic may have pushed as many as 150 million additional people into extreme poverty by the end of 2021. The pandemic also illustrated the importance of social cohesion and collective action, as well as the supporting personal and socio-cultural norms.[104] In contrast, low trust in public authorities impairs the effectiveness of policies and polarizes society.

The challenges to development, inequality and the health of critical Earth systems are intimately linked; and the same is true of their solutions. All countries must strive to meet the needs of their populations, while staying within the planetary boundaries. Development and sustainability must not be in conflict. The SDGs put investment in human capital and wellbeing—health, education, gender equality, food security and an end to extreme poverty in all its forms—at the center of the 2030 Agenda for Sustainable Development. Strong human capital is not only the engine of economic growth, but also a critical enabler for reducing income inequalities. We know that significant inequalities are profoundly harmful to societies and individuals.[105] Societies that are beset by poverty or significant inequalities will struggle to mobilize the shared purpose and energy to tackle the four system transformations for Global Commons stewardship. The latest IPCC report suggests that climate change mitigation action designed and conducted in the context of sustainable development, equity and poverty eradication, and rooted in the development aspirations of the societies within which it takes place, will be more acceptable, durable and effective.[27] Investing in human capital and wellbeing is therefore investing in the transformations for Global Commons stewardship. This report does not discuss social transformations and investments in human capital in operational detail. However, it does underscore that

i For good reviews, see Leach et al. (2018) [101] and WBGU (2018).[102]

tackling climate change, making land use and food systems sustainable, and promoting thriving and inclusive cities and the circular economy all rest on the foundation of investment in health, education, food security and other dimensions of human capital, ensuring universal access to basic services.

Healthy and resilient Earth systems are essential to the health, prosperity and security of all people. Therefore, all countries have an interest in preserving and restoring the Global Commons. Low-income countries tend to be even more reliant on healthy natural systems, particulary through agriculture and fisheries.[104] Quantifications of the aggregate global economic repercussions of mitigation pathways—particularly for low-income countries—reveal that mitigation is a welfare-enhancing strategy when benefits from avoided climate change impacts are accounted for.[104]

While it is in all countries' interest to ensure the health and and resilience of the Global Commons, as outlined in Section B, some countries bear a disproportionate responsibility for safeguarding them. In particular, developed countries have both the responsibility and the resources to lead the system transformations toward Global Commons stewardship. All countries must work together by developing equal and mutually beneficial partnerships around diplomacy, investment and trade that value, preserve and restore the Global Commons. High ambitions and solidarity within and across countries must go hand in hand. ODA provided by rich countries to low-income countries is critical to promoting Global Commons stewardship and ensuring that these countries can escape extreme poverty by 2030.[16] Harnessing the full potential of ODA will require clearer standards and measurements. For example, the OECD's Development Assistance Committee could review its "Rio Markers" to ensure that they promote and accurately measure ODA for Global Commons stewardship.

Moreover, assistance does not always require the transfer of significant funding. Countries can provide technical expertise to help facilitate the adoption of policies that are more effective at attracting and mobilizing private investment. For example, stable and well-designed policies for renewable energy are a critical factor to mobilize private investment in developing countries. Alongside the right regulations, such measures include auctions, feed-in tariffs, tax policies and deployment targets that increase transparency and competition. On average, developing countries with such enabling conditions in place attracted 17 times more renewable energy investments between 2015 and 2019 than those without them.[106] To avoid potential adverse side-effects of technology transfer (e.g., low-value employment and dependence on foreign knowledge and suppliers), strengthened enabling conditions can reinforce development benefits, which in turn can create feedbacks toward greater public support for policy.[27]

To successfully embark on and maintain progress toward the four system transformations, all countries must find ways to manage disruption and share success. Every transformation generates winners

and losers. This is evident in most market economies, in which shifting market forces both create and destroy industries and businesses. Many countries with the means to do so are opting for social safety nets that aim to cushion the impact of such shifts. The equity and distributional effects of economic instruments (e.g., carbon pricing) can be addressed by using revenue from carbon taxes or emissions trading to support low-income households.[27] Such measures should be deployed as part of a comprehensive mix of economic and regulatory instruments to facilitate rapid responses and—particularly for higher-cost measures—to mitigate the potential equity impacts of relying on high price signals. When countries decide to transform major parts of their economies to reduce society's impact on the environment, there is a strong case for supporting the losers from these transformations through a just transition fund. This is particularly the case when transitions affect entire regions or territories—as can happen when major industries and employment generators, such as coal, are phased out.

