#globalcommons

The Opportunity of the Commons

gef GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

Global Commons

IUCN

ALL LIFE ON EARTH DEPENDS ON CLEAN AIR AND WATER, BIODIVERSITY, AND HEALTHY FORESTS, LAND, OCEANS AND A STABLE CLIMATE. THESE GLOBAL COMMONS—THE ECOSYSTEMS, BIOMES AND PROCESSES THAT REGULATE THE STABILITY AND RESILIENCE OF THE EARTH SYSTEM—ARE THE VERY FOUNDATION OF OUR GLOBAL ECONOMY AND MODERN SOCIETY. TODAY, THEY ARE FACING AN ALL-TOO FAMILIAR TRAGEDY OF OVER-EXPLOITATION AND RAPID DEGRADATION.

A DEFINING MOMENT

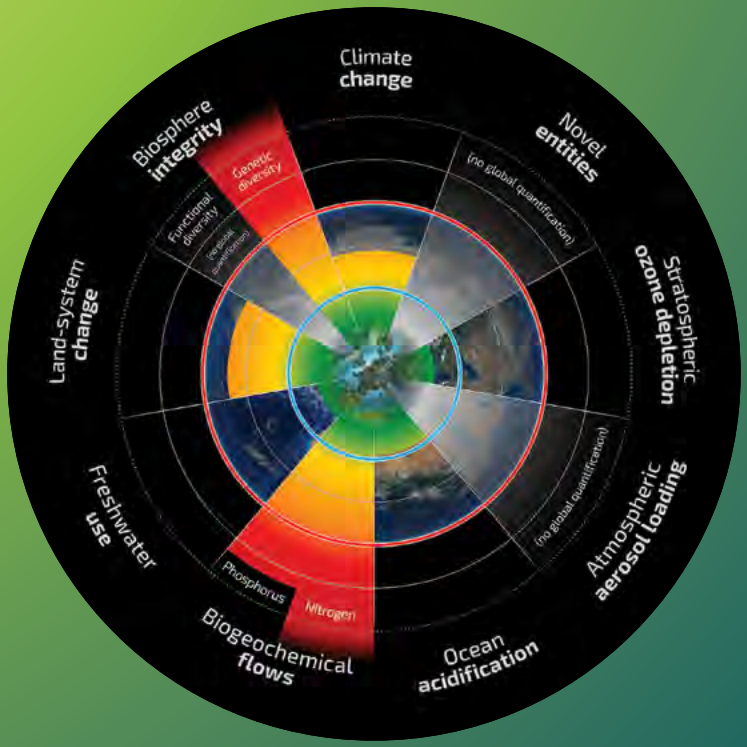
We stand at a defining moment for the future of the planet and human well-being. The Global Commons—the ecosystems, biomes and processes that regulate the stability and resilience of the Earth system—are being stretched to breaking point.

Scientists warn that the "planetary boundaries", that have ensured the stable conditions that have enabled all civilizations to form and prosper over the last 11,000 years are being strained, and in some cases, exceeded. Indeed, they add, we have forced our way out of the Holocene geological epoch—the only one known to be able to support a growing world population of 7.4 billion—to begin a new one, the Anthropocene.

Johan Rockström, Executive Director
Stockholm Resilience Centre
Goodbye Forever, Friendly Holocene

> *"It is time to re-evaluate our economic and political models for the Anthropocene. The starting point must be our very notion of the global commons… Industrial societies now wield astonishing power. Earth's future is in the balance and we must handle it with care and respect."*

Several of the planetary boundaries have already been breached. These include; biodiversity, now being lost at a rate unprecedented in the last 65 million years; land use change, where nearly a third of forest cover has been cleared worldwide and almost a quarter of the total land area under human use is being degraded; and climate, where atmospheric concentration of carbon dioxide now exceeds 400 parts per million, their highest level in 800,000 years. Meanwhile greenhouse gases are also acidifying the oceans, changing their chemistry faster than at any point in perhaps 300 million years.



Source: Steffen et al. 2015. Planetary Boundaries: Guiding human development on a changing planet. Science Vol. 347 no. 6223

CHANGING RISK PERCEPTIONS

It is increasingly being recognized that a deteriorating global environment poses significant risks to prospects for future economic growth and development. In the World Economic Forum's 2017 Global Risk report, environment-related risks feature among the top-ranked global risks.

Specifically, four of the top five perceived risks in terms of impact identified in this year's Risk Report were environmental risks Ten years ago, none of the top five risks were an environment risk.

Christiana Figueres, Former Executive Secretary of the UNFCCC, Convener, Mission 2020
Why 2020 is a Critical Milestone on Our Journey to a Climate-Safe World

> *"We are at a precarious point for the fate of the global commons. Our actions on climate protection over the next few years will determine whether we continue on a path of exponentially growing national disasters, or pivot onto a path toward a safer, more prosperous world."*

Dominic Waughray, Senior Director and Head of Environmental Initiatives, World Economic Forum
Three Wicked Problems of the Commons

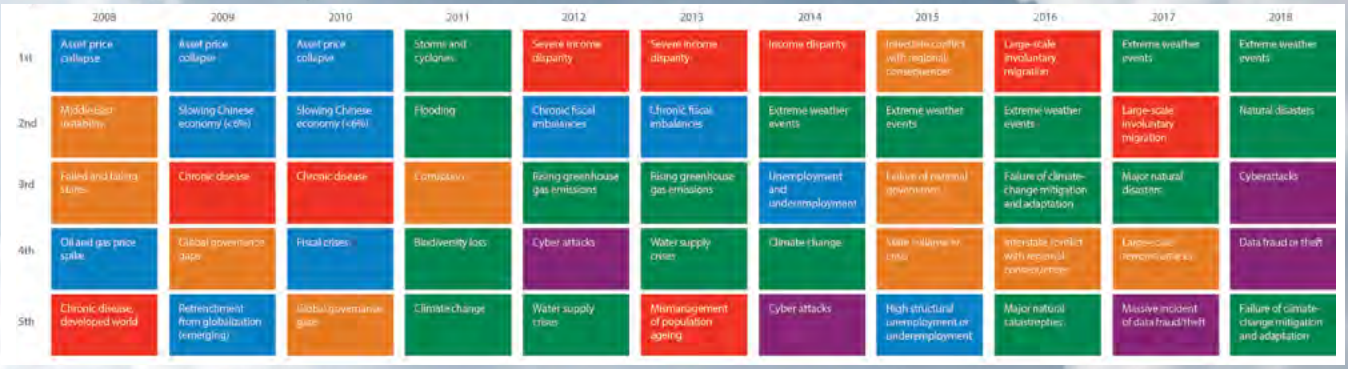
> *"Someone will have to do all this, and soon, or these wicked problems will come home to roost, and we will never properly address the competing challenges of managing our global commons and ensuring needed economic development. Then, as ever, it is likely to be the poorest people who will lose out."*

Sunny Verghese, Co-Founder and Group CEO, Olam International
What is the Point of Agribusiness, If it Doesn't Do Good

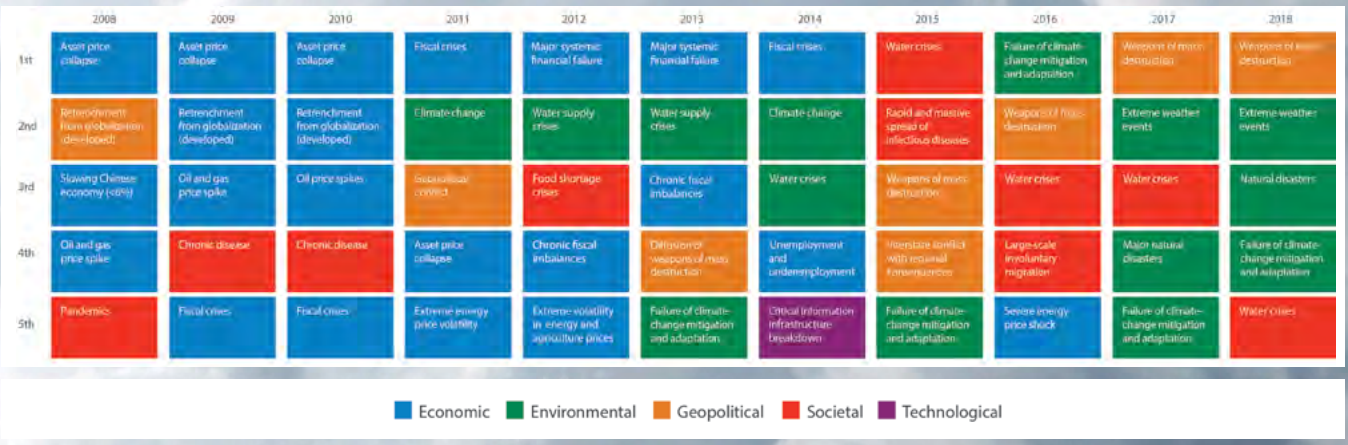
> *"The global agri-sector is at the nexus of some of the most intractable challenges the world faces—food, water, energy security, inclusive growth and sustainable growth. Do we want to contribute to the problem or become part of the solution?"*

CHANGING GLOBAL RISK PERCEPTIONS: FROM ECONOMIC AND SOCIAL TO ENVIRONMENTAL

Top 5 Global Risks in Terms of Likelihood



Top 5 Global Risks in Terms of Impact



Source: World Economic Forum, *The Global Risks Report 2018, 13th Edition*

THE WORLD IS RESPONDING

Up to now, the transition into the Anthropocene—momentous though it is—has been largely ignored, figuring little in public policy or private discourse. Fortunately, there are signs that this is beginning to change.

The Sustainable Development Goals, adopted by the world's governments in the autumn of 2015, are designed to set development and growth on a new track, ending poverty and increasing prosperity, while safeguarding the global commons. So is the Paris climate agreement, struck the following December, which aims to bring net emissions of greenhouse gases down to zero in the second half of the century. Countries will submit updated climate plans—called nationally determined contributions (NDCs)—every five years, thereby steadily increasing their ambition in the long-term.

Multi-Stakeholder sustainability platforms have also proliferated in recent years, including the Bonn Challenge—which brings together 40 countries, the private sector and civil society around commitments to restore around 150 million hectares of degraded land—and RE100, an energy-related collaborative, global platform in which leading businesses are encouraged to set a public goal to procure 100% of their electricity from renewable sources of energy by a specified year. Other initiatives focusing on delivering concrete action in specific areas include The Tropical Forest Alliance 2020 (TFA 2020), the Trash Free Seas Alliance, and C40, a network of the world's megacities committed to addressing climate change. This momentum reflects a growing recognition from business of the economic opportunities that exist.

Peter Bakker, President, World Business Council for Sustainable Development
A Wealth of Opportunities

> *"Business is in a unique position to observe and intervene in many issues facing the global commons — from reducing emissions and addressing climate change, to stopping ocean pollution and fixing broken food systems. Across the world, companies are stepping up to meet the challenge."*

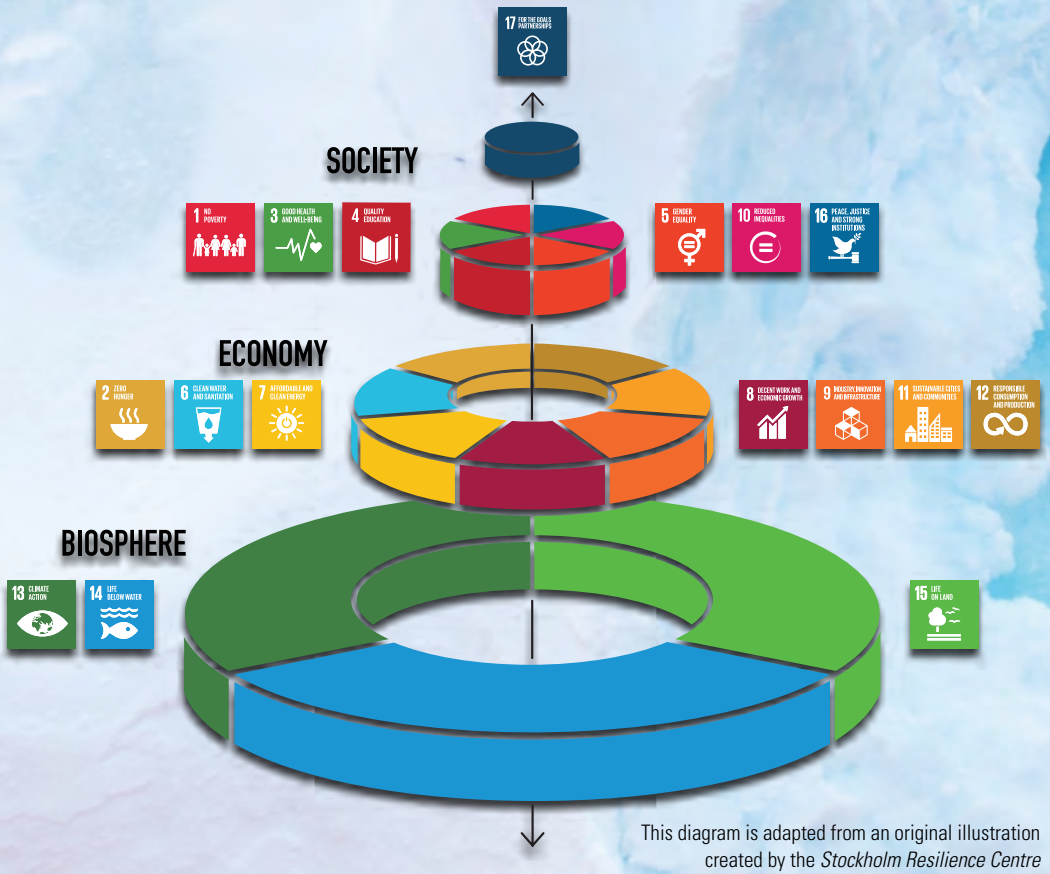
Ngozi Okonjo-Iweala, Co-chair, Global Commission on the Economy and Climate
It's Time To Be Smart About Financing Clean Development

> *"The question is therefore not whether the transformation to a low-carbon future will happen, but how quickly it will take place."*

Mark Malloch-Brown, Chair, Business and Sustainable Development Commission
Transforming Globalisation

> *"What we need—and urgently—is a radical shift in perception by the private sector to view the global goals as the greatest economic opportunity any generation has had, rather than a burden and constraint to growth."*

THE GLOBAL ENVIRONMENT— A FOUNDATION FOR THE SDGs



This diagram is adapted from an original illustration created by the *Stockholm Resilience Centre*

Nebojsa Nakicenovic, Deputy Director General/Deputy CEO, and Caroline Zimm, Research Assistant, Transitions to New Technologies, IIASA

Leave No SDG Behind

> *Jointly implementing all the SDGs would contribute both to further human development and to safeguarding the commons and the stability of the Earth systems. Importantly, joint implementation that avoids silo-type thinking would be cheaper and faster than tackling them separately.*

A RADICAL TRANSFORMATION OF KEY ECONOMIC SYSTEMS IS REQUIRED

Despite the progress made, incremental steps will not suffice. The only hope lies in transformational—and permanent—change.

To stay within the planetary boundaries, a radical transformation of key economic systems will be required to significantly reduce their environmental footprint.

Four systems are of particular importance: the food system, the energy system, the urban system, and the global production/consumption system, where the current "take-make-waste" model has nearly quadrupled global waste creation since 1970.

A transformation of these four economic systems can change the course of the planet, and safeguard the health of the global commons.

The necessity of making our societies and economies more sustainable and less inequitable is not just to avoid disaster, but to build lasting prosperity. Operating within planetary boundaries is not just the only way to ensure healthy economies, but has the potential to provide much greater and better-shared growth. **That's the opportunity of the commons.**

Andrew Steer, President and CEO, World Resources Institute
Taming Bigfoot

> *"Four revolutionary shifts in social and economic life are needed to tame Bigfoot-style economic impacts and safeguard the global commons: transforming cities, re-thinking food and agriculture, decarbonizing energy systems, and transitioning from linear approaches to production, design, use and disposal of materials to circular economic models."*

Inger Andersen, Director General, IUCN
The Natural Way Forward

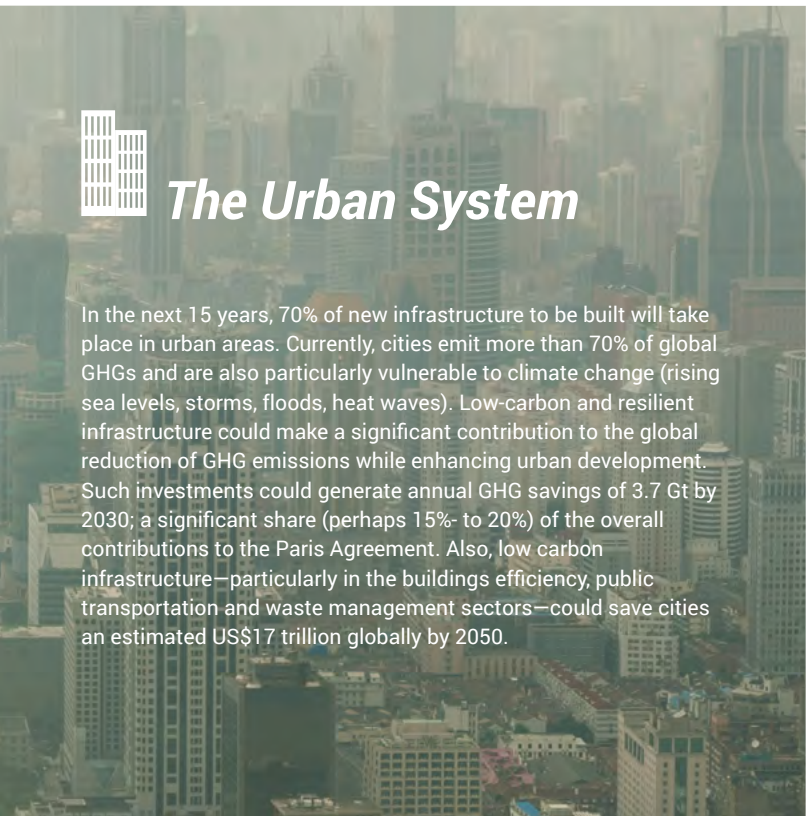
> *"Despite such tremendous forces of transformation as climate change and dramatic socioeconomic inequality, there are credible and accessible political, economic, cultural and technological choices that can promote general welfare in ways that support and even enhance our planet's natural assets."*

The Food System

The world will require about 70% increase in food production to meet dietary demands from a world population of nine to ten billion by 2050. Producing sustainable food while dealing with land use and degradation will be essential. A concentrated focus on global commodities with a significant deforestation footprint, on food security goals in areas of rapid agriculture expansion, restoration of fisheries, and to a certain extent, expanded efforts on land restoration, will contribute significant environmental gains while reversing the negative effects of land and costal habitat degradation.

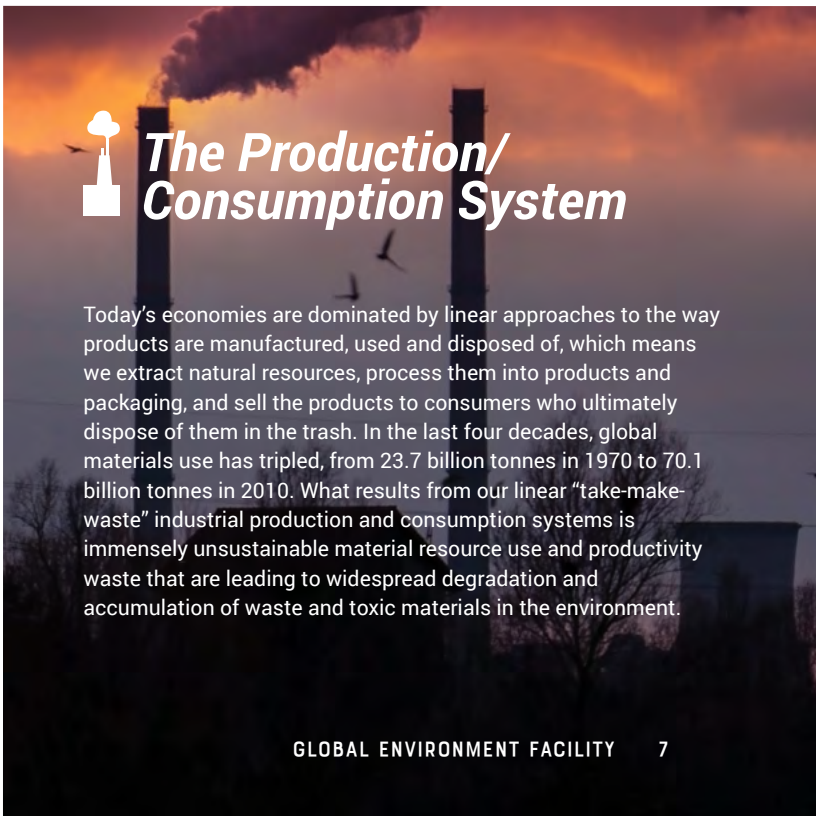
The Energy System

Decarbonization of the global energy system is of critical importance for a 1.5–2 °C future global temperature increase, in line with the Paris Agreement. The energy system represents 68 percent of global GHG emissions, and despite recent improvements only 23 percent of energy is provided by renewables today; and 1 billion people still lack access to electricity. By 2040 energy demand is projected to increase by 30 percent. In the face of these trends, deployment of renewable energy needs to accelerate sharply, as do energy efficiency improvements, all while increased energy demand—including from what is needed to close the electricity gap, especially in Sub-Saharan Africa and South Asia—is being met.



The Urban System

In the next 15 years, 70% of new infrastructure to be built will take place in urban areas. Currently, cities emit more than 70% of global GHGs and are also particularly vulnerable to climate change (rising sea levels, storms, floods, heat waves). Low-carbon and resilient infrastructure could make a significant contribution to the global reduction of GHG emissions while enhancing urban development. Such investments could generate annual GHG savings of 3.7 Gt by 2030; a significant share (perhaps 15%- to 20%) of the overall contributions to the Paris Agreement. Also, low carbon infrastructure—particularly in the buildings efficiency, public transportation and waste management sectors—could save cities an estimated US$17 trillion globally by 2050.



The Production/ Consumption System

Today's economies are dominated by linear approaches to the way products are manufactured, used and disposed of, which means we extract natural resources, process them into products and packaging, and sell the products to consumers who ultimately dispose of them in the trash. In the last four decades, global materials use has tripled, from 23.7 billion tonnes in 1970 to 70.1 billion tonnes in 2010. What results from our linear "take-make-waste" industrial production and consumption systems is immensely unsustainable material resource use and productivity waste that are leading to widespread degradation and accumulation of waste and toxic materials in the environment.

BUILDING A MOVEMENT FOR THE GLOBAL COMMONS

In October 2016, over 200 leading environment, development and system design thinkers met in Washington, DC to discuss how mobilization of leadership, technology, science, innovation and communication can help bring about the transformation in economic systems that the planet needs.

The participants came together around a "shared purpose" included in a summary of key "principles" (see page 10).

The Dialogue was convened by the Global Environment Facility (GEF) and the International Union for the Conservation of Nature (IUCN), in partnership with the International Institute for Applied Systems Analysis (IIASA), the Stockholm Resilience Centre (SRC), the World Resources Institute (WRI) and the World Economic Forum (WEF) Environmental Systems Initiative.

This booklet includes quotes from each of the partners and other participants. They are taken from a series of articles in the online Guardian newspaper, where senior figures are exploring the state of the commons and how to address it.

The articles, and other contributions from well-known leaders in the sustainable development community, are featured in a special "GEF Partner Zone" as part of the paper's Development 2030 Campaign. It can be found online at globalcommons.earth.

The October dialogue and online series is just the beginning of what promises to be a vigorous, authoritative—yet constructive debate about one of the defining issues of our time.

For more information
thegef.org/globalcommons

Peter Thomson, UN Secretary-General's Special Envoy for the Ocean
Reversing The Ccean's Accelerating Decline

> *"We shouldn't underestimate the powerful attraction of a "sustainable blue economy", which – I firmly believe – will feed and support the lives of our children and those who come after them. Getting it right… is vital not just for SDG14, but for the future of the global commons, and humankind itself."*

Mary Robinson, President, Mary Robinson Foundation—Climate Justice
Climate Change Isn't Fair

> *"We are custodians of our planet, a global commons that, by 2050, will be home to some 9 billion people. It is our duty to live in such a way that the precious, life sustaining environment which keeps us is passed to future generations in at least as healthy a state as we received it from those before us."*

Nicholas Stern, Chair, Grantham Research Institute on Climate Change and the Environment at LSE, and President, British Academy
Only Green Growth Can Bring Prosperity

> *"The agenda that preserves our global commons is also the only sustainable route to growth and poverty reduction. But action with real pace and scale is urgent: the window of opportunity is narrow. The decisions we make over the next 15 years will determine what kind of world we will have for the rest of the century."*

Erik Solheim, Executive Director, UN Environment
The Care Horizon

> *"The answer to the tragedy of the commons is the answer to how we bring it within this horizon. We are smart enough, and have resources aplenty to solve our problems. We need the will and motivation—personal and political—to do it. For that to happen, we need to make an appeal within the care horizon."*

MOVEMENT FOR THE GLOBAL COMMONS STATEMENT OF PRINCIPLES

Our Lessons from Science

Life on Earth as we know it depends on what all humans share: a stable climate, healthy oceans, and the species, ecosystems, biomes and processes that provide the stability and resilience of the planet.

This is the Global Commons. For the past 10,000 years, the Global Commons has served as the foundation for dramatic growth in agriculture, cities, economies and cultures—in short, for civilization to emerge.

The prospects for sustainable development rest squarely on the integrity of the Global Commons, which is now being compromised.

The message from science is clear: humans are pushing the Global Commons to the limits of their coping capacity. We are facing a tragedy of the commons on a profound, global scale that only we can overcome.

Our Shared Purpose

At this critical juncture for the survival of the diversity of life on earth and the systems upon which humanity depends, we are catalyzing a movement to defend, enhance and sustain our Global Commons through:

- protecting the diversity of life on earth;
- developing innovative solutions that reflect the interdependence of all systems, including food, urban, energy, production and consumption, freshwater and oceans;
- engaging broadly, from communities to corporations to cabinets.

Because never before have we understood our place in the Global Commons as we do now; never before have we had the tools, knowledge and creativity that we do now; and never before have we had the shared purpose and will to act that we have now.

And because never again, will we have the opportunity.

Our resolve to achieve systems-level change

While time is short and the risks immense, the goal of a diverse, stable and prosperous planet is still within reach if we act now with a boldness that matches the unprecedented scale of the challenge.

With the Sustainable Development Goals and the Paris Climate Agreement, the world's nations have provided momentum and direction that must be seized.

But incremental progress will not be enough. Only with disruptive, systems-level change can we hope to get on the right path. Our focus should be a complete overhaul of key economic systems and development pathways:

- Our food system must be dramatically reshaped in a way that enables it to meet a 60–70 percent increase in global calorie demand—from aquatic and land-based sources—by 2050 while at the same time dramatically shrinking its footprint on the global environment.
- The world's cities to a significant degree hold the keys to success for the Global Commons. The coming decades will see a sharp burst in cities' growth. This is a once-in-a-lifetime opportunity to create the compact, connected and coordinated cities that the future requires.
- Decarbonizing the world's energy systems is a sine-qua-non. Recent data suggesting that global energy-related GHG emissions have plateaued despite continued economic growth are welcome, but the underlying power demand is still on the rise, and we are still a long way away from a radical shift towards a carbon-free energy system.
- The move from a "take-make-waste" to a circular economy must be radically accelerated. Today's linear approach to production, consumption and disposal of products is highly resource inefficient.

For each, we must continue to develop a compelling story about needs and opportunities for the Global Commons and work with those who can amplify the message; we must help unleash and leverage technology, and we must build and support emerging coalitions for change both from the bottom-up and the top-down.

Our Mutual and Individual Roles

Only a broad and truly diverse movement can solve the problem of the Global Commons. No individual, organization, business or nation can succeed on her own. We must all play our part to catalyze change and build the movement. Some are champions who deliver the message, engage, excite, and help build momentum. Others are drivers who bring the evidence forward and point towards scalable solutions. Enablers provide the financing, the policy frameworks, and the necessary technical support. And conveners create the platforms for dialogue, facilitate discussion, and bring in new actors.

Our bottom line for safeguarding the Global Commons is the following: It is urgent, it is needed for people and planet, and the world will be so much better for it—so let's get on with it!

Mario Molina, Nobel Prize Winner for Chemistry for Work on Ozone Depleting Substances
Protecting the Climate and the Ozone Layer Together

> *"The Montreal Protocol is, therefore, indeed a unique, planet-saving agreement. And it is still getting stronger, and playing a critical role safeguarding the global commons of the planetary system."*

Cristiana Paşca Palmer, UN Assistant Secretary-General; Executive Secretary, Convention on Biological Diversity
Science Can Help Forge A New Deal For Nature

> *"The global community has a unique window of opportunity to define the post-2020 global biodiversity framework. It will need bold commitment and determination, innovative approaches and transformative processes to ensure that such a new deal will be effective."*

Paul Polman, CEO, Unilever
Our Food System Is Broken: We Must Repair It

> *"There is an urgent need for a new, independent coalition of public and private stakeholders that can combine leadership and vision with the technical depth necessary to solve these complex challenges. But there is no time to waste… We now need to turn our efforts towards repairing today's broken food system and make it work for the long-term benefit of people and planet."*

Naoko Ishii, CEO and Chairperson, GEF
Safeguarding the Global Commons is the Wisest Investment We Can Make

> *"Operating within the planetary boundaries is not just the only way to ensure healthy economies, but has the potential to provide much greater and better shared growth than sticking to business as usual. Safeguarding and enhancing the global commons is therefore the wisest investment we can possibly make."*

We invite all to join and contribute.

THOUGHT LEADERS ON THE GLOBAL COMMONS

The following articles appear in the GEF-Guardian Partner Zone:

- **Inger Andersen, Director General, IUCN**
  The Natural Way Forward
- **Peter Bakker, President, World Business Council for Sustainable Development**
  A Wealth of Opportunities
- **Daniella Ballou-Aares, Partner, Dalberg Global Development Advisors**
  Investing $20tn To Change The World
- **Sharan Burrow, General Secretary, International Trade Union Confederation**
  Sustainability Must Create Good Jobs
- **Kathy Calvin, President and CEO, UN Foundation**
  Making Change Decisive
- **Daniel C. Esty, Hillhouse Professor of Environmental Law and Policy, Yale University; Co-author, Green to Gold**
  Climate Action Needs Green, Not Just Red Lights
- **Sofia Faruqi, Manager, New Restoration Economy, World Resources Institute; Eriks Brolis, Conservation Business Lead, The Nature Conservancy;**
  Reviving Land Makes Businesses Grow
- **Christiana Figueres, Former Executive Secretary of the UNFCCC, Convener, Mission 2020**
  Why 2020 Is A Critical Milestone On Our Journey To A Climate-Safe World
- **José Maria Figueres, former Co-chair of the Global Ocean Commission and Co-founder of Ocean Unite**
  From Decline to Recovery: A Rescue Package for the Ocean
- **J. Carl Ganter and Eileen E. Ganter, Co-founders, Circle of Blue**
  Saving A Thirsty Planet Must Be Based On Reality, Not Perception
- **Antonia Gawel, Head of the Circular Economy Initiative at the World Economic Forum; Mathy Stanislaus, Policy Advisor to the World Economic Forum Platform for Accelerating the Circular Economy;**
  How To Make Economies Create More Value And Less Waste
- **Luc Gnacadja, Former Executive Secretary, UN Convention to Combat Desertification**
  How To Slow Migration and Save The Climate
- **Celine Herweijer, Partner, Innovation and Sustainability; Will Evison, Assistant Director, PwC**
  It's Time To Set Clear Targets For A Safer Earth
- **André Hoffmann, Vice-Chairman, Roche Holding Ltd.**
  The Purpose of Business? It's Not Just About Money
- **Jonathan Horrell, Director Global Sustainability, Mondeléz International**
  How Food Companies Can Protect Forests And The Oceans
- **Rupert Howes, CEO, The Marine Stewardship Council**
  Incentivising Sustainable Fishing Through Certification
- **Naoko Ishii, CEO and Chairperson, GEF**
  Safeguarding The Global Commons Is The Wisest Investment We Can Make
- **Mary Ellen Iskenderian, President and CEO, Women's World Banking**
  Give Women Credit And Meet The Global Goals
- **Jeremy Jackson, Senior Scientist Emeritus, Smithsonian Institution, Professor Emeritus, Scripps Institution of Oceanography**
  We Only Have 20 Years To Save The Oceans
- **Cecily Joseph, Vice President, Corporate Responsibility, Symantec**
  Women Are At The Heart Of Making Business—And The World—Sustainable
- **Yolanda Kakabadse, Former President, WWF International**
  Turning The Tide On Ocean Degradation
- **Homi Kharas, Senior Fellow and Co-Director, Global Economy and Development Programme, Brookings Institute**
  Middle Class Prosperity Can Save The Planet
- **Naina Lal Kidwai, Member of the Global Commission on the Economy and Climate**
  Connected, Shared And Electric: The Road To Sustainable Transport
- **W. John Kress, Distinguished Scientist and Curator of Botany, Smithsonian Institution**
  Seven Steps To Avoid The Irreversible Degradation Of Nature
- **Peggy Liu, Chairperson, JUCCCE**
  Changing How A Billion People Eat, Through Games
- **Carlos Lopes, Professor, University of Cape Town and Member, Global Commission on the Economy and Climate**
  Africa's Impala-like Leap Into A Green Industrial Economy
- **Thomas Lovejoy, Professor of Environmental Science and Policy, George Mason University**
  Crossing The Living Boundary
- **Chris Luebkeman, Arup Fellow and Director; Jonelle Simunich, Senior Strategist, Global Foresight, Research and Innovation, Arup**
  Re-Designing Urban Systems To Replenish Spaceship Earth
- **Amy Luers, Executive Director, Future Earth**
  Wanted: Clear Targets To Save The Global Commons
- **Mark Malloch-Brown, Chair of the Business and Sustainable Development Commission**
  Transforming Globalisation

- **Catherine McKenna, Minister of Environment and Climate Change, Canada**
  How The World Rallied To Repair The Ozone Layer
- **Henry McLoughlin, Director, Corporate Development;**
  Dipender Saluja, Managing Director, Capricorn Investment Group
  How Clean Technology Is Accelerating Low-Carbon Prosperity
- **Andreas Merkl, Former President, Ocean Conservancy**
  How New Technology Can Help Prevent Environmental Crises
- **Mario Molina, Nobel Prizewinner for Chemistry for Work on Ozone Depleting Substances**
  Protecting The Climate And The Ozone Layer Together
- **Nebojsa Nakicenovic, Deputy Director General/Deputy CEO; Caroline Zimm, Research Assistant, Transitions to New Technologies, IIASA**
  Leave No SDG Behind
- **Carlos Nobre, Member, UN Scientific Advisory Board for Global Sustainability; Juan Carlos Castilla-Rubio, Chairman, Space Time Ventures**
  The Amazon's New Industrial Revolution
- **Ngozi Okonjo-Iweala, Co-chair, Global Commission on the Economy and Climate**
  It's Time To Be Smart About Financing Clean Development
- **Jeremy Oppenheim, Programme Director, Business and Sustainable Development Commission**
  Prosperity That Preserves The Planet
- **Cristiana Pasca Palmer, UN Assistant Secretary-General; Executive Secretary, Convention on Biological Diversity**
  Science Can Help Forge A New Deal For Nature
- **Rolph Payet, Executive Secretary, Basel, Rotterdam, and Stockholm Conventions**
  Waste Not, Want Not
- **Laura Phillips, Senior Vice President for Global Sustainability, Walmart Inc.**
  How Sustainable Business Practices Help The Bottom Line
- **Paul Polman, CEO, Unilever**
  Our Food System Is Broken: We Must Repair It
- **Kevin Rabinovitch, Global Vice-President, Sustainability, and Chief Climate Officer, Mars, Inc.**
  Three Steps To Setting Business Targets For A Healthy Earth
- **N.H. Ravindranath, Professor, Indian Institute of Science, Bangalore**
  Losing Ground In A Warmer World
- **Kate Raworth, Author, Doughnut Economics, Senior Visiting Research Associate,Environmental Change Institute, Oxford University**
  How To Tell If A Company Really Protects The Global Commons
- **Mary Robinson, President, Mary Robinson Foundation—Climate Justice**
  Climate Change Isn't Fair
- **Johan Rockström, Executive Director, Stockholm Resilience Centre**
  Goodbye Forever, Friendly Holocene
- **Guido Schmidt-Traub, Executive Director, UN Sustainable Development Solutions Network**
  Three Challenges We Must Overcome To Secure The Future Of Food
- **Paul Simpson, CEO, CDP**
  How The Low Carbon Economy Is This Century's Biggest Business Opportunity
- **Erik Solheim, Executive Director, UN Environment**
  The Care Horizon
- **Phaedon Stamatopoulos, Director, Refining and Bank Products, Argor-Heraeus SA**
  A Golden Opportunity To Cut Mercury Pollution And Pay Miners Fairly
- **Andrew Steer, President and CEO, World Resources Institute**
  Taming Bigfoot
- **Nicholas Stern, Chair, Grantham Research Institute on Climate Change and the Environment at London School of Economics, and President, British Academy, IG Patel, Professor of Economics and Government, London School of Economics and Political Science; Naoko Ishii, CEO and Chairperson, GEF**
  Only Green Growth Can Bring Prosperity
- **Per Espen Stoknes, Chair, Centre for Green Growth, Norwegian Business School**
  Three Steps To Achieving A Sun-rich Future
- **Pavan Sukhdev, Founder-CEO, GIST Advisory, and President, WWF International**
  Embracing The SDGs' Complexity
- **Jahda Swanborough, Lead, Environment Initiatives, World Economic Forum; Aengus Collins, Practice Lead, Global Risks, World Economic Forum**
  Environmental Threats Are The Greatest Risks We Face
- **Peter Thomson, UN Secretary-General's Special Envoy for the Ocean**
  Reversing The Ccean's Accelerating Decline
- **Ralph Thurm, Managing Director; Bill Baue, Senior Director, Reporting 3.0**
  How To Share Out The World's Resource Pie Sustainably
- **Nigel Topping, CEO, We Mean Business**
  Just Managing
- **Keith Tuffley, Former-CEO, the B Team, CEO, NEUW Ventures**
  Business Is On Thin Ice—As I Found In An Antarctic Crevasse
- **Sunny Verghese, Co-Founder and Group CEO, Olam International**
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- **Mathis Wackernagel, CEO and Co-founder, Global Footprint Network**
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- **Dominic Waughray, Senior Director and Head of Environmental Initiatives of the World Economic Forum**
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- **Fokko Wientjes, Vice President, Nutrition in Emerging Markets & Food Systems Transformation, Royal DSM**
  We Need To Reimagine Food And Agriculture To Eradicate World Hunger
- **Park Won-Soon, Mayor of Seoul and President of ICLEI Local Governments for Sustainability**
  Achieving The Urban Dream
- **Elizabeth Yee, Vice-President, City Solutions, 100 Resilient Cities**
  Cities Must Embrace Nature To Survive
- **Durwood Zaelke, President, Institute for Governance and Sustainable Development**
  How Changing Refrigerants Will Help Slow Down Global Warming

GOODBYE FOREVER, FRIENDLY HOLOCENE

JOHAN ROCKSTRÖM
Executive Director of the Stockholm Resilience Centre

Earth has left the geological epoch that we know and love. Now our political and economic systems must change fast to deal with the Anthropocene

Geologists rarely make headlines. But this month the word 'Anthropocene' flooded the media following an intervention by scientists at the International Geological Congress in Cape Town. Since 2009, they have been poring over the evidence to work out whether the Earth has slipped abruptly and unexpectedly into a new geological epoch.

They reached a startling conclusion: Earth has left the cosy confines of the epoch we humans know, love and absolutely depend upon—the Holocene.

This was as profound an observation as two of science's most significant discoveries—Copernican heliocentricity and or Darwin's evolution. Like them, the coming of the Anthropocene demands we rethink our world view. No longer are we a small world on a big planet; we leave a giant footprint. When future historians look back at the 20th century, the most significant event will not be the world wars, the Cold War, the Great Depression or the end of apartheid—as important as these are. Instead, it will be the great acceleration of the human enterprise that drove Earth into a new state.

The Holocene has been good for us. It began 11,700 years ago as Earth slipped from the grip of a deep ice age—as it has, like clockwork, every 100,000 years. Since then, the average temperature of the planet has fluctuated no more than one degree Celsius or so.

Without this remarkable stability, which provides us with reliable growing and rainy seasons, we would not have developed agriculture. It is the reason why we have complex societies. It is the foundation for our cities and science, art and culture. It is how we can feed seven billion people, cure diseases and land on the moon.

Unfortunately, this stability can no longer be relied upon. Records keep getting smashed. August was the warmest month globally since modern records began 136 years ago. September is the tenth straight month of record temperatures. According to NASA, it is now "almost a certainty" that 2016 will go down in history as the warmest year on record, beating the warmest so far, 2015. Alarm bells are ringing in the Earth research community.

But are they ringing elsewhere? Up to this month, all has been worryingly quiet as nations deal with more immediate calamities. Almost one year after the launch of the Sustainable Development Goals and nine months after the Paris Agreement on climate change, short-term political agendas seem to have trumped planetary stability. It is worth recalling the September 2015 speech by Mark Carney, governor of the Bank of England, in which he argued that once climate change becomes a defining issue for financial stability, it may be too late.

This is perhaps the greatest paradox of the world we now live in. We have a frontiers mentality. The vastness of Earth's atmosphere, oceans, ice sheets and rainforests seem to continue forever over an endless horizon. This was certainly true throughout the 200,000 years since humans first walked the African savanna. It was true even 40 years ago. But it is not true now. The exponential growth of industrial societies since the 1950s means that Earth has reached saturation point.

Last year, my colleagues and I published a detailed assessment of the state of the planet. We confirmed that Earth's resilience is dependent upon nine planetary boundaries relating to climate, deforestation, biodiversity, ocean acidification, chemical pollution, ozone, water, fertiliser use and aerosols. We also estimated that human activity has driven Earth across four such boundaries, particularly relating to greenhouse gas emissions and the devastating loss of species which may place us at the start of a sixth mass extinction on Earth.

