LUCAS SIMONS AND ANDRÉ NIJHOF

CHANGING THE GAME

SUSTAINABLE MARKET TRANSFORMATION STRATEGIES TO UNDERSTAND AND TACKLE THE BIG AND COMPLEX SUSTAINABILITY CHALLENGES OF OUR GENERATION

ROUTLEDGE

"You cannot be successful in a world that fails. Companies today have the scale, the power and the innovative strength to contribute to a better world. They also have the responsibility to do so. This book shows you how. From understanding why markets become unsustainable, why it is so hard to change it, to what can be done to change the system. This book covers it all and gives the stepwise approach for sustainable market transformation. If you are serious about sustainability, study this work and apply it."

– Feike Sijbesma, Former CEO of DSM, designated Global Climate Leader for the World Bank Group, Co-Chair of the High Level Assembly of the group's Carbon Pricing Leadership Coalition and Co-Chair of the Board of the Global Center on Adaptation

"Becoming a systems thinker is perhaps the most important step any of us can take in fighting climate change, poverty, inequality and other global challenges. This book is an excellent resource for those looking to make the shift. The authors take the reader on a journey from understanding our problems in terms of the systems that created them, through how these systems work to what we can do to change them. They also provide inspiring and practical examples of how systemic change can and is being achieved in many of the key industries that shape our societies. We need

more systems thinkers to tackle the problems we are facing, and more books like this to train more systems thinkers."

– Luke Disney, CEO Just-BI, former Executive Director of the INSEAD Social Innovation Centre, former Executive Director of North Star Alliance

"This is a terrific book that helps us understand what we have to do to respond to the climate crisis. It is a thoughtful analysis of the role that businesses can play if they are serious about becoming sustainable. There is much practical wisdom here."

– R. Edward Freeman, University Professor, The Darden School of Business, University of Virginia

"Corporate responsibility should not be just a nice project in the margins, but should be embedded in the corporate DNA. It takes systems thinking to realize fundamental market transformations. This book gives you the tools to analyze step by step what needs to be done. The book provides colorful practical examples and helps to answer the essential question: how can you become a sustainability change-maker?"

– Professor Dr. Roel Nieuwenkamp, former Chair OECD Committee on Corporate Responsibility, currently Ambassador of the Kingdom of The Netherlands to Argentina

"Proven drivers for fundamental change are charismatic leadership, 'pain in the value chain' and disruptive business models. This book proposes that 'getting far together' as business, civil society and government, guided by a positive, global, universal agenda (such as the SDGs) is offering an alternative inspiring and equally effective approach. Particularly if driven by individual game-changers in all sectors and facilitated by a proactive government in its roles as law-maker regulator, policymaker and market actor. The book should be a platform for such multi-stakeholder cooperation to take 'the collective actions for the world we want'!"

– Herman Mulder, Chairman SDG Netherlands, co-founder and Chair of the True Price and Impact Economy Foundations

"The need to change business as usual towards a significantly more environmentally and socially sustainable trajectory is ever more pressing, but how can this challenge be tackled? *Changing the Game* is an engaging read

that starts off with highlighting the world's most pressing sustainability challenges, followed by the root-causes, and then ends with possible pathways forward. The inclusion of 40 expert contributions from business and academia covering eight sectors - mining, energy, textiles, chemicals, construction, agriculture, tourism and finance – will be helpful and inspiring for change-makers of all walks of life."

– Nancy Bocken, Professor in Sustainable Business, Maastricht Sustainability Institute; Fellow Cambridge Institute for Sustainability Leadership; co-founder HOMIE pay-per-use

"This book draws on comprehensive academic research and the wisdom of 40 practitioners to offer a coherent picture of sustainability challenges and strategies for overcoming them. It digs into the causes of these problems to develop a model that facilitates practical solutions applicable to a variety of markets. Thoughtful and engaging, the book is a must-read for practitioners who want to learn how their organizations can do well by doing good for society and the planet."

– Joanne B. Ciulla, Professor, Department of Management and Global Business, Director, Institute for Ethical Leadership, Rutgers Business School-Newark and New Brunswick

"'We need less talkers, we need more do-ers,' say the authors of *Changing the Game*. I could not agree more! Happily, this book gives plenty of practical actions to help build a more sustainable world."

– Professor David Grayson CBE, Emeritus Professor of Corporate Responsibility, Cranfield School of Management and Chair of the Institute of Business Ethics

"Many Governments, Companies and Organizations have made admirable commitments to the Sustainable Development Goals. However, commitments alone are not enough. It is time to put them into action. This book will give you the insights and the strategies you need to move the needle. This book raises the bar on sustainability strategies. It's simple, engaging and it works."

– H.R.H. Prince Jaime de Bourbon de Parme, UNHCR, Senior Advisor Private Sector Partnership, former Dutch ambassador to the Holy See (the Vatican)

"This book reflects on, and analyzes in depth, the dramatic changes regarding sustainability, that threaten our planet's future in so many respects. Building on a huge experience, and extensive research in eight different sectors, the authors offer challenging and actionable insights and instruments to create the urgently needed conditions for paths to a real human future. The book is an absolute must for business life and education, as a basis for joint reflection and collaborative action."