As one example, the EU has established the European Just Transition Fund to support territories in making the transformation under the European Green Deal. It aims to alleviate the impact of the transformation by financing the diversification and modernization of local economies. The fund will prioritize investments in digital connectivity, the regeneration of industrial sites, the reskilling of workers and the provision of technical assistance to accompany the transformation.

Other countries will need to consider similar mechanisms to enable just transitions. Where domestic resources are insufficient—as is the case in low-income countries—international assistance will be needed. Economies that are highly dependent on the extraction and export of fossil fuels will face particular challenges arising from the deep and rapid transformation of their economies.[27] International cooperation and new mechanisms to help countries successfully navigate this transformation will also be required.

Countries that do not diagnose the transition challenges carefully enough, or that fail to tackle them, will struggle to meet their targets. For example, Germany's energy transition and the exit from coal were held up for some time by resistance in lignite mining areas, where some 20,000 jobs depend on coal. For an economy the size of Germany's, this represents far less than weekly fluctuations in the labor market; but the issue became highly politicized because the government and advocates of the energy transition failed to anticipate the attendant job losses and work with affected communities to develop a transition strategy. Instead, policymakers focused on estimates of overall job gains from the energy transition, without considering the needs of those who would lose their jobs. Understandably, this was unacceptable to the miners; so they mobilized and ended up delaying the country's exit from coal.

By contrast, Spain developed a just transition strategy in 2019 as part of a wider decarbonization effort that outlined a structured, participatory process to protect coalminers and power plant workers and

plan for the economic future of coal regions. This strategy will facilitate the assessment of potential job losses, challenges and opportunities in affected regions through a participatory negotiation process involving a wide range of actors, especially local authorities.[107]

These contrasting examples yield two important lessons. First, even social costs that might appear small can scupper efforts to implement the system transformations. Therefore, it is critical to understand *ex ante* who might be the losers from the transformations and how their needs can be met through support strategies. Aggregate estimates of net job gains are of little use; instead, countries must identify and engage with those who might (understandably) resist the transformations for fear of losing out. The second lesson is that such issues can be resolved through careful, transparent and participatory design of the transformations. In Spain, this was achieved through a clearly structured and transparently documented process, with the engagement and coordination of diverse governmental and non-governmental stakeholders. These lessons should be applied to all transformation pathways and their implementation, as also reviewed in Section D.1.1.

D.3.2 Value and champion Indigenous Peoples and local communities

Indigenous Peoples and other local communities are at the heart of managing critical habitats, particularly in the land biosphere and the ocean. These communities have lived in balance with the environment for generations; but the threats of climate change, deforestation, development and externally driven resource extraction are endangering this way of life. Valuing Indigenous Peoples and local communities means recognizing and upholding their substantive rights (e.g., to their land) as well as their procedural rights (e.g., to free, prior and informed consent; to information; to justice). Businesses and governments should not only respect these rights, but actively seek out the skills and expertise of these groups while ensuring inclusive and equitable decision making for the benefit of the local and Global Commons. Local commons can thrive only when the communities that depend on them—and often manage them—can thrive too.

Indigenous Peoples and local communities manage close to 25% of the Earth's surface and ocean areas, which hold approximately 80% of the Earth's biodiversity. Lands in which Indigenous Peoples and local communities have full legal tenure hold an estimated 37.7 billion metric tons of carbon.[108] However, dams and hydropower projects have flooded much collectively held land around the world. Mining for precious metals is another grave threat to indigenous lands.[109]

The contribution of Indigenous Peoples is essential in designing and implementing solutions for ecosystems.[110] Box 3 provides

an example of the importance of empowering local communities in the forests of Nepal. Strengthening intercultural dialogue between Indigenous populations and the scientific community represents an opportunity to integrate cultural management practices into the management of national and regional natural resources. Knowledge dialogue platforms in universities and research centers should start by including Indigenous and local knowledge holders and local experts on their faculties.