This generation is facing a "tragedy of the commons" on a profound scale. We are simply not geared up to deal with this. Our institutions—such as the United Nations, the banking system, and nation states—were designed for the Holocene, not the Anthropocene. Economics assume a forgiving planet with infinite resilience, the capacity to buffer such abuse as the injection of 40bn tonnes of CO_2 each year.

Up until 1990 Earth could withstand our pressures. But since then it has started to send invoices back to society in the form of heatwaves, droughts, accelerated ice melt and sea level rise, and collapsing lakes and fish stocks. And we have not recognised how a nation's security and economy depends on a stable Earth. Our notion of global commons focuses on user rights over "resources" such as Antarctica, outer space, the high seas and the atmosphere. In practice, the ice sheets, oceans, waterways and rainforests—essential for the stability of the whole planet—are priced in the same way as luxury goods: their value in the distant future calculated as negligible.

It is time to re-evaluate our economic and political models for the Anthropocene. The starting point must be our very notion of the global commons. Any attempt to stabilise global temperatures, for example, implies a finite carbon budget—the amount of greenhouse gas emissions—that we must not exceed. At current rates we will use up this budget in the next 10 to 20 years (as far as science can tell). Earth can only tolerate only 400 to 800bn tonnes of CO_2 without tipping over the two degrees Celsius planetary limit. This is humanity's budget for our remaining time on Earth. And you do not negotiate with Earth.

The global carbon cycle, whether within or beyond national jurisdiction, is a global common. The same applies to rainforests, freshwater,the ozone layer, biodiversity. Our thoughtless assumption that we can take all this for granted is humanity's biggest gamble, as myself and colleagues argued recently and in the Earth Statement last year.

Industrial societies now wield astonishing power. Earth's future is in the balance and we must handle it with care and respect. We need new institutions to catalyse the transformation of societies. The new global goals and the Paris Agreement on climate are the first signs of a new approach to the global commons. The US and China's ratification of the Paris Agreement has sent a powerful signal to all nations that is impossible to ignore. We now need this signal to spark rapid, deep, systemic change across all societies.

TAMING BIGFOOT

ANDREW STEER
President and CEO of World Resources Institute

Ways to shrink our environmental footprint so as to safeguard the global commons

Welcome to the Anthropocene, an era built on centuries of economic growth. In the 50 years before this new age, the human economic footprint grew faster in terms of GDP than at any time in recorded history. By the year 2100, it could grow to Bigfoot proportions, possibly 1,000 times the size it was in 1900.

This rapid growth has been a sign of markets working, leading to broader prosperity and falling real commodity prices despite a 25-fold increase in demand. Poverty levels dropped, demand in emerging markets skyrocketed and the global middle class is likely to double or even triple by 2030.

These economic advances have been built on a key characteristic of the old geologic era, the Holocene: stability. For 10,000 years, patterns of temperature, precipitation and seasonality stayed essentially the same, with global temperatures varying less than a degree. This "Goldilocks" pattern—not too hot or cold—encouraged society to grow. But we have taken the stability of our global environmental systems for granted —just as we have the global environmental commons that sustain them.

Economic growth has reached a scale that puts the global commons under immense pressure from such threats as climate change, pollution, extinction, habitat loss, overuse and over-extraction. Unlike in functioning economic markets, no clear market signals or rules and regulations exist to manage the global environmental commons. And current traditional approaches to securing them have fallen far too short.

The resulting Bigfoot-size impact of cumulative human economic and industrial activities severely strains the commons. So what can be done when doing more of the same is clearly not enough?

Four revolutionary shifts in social and economic life are needed to tame Bigfoot-style economic impacts and safeguard the global commons.

First, as the global population shifts quickly from rural to urban, transforming the world's cities from congested, disorganised and sprawling to compact, connected and coordinated ones are critical. The magnitude of the shift can be mind-boggling: in 1900, only 3% of people lived in cities; now 55% do. Urban population is expected to grow by 700 million each decade until 2060, while 3 billion people are expected to join the global middle class, almost all of them in urban areas.

Congestion and sprawl are expensive. In the United States alone, urban sprawl costs an estimated $1 trillion annually. In many emerging economies, the spread of cities pushes infrastructure to the breaking point, making for longer commutes and the use of scarce resources to build roads, which worsens quality of life and the environment.

Designing cities for people instead of cars can shrink environmental pressures and make businesses more productive, saving $3 trillion in urban infrastructure investment worldwide over the next 15 years.

Second, we need to re-think food and agriculture. Food production already takes up 37% of the world's landmass (excluding Antarctica), and accounts for 70% of global freshwater withdrawals and 24% of the world's greenhouse gas emissions. Even as population and appetite grow, agriculture is exhausting cropland, with 10m hectares abandoned each year due to soil degradation.

By 2050, we will need 60–70% more food calories for an estimated 9.7 billion people, many of them with middle-class tastes for resource-intensive products like beef and dairy. We must make cropland, livestock and aquaculture more productive while minimising food loss and waste and shifting diets to less resource costly foods.

Third, decarbonising energy systems can help us decouple global greenhouse gas emissions and economic growth. Global energy use has increased roughly 13-fold since 1900. To create energy access for all, energy use will probably need to increase by another 50% by 2040. Under current patterns this will create a 34% rise in energy-related carbon dioxide emissions when they actually need to be falling by at least the same amount.

The good news is 70% of the energy infrastructure needed to meet this growing demand has yet to be built, providing immense opportunity for investment in energy efficiency and clean energy sources.

Fourth, we need to transition from linear approaches to production, design, use and disposal of materials to circular economic models that can make us more resource productive and efficient across the economy.

We must minimise waste by keeping resources and products—and their value—circulating in the economy as long as possible. This means discovering how to loop our production, consumption and waste management processes, improve designs and make use of waste outputs from one system as inputs for others.

Revolutions aren't easy, but they are possible. However, the shifts we need—in policies, behaviours and business—to "tip" our economic and social systems worldwide are not happening at the speed and scale required.

We must identify potential paths of influence that can catalyse revolutionary changes and learn from examples of positive tipping points. And we must develop strategies to bring them together with the disruptive power of information technology and multi-stakeholder cooperation that are already driving profound, far-reaching convulsions in our wider models of government, business and society.

A diverse group of first movers from business, international organisations, think tanks and civil society met in Washington DC this month to do just that. The dialogue on the global commons—led by the Global Environment Facility and the International Union for the Conservation of Nature, with World Resources Institute's full and active support—proved to be an exciting first step towards agreeing on such strategies.

The task ahead is immense. But existing tipping points—like the radical improvement of economic policies in 100 countries between 1985 and 2000 or the spread of bike sharing from zero to 850 cities in less than 10 years—along with technological advancements and emerging practices offer unprecedented hope for the economic and environmental action we need.

SAFEGUARDING THE GLOBAL COMMONS IS THE WISEST INVESTMENT WE CAN MAKE

NAOKO ISHII
CEO and Chairperson of the Global Environment Facility

We are at a defining moment for the future of our planet and its people

Scientists tell us that the biophysical processes that determine the stability and resilience of earth, our "planetary boundaries" that allowed our societies to thrive during the past 10,000 years, are being pushed to their limit. Evidence is mounting that the miraculously, favourable earth conditions that scientist call the Holocene—the only ones we know can support a human population of 7.4 billion and more —risk coming to an end.

The greenhouse gases that cause climate change are at higher levels than at any time in at least 800,000 years; 2015 was the hottest year on record, and 2016 may be hotter still. Globally, species are being lost at a rate only seen before during mass extinctions. The health of our oceans is declining rapidly.

The alarm bells are ringing. On the current trajectory, the worsening global environment will be an ever-increasing threat to our global aspirations for economic growth, jobs, security and prosperity. There is an enormous amount of work to be done, and success remains far from certain, but now is the time to tackle the world's most pressing environmental and social problems

Our fate is in our own hands. As the world moves out of the Holocene into what is being gradually recognised as a new Anthropocene epoch—an epoch where humans are the largest driving force of change on planet Earth—it is our common responsibility to change our ways of operating to ensure that this vital system continues as our essential global commons.

The world's governments took the firsts steps in that direction last year. In September, nearly 200 nations gathered in New York, pledged their commitment to 17 sustainable development goals (SDGs) to guide growth over the next 15 years in ways designed to end poverty and ensure prosperity while respecting planetary boundaries. Three months later in Paris the same governments adopted an agreement to combat climate change, committing to achieving zero net emissions of greenhouse gases in the second half of the century.

Shifting to a low carbon and resilient trajectory will require coordinated, integrated solutions to catalyse the transformation of three key economic systems: energy—how we power our homes, offices and industry, and move goods and people; urban—how we live in cities and build new ones; and land use—how and where we produce food, and what we eat.

As an institution dedicated to ensuring the health of the global environmental commons, we at the Global Environment Facility recognise that while we have won some battles the war to maintain the conditions for future prosperity and well-being is still being lost. There have been many good individual actions, but they have not added up to the systemic changes that are needed.

Transformational change will require actions on multiple fronts and at all levels of society. It will require political and social mobilisation and bold leadership.

It is our hope that this new effort will lay the foundation for a new paradigm for the global commons. We need a new way of thinking that enables transformational change, new alliances, social and economic opportunities, and provides the stable conditions necessary for sustainable growth, poverty reduction, peace and security.

It will be a journey not just to avoid disaster, but to build lasting prosperity. Operating within the planetary boundaries is not just the only way to ensure healthy economies, but has the potential to provide much greater and better shared growth than sticking to business as usual. Safeguarding and enhancing the global commons is therefore the wisest investment we can possibly make.


“Our fate is in our own hands”

THE NATURAL WAY FORWARD

INGER ANDERSEN
Director General, IUCN

We must work collectively to secure the support systems that nature provides

Two competing narratives frame the debate of the future of the global commons, of the earth's operating system, on which all life depends. One pessimistically claims that it is already too late to avoid catastrophe and that we must therefore now focus on survival and recovery. The other is a stubborn optimism, which argues that humanity has faced and overcome many great challenges in the past and will continue to do so. The first leaves people in despair, the second risks indifference and denial.

There is, however, an emerging viable alternative—one that embraces the reality that we live in a world of complex, interdependent systems and acknowledges that changes to them can either enhance resilience or result in greater instability and uncertainty. It stresses that nature conservation and human progress are not mutually exclusive. Despite such tremendous forces of transformation as climate change and dramatic socioeconomic inequality, there are credible and accessible political, economic, cultural and technological choices that can promote general welfare in ways that support and even enhance our planet's natural assets.

This alternative future has long been given expression by the international community through such declarations as The World Charter for Nature, Agenda 21, The Earth Charter, and the UN General Assembly resolutions on harmony with nature, which point to the need for profound transformations in our patterns of production and consumption, and recognise that every form of life has value regardless of its worth to human beings.

Now it has climaxed in the world's commitment to deliver the ambitious sustainable development goals, within a 15 year timeframe. There is a real sense of urgency in this call to action, since we live in a time of tremendous change when the imperative of meeting immediate human needs clashes with its long-term impact on the planet's capacity to support life. Many believe that current trends are not sustainable and that there is a closing window of opportunity to effect meaningful change in humanity's trajectory. Time is running out to find ways of making progress that both safeguard and reinforce the natural world that sustains us. Our future will be decided by the choices we make now.

Certainly there are grounds for concern. We are now some 7.3 billion people on Earth and the UN estimates that, under a medium growth scenario, we will be more than 8.5 billion by 2030. Over half the world's population is already living in urban areas, increasingly disconnected from the complex systems of nature and biodiversity that keep us all alive.

Shifting patterns of global wealth and economic growth over the past 15 years have led to important increases in economic wellbeing, lifting hundreds of millions of people from poverty, and improving other such important indicators as maternal health. But other problems persist or grow steadily worse. The benefits of development are not shared equitably, the gap between rich and poor is widening, and economic growth is occurring at the expense of ecological integrity. Scientists have reported that the "planetary boundaries" to the biophysical processes on which the earth depends are being pushed to the limit: some, such as the climate and the integrity of the biosphere, have already been exceeded.

We can expect more of this to happen over the next 15 years, in ways that simultaneously bring hope yet further strain the planet's biodiversity and its capacity to support human needs and expectations. Yet a steady increase in global wellbeing can only be achieved through an enhanced understanding of the planet's complex life support systems and the predominant global trends that act upon them—urbanisation, economic growth, burgeoning consumption, disappearing biodiversity, wealth inequality, climate change, population growth, and so on. Nature will most likely go on, whatever happens, so the relevant questions are: to what extent will healthy, prosperous and secure societies continue to be a part of the story, and how much of the greater community of life will persist?

IUCN—which holds its World Conservation Congress in Hawaii in the first 10 days of September—has been aligning conservation efforts all over the world around three solid lines of work: valuing and conserving nature's diversity; advancing effective and equitable governance of its use; and deploying nature-based solutions to climate, food and development challenges. The approach emerging from our collective efforts demonstrates that nature is not an obstacle to human aspirations, but an essential partner, offering valuable contributions towards all our endeavours.

For the alternative path to be credible and viable, we need new partnerships across the planet, between governments, NGOs, conservationists, scientists, consumers, producers, urban planners, entrepreneurs, grassroots and indigenous organisations and financial backers. Each partner holds a vital piece of the puzzle, in knowledge, tools and resources. We need to bring these pieces together, and collectively complete the greatest puzzle ever attempted, to secure nature's support systems so that humanity and the greater community of life may continue to prosper on earth. This is our collective challenge for the next 15 years.

"Our future will be decided by the choices we make now."

LEAVE NO SDG BEHIND

NEBOJSA NAKICENOVIC
Deputy Director General and Deputy CEO of the International Institute for Applied Systems Analysis (IIASA)

CAROLINE ZIMM
Researcher at Transitions to New Technologies Program, IIASA

Science has an important role in supporting new global social contract and the 2030 agenda

2015 marked a historic turning point. The Sustainable Development Goals (SDGs) unanimously adopted by the United Nations last September provide an aspirational narrative and specific targets for human development: a world free from hunger, injustice and absolute poverty; a world with universal education, health and employment; a world with inclusive economic growth, based on transparency, dignity and equity.

The 17 SDGs' call for "global citizenship and shared responsibility" and provide legitimacy for a new global social contract for a grand transformation toward a sustainable future. They fully acknowledge the scientific advances achieved during the last three decades that have established compelling evidence that otherwise, as the UN general assembly warned, "the survival of many societies, and of the biological support systems of the planet, is at risk." Humanity has pushed the Earth system and its global commons to their limits and the SDGs provide us with the long-needed paradigm shift towards realising the opportunity of a sustainable future for all.

The climate agreement adopted in Paris last December has further strengthened understanding that our society depends on sustainable

stewardship of the global commons, shared by us all—and particularly on the stability of the climate system. The Earth system can no longer be viewed as an economic or social externality. Last year we moved beyond the traditional view of global commons as merely the common heritage of humankind outside national jurisdiction. Now we must move beyond national sovereignty to deal with the Earth system and human systems holistically, as the SDGs require. The Paris agreement is a huge step in the right direction.

Time is running out, so we must take urgent action to implement the UN 2030 agenda. Just 14 years are left—less than the wink of an eye in the history of human development, or of the Holocene's stable Earth systems. But where to start? Which of the 17 goals, which of the 169 targets should be tackled first? Policy makers, the media, civil society and scientists all ask these questions.

However, the 2030 agenda stresses that the SDGs are indivisible and integrated—and cumulative, since efforts to achieve them must be sustained well into the second half of the century, especially in preserving the regulating function of the global commons, Some of the goals, such as SDG13 on climate, must operate on a time scale longer than century.

Moreover, there are interactions between and among the SDGs. For example, achieving SDG7, the energy goal, could jeopardise SDGs related to water, health and climate. Tackled in harmony, however, these goals can support one another: there would, for example, be clear health benefits from reducing indoor and outdoor air pollution through global decarbonisation. Jointly implementing all the SDGs would contribute both to further human development and to safeguarding the commons and the stability of the Earth systems. Importantly, joint implementation that avoids silo-type thinking would be cheaper and faster than tackling them separately.

All these goals should be achieved in such a way as to maximise synergies and minimise investment costs and trade-offs. The SDG credo "leave no one behind" also applies to the SDGs themselves. They are indivisible. We have to deliver on all of them if we want to succeed.

The SDGs are very ambitious but it appears that tackling them together will help humanity make rapid progress and enter a new era for human societies and the Earth system. Yet, many interactions—and their scope—are unknown, and this hampers holistic policy making. We lack clear understanding of the benefits of achieving SDGs and of costs of inaction, especially when it comes to regional and national differences. We urgently need this fact-based information.

We have a plethora of knowledge, but need new ways to synthesise, integrate and share it so as to use its full potential in support of the SDGs and the global commons. Science—one of the strongest voices of the environment in governance—must become more active and leave its ivory tower to engage more intensely with other stakeholders.

This is why we at IIASA, together with the Stockholm Resilience Center, and the Sustainable Development Solutions Network have launched the scientific initiative The World in 2050 (TWI2050), designed to provide the scientific knowledge to support the policy process and implementation of the 2030 agenda.

TWI2050 aims to address the full spectrum of transformational challenges in fulfilling the SDGs in an integrated way so as to avoid potential conflicts among them and reap the benefits of potential synergies through achieving them in unison. This requires a systemic approach.

The time for "climate-only" or "economic development-only" approaches is over. We urgently need an integrated understanding of the processes that account for the inter-linkages between the economy, demography, technology, environment, climate, human development, all global commons and planetary boundaries. TWI2050 brings together leading policymakers, analysts, and modelling and analytical teams to collaborate in developing pathways towards the sustainable futures and policy frameworks necessary for achieving the needed transformational change.

Such a grand transformation goes beyond a purely technology-centred view of the world or the substitution of one technology by another. It encompasses social and behavioural changes at all levels, as well as technological ones. Incremental changes, now being experienced in some areas, are useful but will not suffice: we have waited too long and the window for action is closing rapidly in some domains including such global commons as climate. We will need radical changes in human behaviour and technological paradigms. TWI2050 will look beyond 2030 to 2050—and, in some cases, even to 2100—to draw a vision of the world where the SDGs are eventually fulfilled.

The SDGs and the Paris agreement show what institutional international governance can achieve with joined forces. We have entered a new era of global governance, acknowledging the complexity and the connectivity of human development with the global commons and the Earth system. TWI2050 hopes to serve the global community with the best science available in tackling these key global challenges for humankind.

THREE WICKED PROBLEMS OF THE COMMONS

DOMINIC WAUGHRAY
Head of Public Private Cooperation at the World Economic Forum; Visiting Scholar at Stanford University Woods Institute for the Environment

We urgently need to manage the interrelated challenges of energy, water and agriculture in a changing climate

Global energy consumption is forecast to increase by nearly 50% by 2040 according to the International Energy Agency (IEA) 2016 Global Energy Forecast, with energy-related CO_2 emissions rising by 34% from 2012 levels. Emerging economies like China and India will drive most of this, as they continue to rely heavily on fossil fuels to meet demands from their expanding industry and cities. India will need to quadruple its present installed capacity of about 270GW by then, creating another United States in terms of energy use.

On top of this there is, of course, the urgent need for more energy access for rural and poorer people. At present more than three billion people in developing countries still rely on traditional "biomass" for heating and cooking: 1.5 billion lack access to electricity. India alone has 240 million, mostly rural, people without such access and rightly seeks to move them out of energy poverty as quickly as possible. It submitted a bold target of achieving a 40% share of non-fossil fuels in its energy mix by 2030 to last year's climate negotiations in Paris. But it also plans to expand its coal capacity to 400GW of coal fired electricity, over 40% of the mix, by 2035. Its greenhouse gas

emissions will grow rapidly to around 5 gigatonnes by 2030, about as big as those of the United States today.

So here is wicked problem number one in protecting our global commons: how do we get millions of people out of energy poverty without significantly increasing greenhouse gas emissions?

Electricity production can also be surprisingly thirsty. A megawatt hour of electricity generated from sub-critical coal-fired power stations can require up to 2,000 litres of water. The US Geological Survey estimates that to produce and burn the around 900m tons of coal the United States uses each year to provide about 34% its electricity, requires between 55-75tn gallons of water annually; about equal to the amount that pours over Niagara Falls in five months!

India, the IEA estimates, will need up to 60bn cubic metres of water a year for its coal-fired electricity plans by 2035. Its expansion of coal will push the water requirements of its industry and energy sectors up from 2-8% as a share of overall withdrawals.

This extra water equates to about 37m3—more than an oil-tanker truckload—for every person in India just to meet India's coal fired electricity plans by 2035 (assuming its population is then about 1.6 billion). Or, to put it another way, it would mean accessing some 12% of the Ganges average historic annual flow of 500bn metres cubed of water, including in non-monsoon seasons when energy is still needed but rivers are low.

As emerging economies urbanise and industrialise, using fossil fuel power, more of their water will need to be allocated to energy. Modelling by the Colombia University Water Group for the World Economic Forum suggests a 76% increase in water demand for energy and industry will be required across Asia by 2030. And 70% of the continent's river and groundwater is on average already being used for agriculture.

So here is wicked problem number two in protecting our global commons: how can the competing needs of water for agriculture and fossil-fuel energy be squared off? Without radical changes in agricultural or energy production, it is not clear how well the future water needs for India's coal sector will go down with the country's farmers.

And here's the third wicked problem: India's coal fired power stations will have to be built somewhere.

More than 70% of India's power plants are located in areas that are already water stressed or water scarce, and most of the new coal-fired ones will be required where it is scarcest. The country's warm temperatures and the poor quality coal used in most of its power plants will increase their cooling water requirements. The high levels of pollution in rivers and waterways won't help either; nor will the seasonality of river flow. Power plant costs can rise 40-400% as you try to improve water use efficiency, without much benefit in wider efficiency ratios, as Eskom in South Africa has experienced—making coal no longer cheap.

Yet without water there can be no coal fired electricity production, making energy security a problem. In March, the flagship 2,300MW coal plant at Farakka town in West Bengal had to suspend its generation due to low water in the canal that feeds it. India's 91 reservoirs are at an average 29% of storage capacity according to the Central Water Commission. Historic levels of over-abstraction combined with forecast climate change will add extra stress on future water availability, making an already wicked problem super wicked.

These interrelated challenges of energy, agriculture, water and climate change are what we would call a "systems" challenge. The United States and India are by no means alone in facing it. Who is working with the power sector to place their investment programmes into the context of basin wide hydrological risk maps assessing who will need what water (including for the environment)? Answer: no one. Who is agreeing on adjustments to the cost benefit analysis of investment appraisals to take proper account of these risks? Answer: no one. Who is overlaying these investment analyses with different climate scenarios for water scarcity? Answer: again, no one.

Someone will have to do all this, and soon, or these wicked problems will come home to roost, and we will never properly address the competing challenges of managing our global commons and ensuring needed economic development. Then, as ever, it is likely to be the poorest people who will lose out.

A WEALTH OF OPPORTUNITIES

PETER BAKKER
President of the World Business Council for Sustainable Development

Transformative change to safeguard the global commons could mobilise investment

For decades, the "tragedy of the commons" has been a useful tool for understanding and explaining the risks of undervaluing shared resources. Today such issues—those of the "global commons"—touch upon almost every aspect of our daily lives.

What was once a hypothetical theory is now a global reality—and it's our responsibility to do whatever we can to address it.

Business is in a unique position to observe and intervene in many issues facing the global commons—from reducing emissions and addressing climate change, to stopping ocean pollution and fixing broken food systems. Across the world, companies are stepping up to meet the challenge.

At the World Business Council for Sustainable Development (WBCSD) over 200 of the world's biggest companies are focused on addressing global commons issues through two key pillars: catalysing systemic change across key economy sectors and changing the rules of the game to ensure that businesses are measured by their true cost, true profits and true value.

The adoption of the Sustainable Development Goals (SDGs) and the Paris Agreement sent a powerful signal that the world is ready to change—that businesses who don't adapt and who don't respect the global commons will be left behind as more sustainable businesses become more successful. This new framework represents an

unprecedented wealth of opportunities that are good for business, society and the environment.

The Business and Sustainable Development Commission (BSDC) is working to quantify these opportunities—because getting any CEO on board will require translating sustainability jargon into a language he or she will understand.

The data the BSDC is uncovering is compelling, especially from a business standpoint. Preliminary research suggests that the new global development framework (ie opportunities associated with addressing global commons issues through the SDGs) could channel significant financial investment into the global economy. To seize these opportunities, we must move beyond incremental change.

It does not make sense for business to address each SDG one by one. Instead, it is calling for complete systems transformation across global economic sectors to address many SDGs at once.

By implementing business solutions across energy systems, food and land use systems and cities and mobility systems, WBCSD member companies are bringing their skills and expertise to scale up solutions in the widest, most positive way possible.

Representatives from business, government, academia and civil society must come together to truly transform the entire economic system. Redefining the way we value business and society, must be a key element of that.

We know that addressing global commons issues and meeting the SDGs is the right thing to do. We must now ensure that it also becomes the easiest and clearest choice for business. In other words, we need to re-evaluate the way we measure success.

Focusing solely on financial performance has, for too long, allowed companies to neglect important aspects of material risk management and disclosure, reinforcing business patterns that degrade the global commons.

All of this is about to change. Companies are beginning to see that it's critical to consider additional performance metrics in order to set appropriate goals, understand progress and share accurate and relevant information. The revolutionary Natural and Social Capital Protocols aim at creating a new framework for companies to understand and measure their impacts and dependencies on nature and society.

In July 2016, the world took a giant step towards natural capital accounting by officially launching the Natural Capital Protocol—opening a new pathway for companies.

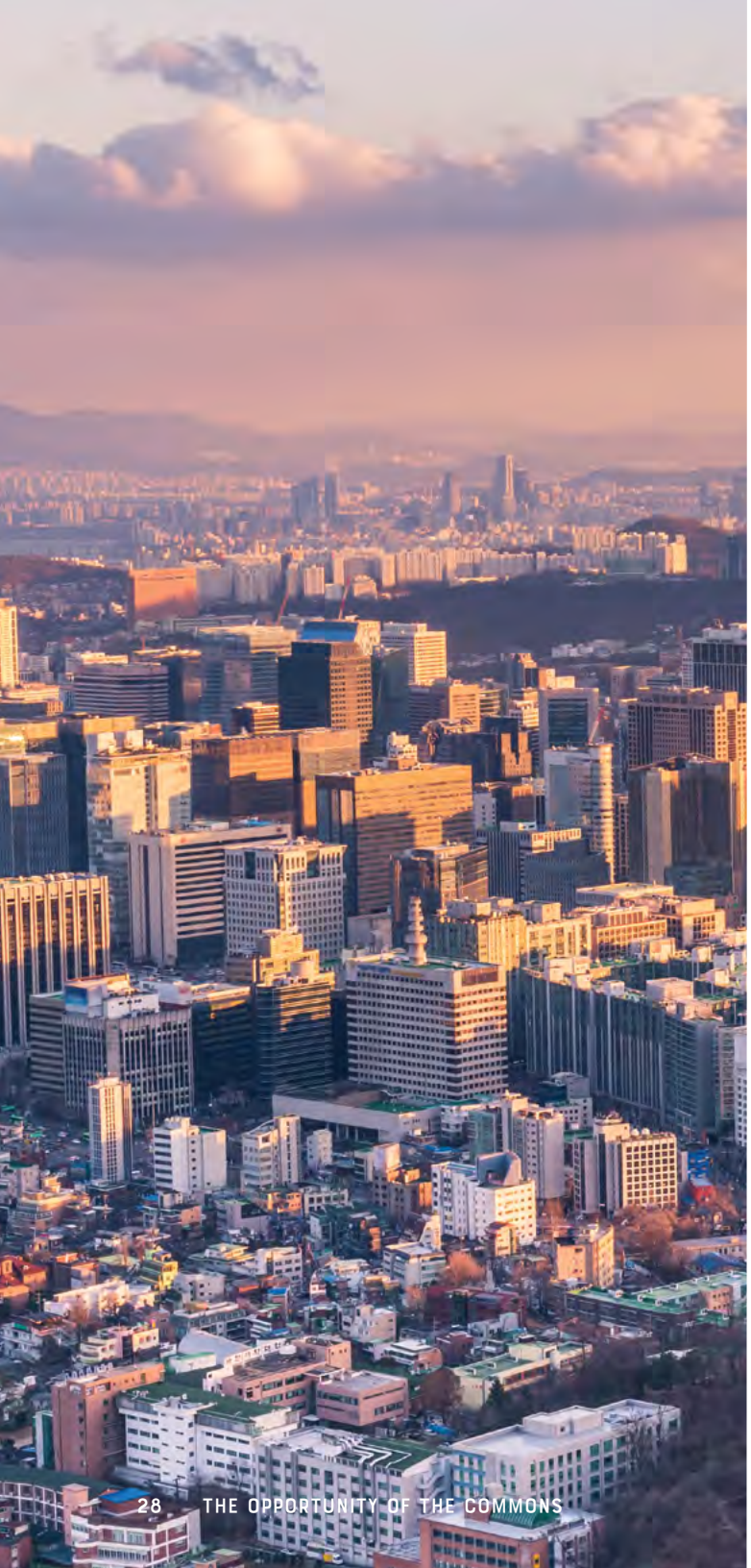
By thinking strategically about natural capital decisions and implementing the Protocol, forward thinking companies now have the opportunity to impact sustainability while reducing the market distortions that allow for damage to the global commons to occur in the first place.

The combination of systems transformation at the industry and business level, and economic restructuring on the financial and reporting level, will push the world in the right direction. But we need to abandon incrementalism in favour of complete transformation.

Each and every one of us—business included—depends on common global resources and we all have an important role to play in leading the change.

Business must continue to step up, and the collective global community must also come together to move forward. We have cleared the first hurdle in agreeing on a sustainable pathway forward, but now it's time to work together to implement meaningful and lasting change.

"This is only the beginning."



ACHIEVING THE URBAN DREAM

PARK WON-SOON
Mayor of Seoul and President of ICLEI Local Governments for Sustainability

Ways to shrink our environmental footprint so as to safeguard the global commons

Cities have been playing a pivotal role in global development since industrialization. They have grown intensively and become the center for politics, administration, culture and industrialization. They are truly symbols of advanced civilization, where innovation and opportunity are booming.

And they continue to grow. According to the UN-Habitat report, the global urban population is expected to reach 5 billion—or 67% of the global population—and there will be at least 40 megacities with more than 10 million residents by 2030. This sort of growth also means that cities have an important role to play in protecting our global commons including, among many other actions, reducing our contribution to global greenhouse gas emissions.

Cities need to face their rapid expansion head-on with a clear vision for low-carbon, resilient—and overall sustainable—development that protects our shared natural resources.

Seoul, like most cities, is not free from the negative impacts of urban development. We have undergone rapid urbanization and fast economic growth, which in turn has created challenges to the good care of our environment and the management of the transport sector. Acting, with the engagement of our citizens, to overcome these challenges, we realised firsthand that cities have a crucial role to play in making sustainable development possible. After all, cities are home to most people in the world.

Since I became mayor, Seoul has been taking active steps to stay on a sustainable path and fulfil our responsibility, as a megacity, towards the planet. We are implementing the Sustainable Development Goals (SDGs) based on a vision of Seoul as "the world-leading sustainable city". I am also pushing for Seoul to lead by example, reflecting the 10 Urban Agendas of ICLEI - Local Governments for Sustainability and the SDGs in our development trajectory, so that it is environmentally, socially, culturally, and economically conscious.

We have taken a number of critical steps, in close collaboration with our residents, over the environmental dimension of sustainability. Our 'One Less Nuclear Power Plant Project', one of the main environmental projects in Seoul, aims to tackle climate change and strengthen energy demand management.

Residents of Seoul joined the many initiatives connected to the project helping the city to save energy and increase renewable energy production. As a result, Seoul reduced energy consumption by 3.17 million tons of oil equivalent (TOE) between the project launch in April 2012 and 2015—equal to the annual amount of energy produced by 1.5 nuclear power plants. Seoul will continue implementing this project until 2020, aiming to save 6 million TOE of energy—equivalent to the energy generated by 3 nuclear power plants—and eventually reduce 10 million tons of greenhouse gas emissions.

Most cities face the same challenges, which makes close cooperation between them of paramount importance. As President of ICLEI, I am working to transfer these ideas around its wider network and to encourage greater ambition at the local, national and international levels.

To enhance cooperation between cities and deliver our voice clearly on the international stage, we have announced the "ICLEI Declaration to the Ministers at COP21" in Paris, which shows cities' commitments to tackle climate change. Following this announcement, Seoul hosted the "Seoul Mayors Forum on Climate Change 2016" and, together with the participating cities, announced the "Seoul Communiqué for the New Climate Regime", to re-emphasize that cities are committed to supporting global climate goals established in the Paris Agreement. We expect that the Seoul Communiqué will be discussed in-depth at the Habitat III conference, and that it will be shared as a message from cities and local governments at COP22, later this year in Marrakech.

Seoul and other cities in the ICLEI Network have clear reasons to build a sustainable world and protect our global commons, while working collaboratively. We can only develop sustainably and protect our common resources when cities reach across borders and aggregate even small actions into a concerted global effort.

Humankind can be sustainable only if the cities are sustainable. If the efforts of cities is encouraged and supported, development can indeed become sustainable. Together with the cities in ICLEI's network, Seoul dreams to build a sustainable city where citizens live in a protected environment and enjoy a better life. If we dream together, cities will have the power to achieve such a dream.

CROSSING THE LIVING BOUNDARY

THOMAS LOVEJOY
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Why degrading biodiversity is the greatest of all violations of the global commons

Humans are a curious species. We are remarkably adept at manipulating, even more so at communicating and thinking symbolically and analytically. The result is a multicultural fount of intellectual products - scientific, artistic, humanistic and more—all fostered by our innate social primate nature.

But there's also a dangerous underside—an almost narcissistic and myopic focus on ourselves. We tend to be absorbed by mutual grooming, in various forms, while ignoring self-created environmental chimeras even to the point of crossing planetary boundaries—exceeding the conditions, basically, which nurtured the rise of our civilisation.

The ways in which we are crossing these boundaries all have biological consequences. Almost by definition—even if this is not widely recognised—nothing is considered to be an environmental problem unless it affects living systems. By far the greatest violation is that of the biodiversity planetary boundary - because, in a sense, it is the sum of the impact of all the other boundary transgressions.

So it is not surprising that we are at the beginning of the sixth great extinction of life on earth. The difference from the previous extinction events is not only that a single species (our own) is causing it, but also that it is at least partly aware of what it is doing, and is capable of acting to stop the loss. Flushed with our apparent success, we are perilously close to losing a significant portion of the

global commons which, in many senses, made the success possible in the first place.

Biodiversity largely occurs within national jurisdictions on land and within coastal economic zones (even though enormous marine areas beyond national jurisdiction cover almost half the planet). So much of the early history of the Convention on Biological Diversity was focused on "who" benefits from the immediate value of a species that has been newly recognised to have human, and therefore economic, benefit. That is why national GEF biodiversity projects are viewed as having both national and global benefits.

It has been important to set up rules about how such benefits could be shared. But, if taken to exclusion, doing this overlooks how much of them are generated not so much by the actual plant or animal species in itself, but from what science learns about it. Biodiversity is, in fact, a kind of living library for the life sciences, since each species represents a set of solutions to a very specific set of biological problems.

The concept of antibiotics, responsible for the health of untold numbers of people, came from the chance airborne contamination of Fleming's laboratory cultures by Penicillium mould. That could have happened anywhere, because the mould is so widespread, but most species are much more restricted biologically and geographically. The class of medicines known as ACE inhibitors, for example, stem from studies of the venom of a new world tropical pit viper. The result: the treatment of choice for hypertension worldwide.

The point is that a major portion of the potential of the planet's biodiversity lies in the intellectual realm of what investigators might do with it. This is, therefore, as much part of the global commons as a molecule of carbon-dioxide, released by burning a fossil fuel, which adds to the climate change burden of all countries.

Biodiversity provides vital goods and services, which—though produced locally by metabolic activity—have a global impact. These include: producing oxygen through photosynthesis; sequestrating CO2 through soil formation (simultaneously increasing soil fertility) and—since life is built of carbon, through the growth of organisms and the recovery and restoration of ecosystems; and fixing nitrogen through leguminous plants.

Other services—such as forests regulating watersheds—provide local benefits. New York City's Catskills and the forested watersheds of a number of Latin American cities, for example, provide reliable water in both quality and quantity. People turning on the taps rarely give a thought to the biodiversity responsible, and—even if they do—they are unlikely to be aware that the watershed ecosystems are simultaneously pulling CO2 from the atmosphere. In Australia the caterpillars of subfamily of moths (mallee moths) are central to decomposition and soil formation for the "dry continent"– because they are uniquely capable of breaking down leaf litter laced with protective compounds from countless species of gum trees.

The time has come to halt the degradation of biodiversity which sustains humanity and the rest of life on Earth. We need to take on planetary scale efforts to safeguard the living global commons through massive campaigns to restore ecosystems and reduce the atmospheric load of C02. That would not only reduce the global rate of extinction to one approximating its normal, historic rate, but undergird sustainable development. The destinies of life on Earth and of humanity are inextricably intertwined.

EMBRACING THE SDGS' COMPLEXITY

PAVAN SUKHDEV
Founder-CEO, GIST Advisory, and President, WWF International

Food and diet illustrate how the issues threatening the global commons—and their solutions—are intimately interlinked

More than a year has passed since the world's governments agreed the sustainable development goals (SDGs). But as the theoretical rubber of their targets and indicators meets the road of practical policy reform to implement them, we are hearing a discordant sound.

The noise does not in any way resemble the well-crafted orchestral score that might be expected while implementing such long planned goals. This is a familiar challenge for sustainable development: policymaking typically follows the mandates and administrative boundaries of government ministries rather than "whole system thinking".

Implementing the SDGs will add more dimensions to this challenge. It will, for example, involve drawing and navigating a map showing how they are interlinked across different economic sectors and policy domains—and understanding how policy responses that target one goal will help or hinder progress towards others.

Food and agriculture illustrate the point well. For a start, SDG two is about ending hunger, sustainable agriculture, and achieving food security and improved nutrition. Yet, since fish provide the main source of animal protein for more than a billion people in the developing world, are food security and better nutrition even possible without first achieving SDG 14, which entails conserving and sustainably using the

oceans? At present, we seem intent on competitively mining fish stocks to depletion and destroying underwater life in defiance of both common sense and good economics.

Food systems are undermining human health, and permitting—even promoting—inappropriate diets and unsafe foods.

The relationship is similarly strained when it comes to life on land, the subject of SDG 15. We already use around 40% of available land for growing our food—three-fourths of it for growing meat and feedstock for livestock. That is projected to reach a staggering 70% under "business as usual", which would ring the death-knell for many terrestrial ecosystems and significantly threaten land-based biodiversity. Our food system also generates more than a quarter of the greenhouse gas emissions driving global climate change, the subject of SDG 13. This connection also works dangerously in the other direction: some of our most important staple crops are vulnerable to a changing climate.

Nor do these interlinkages stop with the SDGs' ecological foundations—life on land and under water, and climate change—they continue through their "social" layer as well. Food systems are undermining human health, and permitting—even promoting—inappropriate diets and unsafe foods. As last September's Global Nutrition Report states: "Diet is now the number one risk factor for the global burden of disease".

This defines perhaps the biggest health challenge of our times, and takes us to the heart of SDG three, which aims to ensure healthy lives and promote wellbeing for all ages. While an estimated 0.8 billion people remain hungry, another 1.9 billion consume over 3,000 kcal/day—well above the World Food Program's recommended 2,100 kcal/day. Far from reducing inequalities—as envisaged by SDG 10—our food system appears to be adding to them. Obesity is growing in developing as well as developed nations—especially among children whose diets are increasingly dominated by processed foods high in fats and carbohydrates, and sugar-laden fizzy drinks. Thus SDG 12 on responsible consumption and production is also comprehensively challenged by the food system.

Many other goals targeting social change—such as SDG one on poverty and SDG 10 on reduced inequalities—depend on biospheric resilience and stability, and on equitable access to abundant natural capital. Indeed the biospheric goals (six, 13, 14, and 15) can be envisaged as the base of a wedding cake. Stability and resilience are essential in achieving them. One level above them are the "social" goals where equitable access is critical, while the final layer is made up of economic goals, driven by productivity and efficiency.

On the positive side, tracing these interlinkages to their logical conclusions reveals system-wide solutions. Agriculture, for example, is the world's largest employer, with over 1.3bn jobs—around a billion of them in small farms of under two hectares. If policy reforms could be focussed on making small farms better—lowering risks, increasing yield, and achieving fairer prices—that would go a long way to achieving SDGs one, two, 10, and five (on poverty, hunger, reduced inequalities, and gender equality).

Furthermore, a strong case is emerging that shifts towards healthier diets with more plant-based foods, and less meat could cut food-related greenhouse gas emissions by an estimated 29-70% as well as reducing mortality by 6-10% by 2050. If this change could be achieved, it would also go a long way towards achieving several SDGs—especially three, 12, and 13.

In other words, policymakers should not avoid, but rather embrace, the complexity of the SDGs, and seek collaborative and holistic solutions—cutting across ministries, sectors and the whole economy—as they seek to tackle poverty while protecting the global commons.

"The new world of 2030 awaits!"

JUST MANAGING

NIGEL TOPPING
CEO, We Mean Business

The transition to a green economy must be fair—or it risks provoking an even greater backlash

The world economy is in a transition to a low-carbon one that respects the planet's climate and its other vital global commons. But will it be just, or unjust?

Just transitions happen when a failing sector or business is helped to move towards a new, low-carbon growth area. Some quite widespread examples are already under way. The former steel city of Pittsburgh, for example, is reinventing itself as a leading centre for developing self-driving autonomous cars.

As we move into a low emissions future, we need to ensure that the impact on local employment and economies is managed in a way that allows obsolete jobs to be replaced by equally skilled and well-paid, low-carbon ones. The B Team and Sharan Burrow of the International Trade Union Confederation have done a great deal to highlight how important this is.

But there is also a very real danger of an unjust transition. Blindness to unintended consequences—or a lack of adequate planning to ensure that opportunities for local jobs and economies are maximised—could lead to public sentiment quickly turning against efforts to combat climate change and safeguard the global commons.

The shift to electric vehicles continues apace. A recent report by Climate Action Tracker suggests that the last gasoline-powered car will have to be sold by around 2035 if the world is to be on track to

meet its target of keeping the rise in average global temperature below two degrees above pre-industrial levels. Certain car makers, including Volkswagen, have warned that this is likely to cost jobs because fewer components will be needed in production. Many companies, such as Tesla, are focusing on autonomous electric car prototypes. Unmanaged, these structural changes to the automotive sector will have huge implications for jobs in the automotive supply chain, and for professional drivers.