– Olaf Fisscher, Professor of Organisation Studies and Business Ethics, University of Twente, the Netherlands

"Sustainability has to become hardcore business. And that will only be possible if our economies transform towards a more inclusive form of capitalism. This book aims to do exactly this. It challenges the reader to zoom out, look at the bigger picture and understand the systems at play. Once you have those insights, systems can be changed one step at a time."

– Jan Peter Balkenende, Professor of Governance, Institutions and Internationalizaton at Erasmus University, Chairman of the Dutch Sustainable Growth Coalition and Former Prime Minister of the Netherlands

"*Changing the Game* is both topical and timely. The authors approach the topic of sustainable market transformation with both academic rigor and a passion for storytelling. I especially liked the approach of explaining our current situation by four cause and effect chains called system loops. This makes the book an ideal reading in classes on strategy, environmental management and sustainability. As these issues will be weaved into existing core courses more and more, we need books and approaches like *Changing the Game* to help students approach the topic of climate change in a systematic and engaging way. The book provides rich descriptions of situations in eight different sectors that when discussed in class and reflected upon helps the participants to learn and develop. Even more so the writing style of the book is inviting to apply these learnings within their own sector and engage in a dialogue how to improve the current strategies for implementing the sustainable development goals."

– Martin Kupp, Associate Professor for Entrepreneurship and Strategy, ESCP Business School and member of the Jean-Baptiste Say Institute

"In *Changing the Game* Lucas Simons & André Nijhof have done this and future generations a great favour. The debate and dialogue regarding sustainability is not new, but it has often still been at a conceptual level without delving into defining the critical interdependencies, structural responses, and the fierce resolve to take appropriate action. By adopting a systems approach to defining the dynamics of this grave challenge to humanity and our surroundings, and then honing in on specific sectors of the economy and markets, Lucas and André take that next crucial step of moving from the conceptual to the strategic and most important pragmatic resolve. It should be essential reading for leaders in organisations in the private, government, NGO and NPO sectors and academia who are serious about changing their ways of playing perhaps the most important game of our and future generations."

– Christo Nel, The Village Leadership Consulting, Visiting Lecturer at Stellenbosch University School of Business and Rotterdam School of Management, Erasmus University

"The analysis of Lucas Simons and André Nijhof, *Changing the Game*, poses central dilemmas of radical global transformations, from the global to the micro/personal. Each of them affects the life of the planet and of humanity. What we know is that, without changes in these processes, the results will be increased warfare, increased conflicts and a greater and more constant loss of life and biodiversity. There is still time for Changing the Game? Time defines what is possible. Studies provide models of what is possible. Complex problems do not have one-dimensional solutions. This book points out that there are recurring patterns. It is a didactic book that tackles complex problems with erudition. It offers a holistic look at the models that demand changes in patterns and recurrences to avoid a global catastrophe."

– Dr. Francisco Rojas Aravena, Rector, University for Peace, Costa Rica

"In *Changing the Game*, the authors present how to change the rules of an existing game. This is powerful and much needed. The question is how this relates to exploring how we at the same time create a radically

different multi-dimensional value creation game. Both are important to move deeper into the Anthropocene."

– John Elkington, Founder & Chief Pollinator at Volans, pioneer of the global sustainability movement

"Please give yourself permission: You truly can be a changemaker who frees society from any of its many stuck, unsafe systems by birthing its socially and environmentally healthful replacement. *Changing the Game*, written by top social entrepreneur Lucas Simons and André Nijhof, spell out in simple, practical terms the steps required."

– Bill Drayton, Founder and CEO, Ashoka: Everyone a Changemaker

CHANGING THE GAME

We are at the beginning of the sustainability era. The biggest challenge of our generation is to reach the Sustainable Development Goals. For this we must be willing to understand and change the root causes that create these challenges in the first place. The system itself needs to change. But how to do that?

This ground-breaking book *Changing the Game* reveals the missing insights and strategies to actually achieve system change. The authors Lucas Simons and André Nijhof bring decades of real life and academic experience, and state that most of the sustainability challenges are actually caused by the same system failures, every time. Therefore, the way to accelerate and manage system change is also similar every time – if you know where to look and how to act.

The theory of sustainable market transformation and system change is described in a compelling and easy to understand eight-step approach applied to eight different sectors. The authors, together with respected sector experts, describe the drivers, triggers and dominant thinking in each of these sectors as well as the strategies needed to move towards higher levels of sustainability.

This book is highly accessible and engaging, and is perfect for use by professionals, leaders and students for understanding how to move markets to a more sustainable future.

Lucas Simons is the founder of NewForesight and SCOPEinsight. He is a leading and award-winning business and sustainability advisor, international public speaker, and author of *Changing the Food Game* (2014) and *Changing the Game* (2020). Lucas is known for getting results in system change and sustainable market transformation on a global scale.

André Nijhof is a professor in the field of Sustainable Business and Stewardship at Nyenrode Business Universiteit, the Netherlands. He is author of the book *Triple P Business Development* (with Taco van Someren) and leads executive programs like CSR in Action, Finance in Transition and Frontrunners in Stewardship.