As the IPCC notes[104]—and as is recognized in Target 1 of the draft Global Biodiversity Framework[111]—integrated land use planning and management framed by the SDGs is critical to halt deforestation and support the livelihoods of Indigenous Peoples and local communities. To this end, countries should consider participatory spatial planning for nature, climate and people to support Global Commons stewardship.

Box 3 | Community forest management in Nepal[112]

Forests in Nepal were nationalized in 1957, which often resulted in conflict between government policies for forest protection and local forest-dependent livelihood needs (e.g., firewood, fuel, fodder and timber). In 1976, in response to overexploitation of forests, government policies began emphasizing community forestry and handing over parts of the government-owned forests to the smallest local governance unit. Subsequently, forest administration began handing over forests directly to local groups, which greatly enhanced forest protection, as users engaged in sustainable management activities such as thinning, pruning and weeding, in addition to gaining livelihood benefits from resources such as tree fodder, grass, poles and firewood. Additional government regulations introduced in 1989, 1993 and 1995 further embedded community forestry as a key program for the Nepalese forestry sector. The scale out of this program across Nepal has led to tree regeneration and improved forest health, as well as significantly positive effects on local resource conservation (e.g., watershed conservation) and livelihood conditions.

This example demonstrates the positive impact of empowering and valuing Indigenous Peoples on a range of Global Commons—from land use change to climate, biodiversity and water—while also addressing issues of poverty and social inequality. With strong government regulations and support, community forest management in Nepal has increased significantly over time. As of 2020, there were some 22,519 community forests in Nepal, covering 16% of all land and 35% of the total forest area.[113, 114]

D.4 Harness innovation, technologies and data

Innovation—which broadly encompasses new technologies, practices and approaches—often offers solutions to seemingly intractable challenges. We live in an era of unprecedented technological innovation, which is sometimes called the Fourth Industrial Revolution. While some technologies—such as cheap plastic and the internal combustion engine—are driving the degradation of the Global Commons, modern technologies and the big data they yield lie at the heart of many solutions. We are excited that increasing amounts of private finance are flowing into innovations that promote Global Commons stewardship. To bring about positive tipping points in innovation, including the rapid development and deployment of new technologies, coherent mission-oriented collaboration is essential. As a result of technological breakthroughs, we are also witnessing an explosion of data on the Global Commons and the transformations required to preserve them. Much of this data must be managed and disseminated through global cyberinfrastructure; but our management of the cybersphere is not currently fit for purpose.

D.4.1 Focus national innovation systems and industrial strategies on Global Commons stewardship

Beyond fixing market failures, as discussed in Section D.2, countries must rethink their innovation systems, including the role of public support for innovation. Economic history and theory teach us that markets can solve many, but not all complex problems. Deep technological and system change requires an "entrepreneurial state"[115] and public-private cooperation.[116]

As famously explained by the World Bank[117] in 1993, many countries in Asia and elsewhere have successfully "caught up" with industrialized nations through a deliberate process of public-private partnership that has profoundly transformed their economies. More recent assessments have shown how China and other countries have since adapted and refined this model.[118, 119] These catch-up processes—all organized around an entrepreneurial state—have resulted in major reductions in poverty and technological advancements, particularly throughout Asia. In the age of the Anthropocene, the question is how countries can direct their development away from merely catching up with advanced economies toward securing human wellbeing through Global Commons stewardship.

However, catch-up economics might nonetheless afford some important lessons on how to upgrade technological capabilities for sustainable development directed toward the objectives of the SDGs and the Paris Agreement. China's "Made in China 2025" strategy is a bold example of the pursuit of technological leadership in key areas. Though not primarily motivated by environmental objectives, China is also advancing key environmental technologies, such as solar panels, wind power and electric vehicles. Partly in response, the EU launched a new industrial strategy for Europe which, in the words of the European Commission, aims to ensure the long-term prosperity and sovereignty of the EU. These are strong words, but they are apt. Every country must therefore consider whether its innovation system is fit for purpose and how it can best advance the shift toward Global Commons stewardship.

