SHAPING THE FUTURE OF HUMANITY
EXPLORE, IMAGINE, ACT
PART 1

EXPLORE THE BIG PICTURE

Forces shaping the future of humanity

Mario van Rijn
With contributions from René van der Burgt

Pearson

ISBN: 978-90-430-4015-0
NUR: 163
Key terms: future, trends, technology, planet earth, society, power, space, innovation, scenario planning, SDG, Sustainable Development Goals, climate change, humanity

Pearson Benelux BV, Amsterdam
Website: www.pearson.com/nl
Email: amsterdam@pearson.com
Interior: Crius Group
Cover: Studio Pearson Benelux, Amsterdam

Edited by Sarah-Jane Fisher (lead editor) and Ardelle Mertens (Chapter 4)
With illustrations from Doede Okkema

This book is printed on FSC certified paper.

A selection of first recommendations

The Big Picture *is an essential compilation of the serious issues, problems and challenges all of us living on the planet face. Everybody should read this to understand better what is going on around us.*

ANDRÉ KUIPERS
Astronaut European Space Agency

The Big Picture *is a comprehensive read that tackles the most pressing challenges and opportunities of our time. Topics are presented in an interconnected manner and are put forward with such urgency that the reader is forced to challenge their own beliefs and values. Bringing together cutting-edge research and multiple perspectives, this work is an invaluable tool for everyone supporting the implementation of the UN Sustainable Development Goals.* The Big Picture *leaves us in little doubt of the need for rapid change in order to secure the brightest and most sustainable future for generations to come.*

PROF. DR. JAN PETER BALKENENDE
Former Prime Minister of the Netherlands
Chairman Dutch Sustainable Growth Coalition
Professor Governance, Institutions and Internationalisation (Full Professor), Erasmus University Rotterdam

Holding governments and companies accountable for their actions is necessary in order to ensure that pressing global challenges such as climate change or inequality move up the political agenda. The other tool we have at our disposal is our collective leadership that globally can help move us forward in a way that is both inspiring and change inducing. The Big Picture *supports this cause. With great clarity and detail, this book takes the reader on a journey, not only exploring the multiple forces that are changing our world but connecting the dots between them. This is a must-read for anyone who wants to play an active role in positively shaping the future of humanity.*

MARJAN MINNESMA
Director and founder of the Urgenda Foundation

Most of us struggle to understand the complexity and interdependency of our rapidly changing world. In the daily news, we witness geopolitical dynamics, new emerging technologies, human tragedies and the impact of our changing climate. Meanwhile, we find it hard to connect the dots helping to do something about it. The Big Picture *brings light to this darkness. It very comprehensively helps us to understand the drivers of change and their root causes with astonishing clarity. And through that understanding it allows us to make the right choices for our future and the future of our children. It helps us to "think big, act small, and start somewhere."*

GENERAL TOM MIDDENDORP
Former Chief of Defence of the Netherlands
Chairman – International Military Council on Climate and Security

"A butterfly flapping its wings in Brazil can produce a tornado in Texas."

Thanks to Edward Lorenz's discovery of the butterfly effect over 60 years ago, we know that small changes can, in fact, lead to much bigger changes. Sometimes this results in dangerous situations, like COVID-19, as we all know too well. But sometimes the Butterfly effect can also change the world for the better and a single person can set it off. We know that in this chaotic world we live in, everything is connected. Capturing all of this in one book seems an impossible task, yet The Big Picture *does exactly that. In a world of increasing specialism, this book, which broadly covers all fields of science, is an Olympic achievement. It convinces the reader that we can achieve more, both individually and together. If you care about the future of humanity, you can't ignore this book.*

PAUL RÜPP
Former Chairman & President Avans University of Applied Sciences
10-year best University of Applied Sciences of the Netherlands

The Big Picture *does what it says, it paints a picture of our world in an accessible and approachable way. Major topics covered, such as sustainability, technology and societal relationships are richly illustrated, and thought has been given to the interrelatedness of each subject. The book provides many interesting glimpses into underlying patterns and connections, challenging readers to add their own insights. My hope is that this book will grow into a knowledge platform where the wisdom and insights of humanity contribute to understanding* The Big Picture *even further and in more depth.*

PROF. DR. MARC VERMEULEN
Professor Public Strategy, Innovation and Governance (Full Professor)
TIAS, School for Business and Society and Tilburg University

We are standing at a crossroads. Will we unite to solve the challenges that we are facing? Or, will we continue on the same path until we cross the line of no return? For us to have any chance of success, we need to embrace multiple perspectives. The Big Picture *takes the reader on a transformative journey. Like a shifting kaleidoscope, it allows us to discover underlying patterns and connections of the world we created. It is quite remarkable, beautiful and shocking at the same time.*

PROF. DR. TONI SFIRTSIS
Professor of Strategic Innovation and Future Leadership (Associate Professor)
TIAS, School for Business and Society

A collection of stories and images that encourage readers to question the obvious, change routines and rethink the underlying concepts of our economic, social and political realms. Are we able to understand the signs of the times and to act upon them? Are we prepared to change our ways of living and co-create new narratives rooted in social, ecological, economic and cultural justice? Reading this book leaves you no choice other than to follow your own calling to contribute to a better world.

DR. GODELIEVE SPAAS
Professor of New Economy
Avans University of Applied Science

Vast in its scope ... vast in its intentions. Mario van Rijn has done an excellent job at bringing to the curious lay reader an outline of a wide range of important and timely topics interspersed with thought provoking questions. While ambitious, he has succeeded in painting The Big Picture. *Well done.*

DR. RICHARD LUCAS
TechLauncher Program, Australian National University

The Big Picture *is an impressive and immersive experience. The book takes a true connected view of the state of the world. The Big Picture shows how everything is linked -from AI to deforestation to education- and it invites the reader to explore and act in a meaningful connected way.*

RAMON VULLINGS
Author of *Not Invented Here: Cross-Industry Innovation*

Contents

Introduction

What if you would have a single book that addresses all the great major developments of our time – that not only scratches the surface but invites you to think beyond? A book in which you can explore what the future really means for you? For your family, your business, and humanity as a whole? For today, as well as, let's say the next twenty years. Well, the good news is you don't need to look any further because, guess what, this is that book.