CHANGING THE GAME

Sustainable Market Transformation Strategies to Understand and Tackle the Big and Complex Sustainability Challenges of our Generation

Lucas Simons and André Nijhof

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CONTENTS

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The discussions included in Part IV were written by co-authors. These co-authors are the relevant specialist working on the sustainable market transformation in their specific sectors.

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INTRODUCTION BY LUCAS SIMONS AND ANDRÉ NIJHOF

The title of this book is *Changing the Game: Sustainable Market Transformation Strategies to Understand and Tackle the Big and Complex Sustainability Challenges of our Generation*. The theme and topic of this book are more real and needed than ever. The climate is changing fast. The last ten years were the hottest years in our recorded history. We are confronted with uncontrollable forest fires of biblical proportions. We have polluted our environment to the deepest levels of our food chain and in the most remote areas of our planet. The rate of extinction of life in our ecosystems has increased to such high levels that we are calling it the 6th extinction. We have learned to accept extreme levels of inequality and social unfairness. We are living well beyond our limits and time is ticking. When it comes to sustainability all warning and alarm bells are now going off. Clearly the current direction and way that our economies and society work can no longer be sustained. The biggest challenge of our generation for the next 30 years is to ensure we as humans can live within the planetary boundaries and the social dimensions.

All of this is man-made. It is the result of our collective behavior and the decisions we make every day. On an individual level we know this, and yet it is so hard to change it for yourself and certainly for others. Meanwhile, continuing with business as usual, but slightly better

– greener or fairer – is no longer enough. We must come up with more radical solutions and designs. The system itself needs to change. But how to do this? And what role can you play in this?

This is why we wrote the book *Changing the Game*. It will reveal the missing insights, strategies and links between wanting to solve the biggest sustainability challenges of our generation and actually achieving it. Building on the success of the bestselling book *Changing the Food Game* (2014), this book takes an exciting new approach on how to take sustainable change further, broader and deeper. In this book we state that although most sustainability challenges look big, complex and different, they are actually caused by the same system failure dynamics, every time. We explain this market failure in four cause and effect chains called system loops. As these cause and effect chains are the same every time, the way to solve them is also very similar in every market and sector, every time. You just need to understand and recognize the phases of market transformation and how each phase calls for different interventions and actions by different stakeholders. After that, it is a matter of getting your role in this organized in the right way to suit your life. To proof this claim, we have worked with 33 co-authors and experts for this book and we have applied this thinking in eight different markets. So, you can see how the same patterns and phases occur over and over again.

This book combines the best that both NewForesight and Nyenrode Business Universiteit have been able to develop individually and together and represents decades of theoretic, educational, training and real field transformation experience. It has been designed to give you core distinctions that will help you massively improve your sustainability strategies and skills and most important, your mindset.

Though the sustainability challenges we are faced with are big and complex, the language in this book is easy and simple. This is also a positive book. One that claims large scale systemic change is possible. It can be accelerated, and it can be done much more effectively and cost efficiently. The strategies and models have been developed and applied in real life, and they have been supported and deepened by research and science. It talks in simple words and easy to understand examples and avoids technical jargon. And yes, it claims that *you* can contribute

to systemic change. Your contribution can and should go far beyond making choices like eating less meat, recycling your plastic bags and flying less. Although all of these tips are great and important, we suggest that with the right strategy you can do more. You can be a systemic change-maker.

Changing the Game explains you how it works and how you can apply it in eight effective steps. The book will also challenge you to apply these eight steps yourself. After all, there is difference between knowing something and doing something. It is only through doing that we will see results. We need less talkers, we need more do-ers, we need change-makers. We need you to help us change the rules of the game. We are reminded of the famous words spoken by Margaret Mead:

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has".

We just need the right strategy to do this. Welcome to *Changing the Game*.

What is the best way to read this book?

> "The most important work today is both highly systemic and deeply personal."

Welcome to *Changing the Game*. We may not know you personally, but if you are reading this book, that says a lot about you. You are part of a fast-growing group of people who are becoming concerned about the current state of the world. You may be a (senior) manager of a company or bank, an entrepreneur, a civil servant working for a government, a researcher, an employee working for a civil society organization, a student or maybe you are a concerned citizen and consumer. Whoever you are, know that people all over the world from different age groups, different walks of life, different career paths and different countries are becoming increasingly concerned and frustrated with the lack of progress in facing sustainability challenges. It is time to understand what is going on and what we can do to accelerate meaningful change. Our future and our children's futures depend on what we do now.

If this reflects your intentions, then welcome. You have chosen the right book. Whether you are already familiar with the topic of sustainability

or new to it, we have carefully designed and written this book with you in mind.

The book consists of five parts, and each part addresses a big question. The sequence is deliberate, so we recommend that you read the five parts in sequential order.

Let's start with a brief overview:

Part I: What are the sustainability challenges of our generation? Here we take a step back and look at the big picture – the complex sustainability challenges that we face as a society. We look at these challenges from four perspectives to understand the extent of the problems and see how little time we have left to solve them. This part of the book will probably take you out of your comfort zone and may make you feel uneasy. This is a good thing. For anything to change, we need to become uncomfortable first. If you are already familiar with concepts like Overshoot Day, Planetary Boundaries, the Doughnut Economy and the Sustainable Development Goals, then you may want to browse through this part quickly and use it as a refresher.