Universities play three important roles, as educators, knowledge generators and solution developers. To effectively fulfill the latter role, collaboration both across disciplines and with industry are particularly vital. Thus, in addition to investments in research and development, the development of research networks and consortiums is critical. We suggest that universities and research organizations should consider the Global Commons and the four system transformations as frameworks for teaching, research and problem solving. This will help break down academic silos and promote integrated and practical research. The SDSN's guide on *Accelerating Education for the SDGs in Universities* outlines the case for mainstreaming education on the SDGs at universities, what this looks like in practice, and the processes and activities universities can take to support implementation.[120] The Global Alliance of Universities on Climate is a group of 15 universities that are jointly advancing climate change solutions through research, education and public outreach; and that are partnering with industry, non-profit and government organizations to promote rapid implementation from local to global scales.

Evidence-based, mission-oriented industrial strategies can provide the long-term funding and direction needed to promote innovation and facilitate its deployment at scale. They provide a signal for market participants and can be used to reduce regulatory barriers and uncertainty. In areas such as global health, innovation challenges and technology competitions have been successfully used to identify promising technology solutions for public goods. Many models exist, such as Grand Challenges Canada, innovation grants by the Gates Foundation and the X-Prize. We call on public and private innovation agencies, foundations and research funders to consider innovation challenges for Global Commons stewardship.

Similarly, creating protected spaces for experimentation, pilot projects and small-scale demonstrations facilitates learning that can lead to improvements in performance and reductions in cost. For example, real-world laboratories allow firms, universities and research institutes, customers and regulators to test and scale novel approaches under realistic conditions and relaxed

regulatory constraints. This can help identify the right interplay of regulations and market mechanisms that will allow for the safe and efficient rollout of new technologies. A clear strategy and effective mechanisms for demonstration can be particularly important where complementary technologies (e.g., batteries and charging infrastructure for electric vehicles) must be rolled out.

D.4.2 Promote new progress measures and harness new data

What does not get measured does not get done. Rigorous tracking of progress is therefore vital to make Global Commons stewardship actionable and effective. Better data and tracking are needed across all scales, including global, national, regional, municipal and corporate. This will also lead to a clearer understanding of what works and what does not. The GCSI is already supporting two major efforts to improve data on the Global Commons.

First, the Center for Global Commons at Tokyo University, the SDSN and Yale University have developed the GCS Index (Annex 1), which tracks countries' contributions to the Global Commons, distinguishing between domestic impact and international spillovers through trade systems and other mechanisms.[62] The GCS Index aims to inform policymaking to reduce negative impacts on the Global Commons and accelerate the implementation of the Paris Agreement and the UN SDGs.

Second, WRI, the Center for Global Commons at the University of Tokyo, the Bezos Earth Fund, the Global Commons Alliance, the UN High-Level Climate Champions and other partners have launched the Systems Change Lab to identify and track sectoral shifts that will enable the four critical system transformations toward Global Commons stewardship (Section C). This effort will give a clearer sense of key shifts for safeguarding the Global Commons and how fast these are advancing; and will allow lessons to be shared on key ingredients for change across countries. The Lab will also work with multistakeholder coalitions to nudge and campaign on the areas of greatest risk.

The Systems Change Lab aims to serve as a "one-stop shop" for monitoring progress across the four system transformations. It will complement traditional monitoring of outcomes (e.g., hectares of forest restored) by tracking inputs—such as the deployment of new technologies—which give a sense of how each system transformation is progressing. By partnering with leading data providers and users, the Lab will develop an accessible, open-data platform that tracks progress against science-based benchmarks. In particular, this will give a clearer sense of which transformations are accelerating and where progress might be slowing.