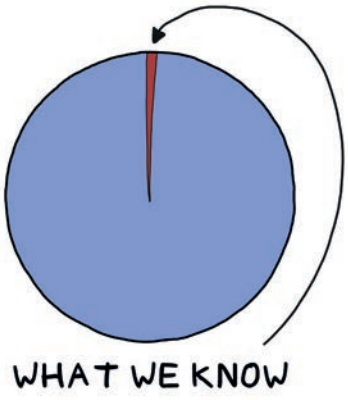
This book is about us. All of us. It's for anyone with a deep interest in what lies beyond the horizon: our future. It's a serious attempt to allow you to explore the big picture and find out what it might mean to you on a personal level. To give insight as to where humanity currently stands, including our accomplishments, and where we could be heading. To bring order to a world that some might experience at times as quite chaotic. To dive deep into the major forces that shape our future. To let you connect the dots and think beyond. To give you a tool that allows you to imagine new possibilities and new directions.

Finding new ways is important because in the upcoming decades, the world, as we know it, will change rapidly. Technological innovations are going to happen on such a scale, at such a speed, and with such intensity that it would look as if the first Industrial Revolution was merely a minor bump on the road of evolution. At the same time, humans are facing enormous threats on a grand scale, such as climate change, a staggering increase in the population, and increasing political unrest. The upcoming changes will disrupt almost every sector in every country on Earth. Are we getting ahead of ourselves? Will we be able to control all these developments so that we avoid serious risks and benefit as a whole? How can we find a new equilibrium to create a better, new world that works for all of us? Nobody knows for sure. But what we do know, is that if we lose control, developments could rip our social and economic structures right off their foundations. We can't let that happen, because it could not only lead to serious bloodshed – it could set back humanity as a whole.

But how do we create the action that will move us forward in a sustainable and meaningful manner? The issue is that most of us are just busy living our lives, working, taking care of our loved ones, visiting friends, and trying to stay healthy. We often lack the time and space to try to deeply understand what's really going on in the world, and information that does come by is often scattered and fragmented. In fact, many people are pretty disconnected

from the world we live in, and more than a billion[1] of us are just struggling to survive. This book is helpful for families, businesses, and governmental institutions that want to purposefully lead humanity forward. Which actions can we take in our daily lives? Which innovations should we pursue? Which policies can steer us in the right direction? Because we are the individuals that form the families, businesses, and governmental institutions that steer our future, in the end, it is really up to you. To us. Together, we all contribute toward building the world we would like to live in.

This book is the first in a series of two — our ultimate goal is to help shape the future of humanity for the better. It is also the first of a three-step approach: explore, imagine, act. Whereas the book you are currently reading is all about understanding the big picture, our follow-up will combine the final two steps, imagination and action, into one. What do we mean by this? Well, where imagination is concerned, we take all the observations made in this book and define what we mean when we say, "building a brighter future". Is it the same for all of us? What, in fact, are our goals? What are our desires? How do we actually define success and what does it look like? We then take the final and arguably most important step of all, defining an action plan. Here, we share both our own possible solutions to help create a better world along with tangible ideas and suggestions from some of the greatest minds of our time. Yes, indeed, it is a bold idea and a huge undertaking. We truly believe, however, that humanity has the power to become so much more than what we already are. For that to happen, there is a role we all need to play— together. Let's hope a day will come when we make history, not only a history that we can be proud of but one that we will have shaped collectively. But before we can think about new ways to shape the future, we first need to get a better understanding of our current situation and explore the possibilities of how things might evolve. Where do we see benefits and risks? The more we under-



FO.1 **What we know.**

1 (UNDP & OPVHD, 2019)

stand about the world, the more we can change it effectively and steer it in the desired direction. In order to do that, our quest starts here and now, as we will try to find out what is happening in the world and why. It certainly isn't a simple task, but the question is, can it actually be done?

Systems such as the Earth itself, our society, and the way our economy works are very complex. They consist of countless events that often act in a non-linear manner and are connected in so many unknown ways, that it is simply too difficult to know how things will eventually play out in the future. Some might say the world is too big and too complex to capture in one book, and they would be right. There is a limit to our understanding of what is happening and what might happen in the world (FO.1). So no, this book is anything but a theory of everything. It is a humble attempt to broaden your view of the world in the knowledge that it will never be complete nor accurate enough. Just like you we are shaped by our experiences and our environment. This means that despite our best efforts, it is impossible to consider every cultural or religious element and the impact they may have.

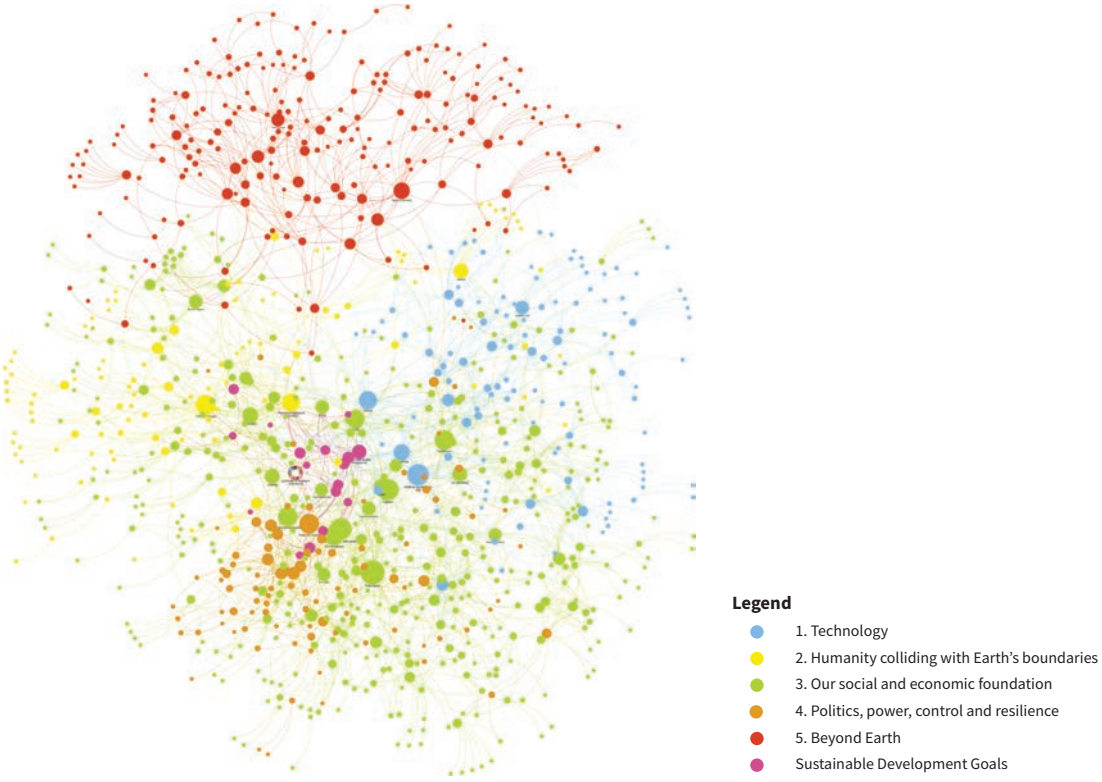
Bearing this in mind we hope that by reading this book, you are really challenged to start thinking about the future. If we want to steer developments in a meaningful and sustainable direction, we need to start putting the pieces together. We believe that through new understandings, we can even make things less complicated, reducing complexity. In the end we think it is better to make an educated guess rather than shooting in the dark.