Part II: What is the real problem? This is an important question that we should ask ourselves much more often. Part II explains that the problem we see is actually not the problem we need to solve. Something much deeper and bigger is actually causing these sustainability problems. Instead of looking at the outcome of the game, we look at the rules of the game. For this purpose we introduce some powerful models and language that can help to change the way we perceive and think about these sustainability problems. Everyone should read this part. This part is essential.

Part III: How do we deal with the underlying causes of sustainability problems? If we are serious about solving sustainability problems, we need deliberate, well-informed and well-managed efforts to deal with the underlying causes of these problems. This requires changing the rules of the game. This part of the book introduces a new and practical strategy – based on models – to help us understand and deal with the issues in a more structural way. It is crucial for you to understand these models, so we suggest that you read this part of the book at least twice!

Part IV: How does this work in practice? In this part we analyze eight completely different sectors and markets. We asked 33 experts to apply the theories and models described in Part II to their respective sectors.

The results are stunning. It is fascinating to see how the same patterns affect every sector, the same loops and same phases appear again and again. This part presents concrete findings that will help you to understand why these sectors are experiencing sustainability issues and why they struggle to solve them. It also explains the steps that are needed to advance each sector. This part is also meant to hold up a mirror to the readers. While reading about other sectors and markets, we hope that you will start to recognize similar patterns in your own sector or market. That is the power of these case studies.

Part V: How can I apply these models to my own working environment? Once you understand the patterns of sustainable market transformation in other sectors, this will trigger the question of how you can apply this knowledge to your job, voluntary work or other role. How can you be a change-maker that focuses on changing the rules of the game in your sector or market? Our experience has shown that this is possible! It only requires the awareness to identify the current phase of a sector or market and an understanding of who should be doing what to take it to the next level. This step is relatively simple. The hard part is to overcome certain myths that might withhold you from becoming a change-maker or enhancing your impact in this role. Part V is therefore as much about mindset as it is about what is happening around you.

Remember that the most important work today is both highly systemic and deeply personal. Therefore we want you to not just read this book, but commit to live it. Commit now to read the whole book, and not just part of it. Or worse, let it just collect dust on your book shelve. Commit now to really understand the logic and thinking about what it means for you. Commit now to discuss the content with others; do this not only to understand it better yourself, but also to help others improve their thinking. Commit now to use this thinking to take action in real life.

Warning! Reading this book comes with two important risks. First, understanding what influences collective behavior in a market and how you can change that. This may cause you to never read the newspaper in the same way again. The theories and models presented in this book are powerful and will make you look at the world in a different way as

you will begin to recognize the same behavioral patterns, phases and cycles and arguments emerging again and again. Second, if you decide to apply these insights and ways of thinking in practice, you will be able to significantly contribute to solving some of the biggest challenges of our generation. You will be a change-maker.

Are you excited to start this journey?

PREFACE BY PAUL POLMAN

No one ever solved a problem with old thinking: when you get into a hole, you don't keep digging.

This applies to fixing our broken and destructive economic model, which continues to drive widening global inequality and climate change. In order to build circular, regenerative economies which give back more than they take – both to the planet and to the societies they serve – we need bold new ideas and leaders ready to embrace them. And we need unprecedented collaboration, not least among businesses, if we are to drive change at the speed and scale required. Nowhere is this truer than to protect our world for the next generation: we have just thirty years to keep global temperatures under catastrophic levels.

This book provides much-needed fresh thinking and it explains how and when businesses, governments, civil society and other stakeholders can join forces to boost their shared interests and accelerate the urgent change humanity needs.

In 2010, when I took over as CEO of Unilever, faced with a declining business and a world filled with challenges, we decided we would think differently. Business as usual wasn't going to cut it, and so we launched our Unilever Sustainable Living Plan when no other company had made such far-reaching public commitments to sustainability. We took on damaging short-termism and reoriented our brands to serve a higher

ecological and societal purpose than simply the next round of quarterly profits. We knew that sustainability had to become an integrated part of the business and that, in order to make it stick, we would have to work closely with a whole range of stakeholders, including employees, suppliers and customers and also NGOs, governments, international organisations and, crucially, our competitors. More importantly, we saw planet earth as a crucial partner as well.

I don't pretend it was an easy ride. Nor did we achieve everything I would have hoped for. But I am proud of the many successes we had. We set ourselves the target of improving the lives of an additional 1 billion people, whether through handwashing, nutrition or oral care, and by decoupling our growth from our environmental impact and increasing our social impact at the same time.

Of course we had to make some difficult trade-offs, but by sticking to our plan and principles we developed an increasingly attractive agenda for our shareholders who saw a near 300% shareholder return over ten years plus growth well outpacing the rest of the industry industry. This was only possible because a fantastic team of people learned how to think bigger than ourselves. We sought out new partnerships and a higher meaning for our company, and in many ways our experiences are woven through this book.

The authors make clear that the most sustainable companies will be those who move beyond incremental CSR, no matter how well-meaning, to fundamentally put their business to a greater service. It will be those who see the huge opportunities of doing so, recognising that profit, resilience and longevity derive from giving your business a clear North Star. As the following pages explain, this requires leadership with a clear statement about why your organisation exists, a curious and adaptable attitude among your leaders, and honesty when you don't have all the answers.