A third set of tracking needs concerns national policy action. The Climate Action Tracker (CAT) has pioneered the inventory and assessment of forward-looking energy policies to assess which countries are on target to achieve the objectives of the Paris Agreement.[15] CAT not only identifies shortfalls in policy ambition and implementation in individual countries, but also helps build knowledge of how to transform energy systems. Its freely accessible database of climate policies facilitates the comparison of policies across governments and identifies which are working and which may be working less well. This combination of near-real-time tracking of forward-looking policies and information sharing across countries has played a critical role in advancing decarbonization efforts across countries.

However, similar efforts are needed for the other system transformations. One notable development in this regard is FOLU's launch of a Food, Environment, Land and Development (FELD) action tracker. Modeled on CAT, this initiative aims to build databases and assessments of national policies toward sustainable land use and food systems. But to our knowledge, no systematic trackers of country policies toward sustainable oceans, sustainable material use or sustainable cities are currently available. These represent crucial gaps in making Global Commons stewardship actionable at the national and international levels.

We therefore call on the policy and research communities to consider in particular policy action trackers for sustainable ocean management, sustainable industry and sustainable consumption, to fill these gaps in our understanding of how to operationalize Global Commons stewardship. These instruments should be carefully designed to ensure complementarity with CAT, FELD and other action trackers focused on socioeconomic transformations. Drawing in particular on the GCS Index[62] and the Systems Change Lab, the GCSI will explore ways to fill these gaps. PIK's scientific modeling of global transformation pathways for achieving the SDGs while staying within the planetary boundaries can also combine these tracking efforts with the latest available integrated systems analyses.

We also need to fill gaps in our understanding of the state of the Global Commons. A comprehensive review of these data gaps is beyond the scope of this report, but several stand out in particular. First, as the authors of *Planetary Boundaries* emphasize,[6] we lack data on the myriad chemical pollutants ("novel entities") that are released daily into the environment, with unknown effects on ecology and human health. Closing these gaps will require better analytical devices that are low cost and can ideally be deployed for automated sampling and analysis. Remote-sensing satellite technologies can complement these analyses by tracking critical air pollutants.

Second, our data on biodiversity remains woefully inadequate. While Nature Map and other efforts have made important advances in consolidating available spatial data, our knowledge of biodiversity remains extremely partial, with only an estimated 14% of land species and 9% marine species known to

science out of an estimated 7.4-10 million total species on Earth.[121] At current rates, we risk losing species faster than we can identify and track them. This needs to change. Fortunately, new technologies such as environmental DNA sampling (eDNA) can enable us to identify vast numbers of species through routine automated processes, giving us a real-time sense of the status of entire ecosystems at vastly lower cost than traditional methods. A global effort is needed to reduce the cost of these technologies, increase their accuracy and promote their widespread deployment. The Earth BioGenome Project proposes to sequence all life on Earth—a bold ambition that deserves attention as part of the effort to promote Global Commons stewardship.

A third major gap concerns the tracking and measurement of aerosols. Despite their major impact on the climate systems, we lack clear data in this regard. However, it appears that next-generation satellites launched by the European Space Agency and others could help close this gap in our understanding of the Global Commons. This should be made a priority—particularly in relation to regional-scale weather patterns, such as the monsoons in South Asia and West Africa, which are vulnerable to aerosol-induced climate disturbances.[66]

Finally, the rollout of robotic Argo floats that collect and transmit data on the state of the ocean and the latest generation of remote-sensing satellites has vastly improved data on marine ecosystems and ocean dynamics. However, many major gaps remain—particularly in relation to the state of fisheries and biodiversity on the high seas. Given the vital importance that the ocean biosphere plays in regulating the Earth system, filling these data gaps should be a high priority for Global Commons stewardship.

At least as important as closing data gaps is utilizing available data more effectively for Global Commons stewardship. One key priority in this regard is to make data freely available online and in real time. Many such portals are being developed, such as WRI's Land and Carbon Lab, Global Forest Watch, Global Fishing Watch and Earth HQ. Digital Earth Africa is a promising regional portal for spatial data. But many more are needed—particularly in relation to material flows, nutrient cycles and biodiversity.