Some of this is creative destruction, as businesses either adapt or become gobbled up in the new order. And while, at a macro level, progress of this kind is exciting and paradigm-shifting from both an economic and a low-carbon perspective, that's not how it is likely to feel to the people whose usurped businesses and jobs are at stake. Instead of celebrating the closing of coal-fired power stations, we need both to acknowledge sensitively the impact of such a transition on individual people and communities, and to mitigate it as far as possible. Otherwise we only exacerbate divisions that already exist.

The current political polarisation around the world, particularly in Europe and America—the sense of injustice, of being left behind—whether justified or not, is fuelling populism and is potentially destabilising for society. We can't think narrowly about climate and the other global commons in future. We must also think more politically about the overall balance of jobs and wealth distribution. A resurgence of protectionism and anti-globalisation is both bad for business and likely to slow down positive change. When populist governments move in that direction they typically prop up industries that would otherwise die out. Businesses should seek out new opportunities, rather than ask for the hand-outs that come from government protection. There are plenty of examples of businesses that have skilfully made such transitions. DSM used to be a coal mining company; now it's a materials and nutritional science one.

It is possible to engage constructively with the inevitable transition, supporting communities where jobs are being lost by attracting the industries of the future. Nissan's success in the north-east of England required bold private sector investment into a geographical market of available, trainable and skilled labour.

We can also take hope from the story of Ed Woolsey, a fifth-generation farmer from Iowa, whose crop has recently changed radically. "Before, I raised corn and soybeans and cattle", he told Bloomberg. "Now…I'm a wind farmer." He's part of a community collective that manages 10 wind turbines and sells the power to rural electric cooperatives. By 2030, it is projected that rural landowners in the US will generate as much as $900m (£729m) a year in revenues from wind energy.

Importantly, this is investing in the future, not the past. Woolsey had seen the price of corn fall from $7 a bushel to $4.20 and finally to around $2.70. He could have continued what he was doing and watch his situation slowly become untenable. Or, with a nudge from government (in this case a federal tax credit), he could transition to a profitable future. He chose the latter. We need to help others to do the same.

"Businesses should seek out new opportunities, rather than ask for the hand-outs that come from government protection."

LOSING GROUND IN A WARMER WORLD

N H RAVINDRANATH
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Transformational change is needed to solve crises in the vital global commons resources of fertile land and water which will be exacerbated by climate change

Two global commons resources, fertile land and water, will be critical as the world's population increases. Having crossed 7 billion in 2010—rising from about 3.7 billion 40 years earlier—the number of people is likely to rise to 9-10 billion by 2050. This presents a big challenge: can the world feed so many and provide them fresh water?

These resources are characterised by land degradation and water shortages. According to the United Nations, nearly 6bn hectares (14.8 acres) of global fertile land—two thirds of the total—is subject to different levels of degradation, most of it irreversible. This could potentially contribute to long term reductions in soil fertility and water-holding capacity, leading to declines in crop production, especially in the developing world.

The water crisis is already around us. Large parts of the world, particularly in developing countries, are already facing it in a severe form. It is common to hear of potential "water wars" within and between countries. Nearly 80% of the global population is estimated to live in areas with high water security threats, with 3.5 billion people facing the most severe category of them. If current land and water management practices continue, the land degradation and water crisis will accelerate.

Climate change will intensify existing difficulties in sustaining food production and providing fresh water to a growing population. The Intergovernmental Panel on Climate Change has concluded that it will worsen land degradation—most severely in the arid and semi-arid regions of the developing world. It will also impact both surface water availability and groundwater resources, through changes in rainfall pattern and warming, contributing to increased evapo-transpiration and run-off—which may, in turn, lead to additional demand for water for crops.

Globally, the area of land used for agriculture increased from about 1,372m hectares in 1960 to around 1,600m in 2012, and the Food and Agriculture Organisation (FAO), expects the demand for cropland to reach 1,660m hectares by 2050. The rate of increase in developing countries is significantly higher, from about 693m to 968m hectares between 1960 and 2012. Thus, even in the absence of climate change, large-scale conversion of forest and grassland is projected for the coming decades.

The FAO says that, though there has generally been an increasing trend in crop productivity over recent decades, the average annual growth rate in crop yields is declining and is projected to fall even further by 2030, even without the impact of climate change. Also, as is well-known, changes in diet patterns—with economic development and increasing incomes, especially in the developing world—are likely to increase demand for land- and water-intensive food products such as meat, milk and sugar.

The changing climate could lead to significant changes in land use patterns, increasing the amount required to produce cereals, fruits, vegetables, dairy products and meat both directly and indirectly. Land degradation, water stress, incidence of pests and diseases—all expected to be exacerbated with climate change—will lead to reductions in crop yields, potentially requiring agriculture to expand into such global commons as forests and grasslands. And the expansion of biofuel crops—such as oil palm, jatropa, sugarcane and maize—as substitutes for fossil fuels, as a mitigation option, can also lead to large-scale conversion of these global commons. Meanwhile, forest fires, which have already reached crisis proportion in all the continents, will be exacerbated by warming and drought.

Reversing these trends will be a challenge. The Paris Agreement is unlikely to make any significant impact on any of the pressures on global land and water resources.

Transformational change is needed in land and water management to ensure sustained food production and fresh water supply. We need to address climate change more seriously than the Paris Agreement allows, halt land degradation, adopt sustainable practices to conserve and enhance soil fertility and water resources, and sustainably increase crop productivity.

Research is needed to develop climate resilient crop production and water management systems, which must then be disseminated on a large-scale, especially in the developing world. There may also be a need to change diet patterns, from land- and water-intensive products, to more healthy whole grains, fruits, vegetables and fish.

At present all the potential drivers of land degradation and water scarcity seem to continue unchecked, and climate change will only exacerbate them in coming decades. The global commons of land, water and biodiversity are threatened and we need a radical new approach to save them.

MAKING CHANGE DECISIVE

KATHY CALVIN
President and CEO, the UN Foundation

The global consensus on climate change and the sustainable development goals is breathtaking in its speed and breadth

It was a unique moment when world leaders adopted the sustainable development goals (SDGs) in 2015. Every single government in the world—informed by input from millions of citizens, private sector leaders, and nonprofit experts—came together at the United Nations to agree to a collective, ambitious vision for a better future for everyone, at a time of considerable international tension in other domains. The vision outlined by the 17 SDGs includes the ambition to end poverty and hunger, ensure kids get quality education, empower girls and women as equal to men in all walks of life, and steward natural resources for the future health of all our societies.

In parallel, countries worked to craft what we now recognise as a landmark global deal on climate change, agreed in Paris at the end of 2015 and entering into force this November. While the two processes were separate, the SDGs and the Paris Agreementare indivisible in substance. Indeed, the SDGs include "urgent action to combat climate change" as Goal 13—and are only achievable if the curve of climate change is bent. Left unchecked, rising sea levels and extreme weather events such as droughts and floods, will set back global efforts to eliminate poverty, alleviate hunger, and improve public health, even as rising temperatures disrupt ecosystems on land and in the seas. Climate action, in turn, depends on ambition and innovation in the systems addressed by the SDGs—like agriculture, energy, and infrastructure.

The speed and breadth of global consensus around climate action has been breathtaking: countries acted to adopt the Paris Agreement on climate change unprecedentedly fast. It was reached in December 2015 and signed in April 2016—and by mid-November made national policy by 111 countries that together ensured it would enter into force in advance of this year's Conference of the Parties (COP 22) in Marrakech.

The first major sectoral agreement to slow growth in carbon emissions—in civil aviation—was reached under UN auspices in October, and world leaders that same month agreed to phase out the production and use of hydrofluorocarbons (HFCs), which are powerful greenhouse gases.

Perhaps most importantly, there was widespread recognition and acceptance that the global development and climate agendas are one, and that country action on the Nationally Determined Contributions (NDCs)—or national plans—as part of the Paris agreement is fully consistent with pursuit of the SDGs—and indeed, of national economic development strategies.

Less than a year after Paris, 195 countries took the next step by endorsing the Marrakech Action Proclamation for Our Climate and Sustainable Development, calling for "the highest political commitment to combat climate change, as a matter of urgent priority", noting: "This momentum is irreversible—it is being driven not only by governments, but by science, business and global action of all types at all levels."

Agreements are important, but their promise is made real through action. Marrakech advanced on that front as well, with the announcement of numerous initiatives, including partnerships on energy efficiency, bioenergy, and African agriculture, and with a call by more than 365 companies and investors for the US to continue the leadership that has been widely heralded by business, citizens, and other stakeholders.

Indeed, the official COP itself was almost overshadowed by the dynamism on its margins: civil society's "green zone" had the look and feel of a trade show for low-carbon solutions, side events were lasered on implementation and action. Rather than debate about negotiations and texts, delegates sought out success stories of clean energy technologies and carbon-capturing farming practices.

Marrakech showcased how countries can reverse climate change while growing their economies and increasing wealth. The US put forward a Mid-Century Strategy for Deep Decarbonization (pdf) as did Mexico, Canada, and Germany—important long-term visions for reducing emissions by 80% by 2050, while maintaining robust economic growth. "Ambitious and sustained global action on climate change is not just an environmental priority, it is also a pro-growth economic strategy," the report states.

The Climate Vulnerable Forum, a group of 48 countries with 1 billion combined citizens, pledged to achieve 100% domestic renewable energy production as rapidly as possible and to prepare mid-century low-carbon development strategies before 2020, affirming that "climate action does not limit development—it strengthens it."

This dynamism, enterprise and innovation is the true legacy of the Paris agreement and is the reason that US leadership—however desirable, and however much in its economic interests—is not required for further progress. We have moved decisively from envisaging climate action as a burden and have come to see it as an unprecedented opportunity in national self-interest. Governments forged their plans as enhancing economic growth, wealth-creation, and long-term competitiveness, and for that reason they will make good on their pledges and raise ambition as benefits start to accrue.

Increased demand for low-carbon technologies, supported by enabling policies in many places, has set off a virtuous cycle of continuous improvement and falling costs that can transform the way we all live for the better. And, in 2020, when nations gather to reaffirm and strengthen the commitments they made before Paris, they will do so with the winds of the market and popular support at their backs.

The steps they take to limit the rise in global average temperatures to "well below 2C"—the Paris target—will also deliver for the SDGs. Today, more than a billion people still have no access to electricity. Providing them with "affordable, reliable, sustainable and modern energy"—as outlined in SDG seven—will spur economic opportunity and improved health, especially for women and girls now consigned to lifetimes of fuel gathering and of breathing toxic smoke as they cook over open fires.

UN secretary-general Ban Ki-moon presided over 2015's historic achievement of global agreements on sustainable development and climate change, and his persistent advocacy helped bring them both to the finish line. One year later, according to the UN's World Meteorological Organisation and every credible source, we are experiencing what is set to be the warmest year in recorded history for the third year running—underscoring the imperative of seizing the opportunity of these ambitious, interlocked plans. We have now started the shift toward a sustainable future for our children and generations to come. Together, we can make it decisive.

MIDDLE CLASS PROSPERITY CAN SAVE THE PLANET

HOMI KHARAS
Deputy Director, Global Economy and Development Programme, Brookings Institute

The environment and development communities can unite in their approach to the rapidly increasing global middle class

"The best things in life are free", says the old song. When it comes to the global commons—clean air, healthy oceans, conservation of diverse species—this is no longer true. We've abused the great systems of our planet for centuries and now it's time to pay the bill.

There are two ways of protecting the commons. The first is to reduce the human footprint. This was the early message of the Club of Rome in its famous The Limits to Growth treatise, published in 1972. The second is to innovate technology or approaches.

Agenda 2030, and the consensus on the global goals, is all about the second way forward, where the key to success is to create bridges between environmentalists, who argue for the primacy of sustainability, and development practitioners who put people first.

It would be naive to dismiss the tensions between these communities, despite the fact that they share common goals. Everyone wants both prosperity for individuals and a healthy planet. But the tools that are used to try to achieve these aims often have conflicting effects.

The most obvious example of this tension is the divergent views on coal-fired energy plants. The low upfront financial costs of such plants make them appealing to many policymakers interested in economic

growth, while the devastating environmental costs (in terms of both global climate change and domestic health hazards) make them anathema to environmentalists.

In this case, technology now provides a suitable alternative. In India, the cost of solar power may now be cheaper than coal. Win-win solutions based on renewables and energy efficiency can provide both growth and lower carbon emissions.

In other instances, however, technology is not the answer, at least not at current rates of adoption. The modern version of constraints to growth is the ambivalence of many environmentalists towards the emerging middle class in developing countries. People in this class consume more goods and services than poorer ones. They pollute and degrade more: plastic bags from their shopping; carbon emissions from their cars; degraded land from the food they waste; reduced water tables from irrigation needed to produce animal feed grain production; coral reef destruction from sun-screens used on vacations. The list is long.

It is no use trying to fight against middle class progress. The economic and political forces are too strong. The middle class—now about 3 billion people—is growing more rapidly than at any other time in history, thanks to fast economic growth in China, India, and other Asian countries. It probably took 150 years from the start of the Industrial Revolution to create the first 1 billion middle class consumers, somewhere around 1985. The second billion took 21 years to cross the threshold; the third billion just 9 years. If the global economy recovers along the lines projected by the International Monetary Fund, 2 billion more will be added to the middle class by 2028—a total of 5 billion people.

The fundamental issue, then, is how to reconcile this massive middle class expansion with a healthy planet. Appealing to people's good nature will not work. Individuals do not see themselves and their normal daily habits as doing significant harm to the Earth. There is a large collective action failure—each individual thinks they can leave the problem to someone else to deal with—so few people change their behaviour and habits. And when they do, the impact is small. In the US, a single person's carbon emissions only decline by about 5% when he or she becomes more conscious of his or her carbon footprint and switches to using LED light bulbs and driving electric cars.

Equally, trying to use economic incentives like taxes and regulations could backfire if these are seen as harming prospects for growth and prosperity. The middle class may be sympathetic to the cause, but they also care deeply about their wallets. Data from the World Values Surveys suggest that many in the middle class are not prepared to pay higher taxes to support a better environment even within their own country, let alone globally.

There are, however, other ways through which the middle class impact on the global commons can be mitigated. In the long-run, a larger middle class can be a powerful force for halting population growth. Look at Europe today: its population growth rate is only about 0.2% per year. Indeed, almost all the world's projected population growth is happening in places with small middle classes like Nigeria and the Democratic Republic of Congo.

The link between the middle class and population growth is clear. Middle class households are more educated and more urban. They invest more in their children. Their daughters go through secondary school and on to higher education in many places. This has a dramatic effect on fertility. A woman with no schooling has, on average, four to five more children than one who completes high school.

Added up across the world, the impact can be considerable. The United Nations, which puts out different scenarios for population, thinks the most likely global number for 2100 is 10.9 billion (compared to 7.4 billion today). But demographers at the International Institute for Applied Systems Analysis in Vienna figure that the population in 2100 could be only 9 billion people, if better education is taken into account.

This reduction by 2 billion shows what can happen if a package of access to schooling and family planning is made available to middle class households. In fact, total aid for education would be doubled if just one-eighth of the $100bn (£79.8bn) promised annually in climate aid was redirected to it: this would help build prosperity and protect the planet at the same time. Win-win propositions like this can help create bridges between the environmental and development communities—a coalition that is desperately needed to safeguard the global commons and achieve the global goals.

"The fundamental issue, then, is how to reconcile this massive middle class expansion with a healthy planet."

THE AMAZON'S NEW INDUSTRIAL REVOLUTION

CARLOS NOBRE
Member of the UN Scientific Advisory Board for Global Sustainability and Volvo Environment Prize laureate of 2016

JUAN CARLOS CASTILLA-RUBIO
Chairman of Space Time Ventures and a member of the World Economic Forum's Global Future Council on Environment and Resource Security

Saving the rainforest and creating a new inclusive economy by catalysing an entrepreneurial revolution and constructing a digital Amazonian 'Library of Alexandria'

The Amazon system exemplifies the global commons on which the health and stability of the planet depends. Its ecosystems harbour about 10-15% of the planet's land biodiversity. Its abundant rainfall—averaging about 2.3 metres a year—makes the region an important heat source for the atmosphere, while generating an estimated 210,000-220,000 cubic meters of river discharge every second, approximately 15% of the world's freshwater input into the oceans. It stores an estimated 150-200bn tonnes of carbon and has been functioning as a potent carbon sink removing over 2bn tonnes of CO2 a year. And it presents a mosaic of ethno and linguistic diversity.

Like other global commons, it is under threat from large-scale drivers of environmental change operating simultaneously and interacting non-linearly. These are dominated by land use change and climate changes—due to global warming and deforestation—which may, in turn, increase extreme climate events and fires, increasing the exposure and vulnerability of tropical forests. Earth system models predict that up to 60% of the Amazon forests could vanish by 2050, with most replaced by degraded cerrado-dry savannas with far fewer species, storing much less carbon.

There have been two dominant policy pathways in the Amazon. The first approach has focused on converting or degrading forests to produce either tropical timber or protein, such as meat and soya, or to build massive hydropower generation and extractive industry capacity: it has been responsible for massive deforestation, among other significant negative effects. The other has been a valuable nature conservation approach which has legally protected large swathes of territory from any economic and human activity, except by indigenous peoples. These now comprise 2.3m square kilometers, covering about 54% of Brazilian Amazon forest.

The prevailing model for rural development over the last half century—replacing forests with agriculture, cattle ranching and large scale hydropower generation—has long been outdated for a number of environmental, economic and social reasons. It has not resulted in wealth creation or a better quality of life for those living in the region. The challenge is to reconcile it with a new model of sustainable development of the Amazon.

Large reductions in the rate of deforestation in the Brazilian Amazon—80% between 2004 and 2014—open up opportunities for an alternative model based on seeing the Amazon as a global public good of biological assets for creating high-value products and ecosystem services. The urgency of finding this, however, has become more evident through a recent reversal: the Brazilian Institute of Space Research reported in late November that deforestation rates have gone up from 5,000 in 2014 to nearly 8,000 square kilometers in 2016.

Biological systems in the Amazon are the result of million years of evolution. We are rapidly gaining understanding of how things are created in nature, how organisms sense their surroundings, how they move in their environment and how they behave and function. This is bringing within reach a third pathway where we aggressively research, develop, and scale up a new high-tech approach that sees the Amazon as a global public good of biological assets that can enable the creation of innovative high value products, services and platforms for current, and entirely new, markets.

In the short-term—and with a low-tech approach—it is quite feasible to develop a number of biodiversity-based value chains capable of reaching global markets. Already there are some pioneering examples, following in the wake of Brazil nuts and babassu. Production from the assai palm, for example, has already reached the multibillion-dollar scale. An alkaloid found in the leaves, branches and flowers of jambu is described in patents as appropriate for anesthetic, antiseptic, antiwrinkle, toothpaste, gynecological and anti-inflammatory uses. The bacuri fruit is in increasing demand for ice cream, candy and juice products, while the oil extracted from its seeds is used in the cosmetic industry and as an anti-inflammatory substance in traditional folk medicine.

Beyond such new developments, lies the potential for biomimicry in learning from—and then emulating—Amazonian natural forms, processes and ecosystems to create more sustainable designs and innovations. The Tungara frog species, for example, creates long-lived foams that have inspired new energy generation and carbon sequestration technologies. Plants have directly provoked potentially much cheaper solar cell designs, while photosynthesis, and the ways in which microorganisms generate their own energy, have given rise to innovations in advanced microbial fuel cells.

There is also significant innovation potential in learning from the Amazon through biomimcry-inspired nanoscience—reproducing complex biological systems on a nano-molecular scale, and developing new environmental friendly processes and technologies for preventing and remedying pollution, new bioinspired textile structures, new revolutionary energy production and carbon sequestration technologies, new robotic applications, and new autonomous vehicle artificial intelligence algorithms, to mention a few.

Our approach would both embrace and enhance the emerging Fourth Industrial Revolution, an accelerating confluence of technology breakthroughs covering such wide-ranging fields as artificial intelligence, robotics, the internet of things, blockchain distributed data ledger technologies, synthetic biology, DNA editing, nanotechnology, energy storage and quantum computing, as well as biomimicry.

This new economy has the potential to become much larger than the present one based on the unsustainable use of natural resources. Key to this would be to leverage artificial intelligence, internet of things and blockchain technologies to build a digital Amazonian "Library of Alexandria" to create an open and immutable registry of rights and obligations associated with all biological and biomimetic knowledge assets of the Amazon. This would both catalyze disruptive innovations and provide a needed mechanism to build trust.

Such system-level change in the Amazon cannot be executed single-handedly. We are in the process of setting up a coalition of the willing with leading public, private, academic and philanthropic actors, engaging indigenous peoples and uniting the best capabilities of R&D centres, universities, technology startups and visionary companies all over the world to set in motion the entrepreneurial revolution required. If successful, this new development model could be applied to all tropical regions helping to preserve the vital global commons of the Earth's great biological diversity.

More details can be found in a recently published article, *Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm in the Proceedings of the National Academies of Science (PNAS).*

TRANSFORMING GLOBALISATION

MARK MALLOCH-BROWN
Chair of the Business and Sustainable Development Commission

The sustainable development goals present the biggest business opportunity of our time—and they are the responsibility of everyone

Mid 2016 may be remembered as the summer of globalisation's discontent, one that has arguably been decades in the making. Though it helped bring about a golden era of growth, trade, and foreign direct investment, globalisation has not benefited society equitably, and it has forged ahead at calamitous expense to the environment.

On the upside, extreme poverty declined by more than 50% from 1990 to 2015. But the chasm between rich and poor is widening. Oxfam reports that the combined wealth of the richest 1% will overtake the remaining 99% of humanity by the close of this year. Climate change will only exacerbate this perverse inequality. Unabated, it threatens to push more than 100 million additional people into poverty by 2030.

Against this backdrop, the global economy is facing strong headwinds: stagnating wages, stuttering growth and job creation, decreasing trade and cross-border capital flows, and increasing environmental impacts. There is also the enormous task of creating 600m new jobs in the next 15 years to absorb a growing global workforce.

All this has led to a perfect storm that has heightened social and economic uncertainty, and (in some places) instability. We urgently need a new kind of globalisation—one that brings billions more

people to sup at its table, rather than just the elite few, and ensures future environmental abundance.

The importance of the global goals

The Business and Sustainable Development Commission (BSDC), launched in January 2016, was founded on the belief that the sustainable development goals are the world's roadmap to a more inclusive globalisation that ensures no one is sidelined by economic progress. Backed by 193 countries, the global goals, as they are popularly known, consist of 17 objectives for ending poverty, closing the gap on inequality, effectively tackling climate change and protecting our finite resources by 2030.

The dominant perception is that the responsibility for achieving these ambitious objectives rests with government alone. This is a fallacy. It will take government, business and society working in concert to achieve the transition. And, in truth, it will particularly require the capital, innovation and capacity that only the private sector can unleash. What we need—and urgently—is a radical shift in perception by the private sector to view the global goals as the greatest economic opportunity any generation has had, rather than a burden and constraint to growth.

The Business Commission's core purpose is to achieve this shift by making a compelling case for the private sector to put the global goals at the heart of its business, and thus accelerate the world's transition to sustainable and inclusive markets. As part of our argument, our flagship report—to be launched in January 2017—will quantify the economic value of achieving the goals. Our early findings show that pursuing innovative, sustainable business models could unleash trillions of dollars in new opportunities across four key systems—food and agriculture, cities and mobility, energy and materials, and health and wellbeing—alone.

Change is already underway. Companies are spawning ground-breaking innovations and new ways of operating—and not just the innovative newcomers that we call global disruptors, or their local counterparts. Some long-established companies like Unilever—whose CEO, Paul Polman, is a founding member of the Commission—are also leading the charge. By shunning short-term goals, which prioritise immediate profit over creating shared value, these radical incumbents are benefiting from their focus on sustainability. Indeed, Unilever's sustainable living brands are growing 30% faster than the rest of its business, and delivered nearly half of its total growth in 2015.

A united approach

But these companies remain the exception. Our commissioners—representing major multinational corporations as well as civil society—have joined the Business Commission because they believe the world can achieve the goals with a critical mass of CEOs, investors and entrepreneurs who see these challenges as opportunities of substantial value.

New financing approaches will be needed to bridge the estimated $2-3tn annual funding gap required to fulfil the goals. This will involve a combination of new financial models, and investors who recognise both the risk of social and environmental externalities affecting asset values, and the higher, long-term returns generated by strong environmental and social performance.

Unless the private sector earns the social license it needs to unlock these new opportunities, the global goals risk being remembered as just good intentions. The essential foundation is for business and government to gain trust with society. This will require business to relinquish short-term thinking and the relentless drive for profit without purpose—and to engage with government and society in an entirely new way through a social contract that reinforces all of their abilities to thrive.

The sustainable development agenda is about better markets and better government. The Business Commission argues that business, government, and society can work together to ensure a fair transition to stem the tide of global turbulence and instability, and to bring the market shift that is already underway to both speed and scale. Together they can encourage environments that foster new enterprise and employment, do more to support small- and medium-sized enterprises, and create policies that provide greater economic security for everyone, particularly the most vulnerable.

The Business Commission's ultimate goal is to create the sea change needed to make sustainable development the new business norm. Our commissioners represent a number of industries, but they are just the start of what we hope will be a business-led movement that will help to transform the private sector and achieve the global goals by 2030.

TURNING THE TIDE ON OCEAN DEGRADATION

YOLANDA KAKABADSE
Former President, WWF International

Momentum is building up to conserve the vital global commons of the seas, halting its decline into a vast saltwater desert

Underneath its vast blue surface, the ocean's value—to our planet and people alike—is almost incalculable. It puts food on the table and underpins trillions of dollars of economic activity worldwide. It produces 50 % of our oxygen, absorbs heat and re-distributes it around the world, and regulates the world's weather systems. Quite simply, life could not exist without these enormous marine resources and the goods and services they provide, seemingly endlessly.

Furthermore, the ocean's beauty, mystery and power has inspired us for centuries, drawing us to enjoy its shores, explore its wild vastness and discover its hidden treasures.

But this global commons that inspires and feeds us, stabilises the climate and provides countless other benefits is showing signs of failing health. Such pressures as habitat destruction, pollution and overfishing have been rapidly building for the last hundred years. Today, almost 90% of global fish stocks are fully or over-exploited, leaving very little room for feeding a rapidly increasing population.

The impact of this excess harvesting and dumping is being exacerbated by climate change and unprecedented changes in ocean

temperature and acidity. Last month the extent of sea ice in the Arctic and the Antarctic hit record lows every single day, continuing the worrying pattern that began in November. And a new UN study released a few days ago warns that, if current trends continue and we fail to tackle climate change, the world is on track to lose its tropical coral reefs by mid-century.

If the ocean was a company, its stocks would be plummeting and its shareholders demanding action. The message is clear: we are decimating ocean assets, and the ocean economy will fail if we do not respond.

The ocean belongs to everyone—and to no one—and too many have taken too much. Centuries of overuse and neglect threaten to leave us with a vast saltwater desert. It is time to change the way we see the ocean—from a place where we take what we want and dump what we don't, to a shared resource of immense value. Governments, companies, NGOs and citizens need to pull together to turn the tide on failing ocean health. It cannot just be the responsibility of governments.

And the tide can be turned. In many places this is being done. I am heartened by great progress over the past year. In November, 24 countries and the European Union agreed on the world's largest ocean protection plan, the culmination of decades of efforts to safeguard the Antarctic's Ross Sea, a landmark agreement which shows how nations can come together to make real progress for the planet at a critical time.

Momentum and awareness is also building nationally: new marine protected areas were also announced in 2016, including off the US, Chile and Malaysia, to name a few. This gives me real hope for ocean conservation everywhere.

Increasing numbers of local communities are also doing truly inspirational work to protect and manage their islands and local coastlines. The Local Managed Marine Area Network (LMMA) in Asia and the Pacific provides one example where communities in developing countries are taking the initiative to secure their ocean futures.

Indeed there was positive news—even as the world witnessed the shocking impact of the third global coral bleaching event. The Belize barrier reef system—the longest in the northern hemisphere and a world heritage site—received a reprieve from seismic surveying. Following an outcry from concerned citizens, national civil society groups and international conservation organisations (including WWF) and their supporters, officials in Belize agreed to suspend the seismic portion of offshore oil exploration, bringing relief to the 190,000 people—over half of the country's population—who depend on the reef for their lives and livelihoods.

But so much more needs to be done. We must ride a new wave of determination as we look toward 2020, the year when the commitments made under the Paris climate deal will kick in. Countries will also need to meet international biodiversity targets that year and the first environmental actions under the globe's new sustainable development plan—where the ocean has its own dedicated goal—will be due.

These tools provide the frameworks we need for action towards a sustainable future for the hundreds of millions of people who rely directly on the ocean for their food and jobs—and for all humanity which ultimately depends on the ocean's critical role in maintaining the health of our planet.

We have the tools, the know-how and the technology to address the root causes pushing the ocean to the brink. Business has a strong vested interest in healthy oceans: we need it to lead the way with visionary leadership to translate momentum into action. Businesses can yet again be the trailblazers in protecting our planet's incredible biodiversity and its life-enabling ocean. No effort is a drop in the ocean when the stakes are so high.

"If the ocean was a company, its stocks would be plummeting and its shareholders demanding action."

THE CARE HORIZON

ERIK SOLHEIM
Executive Director, UN Environment

The global commons must be brought closer to people if they are to care enough to safeguard them

For ages, our safety, security and prosperity meant mining—literally and figuratively—the resources around us.

Our impact on the commons—our oceans, our atmosphere, biodiversity, and other complex global systems—was rarely noticed. For many, damaging something like our atmosphere was simply too abstract.

Most simply didn't care because changes didn't touch their daily lives. But we have the technology to show how it does so now. We know that the concentration of greenhouse gases in our atmosphere is growing steadily. We know that our oceans are heating up, killing coral reefs, and that currents of plastic debris flow around the planet. We know that we've fished and hunted untold numbers of species to extinction, and destroyed habitats of countless more.

We know all this, but there is a certain inertia that we can't seem to shake. There is no longer the excuse that we are ignorant of our individual impact, yet still many find it difficult to care. Why?

We tend to have a natural upper limit on what we can care about both in proximity and time: a care horizon. We care about things that are close to us. We worry about the safety and security of our family and community, about paying bills, about making ends meet. Even though we are aware of great global problems, it is difficult to motivate people to tackle issues outside their care horizon.

The answer to the tragedy of the commons is the answer to how we bring it within this horizon. We are smart enough, and have resources aplenty to solve our problems. We need the will and motivation—personal and political—to do it. For that to happen, we need to make an appeal within the care horizon.

Take our atmosphere. Few people personally relate to carbon dioxide emissions. But billions live in cities where they can see, smell and taste horrendous smog. Around 7 million die from air pollution every year. Nobody likes dirty air. So they let their politicians know. And governments hustle to fix it.

In China, for example, hundreds of millions have been brought out of poverty, but the people now endure a scary amount of air pollution as a result. They have made clear that they have had enough, and the government is now working hard to solve the problem.

And here lies the trick: by ridding ourselves of air pollution, we are ridding ourselves of countless greenhouse gases and pollutants that are contributing to climate change. Broad-based appeals to protect nature, especially in countries where exploiting the environment is an easy—and often the only—source of income, is ineffective. If you were struggling to feed your family, would you think twice about cutting down protected trees?

We need to prove that protecting the environment is profitable and in everyone's best interests. We can do this by holding up successful examples. In parts of coastal Kenya, fishermen have traditionally cut down mangrove forests to make boats. With the advent of carbon markets, some of them are now being paid tens of thousands of dollars a year simply to protect mangrove ecosystems along the shore. They have found another way to make their boats. And as mangroves come back, so do fish stocks, helping their core business, and restoring the marine ecosystem as well.

By appealing to the immediacy of the fishermen's financial needs, multiple ecosystems are being saved and rejuvenated. The care horizon also obliges us to speak to people who are outside the environmental echo chamber. As environmentalists, we spend far too much time preaching to the converted. If we can't make protecting the environment a kitchen conversation from Kansas to Kazakhstan, then we are failing. We should be speaking a language that people understand, and connect with.

None of this is to say that broader approaches are not needed or are ineffective. Very much the opposite. Not every problem can easily be brought close to people. But we can make fast progress where problems can be brought within the care horizon. Nobody wants their story to be a tragedy. If we personalise the tragedy of the commons, we ensure that people will personally work towards a happily-ever-after.

WASTE NOT, WANT NOT

ROLPH PAYET
Executive Secretary, Basel, Rotterdam, and Stockholm Conventions

Managing pollution and waste soundly promotes economic growth as well as protecting the global commons

Society benefits from hundreds of thousands of chemical products, but some have undesired effects. We also produce a lot of waste, much of it hazardous, and seem to think it will go away and vanish. Yet - despite being separated by half a century and half a planet - Rachel Carson, and the Beijing anti-smog police are united in clearly demonstrating that chemical products damage not just the environment and human health, but jobs and the economy.

Our planet—and its global commons - do not have the means to detoxify wastes unassisted, so all countries should be concerned about managing and disposing of chemicals and products. The international legal framework for addressing growing air, land and water pollution—and illegal dumping of hazardous wastes across borders - is partly established by three global United Nations conventions: the Basel, Rotterdam and Stockholm Conventions. Any planet-wide solution for managing chemicals, wastes and pollution implies implementing them effectively.

Toxic smogs engulf many mega-cities, up to a reported 12.7m metric tonnes of plastic enters the oceans each year, and a reported 40-50m tonnes of electronic waste illegally crosses borders annually. All are consequences of unsustainable consumption and poor management of polluting products.

After traversing our rivers, oceans and atmosphere, many of those chemicals end up in cities and villages, on our plates, and in our bodies.

Most things around us derive from, or are contaminated by, some chemical product. Our children grow up with hundreds of chemicals accumulating in their bodies. Human bodies accumulate more than a thousand man-made chemicals, some of which undoubtedly affect health, including retarding development in young children, prompting dementia in the elderly, and causing cancer. The World Health Organization attributes 12.6 million annual deaths to an unhealthy environment.

International negotiations on controlling and managing dangerous chemicals are often challenging, as they have to balance and trade off economic interests, impacts on markets, jobs, health, livelihoods and the environment. Placed in the right perspective, and subject to rigorous scientific assessment, the business case for managing chemicals and wastes better is strikingly evident. The World Bank estimates that air pollution costs the global economy about $225bn (£182bn) a year.

Lost labour income and increased healthcare costs together justify efforts to reduce pollution and invest in alternatives—and create opportunities to do so - particularly in less-developed regions. There are significant opportunities for safer, non-toxic alternatives, for better design to extend value chains over products' life cycle, and for recycling: all can be exploited by industry for economic, environmental, and social gain.

Consumers send powerful signals to industry and governments. We have individual and collective responsibilities in how we consume and dispose of products and wastes, since pollutions knows no borders. However all nations must urgently prioritise their management: what individual people or countries can do is limited.

The Stockholm Convention, with 180 national parties, was instrumental in banning the widespread use of DDT, and restricting it to such specific uses as managing malaria epidemics in certain regions. Efforts to find a cure for malaria and research into alternatives have also reduced its use.

So far the Convention has listed 26 persistent organic pollutants (POPs), unfortunately only a small fraction of the chemicals known to be toxic to human health and the environment. With financial support from - inter alia - the Global Environment Facility (GEF), many countries eliminated a large part of them from consumer markets and industrial production. By June 2016 the GEF had committed $1bn, leveraging approximately $3bn in co-financing - for projects targeted at global reductions, for example of: 10,200 tonnes of PCBs used in power transformers; some 100,000 tonnes of PFOS used in carpeting, leather and upholstery; and 6,130 tonnes of obsolete POPs stockpiles.

Impressive progress, but challenges remain as large stockpiles persist in many parts of the world: leakage from them may result in air, water and soil contamination, causing environmental health issues particularly for vulnerable groups.

Industry remains an important partner. It has the know-how, technologies and resources to reduce or eliminate the use of such chemicals and develop better alternatives. Public-private partnerships brokered by the international community - such as the Partnership for Action on Computing Equipment - have made best practices widely available, and have developed guidance for governments and other stakeholders.

Adopting a life-cycle approach is key, as are policies and incentives to encourage and accelerate a shift towards seeing waste as an economic opportunity if managed properly, rather than an environmental, social and economic cost.

Nevertheless, new chemicals and products proliferate and waste increases as do demands for chemicals in food production. These continue to strain meagre resources for sound management. The global chemicals industry earns more than $5tn annually but contributes less than 1% of that to managing chemicals and wastes, through the GEF chemicals and waste portfolio ($2.7bn) and the UN Environment's Special Programme ($14m).

Sound management of chemicals and wastes must thus be mainstreamed throughout all the sustainable development goals, in which aspects of their use are ubiquitous. Focussing on impacts on the global environment and human health helps solve challenges—whether climate change, biodiversity loss or chemicals and waste management—and promotes wider sustainable development.

The conventions' Conference of the Parties in April will address some of these challenges and explore a greater role for industry. The conventions create opportunities not barriers. Pollution, in all its forms, undermines economic development, allowing poverty, instability and other crises to persist. The SDGs will surely fail if we cannot halt and reverse the rising tide of contamination, ocean plastics, toxic waste, and poison pumped into our shared planet. But sound management of chemicals and wastes will make it healthier, wealthier and more productive.

SUSTAINABILITY MUST CREATE GOOD JOBS

SHARAN BURROW
General Secretary, International Trade Union Confederation

A recipe for rebuilding both trust in business and the global economy, with the dignity of decent work, while acting on climate to safeguard the global commons

The world economy has grown three times richer over the last 30 years, yet working people have been marginalised. People are frightened about the future. They want to know there is security and opportunity for themselves and their children.

If working people don't feel like they have a secure future, if people can't earn a minimum wage on which they can live with dignity, if there is no rule of law to sort grievances from disputes in the workplace and if there is a dominant supply chain model of low wages and insecure and unsafe work, trust breaks down.

The sustainable development goals —also known as the global goals —can make a real difference. In the private sector alone, an estimated 380m new jobs could be created by 2030 through achieving them. Together, the goals put business, governments and communities on a path to end poverty with the dignity of decent work as the catalyst to achieve it.

The Business and Sustainable Development Commission, on which I served, reported in January that putting the goals at the heart of the world's economic strategy could unleash a step-change in growth and productivity, while creating a world that is both sustainable and inclusive —but that this would require radical change in the business and investment community.

Such change is urgently needed, not least for the up to 94% of the workforce of 50 of the world's largest major multinationals which is effectively hidden. Global supply chains —now the dominant source of wealth in the global economy —depend upon them but they are not directly employed and are in low wage jobs with few rights.

Companies take little or no responsibility for these workers, knowing that this is a model of low wages, insecure and often unsafe work, and that informal work and modern slavery are increasingly rife in their supply chains. People often have no knowledge of who they really work for in global supply chains. What they do know, however, is that the business model, and the social contract between workers and business, is broken.

Two hundred million people are now unemployed worldwide, well above 2007's pre-crisis level. Yet by 2030 there will be 7% more people aged 15-24, over 80% of them in Africa and Asia. Overall, 600m new jobs will be needed over the next 15 years.

Those in work, and their families, face a struggle, at best to live on their wages. A global poll on wages and inequality across nine countries representing over half of global GDP, carried out for the International Trade Union Confederation, shows that 45% of the world's people are living on the edge with another 52% just about managing.

The overwhelming majority of people, therefore, have no buffer for the future even if they get by one day at a time. A significant share of households, even in industrialised countries, have experienced flat or falling real incomes for a decade or longer.

The share of labour in national income has declined by, on average, 10 percentage points of GDP in industrialised economies over the last three decades. This has serious inter-generational effects. Jobs and gender gaps are not shrinking —and neither is the level of youth unemployment.

Income inequality has increased in 22 out of 25 OECD countries with comparable statistics. OECD work shows that in all countries the "very top of the income distribution" have benefited most.

These factors have combined to raise the real prospect of secular stagnation and have contributed to a popular backlash against governments, institutions and the very functioning of economic systems. All this inequality is by design. Workers know it and they resent the behaviour that perpetrates it.

In the short term, inequality is stifling recovery. In the medium term, it is fuelling public mistrust, creating the conditions for rising populism. In the longer term, it will result in rising skills gaps, increased unemployment and fear of survival on stagnant or declining incomes. The anxiety generated by all this —in the absence of just transition measures —mitigates against a smooth transition to a zero carbon economy.

We need an industrial transformation agenda to create the jobs of the future. We need innovative industries and industrial policies which design their production around looking after workers' health, respecting the environment, establishing safer processes, and researching and developing clean technologies. As this must happen holistically during the whole product life-cycle and along the entire supply chain, the global job-creating potential of such a transformation is convincing.

At a minimum, businesses who commit to the global goals should ensure that jobs throughout their supply chains are safe and integrate business into their operations using the UN Guiding Principles on Business and Human Rights.

We have a shared responsibility. Trade unions engaging in social dialogue with business and government give workers a voice in securing dignity at work and this rebuilds the social contract. With dialogue we can achieve real reform.

There has been progress. Since 2000 there has been an increase in global framework agreements between multi-national firms and global union federations, where companies consent to respect workers' rights and to promote decent work worldwide within their subsidiaries and along their global supply chains.

The G20 under the German Presidency can take a lead by resetting the parameters for rights, the rule of law, social protection, wage mechanisms, and —consequently —shared prosperity.

Business needs to adopt the global goals and to look at how they make their supply chains and their key operations not just sustainable but work for working people, thus sharing prosperity.

A new social contact where people, their environment and economic development are rebalanced can ensure that everybody's sons and daughters are respected —with freedom of association, minimum living wages, collective bargaining and safe work assured. Only a new business model based on old principles of human rights and social justice will support a sustainable, zero carbon, zero poverty world.

WE ONLY HAVE 20 YEARS TO SAVE THE OCEANS

JEREMY JACKSON
Senior Scientist Emeritus at the Smithsonian Institution, and Professor Emeritus at the Scripps Institution of Oceanography

A revolution in thinking is needed to protect this vital commons

The oceans are alarmingly unhealthy and getting sicker fast. At first, crises were localised, as in the collapse of Newfoundland cod and the lifeless dead zone in the Baltic Sea due to runoff of agricultural waste. Now the problems are global.