Our extensive background in futuring (exploring, planning and picturing possible outcomes for the future) has helped us to make a selection of topics that, we believe, all play a major role when it comes to the future of our species. Apart from this, when it came to our selection, an important consideration was that each topic also had to contain enough food for thought (think opportunities, risks or ethical dilemmas) to feed the imagination of the reader and to help create a broader conversation. We are well aware that we have had to make choices and that we have not been able to cover every topic that may impact the future (apart from being an almost impossible task, the book you are holding would have been significantly thicker). What we do hope, however, is that reading this book will feed your enthusiasm to explore even further.

This book consists of five chapters that build upon each other. Therefore, to really see the big picture it is best to read the book as one complete story, but for those who really want to read about certain topics first – feel free to jump ahead. The first two chapters contain the major developments that we think will shape the future of humanity for decades to come: new technologies and the rapid changes in the functioning of the Earth System. From there, we will look at how these developments might impact our social foundations. We

have put economy, politics, and power in a separate chapter in order to gain a better understanding of how these forces play a role in our daily lives and thus determine our future. In the final chapter, we take a major leap forward and travel beyond Earth, where we try to zoom out even further learning more about our place in the Universe and what it would take to become a multi-planet species. In addition, as there can and will be shifts in some of the developments discussed in this book, we will update events and facts on the accompanying learning platform learningplace.pearson.com.

Each time we move forward in this book we will include the findings from previous chapters to create a more holistic picture. We have even gone so far as to build a single model (FO.2) of all of the topics we discuss in this book, which helps to give a visual representation of the relationships between what can be quite complex topics. Having said that, and as we have mentioned previously – if you want to know about what is going on in the world and the direction we are headed, all in one book, you've come to the right place.



FO.2 **Model made of the topics addressed in *Explore The Big Picture.***
Visit our website www.explore-the-big-picture.com for more information.

We have also put in the extra effort to make this book attractive to teachers and students, and that is not without reason. Most courses in higher education, such as strategic management, business innovation, and futuring apply a form of exploration, external analysis or horizon scanning; therefore, this book can give students a kick-start. This is important because today's students will be tomorrow's leaders. They will shape our economy, our society, and our democracy. In twenty years, they will set the rules about how we play the game. In our opinion, Nelson Mandela was right when he said: "Education is the most powerful weapon to change the world." On learningplace.pearson.com you will find additional learning content available.

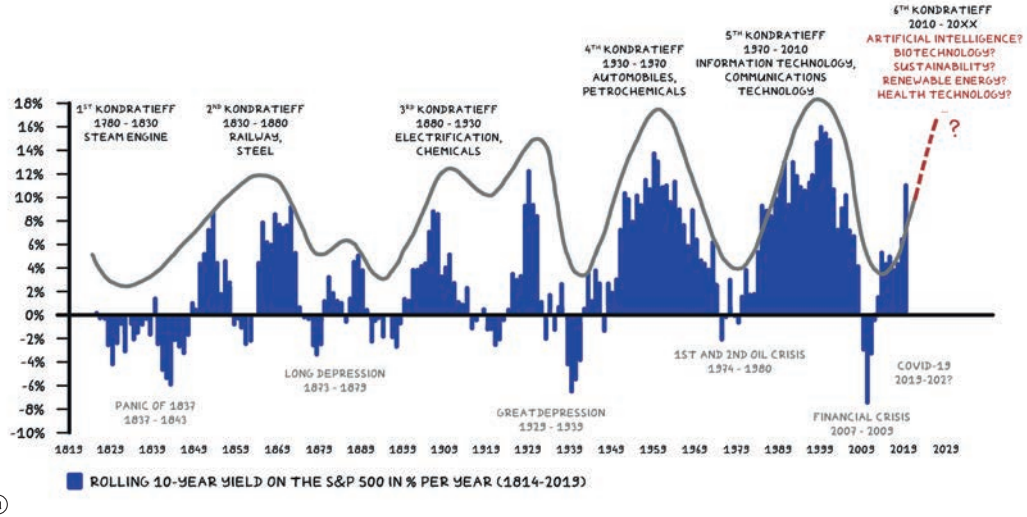
This book might also be of value to companies and institutions that work on the Sustainable Development Goals (SDGs). As most SDGs involve solving complex problems, understanding the big picture can be helpful in finding new approaches, check out Appendix A for more information.

Finally, we hope you find this book to be inspiring and useful. Let it be an invitation to explore further and understand the world so it will widen your view even more. Yes, indeed, there is still a lot more to discover. A whole lot more, if we only knew where to look. So, let's get ready for lift-off and start our journey with the first significant development that is changing our world beyond recognition: technology.

CHAPTER 1

Technology

The influence of technology is everywhere. It's in the food you eat, the car you drive, and even in the chair you sit on. It's technology that has pulled us out of the Stone Age. If James Watt hadn't invented the steam-engine in 1781, things would have looked quite differently. Technological progress and economic growth are connected, and new technologies have fueled the economy in a way that has increased our wealth and well-being significantly. All of us have benefited, even those who currently live below the poverty line. Kondratieff, a Russian scientist, discovered that there were long-wave cycles associated with economic development and that these cycles typically last somewhere between 45 to 60 years.[1] Looking at it from a technological point of view, humanity has already gone through as many as five waves (F1.1a).