Well-designed real-time data portals combined with advances in artificial intelligence can bring Global Commons data to life for experts and laypeople alike. They can also highlight the areas of greatest change and increase accountability for businesses and policymakers. Particularly impressive examples of such near-real-time data portals include Trase, which tracks the impact of agricultural supply chains on deforestation, and Global Fishing Watch.

One particular challenge is to integrate remote-sensing data with other forms of data to arrive at a robust understanding of the Global Commons. For example, our understanding of forest management and above and below-ground carbon stocks is greatly aided by satellite data; but typically also requires in-situ measurements, including through drones, soil samples or the abovementioned eDNA. Scientists at the

International Institute for Applied Systems Analysis and elsewhere have successfully experimented with citizen science tools that can produce large volumes of reliable in-situ measurements in a short period of time.[122] These different forms of data should now be integrated to arrive at a robust understanding of the Global Commons and generate data that governments around the world can use. We are encouraged by the substantial philanthropic investments that Jeff Bezos, the Moore Foundation and many others are making in this space.

Another critical data trend for Global Commons stewardship is the use of Big Data to monitor the ESG performance of companies around the world. By combining large numbers of databases—including spatial data as provided by Trase and others—with internal company data, an in-depth, near-real-time picture can emerge of the contributions of large companies and their supply chains to ESG impact objectives. There is a need for more comprehensive and timely data to assess impacts embodied in international supply chains—including more granular assessments looking at impacts embodied in specific supply chains (e.g., food, textiles, construction) and commodities (e.g., coffee, soy, cocoa, cobalt) —to inform the governance and alignment of key sectors, industries and businesses with the SDGs and the Paris Agreement. Many start-ups operating in this space promise to greatly enhance our ability to track and manage complex international supply chains, which often drive negative spillovers across countries and undermine Global Commons stewardship.

A final priority for data innovation is the use of new digital governance technologies—such as Ethelo, Metagov and Holochain—which use distributed ledger technologies based on peer-to-peer networks to verify the authenticity of unique digital objects. These technologies can increase transparency in international supply chains, facilitate participatory and collective decision-making processes, and enable large-scale social cooperation for commoning and for multistakeholder coalition governance. They could even form the basis for legal agreements, voting tools and other decision-supporting tools that would enhance data security, transparency and collective action processes for Global Commons stewardship. Such platforms could also support accountability and expose illegal or ecologically destructive activities, as in the case of OpenSC. There is a role for government to promote further testing and adoption of these technologies.

D.4.3 Enhance the cybersphere

The Internet and its accompanying information, data and digital technologies are of vital importance for economic development, human wellbeing and Global Commons stewardship. The cybersphere should be commonly managed, open and directed toward promoting Global Commons stewardship. However, current trends—such as the spread of fake news, security attacks and public election interference—show that global cyberinfrastructure and standards are not fit for purpose. Cyberspace governance is complicated by diffuse accountabilities, as different layers of technology are owned by different actors across diverse jurisdictions.

Open, commons-based models, such as those adopted by the open-source software movement,[j] could improve transparency and security in the cybersphere and hold transformative potential for improving knowledge, information, data and social cooperation to promote Global Commons stewardship.

For example, Open AI—founded by Elon Musk and Sam Altman—aims to develop safe artificial general intelligence for the benefit of humanity. Additionally, the Open Source Climate Initiative is a collaboration between the Linux Foundation, Allianz, Microsoft, Amazon, Federated Hermes, S&P and Goldman Sachs aimed at creating an open source "data commons" that will make it easy for anyone to access information on companies' environmental performance. Finally, Open Sustainable Technology curates open technology projects for environmental sustainability.

Yet these are clearly not enough. Stronger national and global rules are needed to combat fake news without undermining open societies, and existing rules must be enforced. Recent cyberattacks illustrate the destructive power of cybercrime—a scourge which can only be tackled through greater collaboration. The G20 and other fora can and should play a proactive role in advancing cybersecurity.

j The open-source software movement supports the use of open-source licenses for some or all software as part of the broader notion of open collaboration. Major players in this space include the Linux Foundation, Mozilla, GitHub and GitLab.