Perhaps the most important insight, and the one which still doesn't come naturally for many C-suites, is that successful and responsible leaders see the degree to which they need others to achieve their goals. Changing your company will, alone, never be enough if the system you are operating in is tipped towards injustice and environmental harm. Don't just play the game, rewrite the rules, and understand that systems change is a team sport. One of the reasons I have co-founded a new venture IMAGINE is

precisely to bring together CEOs and others to drive we industry-wide transformation to help create a more sustainable and equitable future for all. Who does not want to be part of that?

I thank the authors for addressing these vital issues. This is a valuable handbook for all those seeking to think bigger. Read it, debate it, test and be sure to put it to good use.

Paul Polman
Co- Founder and Chair of IMAGINE,
Former CEO Unilever

ACKNOWLEDGEMENTS

It was on their way back home – after another inspiring executive session about systemic change in relation to sustainability – that the plan for this book emerged. As a foundation for the format, we looked at *Changing the Food Game* by Lucas Simons. But we soon realized that the kind of foundational reasoning needed for this book was not only relevant to people working in the food sector, but to groups with backgrounds in construction, finance, water management or various other sectors. So, we asked ourselves, what would be the value of a book that is written for a broad range of practitioners working on sustainable market transformations?

The decision to write this book was made during that journey home. But we also realized that we are not the specialists who know what is going on in every single sector. That's why we organized a first kick-off session in March 2018 with a general invitation through our networks towards anybody who is interested in contributing to this new book. That resulted in a session with about 60 participants. We remain grateful to everyone who was present in that first kick-off session.

In this session the groups were formed to write the specialist parts. Some members contributed only to a "brain dump" about relevant initiatives, while others started with the writing. Some members dropped out

along the way, while others joined later. We want to thank everyone who contributed to this process and especially the ones who stayed to the end and became our co-authors.

In this writing process we organized several workshops, webinars, feedback sessions and one-on-one conversations. The inspiration and coordination provided by Andrea Viviers and Julie Philips was indispensable and Joost Backer, Silvana Paniagua, Peter Chauvel, Peter Williamson and John Babb did a wonderful job with all the feedback and alignment between the books' parts. Furthermore, we want to thank Charles Frink for the editorial work. Also, Ineke Berkmortel, Sacha Spoor and Bianka Urbanovska made valuable contributions to different parts of the writing process of this book.

When the individual nuances of the book became visible, we became more ambitious regarding the uniformity in style and structure. That delayed the process and took quite some effort from all members of the writing team, including the co-authors. But looking at the result, we are glad we took this road. Through this whole process, Rebecca Marsh and Sophie Peoples of Taylor & Francis and Sarah Silva at Deanta Global proved to be great companions in getting the best result for this book.

And now that the book is published, the journey just continues. We want to thank you as a reader of this book for your curiosity. Irrespective of whether you are an entrepreneur, working for a company or corporation, a researcher, a government or for a non-profit worker or simply are a concerned citizen, we hope that this book inspires you to act. Especially when you intuitively already know that the current sustainability problems are fundamental, even existential, we hope this book will trigger you to become even more active as a change-maker. That starts with ceasing some old mindsets and behaviors. We can't solve the biggest problems of our generation by blaming our way out of it. We can't pilot our way out of it. We can't charitably or subsidise our way out of it. We cannot buy our way out of it. We cannot "development aid" our way out of it. The only way to solve these issues structurally is to understand the rules of the game that are causing our unsustainable collective behavior and therefore of our unsustainable collective outcomes.

An effective strategy to change the rules of the game is what we call Sustainable Market Transformation. It is a fancy name for understanding

what drives collective behavior in a market and how to change the incentives in the market so that over time, we begin to behave differently – more sustainably. Once we behave differently, we will get different outcomes.

Together we can create a sustainable future.

Thank you!

Lucas Simons & André Nijhof

1

WHAT ARE THE SUSTAINABILITY CHALLENGES OF OUR GENERATION?

1 The biggest challenges of our generation

1.1 Overshoot Day

For most people July 29, 2019 was a day like any other. People woke up, had breakfast, brought their kids to school, went to work, had dinner with their family, watched some television or went to the gym. Nothing special, right? Except that Monday July 29, 2019 was in fact an important milestone for everyone on the planet: it was Earth Overshoot Day 2019.[1]

Overshoot Day is the date each year on which the global population is estimated to have consumed all the resources that planet Earth is able to regenerate in a year. In other words, by this day on Monday July 29, 2019, humanity had already extracted more out of the planet in terms of resources and materials than the earth could replenish in that year. And we had put more pollution into the system than the planet could remove.

This is a big deal.

Compare this planetary dilemma to a family having enough income at the beginning of each month to last at least the rest of the month.