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1 (Kondratieff, 1926) (Kondratieff & Stolper, 1935)

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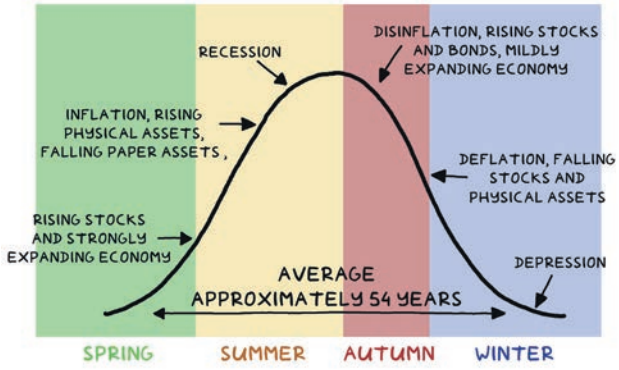


F1.1 ⓐ **Kondratieff long-waves.** ⓑ **Idealized Kondratieff Cycle.**
Source: ⓐ Adapted from: (Allianz Global Investors, 2010). ⓑ Adapted from: (Prechter, 2002).

Each wave can be divided into four phases (F1.1b): spring (improvement), summer (prosperity), fall (recession), and winter (depression). Looking at F1.1a, we can see that historically, each new wave of innovation has started after a great depression. This isn't strange, as in times of despair people try to find new ways to move forward. For us the last recession took place around 2008: the financial crisis. In 2020, the COVID-19 pandemic, also known as coronavirus disease, has added fuel to the fire. We are currently riding what is being called the sixth Kondratieff wave, or, from a slightly different perspective – the **Fourth Industrial Revolution**.[2] To find out what it's all about, we need to understand what it thrives on. To do that, we need to step back in time, just briefly, and look at what happened in the previous wave: the age of information and communication technology, otherwise known as the rise of computer power.

1.1 Riding the wave of raw computer power

In the 1930s, digital computers had not yet been invented, and words like *processor* or *data storage* were simply unheard of. Calculations were mostly done by hand, and only a few simple, specific-purpose mechanical machines existed. Alan Turing and John von Neumann, both mathematicians with broad interests, were two major contributors to the founding of computer science.

In 1936, Turing developed a theoretical mathematical model of computation called a **Turing Machine**.[3] At the time it was brilliant, so brilliant in fact, that

2 The steam engine led to the first Industrial Revolution, electricity to the second, and information and communication technology to the third.

3 A Turing Machine, which consists of, in theory, a tape for storage, a head for reading and/or writing the tape, a state register to determine the current state of the machine, and a table of instructions. Taking into account the state the machine is in, the instructions indicate what to do next, for example, move the head or write a symbol. Turing showed that a universal Turing

CHAPTER 2

Humanity colliding with Earth's boundaries

There it is – Earth – a planet unique in so many ways. It's a place we all share. It's all we've got … for now. It's where we were born, raised, celebrated our victories, fell in love and grieved our losses. Despite its size, life on Earth is very fragile – just a paper-thin layer of atmosphere keeps us safe from the cold and harsh environment of space.

We, Homo sapiens, have been around for 300,000 years,[1] which is relatively short when compared to the age of the earth (4.5 billion years[2]). For roughly the last 250 years the human population has skyrocketed, and all of these people are seeking better lives, all in their own individual ways. Altogether, the way we currently live our lives, we are putting enormous pressure on our resources and, therefore, the well-being of our planet. Our actions have put us on a very dangerous path, pushing the earth into a new state, a state that is far less hospitable to humans. We have not looked after Earth very well. The challenges we face on a planetary scale are unprecedented, and the way we handle them may mean we have just driven past the last safe exit.

In this chapter, we will start by discussing the driving forces responsible for the changing Earth system: unsustainable population growth and economic growth. Next, we will look at how this growth is affecting some of our crucial planetary processes. We will emphasize both climate change and biosphere integrity because each of them has the ability to push the earth into a new state.

Most of the changes described in this chapter are discussed on a global scale. Be aware that climate change can vary hugely depending on the region where

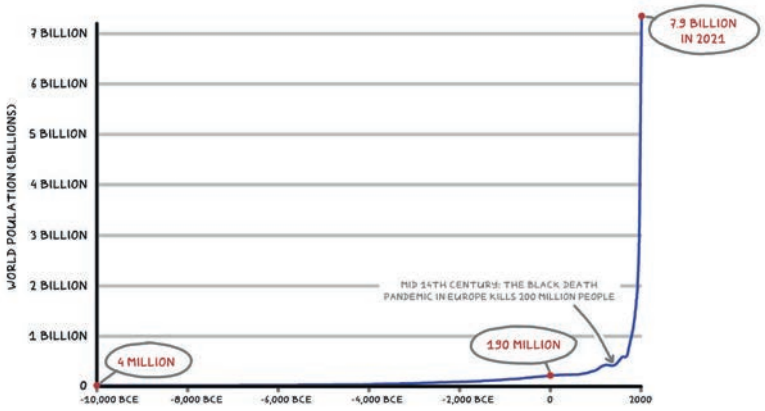
1 (Richter et al., 2017)
2 (Dalrymple, 2001)

you live. Therefore, it is wise to do some additional research if you want to have a better understanding of how things might work out for you on a local level.

Finally, reading (and writing too) about the upcoming changes in this chapter can make you feel pretty desperate. It might even make you think that getting back on track is impossible, that it's already beyond our control. We shouldn't, however, turn our back on it. We need to move forward. Understanding what is happening and why will eventually help us to do what's right. The only way we will be victorious is by working together, all of us. If not, hold on tight and brace for impact.

2.1 Shifting towards the Anthropocene Epoch

The world's population was fairly stable for thousands of years (F2.1). It all began to change when the Agricultural Revolution started in England in the late 17th century, this, in combination with technological and economic advancements,[3] set the stage for the Industrial Revolution. Improvements[4] in agriculture resulted in increased food production and food quality. It was, therefore, possible to feed and maintain a larger population, and the population started to proliferate after 1750. In fact, between 1750 and 1800, the population in England doubled. By the beginning of the 19th century, the success in fighting off infectious diseases alongside other major improvements in health and sanitation began to decrease mortality rates across the globe, leading to even greater population growth.



F2.1 **Global population 10,000 B.C.E. – 2021 C.E.**

Based on estimates by the History Database of the Global Environment (HYDE) and the United Nations. Image adapted from: OurWorldInData.org.

3 Such as the development of pre-industrial cities, pre-industrial financial innovations, and the spinning and weaving of clothes.