Ocean fisheries have been pushed past the limit for the 1 billion people who have no readily available protein substitute, and worldwide there are now more than 400 marine dead zones—areas starved of oxygen—up from 49 in the 1960s. Global piracy, modern slavery, and a lawless supply chain are disguising the source, species, and healthiness of one fifth of global seafood. In 2012, almost three in five of 81 retail outlets sampled in New York City were found to be selling flagrantly mislabelled fish.

Rapidly warming and rising seas are powering stronger hurricanes and storm surges, eating away at our coastal lands and cities, presenting the ominous prospect of hundreds of millions of climate refugees within the next few decades. The UN's sustainable development goals for the environment, biodiversity, and human wellbeing will be impossible to achieve—with severe consequences for people and the global commons—unless we turn things around very fast.

Fisheries present the most obvious solutions. Over 80% of the global fleet make zero or negative profit, and is propped up by about $35bn

(£27bn) in annual subsidies. Removing subsidies would dramatically decrease fishing fleets by roughly 60%; stocks would immediately rebound. Surprisingly few jobs would be lost because most are in small-scale fisheries with few, if any, subsidies. Fish catches in developing countries would stay closer to home, where people need them most, instead of being siphoned off to the US, Europe, and Japan.

Rebuilding depleted fisheries involves eliminating harmful fishing practices and establishing large marine protected areas to provide refuges. There have been important breakthroughs, including the 1990s United Nations ban on high seas drift nets to reduce the harmful bycatch of sea turtles and dolphins, though law-breaking remains a major threat. The UN also nearly passed a global ban on deep-sea trawling in 2006 and, despite this initial failure, the movement is still very much alive. In 2016, the European parliament banned all trawling below 800 metres in EU waters, as well as fishing in areas with vulnerable ecosystems.

The US, Australia, and the UK have established huge marine protected areas in the Indo-Pacific, and the international Commission for the Conservation of Antarctic Marine Living Resources designated the Ross Sea as the world's largest marine protected area (MPA) in 2016. The total proportion of the oceans in MPAs still hovers around 3%, with only 1% closed to fishing—but they provide critically important refuges for an enormous variety of species and the trends are moving in the right direction.

Closing the high seas to fishing would make financial as well as conservation sense. Bordering countries would make up for lost income from spillover into their national exclusive economic zones: more than 99% of high seas fisheries exploit species also caught in them. Only the half dozen wealthy countries that dominate the high seas fishery would lose out. Developing countries, which lack the resources to participate in high seas fisheries that reduce their stocks, would benefit and global income inequality from fisheries would halve.

Individual countries have begun to rebuild depleted stocks. The US has made progress under the 1996 revised Magnuson-Stevens Fishery and Conservation Act that mandates rebuilding overfished stocks within a decade. An independent assessment in 2013 showed that 70% of its stocks with well-developed recovery plans were no longer overfished: government statistics now suggest that just 16% of 233 stocks are overexploited. But the status of New England groundfish has worsened, raising questions about how nimble federal policies are in adapting to local circumstances. The locally regulated lobster fishery in the Gulf of Maine, however, is booming through effective management.

Coastal pollution and dead zones continue to increase because governments have failed to regulate destructive industrial farming practices and sewage discharges that send topsoil and excess nutrients downstream. The nutrients also poison groundwater and reservoirs: in Iowa, it costs $1,000 per person annually to make drinking water safe.

The irony is that green farming is booming, turning dramatically larger profits than the poison-addicted crops of genetically modified corn and soya beans that cause the problems. Eliminating the US ethanol mandate would tip the scales dramatically in its favour, with enormous environmental benefits. We know reforms can make a difference: coordinated efforts to clean up pollution in Tampa Bay, Florida, enabled seagrasses—critical habitat for shrimp and juvenile fish—to recover to 1950s levels.

The recent explosion in renewable energy may help curb the threat of ocean acidification that impedes reef corals and commercially important shellfish in building their skeletons. Ocean surfaces and the atmosphere are closely coupled, so reductions in carbon dioxide emissions should be rapidly reflected in surface water pH.

Increasing temperatures will have much longer-lasting effects and it is increasingly evident that global sea levels will rise one to two metres by 2100. Coupled with stronger storms and storm surges, that's bad news for the roughly 6% of global population living less than five metres above sea level.

Engineered barriers, as in the Netherlands and the mouth of the Thames, could buy perhaps a century of protection for well-situated cities that can afford them, such as New York. But there are few, if any, practical solutions for Miami and New Orleans, the coastal megacities of Asia and Latin America, or the low lying island nations of the Indo-Pacific. We need to prepare for massive human population displacements.

We are making progress on mostly local problems, but its pace is dangerously slow. We have failed to wake up to the deadly implications of climate change for coastal populations worldwide. Real progress will require a more realistic assessment of the risks—and a revolution in thinking that places the common good above selfish interests defending the status quo. We have at most 20 years to act.

PROSPERITY THAT PRESERVES THE PLANET

JEREMY OPPENHEIM
Programme Director, Business and Sustainable Development Commission

Growth that safeguards the commons will produce vast economic returns for business

This week, business leaders from the world's major economies—both developed and developing—meet in Berlin to consider a new industrial revolution. The B20 summit—mirroring the better known G20 meetings—will discuss issues that will decide whether the world achieves universal prosperity while safeguarding the global commons on which it ultimately and intimately depends.

The issues include energy, climate and resource efficiency, financing growth and infrastructure, and responsible business conduct—all under the unifying theme: "Resilience, Responsibility, Responsiveness: Towards a Future-oriented, Sustainable World Economy".

The common thread to achieving the B20's ambitious and varied agenda lies in the sustainable development goals. Since these global goals were adopted in 2015—the year which also produced the Paris agreement on climate change—there have been a succession of dramatic developments.

2016 shook our assumptions about the global economy, with many asking whether the costs of globalisation are greater than its benefits. And now, more than four months into 2017, the world arguably faces more uncertainty than in the past two years. There's the increasing nuclear threat from North Korea, heightened political and economic turbulence in the UK following the triggering of article 50, and elsewhere,

the uncertainty that comes with globally and regionally significant national elections in the UK, Germany, France, Italy and South Korea.

Yet the future is far from bleak. A growing wave of companies—including multinational, national and small ones—fundamentally believe that prosperity—whether global, national or for individuals—can only be achieved if it is founded on the principles of a more sustainable, inclusive model of economic growth.

Indeed, the Business and Sustainable Development Commission reported in January 2017 that putting the goals at the heart of economic strategy could unleash a step-change in growth and prosperity, and create an inclusive and sustainable world—if there is radical change in business and investment.

But these opportunities will not materialise on their own. Good disruption must take place. This will require breakthrough technology, such as digital platforms, as well as innovative financing tools. The private sector will not be able to accomplish this alone. Government must help to scale sustainable markets through smart regulation and forward-looking policies, in particular:

- **Establishing the right prices for natural resources.** Prices for carbon, water and energy do not reflect environmental or social externalities. Business leaders must work openly with regulators and civil society to shape policies that create a level playing field more in line with the global goals. This could involve fiscal systems becoming more progressive through taxing labour income less and pollution and under-priced resources more.

- **Creating the right regulatory conditions to attract private investment into sustainable infrastructure.** In all, $90tn (£70tn) will need to be spent on infrastructure worldwide over the next 15 years. Aligning financial regulations with the goals would encourage long-term investment and reduce systemic risk, contribute to growth-boosting and much-needed infrastructure, and provide better returns for individual investors all at the same time.

- **Providing stronger incentives for long-term investing, including through blended finance instruments.** Achieving the goals is likely to require additional investment of $2.4tn a year. This will depend on orienting the global financial system towards long-term sustainability, with public and private sectors sharing both the risks and returns. Enough capital is available: total private financial assets now stand at more than $290tn, and are growing by 5% a year. We must take a fresh strategic look at how best to mobilise and deploy a smart mix of public and private capital to drive sustainable infrastructure investment. The commission is mobilising a taskforce of leading institutional investors, sovereign wealth funds, development finance institutions, investment banks and private companies to lay out a blended finance action plan for the goals.

- **Encouraging businesses to step-up investment in developing their employees' skills and productivity.** Governments must deliver on much-needed shifts in labour and education policies to address underlying systemic weaknesses. This would enable business leaders to invest more to improve productivity, skills, resilience, access to credit—and as far as possible, ensure that no one is left behind. Such a task is becoming more important than ever, as new technologies create structural changes in labour markets across the world.

- **Stamping out corruption.** As the drive for greater transparency over beneficial ownership of anonymous companies is gaining momentum, regulators must tackle corruption more actively. The B20 has already publicly called for such increased transparency, estimating that corruption facilitated by the status quo adds 10% to the costs of doing business globally and inevitably hinders businesses' ability to align their strategy with the goals.

Business leaders who are serious about the transition to a sustainable economy can help push public regulation in the right direction, and scale up cooperation between governments and the private sector to achieve the global goals.

The rewards are great. The commission's report, Better Business, Better World, concludes that there would be an economic prize for business up to $12tn, which could reach $30tn through even broader global goal opportunities by 2030. By then, up to 380m jobs would be created.

The commission also identified 60 hotspots across four economic systems—food and agriculture, cities, energy and materials, and health and wellbeing—that could grow two to three times faster than the global economy, and generate business revenue and savings equal to 10% of forecast global GDP.

The next generation of purpose-driven economic growth is within our reach. So is the next era of purpose-driven competitive advantage. This week's B20 summit could help bring them about.

HOW TO TELL IF A COMPANY REALLY PROTECTS THE GLOBAL COMMONS

KATE RAWORTH
Author of Doughnut Economics

Businesses must leave behind an era of reckless overshoot, and pioneer one of generous turnaround

What in the world have we inherited? Thanks to the 20th century's degenerative industrial design, our economies are systematically running down this extraordinary planet. We take Earth's materials, turn them into stuff which we use for a while, then throw away. This take-make-use-lose industry cuts against the very cycles of life, logging ancient forests and fracking the land, filling the atmosphere with greenhouse gases and the oceans with plastic—all in the name of turning a profit. We seem set to go down in history as the "era of reckless overshoot"—to be remembered as the generation that pushed the global commons, Earth's life-supporting systems, towards collapse.

Do we have the vision to turn this legacy around—and what role could business play in that? Over the past five years, I have discussed this with a wide range of business leaders, from FTSE 100 executives to the founders of community-based cooperatives—and have been fascinated by the wide array of their responses.

Maximising profits

The first and oldest response is simple: do nothing. Why change the business model when it is delivering strong returns? The aim is to maximise profits and this is mostly done entirely legally—so, until regulation hits a business' costs, many will carry on as before. For decades, most companies worldwide took this tack, treating sustainability as something they didn't need as it did not increase their share prices. But times have changed, along with the climate, and many now recognise that doing nothing no longer seems so smart, for people, planet or profit.

That's why the next response has become the most common: do what pays by adopting eco-efficiency measures that cut costs or boost the brand. Cutting greenhouse gas emissions and reducing industrial water use are classic efficiency measures that tend to lower company bills. Other businesses pursue "green" labelling to appeal to customers willing to pay a premium for eco-friendly products. This looks like a good start, but it is a long way off the scale of what is needed.

The third, more serious response is: do our fair share in promoting sustainability. To their credit, companies taking this approach at least adopt science-based targets for reducing resource use, from fertiliser and water to greenhouse gas emissions. But—as anyone who has been left holding the restaurant bill once fellow diners have chipped in with what they think is their fair share knows—it never quite adds up. Worse, "doing our fair share" can quickly flip into "taking our fair share". When some companies first learn about planetary boundaries—and the limits of pressure that can be put on Earth's systems—they behave as if they are looking at a cake to be sliced up and handed out. Trapped in the old mindset of degenerative industry, the first question that occurs to many of them is: how big a slice of that ecological cake is ours? How many tonnes of carbon dioxide can we emit? How much forest can we log? Calling for fair shares risks perpetuating the idea that running down the living world is still a corporate right worth fighting for.

Mission zero

The fourth response—a true step-change in outlook—is to do no harm, an ambition often known as "mission zero": designing products, services, buildings and businesses that aim for zero environmental impact. Examples include zero-energy buildings that generate as much electricity as they use, and net-zero-water factories that continually recycle their internal water supply instead of extracting ever more water from stressed underground reservoirs.

Aiming for net-zero impact is an impressive departure from last century's degenerative industrial design—even more so if it includes not just energy and water but all resource-related aspects of a company's operations. It's a sign of impressive efficiency—but an avid pursuit of resource efficiency is simply not enough. As the architect and designer William McDonough said: "Being less bad is not being good. It is being bad, just less so."

And, once you think about it, pursuing mission zero's do-no-harm goal seems to almost intentionally stop short of something far more transformative. After all, if your factory can generate as much energy as it uses from the sun, why not aim to generate more? Instead of seeking merely to "do less bad", industrial design can do good by continually replenishing, rather than more slowly depleting, the living world. Why simply take nothing, when you can give something instead?

Giving back

That's the essence of the fifth business response: be generous and create an enterprise that is regenerative by design, giving back to the global commons that we all rely on. More than a task on a to-do list, it is a way of operating that embraces biosphere stewardship. Think of farms that sequester carbon and restore the soil as they grow food; buildings that put cleaner air back out into the surrounding city; plastics companies that turn methane into textiles to be used again and again rather than thrown away. Such enterprises serve to reconnect human activity with nature's cycles—and hence regenerate the living world.

Every company can ask itself: what are we currently set up to do? And, crucially, what changes in our company's design—from its values and purpose to how it is owned and financed —are needed to make the leap to regenerative industrial design possible? Once these questions are answered, business can play a key part in transforming our future and our reputation. We still have a chance to reinvent our legacy and—instead of reckless overshoot—be remembered as the era of generous turnaround. So what is business going to do?

ONLY GREEN GROWTH CAN BRING PROSPERITY

NICHOLAS STERN
Chair, Grantham Research Institute on Climate Change and the Environment, IG Patel ; Professor of Economics and Government, London School of Economics and Political Science

NAOKO ISHII
CEO and Chairperson, Global Environment Facility

The next 15 years will determine the shape of the world for the rest of the century

Our global commons—the land, seas and atmosphere we share, and the ecosystems they host—are under severe threat from human activities.

We are at risk of irreversibly damaging the natural assets of the planet that allow human communities to thrive and prosper.

Our world is being depleted of plant and animal species at an alarming rate, our natural landscapes and productive agricultural land are becoming progressively degraded, and our cities are choking from air pollution and congestion. In addition to this, our atmosphere is filling up with greenhouse gases that are pushing us towards the potentially catastrophic impacts of climate change.

We are making the world a more hostile and difficult place for ourselves and for future generations. But we have the opportunity to save and preserve our global commons by implementing the global agenda created by the international agreements in 2015 on sustainable development, finance and climate change.

This agenda is based on the recognition that living standards can be raised and poverty can be overcome around the world only if economic growth

and development is accompanied by action to protect the environment.

The agenda that preserves our global commons is also the only sustainable route to growth and poverty reduction. But action with real pace and scale is urgent: the window of opportunity is narrow.

The decisions we make over the next 15 years will determine what kind of world we will have for the rest of the century. Between now and 2030, we will build cities, energy systems and transport networks on a scale never before seen (pdf), bigger than the amount of infrastructure that already exists in the world.

If we build it badly, our global commons is likely to buckle under the strain, but if we make sure our new infrastructure is modern, smart, clean, efficient and resilient, we can ensure that our children and grandchildren have the opportunity to enjoy healthy and productive lives, and tackle poverty in our generation.

Much of the new infrastructure will be developed in what are currently classified as emerging markets and developing countries. Thus, it is the six billion who live outside today's rich countries who will in large measure determine the future.

More than half of the world's people are currently found in towns and cities and, by the middle of the century, it is likely that two-thirds or more of the population will be urban dwellers. The population of cities is likely to rise from about 4 billion today to 6.5 billion or more in the next three or four decades.

If we manage this extraordinary expansion well, we can have cities that are attractive and productive, where we can move and breathe, and where communities flourish.

If we fail, our cities could be profoundly unhealthy, damaging and unproductive places to be, particularly for poor people. And any chance of attaining the Paris Agreement's target of holding global warming to well below 2C would be gone.

Indeed, it would become very difficult to hold warming to less than 3C, leading to global temperatures that are likely to be highly dangerous and unseen on Earth for millions of years. So we must design policies that tackle congestion, air pollution and climate change together by, for instance, promoting better public transport and autonomous electric vehicles.

Our ability to feed and clothe both growing urban and rural populations depends crucially on protecting and conserving our oceans, forests, grasslands and soils.

The UN's Food and Agriculture Organisation estimates that annual food production will have to increase from 8.4bn tonnes today to 13.5bn tonnes to provide for a projected population of 9.7 billion in 2050.

Yet a third of the agricultural land around the world is already moderately to highly degraded due to soil erosion, salinisation, compaction, acidification and chemical pollution.

It is for this reason that the Global Commission on the Economy and Climate has called for the restoration of at least 500m hectares of degraded land (pdf) by 2030, and an end to the deforestation that has such devastating consequences for biodiversity and efforts to limit the rise of carbon dioxide levels in the atmosphere.

Reversing the destruction of productive land requires strong leadership and collective action by communities, businesses and governments.

For instance, in September, the Global Environment Facility will launch its new global programme, 'Taking deforestation out of commodity supply chains', led by the United Nations Development Programme, to increase the supply of, and demand for, sustainable beef, palm oil and soy in collaboration with national and regional governments in Brazil, Indonesia, Liberia and Paraguay.

The programme will work with existing platforms, such as the Tropical Forest Alliance 2020. The alliance already has 94 partners from the private sector, civil society and governments committed to reducing tropical deforestation related to key global commodities, including paper and pulp, by 2020.

It is developing better business models based on the understanding that sustainable land use and local economic prosperity can go hand in hand and generate significant opportunities for investment.

Meanwhile, the Global Agri-business Alliance is a groundbreaking initiative bringing together growers and traders, fertiliser and agro-chemical manufacturers, seed suppliers, primary processors and agri-tech suppliers to promote sustainable practices and to improve the resilience of farmers across the world.

Its membership already includes the chief executives of 40 companies across the world, all of whom are committed to helping the achievement of the sustainable development goals.

Beyond this, we need to find ways to mobilise global business to help finance action to protect our global commons. These are the kinds of partnerships that can deliver a more attractive form of economic growth and development, and preserve our global commons. They can deliver the sustainable development goals and the Paris Agreement on climate change, thereby bringing down poverty in our generation and creating an environment for sustainable growth and rising living standards for those who follow.

GIVE WOMEN CREDIT AND MEET THE GLOBAL GOALS

MARY ELLEN ISKENDERIAN
President and CEO, Women's World Banking

If we are serious about achieving sustainable development, we must invest in women

Over the past 30 years, the world has seen unprecedented economic growth and a digital revolution that could help solve our most pressing social and environmental challenges. Yet despite this, our current model of development is deeply flawed, threatening our global sustainability.

Social inequality is worsening in many countries and inequality of economic opportunity—particularly for women—persists. On average women are still paid 25% less than men for comparable work and one billion women do not have access to formal financial services.

These inequalities are signs that business leaders have yet to embrace their role in building a more prosperous, secure, and sustainable world. The recent report, Better Business, Better World, by the Business and Sustainable Development Commission, on which I serve, offers a solution: set business strategy in line with the UN sustainable development goals, which provide a blueprint for global development that ends poverty, protects the planet and ensures universal prosperity. The commission estimates the economic "prize" for achieving these global goals at $12tn (£9.5tn) by 2030.

The report offers a prescription for a new, socially and environmentally focused business model that can bring new resources and energy to parts of the global economy, previously left largely to public aid and thus ensure sustainable and inclusive growth. This can be a compelling growth strategy for individual businesses, especially in the financial services industry.

Financial inclusion is a cross-cutting theme critical to the success of all 17 of the global goals. Of the four global goals identified by the commission as hotspots of private sector opportunity, two—zero hunger (goal two) and good health and wellbeing (goal three)—have a major impact on the financial inclusion of women.

Globally only 10% of rural residents use credit and only half have access to a formal bank account. Women, who make up about half of the world's farmers, are even more excluded. Recognising this market opportunity, Women's World Banking worked with three institutions in Latin America—Banco Interfisa (Paraguay), Fundación delamujer (Colombia) and Caja Arequipa (Peru)—to develop rural lending products tailored to women's needs.

The institutions broadened their footprint in rural areas, and women clients grew their businesses and brought more security to their household finances. Together the three institutions reached more than 100,000 clients with loans; one more than doubled the percentage of women in its portfolio.

A recently completed study revealed that women who received this economic lifeline were also empowered in the rest of their lives, reporting stronger decision-making positions in their household.

Giving women access to meaningful financial services can also make a huge difference in health and wellbeing. Insurance can prevent low-income families from falling deeper into poverty when health emergencies strike. Women in emerging markets represent an important untapped opportunity for insurers.

The IFC's SheforShield found that the value of health insurance premiums paid by women in these countries could grow from $5bn today to $29–46bn by 2030. Women's World Banking tapped this potential by developing Caregiver, a hospital micro-insurance product, with Microfund for Women (Jordan), with a specific focus on covering maternal health issues. We have since expanded it with partners in Peru, Morocco, Uganda and Egypt—reaching a total of nearly 1.5 million clients.

Women's financial inclusion also contributes to meeting the global goals in other ways. We know that when women have control over discretionary income, they spend it on their families, and particularly on their children's education—key to succeeding in goal four, quality education. And for the first time, we have evidence that financial inclusion helps eliminate poverty (goal one).

New research shows that M-Pesa mobile phone financial services have helped an estimated 186,000 households in Kenya—around 2% of the country's total population—to move out of poverty. The impact for women was even more pronounced. Women-headed households were twice as likely to be lifted out of poverty, and researchers also found that women shifted from subsistence farming to starting their own small businesses.

By setting business strategy in line with the global goals, financial service providers can tap into the economic prize of financial inclusion, opening up new markets and a source of revenue that is more sustainable, both for their business and for the planet.

"Giving women access to meaningful financial services can also make a huge difference in health and wellbeing."

BUSINESS IS ON THIN ICE—AS I FOUND IN AN ANTARCTIC CREVASSE

KEITH TUFFLEY
Former CEO, the B Team; CEO, NEUW Ventures

Corporate champions are needed to save polar ice and the planet—and prosper in the process

Two months ago I had the good fortune of falling into a collapsing crevasse on the Antarctic ice cap while on an expedition from the Ross ice shelf to the south pole. Good fortune? Yes, because—apart from the fact that I survived—I had the experience of seeing first-hand the thickness of the ice covering the frozen continent.

I wouldn't suggest that all business leaders should get such a head-down, bottom-up perspective of Antarctica. But there is something to be said for arguing that they do achieve some personal knowledge of the state of the world's ice, and of the global commons in general. For companies will only be saved from destruction if they transform the way they operate. And business will only thrive if it creates the solutions for global problems for which it is primarily the cause.

As I hung in the crevasse, the massive chasm below me appeared endless, and no wonder: the average thickness of the ice sheet across the entire continent is over 3km. But it is melting—simply due to anthropogenic climate change. And, whether we know it not, we depend upon it.

The Antarctic continent is larger than the US, Europe or Australia, and its ice sheet contains 30m cubic kilometres of ice, around 90% of the world's freshwater. If all that melts, average sea levels will rise by around 70 metres; the Greenland ice sheet would add another seven metres. Of course, full melting of these ice sheets may take hundreds of years. But the latest research indicates that on current trends we should now expect it to be the main cause—supplemented by melting mountain glaciers and the expansion of warming ocean water—of a rise in sea levels of up to two metres over the next 75 years.

The Antarctic ice shelves, anywhere between 1–100 metres in thickness, that surround much of the continent are already melting rapidly. Since these ice shelves float on the sea surface, they do not directly increase sea levels. But the shelves do play a significant role in the speed at which the ice sheets melt, as they act as giant plugs that slow down the flow of glaciers into the warming ocean. And given that the ocean absorbs 93% of the heat that is being created by the burning of fossil fuels and other anthropogenic causes, the warming ocean is having a significant impact on these ice shelves.

Sea ice is also disappearing fast. It is at a historic low in the Antarctic while, in the Arctic, January 2017 marked the lowest sea ice extent since we began using satellites to monitor it 38 years ago.

All this ice plays a hugely important role in regulating the global climate. Polar ice reflects 80% of the sunlight that strikes it back into space, moderating global temperatures and keeping the polar regions cool. As we continue to lose it to rising temperatures—thereby exposing the land and sea which conversely absorb solar heat—the pace of climate change is expected to significantly increase. Already the polar regions are experiencing much higher temperature rises than the global average. The Antarctic Peninsula, for example, has seen a rise of 2.5C since the 1950s.

Preserving polar ice is everyone's—and every business'—concern. Unfortunately, human consciousness does not easily focus on what is happening in remote regions that few have the good fortune to visit, and hence it is too easy for us to ignore the implications of its melting ice. But they are important to all of us.

A two metre sea level rise over the next 75 years will be devastating for all people living on or near the coast. The hundreds of millions of people—both in developing and developed nations—who will become climate refugees will affect everyone on earth. If we think we now have a refugee crisis, imagine what we will all face over this century as rising seas start to impact coastal communities across the globe.

Then there is the cost of protecting the built environment, and ultimately moving coastal cities and rebuilding roads, railway lines, and ports. These are resources that could otherwise be deployed to invest in education, public health and social welfare.

Melting polar ice will also impact regional and global weather patterns, ocean currents, and the sea-life that has become dependent on a stable climate. It is difficult to forecast an environment that civilised humanity has never experienced; but more unpredictability and instability should be expected in future global weather patterns. In the words of Julienne Stroeve, a sea ice researcher at University College London: "It's not just that we're talking about polar bears or seals. We all are ice-dependent species."

The only way to address this impending crisis is to transform our global economy to a net-zero greenhouse gas system by 2050. This is the target we must achieve to keep global temperatures well below 2C, something all countries have agreed to do through the Paris Agreement. This requires us to eliminate coal, oil and gas from our energy system and to address other emitters such as our agriculture and food system.

Business cannot thrive in a failed world where millions of climate refugees seek safety from rising sea levels and unpredictable weather. Business cannot be respected or trusted unless it addresses and takes responsibility for the pollution it generates that is melting our polar ice.

Fortunately, some forward-thinking companies recognise not just the problems, but the business opportunities in addressing our climate challenge. In a report released January 2017, the Business and Sustainable Development Commission estimated that meeting the sustainable development goals, many of which address climate change, could generate more than $12tn (£9.6tn) in opportunities by 2030—equal to around 10% of forecast global growth.

We need many corporate champions to save our ice—and thus our precious planet and humanity itself. This is the private sector's moment in history to act, mobilise and bring solutions.

CLIMATE CHANGE ISN'T FAIR

MARY ROBINSON
President, Mary Robinson Foundation—Climate Justice

Justice is key to protecting the global commons for future generation

In the face of the existential threat of climate change, the task of protecting future generations must start with ensuring fairness and equality in the current one. We are living through deeply troubling times—anxious about security, subjected to the shallow appeal of populism around the world and shifting towards increasingly myopic national policymaking in many countries. But for every regressive policy, for every small-minded comment demonising "the other", we are witnessing communities coming together to deliver a different message.

Millions have taken to the streets to call for an end to the use of fossil fuels, respect of human rights and intergenerational equity. Around the world, university students are leading the charge calling for divestment from fossil fuels and investment in renewable energy services. People are becoming increasingly aware of their role as global citizens and the need to protect the global commons. We can see all around us an indomitable spirit of empathy and compassion that will not be cowed by cynicism or fear mongering. In this spirit, I recognise the emergence of a new wave of guardians for future generations.

When, like me, you have experienced the joy of becoming a grandparent you begin to think a lot more about the future. I have become very aware that world leaders and policymakers today are drafting decisions that will shape the world that my grandchildren, and their children, live in. And yet we afford little thought to how the

policies we make today will impact the world of 2050, when my youngest grandchild will not yet be 40.

We are custodians of our planet, a global commons that, by 2050, will be home to some 9 billion people. It is our duty to live in such a way that the precious, life sustaining environment which keeps us is passed to future generations in at least as healthy a state as we received it from those before us.

Today we are knowingly jeopardising the wellbeing of those future generations if we do not take action to achieve sustainable development. Without ambitious and sustained action to end poverty and tackle climate change, we are condemning them to an uncertain world, where the impacts of climate change exacerbate food and water insecurity, conflict, and the displacement of people from their homes and countries.

To tackle the common enemy of climate change we must view the challenge through a climate justice lens. Climate justice is the antithesis of the rise of populism and short-termism. Climate change confronts us with our global interdependence. Climate justice tells us that, in order to realise the right to development while avoiding the worst impacts of climate change, which means achieving the ultimate goal of the Paris Agreement—to hold the increase in the global average temperature to well below 2C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5C above preindustrial levels—world leaders must act in solidarity, motivated by an enlightened self-interest.

The solutions and national strategies that will ensure we stabilise our climate and pioneer new pathways to sustainable development will come out of a sense of empathy and fairness as much as by technical skills and expertise. The industrial revolution, the transition that ushered in the prosperity in which those in developed countries now live, left billions of people behind. Global inequality continues to worsen today.

Therefore, the challenge we face is not simply about leaving fossil fuels in the ground. In fact, weaning the industrialised world off them, though requiring great urgency, is perhaps the easier problem to solve. Avoiding the most devastating impacts of climate change, while eradicating poverty and enabling all people to enjoy the benefits of sustainable development, is the greater challenge.

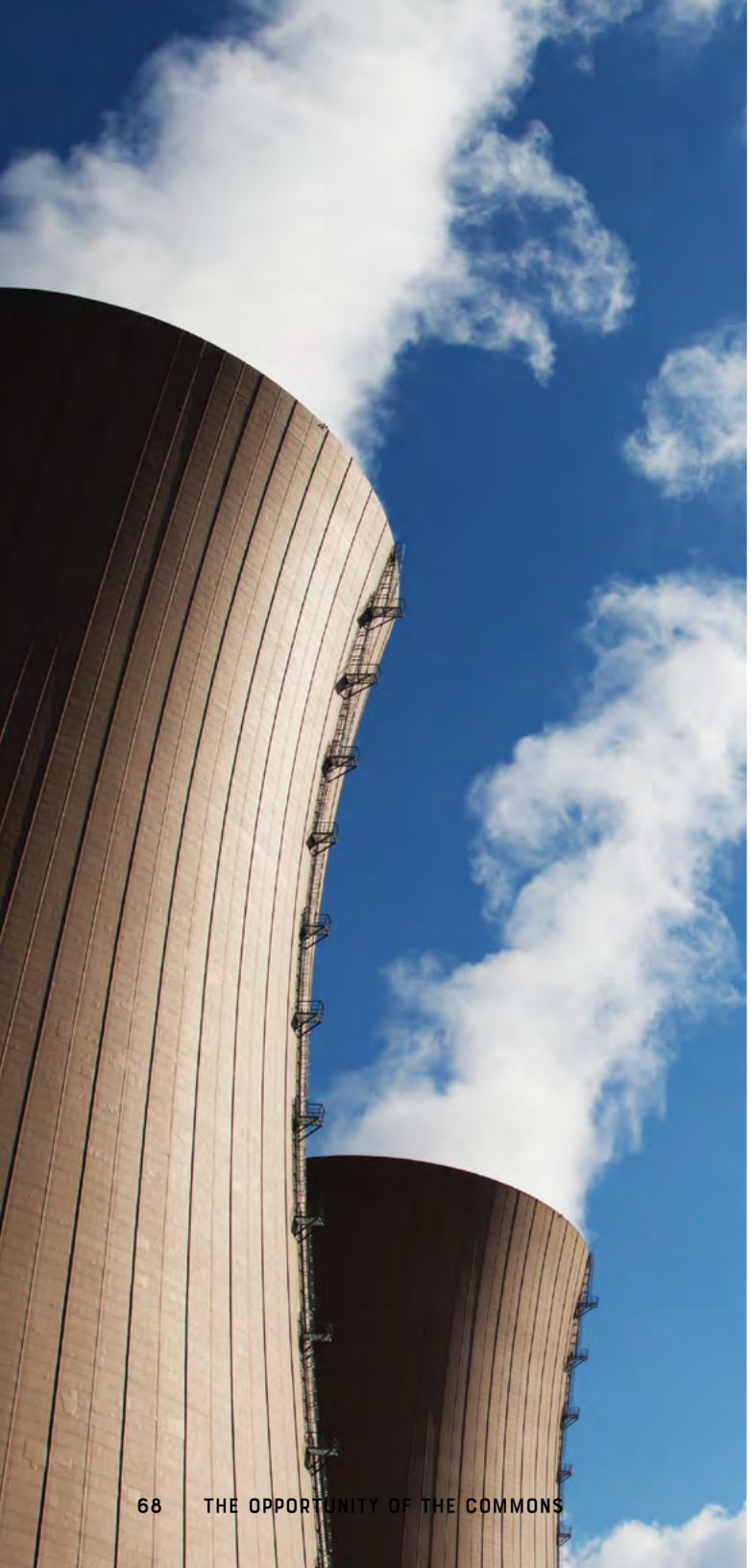
In the face of this unprecedented challenge, the leadership demonstrated by so many developing countries is inspiring. Developing countries, small and large, grasp the urgency of the moment we are in and are working out how to transition to low carbon economies.

Fiji, serving as president of the climate negotiations this year, has confirmed its determination to become carbon neutral, and recently announced the creation of a future generations trust fund. Ethiopia aims to be middle-income, achieve ambitious greenhouse gas emissions reductions and invest in renewable energy by 2025, despite its backdrop as one of the world's poorest countries, with 74% of its population currently living without access to energy. Costa Rica is also transitioning to a low carbon economy—in 2016 it achieved 98% renewable energy. This leadership must be emulated around the world.

In his 1968 paper in Science, the Tragedy of the Commons, Garrett Hardin wrote, "Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons." Today, we are faced with a dilemma. If we pursue national interests, if we close ourselves off from collaboration and unified action, the global commons will fall foul of the grim future that Hardin foresaw.

It is only by urgently and ambitiously pursuing a new paradigm of sustainable development for all people that we can ensure a safer future for those yet to be born. This is our obligation as guardians for future generations.

"We are knowingly jeopardising the wellbeing of future generations if we do not take action."



WHY 2020 IS A CRITICAL MILESTONE FOR A CLIMATE-SAFE WORLD

CHRISTIANA FIGUERES
Former Executive Secretary, UNFCCC; Convener, Mission 2020

A game-changing opportunity to keep the promise of Paris

We are at a precarious point for the fate of the global commons. Our actions on climate protection over the next few years will determine whether we continue on a path of exponentially growing national disasters or pivot onto a path toward a safer, more prosperous world.

At the 2015 Paris summit, 194 countries committed to work collaboratively to limit the impact of global warming. Data shows that—if we are to achieve the Paris goals—we must reach a climate turning point in 2020 as the graph below shows.

This is critically important because the world community has also agreed to meet 17 sustainable development goals, or global goals, by 2030, including ending poverty and hunger, and ensuring universal access to affordable, reliable, sustainable and modern energy.

If we are late to the 2020 milestone, and emissions have not begun a steady decline by then, we will all but eliminate our chance to stay within the range of a 1.5C to 2C temperature rise, beyond which the impacts we are seeing already—record Arctic ice melting, famine-

inducing drought in Africa, unprecedented coral-reef bleaching at the Great Barrier Reef—are likely to worsen dramatically, threatening everyone, especially the most vulnerable. Missing the 2020 milestone would also put meeting all the global goals at risk. A temperature rise that exceeds 2C would also make the world systemically uninsurable.

All this shows us that urgent action is necessary to meet the 2020 climate turning point.

It is also desirable; not just to avoid negative impacts from a rapidly warming world, but because the resulting health, energy and food security, and jobs—providing a basis for shared prosperity and financial stability—will benefit everybody.

The question then becomes: is the 2020 climate turning point achievable?

There are many arguments against it:

- In 2016, the Earth set a temperature record for the third year in a row, an ominous trend, which has unleashed remarkable physical changes to our planet that will last for centuries.

- Developing countries need much higher, and faster, investment now than is currently available so as to lock in clean energy infrastructure to meet their development agendas. Otherwise they will turn in the short-term to coal.

- There is significant inertia in the financial system, where externalities like carbon pollution are mostly not yet adequately priced in, and where short-term valuations still prevail.

- Finally, of course, there is politics, with some governments undoing climate-related policies and public funding drying up.

- But, as you might expect, I see many more arguments for the achievability of the 2020 turning point. This is because, in the end, all of our self-interests lie in wanting a stable, safe environment, where we can provide for our families without the threats of hunger, conflict or forced migration.

- The financial sector, recognizing the risks and opportunities, now has a series of recommendations—via the Taskforce for Climate-related Financial Disclosure—that will help investors stress test their portfolios against the 2C pathway. BlackRock—with over $5tn (£4tn) in assets—has warned companies it will vote out directors of companies that fail to address the risks posed to their businesses by climate change; and State Street Research has pointed to an industry-wide shift as investors discover sustainable value in environmental, social and governance based investing.

- We've just experienced the third year in a row where the world's carbon dioxide emissions have stayed flat while economic growth has continued.

- The pace of technological advances in renewables is enabling them to compete robustly, unsubsidized, with fossil fuels. The scale of their use is already comparable to nuclear.

- Battery storage and capacity, with better integration into the grid is improving exponentially. China is planning to put electric vehicles costing just $8,000, without subsidy, on the road. And India is leading the charge by announcing ambitious plans to be a 100% electric vehicle country by 2030.

- There is broad participation and real leadership from the world's biggest businesses and investors in addressing climate change. Cities and states, and some nations, are already demonstrating ambitions on coal phase-outs, renewable energy and halting deforestation over and above the plans announced for Paris.

- There has been renewed determination over the Paris agreement in recent months rather than a falling back, with a galvanized environmental movement and successful interventions from indigenous communities worldwide as they work to protect their land and water from threats and degradation.

Whether we can achieve the 2020 turning point will depend on our ambition, our will-power in staying the course and on how we define the acronym BAU. We are no longer in a world of business as usual; we are now in business as urgent. We must be determined, and stubbornly foster innovative thinking and radical collaboration so that we reach the junction on time, together.

The 2020 turning point is already in sight. It's happening!

Join the conversation with the hashtag #2020DontBeLate

CITIES MUST EMBRACE NATURE TO SURVIVE

ELIZABETH YEE
Vice-president, City Solutions, 100 Resilient Cities

Innovative, scalable solutions in cities can build resilience and defend the global commons

Ensuring the vitality of the global commons—the natural assets and ecosystems that form and sustain our world—has become urgent for planetary survival. Cities are poised to either accelerate the commons' demise, or to provide innovative, scalable solutions that can restore natural assets and the value they provide.

More than half of the world's population now lives in cities. By 2050, this will reach a staggering 70%, adding more than 3 billion people to urban centres. And more than 60% of mid-century metropolitan regions have yet to form. According to the World Economic Forum, $3.7 trillion (£2.4tn) will be needed every year to 2050 to fund basic infrastructure. The actions cities take to build their own resilience to climate change, mass migration, and other major challenges of the 21st century, will have a fundamental impact on the rest of the world.

Building urban resilience requires an approach that cuts across different systems, with cities addressing their relationship with the natural environment as a critical part of strengthening themselves. Understanding the value of natural assets lies at the heart of any viable solution for protecting our commons.

Traditional models of conservation and regulation alone cannot catalyse the kind of systemic behavioural change that will renew our relationship with the environment, and return it to its central role in our affairs. We must design and implement strategies that articulate the benefits of nature—economically, socially and as a critical piece of building future resilience.

Through our work at 100 Resilient Cities (100RC), we have begun to see successful approaches that do just that—programmes and projects that incentivise investment in cultivating natural assets. From supporting environmentally friendly growth and sustainable waste management in Bangkok, Thailand, to identifying measures for coastal management and the protection of marine biodiversity in Byblos, Lebanon, cities are committing to defend the global commons as a natural way to create resilience.

El Paso, Texas, is balancing the tension between urban sprawl and the importance of maintaining its delicate desert ecosystem. Its office of resilience and sustainability collaborated with our partner, Earth Economics, to complete ecosystem service identification and valuation for a critical area near the Franklin mountains. Together, they are working to make the business case for preserving and responsibly developing land.

Just last month, Earth Economics also took part in a 100RC network exchange in Melbourne, Australia. Chief resilience officers representing the cities of Boulder and New Orleans in the US, Durban in South Africa and Semarang in Indonesia explored and developed multi-benefit solutions that build urban resilience through biodiversity. They committed to bridging the gap between the need to value nature, and political and financial will in policy and capital investments.

The work of another 100RC partner—Arcadis, the Dutch engineering firm—reflects a growing trend to move away from traditional rigid barriers against flooding and sea level rise, and towards restoration projects that cultivate natural infrastructure. New York's Big U, also known as the Dryline—an Arcadis project done in collaboration with yet another 100RC partner, Rebuild by Design—combines flood protection with amenities that foster social cohesion and revitalise neighbourhoods.

Using berms creatively and relying on salt-tolerant trees and plants to build a resilient urban habitat, it is adding beautiful parks and public areas—unique to each location—in a 10 mile "U" around lower Manhattan. Such new landscapes provide natural infrastructure that is much more effective than traditional manmade structures in withstanding water. Rather than endlessly plugging proverbial holes in concrete walls, we can help nature synchronise with such economic needs.

If they are to build meaningful resilience, cities must develop solutions for the entire urban ecosystem. This requires articulating the value of natural assets and their essential role in ensuring we not only survive but thrive amid the challenges of the 21st century. Only by making them intrinsic to economic, social and political solutions in our cities will we be able to save the global commons and endure as a society.

CLIMATE ACTION NEEDS GREEN, NOT JUST RED LIGHTS

DANIEL C ESTY
Hillhouse Professor of Environmental Law and Policy, Yale University; Co-author, Green to Gold

Incentives for reducing emissions work better than old-style regulatory approaches

In the twentieth century environmental protection centred on national government regulations and standards, often requiring emitters to install mandated pollution control equipment. This approach delivered some gains: across Europe and North America, the air is now much cleaner and rivers, streams, and lakes are less polluted. But such "command and control" regulation has not delivered much progress on some other big issues endangering the global commons, including climate change.

Despite more than two decades of the 1992 UN Framework Convention on Climate Change, emissions have continued to rise—threatening to produce global warming, rising sea levels, more frequent and intense hurricanes, changed rainfall patterns, more floods and droughts, and diminished farm productivity in many places. This failure can be traced to structural flaws in the past global response to climate change.