Preferably, there is something left over at the end of the month to save some for a rainy day or for an investment. Instead, all the money is already spent by the third week. The family, in need of groceries, paying rent and expenditures, has to borrow money to make it through the rest of the month. The borrowed money needs to be paid back with interest the following month, reducing the money that is available next month. Sure enough, the next month again the same thing happens. Only this time, since they had to pay interest on the borrowed amount last month, they have less disposable income to start with, and as a result they run out of money even sooner. On top of that, the family decides to spend even more. Clearly the income for that month will not be sufficient, and the family needs to borrow even more to cover both the interest and the increased spending. The next month this happens again. More interest needs to be paid, and again they increase their spending. This goes on month after month. Slowly the amount of money they have at the start of the month will be increasingly less sufficient to make it through a month. Until one day…

When we talk about Earth Overshoot Day we, of course, don't talk about borrowing money that we have to pay back with interest. But it is still a good analogy. In reality, we are talking about taking more resources out of forests, oceans, biodiversity, the soil and the atmosphere than the Earth can replenish. Each year we increase what we take out. And we are not paying it back. Each year we are further diminishing the Earth's capacity to clean up pollution or restore damage to living resources. As a result, Overshoot Day is coming earlier and earlier every year. Until one day…

As shown in Figure 1.1, during a 20-year period from 1980 to 2000, Overshoot Day went from early November (a two months deficit) to 1 October (a three months deficit). During the next 18-year period, this process accelerated. Between 2000 and 2018, Overshoot Day went from 1 October to 1 August – a five month deficit. Overshoot Day is now two months sooner! This is alarming news.

The Global Footprint Network, which is the organization that calculates Earth Overshoot Day, estimates that to maintain our current level of consumption we would need 1.7[2] planets like the Earth[3]. Our rate of consumption is accelerating, and there are no signs that it is slowing down. If we continue like this over the next 50 to 60 years we will be on 100% overshoot at the beginning of each year. For most of us that will

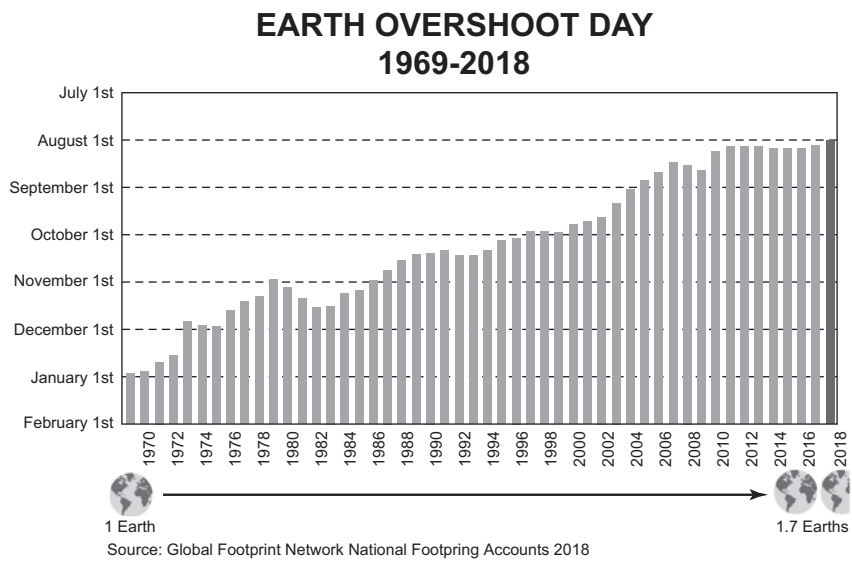

Figure 1.1 Overshoot Day is coming earlier every year. Original model from Global Footprint network.

happen in our lifetime or the lives of our children, unless we change the direction we are going.

1.2 Staying within planetary boundaries

Overshoot Day is just one approach to measure our level of unsustianability as a society. There are others models that are useful to understand how serious the situation is.

In 2009, a group of environmental scientists, led by Professor Johan Rockström, published *Planetary Boundaries: Exploring the Safe Operating Space for Humanity*. This study outlines nine key ecological processes that are being severely affected by human activity and suggests that "pressures on the Earth System have reached a scale where abrupt global environmental change can no longer be excluded"[4]. Rockström et al. concluded that changing these natural processes by too big a margin or too quickly could be catastrophic for human life and wellbeing.[5] Consequently, they proposed limits or boundaries for these processes; staying within those boundaries should allow a "safe space for human development" and avoid large-scale, planet-wide changes to the environment on which all of us depend totally for our existence.[6]

These key planetary processes are:

1. Freshwater consumption;
2. Climate change;
3. Land use/conversion and degradation;
4. Biodiversity loss;
5. Ocean acidification;
6. Depletion of the ozone layer;
7. Chemical pollution;
8. The release of aerosols into the atmosphere (air pollution);
9. Disruption to the biogeochemical cycle (e.g. through excessive use of nitrogen-based fertilizers).

For seven of the nine processes, scientists have calculated quantifiable, measurable targets that are absolute limits to what our planet can sustain.[7] They put maximum number limits on how much we can pollute, destroy, take or eliminate and still get away with it. For two of the nine processes, they have been unable to agree on quantifiable boundaries for chemical pollution and atmospheric aerosols (a type of air pollution) for now. These boundaries are crucial, but for the time being, without a limit, we simply do not know if we are overshooting them or not.

Of the seven planetary boundaries with absolute quantifiable targets, we do know we are already exceeding four of them in absolute terms. These boundaries are:

- Changes to the global nitrogen cycle;
- Climate change;
- Land-use conversion;
- Biodiversity loss.