4 Crop rotation allowed farmers to rotate a series of crops on their fields without depleting the soil. Also, crops from the new world (America) were introduced in Europe.

CHAPTER 3

Our social foundation

We certainly live in interesting times. New technologies, population growth, and climate change, to name just a few, are reshaping our future at breakneck speed. Now that humanity is facing an increasing number of global challenges, it becomes more and more difficult not only to see the big picture but also to decide what is best to do next. Where the Sustainable Development Goals are a very important guide in helping us achieve the bare minimum social standards, beyond that, nobody really knows where we are going and why. Humanity lacks a grand vision.

The reality is that our future is becoming increasingly uncertain as the demands of our society and economy constantly shift. The system that once moved humanity forward now keeps us in a stranglehold, continually seeking more profit, crossing planetary boundaries, while at the same time testing the limits of our own human boundaries. Human exploitation is everywhere; it knows no bounds. It is not limited to sweatshops; it can even be found in well-established, so-called developed countries. While we often amaze ourselves with our incredible technological achievements, technology alone can't put us back within the necessary safe planetary boundaries. In fact, it is the way we use technology that has allowed us to operate so deep in the red zones in the first place. So, bearing all of this in mind, what happens next?

In this chapter, we explore developments that will shape the future of our global social foundation, which forms the basis of our economy. We have chosen to put the emphasis more on global phenomena as we recognize that even within individual nation-states, both society and the economy can differ hugely. It is worth noting at the outset that some may find this chapter has a slightly Western influence because of our backgrounds.

Before we continue, let's first understand some of the regional differences that can have a significant influence on socioeconomic factors and, therefore, in turn, a person's daily life. Economically speaking, whether you live your life

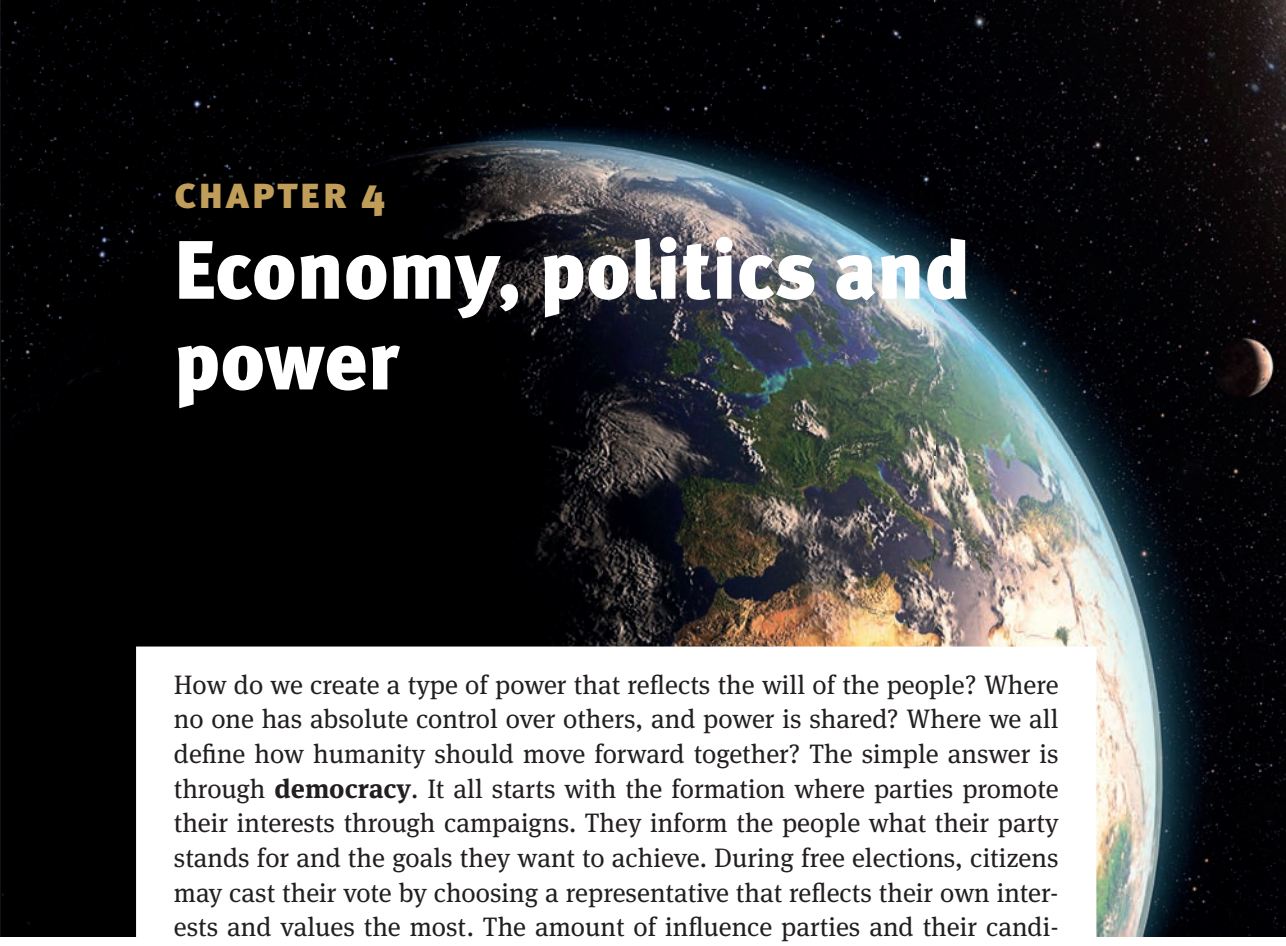
in wealth or in poverty is largely determined by where and in which family you are born. It comes down to a matter of luck ... or not. Likewise, living in an urban area or rural area, a high-income country or low-income country will have a severe impact on both your livelihood and your **social mobility** (the ability to change social status). Whereas in rural areas the main economic activity is agriculture, in urban areas it's manufacturing and services. Where **landlocked countries** encounter an extra hurdle when it comes to trading goods, countries with a coastline can easily trade goods. Where high-income countries can invest in technological innovation, low-income countries often lack access to the most basic technology. Take, for example, high-income countries that have the ability to create new technological advancements from within their economic system by using their investments in knowledge, human capital, and innovative power, something called **endogenous growth**.[1] Low-income countries, however, often have to depend on external forces to achieve growth, for example, supply and demand. Interestingly, when low-income nations do get access to new technologies, their economy grows much faster than their wealthier counterparts, resulting in a **growth catch-up effect**. An example of this can be seen in several African countries that can and have built cell-phone networks without the need to invest in the expensive infrastructure that is required for a fixed-line network.