The 20th century regulatory model, on which the 1992 treaty builds, makes what could be called the "lawyer's mistake" of assuming it is enough to pass a law, draft regulations, or sign an international agreement. Telling people, particularly in the corporate world, what not to do is insufficient. What is really needed is a framework of incentives that changes behaviour and induces innovation to solve problems.

If we are successfully to address the build-up of greenhouse gases in the atmosphere, and many other persistent environmental challenges, we need to move from a regulatory structure that depends on red lights and stop signs to one that also presents green lights.

These incentives to spur action and investment will signal to business leaders and creative minds where to devote time and resources, promising a marketplace return for breakthrough technologies and other innovations that address priorities in public policy. We must make clear to entrepreneurs and investors that efforts to bring forward a clean energy future and other cleantech advances will be rewarded with financial success.

Fortunately, the 2015 Paris climate agreement includes steps toward a world of green lights, with an array of 21st century regulatory tools that will help spur innovation and deliver better policy results. Its negotiators drew on ideas put forward not just by national governments but by mayors, governors, premiers, and corporate leaders. And cities, states, provinces, and companies are all poised to follow through on its commitments—representing a major break with past reliance on national governments.

In fact, presidents and prime ministers have relatively little control over their societies' carbon footprints. Subnational government leaders and business executives have much more day-to-day influence over transit systems, economic development, building construction, infrastructure investments, and decisions about what products get produced, and how.

The relentless pushes by Paris mayor Anne Hidalgo—who chairs C40, the cities' group that has mobilised action among mayors of 90 of the world's biggest urban centres—and by former California governor Arnold Schwarzenegger—who launched the R20 group that has galvanised state and provincial climate change projects—demonstrate a depth of commitment on the ground that was missing from past global efforts.

The Paris agreement also leaves each country to establish its own regulatory programmes and strategies to reduce emissions, providing room for fresh thinking and new policy tools. Indeed, many of the nationally determined contributions that have been put forward reflect the trend away from command and control regulations toward economic drivers such as emissions allowance trading systems and carbon pricing. Such market mechanisms provide much clearer incentives for investment in renewable power, energy efficiency, smart grids, and other clean energy systems.

More than 1,200 companies have aligned with the World Bank's Carbon Pricing Leadership Coalition to explore ways of using price signals to shift their internal energy decision making towards a decarbonised future. Even universities are adopting carbon pricing to change behaviour. At Yale, a $40 (£31) per tonne carbon charge has induced significant shifts in building design and energy management practices.

Business leaders across the world are developing pathways to a clean energy future. Bill Gates and his fellow billionaire backers of the Energy Breakthrough Coalition have committed $2bn to drive innovation across a spectrum of technologies that might change the energy foundations of our economy.

Companies such as HSBC, Areva, Engie, Enel, and Tata have joined a solar power alliance launched by French president Francois Hollande and Indian prime minister Narendra Modi to expand access to clean electricity in developing world villages. While business was seen as the enemy of environmental progress in the 20th century, today's policy frameworks seek to engage it as a critical engine of innovation.

Similarly, the Paris agreement moves away from the reliance on government subsidies of past global efforts to fund investments in climate change action. It seeks instead to use limited public resources to leverage private capital through green banks, green bonds, and other creative financial instruments.

This shift has already begun to pay dividends. Connecticut's Green Bank has increased the state's deployment of energy efficiency and renewable power projects more than 10-fold. Britain, Malaysia, New York and other jurisdictions have similar mechanisms, while more than $90bn of green bonds were placed last year.

Finally, opportunities abound to use information technologies to sharpen incentives for solving problems that hinder environmental advances and a sustainable future. Harnessing computer power and modern communications tools makes it much easier to track emissions, charge for pollution damage, identify successful policy strategies, disseminate technology breakthroughs, benchmark government and business greenhouse gas control efforts, celebrate leaders, spur on laggards, and highlight best practices.

Though the Paris agreement lacks binding obligations and enforcement mechanisms, it does provide for evaluation and reporting on results every five years. It also demands increased commitments if progress falls short of what will be required to stem the build-up of greenhouse gases in the atmosphere.

Thus, while worries about weakening resolve over climate change in some national governments are real, there are parallel reasons for optimism. The Paris agreement—with its commitment to multi-tier governance and its engagement of mayors, governors, corporate executives, and NGO leaders—promises to be much more robust than the global community's past efforts.

Deploying 21st century sustainability strategies and broad-based incentives for innovation relies much less on action by any one set of governments. It is thus much more likely that the world has reached an inflection point on climate change.

For more information, read Esty's recent article, Red Lights to Green Lights: From 21st Century Environmental Regulation to 21st Century Sustainability, in Environmental Law (April 2017).

INCENTIVISING SUSTAINABLE FISHING THROUGH CERTIFICATION

RUPERT HOWES
CEO, The Marine Stewardship Council

Market-based measures have an important role to play in ending overfishing

Our oceans are in trouble. Acidification, plastics and other pollution, and climate change present enormous challenges, and we have little time to act to avoid pending catastrophe for humanity and marine ecosystems worldwide.

On the positive side, the sustainability of oceans and their critical role in providing food, livelihoods, climate stability and "blue growth" has been rapidly rising up the political agenda. After a lack of mainstream interest and attention, there has been an explosion in high-level ocean events and conferences.

In 2014, John Kerry, then US secretary of state, kicked off a series of Our Oceans conferences in Washington. The next will be hosted by the EU in Malta in October. The Economist held their fourth World Ocean Summit in February this year. And most recently, in June 2017, the United Nations held the Ocean Conference in New York. The event featured a call to arms to save oceans from continued decline and was billed as "the game changer that will reverse the decline in the health of our ocean for people, planet and prosperity".

The United Nation's sustainable development agenda with its 17 sustainable development goals (SDGs), signed by 193 nations, aims to transform our world and safeguard the global commons. Although the goals are not legally binding, governments are expected to develop national frameworks to make sure they are delivered. This may be humanity's last best chance to deliver a fundamentally more equitable and sustainable world; one that operates within ecological and planetary boundaries, with systems of production and consumption shifted onto a sustainable footing.

Using markets

There is a dedicated oceans SDG, number 14: conserve and sustainably use the oceans, seas and marine resources. Goal 14.4—which is particularly relevant to the Marine Stewardship Council (MSC)—sets an ambitious target to regulate harvesting, end overfishing and pirate fishing, and restore fish stocks as fast as possible.

The time frame—designed to achieve all this by 2020—is singularly ambitious, but ultimately achievable. We know what the issues are and what solutions are needed. While there is no silver bullet, I passionately believe that credible market-based programmes, like the MSC, have an important part to play.

Over the last 20 years the MSC has matured from a bold and innovative idea to a proven concept. Well-managed fisheries are rewarded by a market that is increasingly demanding sustainable and fully traceable seafood. Incentives include supplier preference for certified fisheries in existing markets, access to new ones and, for some, a price premium. Critically, other fisheries are incentivised to improve so as to achieve certification. None of this happens without the leadership of the market and the engagement of marine conservation NGOs.

Growing change

The MSC's global impacts report documents the growing evidence of change. MSC-certified fisheries have more stable biomass, reduced impacts and improved management through better scientific understanding, according to the report's findings.

Certification is driving real and lasting change in the way our oceans are being fished, including the adoption of voluntary closures of fishing grounds, modifications to make fishing gear more selective, and reductions in bycatch and discards of sea birds, juvenile fish and other unwanted species.

There are now over 400 fisheries, landing nearly 12m metric tonnes of seafood annually, engaged in the MSC programme. Together they represent nearly 14% of the global wild marine harvest. Over 25,000 MSC-labelled products are now available in more than 100 countries, with consumers spending an estimated $5.2bn (£4bn) on MSC-certified seafood in 2016.

Yet this is not enough. The world needs healthy, productive and resilient marine ecosystems for food, livelihoods and climate stability. And we need to move and scale up much more quickly to have any chance of delivering SDG 14's fisheries targets. So, the MSC has committed to engage 20% of the marine harvest in the programme by 2020—a mere 30 months away—and over a third of global marine catch by 2030. That will be an incredible achievement, but we cannot deliver it alone.

We will need stronger deep market engagement and commitment to sourcing sustainable and traceable seafood from the retail and food services, and government action to ensure that fisheries are managed appropriately. At the very least, harvest controls on fishing need to be implemented where they are absent, and the World Trade Organization must conclude its 16 years of discussion on ending the harmful fishing subsidies that drive overfishing. We will also need action from everyone who eats seafood to demand assurances that their choices are not contributing to the oceans' demise.

It can be done. In the last 12 months alone, sales of MSC-certified and labelled products grew by 40% in the UK. Half of British landings are now MSC-certified and four supermarket chains—Sainsbury's, Tesco, Waitrose and Lidl—now offer over 100 individual, labelled products at all major price points. Premier Inn offers certified, sustainable and traceable seafood in its 635 hotels across the UK. And McDonalds, a long-term supporter, will only sell MSC-certified Filet-o-Fish across Europe, the US, Canada and Brazil.

market may not be a panacea for resolving all the ills and threats facing our oceans, but it can be a driver of much-needed transformation. If we cannot fix this aspect of ocean sustainability—and there is no excuse not to do so—we have little hope of resolving climate and acidification challenges.

After all, as Karmenu Vella, the EU commissioner for environment, maritime affairs and fisheries put it: "Forests are our planet's green lung, but oceans are its blue heart. It is now up to all of us to keep this blue heart beating."

HOW NEW TECHNOLOGY CAN HELP PREVENT ENVIRONMENTAL CRISES

ANDREAS MERKL
Former President, Ocean Conservancy

Vastly improved information on Earth's natural systems can stop ecological crashes

After spurning Apollo's advances, the Greek goddess Cassandra was punished in a particularly cruel way. She was given the power of prophecy, but robbed of all credibility. She could see all, but warn no one.

For decades, environmentalists have perceived themselves to be similarly cursed. Our warnings have been heard when they could be directly verified and seen, such as in polluted air and water. But our more systemic prophecies about global commons such as the future of biodiversity, climate, and even the planet's overall viability and carrying capacity have been met with much scepticism and inertia—even outright denial.

I cannot think of a more starkly ominous warning than that we are outspending our planet's capacity to sustain us: yet our collective planetary footprint is light years away from guiding the development and implementation of policy.

This is, of course, no accident. Admitting the very notion of limited planetary capacity has huge economic implications. It involves the stranding of fossil fuel reserves, the setting aside of major natural reserves, and the disruption of the way we build cities, organise transport, grow food, catch fish, make electricity and manage water.

Other writers on this site have brilliantly pointed out that it can all be done—and done profitably—but that poses a grave threat to those with vested material interests in the resource-intensive status quo. So, not surprisingly, they fight—fiercely and well. There has been formidable opposition to the very idea of a finite resource base.

Opponents' argument boils down to a debate about the model. They paint environmentalists as defenders of a static natural world that has never existed, and cannot exist. They point out that large-scale natural changes are normal, inexorable and unfathomable, and that any attempt to isolate the human component of large, system-scale change is inherently foolish and impossible.

They say that the climate has always changed, that there have always been extinction events, and that evolution thrives on change. They argue that any rigorous attempt to model the impact of human activity at the planetary level is akin to predicting the weather in London on 21 September 2028. And, therefore, they conclude that the notion that we need to change everything, wean ourselves off fossil fuels, and re-think our addiction to consumption—just because the most extreme scenario of some impenetrable atmospheric model implies catastrophe—is patently absurd.

There is a kernel of truth in this argument, but the conclusion is catastrophically wrong. Yes, environmentalists have at times taken a static view of nature. And yes, it is very difficult indeed to predict the behaviour of large, hyper-complex planetary systems such as the oceans, the atmosphere or food chains in a spatially and temporally specific way.

But does this imply we are left clueless as to the fate of a planet carrying nine, 10, 11 billion people? Is the possibility and consequence of ecological catastrophe diminished by the analytical difficulty of predicting the exact date and place of its occurrence? Should we conclude, as they do, that the answer is to do nothing? Or should we conclude that our analytics have to improve and that we must look at our resource intensity very carefully?

Fortunately, it is about to become much, much harder for the defenders of the resource-intensive status quo to hide behind uncertainty. Computer networks now have such stunning capacity that our ability to understand complex systems is being revolutionised. No, we will never be able precisely to predict stock prices, currency rates or ocean currents. But new powerful analytical techniques are able to track the stability of the system as a whole, to identify areas of instability, to develop and quantify failure scenarios and to point out the redundancies and controls needed to stave off crashes and collapses.

These techniques are already at work in complex systems like international capital markets and the internet. These are impossibly complex and ultimately unpredictable systems, and it is impossible to avoid crashes entirely. But we are learning to manage them to the point where crashes are becoming increasingly rare and isolated and it is possible for us to recover from them.

These techniques are now being applied to complex interactions between humanity and the environment. Ocean Conservancy, for example, is working with Oxford University's Martin School to apply network monitoring techniques to understanding the stability of the ocean system. It aims to answer such questions as: How likely is catastrophic failure as a result of the compound stressors of climate change, overfishing, and pollution? What timespans are involved? What are the warning indicators? The new models are entirely transparent in regards to uncertainty, and they make it impossible to hide behind the argument that "the future is unknowable, and thus unactionable".

We are unlikely ever to be able to predict the weather five months in advance. But we are on the verge of understanding—for better or worse—the effect of complex, synergistic man-made forces on the natural environment. We will have vastly better information about tipping points, non-recoverable events, indicators of trouble, and the potential of losing essential ecosystem services—such as the ocean's ability to create oxygen, or to moderate our weather.

This gives me hope. If our understanding of complex natural systems such as the ocean improves faster than the rate at which we're disturbing them, we have a chance to adjust, adapt, mitigate, and prevent the crash. We can avoid Cassandra's fate. But we have to stop pretending that there is no signal in the noise and that rigorous work on quantifying man-made risks to critical Earth systems is impossible.

THREE CHALLENGES WE MUST OVERCOME TO SECURE THE FUTURE OF FOOD

GUIDO SCHMIDT-TRAUB
Executive Director, UN Sustainable Development Solutions Network

Governments, countries and academics must work together to safeguard food systems for the future

Nothing has a greater environmental impact than our food system, including agriculture, livestock, aquaculture and hunting. It drives massive biodiversity loss and deforestation; leads to water stress in many parts of the world; accounts for a quarter of global greenhouse gas emissions; and generates vast quantities of nitrogen and other nutrients that create dead zones in many coastal waters. At the same time, the food system is also vulnerable to climate change, land degradation, and biodiversity loss.

Climate scientists predict that, if left unchecked, global warming will lead to large cuts in agricultural productivity in most parts of the world—with potentially disastrous consequences for food security and livelihoods. On top of this, today's food system leaves an estimated 700 million people undernourished and an additional 2 billion malnourished, with obesity rising in many countries.

We are facing a crisis, and on current trends the situation is going to become worse. As incomes rise in China, India and other parts of the developing world, demand for meat is going to increase too. Since

around 7kg of grain is needed to produce 1kg of beef, this will increase demand for land and water for food production. Population growth in many developing countries, particularly the poorest ones, and the effects of climate change will both increase the pressure.

The 17 sustainable development goals, adopted by all member states of the UN in 2015, set ambitious benchmarks for promoting economic prosperity, enhancing social inclusion, and ensuring environmental sustainability. Like the Paris climate agreement in December of the same year, the goals recognise the central role of food systems and their vulnerability to environmental change. As a result, the world now has a framework for action towards a sustainable food system—but we lack a clear understanding of what success might look like, and of how to get there.

Three major challenges

Governments are the first major obstacle. In both rich and poor countries they operate in silos on issues relating to agriculture, biodiversity, water, health, demography, and other environmental considerations. These issues tend to be discussed in isolation. Governments also fail to adequately tap into expertise from civil society, business, and the science community. A similar disconnect occurs among academics: climate scientists, agronomists, ecologists, hydrologists, economists, and representatives of other fields rarely come together to propose integrated targets for sustainable food and land use systems, or pathways for achieving them.

A lack of detailed country-level analyses of how to achieve long-term objectives is the second challenge that must be overcome. This is where the rubber hits the road.

Policies are formulated, budgets are developed, and political compromises are hatched at the national level. But these individual country strategies, taken together, need to respect the planetary boundaries essential for preserving the global commons, such as the carbon budget associated with keeping the rise in global temperatures to well below 2C above pre-industrial levels. Similarly, the release of nitrogen, phosphorous, and other nutrients from all countries put together must not exceed the ocean's capacity. So global and national pathways must be consistent in the context of planetary boundaries and rising agricultural trade.

The third major challenge is to get countries to consider the long-term consequences of short-term strategies, so that they avoid locking themselves into unsustainable practices.

With energy, we have learned that 10 to 15-year decarbonisation strategies lead to countries pursuing low-hanging fruits, such as shifting from coal to gas-powered electricity generation or increasing the efficiency of the internal combustion engine. These may generate significant short-term emission reductions, but they also lock countries into a fossil fuel-based economy that will make the long-term objective of net zero greenhouse gas emissions impossible to achieve.

Similar issues arise in the transformation towards sustainable food and land use systems, which require long-term changes in agriculture, livestock management, aquaculture, water management, ecosystem protection, and many other areas.

Since politicians and business leaders around the world focus on the short-term, the 193 signatory countries to the Paris climate agreement decided to prepare long-term low-emission development strategies. Now several policy, business and scientific organisations, including the UN Sustainable Development Solutions Network, working with the Global Environment Facility have recently launched the Food and Land-use Coalition to promote integrated, long-term thinking on food and land use systems. This will, among other things, work with researchers and practitioners in the major G20 economies and other countries with large agriculture and forestry sectors to develop integrated, long-term targets and pathways covering food, agriculture, biodiversity, land use and energy.

Together we plan to build the knowledge base that countries need in order to make informed decisions on their food and land use systems. And we will help countries prepare their low-emission development strategies to guide short-term policies, while also taking into account the long-term consequences.

HOW TO SLOW MIGRATION AND SAVE THE CLIMATE

LUC GNACADJA
Former Executive Secretary, UN Convention to Combat Desertification

Restoring degraded land increases security and gives hope to vulnerable communities

Halting land degradation and restoring soil is a vital part of preserving the Earth's global commons—the world simply cannot afford to continue to lose 24 billion tons of precious fertile topsoil a year—but it's also an urgent matter of security.

More than three quarters of the world's conflicts already take place in its drylands, and about half of all those in fragile regions and economies stem from battles for resources resulting from environmental degradation. The war in Syria followed six consecutive years of drought, and the extremism and violence of groups like Boko Haram are rooted in the loss of productive land. And the crisis is getting worse: since 1970 the area affected by drought worldwide has doubled.

Over the last two years, fewer than 2 million migrants seeking to get into Europe have changed the politics of the continent. But by 2030, as the climate changes and more land is lost, 60-130 million people are expected to want to migrate there.

Migration is often driven by lack of hope of a reasonable future at home. Restoring land can restore hope. It increases food production

and incomes, reduces conflicts because there are more resources to go round, and combats climate change by sequestering carbon. It is central to implementing the universally agreed sustainable development goals and to enabling countries to fulfil their pledges under the Paris climate agreement.

It is becoming increasingly clear that transformational change is necessary. For example, a high level roundtable of representatives of both the executive and legislative arms of government, business, finance, thinktanks, NGOs and the media from both north and south, which I chaired at the Caux Dialogue on Land and Security earlier this month, called on leaders and stakeholders at all levels to "address the urgent need for systems change rather than incremental improvement".

It also agreed that "this transformation should target reshaping the context of investment in agriculture, not least in providing incentives for farmers to remove carbon from the atmosphere by restoring and afforesting land".

Most of the world's knowledge on how to manage land is stored in local communities. This is also where conflicts—such as the constant ones between settled farmers and nomadic pastoralists—tend to be triggered, and can be prevented or resolved. It is here too that partnerships for change can most easily be forged.

Much can be done with simple well-known, labour intensive techniques. Pruning offshoots from the still-living roots of trees felled long ago to a single stem, and keeping away goats that would otherwise eat it, for example, has regenerated forests in Niger and Ethiopia. Such farmer-managed natural regeneration has resulted in spectacular increases in harvests and incomes, the capturing of vast amounts of carbon, and the reduction or ending of conflicts, while building communities' resilience to drought.

By the same token, the roundtable—held under the aegis of the secretariat of the UN Convention to Combat Desertification and the International Union for the Conservation of Nature—had little time for the top-down capacity building, so beloved by many international organisations which often involves officials far from the grassroots. Instead it called for greater emphasis on "strengthening the capacity of those working on the ground and those directly affected by land degradation". Bridges also need to be built between local people and policymakers. Women are critical agents of change, and make up the majority of farmers in many developing countries. They need to see an end to the gender inequalities that hinder their engagement. Young people can also be crucial changemakers and they particularly need the jobs that land restoration can provide.

Communities and governments alike will become more resilient to drought if they are better prepared for it. Early warning systems are essential, as is better assessment of vulnerabilities to drought, and of its impacts.

There are enormous investment opportunities in restoring land, but governments, businesses and financial institutions are failing to realise them. Incentives provided for activities that, often unwittingly, destroy land are at least an order of magnitude greater than those given for preserving, let alone restoring it. Public finance is needed to encourage entrepreneurship and the development of new technologies, but more especially to reward the services small farmers who nourish their soils make to the global commons through conserving biodiversity, combating climate change, enhancing food security and water supplies, and increasing security.

There also, of course, needs to be more private investment. Introducing special restoration bonds—modelled on the very successful green bonds, issued to provide a return to investors while furthering environmental sustainability and creating jobs and other social benefits—could play an important part. So could public-private partnerships, but these must involve local people, and local as well as central government. Above all, investors will need to be ready to receive returns not in the short, but in the medium to long-term.

The truth is that restoring the world's over 2bn hectares of degraded land—starting with achieving land degradation neutrality by 2030, the landmark tipping point set in the SDGs for moving humanity into the restoration age—is an immense opportunity. Communicating that, as well as the challenges it presents, is a precondition of success. We owe it to present and future generations to undertake it speedily, and at scale.

"There are enormous investment opportunities in restoring land."

WHAT IS THE POINT OF AGRIBUSINESS, IF IT DOESN'T DO GOOD?

SUNNY VERGHESE
Co-Founder and Group CEO, Olam International

Companies must produce enough to feed the world while respecting natural boundaries

An increasing number of CEOs and boards are asking themselves a somewhat surprising question, one that at first glance might seem to sceptics to be almost "un-corporate": if my business is not helping to create a better future for the planet and its people, what is the point of all this overwhelming effort?

"Purpose-driven leadership" can sound like a buzz phrase, or worse, the latest in management consulting-speak. It can be dismissed as the politically correct quote for annual reports, or as new-age soul searching by companies that have reaped profits by focusing only on value creation at any cost in the past.

Yet, increasingly, successful companies are those that truly adopt purpose-driven leadership. This helps them grow and prosper. It helps them attract and keep the best people. It ensures they find like-minded partners to help them tackle challenges. And it generates investment from shareholders with a long-term view. Companies can maximise purpose and value at the same time, with each supporting the other. It need not be an either/or choice, but can be both.

I am 57 years old, co-founded Olam, and have been its global CEO since inception. But it is only in the last 10 years that I have been forced to confront this issue head on. It started with having to answer simple questions from my own children: why do I do what I do? How does the company that I have spent my life building create a better future for people living in poverty and for the world? If it does not, then why bother?

Facing up to these tough questions crystalised my sensibility on why sustainability and growing responsibly must be at the core of Olam. It needs to live up to the meaning of its name, transcending boundaries and enduring.

The global agri-sector is at the nexus of some of the most intractable challenges the world faces—food, water, energy security, inclusive growth and sustainable growth. Do we want to contribute to the problem or become part of the solution? Sustainable growth without depleting the world's natural capital—its global commons—is critical to tackling climate change. And delivering inclusive growth through livelihoods and engaging with communities is essential to reducing poverty and hunger.

For those seeking purpose in what they do, the agriculture sector offers a range of options.

It generates employment for 40% of the world's population, often the poorest in society. It is therefore crucial to creating viable livelihoods for them. Many are smallholders who can be helped to organise themselves into cooperatives. Once in a collective structure, they increase their access to funding, their produce is easier to aggregate and sell, and they are more likely to benefit from collective training to increase the yield and quality of their crops.

Sustainable supply chains improve the lives of millions of smallholders through creating a more entrepreneurial mindset, generating higher price premiums for certified or high quality produce and opening access to technology-driven innovation. Ultimately they put power in the hands of the farmers themselves to drive their own businesses. As we do so, the economic competitiveness of countries and their environmental track records can be enhanced.

Despite great leaps forward in agricultural practices, we are still in a world where 3.1 million children die each year through malnutrition and 795 million people go to bed each night hungry. This in the same world where 35% of all the food we produce is wasted. Surely there are few greater purposes for the agriculture sector than partnering to improve how we produce and deliver food sustainably to reduce preventable hunger and death.

The agri-industry is a huge draw on natural capital—water in particular—and on land use change. Yet to feed a world population expected to reach 9.7 billion, the amount of crops we grow is going to have to double. This is one of the "grand challenges" that we face and one to which no one as yet has the answer. Mobilising technology and scientific breakthroughs to increase yields will make a contribution, but will still leave a productivity gap.

The United Nations' sustainable development goals are shaping purpose-driven business models—across the spectrum of poverty, hunger, health, education, equality and the economy—on land and below water. They acknowledge and encourage the role of industry in innovating, building infrastructure and partnering to get these goals met.

Company purpose must come both from the top down and from the bottom up in an organisation. As CEOs we must become purpose activists—driving our own beliefs, but actively listening to our people too. The purpose a company settles on only becomes real when everyone in the organisation lives and breathes it on a daily basis. It is not a statement for wall art.

At Olam, our people are fired up about our purpose, "re-imagining global agriculture: growing responsibly". They are engaged with the idea that Olam and the 4 million farmers we work with can play a part in helping to produce enough food to feed the world, while respecting the earth's natural boundaries. And our continuing shareholders increasingly understand that being purpose-driven will create lasting value. It makes everyone, including me, want to get up and go to work every day to tackle that "what is the point question"—and to find the answers.

"Sustainable supply chains improve the lives of millions of smallholders."

HOW TO MAKE ECONOMIES CREATE MORE VALUE AND LESS WASTE

ANTONIA GAWEL
Head of the Circular Economy Initiative at the World Economic Forum

MATHY STANISLAU
Policy Advisor to the World Economic Forum Platform for Accelerating the Circular Economy

The transformation to a circular economy has begun but urgently needs to be scaled up

About three quarters of everything consumed in western economies—from packaging to clothing—becomes waste within just one year. A recent study in the journal Science Advances found that 6.3bn tonnes of plastic had entered the global waste stream since large scale production began in the early 1950s. Some 79% of this waste is scattered across the world's oceans and landscapes or lying in landfills. The rest is incinerated or recycled, but even two thirds of recycled plastics end up in the environment after just one use.

The stress on the environment is being felt at both ends of this cycle. We are extracting an unprecedented amount of natural resources to produce all this stuff, and we are toxifying and damaging the environment by discarding it. As the global population grows and becomes wealthier, these impacts will only intensify. Estimates suggest that resource demand will triple by 2050 if these trends continue.

This is simply not sustainable. The dramatic increase in the use of materials is intensifying climate change, increasing air pollution, reducing biodiversity and leading to the depletion of natural resources. The extraction, production, transportation, use and disposal of natural resources in the world's economies is estimated to be responsible for about 50% of greenhouse gas emissions.

While the picture is bleak, there is a growing movement of innovators in the private and public sectors who recognise that there is a better way to provide the things we want. New technologies, new business models and smarter approaches to what we produce and how, and the way we consume are emerging. The combination of these can lead us towards a circular economy where we create much more value and much less waste from the resources we use.

A few global market leaders are driving the charge and starting to create demand signals. Philips, for example, offers "lighting as a service", which enables it to provide a product that customers want, while retaining ownership of its materials so as to be able to eventually reintegrate them into its supply chain. Nike has committed to closing their product loops. Lego has committed to moving away from oil based products by 2030. Renault Nissan Alliance has run an automotive remanufacturing plant since 1949. And Arup is leading thinking on how to transform the built environment: they have achieved reductions of 75% in weight and 40% in materials, compared with traditional construction methods, through using 3D-printed steel components.

This transformation also represents a movement from the ground up, with many technology pioneers emerging worldwide across all sectors to disrupt traditional approaches to production and consumption. Miniwiz in Taiwan is developing building and other materials from waste through "urban mining". Gastromotiva in Latin America is making new products out of food waste, such as salsa from overripe tomatoes that would otherwise be thrown out. Mobike in China has become the largest global smart GPS-enabled bike sharing scheme. Blue Oak, an e-waste recycling company in the US, sources metals from end-of-life electronics. And Fairphone in the Netherlands has developed a smartphone that is easy to disassemble, repair and upgrade.

Individual governments and multilateral government organisations have also identified the need to remove barriers and establish enabling conditions for private sector innovation. The G7 Alliance for Resources Efficiency and the Organization for Economic Cooperation and Development, for example, have identified the need for governments to collaborate with the private sector in advancing policies on materials recovery, design and procurement so as to create market incentives for business models that decouple resource use from growth.

The problem is that these solutions and policies remain nascent and small-scale, and their broader uptake is frustratingly slow. As the statement of principles (pdf) issued after the October 2016 dialogue on the global commons, convened by the Global Environment Facility and the International Union for the Conservation of Nature, puts it: "Humans are pushing the global commons to the limits of their coping capacity…Only with disruptive, systems level change can we hope to get on the right path…Our focus should be a complete overhaul of key economic systems and development pathways." We are still far from achieving that goal.

We need fundamentally, not incrementally, to change the way society produces and consumes. A circular mindset fundamentally shifts from the current linear economic systems of using and disposing of natural resources as waste towards a system that continuously captures and retains their value within economies.

A circular economy approach would recover the value of wasted materials that are currently thrown away; it would replace the wasted resources of "once used" non-renewable materials with regenerative renewable and bio-based materials; it would maximise the wasted capacity of underutilised products and assets by using sharing platforms; and it would extend the use of products through remanufacturing

Accenture Strategy estimates that the value of capturing this waste could be $4.5tn (£3.4tn) by 2030. Such an approach can also act as a key lever to achieving the targets of the United Nations Framework Convention on Climate Change—through the Paris agreement—by potentially delivering over half of the current gap left by present commitments to reduce greenhouse gas emissions.

Collaboration along global value chains—and with the public sector and consumers—is essential to overcome fundamental economic, policy and infrastructural challenges that stand in the way of achieving scale. The Global Environmental Facility, Philips, and UN Environment, in partnership with the World Economic Forum, Accenture Strategy, and the Ellen MacArthur Foundation have come together to establish the Platform For Accelerating Circular Economy to respond to this challenge. The project aims to convene leaders from companies, international organisations, financial institutions, governments and civil society to bring this emerging, yet critical circular economy transformation to scale.

Transforming entire sectors and value chains cannot rely on the few who stand out front. What is needed is a true system transformation that creates the right framework for all actors to engage in it.

HOW CLEAN TECHNOLOGY IS ACCELERATING LOW-CARBON PROSPERITY

HENRY MCLOUGHLIN
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DIPENDER SALUJA
Managing Director, Capricorn Investment Group

The move to cheap, non-polluting energy and transport is now irresistible

Not a day goes by without a headline on the rapid increase of renewable energy. The transition to a low carbon economy is already under way, and new technologies are about to accelerate it dramatically.

Renewables now produce 15% of electricity in the US, and this is projected to reach 25% by 2030. In Europe, the proportion will be at least 27%, with 20% achieved by 2020.

Globally, the International Energy Agency projects that renewables will be the world's primary power source by 2030. In India and China, where the mix of renewables in electricity generation is currently 25% and 16%, projections for 2030 are as high as 50% and 40% respectively.

These increases are driven by economics. The cost of wind energy, and in many places solar energy, is now lower than gas, coal and

nuclear—before any subsidies. In fact, the costs are so low for wind in some areas that it is actually cheaper to build a new wind farm than to continue operating an existing coal plant. At the same time, ground transport is seeing an unprecedented shift to electric vehicles (EVs), ride sharing and automation, leading to smarter, safer cars, with significantly lower carbon footprints than internal combustion engine vehicles.

Other enabling technologies also occasionally catch the headlines. Batteries are the key to both renewable energy and electric vehicles. Their storage capacity can provide a solution to the intermittency of solar and wind energy and so enable these renewable sources to provide electrical baseload—the basic minimum demand over a long period—to the grid. Better and cheaper batteries will lead to longer range, faster charging and affordable EVs.

Investment is scaling up around the world. It is estimated that two dozen gigafactories—the size of one already being built by Tesla, in Nevada—will be needed to meet EV demand alone in the next decade, an investment of tens of billions of dollars. Add the need for energy storage from wind and solar farms and a massive industrialisation programme is clearly beginning around battery production.

New developments are improving the outlook on cost and storage capacity. Lithium-ion batteries have gone from $1,000 (£773) per kWh in 2010 to $125 today—with $100 and below projected by the end of the decade. This dramatic drop is enabling rapid price reductions in EVs while their range is doubling every few years. Solid state batteries, manufactured with processes similar to those used in the semi-conductor industry, could drive costs down even further. This will lead to faster adoption of EVs and to even more deployment of solar and wind energy as the intermittency issue is addressed.

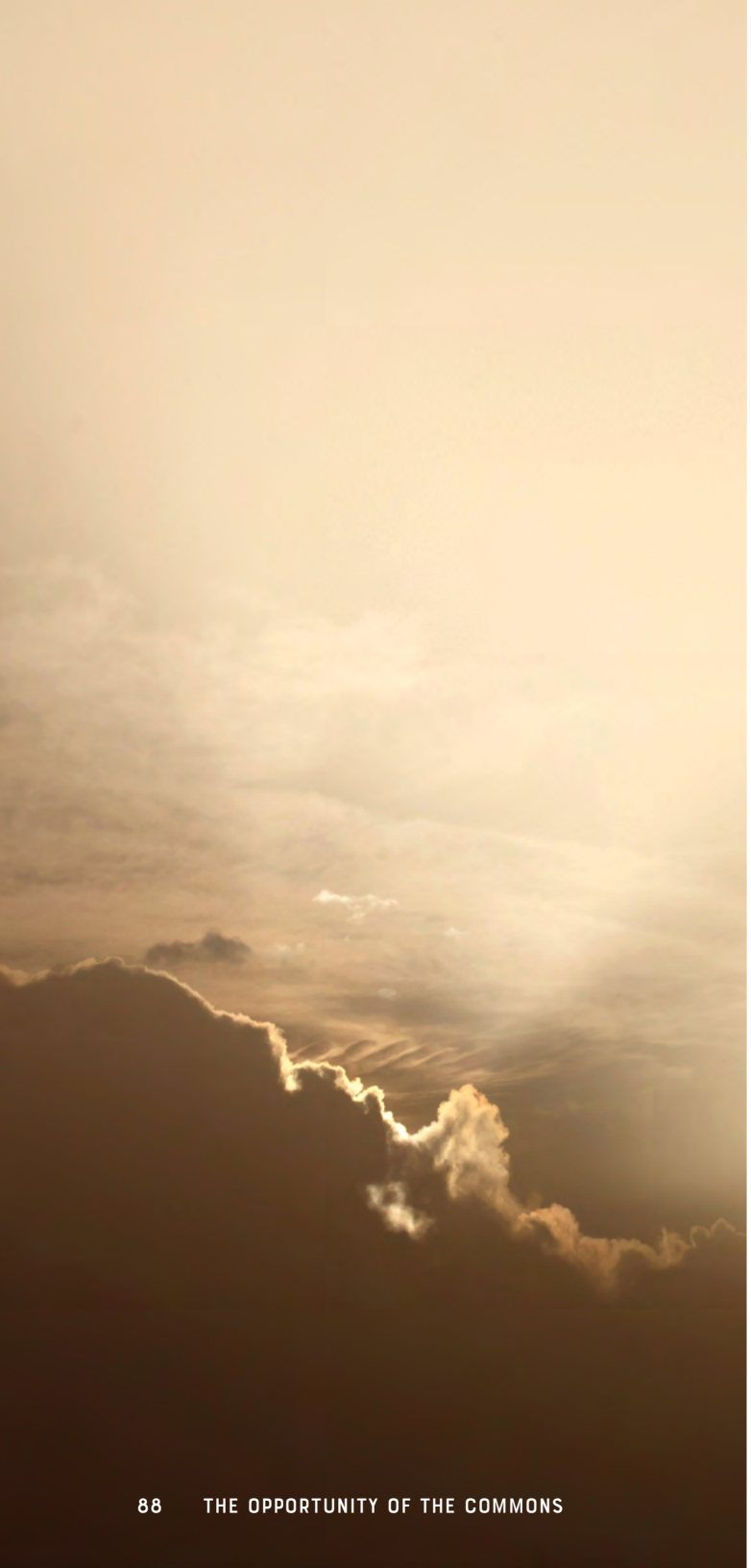
Other changes, of potentially even greater scale, are less well understood. Nuclear fusion is advancing rapidly as a realistic pathway to energy generation, without the risks—from waste, accidents and proliferation—associated with fission. Several teams around the world are pursuing commercially viable fusion reactors which, if successful, hold the promise of unlimited clean energy at a very low cost. The implications for our climate, and the world economy, would be immensely positive.

Relying on oil for transport is also being challenged by new pathways to electrifying aircraft. Short haul electric air transport—with a range and capacity similar to that of a helicopter, and costs equivalent to operating a car—is just years away and will revolutionise short haul air travel, and even personal transport within cities.

Take another step back, and consider our understanding of the planet, the climate, the oceans and the global commons. The miniaturisation of technology and rapid improvements in distributed sensors are opening up innumerable possibilities for data collection. The ability to reuse rockets is causing the cost of accessing space to plummet, potentially a hundred times over. This will mean more satellites in orbit and, in the near future, many more humans traveling into space.

Thus our ability to monitor, and understand the planet will improve significantly. Progress in automation and sensors will also allow us to gain real time understanding of what is happening at and below the surface of the oceans that cover four fifths of the planet.

A world in which we have a better understanding of the climate, the environment and the global commons as a whole will also be one in which electricity is cheap, plentiful and clean, and where people and goods move safely and without pollution. Deploying such exciting new technologies at scale will turn dreams of a low carbon future and a new wave of economic prosperity into reality.



PROTECTING THE CLIMATE AND THE OZONE LAYER TOGETHER

MARIO MOLINA
Winner of the Nobel Prize for Chemistry for his Work on Ozone Depleting Substances

The Montreal Protocol is a unique, planet-saving treaty

On 16 September 2017, the world celebrates the 30th anniversary of its most effective global environmental agreement ever created. Indeed, the Montreal Protocol on Substances that Deplete the Ozone Layer has a claim to be one of the most successful treaties of any kind. The first and only treaty ever to be ratified by all the world's nations, it has succeeded in putting the stratospheric ozone layer on the road to recovery, and done more than any other measure, so far, to slow down climate change.

The danger that chlorofluorocarbons (CFCs) posed to stratospheric ozone was the first recognised human threat to the global atmosphere. The ozone layer shields terrestrial life from deadly ultraviolet radiation, and if it had continued to be depleted, the worldwide consequences would have been catastrophic, with many millions of people developing skin cancer and widespread damage to crops.

In 1974 F Sherwood Rowland and I published a scientific paper that concluded that CFCs were migrating to the upper atmosphere and affecting the ozone layer. This was initially disputed by many, but

confirmed practically beyond doubt by later scientific and empirical evidence. While the chemical industry initially questioned the science, they subsequently agreed to develop replacement chemicals that would not affect the ozone layer.

Then, a decade after our original paper, research revealed a "hole" in the ozone layer above Antarctica. The magnitude of the ozone loss was so unexpected that the scientists who made the discovery originally thought that their instruments were faulty. But again, empirical and scientific evidence both confirmed its existence, and that it was caused by CFCs and related chemicals.

This catalysed the successful development of the Montreal Protocol, concluded in September 1987. Initially the countries that were party to the treaty agreed just to reduce CFCs by 50% over 12 years. But, at their first annual meeting after it came into force, they increased the reduction to 75% by 1998 and in 1992 they tightened it again to a 100% phase-out by 1996.

The treaty aimed at starting, then strengthening, action. And success has continued to breed still more success. Over three decades it has reduced nearly 100 ozone-depleting chemicals by nearly 100%. The ozone layer is healing, and is likely to recover in several decades.

That, however, is only the start. The same chemicals that attacked the ozone layer also warmed the climate. Thus, in phasing them out, the Montreal Protocol has made a large contribution to protecting the world's climate.

The Montreal Protocol is, therefore, indeed a unique, planet-saving agreement. And it is still getting stronger, and playing a critical role safeguarding the global commons of the planetary system.

Last October in Kigali, Rwanda, the world's governments agreed to a far-reaching amendment to the protocol which will phase down the use of hydrofluorocarbons (HFCs), one of the six main pollutants causing global warming. HFCs were introduced as ozone-friendly alternatives to CFCs and other damaging chemicals, and so helped protect the ozone layer. But they threatened the climate, because molecule-per-molecule they are up to 4,000 times as powerful in warming the atmosphere than carbon dioxide—and their use has been rapidly growing, by some 10-15% a year.

The adoption of the amendment—after an eight-year campaign, initiated by the Federated States of Micronesia and other low-lying countries—will prevent the emission of the equivalent of 100bn tons of carbon dioxide by 2050; and avoid up to a half degree Celsius of warming by the end of the century. Put another way, had it not been passed—and HFC use continued as expected—the amount of fossil fuels that could still be burned without dangerously affecting the climate would have shrunk by 30-60%.

Moreover, this already enormous benefit for the climate could possibly be doubled. Emissions could be cut twice as much—to the equivalent of 200bn tons of carbon dioxide, 34 years of current US emissions, by mid-century—if the efficiency of air conditioners and other cooling appliances is improved as HFCs are withdrawn.

When other refrigerants have been replaced in the past, manufacturers have seized the chance to upgrade components, thus improving energy efficiency. Besides dramatically reducing emissions, taking similar measures now would save consumers money and expand access to affordable cooling, since energy use accounts for 80% or more of the lifetime cost of an air conditioning unit.

These measures can, and must, complement the international action enshrined in the Paris agreement on climate. Governments should quickly ratify the Kigali amendment, and where possible, consider accelerating the phase-down schedule for HFCs. Cutting emissions of these damaging chemicals has a much faster effect than action against carbon dioxide because they stay in the atmosphere for only a decade and a half on average, compared to carbon dioxide, where a significant fraction stays for hundreds and even thousands of years. Governments must also seize the opportunity to improve the efficiency of air conditioners and other cooling products and equipment, in parallel with the phase down of the HFC refrigerants.