E A call to action

Most major economies have committed to net-zero GHG emissions by the middle of the century. To realize this ambition, countries must activate the four system transformations outlined in this report to cut emissions from energy systems, industry, cities and buildings, as well as the food system, land and oceans. Success will require urgent action, building on the momentum from COP26 and leading into CBD COP15. Action must be broad to address livelihoods, nature loss and other challenges outlined in this report.

Decisive action on climate change must be combined with similarly bold steps to secure other Global Commons: the land biosphere, the ocean biosphere and the cryosphere. For example, political leaders from 93 countries and the EU have signed the Leaders' Pledge for Nature. Countries must also be vigilant to sustain progress in repairing the ozone layer, which protects us all from harmful cosmic radiation. Integrated approaches across the Global Commons will achieve superior results for Global Commons stewardship and therefore human wellbeing.

The "Paris Effect" is driving deep and unprecedented changes in energy systems, mobility and key industries. For example, progress in lowering the cost of renewables has consistently exceeded analysts' expectations. This is now also happening in critical technology areas such as electric vehicles, the hydrogen economy and energy storage. We may be on the cusp of similar changes in food and land use, where the data revolution is making precision agriculture a reality for many, and new ways to grow and produce food could finally allow all countries to provide healthy and affordable food without wrecking the environment.

The evidence is clear that bold action from governments (with support from the international community), businesses, investors and civil society can deliver on the SDGs and the objectives of the Paris Agreement.

Note: The resulting action items for different stakeholders outlined in this report are summarised in A.1 to A.4.

E.1 Governments

Let there be no doubt: all countries need more and better policies to enable and drive the four system transformations outlined in this report. Every country should set out how it intends to tackle these interconnected challenges and where it sees the need and opportunity for greater international collaboration. We urge governments to recognize the preservation of the Global Commons as a unifying challenge that requires shared purpose and cooperation, separate from the invariable differences and competition among the major world powers for regional and global influence. This call for unity of purpose and collaboration is not naïve idealism; it is a necessity to ensure the survival of human civilization on this crowded and vulnerable planet Earth.

E.2 Business and finance

Firms and financial systems are vital engines for driving the innovation, investments and new business models that will make the four system transformations possible. But they can also be forces of resistance to change, and in some cases can work actively against Global Commons stewardship. Businesses play a crucial role both in meeting the basic needs and wellbeing of all humans and in ensuring responsible stewardship of the Global Commons; or, as the WBCSD put it in its Vision 2050,[k] in ensuring that more than 9 billion people can live well within the planetary boundaries. It is in companies' own interest to become "net positive"; the economy cannot thrive unless people and the planet are also thriving.

The transformations required across all sectors of the economy to tackle our environmental challenges and deliver on the SDGs represent a multitrillion-dollar opportunity. Now all companies and investors must rise to the challenge by committing to science-based targets. There simply is no longer social license for companies that do not combine the profit motive with active participation in making the system transformations toward Global Commons stewardship a reality. Investors are taking notice, as sustainable companies have been outperforming their unsustainable rivals and public scrutiny of business behavior is growing.

k The WBCSD Vision 2050 provides a framework to help business fulfill its full potential and societal responsibility, and is well aligned with Global Commons stewardship.

E.3 Civil society organizations and multistakeholder coalitions

Civil society organizations are indispensable for Global Commons stewardship, as they can drive accountability, effective communication and stakeholder mobilization, and help ensure justice. Often in the form of new multistakeholder coalitions, they are building powerful movements that both complement and act as a check on government and corporate action to catalyze the four system transformations.

These movements can help bring together different perspectives to develop new insights and approaches to break the impasses that sometimes paralyze our multilateral mechanisms. We need more of this mobilization; and we need youth in particular to raise its voice. Powerful advocates like Greta Thunberg help focus minds and drive us to try harder in tackling the challenges ahead.

E.4 International organizations and financing institutions

Global Commons stewardship depends on international cooperation, which in turn requires institutions for convening governments, agreeing on shared standards and promoting collective action. At a time when international politics has become increasingly divisive, international organizations are more important than ever.