Throughout history, all around the world, different societies and economies have adapted their way of living to the local climate. It was the climate that was the driver behind how we formed cities and grew our food. Now, with climate change and deteriorating biodiversity, that what lies at the very basis of our livelihood is changing rapidly. We need to adapt and become more resilient to external shocks and internal stresses. As virtually all future population growth will be urban,[2] and with the Sustainable Development Goals in the back of our minds, the attention we need to give to the creation of resilient and sustainable cities grows. Cities in which people from different backgrounds and cultures are willing to live together.

In the upcoming sections, taking into account our previous findings from the first two chapters, we will take a look at how different aspects of our social foundation are evolving. This will allow us to understand what we need to take into consideration, whether we build resilient cities, resilient rural environments, or both. We'll start with water, discuss food and migration, and then move on to energy and mobility. We continue with health and education and end with work and income.

1 (Romer, 1994). Endogenous growth in low-income countries, however, is not impossible. Working with what is available, doing more with less, and developing ultra-low-cost products are important in order to allow low-income countries to advance, something also known as **frugal innovation**.

2 (United Nations, 2019a)



CHAPTER 4

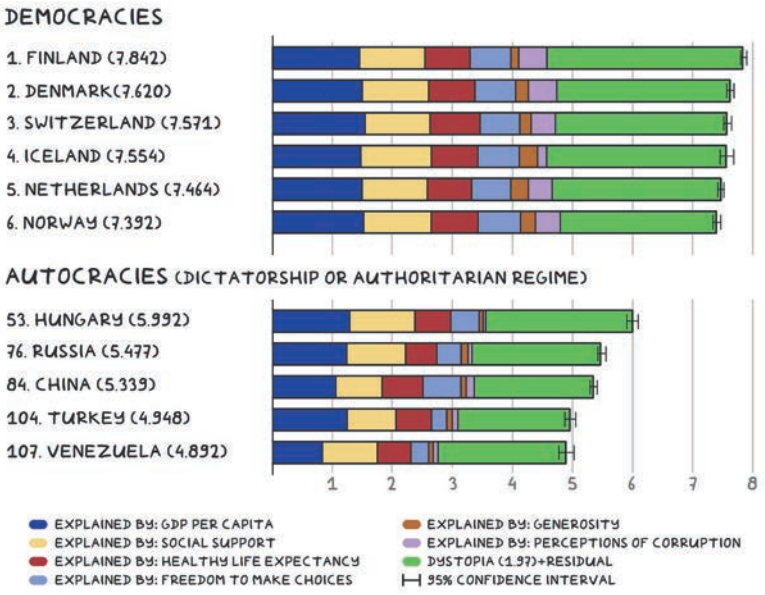
Economy, politics and power

How do we create a type of power that reflects the will of the people? Where no one has absolute control over others, and power is shared? Where we all define how humanity should move forward together? The simple answer is through **democracy**. It all starts with the formation where parties promote their interests through campaigns. They inform the people what their party stands for and the goals they want to achieve. During free elections, citizens may cast their vote by choosing a representative that reflects their own interests and values the most. The amount of influence parties and their candidates gain depends on the number of votes they receive. It creates a government that reflects the will of the people. Therefore, in a democracy, the will of the majority overrules the will of the minority. But can it also be different? What other forms of governments are there?

In an **autocracy**, just one person has all the power over others. They dictate what others do, as is the case with a monarchy or dictatorship. In a **monarchy**, a King or Queen rules the country, and power is inherited through the family line. In a **dictatorship**, one leader has absolute power over all citizens' lives. Closely related to this is an **oligarchy**, where power is held by a small group. An example of this is a military junta where the government is taken over by a military or political group, and the country is ruled by force. Where dictators or juntas can easily decide how to move forward; in a democracy, this process can sometimes be challenging, especially when it comes to topics about which people have entirely different viewpoints. Democracies, therefore, often require a lot of debate, but it is this debate that reflects the will of the people the best.

Research shows that the people in democratic countries are less corrupt, enjoy more human rights, are richer, happier, and healthier than those living

under a dictatorship (F4.1).[1] Humanity, however, has not yet harnessed a way to achieve the full potential of democracy in order to generate an economy that really works for all of us.