Avoiding dangerous climate change may often seem hard. But the 30-year-old Montreal Protocol has not just made it easier by eliminating several dangerous greenhouse gases, but it has shown how the world can unite to avert a global threat to the atmosphere, and offers lessons for how the agreement made in Paris can now be strengthened. Perhaps most important of all, it provides hope and inspiration for the daunting task ahead.

A GOLDEN OPPORTUNITY TO CUT MERCURY POLLUTION AND PAY MINERS FAIRLY

PHAEDON STAMATOPOULOS
Director, Refining and Bank Products, Argor-Heraeus SA

Banning the irresponsible use of the toxic metal under the Minamata Convention can save miners' health and increase their incomes

Every year over 1,400 tonnes of mercury are released into the environment through artisanal and small scale mining for gold. As part of the process of extracting gold particles from rock, miners mix the toxic substance with ore containing gold and the two metals combine to form an amalgam. This is then heated to recover the gold by boiling off the mercury, which is released into the atmosphere and ecosystems.

This release creates an extremely high risk of poisoning, to which the miners are very vulnerable. The effects on their health—muscle weakness, poor coordination, kidney problems, cognitive decline and eventual death—are devastating.

Yet, while they often suffer these consequences, the world's 10–15 million artisanal and small scale miners typically produce only a few kilos of gold every month. Their entire output totals 350 to 400 tonnes

of gold a year, compared to the 2,600 to 3,100 tonnes from large scale industrial mines, which can produce much larger quantities of the precious metal in a sustainable way.

Unlike industrial mines, these small scale miners do not have direct access to the gold market. Most of their gold is sold to intermediaries who pay approximately 65–70% of the market price, and on whom they often depend to purchase the illegal mercury they use. These intermediaries pay the millions of miners some $11bn (£8bn) each year, but sell their gold on for $16bn, depriving them of $5bn.

To tackle this situation, we must do two things: ban the irresponsible use of mercury and bring responsibly extracted gold to global markets at its right price.

The first of these is to be accomplished by the Minamata Convention, an international treaty designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. Named after the Japanese coastal city where local people suffered mercury poisoning after eating contaminated fish and shellfish, this latest addition to the body of international law protecting the global commons came into force last month. Its first Conference of the Parties, the convention's decision-making body, is taking place this week.

The convention entails using mercury responsibly, gradually reducing its use, applying alternative technologies and optimising current mining yields, and will thus encourage extracting gold in a safe and socially and environmentally responsible way.

The Global Environment Facility (GEF), a financial mechanism for the convention, has undertaken a new initiative, Global Opportunities for Long-term Development (GOLD) in the Artisanal Small Gold Mining Sector. As part of it, Argor-Heraeus, and other companies, have an opportunity to source gold fairly from artisanal markets.

Argor-Heraeus is in the middle of the supply chain, between miners who need their gold refined, and manufacturers who need semi-finished products to make jewellery, which accounts for half of all mined gold, and watches. It can therefore accomplish the second objective, by purchasing gold directly from artisanal and small scale miners at a fair market price. It can also guarantee to buy any quantity, thus allowing the miners to plan for increasing their capacity.

These are ambitious tasks but the potential for rewards is very high. Every formal community of these miners, which works to reduce, and eventually eliminate, mercury will see immediate and direct benefit. With gold purchased at a fair market price, earnings will increase. Under the GEF programme, extraction efficiencies will also increase, while the health and environment of the miners will be safeguarded. And consumers of products containing gold- such as the luxury, watch, and electronic industries—will also benefit, as they are increasingly sensitive to responsible and traceable sourcing of their gold.

As the golden link, Argor-Heraeus wants to create, and help propagate, new gold links, between the global population of artisanal and small scale miners and consumers; from the side of a mountain or a hole in the ground to a watch component or jewel. Thus working together to ban the irresponsible use of mercury can be a force for good, impacting the lives of millions of people worldwide.

"With gold purchased at a fair market price, earnings will increase."

HOW CHANGING REFRIGERANTS WILL HELP SLOW DOWN GLOBAL WARMING

DURWOOD ZAELKE
President, Institute for Governance and Sustainable Development

The Kigali amendment to the Montreal Protocol could stop a full degree of temperature rise

One year ago Monday, the world's governments took the single biggest step yet to curb global warming. Meeting in Kigali, Rwanda, they agreed to eliminate one of the six main pollutants causing climate change, thus avoiding a full half a degree of warming by the end of the century.

Their historic agreement, the Kigali amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, is also the first international measure to address the urgent need to take fast action to reduce the rapid rise in global temperatures before it pushes the world's climate past crucial tipping points into uncontrollable change. It is thus probably the most important decision yet to protect the global commons.

Even before last year, the 30-year-old Montreal Protocol was well established as the most successful environmental treaty—and one of the most effective of any kind—ever struck. Originally designed to protect the Earth's vital ozone layer, it has cut almost 100 substances that attack it by almost 100%, putting it on the path to healing.

And it has had another an equally important, collateral consequence—slowing climate change. The chemicals that deplete ozone are also greenhouse gases, something scientists first told us in 1975. By phasing them out, the Montreal Protocol had by last year done five times as much to control climate change as the Kyoto Protocol, which specifically set out to address it.

The Kigali amendment—agreed following an eight-year campaign, kicked off by the Federated States of Micronesia and other countries threatened by sea-level rise—greatly adds to that. It will phase down the use of a class of substances—hydrofluorocarbons (HFCs)—brought in as substitutes for ozone-depleting refrigerants.

HFCs don't destroy stratospheric ozone and helped beat the threat of ozone depletion, but are up to 4,000 times more potent as greenhouse gases than carbon dioxide. And, though their use is still at relatively low levels, it has been soaring by some 10-15% a year, making them one of the biggest coming threats to the climate.

The legally-binding Kigali amendment will curb HFC use by over 80%. It places mandatory phasedown requirements on all countries, starting with developed ones. These are to begin reducing their use in 2019, the vast majority of developing countries are to follow in 2024, apart from 10 lagging ones—including India, Pakistan and Saudi Arabia—who will start in 2028.

The effect will be to prevent emissions equivalent to 90bn tonnes or more of carbon dioxide from contributing to global warming by 2050, and avoid up to 0.5C of warming by the end of the century. This is a highly significant contribution when governments are trying to keep the increase in temperatures since the pre-industrial era to well below 2C—and aiming for no more than 1.5C.

Had HFC use continued to increase as had been expected, the "carbon budget" for a safe planet, including the amount of fossil fuels that could prudently be burned, would be cut by 30-60%.

Importantly, the HFC cuts also act fast, and speed is essential. Reducing emissions of carbon dioxide takes time to take effect, because the gas lasts so long in the atmosphere, with a quarter of it remaining aloft for five centuries. Slow moving climate solutions are not sufficient to solve such a fast-moving problem as climate change.

Self-reinforcing feedback mechanisms are already kicking in, where initial warming feeds upon itself to cause still more, propelling an accelerating risk of irreversible and almost certainly catastrophic impacts. The melting of reflective Arctic sea ice, for example, exposes dark water which absorbs heat, and accelerates melting. This effect alone has warmed the planet by 25% as much as all the world's emissions of carbon dioxide between 1979 and 2011.

HFCs are just one of several pollutants which quickly fall out of the atmosphere and whose reduction therefore offers a much more immediate effect to slow warming: the others are black carbon soot, methane, and tropospheric ozone. Cutting such "short-lived climate pollutants" could reduce warming by more than 0.5C by mid-century, and even more in the sensitive Arctic, while aggressive cuts in carbon dioxide can do at most half of that.

The Kigali amendment is at the leading edge of a broader climate strategy that tackles both carbon dioxide and short-lived climate pollutants at the same time, while also learning how to accelerate the removal of carbon dioxide already in the atmosphere.

It also packs a second punch, with the potential to double its benefits in slowing climate change, avoiding up to an entire degree of warming. A change of refrigerant offers manufacturers a chance to improve their air conditioning units and other appliances and make them more energy efficient. They did this in the past when phasing out ozone-depleting chemicals, and similar measures during the HFC phasedown could avoid emissions equal to another 100bn tonnes or more of carbon dioxide, and possibly avoid up to another 0.5C of warming.

Making the world's air conditioners and other cooling equipment more efficient is urgently needed. The world is poised to add 700m air conditioning units to its present 900m by 2030, with the total soaring to 2.5bn by 2050. Ownership of units in urban China has already increased from 5% to over 100% (with many households having more than one) in just 15 years. India and other hot developing countries are about to follow suit.

Increased efficiency would also lower the cost of cooling for families, since energy use accounts for over 80% or more of a unit's cost over its lifetime. And it would greatly benefit national economies. Improving the efficiency of air conditioning in India by just 30%, for example, could save enough electricity to avoid building up to 140 medium sized power plants to meet peak demand by 2030 and up to 500 by 2050.

This would save billions in construction costs and billions more by reducing imports of the fossil fuels that would have been burned in them. It would also reduce deadly air pollution—the world's leading environmental killer—especially since the peak power demanded to run air conditioners on hot days is usually supplied by the oldest and dirtiest plants.

The world has the opportunity to pursue this double-fisted strategy. Nations must urgently ratify the Kigali amendment, and consider phasing down HFCs even faster than it stipulates. And they must seize the opportunity to improve the energy efficiency of air conditioning and other cooling equipment at the same time.

The Montreal Protocol has never let us down, and as it turns 30 this year, we should thank it for its planet-saving actions; and urge it on to do still more to save the climate and our global commons.v

"The world is poised to add 700m air conditioning units to its present 900m by 2030."

AFRICA'S IMPALA-LIKE LEAP INTO A GREEN INDUSTRIAL ECONOMY

CARLOS LOPES
Professor, University of Cape Town, and member, the Global Commission on the Economy and Climate

How the continent can avoid the polluting stage of industrialisation, and go straight to low carbon prosperity

Africa faces many economic challenges—but, within them, lie significant opportunities. One is for the continent to leapfrog over the polluting, resource-intensive stage of industrialisation, and transform directly into a low-carbon, climate resilient economy that will deliver jobs and help lift people out of poverty.

Avoiding the well-worn path of industrialisation that runs through decades of increasing, but inefficient, use of energy and water resources, is undoubtedly attractive. But how does an entire continent pull off such an agile manoeuvre? As with all big ideas, it will take a vision and a plan. The good news is that many African leaders share this vision and determination—and that there is a way to realise it.

First, Africa needs to shift from a low-productivity agricultural economy, to a high-productivity manufacturing one. This is a lofty goal that, in no small part, relies on the removal of barriers to investment, but the rewards are potentially great. Across Africa, manufacturing employment remains low: most of our people are working in agriculture.

A robust manufacturing economy—in which new technologies are not only built but invented in Africa—would open up global markets and create millions more jobs, particularly for low and semi-skilled workers, youth, and women. These will be needed, since more than 450 million new workers are expected to enter the African labour market by 2035.

Second, we need economic growth that protects Africa's natural environment, and the Earth's global commons, in ways that increase the welfare of today's and tomorrow's citizens, and create new opportunities for development. Without green growth, Africa—already expected to be the region worst affected by climate change—will be even more vulnerable to its impacts. In practice, that means more efficient use of water and energy, the adoption of cleaner technologies, and governments fostering new paths for structural transformation.

Third, and equally important, we need the innovation and risk-taking of Africa's entrepreneurs. They lead small, gazelle-like businesses that are dynamic and quick, with high productivity and potential for rapid growth. Entrepreneurs can thrive in small-scale clean energy industries, such as household solar, clean stoves, waste management and sanitation.

Together, economic transformation, green growth and entrepreneurship can propel Africa's leap into a green industrial revolution. If the continent collectively orchestrates this effort, global conditions are ripe for this transformation to take hold.

Green technology is progressing and its costs are falling every day. Global green markets are growing at a breathtaking pace, trading everything from wind turbines to organic fertilisers. In 2016, the world invested $241.6bn (£183.5bn) in renewable energy, double the amount in fossil fuel investment. "Industries without smokestacks", such as ecotourism and remote IT support, are burgeoning—bringing the economic advantages of manufacturing without the environmental costs.

Africa has vast clean energy resources that can take a lead in the global renewable energy market. It has some of the best biomass, geothermal, hydropower wind and solar resources in the world and we have only just scratched the surface of our full potential. The already unprecedented pace of innovation is evidenced by a rapid growth of pay-as-you-go solar home systems linked to mobile payment technology. More than 450,000 such systems have been deployed in east Africa alone, and some 60 million Africans may already may be using off-grid renewable electricity of some kind.

This is not a futuristic vision, but a description of a future that is already here. Safi Sana, a Ghanaian company that builds public toilets in urban slums and turns the waste into energy, is just one example of this. It is opening a new factory that will provide sanitation for 125,000 people and green power for 7,500. Raymond Ategbi Okrofu, its country manager for Ghana says: "The benefits of this project are not just electricity: you have sanitation, agriculture, job creation and others." The company's model can be scaled or replicated in various parts of the country making it part of the solution for the 700 million people currently lacking access to improved sanitary facilities worldwide.

Many policy directives and incentives are needed to foster this transformation. Amongst them are: adopting green urban policies to promote compact, connected, and coordinated cities; strengthening "export push" policies, including support for green exports by identifying markets and improving certification and standards; and investing in sustainable infrastructure and increased infrastructure efficiency.

If we get the policies right, we can have fuel-efficient stoves in every village, dynamic industries built on recycled inputs, and urban sanitation that provides clean power for all. Africa is already growing, and fast. Whether it can grow based on a sustainable, inclusive economy depends upon whether we can harness this change and propel ourselves into green industrial revolution. It's time for us to leap like an impala, into the future.

THREE STEPS TO ACHIEVING A SUN-RICH FUTURE

PER ESPEN STOKNES
Chair, Centre for Green Growth, Norwegian Business School

Owning a diesel car in 2030 will be as old-fashioned as using a donkey to get around today

The mass-produced car needed around 60 years to spread from 10% to 80% of American households; the radio needed 15, and colour TVs spread even quicker. In the western world as a whole, the internet took around eight years to expand its coverage in a similar way, while smartphones needed just six, from 2009 to 2015. So what about solar and wind power?

Understanding the impact of innovations involves looking at how quickly a technology doubles in size or volume. In the previous 10 years, the amount of solar power installed each year has doubled more than four times from 3GW in 2006 to 75GW in 2016. There's a well-known riddle about lilies on a lake, whose numbers double every day. If the lilies blanket the entire surface after 30 days, when do they cover half of it? On the 15th day? No, as you'll have worked out, on the 29th.

The diffusion of innovations forms an S-curve; slow at first, then accelerating, and then flattening out when nearly everyone has the new technology. The faster the growth, the steeper the curve.

The S-curve also brings, and benefits from, falling costs. Each time the volume doubles, costs come down by around one quarter. These have gone through a little-noticed revolution. Since the 1970s the cost of photovoltaic solar power has dropped by 99%. From 2008 to 2016 alone, it fell, incredibly, by more more than 80%.

As prices for solar and wind power come crashing down, they shatter the coal and gas price floor, and continue downwards. These are already—or very soon will be—the cheapest power for anyone anywhere. All 7 billion of us must re-programme our assumptions of what combinations of cheap solar, wind, storage and smart grids will bring.

The impact of these price drops can be seen in the increased popularity of solar technology. Every day in 2015 around 500,000 solar panels were installed—mostly in China, India, Japan and the US. By 2016, this had already risen to 800,000 panels per day. Now, in 2017, more than 3 million people head out to work each day to set up ever more solar panels.

We estimate that—to have a good life in 2050—a person will use around 2,500 kWh a year for transport, the same for heating and cooling, and 5,000 kWh for producing food, clothes, gadgets, entertainment, and everything else. That adds up to about 10,000 kWh. In Nordic countries today, we use around 14,000 kWh per person-year—the world's highest amount—in quite wasteful ways.

Suddenly people everywhere can profitably start building a sunny future without plundering the planet. This can happen in three main steps.

Step 1: Power
We can build more sun and wind power over the next 20 years, doubling annual installations just three more times—from 150GW of sun and wind power technologies now, to 1,200GW new power by around 2037 (see figure 1). Continuing to add 1,200GW per year for another decade will give all 9 billion people then on Earth enough power. Finally, there'll be "power to the people". It will get cheaper and cheaper to the point where the cost of generating an extra kWh is close to zero.

How much space will it all take? Surprisingly little. Meeting the entire world's energy needs only with solar, would require just 1% of the Sahara desert. Of course, in practice, all the panels won't go there: they will be put wherever needed. And solar will be combined with windmills and storage for power when there is little sun or wind.

Step 2: Transport
Electric cars, buses and trucks will soon be cheaper to buy, own and run than those powered by fossil fuels. They will use ever better and cheaper batteries and hydrogen, charged or produced from solar and wind. The cars will accelerate quicker. They'll help pay electricity bills by stabilising the grid.

Owning a diesel car in 2030 will be as old-fashioned as using a horse or donkey to get around today. Self-driving electric vehicles will come and pick people up when needed. Ships and planes will eventually become electrified as well.

Step 3: Heating
Other fossil energy use—for heating and cooling buildings and materials—can be cut by efficient design, better insulation and energy storage. And heat-pumps can provide the remaining heating needs. When these run on solar or wind power, demand for fossil fuels will approach zero.

These three steps, taken in parallel, will profitably cut demand for coal, oil and gas by 70% by 2040—slowing global warming. They can and will give everyone a good life while starting to restore the global commons.

Many fossil fuel companies, of course, will fight against this with all their lobbying power and dirty money. But they will go bust if they don't reinvent their business models.

All the building blocks for kick-starting this renewable economy are now available. But two main challenges remain. Can we both increase investments quickly enough, and solve energy poverty?

Around $300bn (£227bn) is now invested in renewables every year—a huge amount. But, if the revolution is to happen fast enough, this must triple to $1tn by 2030. So we must support government action until markets grow to that level.

Meanwhile, 1.4 billion people still lack access to electricity. Will the new solar power be only for the rich? Large financing of small-scale power with storage on rooftops in cities, slums and villages—everywhere—is critical. If all the money goes to big solar parks for big utilities, the poor won't get access to clean power. More crime, refugees, and urban breakdown will follow.

Solar power for everyone can give real energy democracy. There's daylight and wind freely available for all. But producing this freedom won't happen by itself. We need more leadership, political will, entrepreneurship and crowdfunding. We should support the NGOs and new companies, such as Sweden's TRINE investment service, that are on this job.

Above all, making this bright sun-rich future happen quickly enough needs all of us to support it: telling and re-telling the story of these three steps with our voices and votes, our money and actions.

"Solar power for everyone can give real energy democracy. There's daylight and wind freely available for all."

HUMANITY USES 70% MORE OF THE GLOBAL COMMONS THAN THE EARTH CAN REGENERATE

MATHIS WACKERNAGEL, *CEO and co-founder of Global Footprint Network*

Measuring humanity's ecological footprint is essential for keeping its demands within the planet's biocapacity, a minimum requirement for sustainability

Households and governments who want to succeed track both expenditure and income. Businesses similarly keep a keen eye on their balance sheets. So what does the physical balance sheet of our biggest household—the Earth—look like?

The income side would tell us how much our planet provides in matter and energy. The expenditure side would tell us how much material and energy people use—or what we call humanity's ecological footprint.

Ecological footprint accounting was developed to address the question: how much of the biosphere's regenerative capacity—or biocapacity—does human activity demand? Global Footprint Network measures this human demand for ecosystem services by adding up the space occupied by food, fibre and timber provision, space occupied by infrastructure, and the absorption of carbon dioxide in the atmosphere. Indeed, carbon dioxide emissions take up approximately 60% of humanity's ecological footprint.

This audit can be done at any scale. Analysing the accounts for the entire world enables us to compare the material demands of humanity against the size of the global commons.

Global Footprint Network's most recent data show that humanity overshoots the regenerative capacity of our global commons, and now demands about 70% more than what the biosphere can regenerate. In other words, we are using 1.7 Earths.

Keeping humanity's ecological footprint within the planet's biocapacity is the minimum threshold for sustainability. That threshold can be exceeded for some time, just as households can spend more money than they earn by dipping into savings, thereby depleting their assets. But persistent ecological overuse inevitably depletes nature's stocks, through the collapse of fisheries, soil loss, freshwater overuse, over harvesting of forests - or leads to climate change from the accumulation of carbon dioxide in the atmosphere.

The Stockholm Resilience Centre has identified nine planetary boundaries, required to maintain the integrity of healthy, productive ecosystems. The UN sustainable development goals (SDGs)bring together a vision for safeguarding the health of the global commons while ensuring flourishing lives and wellbeing for everyone. The Stockholm Resilience Centre calls this vision the safe operating space. Oxford University economist Kate Raworth adds the social dimensions and calls it doughnut economics—with the outer circle of the doughnut representing the ecological boundaries within which we need to operate, and the inner one the social necessities required for thriving lives for all.

The core idea of socially and ecologically safe operating space was quantified for the first time in 2002 by Aurélien Boutaud. He combined the Ecological Footprint and United Nations Development Programme's (UNDP)'s Human Development Index (HDI) to track sustainable development outcomes country by country, city by city. His approach

has evolved into the HDI footprint diagram. His framework has been used widely, by those including UNDP, UN Environment, PBL Netherlands Environmental Assessment Agency, and WWF's Living Planet Report. It even serves as the foundation of the Philips sustainability programme.

One axis of the diagram is sustainability—or to what extent development can be supported within the Earth's means. It is measured by the ratio between what people take compared to what the global commons can renew. The second axis, development, is measured by HDI, which captures income, access to basic education, and longevity.

Global sustainable development occurs where these two dimensions intersect. Available biocapacity is now 1.7 hectares per person. Some of this, however, is needed to support wildlife—and we also need to leave room for a growing human population. So the average ecological footprint per person worldwide needs to be significantly smaller if we are to live within nature's means.

FIGURE 1: MAPPING SUSTAINABLE DEVELOPMENT OUTCOME: HDI AND THE FOOTPRINT OF NATIONS, IN 2013

The figure on the left shows the latest results for most countries of the world (2013), comparing their footprints per person against the world's per capita biocapacity, to show how far their development models could be replicated worldwide. Most countries do not meet both minimum requirements. Since every country has different amounts of biocapacity within its natural boundaries, this analysis can be adapted to each country. Using a scale from zero to one, UNDP considers an HDI of more than 0.7 to be "high human development", with 0.8 "very high".

For global sustainable development to occur, the world average would need to be in the marked panel at the bottom right (the global sustainable development quadrant). This is defined by an average footprint of less than 1.7 global hectares per person and an HDI score of more than 0.7. Yet the quadrant is ominously empty. The HDI score of the UK is 0.9, but its ecological footprint per person is five global hectares, high above the sustainable development quadrant. India has an HDI score of 0.6, and an ecological footprint per person of 1.1 global hectares, suggesting the need to increase the quality of life of citizens and the footprint.

Global sustainable development is necessary for a thriving future. The SDGs give us strategies on how to get there. Global Environment Facility's (GEF) global commons initiative makes obvious the dependence on Earth's physical health. It reminds us that our fabulous planet enables the wellbeing of all, if we manage it carefully.

Measuring whether we are achieving these desired outcomes enables us to take charge of the future we want. We can explore countries' resource balances, and compare them with what would be in their economic self interest. And we can allocate our budgets and choose our development strategies more effectively so that they serve the goals we have wisely chosen through the SDGs and the Paris Climate Agreement.

Therefore, Global Footprint Network firmly endorses the GEF's initiative, which stimulates the collaborative effort needed to create a world where all thrive within the means of the planet's regenerative capacity.

HOW THE WORLD RALLIED TO REPAIR THE OZONE LAYER

CATHERINE MCKENNA
Minister of Environment and Climate Change, Canada

Celebrating 30 years of success in combating a pressing global crisis

When you look up at a cloudless blue sky, you might think it goes on forever. And yet, our planet's atmosphere is actually made up of several layers. One of these, the ozone layer, is among the atmosphere's most vital components. It acts like a shield, absorbing UV radiation from the sun and protecting us from its harmful effects.

Growing up in Canada in the 1980s, I remember learning that the thinning of the Earth's ozone layer was one of the most pressing global environmental crises. The world was alarmed after the discovery of a hole in it over the Antarctic, and concerned about its potential health and environmental impacts if it continued to grow.

What we did to fix this problem was remarkable.

Thirty years ago, countries gathered in Canada's second largest city to sign the historic Montreal Protocol on Substances that Deplete the Ozone Layer. In the years that followed, this became the first treaty in the history of the United Nations to achieve universal ratification by all its member countries—making it one of the most successful, global environmental agreements ever.

Protocol's accomplishments over the last 30 years speak for themselves:

- More than 99% of ozone-depleting substances controlled under the Montreal Protocol have been eliminated.
- The ozone layer is on track to full recovery by the middle of this century. Up to 2m cases of skin cancer may be prevented globally each year by 2030.
- Emissions of the equivalent of more than 135bn tonnes of carbon dioxide have been prevented. Savings worth more than $2.2tn (£1.6tn) are expected by the middle of this century in health and economic benefits due to avoided damage to industries such as agriculture and fisheries.

This is an unprecedented, unmatched success story of governments, experts and ordinary people acting to overcome one of the greatest threats the world has faced and to safeguard the Earth's global commons. And now this combination of science, innovation, and political leadership has inspired a new global effort under the Protocol.

Last October all 197 Montreal Protocol partner countries agreed in Kigali, Rwanda, to phase down hydrofluorocarbons (HFCs). These replaced chemicals in air conditioners, refrigerators and foam products that were harming the ozone layer, but some are potent greenhouse gases hundreds to thousands of times more powerful than carbon dioxide. Phasing down HFCs will help avoid up to 0.5C of global warming by the end of the century, while continuing to protect the ozone layer.

Canada was among the first countries to ratify the Kigali Amendment to the Montreal Protocol. And in the past few days a historic moment was reached when the number of countries doing so reached over 20, enabling the Amendment to enter into force on 1 January 2019.

This is a major development. By phasing down HFC production and consumption under the Montreal Protocol, we will reduce future impacts of climate change worldwide. Fewer HFCs will lessen the economic costs associated with sea level rise, drought, and floods, among other things. The phasedown also supports the key goal of the Paris climate change agreement to keep global temperature rise well below 2C.

The Montreal Protocol remains to this day one of the most successful examples of the world working together to address global environmental challenges. Let's not forget that although this was an achievement on a super heroic scale, it wasn't done by one super hero, but by millions of people. We have all been ozone heroes, as a new campaign puts it.

But we cannot stop here. This week Canada is hosting the 30th annual meeting of the Protocol in Montreal. We must ensure a global effort by encouraging more countries to join those who have already ratified it. Bold action will bring real results. By working together we can address climate change, protect the environment, and support economic growth today and for future generations.

CHANGING HOW A BILLION PEOPLE EAT, THROUGH GAMES

PEGGY LIU
Chair, JUCCCE, China, and Advisor to the EAT Foundation

Educating young children on diet can preserve both their health and the planet

Before every meal, the Maori people of New Zealand say a simple thanks for their food. A child might recite:

> *"Welcome the gifts of food from the guardian of the forest, the God of peace and agriculture, the guardian of wild and uncultivated food, the guardian of the sea, the God of rivers and streams. Ranginui Sky Father and Papatuanuku Earth Mother, bless our food as wellbeing for our body. Feed our spirit with the food of wellness. Share food for me, food for you, food for us all. The breath of life."*

In most of the industrialised world, the knowledge embedded in this blessing of how food is integral to everything—and gratitude for the community that brought it to our plates—has been lost. Our bodily wellbeing, our Earth, our economies, our society, our spirit have all wasted away with it. We ignore the disastrous consequences of our choices; of the sugary garbage we have become addicted to and the toxins we feed our food and soils.

Some 3 billion people, around 40% of the world's population, face some form of malnutrition. Stunting from hunger is decreasing, but obesity has nearly tripledworldwide in four decades since 1975: by 2015, about 12% of all adults and 5% of all children were obese. In most places,

more people die from being overweight than underweight. Diabetes will be the world's seventh largest killer by 2030.

China first introduced ultraprocessed foods—combining processed ingredients—in supermarkets in 1990. Since then, in one generation, the proportion of children who are overweight soared from 5% to 20%. With one fifth of the world's population, China now has one third of its diabetics. Indeed, Dr Xu Zhangrong, deputy secretary of the China Diabetes Society says that the disease could singlehandedly bankrupt the Chinese healthcare system.

The food system also has a major effect on the global commons. Professor Johan Rockström, executive director of the Stockholm Resilience Centre reports that it is responsible for approximately 30% of greenhouse gases: 15% come from beef alone. Some 70% of fresh water supplies are used by, and polluted by, agriculture.

No wonder David Nabarro, special adviser to the United Nations Secretary-General on the 2030 Agenda for Sustainable Development and Climate Change, has said that changing diet is the single intervention that runs across all 17 global goals. Indeed, Project Drawdown, which lists the top 80 solutions for tackling carbon dioxide emissions in our atmosphere, ranks reducing food waste and eating a plant-rich diet third and fourth. Combining these food solutions could be the biggest lever for combatting climate change.

Truths about food need to be incorporated into early education, before kids become addicted to ultraprocessed sugary foods. As the food journalist Mark Bittman puts it: "We can't have a generation of healthy adults until we raise a generation of healthy children." It's easier to influence children under nine years of age, before their dietary habits have been set. And it's easier to influence adults once they become concerned parents.

Food education in schools has proved effective. Only around 5% of adults are obese in Japan and Korea, both of which have mandatory food education starting in primary school, compared to (pdf) 38% in the US.

JUCCCE, the environmental organisation I chair, is setting out to change the way young families eat. We have launched Food Heroes, one of the first food education programs in China that integrates nutrition and sustainability into recommendations on diet. Fortunately, what is good for personal health is often good for the environment too.

Our Food Heroes learn to "eat a rainbow everyday" which encourages them to consume micronutrients and promotes biodiversity where the food is produced. Teaching kids "the true costs of their meals" on air, water, soil, and landfills naturally turns them away from emission-heavy meats such as beef, which take their toll on heart health. Learning how much "sneaky sugar" is in popular drinks also reduces purchases of plastic bottles.

In constructing our Food Heroes education program, we've learned two important lessons on behaviour change.

First, food education is only useful if it turns expert knowledge into an emotional relationship with healthy foods. Nutritionists and doctors shouldn't be the only ones helping kids to choose to eat better foods. Master storytellers must be involved too.

With Food Heroes, we capture children's imaginations with a storybook world of rainbow foods, inspired by playologists such as amusement park ride designer Denise Chapman. Kids can bond with Food Hero characters that model their struggles and delights in eating meals. Character designers, TV scriptwriters, voice performers, and even spiritual practitioners help speak to kids' hearts, not just their heads. We keep kids motivated as they master the Food Heroes games over time, using gamification techniques from the Octalysis Group. The result is a curriculum in kindergarten based on play, and educational toys to turn the dining room into a Food Heroes adventure land.

Second, creating the desire to change is not enough. Kids need tools to help differentiate good from bad at every bite. This year, JUCCCE launched the Food Heroes Eco-Eaters Table, designating individual dishes as "superboost", "sidekick", "caution" or "runaway" foods. Walter Willet—former dean of nutrition at the Harvard TH Chan Public School of Health, and co-commissioner of a forthcoming Lancet Commission study on a healthy and sustainable diet—calls this dish-based approach "brilliant" because it is more actionable than counting grams of ingredients or calories.

Providing children with the desire and tools to be Food Heroes is a cost-effective way to help all countries easily reach their global goal targets by 2030. Ministers of health and education should work together to incorporate food education into core curricula. By starting with saying thanks together before eating at the school cafeteria, we can all become Food Heroes who know how to grow, prepare and share food with love for ourselves and the Earth.

SEVEN STEPS TO AVOID THE IRREVERSIBLE DEGRADATION OF NATURE

W. JOHN KRESS
Distinguished Scientist and Curator of Botany, National Museum of Natural History, Smithsonian Institution

Scientists need to leave their labs to address the Anthropocene

This summer 7,000 botanists from 77 countries—attending the largest international conference of plant scientists in nearly a decade—agreed, almost unanimously, to focus their research and educational efforts on finding solutions to increasing environmental degradation, unsustainable resource use, and biodiversity loss.

Time and again—throughout the XIX International Botanical Congress in Shenzhen, China—botanists from around the world recognised that our planet is changing in ways that will substantially affect the social, political, and economic frameworks of our lives for the foreseeable future. And everyone there agreed that these immense changes are the result of unbridled human activities across the planet. The Anthropocene is here.

The Shenzhen Declaration on Plant Sciences, conceived and composed by a broadly representative group of scientists and endorsed by the Congress, aims to raise awareness that botanists need to take social

and political action if the accelerating rate of environmental change around the globe is to be slowed. It calls on all scientists to commit to immediate action in both their lifestyles and their research programmes to find solutions before the crossing of a threshold that will inevitably lead to irreversible degradation of societies, natural habitats and biodiversity. Although many scientists are convinced that the threshold has already been crossed, the botanists who endorsed the Declaration believe that there is still time for answers to be found and implemented. However, no-one disputes that time is short.

The Declaration outlines several priorities:

1. to become responsible scientists and research communities pursuing plant sciences in the context of a changing world;
2. to enhance support for the plant sciences to achieve global sustainability;
3. to cooperate and integrate across nations and regions and work together across disciplines and cultures to address common goals;
4. to build and use new technologies and big data platforms to increase exploration and understanding of nature;
5. to accelerate the inventory of life on Earth for the wise use of nature and the benefit of humankind;
6. to value, document, and protect indigenous, traditional, and local knowledge about plants and nature; and
7. to engage the public on the power of plants through greater participation and outreach, innovative education and citizen science.

These bold statements follow other declarations by engaged scientists across the globe. The World Scientists' Warning to Humanity (pdf), issued in 1992 by the Union of Concerned Scientists and 1,700 co-signatories, recognised the impending environmental disaster we now call the Anthropocene and called for action to increase our stewardship of the planet. That 25 year-old pronouncement has now been reinforced by the World Scientists' Warning to Humanity: a Second Notice, with over 15,300 signatories, recently published in a major scientific journal.

Heeding the Scientists' Warning, and realising and achieving the Declarations' seven priorities is a major challenge that will require new resources and re-orienting research agendas. However, the enthusiastic response to the Declaration in Shenzhen suggests that the scientific community is building a solid and inspiring roadmap for the future. If we are successfully to build a green and sustainable Earth, all scientists and citizens should carefully read, study, and take steps to participate in collective action to make the seven priorities of the Shenzhen Declaration a reality for the future of our global commons. A third Scientists' Warning to Humanity may come too late.

IT'S TIME TO BE SMART ABOUT FINANCING CLEAN DEVELOPMENT

NGOZI OKONJO-IWEALA
Co-Chair of the Global Commission on the Economy and Climate

Future-smart investments are those that are sustainable

It has been two years since the historic Paris agreement to limit global temperature rise was struck. Now, on its second anniversary, the One Planet Summit hosted by French president Emmanuel Macron, is rightly putting finance at the centre of its agenda. Financing the transition to a low-carbon economy is fundamental to securing a more sustainable, secure and prosperous future.

We know that the low-carbon transition does not need to cost more than our current, high-polluting pathway, and will avoid the potentially enormous human and economic costs of congested cities, degraded agricultural and forest lands, and a changing climate. Research has shown that either path—the business-as-usual or the low-carbon, sustainable one—would require investing approximately $90tn (£67.5tn) over the next 15 years (pdf) to meet global infrastructure needs, and that this capital already exists. The problem is that we are still making the wrong investment choices in too many places and across too many sectors. These are only going to yield bigger and costlier stranded assets. It is time to be smart about finance.

The good news is that the wind—quite literally—is at our backs. Public and private investment in clean energy is scaling up. Global

investment in renewable energy capacity has exceeded that in fossil fuel generation for the fifth year in a row (pdf). And South Australia, courtesy of Tesla, has just switched on the world's biggest lithium ion battery – capable of storing enough energy to power 30,000 homes for an hour—a major game-changer in improving the reliability of sustainable energy.

The question is therefore not whether the transformation to a low-carbon future will happen, but how quickly it will take place. And what can financial decision-makers—finance ministers, institutional investors, and heads of private or multilateral development banks—do to help speed this process? There are exciting signs of momentum in each group: more must now seize the opportunity.

Countries must develop economy-wide development strategies to guide long-term investment that is consistent with their climate commitments. As a former finance minister myself, I know how intensive a process this will be. Every country—whether a mature or emerging economy—will need to undertake it. There are clear rewards for doing so.

Consider Uganda, for instance. Its finance ministry has adopted a holistic approach, identifying 23 specific investment opportunities (pdf) in the country that will increase growth—providing as much as 10% higher GDP than business-as-usual in 2020—while helping the country meet or exceed its climate targets. These opportunities have been reflected in the Uganda Green Growth Development Strategy, released earlier this year, and the

Meanwhile, Indonesia's planning minister announced in November 2017 that his country's next five-year development plan would also be its first low-carbon development one. More countries should adopt this strong approach to policy alignment: it offers a clear win both for immediate investment and for future growth.

Then, take the work of the Task Force on Climate-related Financial Risk Disclosure, with its potentially global impact on the finance industry. Commissioned in 2016 by G20 finance ministers, the Task Force's recommendations effectively establish a way of identifying and reporting what makes a good investment in the face of climate risk.

Already more than 100 businesses, investors, and banks—including Unilever, Barclays and HSBC—are working to implement them. Another recommendation—voluntary climate-related disclosures—should be part of mainstream financial filings. Indeed we should look to make these mandatory as soon as possible, as in France.

Next, there are important signals from investors. Over 400 of them, with $25tn in assets, have joined the Investor Platform for Climate Actions. Around 520 institutions with $3.4tn in assets, have committed to divest from fossil fuels. Norway's Sovereign Wealth Fund, the world's largest with assets of $1tn, took steps to divest from coal in 2016 and in November proposed the selling off of $35bn in oil and natural gas. It would be among the largest investors to undertake such a shift—and European oil stocks promptly plummeted. The signal should be clear to investors and shareholders everywhere: future-smart investments are those that are sustainable.

Multilateral development banks and other development finance institutions hold a final and critical part of the puzzle. They must work harder to catalyse a virtuous circle of sustainable investment, especially in some of the world's poorest countries, which both have the greatest investment needs and are facing the most significant impacts of a changing climate. Some have already committed to increasing climate-smart financing over the next five years. That is a welcome step, but it must quickly be bolstered by efforts comprehensively to assess the rest of their portfolios to ensure that other investments are not hindering sustainable development or efforts to protect the global commons.

There's no shortcut or special secret to achieving a low-carbon economy. It will require concerted, consistent and coordinated effort from the public and private sectors, and from governments at all levels. Developed countries and large emerging markets should particularly step up to be good examples, taking the lead in aligning their growth and climate strategies and meeting their financial pledges to support poor countries.

The world displayed all these qualities in Paris two years ago. Now we need to keep that spirit alive as we work to make its goals a reality.

THREE STEPS TO SETTING BUSINESS TARGETS FOR A HEALTHY EARTH

KEVIN RABINOVITCH
Global Vice-President Sustainability, and Chief Climate Officer, Mars Incorporated

The "tragedy of the commons" is real—but not inevitable

When you go to the doctor for a checkup she measures your weight, blood pressure, temperature, pulse rate and more to assess your health, and compares your numbers to science based benchmarks. If your numbers are off, you put together a plan for getting back on track. Wouldn't it be great if we had such a checkup to assess the health of the environment that sustains us all?

Thanks to the work of thousands of scientists over many decades, we now have the Planetary Boundaries model, a powerful tool for helping us understand the key indicators of planetary health and the risks we've created by neglecting the global commons. More and better data is also coming in all the time about how the decisions we make as companies relate to resource use and environmental impact. Now it's time to take the next step and work collectively on targets and action plans that allow business to make decisions informed by planetary health measures.

There are at least three challenges to solve in connecting measures for planetary health with the operational metrics that can guide business decisions:

Finding the right metrics
Just as getting on a scale after every bite of food is neither practical nor helpful, measuring the change in the Earth's energy balance for every business decision doesn't work either. But quantifying the greenhouse gas (GHG) emissions which drive such energy imbalance can be done and applied to every business decision. This idea led to the Science Based Targetsinitiative, a game changer in corporate GHG targets.

What about the other environmental boundaries? Biodiversity loss is an important limit to consider, but drawing a direct quantitative connection between rates of species extinctions and purchasing decisions doesn't work. However, some of the drivers of that loss—like the expansion of land used for agriculture—are easy to see and understand as operational metrics for business. More of this type of thinking can help us adapt the other boundaries in similar ways.

Working out your share
In delivering a global target, the only requirements of the science are that everyone sets targets which, when they are all added together, meet the global total. There are many ways to make this allocation, but the pieces must add up to a whole: otherwise we risk missing the overall goal, to our collective suffering. This can be seen, for example, in how the current sum of national climate commitments would not get us below the 2C threshold.

Making the targets actionable
A manageable framework for organising operational metrics is needed. Today's sustainability metrics are a pile of broken pottery, when what is required is a mosaic. Insight can be drawn from financial metrics: at the management team level, most businesses track three to five key metrics (eg sales, earnings, return on assets, cash), which are largely the same across all companies. The thousands of other financial metrics all have a home somewhere in a structure that quantitatively adds up to those key ones.

Over a period of several years, working with a range of key external partners including the World Resources Institute (WRI), we at Mars have sought to develop the science-based operational metrics that would enable us to do our share in operating within the planet's boundaries. This past September we announced and committed to them as part of our Sustainable in a Generation Plan. Our targets—on reducing global GHG emissions, using water sustainably, and holding constant the total land area used to grow our ingredients—are our answer to what individual companies should do as part of the collective action that is needed.

We're excited about this approach—and about the enthusiastic dialogue it has generated inside and outside our business. We're rolling up our sleeves and getting to work on action plans to drive progress on our new goals. But there are pieces of the puzzle that haven't yet been worked out—so we are pleased to be part of a team that includes leading thinkers from the Global Environment Facility, the Stockholm Resilience Center, WRI and others working to make science based targets for climate, land, soil health, water—and perhaps other areas—common practice.

By working together, we can turn the current tragedy of the commons into the most meaningful opportunity for a prosperous, sustainable future.