The UNFCCC process shows how the planetary boundaries can be respected through bottom-up, country-led strategies. Multilateral financing institutions provide critical financing for activating the four transformations, including by leveraging greater volumes of private financing.

The time is now to bring humanity's impact on the Earth in line with the planetary boundaries.

We are conscious of the catastrophic costs that inaction will incur for all people on this planet. We also know how painfully slow and difficult international cooperation can be—particularly when major powers compete for global leadership. But having studied the issues carefully, we are convinced of the feasibility of rapid progress in securing the Global Commons. We are inspired by the Paris Effect and the advances that have occurred in recent years. When we put our minds to the four system transformations, human ingenuity and cooperation will prevail. There can be no more bystanders in 2022; so we call on everyone to join the fight for a better future.

Annex 1
Results of 2021 Global Commons Stewardship Index

The sustainable management of the Global Commons requires better data and metrics to guide better policies. To this end, the Sustainable Development Solutions Network (SDSN), Yale University and the Center for Global Commons have launched the Global Commons Stewardship (GCS) Index, which assesses both countries' domestic impacts on the Global Commons and the impacts embodied in trade and consumption (so-called "international spillovers"). The GCS Index aims to inform policymaking to reduce negative impacts on the Global Commons and accelerate the implementation of the Paris Agreement and the UN SDGs.

Five major principles inform the design of the GCS Index. First, it uses a framework that integrates multiple dimensions of the Global Commons into a comprehensive assessment of impacts. Second, it tracks both impacts within territorial borders and transboundary impacts, or spillovers embodied in traded goods and services. Third, it estimates the distance to predefined sustainability thresholds for all metrics in the Index to quantify and compare priorities within and across countries. Fourth, it focuses on outcome-based measures of environmental impacts at the country level, leaving out policies and input measures or measures of access to resources such as access to drinking water and sanitation. Fifth, it relies on data that is fresh and high quality, and that can be updated regularly.

A detailed working paper and a chapter in the OECD-Joint Research Centre publication on transboundary impacts explain the rationale and construction of the GCS Index.[123, 124] The 2021 Index provides scores for 100 entities: 99 countries and the European Union (EU27). The organization of the Index is structured around two major pillars: domestic impacts and international spillovers. There are six impact categories: aerosols; greenhouse gas emissions; terrestrial biodiversity loss; marine biodiversity loss; nutrient cycle disruptions; and water cycle disruptions.

This year's edition includes 33 indicators using data from official sources and scientific research. Based on a decision tree presented in the methodology section of the GCS Index, and building on methods used by the SDSN[125] and the OECD[126], aspirational sustainability thresholds are set for 2030 (interim) and 2050 (more ambitious) to evaluate whether the pace of progress is sufficient to achieve transformational objectives. Scores and dashboards are presented in proportional terms that allow comparison across countries of very different sizes—usually in per-capita units, but also in absolute terms—to identify which countries are having the greatest absolute impacts on the Global Commons (see Tables 1 and 2). Results presented in the GCS Index 2021 are based on data collected largely pre-COVID-19. The methodology section of the GCS Index summarizes the various steps for its construction.

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The Global Commons Stewardship Framework: Safeguarding the Global Commons for human prosperity and environmental sustainability

The scientific evidence is overwhelming: we are on a collision course with the stable and resilient Earth systems on which human wellbeing, prosperity and safety depend – our Global Commons. We need to transform our economic and social systems to safeguard these Global Commons or risk exceeding dangerous tipping points beyond which ecological damage may become self-reinforcing and irreversible. To avoid these tipping points, decisionmakers need to take concerted action to drastically accelerate the progress made in some sectors and unlock positive tipping points for transformation.

To inspire and guide decisionmakers from governments, business and finance, civil society and international organizations, the Center for Global Commons at the University of Tokyo, with support from SYSTEMIQ, the Potsdam Institute for Climate Impact Research and the Sustainable Development Solutions Network, has developed the Global Commons Stewardship Framework. Drawing on the latest science, this framework for action can bring together stakeholders, guide transformations and inform deft diplomacy in support of security and the Global Commons.

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