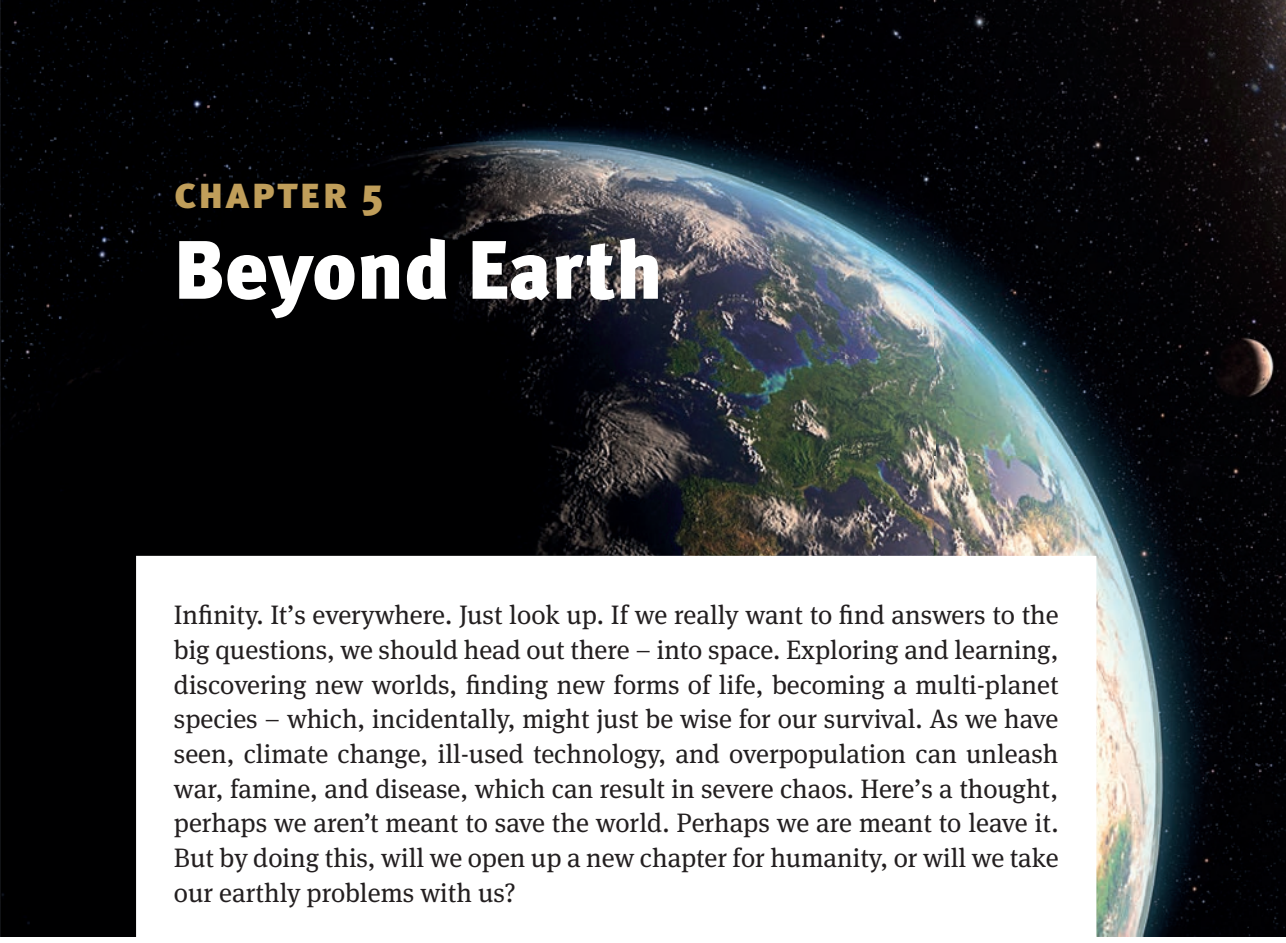


F4.1 **Ranking of Happiness 2018-2020.**
Sources: Adapted from: World Happiness Report 2021 (Helliwell et al., 2021).

So, in short, if one finds every life equally valuable, then democracy is the best thing we have. This is especially true as we all share the same planet with finite resources and a global economy; we all face the same substantial global problems and depend on each other for survival and prosperity. However, we often use the term democracy in the wrong way. To achieve the purest form of democracy, the real challenge is not only to create free elections and choose representatives, but also to find a way to maximize the core principles that define a democracy: equality and individual freedom, both at the same time. Another way to look at it is through the lens of socialism and capitalism; the main difference is the extent to which the government intervenes within the economy and how ownership is viewed.

In a **socialist economy**,[2] assets are owned by a community or by the government. Through tax collection, basic needs like healthcare, education, energy, and infrastructure are financed and distributed equally. Socialism strengthens equality and social welfare, but some believe it also reduces economic freedom as we all need to share some of our wealth in order to fund social services for

1 (Helliwell, Layard, Sachs, & De Neve, 2020) (Knutsen, 2011)
2 Also sometimes associated with left-wing politics.



CHAPTER 5

Beyond Earth

Infinity. It's everywhere. Just look up. If we really want to find answers to the big questions, we should head out there – into space. Exploring and learning, discovering new worlds, finding new forms of life, becoming a multi-planet species – which, incidentally, might just be wise for our survival. As we have seen, climate change, ill-used technology, and overpopulation can unleash war, famine, and disease, which can result in severe chaos. Here's a thought, perhaps we aren't meant to save the world. Perhaps we are meant to leave it. But by doing this, will we open up a new chapter for humanity, or will we take our earthly problems with us?

Space is mysterious. So is planet Earth. Many of us wander the Earth in search of places of incredible beauty. For example, take Mount Everest; it is truly extraordinary. It's the kind of place that you know would be incredible to visit, but at the same time, conceals an element of darkness and absolute terror if you were to attempt to make it to the top. Imagine how you would feel standing in front of **Olympus Mons**? At 22 kilometers high, it is not only the tallest known mountain on Mars but the tallest mountain in our entire solar system. It is this sublime beauty of our galaxy – the Milky Way – and the universe that surrounds it that you can experience by simply gazing at the stars on a clear night. It might keep you wondering what really lies beyond the horizon, far, far away. It's our curiosity that drives our creativity to come up with new ideas, to make the impossible, possible. It is this built-in human desire to explore that activates our inner strength driving us to greatness, to achieve something that is, at first sight, way beyond our limited physical size and ability.

In the coming decades, humanity will go where no person has gone before. We will go to the moon, to Mars, and way beyond – not just to peek around – but to stay. It's just a matter of time before humanity will become a multi-planet species. We are on the brink of returning toward a new era of endless exploration, just like Columbus and Marco Polo, when they sailed the oceans