ENVIRONMENTAL THREATS ARE THE GREATEST RISKS WE FACE

JAHDA SWANBOROUGH
Lead, Environmental Initiatives, World Economic Forum

AENGUS COLLINS
Lead Author, The Global Risks Report 2018, World Economic Forum

They have overtaken economic ones, as nature bites back

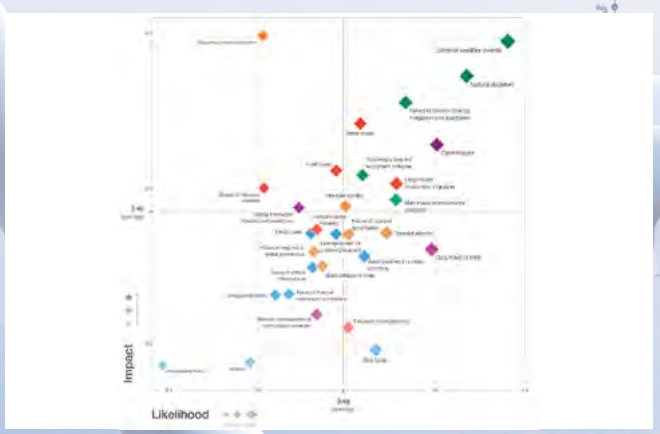
When identifying the biggest threats to humanity, governments and businesses traditionally focus on such risks as conflict and war, economic crises, and breaches of cybersecurity. However, the latest World Economic Forum Global Risks Report, published today, again highlights that the continued deterioration of the global environment is increasingly dominant.

The first figure summarises the results of our annual Global Risks Perception Survey, in which nearly 1,000 experts and decision-makers assess the impact and likelihood of 30 global risks over a 10-year horizon. All five environmental risks—the green diamonds—are in the "higher impact, higher likelihood" quadrant—continuing a marked trend away from economic and towards environmental ones that began in 2011.

Despite landmark policy achievements in recent years, our collective response to environmental risks remains inadequate. As more than 15,000 scientists from 184 countries put it last November, "humanity has failed to make sufficient progress in generally solving these foreseen environmental challenges and alarmingly, most of them are getting far worse".

It is easy to numb ourselves to the scale, urgency, and messiness of this predicament. The terminology we use often makes the problems seem drier, less personal and more remote than they really are, and this can allow environmental concerns to slip down decision-makers' priority lists.

FIGURE 1: THE GLOBAL RISKS LANDSCAPE 2018. PHOTOGRAPH: THE GLOBAL RISKS REPORT 2018, WORLD ECONOMIC FORUM



But these are not slow-burn worries for which we have time to prepare. A few decades ago environmental issues may have been a longer-term concern: but in 2018 the long term is now. The last year, for example, is likely to have been within the three warmest on record and the hottest ever non-El Nino year. The Arctic had its lowest ever February sea ice levels and is warming faster than anywhere else on the planet, potentially disturbing the predictability of the Gulf Stream and jet streams.

Nor are environmental risks abstract phenomena with little day-to-day impact. Evidence is accumulating alarmingly fast that they have an increasing toll on human health, wellbeing and prosperity.

People are ingesting pesticides through honey, consuming thousands of microplastic fibres a year in both seafood and freshwater, and breathing in carcinogenic air pollution in many of our cities. The widely-reported Lancet Commission found that soil, water, and air pollution causes 9 million premature deaths a year.

These trends are also hugely wasteful. The Lancet Commission concluded thatpollution costs the global economy $4.6tn (£3.3tn) per year—roughly equivalent to the combined GDPs of the UK, Canada, and Argentina. And damage from extreme weather in 2017 is estimated to cost around $330bn.

FIGURE 2: THE EVOLVING RISKS LANDSCAPE—LAST 10 YEARS. PHOTOGRAPH: THE GLOBAL RISKS REPORT 2018, WORLD ECONOMIC FORUM.

We are not doing enough to address environmental risks. It is increasingly hard to argue that this stems from a lack of information or tools. We already know what needs to be done to address climate change, for example: we have most—if not all—of the physical tools needed, along with a plethora of studies and models to inform action. We are also poised to harness Fourth Industrial Revolution technologies to tackle environmental issues. By leveraging artificial intelligence, advanced satellites and Earth observation technology, blockchain, quantum computing, DNA sequencing, and advanced robotics we may be able rapidly to scale-up truly transformative approaches.

What is holding the world back? The sheer scale and complexity of the challenge is one factor, political obstacles and resistance another. Psychologically, the need for profound environmental changes is only slowly developing from intellectual awareness to the personal conviction often needed to spur disruptive change.

Encouragingly, the level of conviction among government leaders (not just of nations, but of regions, states and cities) and the private sector, has significantly increased in recent years, particularly over climate change. This may not yet be unanimous, but momentum is building in the right direction.

Despite reasons for hope, the brutal reality is that our planet, and therefore our societies, are being pushed to the brink. Each year the situation continues to get worse. We must do more to build awareness and encourage the development of personal convictions over environmental change. But we also need to step back and remind ourselves just how intertwined environmental risks are with all the other global systems — including, notably, our economic models.

This edition of the Global Risks Report echoes the call in last year's report for "fundamental changes to market capitalism". It does so particularly in the context of building stronger solidarity within and between countries, but there are also strong arguments for making our economic principles and practice much more responsive to the imperative of protecting the environment before it is too late.

We must guard against separating economic and environmental risks into completely discrete categories, rather than seeing them as deeply interconnected parts of the same complex system. The programme notes for our Annual Meeting in Davos highlight that: "the global commons cannot protect or heal itself". An increasing amount of the World Economic Forum's work takes place at this intersection of the environmental and the economic. Interesting work is being done by such authors as Kate Raworth to build mental models that better capture the structural and normative connections between the environment and the economy. But much, much more needs to be done.

As the year begins, it is traditional to make resolutions for the 12 months ahead. Perhaps it would be hoping too much to try to overhaul how we think about, and act towards, the global environmental commons by the end of 2018. But let's see what we can accomplish by 2020, when implementing the Paris agreement will begin and new global action agendas are due to be published for oceans, forests and biodiversity.

That gives us two years to try to grapple better with the complex interdependencies between economic, planetary and societal health. If we fail, the human cost of environmental risks will continue to rise and rise.

HOW TO SHARE OUT THE WORLD'S RESOURCE PIE SUSTAINABLY

RALPH THURM
Managing Director, Founder AIHEADlahead, Co-Founder Reporting 3.0 Platform & Managing Director OnCommons gGmbH

BILL BAUE
Senior Director, Reporting 3.0

Achieving sustainability means determining how much each company should responsibly consume—and produce

The invisible hand needs an invisible "band", constraining it for the common good. So suggested Garrett Hardin in his seminal 1968 essay, The Tragedy of the Commons. In it, he exposes the achilles heel in Adam Smith's 1776 notion of the "invisible hand"—the assumption that "decisions reached individually will, in fact, be the best decisions for an entire society"—and links it to William Forster Lloyd's lesser-known coining of the idea of the "commons". In an obscure pamphlet in 1833, Lloyd described "a pasture open to all" supporting many herds, with natural forces keeping impacts "well below the carrying capacity of the land"—until the "day of reckoning" when:

> *…the rational herdsman [sic] concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another…But this is the conclusion reached by*

each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited.

Replace "herdsman" with "company" and "animal" with "growth" and we have the 21st century dilemma.

The solution is to attune ourselves to thresholds and allocations. What does this mean? In simple terms:

- thresholds define how big a pie is (how much of a resource is available, within its carrying capacity);
- allocations define how big the pie slices are (which depends on the number of users sharing the resource, and their level of need.)

The concept of thresholds and allocations, applied to companies, was established in 2002 with the second iteration of the Global Reporting Initiative (GRI)'s Sustainability Reporting Guidelines. These use the principle of sustainability context, which calls for measuring and reporting on the performance of an organisation in the context of the limits and demands placed on economic, environmental, or social resources at a macro-level.

Unfortunately, a recent Danish studyshows that only 5% of sustainability reports have ever applied this principle—and a mere 0.3% have done so to strategy and operations. This has created a significant context gap—a failure to present performance in the wider context of sustainability. This, in turn, served as an original inspiration for the founding of the initiative, Reporting 3.0 in 2013. Over the past half-decade, Reporting 3.0 has stressed the interlinkages between impacts at the micro level (company), meso level (sector, portfolio, and habitat) and macro level (ecological, social, and economic systems) and on managing resources within their carrying capacities. Now, as a next logical step, it is establishing a Global Thresholds & Allocations Council (GTAC) to close the context gap and scale up the necessary measurement, management, and reporting.

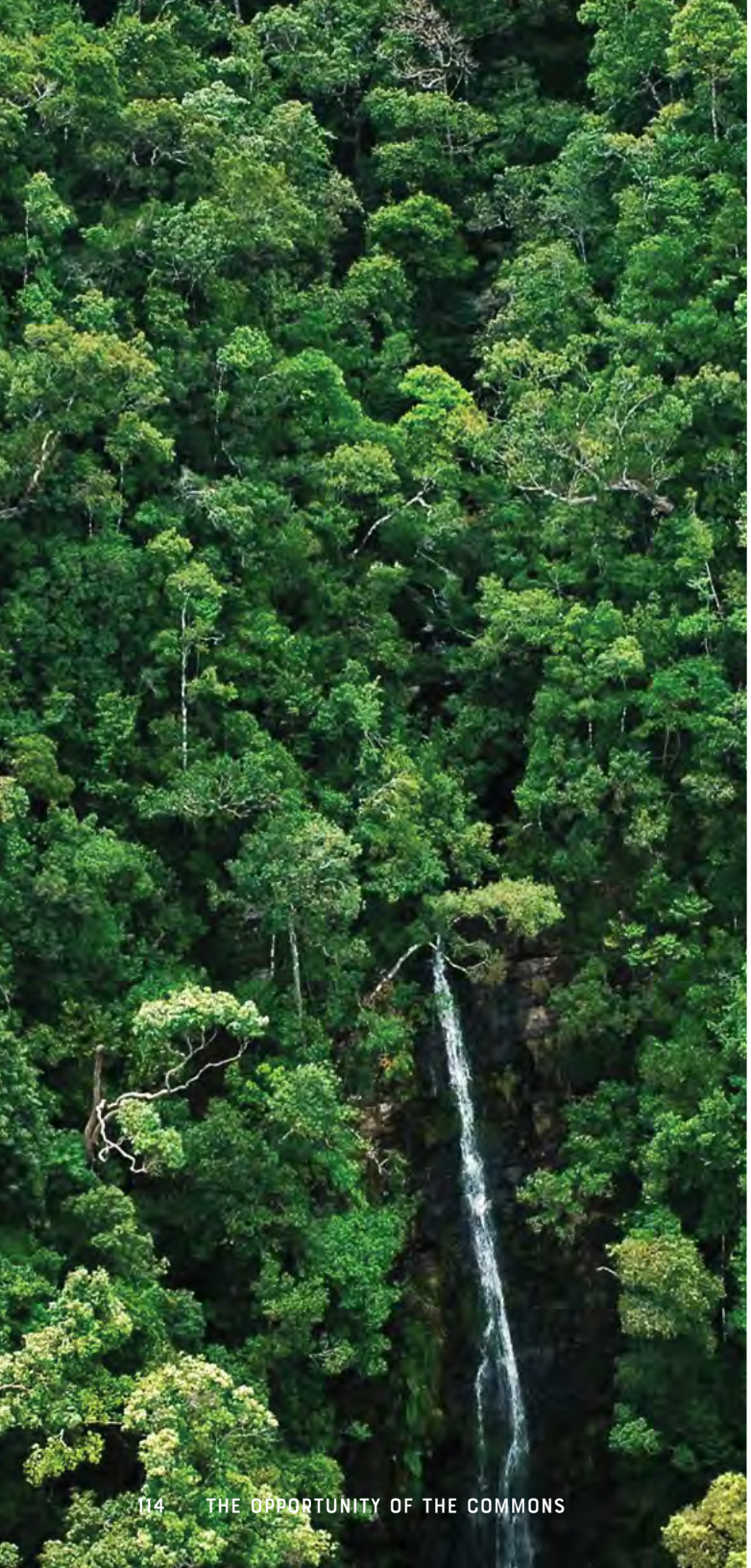
The original inspiration for GTAC came from GRI co-founder Allen White who says it "seeks to close this context gap by validating and, where necessary, developing thresholds and allocation methodologies". Thus, he adds, it will enable companies to implement the sustainability context principle "in concert with an independent, trusted and authoritative expert source".

Ways of determining thresholds and allocations are emerging in some areas—a testament to how a new global consciousness is developing. Take climate change and greenhouse gas emissions. The Science Based Targets initiative provides tools for aligning corporate carbon footprints with the global carbon budget determined by the Intergovernmental Panel on Climate Change, and for distributing allowable emissions proportionately among companies. Similarly, on the social side, the United Nations Guiding Principles on Business and Human Rights (UNGP)—developed under UN Special Representative for Business and Human Rights John Ruggie—represent widely acknowledged norms that function like thresholds.

Other examples include the Future Fit Business Benchmark, which sets "break even" thresholds (though it refrains from setting allocations), and some initial thinking by the Stockholm Resilience Centre, World Resources Institute, Global Environment Facility, International Union for the Conservation of Nature (IUCN) and others—which seek to apply science-based targets across the global commons. Indeed, the One Planet Approaches report from WWF, IUCN, and the Swiss Federal Office of the Environment, catalogues 60 approaches that apply thresholds and allocations, and distills them into a generic eight-step framework that can be applied broadly.

GTAC operates at a level above all these initiatives and provides guidance to companies on the validity, strengths and weaknesses of different approaches. It can also spur necessary development for areas that lack sufficiently rigorous thresholds and allocations. To set it in motion, Reporting 3.0 is convening a kick-off meeting on January 31 at the Dutch Federation of Accountants in Amsterdam with many distinguished contributors.

The ultimate goal is to create and strengthen the "invisible band" that's needed for the invisible hand to work. Without it, it is not possible to close the sustainability context gap and state how sustainable an organisation truly is.



REVIVING LAND MAKES BUSINESSES GROW

SOFIA FARUQI
Manager, New Restoration Economy, World Resources Institute

ERIKS BROLIS
Conservation Business Lead, The Nature Conservancy

How innovative companies make money by restoring forests and farmland

Five years ago, Jurriann Ruys, a successful partner at management firm McKinsey in Amsterdam, did something his former colleagues could never have predicted. He quit, to help solve the problem of land degradation.

Nearly half of Earth's forests have been cleared or degraded. This presents many global challenges, including collapsing biodiversity and loss of ecological function. Forests, which provide critical wildlife habitat and remove carbon from the atmosphere, continue to be threatened by human exploitation: every year, our planet loses an area of forest the size of Panama. One-quarter of agricultural lands are also under threat, under-producing at a time when population growth is driving higher demand for food. And as soil becomes infertile, the mostly poor communities who depend on the land are forced to migrate, fueling civil conflict.

But Ruys reckoned that a business opportunity lay hidden in the great challenge of land degradation, and he started Land Life to help restore the planet's critical ecosystems. Land Life has developed a patented product called the Cocoon, a tube made of recycled paper pulp and

coated with an organic wax to keep it watertight. According to the company, the Cocoon boosts survival rates of young trees from 10% to 90%, dramatically reducing water usage and costs compared to manual watering or irrigation, making it well suited to dry and severely degraded areas. Land Life, which provides a full suite of restoration services, from advising nurseries to collecting satellite data, has grown to 23 employees and has projects in 20 countries, with a special focus on the US, Mexico and China.

Land Life is not alone. A wide range of entrepreneurs and businesses are joining the "restoration economy" with a keen eye to making a profit by restoring forests and agricultural lands. A new report, The Business of Planting Trees: A Growing Investment Opportunity, by World Resources Institute and The Nature Conservancy highlights 14 innovative businesses spanning four sectors—technology, consumer products, project management, and commercial forestry—and eight countries. Three examples are:

- Brinkman & Associates, a Canadian company which manages large reforestation projects across its home country, has expanded into tropical plantations in Latin America. Family-run and started in 1970, it has planted more than 1.4bn trees (enough to cover an area larger than Cyprus) while generating revenues of over $40m (£28m) a year. It has also helped to shape Canada's forest laws, ensuring legal requirements for reforestation.

- Ecosia, an online search engine based in Germany, uses advertising revenues to fund reforestation in key biodiversity hotspots around the world. It has 7 million (and growing) active users, and its revenue has grown six-fold since 2015. It enables users to see how many trees have been planted as a result of their browsing, thus connecting them to their impact in the real world.

- F3 Life has developed a credit scoring system to bring smallholder farmers into the financial system. Its algorithm ties credit to climate-smart agricultural practices, such as planting grass and trees. As farmers re-green their plots of land, their access to credit rises because they become more resilient to climate change. The company has carried out a pilot project with 75 farmers in Kenya and is now starting to work in Ghana and Rwanda.

While these companies are relatively small now, they are growing rapidly. They are part of a broader trend of businesses that make restoration their core value proposition. Our research discovered over 140 such enterprises, taking root all over the world.

These companies have good momentum, because governments have made big pledges to tackle degraded land through the Bonn Challenge and the New York Declaration on Forests (pdf), which together aim to restore 150m hectares by 2020, and 350m by 2030. Similarly, many countries are including these pledges as part of their nationally determined contributions under the Paris climate agreement. There is also a powerful regional impetus. Twenty-six African countries have committed to the African Forest Landscape Restoration (AFR100) initiative which means to restore 100m hectares of the continent by 2030. In Latin America, 16 countries have made commitments to Initiative 20x20, which aims to restore 20m hectares by 2020.

As these countries turn their attention to action, they will need to partner with the private sector—companies both small and big—in order to meet their ambitious goals. The race is on, as time grows shorter in which to reverse land degradation, stop climate change, and halt losses in biodiversity.

Entrepreneurs are responding with innovative market-based solutions, with the underlying belief that human ingenuity can harness the power of nature. Our reportshows many examples of companies that are restoring forests and farmland for a wide array of human and environmental benefits, while also making money for their investors.

With an opportunity this big, isn't it time radically to change our approach to the natural systems that sustain life on earth, our global commons?

WANTED: CLEAR TARGETS TO SAVE THE GLOBAL COMMONS

AMY LUERS
Executive Director, Future Earth

Science-based targets for the Earth are the missing piece of the sustainability puzzle

It is inspiring to see the world mobilise around the global vision of the 17 UN Sustainable Development Goals (SDGs) to end poverty and hunger, ensure sustainable water access for all, fight inequalities, tackle climate change, and more. Local governments, companies, and civil society are developing plans for how they can contribute to achieving them. But a key piece is missing—clear targets for maintaining Earth's life-support systems, the global commons.

Four of the goals focus directly on Earth's life-support systems—on water, climate, oceans, and land—but only one of them has a clear target based on scientific research. SDG 13, which seeks to "combat climate change and its impacts" has adopted the same target that 197 nations agreed to in the Paris agreement—to keep global average temperature rise to well below 2C above pre-industrial levels.

This target may not be perfect, but it has been vital for advancing progress in addressing the climate crisis. It works because it is grounded in science and is quantifiable, simple to communicate, and within the realms of political reality. Many businesses have now adopted climate goals that translate it into targets that work for them, most prominently through the "science-based targets" developed by

World Resources Institute, CDP (formerly the Carbon Disclosure Project), World Wildlife Fund, We Mean Business, and other groups.

We do not yet have science-based targets for the other vital components of Earth's life-support systems, like water, oceans, and land. Most of the SDG targets focused on Earth systems are vague and not actionable. They include, for example, calls to "minimise and address the impact of ocean acidification," or to "restore degraded forests and substantially increase afforestation and reforestation globally".

As with any business or policy decisions, implementing the SDGs will involve tradeoffs. If decision-makers are effectively to evaluate these trade-offs, they will need to understand potential boundaries—similar to 2C for climate—beyond which our natural life-support systems may break down.

Can we develop science-based targets for other parts of Earth's life-support systems? One place to start is the nine planetary boundaries—including, for example, the diversity of life on Earth, freshwater, and air pollution. Identified by scientists in 2009, they are a set of limits that define what makes a "safe operating space for humanity". Researchers refined this concept further in 2015, but much work remains to be done. We don't yet have precise numbers for all of these boundaries and significant uncertainties remain even among those that have been quantified.

Some argue that boundaries relating to soil or plastic pollution, for example, are missing. Others say that the boundaries framework may not work at a global scale for some natural systems, and others may be difficult to apply at local, national or regional levels. All these valid and important issues must be confronted in a search to identify what the limits are for maintaining our planet in a safe operating space.

Taking action

The good news is that the international scientific community—much of it working through Future Earth's global research projects—has been analysing these Earth systems for decades. What is now needed is to assess all that existing knowledge and put it to work in developing a holistic suite of science-based targets—ones, critically, that could be used by any nation, city, or company.

This is a bold and ambitious effort, but it's necessary to realise the vision of the SDGs. To be successful, we will need to consider three principles:

1. The initiative must draw from the best science from all regions of the world.

2. While the targets must be science-based, they must also be shaped through dialogue between scientists and policymakers—with strong engagement from both the global north and south—if they are to be operational.

3. They must be quantifiable and applicable at multiple scales.

We must start soon. Science is a slow process, and ideas take time to cross from academia into society and policy. But we do not have the luxury of time. The world needs to act fast. Without these science-based Earth targets, we cannot fully achieve the ambitious vision of the SDGs. And, perhaps more importantly, without them we may unwittingly cross into an unsafe operating space for humanity.

INVESTING $20TN TO CHANGE THE WORLD

DANIELLA BALLOU-AARES
Partner, Dalberg Global Development Advisors

How sovereign wealth and government pension funds can bring about a sustainable global economy

Last April, the California Public Employees' Retirement System (CalPERS) sent a letter to 504 public companies with no women on their boards of directors. The $330bn pension fund asked, "that each company develop and disclose its corporate board diversity policy and implementation plan to address the lack of diversity."

"Simply put, board diversity is good for business," said Anne Simpson, CalPERS investment director, sustainability, at the time, in a news release. "It is essential in today's global economy that boards avoid 'group think' and ensure there is the breadth of experience, skills and knowledge necessary to meet complex business needs."

This type of action is becoming almost commonplace. It is not just related to gender diversity but to a whole range of environmental, social and governance (ESG) issues.

BlackRock, the world's largest asset manager, recently made climate risk a top priority in engaging with corporations. It says that all directors of companies facing climate risk—such as mining and oil firms, for example—should "have demonstrable fluency in how climate risk affects the business." (pdf) It has also openly opposed practices at Exxon Mobil over climate change—and it owned about 6% of Exxon stock at the time.

These are huge shifts. Board diversity and climate change are now fundamental to both CalPERS and BlackRock's investment decisions—so much so that they are willing to put companies they invest in who

do not meet their expectations on notice that they must change. This is starting to impact corporate priorities. But even they can't drive this shift alone.

Staggering potential scale

So who controls the largest pools of capital? The last two decades have seen an extraordinary expansion of sovereign wealth and government pension funds. These include, CalPERS, Canada's Ontario Teachers' Pension Plan, Norway's oil fund, South Africa's and Korea's sovereign pension funds, and China's and Abu Dhabi's sovereign wealth funds. Such funds' assets totalled more than the entire European Union's GDP last year.

These "asset allocators" are accountable to hundreds of millions of pensioners and citizens worldwide, who are the true owners of their assets. They hold over $20tn in assets, which means that their investment criteria can fundamentally change the direction of businesses and markets across the globe.

Sovereign wealth funds and government pension funds have investment horizons that span generations. This means that—as stewards of long-term capital—they are inherently concerned with anything that creates substantial risk for the value of their portfolios over the long-term. These risks include climate change—where there is a well-defined set of benchmarks for measuring and managing climate risk—to a range of ESG risks.

There are, for instance, looming threats to our "global commons". The deterioration of our environmental commons—the land, seas, ice sheets and atmosphere we share, and the ecosystems and species they host – now top the latest edition of the World Economic Forum's Global Risk Report. This threatens not just the funds' long-term returns, but the very citizens to which they are accountable.

Investing responsibly, with strategic consideration of these risks, is moving from a nice-to-have feature to a critical consideration for success.

"For stewards of long-term capital," said Adrian Orr, CEO of the New Zealand Superannuation Fund, "the question is not can they afford to invest responsibly but, rather, can they afford not to?"

But there has been a crucial barrier to responsible investing thus far: the methodologies and standards that allow investors to account for the full range of ESG risks are still in the nascent stage. Many are complex and have significant reporting requirements: they are geared for use by specialised teams.

A new report seeks to bridge this gap. The Bretton Woods II Initiative, which has been making the case for responsible investing, late last year selected The 25 Most Responsible Asset Allocators (supported by analysis conducted by my firm Dalberg,and the Global Development Incubator). We worked with the asset allocator community to establish a set of common benchmarks—and ranked investors on how well they are addressing long-term sustainability risk in their portfolios. The resulting report sets out easy-to-understand guidelines to encourage greater adoption of responsible investment practices.

Leaders are emerging

The Bretton Woods II report shows that the most responsible asset allocators—controlling $5tn in assets—are already influencing the market in significant ways. Their strategies include: allocating parts of their portfolio to climate/renewable energy; using their votes to veto boards without women directors; and scrutinising labour practices in company supply chains.

These leaders have also recognised there is an incorrect assumption that investors have to choose between financial returns and social responsibility. In fact, considering the ESG performance of investments leads to higher returns and better management of long-term risk. A 2015 Harvard Business School study of 180 US companies over more than a decade, found that companies that scored well on ESG factors also achieved significantly higher returns.

This thinking is becoming increasingly mainstream. A survey (pdf) of 475 global institutions found that 80% of institutional investors now include ESG risks in their investment decision making process.

Stakeholders and the general public want to see (pdf) these long-term risks incorporated into their pensions and long-term savings funds, and this increases the pressure on big investors.

As stewards of long-term capital, major asset allocators are too big and too diversified to hide from global challenges. They hold the power to set standards and promote common methodologies for measuring risks. They are also large enough not to have to accept the world as they find it. If large institutional investors begin rigorously mitigating risks and investing towards the sustainable development goals they will create a massive incentive for companies and markets to follow.

The potential is for nothing short of building a robust, sustainable global economy that truly works for everyone. We hope more and more investors will lead the way.

HOW FOOD COMPANIES CAN PROTECT FORESTS AND THE OCEANS

JONATHAN HORRELL
Director of Global Sustainability, Mondelez International

Business growth can be accompanied by positive changepension funds can bring about a sustainable global economy

Every day, I watch a microcosm of the battle to protect the global commons taking place outside my garden gate here in England. I live on a common—a traditional British land tenure system where land is privately owned but communally managed. Commoners share the rights and responsibilities of free access to a shared resource.

But the system is starting to crack—people who live here (me included) work away, no longer depend on local resources and have different expectations. Dog walking, summer picnics and horse-riding have overtaken food production as a priority, and the common is suffering as a result.

Scale this up to the global level and you capture the challenge of protecting the world's atmosphere, oceans and forests. The responsibility lies with everyone and no-one, so conditions inevitably deteriorate.

As a food business, this matters to Mondelez International. We depend on healthy ecosystems to produce sustainable supplies of agricultural raw materials for our snacks—chocolate brands like Milka, Cadbury and Cote d'Or; or Oreo and LU biscuits.

Our company's future is rooted in helping people to snack in a balanced way and to enjoy life with products that are safely and sustainably sourced, produced, and delivered. So we promote the wellbeing of our colleagues, communities, farmers, and consumers while making smart and sustainable use of natural resources to reduce our environmental footprint.

We call this Impact for Growth—our commitment to driving business growth with positive change in the world.

If we are to make lasting positive impact in the world's forests and oceans, we need partners. So we always aim to scale up our actions with partnerships to address root causes and drive sector-wide change.

Deforestation makes up the largest part of our carbon footprint. We're committed to address it in our key sourcing programs, such as Cocoa Life and our Palm Oil Action Plan (pdf).

Ghana supplies about 20% of the world's cocoa and has one of the highest deforestation rates in Africa, at 3.2% per annum. To address this, we created an environmental focus area in our sustainable cocoa sourcing program, Cocoa Life. We train farmers to produce more cocoa on less land and support communities to protect their local forests. And we work with Global Forest Watch to monitor our efforts to protect forests. Yet, though these actions are important, they only reach the communities where we source cocoa. We want to go further.

Ghanaians say: "If you want to go quickly, travel alone. If you want to go far, travel together." So we formed a cross-sectoral partnership with the Ghanaian government and the United Nations Development Programme (UNDP) to support the government's national forest protection strategy under the UN Framework Convention on Climate Change's (UNFCCC) REDD+ framework.

The Forestry Commission of Ghana and Ghana Cocoa Board will oversee its implementation and promote climate-smart cocoa production; UNDP will share technical expertise; and, through Cocoa Life, Mondelez International will contribute $5m over five years and lead projects on the ground.

We also played a leading role in forming the Cocoa & Forests Initiative, a collaborative, multi-stakeholder framework addressing deforestation and forest degradation in the cocoa supply chain. We unveiled this at the UNFCCC's COP23 in Bonn in 2017 along with governments and 11 other cocoa and chocolate companies. Together, we will create a joint action plan to fight deforestation in Ghana and Ivory Coast—the world's two largest cocoa producers.

It is also important for us to make commitments to source palm oil sustainably. But that is not enough on its own: the situation is too complex, So we are working with UNDP, the government of Indonesia and other partners to support the country's National Action Plan for palm oil. This will help strengthen smallholder farmers, support national policy reform and reduce deforestation through public-private partnerships.

Looking to the oceans, we're very attuned to the current debate around pollution from plastic waste. We will continue to optimise our packaging to reduce material while minimising food waste. About 95% of our packaging is already recycled, recyclable - or ready for recycling, given the right facilities—and we continue to seek opportunities for more.

We estimate that we account for less than 0.25% of the global packaging market, so it is important that we work with partners to scale up our efforts. We participate in the Consumer Goods Forum's work with the Ellen MacArthur Foundation's New Plastics Economy project that seeks to ensure plastic packaging can be recovered and have a valuable second life. And we work with the Trash Free Seas Alliance—an effort to catalyze action to stop the flow of plastic into the world's oceans.

We all need to play our part. If we are to succeed in the long term, all these partnerships must capture the spirit of shared rights and responsibilities that made the English commons flourish.

HOW SUSTAINABLE BUSINESS PRACTICES HELP THE BOTTOM LINE

LAURA PHILLIPS
Senior Vice President for Global Sustainability, Walmart Inc.

Looking after the global commons can cut costs and foster growth

Integrating sustainable practices into a company's operations can improve business performance, spur technological innovation, inspire brand loyalty, and boost employee engagement.

That is our experience at Walmart, where investments in sustainability and efficiency in our own operations—and those made by our suppliers—have enabled us to save money, while striving to support jobs and help reduce impact on the environment.

Our mission is to save our customers money so they can live better. We strive to achieve this in part by focusing on our operational efficiencies, energy expenses, waste reduction and cost-effective procurement of renewable energy. We believe that our focus on sustainability is right for our customers, for our associates, and for our bottom line.

Walmart has now installed more than 1.5m LED (light emitting diode) fixtures across more than 6,000 of our stores, parking lots, distribution centres and corporate offices in 10 countries. This has reduced Walmart's lighting energy consumption and reduced our lighting costs by hundreds of millions of dollars over the past decade.

Our work to reduce emissions and increase efficiency has also helped us to lower some of our other operational expenses. A few years ago, we announced that we had exceeded our goal of doubling the efficiency of our trucking fleet by 2015. This was made possible by our associates' efforts to improve techniques for loading, routing and driving, as well as through collaboration with equipment and system manufacturers on new technologies. With these new efficiencies, we achieved savings of nearly $1bn and avoided emissions of almost 650,000 metric tonnes of carbon dioxide in 2015 compared to 2005.

By the end of 2015 we had upgraded 5,919 rooftop heating and cooling units—the highest number of such high-efficiency installations in the US—with estimated savings of 50m kilowatt hours and 35m pounds of carbon dioxide equivalent. The US department of energy says this is worth as much as $5m a year.

We are sharing our experiences and asking our suppliers to look at whether they may realise similar benefits in their businesses. We have launched an ambitious new initiative, Project Gigaton, designed to encourage suppliers to reduce emissions by one gigaton (one billion tonnes)—equivalent to taking more than 211m passenger vehicles off US roads for a year—by 2030.

The project encourages suppliers to pursue a suite of sustainability strategies, ranging from procuring new renewable energy sources to avoiding deforestation and reducing food waste. Unilever, for example, committed to plant 15m acres of climate-smart cover crops which help to reduce soil erosion, and increase soil fertility and water drainage. The move will also help to address climate change: the aim is to cut 10m tonnes of carbon dioxide emissions by 2030.

We have collaborated with NGOs, like World Wildlife Fund and Environmental Defense Fund, to create an emissions reduction toolkit to help suppliers make and pursue their Project Gigaton commitments. This provides resource materials for progammes and highlights the business case for suppliers considering signing on to the project.

Walmart understands that embracing and incorporating climate solutions can foster growth and cut costs at the same time. It is vital that businesses continue to innovate and contribute to advancing sustainability. We must remain active in telling sustainability success stories to suppliers, customers and investors. By demonstrating how sustainability investments can cut costs, we aim to strengthen businesses, our economy and, most importantly, the planet—and its global commons—on which we all depend.

WOMEN ARE AT THE HEART OF MAKING BUSINESS—AND THE WORLD—SUSTAINABLE

CECILY JOSEPH
Vice President, Corporate Responsibility, Symantec

Bringing a different perspective is essential in achieving the sustainable development goals

Over 25 years ago I began my career as a black female working in technology in Silicon Valley and, ever since, my professional path has continually been shaped and enhanced by my being different. Women comprise only 26% of computing professionals—black women 3%.

I learned very early on that being outside the norm can be a positive differentiator and bring a unique perspective. I was able to collaborate openly and effectively, and my particular mix of competencies balanced well with those of others. As my role expanded into sustainability, these became the qualities I would use to shape the way our business generated value—through its ability to impact the world positively. I quickly understood that corporate responsibility and sustainability support long-term value, yet also challenge us to demonstrate and articulate how this is played out against short-term business objectives.

I also learned that I am in no way alone. The Better Leadership, Better World: Women Leading for the Global Goals report launched by the Business and Sustainable Development Commission earlier this week highlights the unique strengths of female professionals and how they can help business harness what research argues is the greatest economic opportunity of our time, the 17 UN sustainable development goals(SDGs or global goals).

Women tend to exhibit long-term thinking, innovation, collaboration, transparency, environmental management, and social inclusiveness. As the report highlights, "There is considerable evidence of women identifying new technologies, business models, products, and services that are critical to meeting consumer needs while also solving societal problems. For example, a 2017 joint study from the UN Foundation and BNY Mellon identified a US$300 billion market opportunity that could be attained by closing the gender gap in access to products and services in the water, contraception, telecommunications, energy, and childcare sectors."

Women are bringing something different to companies and they are using the global goals as a tool to think about innovation differently, to bring new ideas to the table and thus strengthen companies.

Additionally, the global goals themselves shine a light on the unique role that gender plays in reaching a sustainable future and protecting the global commons. It can break down barriers and unlock opportunity in many ways.

SDG1: No poverty
Women and girls are over-represented among the world's poor: 330 million live on less than $1.90 a day – 4.4 million more than men (pdf).

SDG4: Quality education
As of 2015, two thirds of the approximately 781 million illiterate people aged 15 and older, were women, a proportion that has remained unchanged for two decades. If every woman in sub-Saharan Africa and south and west Asia had access to a secondary education, child marriage would be reduced by two thirds (pdf).

SDG5: Gender equality
71% of victims of human trafficking, the third largest global criminal industry, are women and girls. The International Labour Organization estimates that they also comprise most forced labour victims.

SDG6: Clean water and sanitation
Women and girls are responsible for water collection in 80% of households (pdf) without access to it.

SDG8: Decent work and economic growth
Globally, the labour force participation rate among prime working-age women (aged 25–54) stands at 63% compared to 94% (pdf) among their male counterparts. The global gender pay gap is 23%.

SDG13: Climate action
Climate change has a disproportionate impact on women and children, who are 14 times as likely as men to die during a disaster.

At Symantec we recognised early on our responsibility to protect basic human dignity and human rights, and the role of gender equity as a strength and differentiating factor:

- We have been an advocate of gender equity, signing on to the Calvert Women's principles (pdf), a set of indicators which help corporates track gender justice, and we helped to lead and create tools for the San Francisco Gender Equality Principles initiative. We're also a founding signatory of the Women's Empowerment Principles.
- We join over 9,500 companies committed to embedding the Ten Principles of the UN Global Compact into their business strategies and operations, including expectations that our employees, contractors, and suppliers adhere to our code of conduct, global supplier code of conduct and human rights policy (pdf).
- We have a zero-tolerance policy (pdf) on any aspect of human-trafficking, which we maintain through policies, training and awareness, auditing and confidential/anonymous reporting via our ethics line, managed by an independent third party. Reporting and transparency (pdf) is required by law in the US (and requested by stakeholders across the world).
- We adhere to the Responsible Business Alliance, which establishes standards in treating workers with respect and dignity, and prohibits the use of forced, bonded, and indentured labour and involuntary prison labor. All our suppliers have completed a self-assessment questionnaire, and 48% have these requirements included in their contracts. We are also incorporating human rights questions as part of the procurement process.

Lastly, we continue to leverage sustainability holistically, addressing gender equity through a multifaceted and strategic approach aligned to our business. Through our policies, initiatives, philanthropy, community engagement, and advocacy we aim to break down some of the fundamental barriers mentioned earlier by, for example: opening doors to science, technology, engineering and maths (STEM) education and the growing number of cybersecurity jobs; enabling nonprofits to serve their missions more effectively through our software donation program; and improving infrastructure—such as access to water—that hinders women's ability to educate themselves or start a career.

For example, to date, Symantec has supported over 150 organisations addressing domestic violence and human trafficking through employee volunteering, cash grants and our software donation program with TechSoup.

Across the world—from all industries, income levels, backgrounds—there are many remarkable advocates for gender equality, and the momentum is tangible. We can now see its essential role and that to meet the global goals both halves of the population must be fully engaged. The moral and business cases are clear. Now it's time to figure out how we move forward to best harness this momentum.

Corporate leaders—whether females, males, engineers, human resources, or management—must recognise that equity is our joint responsibility. When we view this balance of diverse talents, strengths and perspectives as a true driver of value, investing in it makes perfect sense - to create businesses, and more importantly a world—of which we can be proud to be part.

CONNECTED, SHARED AND ELECTRIC: THE ROAD TO SUSTAINABLE TRANSPORT

NAINA LAL KIDWAI
Member of the Global Commission on the Economy and Climate

Government strategies and innovative pilot projects can help passengers save money and benefit the environment

It's Monday morning in Bengaluru. As you step out your front door, a rickshaw you ordered with your smartphone is already waiting to whisk you to the metro. After your metro trip, you emerge from the station across the city to find another rickshaw ready to take you to the office. Not a moment is wasted.

This may seem like a dream to the average citizen of Bengalaru (also known as Bangalore), who now spends more than 240 hours a year stuck in traffic jams. But new technologies and the right policies could soon make it a reality.

Across the globe, the way people move in cities is becoming more innovative and technologically sophisticated. Urban dwellers worldwide are becoming more accustomed to having mobility services

on demand, to car- and bicycle-sharing systems, mobile trip-planning, and ticketing apps. The flexibility, convenience and affordability of shared mobility has had a huge impact in India, where, on average, over 6 million trips are taken with Ola, (a rival to Uber), each week.

Working from home could completely change how much we need to commute in the first place. Work hubs and quiet spaces with good wifi could be set up in residential neighbourhoods so that people won't have to travel across a city to get to their offices.

Yet the number of cars on the road in India is growing. Every day, nearly 50,000 newvehicles hit the roads; vehicle registrations have been increasing by 10% a year. This is despite the fact that India has been introducing new metro lines in record time; over 200 kilometres have been built in Delhi, and 42 kilometres in Bengaluru, over the last decade—and another 530 kilometers is under construction across the country.

Indeed, the number of personal vehicles in India is due to multiply three or four times by 2030, at significant cost to the economy and society. Issues such as "first- and last-mile connectivity"—how you get to and from a metro or bus stop from your starting point and to your final destination—have deterred many commuters from taking public transport. Many citizens of Delhi still prefer private vehicles, despite the comfort and efficiency of the metro, because there is no equally dependable system to help them reach their homes or offices from the stations. The World Resources Institute has found that a lack of proper connectivity is the biggest obstacle to using the Bengaluru metro.

This is poised to change dramatically as the government begins to tackle transportation issues head-on. New mobility services are set to take over India thanks to legislation like the recently-launched metro rail policy, which requires companies applying for new subway projects to include integration of different modes of transport, simple payment options, first- and last-mile connectivity, and universally accessible infrastructure. Proposals which do not address these issues have already been sent back to be made compliant with the new policy.

Research from the Coalition for Urban Transitions reports that more than 70 cities around the world (pdf)—including many Indian ones—are already partnering with new and innovative services to address the challenges facing their public transport systems. In Delhi, electric rickshaws are already unofficially filling the transit gap. Hyderabad recently announced partnerships with Ola and Uber to begin solving its connectivity issues. In Bengaluru, mobility start-ups have begun piloting innovative projects to tackle first- and last-mile connectivity; these include a carpool system to and from metro stations, two-wheeler vehicle sharing, and aggregating parking spots near the metro which users can reserve on their phones.

Such partnerships and innovations could be really transformative as we grow our economy in a sustainable way and protect the global commons. Reducing traffic benefits health and the environment. We could recoup millions of working hours lost in traffic jams and significantly reduce accidents. And by making Indians' mobility electric, shared and connected we could cut the energy it uses by a staggering 64% (pdf).

Strong public- and private-sector leadership and skilled information technology and manufacturing workers will make further innovations possible. Getting around should be smooth, efficient, clean and budget-friendly—and in a city near you.

SAVING A THIRSTY PLANET MUST BE BASED ON REALITY, NOT PERCEPTION

J. CARL GANTER AND EILEEN E. GANTER
Co-founders, Circle of Blue

Looks can deceive—one farmer's field may be lush while another's dry. A smart water future means seeing past your own pasture

"Looking out the window, I would see the great sources of freshwater," said Jerry Linenger as he orbited the Earth in the Mir space station in 1997. "Lake Baikal, deeper than deep. The Great Lakes, well-named. The mighty rivers of the world—Nile, Tigris-Euphrates, Amazon—defining civilizations, past and present. But still, when stepping back and looking at the big picture, not so much different than our little orbiting space station. A closed ecosystem. Only so many sources of life-sustaining water. And all the creatures of Earth, just like the three of us circling it, all dependent on water."