The term "exceeding" in the previous sentence is an understatement. The data are very disturbing. Let's look at the current facts on these overshoots. Hold on to your hat.

Overshoot one: nitrogen, the unknown killer

Most of us are familiar with nitrogen as the letter N in chemistry. It is widely available on this planet and used for many valuable purposes like

food preservation production, refrigeration and as fertilizer to increase yields of agricultural production. However, most of us do not know that nitrogen is also a major source of pollution. When it comes to the quantity of nitrogen being used, we're currently operating at almost 150% above a sustainable level. The global boundary for nitrogen is 62 million metric tons per year, but the actual use in 2015 was 150 million metric tons[8]. Note that these are global averages. As you can imagine, the maximum targets used will vary substantially based on soil type, climate, and environmental system.

More than two-thirds of atmospheric emissions of nitrous oxide arise from processes in soils, largely resulting from application of nitrogen fertilizers.[9] The use of nitrogen fertilizer has risen from 11 million tons in 1961 to 108 million tons in 2014.[10] Besides these chemical fertilizers, other sources of excess nitrogen include animal manure, discharged wastewater, use of fossil fuels in cars and industry, but also some of the soaps and detergents we use at home.

Excess nitrogen in the environment can have many consequences for water, soil, human health, and other aspects. All these problems, however, do not occur at the same rate or with the same intensity. Instead, they follow a sequence of effects from one environmental system to the other; this is called the nitrogen cascade.

Some systems, such as rivers and lakes, are quickly affected by excess nitrogen, but other systems, such as soils, can accumulate nitrogen for a longer period. As a result, the effects of excess nitrogen are very divergent. These effects include the following[11]:

- Excess nitrogen in the form of fertilizers is leached away – almost 50% of it is not absorbed by plants – and enters our water systems, resulting in serious eutrophication of freshwater systems and acidification of terrestrial ecosystems. This leads to rapid algae growth, which impacts the ecosystems of water bodies by blocking sunlight, using up oxygen for other species and releasing toxins that are harmful to animals.[12] As a result, excessive nutrients like nitrogen in the water can cause a "dead zone": oxygen-deficient areas in which nothing can live. In March 2004, the UN Environment Program published its first Global Environment Outlook Yearbook in which it reported 146 dead zones in the world's oceans where marine life could not be supported due to depleted oxygen levels. Some of these zones were

as small as a square kilometer (0.4 mi²), but the largest dead zone covered 70,000 square kilometers (27,000 mi²). A study in 2008, four years later, reported a total of 405 dead zones worldwide;[13,14]

- Nutrient pollution in the air also causes acid rain which in turn affects lakes, forests and animals.[15] Acid rain has very damaging effects on life on land and below water. A healthy lake, for example, has a pH of 6.5 or higher. Acid rain causes the pH to fall below 5, which is detrimental to fish life. At a pH below 4, the lake is biologically dead.[16] Some lakes in Sweden have become so acidic that they are no longer able to support fish life.[17] Acid rain also decreases the pH range for growth, which is between pH 5 and pH 8. Plants stop growing if the pH falls below 3.7.[18] In Poland about 50% of the forests have been damaged by acid rain[19]; this figure is about 30% in Switzerland;
- Nitrous oxide is also a particularly potent greenhouse gas; it is over 300 times more effective at trapping heat in the atmosphere than carbon dioxide over a 100-year period;[20]
- Airborne nitrogen compounds such as nitrogen oxides (NOx) also contribute to the formation of air pollutants such as ground-level ozone (a component of smog), which in turn is detrimental to vegetation and animal life;[21]
- Nitrogen emissions such as ammonia and NOx contribute to particulate matter, which cause respiratory problems and cancers, as well as damage to plants and forests;[22]
- Biodiversity loss is another consequence. As a result of the nitrogen build up, most living creatures in terrestrial, freshwater and coastal water systems suffer due to eutrophication and acidification of water and soils.[23]

In Europe alone, the environmental and human health costs of nitrogen pollution are estimated to be between €70 billion and €320 billion per year.[24] This makes nitrogen one of the most unknown, least understood and costliest of all pollutants.

The fact that excess nitrogen is increasingly seen as one of the most important causes of environmental damage was happening at the time of publication in our own country. The issue of nitrogen was prominently in the news. The highest judicial authority in the Netherlands ruled that the current Dutch policy to mitigate the negative consequences of nitrogen in

agriculture, industry and traffic is insufficient and thus invalid.[25] The consequences of this verdict are serious and may incapacitate several economic sectors. Concretely, it means that hundreds of licenses for farms, industries, infrastructural projects and housing projects are likely to be suspended, as they are likely to harm their direct surroundings. This will cost hundreds of thousands of jobs and will put the economy into a recession. To stay within the nitrogen emission limit, plans are being made to reduce the numbers of livestock on virtually all farms in the Netherlands by 50% and to lower the maximum speed limit on motorways. A highly unpopular measure that reflects just how serious this issue is being taken by politicians.