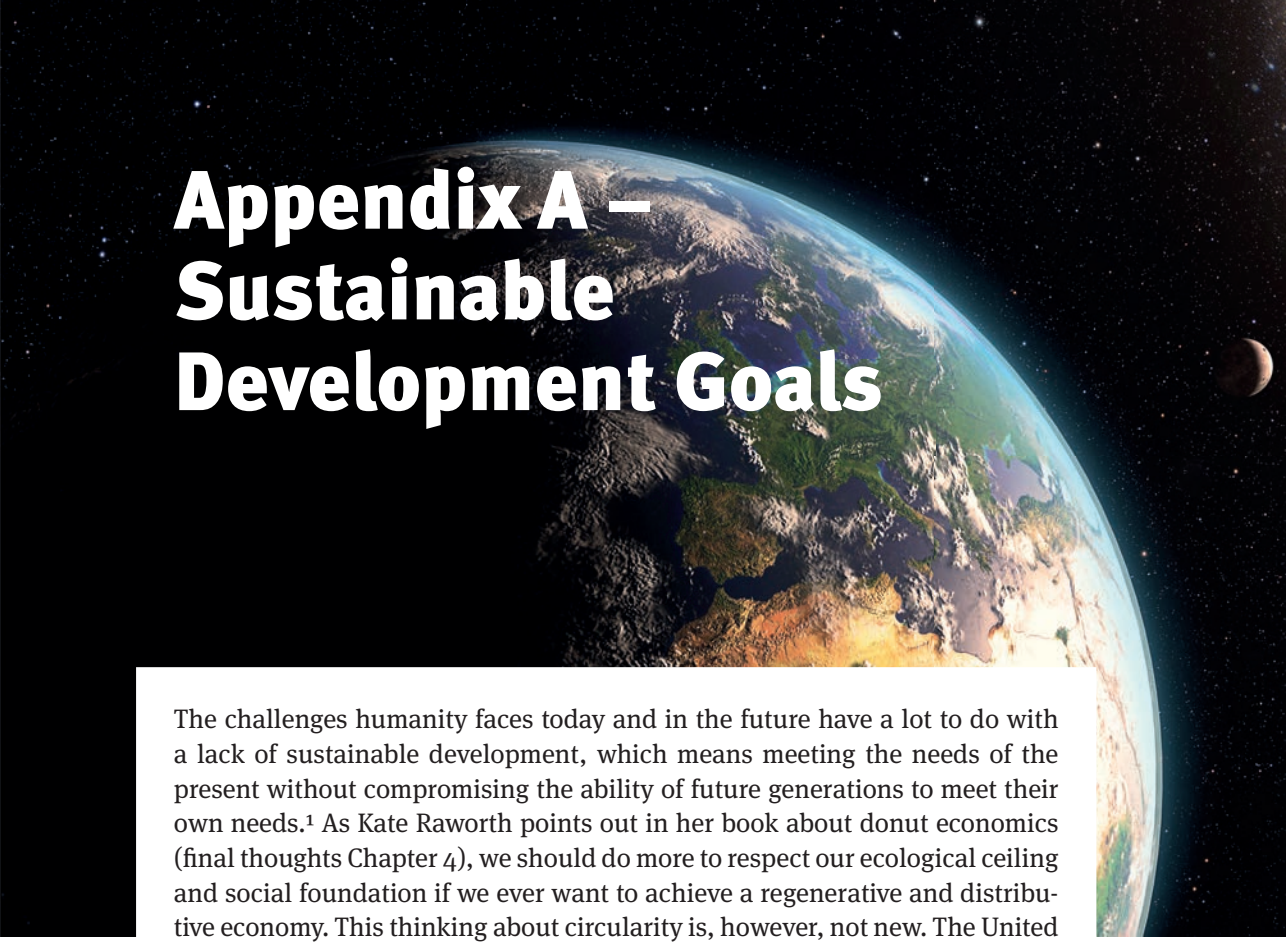
in search of new land. The things we will find will bring tremendous change to the way we think about ourselves and everything else. What we learn will go far beyond our limited view that we have created by living our lives on Earth.

In the following sections we will try to understand how the world beyond Earth might shape our future. We will start by exploring our place in the universe. How big is it, and where exactly do we stand? We will discuss the challenges associated with both space travel and living in space and we move forward by opening up the space economy so that our return to space will be sustainable. From there, we will talk about humanity's long-term space ambitions. Finally, we will dive deeply into the power of mathematics as it is this that lets us discover things about the universe and who we are, well before we actually can observe it.

5.1 Our place in the universe

After we found out that the Earth was, in fact, spherical, that we orbit the sun,[1] and that we are not located at the center of the entire universe, Edwin Hubble gazed at the stars and found something really interesting. He observed that distant galaxies were moving away from us and concluded that, therefore, the universe must be expanding.[2] This is something that had already been theorized by Georges Lemaître in 1927. This discovery led to the now widely accepted **Big-Bang theory**, which, in fact, is the movie in reverse, the universe expanding backward to a time that it was consolidated into an extremely hot and extremely dense single point, smaller than a single atom. When this singularity suddenly exploded, the universe was born (F5.1a). It is now estimated to be 13.8 billion[3] years old. As we all originated from this single point, we are all essentially built from stardust. The sound of the explosion, better known as **Cosmic Microwave Background (CMB)** radiation,[4] was detected in 1965, increasing the supporting evidence for the Big-Bang theory. The speed of the expansion of our universe is accelerating and if it continues, the universe will eventually end in ice.[5] But perhaps we got it all wrong, and it might bounce back, as we will investigate further on.

1 For example, the theory that the Earth orbits the sun was proposed by Copernicus in 1543 in his heliocentric theory. In 1610, Galileo saw Jupiter's moons orbit Jupiter and found evidence to support the heliocentric theory.
2 Better known as the Hubble-Lemaître law (Lemaître, 1927) (Hubble, 1929).
3 In 2013, the Planck space mission from ESA imaged the oldest light in our universe and estimated it to be 13.8 billion years old (Ade et al., 2013).
4 (Penzias & Wilson, 1965)
5 In 2011, Saul Perlmutter, Brian Schmidt, and Adam Riess were rewarded the Nobel Prize for the discovery that the expansion of the universe is accelerating (NobelPrize.org, 2011).



Appendix A – Sustainable Development Goals

The challenges humanity faces today and in the future have a lot to do with a lack of sustainable development, which means meeting the needs of the present without compromising the ability of future generations to meet their own needs.[1] As Kate Raworth points out in her book about donut economics (final thoughts Chapter 4), we should do more to respect our ecological ceiling and social foundation if we ever want to achieve a regenerative and distributive economy. This thinking about circularity is, however, not new. The United Nations realized that the Millennium Development Goals set by the United Nations (UN) between 2000 and 2015 helped fight extreme poverty, but more work needed to be done to create "the future we want". On September 25, 2015, seventeen Sustainable Development Goals (SDGs) were adopted by the UN General Assembly. Each nation could choose its own national targets and priorities. The date for completing the SDGs is end-2030.

1 (Emas, 2015)

TA.1 Sustainable Development Goals

	End poverty in all its forms everywhere.		Reduce inequality within and among countries.
	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.		Make cities and human settlements inclusive, safe, resilient and sustainable.
	Ensure healthy lives and promote well-being for all at all ages.		Ensure sustainable consumption and production patterns.
	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.		Take urgent action to combat climate change and its impacts.
	Achieve gender equality and empower all women and girls.		Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
	Ensure availability and sustainable management of water and sanitation for all.		Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
	Ensure access to affordable, reliable, sustainable and modern energy for all.		Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.		Strengthen the means of implementation and revitalize the global partnership for sustainable development.
	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.		

The goal of this book is not only to let you experience, think about and reflect on the big picture, but also to use its input to think about finding new ways forward, including ideas on how to implement the SDGs. Be aware that the SDGs are not a goal on their own; they are there to help guide our current and future activities, so we transform our society, including our economy, in a sustainable way. To support this transformation, in the following heat map we show how this book gives input to support your thinking about the SDGs. Please use the exploration map on www.explore-the-big-picture.com to really explore how topics relate to one another, including the SDGs. This is a most powerful tool.

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