This ultimate big picture, seen through human eyes, shows us the beauty, complexity, and fragility of our blue planet. We have developed other ways, less poetic but just as prophetic, to view Earth and the exquisite interplay of systems that sustain our life.

They warn us that the blue planet is thirsty.

Our satellites, our sensors, our computers and our consultants describe a reality so profound that the numbers are impossible to

perceive. That more than two billion people are without access to a reliable supply of safe drinking water, and some 4.5 billion do not have safe sanitation services. That 80% of the water humans contaminate is released, without treatment, back into the environment. That in a dozen years, 700 million people could be water refugees.

For all the data, projections and prognostications, all the headlines and the heartbreak, we as a global group still don't grasp the difference between what we think and what we know to be true. Between our perceptions and Earth's reality.

We think we can use water like we always have, because it is there, and it always will be. We rely on our senses and experiences on which we have founded our actions for millennia.

In Punjab, for example, Desraj Khai wades through his plantation of poplar trees and winter wheat. He proudly shows me how the water flows freely through his hand-dug canals between the crop rows. Since water and electricity are free, there must be plenty of each, so he lets the well pumps run 24 hours a day, pulling wantonly from the aquifer underground, just as his neighbours do. What he does not see is that groundwater levels are dropping, and could eventually go dry.

Further south near Vijayapura, farmer K.V. Muniraju is facing the fact that his groundwater is gone, possibly forever. But again, senses are deceiving. His crops are lush and his wife tends rows of mulberry plants that will feed a nearby silkworm farm. When his well went dry, he couldn't afford to dig another and take the risk that it would be dry, too. So he pieced together plastic tubing and rigged a pump to get the black water from a nearby sewage canal into his fields. The reeking liquid bought him time, at the risk of health and habitat, and he saw no other choice.

"If I had had an education, I would not have used wastewater for irrigation," he said. "I would not have been so desperate to continue with farming — I would have searched for a different job. Now we are praying that the wastewater flows will last as long as it takes for our children to find other jobs so that they can support our family."

Muniraju is grappling with the reality that confronts the human family—that north or south, east or west, we share the global commons and the boundaries of a world that is both larger than our comprehension and smaller than our appetites.

We need to make wise decisions before we lose the best options to do so.

We've missed crucial cues and profound threats to the stability of global resources—drought, floods, groundwater depletion, persistent pollution by plastics and pharmaceuticals. We are discovering how far we can push the limits of our finely-balanced ecological foundations before feedback loops become disastrous and unstoppable.

At the same time, we are at the bright dawn of the Fourth Industrial Revolution, where big data, the internet of things, and artificial intelligence promise to help us solve the most intractable problems. It is a moment when we are beginning to see and listen to the world in ways never before imagined.

We are challenged to align this all-seeing perspective with the confines, demands and distractions of our daily lives. We are dared to jump the gulf between perception and reality, when reality might turn out to be a cliff with precious little foothold. In short, we are called to cope on a greater scale than ever before.

Acknowledging this is the first stage in painting the new "big picture," one based on fact but which does not deny feelings - that empowers us as a whole and respects us as individuals.

To explore the roots of perception is to understand better how humanity makes choices, or chooses not to make them. It includes how we communicate, whom we trust, and the context of our culture, communities and values.

We can do this. It is not magical, but methodical. We need only summon the will and humility to pay attention, and take heed.

Insofar as we can discern them, we must respect the planetary boundaries, which limit the world's capacity for example, to lose genetic diversity, absorb carbon dioxide and supply clean water. We must find common cause around the global commons. We must know ourselves, and find ways to make changes that save the planet and make sense to us. We must strengthen and inform the connections that are the hallmark—and hope—of an enlightened species.

Very few of us have had the transformative glimpse of our blue planet from space. Our epic challenge is to find that saving grace upon the Earth, within ourselves.

HOW THE LOW CARBON ECONOMY IS THIS CENTURY'S BIGGEST BUSINESS OPPORTUNITY

PAUL SIMPSON
CEO, CDP (formerly the Carbon Disclosure Project)

Science-based emissions targets future-proof companies

Tackling climate change could unlock a $23tn (£16tn) investment opportunity by 2030 in emerging markets alone, according to a 2017 report by International Finance Corporation. Meanwhile in the US, renewable energy is creating jobs twice as fast as any other industry. And this is just the tip of the proverbial iceberg.

Galvanised by the historic Paris agreement, the transition to a low-carbon economy is underway and accelerating globally. Every sector in every market is undergoing transformation. To Indian industrial tycoon Anand Mahindra, speaking at this year's World Economic Forum, climate action is this century's biggest business opportunity.

Sustainability is now a mainstream business concern, and leading companies the world over recognise the opportunity—and the imperative—of being part of the solution. They are positioning themselves to thrive in the new green economy by setting emissions reduction targets in line with what science says is required to prevent dangerous climate change.

These science-based targets are fast becoming a business norm, with over 350 corporations worldwide already committed to the Science Based Targets initiative. Those that have led the way come from diverse sectors—from energy to retail, food to telecoms—and include household names such as Marks & Spencer, Mars and Sony.

Global emissions need to peak by 2020, and decline thereafter to meet the goals of the Paris agreement. National governments are preparing to come back to the table that year to discuss increasing ambition in their climate pledges. 2018 is a pivotal year in that process.

Tangible reminders abound that this is an urgent mission. From the UK's recent unseasonal freeze that made it briefly colder than parts of the fast-melting Arctic, to the record-breaking drought in Cape Town, the climate system is rapidly changing, and the race is on to transform our economy in time.

At CDP, we collect data from over 6,300 companies, disclosed to us at the request of investors with $87tn in assets. Our latest analysis of corporate climate action found that nine out of 10 (89%) of the world's biggest, highest-emitting companies have climate targets in place.

That's promising. But to be effective, targets need to be based on climate science and aligned with the emissions reduction pathway laid out in the Paris agreement.

Companies have good reason to be engaged. Climate change poses material risks to business—whether from supply chain disruption from extreme weather, regulatory risk as governments and cities ramp up action, or damage to brands as consumers increasingly demand transparency and assurance of sustainability. They have the power to lead the way in the transition to a sustainable low-carbon economy that safeguards the global commons.

Corporate climate targets are considered "science-based" if they are in line with a company's share of the decarbonisation needed to keep the global temperature increase below 2C compared to pre-industrial levels.

The Science Based Targets initiative helps companies navigate the transition, by assessing and validating targets within two years of a company's commitment. As technology giant Dell says, "grounding the energy target in science made sense because it means we know this is what we have to do to help keep temperatures from rising above 2C".

Companies that have already set such targets are seeing benefits to their business, including increased innovation, reduced regulatory risk, strengthened investor confidence and improved profitability and competitiveness.

Energy company EDP says, for example, that its science-based target gives it a competitive edge. Improved efficiency has cut costs along with emissions, and their climate strategy makes the company more resilient to regulatory risk.

Yet before companies can act, they first need to know where they stand. Here at CDP we believe disclosure is the vital first step in managing and reducing environmental impact. Companies must first understand their impact, and the risks and opportunities they face, before they can grasp the benefits of the transition to a low-carbon world.

System transformation

The scale of the climate challenge requires nothing less than the wholesale transformation of the global economy.

Ultimately all companies need to build science-based targets into their business models. We need systemic change, not to merely outsource pollution and risk from one company, sector or country to another.

This change can be triggered when there is concerted social and policy pressure, affordable alternatives and companies ready to seize the business opportunity. Climate change is an engine of innovation in capital markets, as the dramatic fall in renewable energy costs and strengthening policies are now demonstrating.

Leading companies recognise that long-term holistic thinking is needed for future resilience. Kellogg Company says that part of their motivation to set a science-based target is that climate impacts pose a risk to agricultural production of their raw ingredients.

CDP data combined with existing commitments to the Science Based Targets initiative shows that over 1,200 companies have signalled their intention to set science-based targets in the next two years. We are heading towards a tipping point that will mainstream environmental action. But we need to move faster to bend the emissions curve by 2020.

In his Davos speech Mahindra issued a bold challenge to his business peers: commit to set science-based targets before the Global Climate Action Summit in September 2018.

The following week, at the global launch of CDP's supply chain report, Christiana Figueres added her voice, calling on the world's largest corporations to ask three of their top suppliers to commit to such a target before September.

BT is working with its suppliers to cut supply chain emissions by 29% by 2030, starting a ripple effect throughout the value chain. Mars Inc and Kellogg Company are calling on their peers to join them. This snowballing comes not a moment too soon. As this new business norm scales up, the concept of science-based targets is now being discussed as a way forward in addressing other planetary boundaries and the global commons.

As we gear up to the Global Climate Action Summit in San Francisco, all business leaders should step up and contribute to this momentum, by committing to set science-based targets, encouraging their peers to do so and setting their companies up to thrive in the new low-carbon economy.

IT'S TIME TO SET CLEAR TARGETS FOR A SAFER EARTH

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A new joined-up approach is needed to protect the global commons

Why does almost every big business in the world set targets? Because they understand the power of setting—and tracking - progress against them, in order to make things happen.

In recent years there's been a big increase in the number of the world's largest businesses setting targets to reduce their greenhouse gas emissions—driven by international scientific and political agreement that we must limit the average global temperature rise to well below 2C. 89% of them now have some form of emissions reduction goals and 68% have set targets that run to at least to 2020.

But what about major environmental risks beyond climate change? Do businesses and investors understand them and have the clarity they need to set meaningful targets and take action? Do governments or citizens, for that matter?

Over the last 70 years human pressures on our planet have grown exponentially, placing the global commons—our climate, water, air, biodiversity, forests and oceans—under mounting strain. Scientists have identified nine critical planetary boundaries—limits to things like

ocean acidification, freshwater, air pollution, biodiversity loss and climate change—which we must stay within if we are to continue to survive and thrive. Now a group of international leaders across science, government and business are coming together to explore how these boundaries can be turned into practical science-based targets for a safe Earth—to galvanise, and enable, policymakers, businesses and citizens to respond.

The 1980s saw global activism around the depletion of the ozone layer, which protects us from carcinogenic ultraviolet rays. Scientists highlighted the potential consequences of the growing hole in the layer caused by man-made chemicals. Governments agreed to ban the production of these chemicals, defining targets and timeframes to phase them out. Thankfully the ozone layer is now slowly recovering.

The second of the boundaries to enter public consciousness—climate change—has proven far more challenging to address. Unlike the threat to the ozone layer, which could be traced to a limited number of substitutable chemicals, the causes of climate change are intertwined with almost every aspect of our lives. Governments cannot simply ban greenhouse gas emissions; concerted global action is required to address their many sources and sinks. Yet the breakthrough UN global climate agreement reached in Paris in 2015, significant commitments from business groups and investors, and growing awareness in society, all indicate that the tide of understanding and action is turning.

Huge transformation lies ahead: current pledges from nations take us to only half the level (pdf) of annual decarbonisation needed. But there is global commitment to a clear target and timeline for action. We know what is needed to avert a climate catastrophe.

Safeguarding all the planetary boundaries requires concerted international effort at a speed and scale never before achieved. The good news is that governments have demonstrated remarkable international cooperation in agreeing the UN's sustainable development goals (SDGs), which set out an aspirational agenda for human development and environmental improvement up to 2030. Yet, of the environmentally focused SDGs, only climate change currently has a clear science-based target and global action agenda in place. The need is not just to define meaningful targets for the remaining global environmental risks, but to develop the practical management framework for business, investors, cities, and nations to adopt and implement them. It will be a significant—but necessary—undertaking.

Three key lessons from global efforts to address climate change are:

Define simple science-based targets
The 2C limit in the 2015 Paris agreement forms a critical ingredient of the climate action agenda. It is our "guard rail" for climate change; warming beyond this could lead to catastrophic and irreversible impacts. The target's most powerful aspect is its simplicity as an organising principle for governments and business. It is understandable, measurable—and hopefully still achievable if action is taken quickly.

Understand the business case to act
Significant drivers that are spurring innovation, disrupting markets and encouraging environmental action include rising investor pressure to understand material environmental and social risks, and the need to create long term value, make direct cost savings, and reduce regulatory, reputation and litigation risk. Targets enable investors and businesses to assess the financial materiality of risks, set priorities and measure progress in a consistent way. Importantly, risks need to be understood across the value chain, enabling businesses to prioritise efforts to maximise gains.

Galvanise the public
For the largest and most thorny global challenges, public opinion—linked, as it is, to votes and consumer choice—counts. It has already led to decisive government and business action. A powerful media-backed narrative of the impact of inaction on society is key. The impact of losing the protective ozone layer was communicated through alarming but credible projections of the future health effects.

The stark challenges we face as a global community on climate change have been told in numerous movies, documentaries and campaigns, backed by powerful statistics. The Stern Review, for example, estimated that we will lose 5-20% of global annual GDP indefinitely if we fail to act quickly and decisively. A powerful narrative explaining why it is critical for governments and business to rapidly address all the risks to the Earth's systems - together - is still needed.

Thus, we urgently need a new joined-up approach to protect our Earth's natural systems and achieve the SDGs—one that mobilises global action across all key environmental risks at the necessary speed and scale. Defining science-based targets that integrate with business, policy and societal action won't be easy, but they have a crucial role to play in propelling, directing and measuring action.

RE-DESIGNING URBAN SYSTEMS TO REPLENISH SPACESHIP EARTH

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A fundamental rethink of how we design, develop and inhabit our urban environments is needed

We live on a spaceship. So suggested Buckminster Fuller in his 1968 book, Operating Manual for Spaceship Earth. It depicts a self-contained environment with finite resources and no resupply, a closed ecosystem wherein all production, consumption, waste, and materials must originate and remain. If we are successfully to function, and thrive, we must remember that Earth is humanity's sole environment. And like any vessel, we must pay attention to its maintenance.

We have entered the Anthropocene, where human activity is responsible for the dominant impact on the global commons of the Earth's natural systems. It strains our natural resources, damages ecologies and promotes unequal distribution and consumption of materials driven by local needs and desires.

We are already feeling the effects of delayed planet maintenance. In 2007, Nasa climate scientists told us that the safe upper limit for

carbon dioxide—so human life is not jeopardised—is 350 parts per million (ppm), yet the Earth has just passed 400 ppm. Breaching this threshold manifests across the world as severe weather events, sea level rise, ocean acidification, massive temperature anomalies, methane releases and widespread drought. These changes have disastrous implications for natural ecosystems, wildlife, agricultural production, water resources, cities—and human existence.

We are the first generation to have enough data to understand and articulate what has been happening to our planet as a result of our collective behaviour. The Stockholm Resilience Centre has identified nine planetary boundaries which regulate the Earth's stability and resilience. Each has, or will have, a science-based target within which human activity must remain. Science is working to define these safe limits, providing a fantastic opportunity—and responsibility—to take action.

Cities are our collective blessing and curse—economic powerhouses, catalysts for change, and providers of prosperity. They are hubs of innovation full of limitless possibilities. They can also be profoundly wasteful, are major consumers of resources, produce massive amounts of trash, devour immense quantities of food, and have escalated pollution to scales never imagined, putting enormous strain on Earth's ecological and biological systems.

Today, 54% of the global population lives in cities. By 2050 the proportion is projected to be over 66%. We must increase the emphasis on lowering carbon emissions, minimising waste, reducing reliance on fossil fuels and restoring vulnerable supply chains. We have identified 16 urban systems that relate to all cities regardless of size, economy or location. It is a complex system of systems, where everything is connected with and impacted by everything else. Understanding these impacts will help us begin to identify possible, probable and scalable solutions.

Urban systems

1. Mobility
2. Commerce
3. Education
4. Housing
5. Safety
6. Security
7. Sports
8. Entertainment
9. Energy
10. Water
11. Nourishment (food)
12. Governance
13. Nature
14. Waste
15. Wellness
16. Production

Towards restorative cities

The UN estimates that over "60% of the land projected to be urban in 2030 is yet to be built." Now is the time for creators, thought leaders and innovators of the built environment to design and retrofit cities to develop a sustainable and habitable Earth for generations to come.

Our short but steep learning curve has led us to explore and incorporate renewable sources of energy into buildings; to value ecological networks; to integrate street trees and vegetative facades; and to use data-driven design to minimise the ecological footprint of structures. These urban remedies are moving in the right direction, but we need more of them and faster. We need a step change in the design and construction of the built environment to restore Earth's natural resources and build a better future. We must determine how to create restorative cities at varying scales and in every bioclimatic zone. We need science based targets for cities to achieve this and guide the development of new norms, exemplars and best.

If we are to achieve restorative and thriving cities we must fundamentally re-think how we design, develop, and inhabit our urban environments.

Cities are hubs of opportunity. This is what drives us to reside and gather within them. Enacting meaningful change will be a long and winding road. It will require each and every one of us to be engaged participants—awake, aware, and active—on the journey. Envisioning, developing and delivering our ideal future with restorative cities, communities, neighborhoods and structures will be a massive, yet critical, undertaking. We must be intentional in both large and small changes to our daily life, today and tomorrow.

Restorative urban systems will be key to whether all species on our planet thrive. It is in our best interest that we pay attention to this now. We must protect this small blue marble as we hurl through the infinite blackness of space. It is our one, and only, spaceship Earth.

THE PURPOSE OF BUSINESS? IT'S NOT JUST ABOUT MONEY

ANDRÉ HOFFMANN
Vice-Chairman, Roche Holding Ltd.

Companies should be evaluated by their net contribution to society

Business has shaped the world in pursuit of profit and growth with an apparent disregard for consequences, other than financial ones. The process of value creation has been extraordinarily successful in creating wealth through satisfying consumers' needs and wants. The world's fortune is at a historical peak: its economy has never been so highly valued. So, by some measures, the model can be considered a success. But at what cost?

It is increasingly evident that the focus on profitability has led to the neglect of two other dimensions: the environment and the fabric of society. We are rapidly losing species and natural areas. Income inequality is rising, with the latest figures showing a historic high. The world is getting richer, but its wealth is not properly redistributed.

The UN millennium goals were successful at lifting more than a billion people out of extreme poverty, and have been succeeded by the sustainable development goals, which provide us with a framework for building a better world. But, while such goal setting remains a successful mechanism, there is more to do.

A sole focus on short term gains will not drive the change we need. We must think in the longer term. This is particularly important in a one planet system. Where will growth come from when planetary boundaries have been reached?

Nobody likes business any more. The profit motive, once a desirable incentive to wealth creation, is now seen as something evil, and a source of injustice and inequality. There is a need to change the model, an imperative to reassess the purpose of business, not just to satisfy shareholders and accountants but also to work in tune with all relevant stakeholders.

The successful company is no longer one that just makes money. A financial return is a necessary condition, but it is not sufficient. Dividends will keep shareholders happy but what about other stakeholders?

We have to remember that a company is not just a balance sheet. It is also customers, local and global communities and society—and the natural environment, the world in which we live. These long neglected factors must be carefully considered.

So, there is a need for change. True sustainability will only be assured if there is a proper investment return in the three dimensions of business: financial, social and environmental.

This intuitive finding has long been around, but few companies have been able to implement it. Financial markets focus exclusively on financial reporting. If all that matters is immediate profitability how can one justify investing in long term projects? In a family-owned enterprise, trans-generational value creation may come naturally. But this is difficult to replicate in a publicly quoted company where the voice of owners is only answered in term of dividends.

Companies and their performance should be evaluated in terms of their net contribution to society, giving back at least as much as they take. There are many ways in which they can do this. Training employees, promoting ethical values, integrating ethnic minorities and ensuring fair pay for all are only a few of the obvious activities which need to be recognised and valued. In environmental terms, reducing ecological footprints and better managing consumption and the natural resources cycle could work as useful metrics, among many others.

None of this is rocket science, but it is usually met with stock answers such as "we cannot afford it" or "shareholders would not approve, as it has an impact on the margin". I would argue that we cannot afford not to make the change if we care about people and planet as well as profit.

These transformational changes will not take place without the emergence of a new generation of leaders able to change the current management paradigm. Under such enlightened stewardship, companies will again be able to thrive in the dual and common interest of humanity and the planet and evolve a more appropriate response to the current world challenges.

The new technology tsunami, currently underway, could provide an opportunity for a successful reboot. Its disruption to the existing business model must be harnessed for good. If instead it is just seen as a new opportunity for business as usual the situation will become even worse. Company management should be rewarded along the lines of people, planet and profit.

This would encourage companies to repair part of the damages sustained to the global commons since the beginning of the industrial age two centuries ago—and to develop a stable growth engine which will produce the necessary return on investment without, literally, costing, the earth. Let us look towards the corporate sector as a part of the solution and no longer as the problem.

Today, as in the past, growing wealth and prosperity is needed for a properly functioning system where humans can live sustainably and in harmony with nature. Providing this could be the new purpose for business—especially if we truly realise that it is not the way you spend money that matters but the way you make it.

REVERSING THE OCEAN'S ACCELERATING DECLINE

PETER THOMSON
United Nations Secretary-General's Special Envoy for the Ocean

A sustainable blue economy will feed and support future generations

The ocean has shaped my life, from my beginnings in the outer islands of Fiji to my appointment last year as the UN Secretary-General's special envoy for the ocean. Like millions of others before me who have taken sustenance and succour from Neptune's world, I know there is so much for which we should give thanks. And yet, over the intervening decades of my life, a quickening cycle of decline has been imposed on the ocean's health by the ever-accumulating effects of harmful human activities.

Thanks to growing concentrations of greenhouse gases in the atmosphere, marine life must now battle with increasing levels of acidification, warming and oxygen depletion. Once-pristine waters are constantly fouled by unconscionable flows of plastic pollution and damaging effluent from industry, agriculture and sewage. Meanwhile, human greed, as opposed to humanity's need, is depleting the planet's fish stocks and marine resources at an unsustainable rate.

There is a vicious causal link between global warming, thermal stress on coral reefs, massive loss of marine biodiversity, and the wellbeing of coastal communities. Add rising sea levels and the increasing frequency and ferocity of extreme weather events, and—for an islander like me—it's easy to imagine that you are drowning. Does this matter to you, if you live in the urban citadels of post-industrial societies? Just contemplate that every second breath you take comes from the ocean's oxygen, produced by phytoplankton and other marine plant life, and the answer should be abundantly clear. The ocean is this planet's source of life.

Yet, despite this gyre of decline, I remain a steadfast optimist. I am confident that, by 2030, we will reverse the negative cycle, and restore our relationship with the ocean to one of respect and balance. My confidence is based on the fact that we have a comprehensive plan to save the ocean, agreed to by all 193 UN member states in 2015—the Paris climate agreement and the UN's sustainable development goals (SDGs). Fidelity to these is the prime responsibility of all us living in the 21st century. I do not doubt the force of that fidelity, for humankind always bends in the direction of survival.

SDG14, the ocean goal, sets out to conserve and sustainably use its resources. Its 10 targets are in harmony with the other 16 SDGs in working to bring an end to poverty, hunger and environmental degradation of this best of planets. The Ocean Conference was held in June 2017 at the UN headquarters in New York in support of implementing the goal, and proved to be the game-changer required to raise global consciousness on the urgent need for remedial action. Over the last year ocean action has escalated around the world.

In April, the heads of government of 53 Commonwealth nations agreed to a bold Blue Charter to protect the ocean from the threats of climate change, pollution and overfishing. That same month, the International Maritime Organisation adopted an initial strategy to halve global emissions from shipping by 2050. Meanwhile, Canada has announced it is using its 2018 presidency of the G7 to persuade the world's richest countries to invest in a healthy ocean, pushing for a zero-plastics-waste charter, including support for improved waste management in less developed countries.

Last December, the UN declared 2021–2030 to be the International Decade for Ocean Science, setting the global community the challenge

of making a great leap forward in knowledge of our planet. The Ross Sea Marine Protected Area, protecting 1.55m sq kms of rich marine biodiversity off the coast of Antarctica, was established in the same month.

Governments, states, cities, and organisations around the world are banning the scourge of single-use plastic shopping bags, drinking straws, cutlery, food packaging and micro-beads. And major food and beverage corporations are increasingly pledging—in reaction to mounting public concern about ocean plastic—that their packaging will be reused, recycled or composted in the near term.

We shouldn't underestimate the powerful attraction of a "sustainable blue economy", which—I firmly believe—will feed and support the lives of our children and those who come after them. Getting it right—whether through aquaculture, offshore energy, green shipping or ecotourism—is vital not just for SDG14, but for the future of the global commons, and humankind itself. To do this we must move with purposeful steps. Here are five that could be taken immediately.

Curtail subsidies
Let us stop throwing good money after bad, and resolve to prohibit subsidies that support harmful and illegal fishing. A critical opportunity to eliminate them is looming at the 2019 ministerial meeting of the World Trade Organisation. It must not be missed.

Stop illegal consumption
We must cease our criminal consumption of illegally caught fish, estimated to be worth $23bn a year. We must demand this of our fishmongers, our restaurants and ourselves. There are now technologies and systems that can be adopted by governments and retailers to enforce the traceability of fish catches.

Increase marine protected areas
We must meet the SDG14 target of establishing 10% of the ocean as Marine Protected Areas (MPAs) by 2020. Thanks to ones Brazil, Chile, Mexico, the UK and others have recently created in their waters, we are now around 7%. The time has come to establish extensive MPAs in the high seas.

Improve tourism stewardship
Marine and coastal tourism—worth some $390bn a year—has a massive stake in safeguarding the ocean's health. Hotels, cruise ships, tour operators and governments, all need to demonstrate diligent stewardship of the ecosystems their industry exploits, through such measures as sustainable seafood supplies, zero pollution, coral reef restoration and investment in natural capital.

Look down, not up
Let's put further exploration and mapping of Mars and the Moon on hold until we've done more on our own planet. So much of what lies beneath the ocean's surface remains unknown and its time we put serious funding into the science of discovering it. Only then will we be able to produce the right answers for the challenges facing us through ocean acidification, deoxygenation, and changing ocean thermoclines and currents.

SCIENCE CAN HELP FORGE A NEW DEAL FOR NATURE

CRISTIANA PASCA PALMER
United Nations Assistant Secretary-General;
Executive Secretary, Convention on Biological Diversity

We must shift to an economy that stays within ecological boundaries and safeguards the global commons

Biodiversity is life, all life on earth. The air we breathe, the food we eat and the water we drink are all only possible as long as we have healthy biodiversity. The smell of flowers filling the house on special occasions, trees and birds that help make us restful—they all exist and give us life every day thanks to well-functioning ecosystems. Today we celebrate this rich gift. Every year, on 22 May, the world marks and pays respect to life on Earth through the UN-recognised International Day for Biological Diversity. This year is particularly special, since 25 years ago, in December 1993, the UN Convention on Biological Diversity entered into force, realising a project for sustainable development that had taken the world decades to achieve.

For a quarter of a century, Parties to the Convention—now numbering 196—have undertaken national, regional and global commitments to achieve its three objectives: conserving biological diversity; using it sustainably; and sharing - fairly and equitably—the benefits arising from using genetic resources.

But despite these efforts, biodiversity continues both to be threatened or in grave decline in all corners of the world.

The science is clear—the pressures that human systems put on natural ecosystems are endangering survival on our planet. The latest research shows that we are on the brink of crossing ecological boundaries and reaching tipping points in climate and ecosystems that might lead to an acceleration of planetary destruction. The World Economic Forum's 2018 Global Risk Report lists ecological collapse and biodiversity loss among the top 10 risks in terms of impact. Humanity's "Titanic" is moving faster and faster towards the iceberg.

We need to be aware of the broader implications for our wellbeing of losing biodiversity. Losing the bees and insects that naturally pollinate crops, for example, can gravely impact food production systems, affecting our economies, livelihoods, and health.

The pressures we put on our ecosystems are embedded in our societal structures, mostly in how we produce and consume, but also in our system of values and cultural dynamics. These interlinkages and interdependencies, inter-woven with economic and governance complexities, make protecting life on Earth an intricate global challenge.

Our efforts cannot therefore merely seek to remedy and soften the negative impacts of unsustainability. We need to address the root causes that have led to its symptoms. We need to re-design our societies into more sustainable ones.

This means shifting to new ways of production and consumption and reorienting pathways of economic development towards an economy within ecological boundaries that safeguards the world's global commons, while improving the state of the environment and creating opportunities for the long-term wellbeing of society.

As the 193 member states who created the United Nations sustainable development goals in 2015 acknowledged, this requires transformational change. Change in the way governments work. Change in the way the private sector operates. And, above all, change in our own behaviour, as consumers and citizens. This starts by shifting to less meat-intensive diets, wasting far less food, and dramatically reducing our consumption of non-renewable resources.

This also requires investments in research and development to gain a deeper understanding of human, group and corporate behaviour. This understanding will be required to discover the incentives needed to change behaviour, so that they can be incorporated both in decisions on how to address the processes that drive the loss of biodiversity and in mechanisms to implement solutions. The challenge is not simple but it is surmountable.

Advances in science and technologies help us to identify and define the challenges we face. Investing in data and science is crucial for the Convention as Parties lead to 2020—when the current global Strategic Plan for Biodiversity, agreed in 2010 in Nagoya, Japan, comes to an end, and as Parties consider the post 2020 period.

Science must guide the balance between realism and ambition in setting a new action agenda that will allow humanity to avoid "colliding with the iceberg", and live in harmony with nature by 2050. This includes not just the natural and biophysical sciences, but also social sciences, including behavioural psychology, anthropology and sociology, and traditional knowledge systems. It is high time to cross-pollinate knowledge between different fields and sectors and to draw from the lessons of managing transitions by applying principles of innovation and transformational change.

Shifting the paradigm to focus on the opportunities and solutions that nature, biodiversity and healthy planetary systems provide for humans will be essential after 2020. This also applies to action on climate change, where there are abundant nature-based solutions—from halting deforestation and other forms of habitat loss and destruction, to restoring and rehabilitating degraded habitats, and sustainably managing croplands, pastures and coastal ecosystems. These solutions could provide up to half of the cost-effective mitigation of carbon dioxide emissions that will be needed by 2030. Restoring ecosystems will be a major part of this. Done right, these solutions could also improve resilience to climate change, helping communities adapt to unavoidable effects.

The global community has a unique window of opportunity to define the post-2020 global biodiversity framework. It will need bold commitment and determination, innovative approaches and transformative processes to ensure that such a new deal will be effective.

At this historical juncture, let us leverage science to help forge a new deal for nature.

Happy International Day for Biological Diversity!

WE NEED TO REIMAGINE FOOD AND AGRICULTURE TO ERADICATE WORLD HUNGER

FOKKO WIENTJES
Vice President, Nutrition in Emerging Markets & Food Systems Transformation, Royal DSM

Science, not confusion, will help people eat better

Not long ago, major news publications reported a study about the health benefits of red wine. A little later, others reported that alcohol, even one glass of red wine, is bad for you.

I am worried. Not about wine, about the way science is reported.

Conflicting reports on everything from dark chocolate to dietary supplements only damage public perceptions of science and facts. We shouldn't take public interest in science and health for granted. People will become immune to sensationalised headlines, if they aren't already.

The scientific community must not be the boy who cried wolf—not over chocolate and wine. Today's food and health issues are too important—and there may be even more serious ones on the horizon.

The human population is growing fast: by 2050, it is expected to reach 9.8 billion people. Demand for food will be at an all-time high, putting much pressure on the planet's resources. Food systems already use huge amounts of raw materials, land, energy and water. They are both causing, and being impacted by, climate change, pollution, waste, socioeconomic disparity and even conflict.

Nor do they deliver enough nutrition—or the right kind of it. Nearly two billion people are undernourished: around another two billion are overweight.

This is troubling because good nutrition is the foundation of human and socio-economic health. Nutrition shapes us from the moment we are conceived. Science suggests that a proper diet during the first 1,000 days of life is critical for physical and mental development—and lifelong productivity. And of course, it reduces health care costs since well-nourished people fall sick less.

We need to upgrade today's food systems so that all people have access to healthy choices. And, as we can't endlessly sacrifice the earth and its global commons, we must carefully consider how to address human health needs with respect for the environment.

Fixing our food systems

The EAT-Lancet Commission on Food, Planet, Health has brought together 20 leading scientists from around the world to help reach a scientific consensus that defines a healthy and sustainable diet. It will issue a report later this year which could give more insight into these dilemmas and help policymakers and the private sector reimagine food and agriculture for greater productivity, less waste and less environmental impact. It will be an important step toward eradicating hunger, improving health and healing the planet.

However, there are some concerns which the report may not address. Food is extremely personal and cultural, even aspirational. From taste and experience to price and convenience, different factors drive what people like and what they can afford, and they vary around the world. In Asia, for example, the average person eats 150kg of white rice a year, compared to just 12 kg in the US. No matter how sustainable or available food may be, it has to consider cultural differences like these.

Businesses can develop solutions that work with, rather than against, these regional preferences. In Asia, for example, people may want to switch from regular white to fortified rice – which looks, cooks and tastes the same but contains more micronutrients.

Raising awareness about nutrition is also key. When consumers know more about the implications for health they are more likely to make good choices. So fact-based reporting on nutrition studies is important.

Change is not easy, either for individuals or for society. Science should be the North Star guiding us toward better personal and better business decisions. But the sky is full of stars and, as they say, diversity is the spice of life. So let's embrace our cultural differences and create food systems that work for everyone.

OUR FOOD SYSTEM IS BROKEN: WE MUST REPAIR IT

PAUL POLMAN
CEO, Unilever

Making it work for both people and planet is good business, as well as the right thing to do

Let's start with the good news. Humankind is living longer than ever before. Fewer of us are going to bed hungry. Improvements in diets and modern medicine have contributed to a 20-year increase in the average global life expectancy since 1960. The number of undernourished people has fallen from 1 billion in 1991 to 815 million today, even as world population has grown by over 2 billion.

To allow this tremendous progress, the world has applied ingenuity to adapt and scale our agricultural systems to meet the demands of a growing population—but this has come at a heavy price for our people and planet. In fact, our food and land use systems are no longer fit for purpose.

They drive massive environmental destruction, accounting for around 25% of greenhouse gas emissions and cause devastating losses of natural capital—including shrinking biodiversity, soil erosion and reduced fertility. Over half of the land used for agriculture worldwide is moderately or severely degraded and one third of the world's food—costing $940bn per year—is currently lost or wasted. At the same time, rates of obesity and diet-related non-communicable diseases like type 2 diabetes are growing, while food insecurity and malnutrition continue to persist for too many and 500 million smallholder farmers live below the poverty line.

This is simply not sustainable.

As the producers, manufacturers and retailers of most of the world's food, businesses have a responsibility to help drive food and land use system transformation. This is not just because it is the right thing to do, but also because it is good business. A report by the Business and Sustainable Development Commission found that transforming our food and land use systems could generate $2.3tn a year, and create 80m jobs by 2030.

Many companies are already taking action—bringing digital innovation, research and development skills to bear on food and agricultural issues—and, in turn, future-proofing their own supply chains and opening up new market opportunities.

But no company can do this alone. There is an urgent need for a new, independent coalition of public and private stakeholders that can combine leadership and vision with the technical depth necessary to solve these complex challenges. That is why I am proud to chair the Food and Land-Use Coalition which brings together an alliance of progressive businesses, forward-thinking policymakers, foundations, investors, academics, international organisations and members of civil society.

The coalition will develop credible science-based targets and pathways to tackle key environmental and social challenges. These will guide investment in specific business solutions, such as reducing food waste, identifying alternative animal proteins and promoting greater crop diversification. And it will support individual countries. In Colombia, for example, it is presenting a set of integrated policy and investment recommendations—with input from over 130 stakeholders across business, government and civil society organisations—to the incoming government. These are designed to drive action in crucial areas, such as deforestation and farmer livelihoods.

Momentum for transformation is already building. In April this year, 30 countries collectively pledged $4.1bn (£3bn) to the seventh replenishment of the Global Environment Facility (Gef) trust fund. For the first time, this replenishment contains a specific allocation of funds for projects that improve food systems and reduce their environmental impact. This builds on the Gef's continued commitment, for over a quarter of a century, to protecting the global commons. It's a sign of a growing recognition that our food and land use systems should go hand in hand with sustainable, environmentally sound development.

But there is no time to waste. Vast amounts of human ingenuity and investment have gone into making food and land systems capable of meeting the demands of a growing population. We now need to turn our efforts towards repairing today's broken food system and make it work for the long-term benefit of people and planet. With the support of such initiatives as the Gef and the Food and Land Use Coalition, we have a unique opportunity to begin doing just that.

FROM DECLINE TO RECOVERY: A RESCUE PACKAGE FOR THE OCEAN

JOSÉ MARIA FIGUERES
Former co-Chair of the Global Ocean Commission and co-Founder of Ocean Unite

The ocean is everybody's business as we set out to build a sustainable blue economy

Our relationship with the ocean is at a crossroads. The decisions we take in the next five years will determine our future, our security, our very existence. They will make or break whole economies and dictate how and where we live. And there will be many more losers than winners should we ignore the stark signs of warming that the ocean is presenting.

If we steer the right course and confront these challenges head-on, the reward will be an opportunity to build a sustainable blue economy of marine and coastal industries, goods and services that will enhance the wellbeing of humanity and the global commons. But, if we make bad decisions, there will be dire consequences for food security and regional stability: jobs will be lost and whole industries will suffer as the blue economy flounders.

Looking to the future, two oceans are possible: a healthy one, where both marine ecosystems and human enterprises flourish, or an ailing, polluted one, unable to sustain us.

The choice is easy, but the challenges are not. Our ocean is in deep trouble: 85% of fish stocks are over- or fully exploited. And, if we do not take action, within ten years the ocean will contain 1kg of plastic for every 3kg of fish. A 'business as usual' trajectory forecasts a catastrophic economic, social and environmental outlook. To give just one scenario, maintaining the status quo is to likely cause the total disappearance of the world's coral reefs by 2050, resulting in the loss of food, jobs and storm protection for several hundred million people. About US$30 billion would be stripped from global tourism revenues alone.

Considering that the ocean provides billions of people with vital protein and is the world's largest carbon sink—without which we would experience an unimaginable 36oc of global warming—it is entirely in our interest to restore its health. The good news is that it has an amazing ability to regenerate. If we act fast, we can help it, ourselves, and our planet.

I am confident that we will rise to this challenge and am encouraged by the forces mobilizing and uniting for the ocean. There is growing global recognition of the imperative of implementing a rescue package to restore its health, and of the immense opportunity that this entails. Crucially, alongside action in the political sphere, we are seeing more engagement of the business and finance communities, as momentum gathers behind boosting the role of the ocean and its resources—the blue economy - in economic development.

The ocean is already a significant generator of wealth. A recent report by WWF estimates the value of key ocean assets at US$24 trillion, with an annual "Gross Marine Product" of US$2.5 trillion. That's about 5% of global GDP, making the Ocean the world's 7th largest economy—a place usually occvupied by France. A 2016 assessment by UNESCO and UNEP, that includes coastal regions, calculates that the large marine ecosystems where 37% of the world's people live contribute US$28 trillion a year to the global economy in fish, tourism and coastal protection. But these pillars of the blue economy are all threatened by a cocktail of climate change, pollution, overfishing and weak governance.

With so much at stake, it's not surprising businesses are starting to rally to protect marine assets. For example—in reaction to a surge in public interest in ocean plastic—a coalition of major companies responsible for six million tonnes of plastic packaging a year, recently pledged to ensure all their packaging is reused, recycled or composted by 2025. This kind of commitment demonstrates the power of consumers to demand better from the businesses that serve us.

While many governments and businesses are waking up to the power of the blue economy, not all are embracing the fact that protecting the ocean must be its foundation. This is alarming. The blue economy sea-scape requires careful planning to ensure that investments support sustainable development pathways, rather than quick wins. The international community should work together to mobilize resources behind genuinely sustainable projects to this end.

It is crucial to ensure that the US$90 trillion of infrastructure investment predicted over the next 20 years does not jeopardize either the integrity of the marine ecosystems or efforts to reduce carbon emissions – a tall order that demands a global strategy.

As a priority, the international community should help secure public and private financing to support establishing highly protected marine reserves covering at least 30% of the ocean, which the scientific community has declared essential for revitalizing ocean life.

As a co-founder of Ocean Unite, I am helping to amplify the message that the Ocean is Everybody's Business. Just last month, at the first ever Ocean Risk Summit, we welcomed a new member to the extended family of ocean partners, the insurance industry. This milestone gathering highlighted the complex threats linked to a changing ocean, not least the more severe hurricanes being fuelled by ocean warming It is only logical that the risk-management sector plays a lead role in reducing our vulnerability to these threats.

But the Summit wasn't just about talking. Practical outcomes include a breakthrough project on blue carbon credits that will provide financial incentives to conserve the coastal wetlands that both protect our shores from storm damage and help fight climate change by sequestering billions of tonnes of carbon, and a new Ocean Risk Index.

These are just a sample of the myriad opportunities that will help realize the vision of a truly sustainable blue economy, one of the 21st century's prevailing challenges. The transition to "blue" policies and business practices is an historic and unprecedented opportunity. If managed responsibly, it will bring huge benefits to countries at all income levels, including new jobs, a cleaner ocean, abundant biodiversity, and global food security.

We may be at a crossroads, but there is only one viable path to follow. Given what we stand to gain, how could we choose not to invest in and work together for a healthy ocean?

ABOUT THE GEF

The Global Environment Facility (GEF) was established on the eve of the 1992 Rio Earth Summit to help tackle our planet's most pressing environmental problems. Since then, the GEF has provided $17.9 billion in grants and mobilized an additional $93.2 billion in financing for more than 4,500 projects in 170 countries. Today, the GEF is an international partnership of 183 countries, international institutions, civil society organizations, and the private sector that addresses global environmental issues.

The GEF's 18 implementing partners are Asian Development Bank (ADB), African Development Bank (AfDB), Development Bank of Latin America (CAF), Conservation International (CI), Development Bank of Southern Africa (DBSA), European Bank for Reconstruction and Development (EBRD), Foreign Economic Cooperation Office—Ministry of Environmental Protection of China (FECO), Food and Agriculture Organization of the United Nations (FAO), Fundo Brasileiro para a Biodiversidade (FUNBIO), Inter-American Development Bank (IDB), International Fund for Agricultural Development (IFAD), International Union for Conservation of Nature (IUCN), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Industrial Development Organization (UNIDO), West African Development Bank (BOAD), World Bank Group (WBG) and World Wildlife Fund U.S. (WWF-US).

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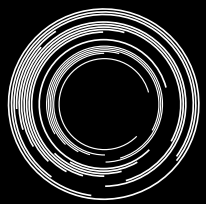

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