Overshoot two: climate change is already here

The second alarming overshoot concerns climate change. According to scientists, the situation has reached critical levels. Currently there are 408 ppm of CO_2 in the Earth's atmosphere, well above the 350-ppm considered to be a safe level.[26] As a result, according to the IPCC we are heading towards serious, long-term climate disruption, melting polar ice sheets and even more pressure on water supplies due to the loss of glacial freshwater supplies.[27,28]

The sad news is that we have already accepted that climate change is inevitable. The ongoing climate talks that have been held since the Paris Agreements are about whether we can accept 1.5 or 2 degrees of warming. The difference between the two options is enormous. Here are a few examples of the consequences of a 2-degree increase compared to a 1.5-degree increase.

- A thawing permafrost. A 2-degree rise in average global temperatures means that 6.6 million km^2 of arctic permafrost will thaw; at 1.5 degrees this will be "only" be 4.8 million km^2, a difference of 38%;
- Ice-free summers in the arctic. A 2-degree rise means that ice-free summers in the arctic will occur at least once per decade, but only once per century with 1.5-degree rise. This is ten times worse;
- Loss of coral reefs. A 2-degree rise will lead to the loss of almost 100% of coral reefs, while loss will be limited to a 70% to 90% decline at a 1.5-degree rise;[29]

- Severe heat waves. At a 2-degree rise, 37% of the global population will be exposed to severe heat waves at least once every five years, but only 14% at a 1.5-degree rise. This is 2.6 times worse.;
- Loss of plant habitats. At a 2-degree rise, 16% of plant species will lose at least half of their range, but only 8% at a 1.5-degree rise.;
- Lower crop yields. At a 2-degree rise, maize yield in the tropics will decline by 7%, but only by 3% at a 1.5-degrees rise. This is 2.3 times worse.

But this is all theory for now. According to the International Panel for Climate Change (IPCC), the reality is that cumulative current measures announced by the governments supporting the Paris Agreements will not be enough to keep the temperature rise below 1.5 degrees or even 2 degrees. Instead we are heading for an increase of 3 degrees. As you can imagine, this will irreversibly change life on earth.[30]

Although we are just at the start of this rapid increase in global temperature, the effects are already apparent. Since 1972, the global average temperature has been above average every single year for 42 years.[31,32] The five years before this book went to press were the hottest in recorded history[33,34] and as a result we witnessed the most destructive hurricanes[35] and wildfires[36] in recorded history. In 2017, 2018 and 2019 we saw unusually hot summers across the Arctic region, Europe, Latin America, parts of the United States and Australia resulting in disastrous droughts and almost uncontrollable wildfires in Spain, France, Greece, Portugal and even in northern regions such as the UK, Denmark, Sweden, Finland and northern Russia.

In other parts of the world, there are equally grim realities and future prospects that are directly linked to climate change. In 2018, Cape Town in South Africa experienced its worst drought in over a century[37]

Australia had a one-in-a-thousand-year drought from 1995 to 2009. Then, in 2010, this reversed completely when, Australia experienced its worst flooding in half a century when an area of Queensland (larger than France and Germany combined) flooded, affecting 200,000 people and costing at least $10 billion. And at the end of 2019 Australia was yet again experiencing record temperatures and hundreds of uncontrollable blazing forest fires.

Drought in Spain's northeastern region of Catalonia grew so severe in 2008 that Barcelona began importing water by ship from France.

Southeastern Brazil, including the cities of São Paolo, Rio de Janeiro and Belo Horizonte, is struggling through the worst drought in 84 years, with 40 million people and the nation's "economic heartland" at risk. As a result of unusual droughts and bad conservation policies, Brazil is experiencing the worst forest fires ever seen in the Amazon. According to the BBC, the official figures show that more than 87,000 forest fires were recorded in Brazil in the first eight months of 2019. In June 2019 alone, more than 2200 km^2 was burned, an absolute record.[38]

California, in the USA, is also facing unprecedented drought, now in its fourth year, resulting in devastating and uncontrollable wildfires. The 2018 wildfire season in California was the deadliest and most destructive on record, with a total of more than 8,500 fires burning an area of 1.89 million acres (766,439 ha), the largest burned area recorded in a single fire season, according to the California Department of Forestry and Fire Protection.[39] When we talk about falling water tables due to drought, the most severe declines can be seen in northern India, where the effects of the droughts can even be observed from space.[40]

Overshoot three: land conversion and land degradation

The most recent overshoot in absolute terms concerns land use and land conversion. Land conversion refers to the permanent transformation of natural habits such as forests, grasslands and wetlands into agricultural land.[41] The most important and most devastating conversion is that of forests to "non-forested" systems, such as agricultural land.[42] Land degradation is generally understood to be the reduction or loss of biological or economic productivity.[43]

The World Wildlife Fund (WWF) estimates that approximately 18.7 million acres of forests are lost worldwide per year, which is equivalent to the area of 27 soccer fields every minute. Industrial agriculture (i.e. the industrialized production of livestock, poultry, fish and crops), along with subsistence agriculture, is the most significant driver of deforestation in tropical and subtropical countries, accounting for 80% of deforestation from 2000 to 2010. Industrial agriculture is responsible for 30% of deforestation in Africa and Asia, and for 70% in Latin America.[44] According to the WWF, 15% of all greenhouse gas emissions are from deforestation.