1 *Introduction*

Look deep into nature and you will understand everything better.
Albert Einstein

To what is common to the greatest number gets the least amount of care.
Attributed to Aristotle

1.1 Why This Book

The effective fight against the climate emergency calls for overcoming the traditional and extant divide between natural science and management silos. In doing so, we propose a disruptive business regenerative strategy that can change the economy and business by putting cutting-edge climate and natural science at the service of humanity through the economic and business sphere on a planetary and emergency scale.

The latest scientific evidence (IPCC, 2023) offers a pessimistic picture of current and future trends in the climate emergency, which corroborates the general state of the planetary emergency introduced to the reader in Chapter 5. Via global warming, surface temperatures reached 1.1°C in 2011–2020, unequivocally due to human activities, such as unsustainable energy use, land use and land-use change, lifestyles and consumption and production patterns across countries, and through the emission of greenhouse gases. The general state of planetary emergency (Ergene et al., 2021) and the widespread and rapid changes occurring in the atmosphere, ocean, cryosphere and biosphere have a disproportionate impact on the most vulnerable communities, precisely those who are least guilty.

Despite the Paris Agreement in 2015 concerning the current mitigation progress (IPCC, 2023), the efforts made by mitigation policies and laws supporting solar energy, the electrification of urban systems and infrastructure, energy efficiency, demand-side management and so on – although they are becoming cost-effective – are not enough.

Table 1.1 *Greenhouse gas (GHG) and carbon dioxide (CO_2) emission reductions in 2019, median and 5–95 percentiles*

		Reductions in 2019 emission levels (%)		
		2030	2040	2050
Limit warming to 1.5°C (>50%) with no or limited overshoot	GHG	43 [34–60]	69 [58–90]	84 [73–98]
	CO_2	48 [36–69]	80 [61–109]	99 [79–119]
Limit warming to 2°C (<67%)	GHC	21 [1–42]	46 [24–63]	64 [53–77]
	CO_2	22 [1–44]	51 [36–70]	73 [55–90]

Source: IPCC (2023:22)

In addition, the adoption of low-emission technologies in developing countries lags due to financial restrictions. Overall, it is likely that warming will exceed 1.5°C during the twenty-first century and that it will be difficult to limit warming below 2°C.

If we want to stop global warming and the related, intensifying, multiple and concurrent planetary hazards, deep, rapid and sustained reductions in greenhouse gas emissions via strategies and actions are necessary within the next two decades (IPCC, 2023). Although current levels of greenhouse gas emissions have already made many changes to natural ecosystems irreversible (risk of species losses, heat-humidity risks to human health and food production impacts, among others), these can be limited by deep, extensive, rapid and sustained global greenhouse gas emissions reduction. In fact, limiting global warming to 1.5°C or 2°C requires net zero carbon dioxide (CO_2) emissions via determined reduction, undertaken during this decade through immediate gas emissions reduction, as Table 1.1 shows.

As the recent IPCC report argues, limiting warming to 1.5°C or 2°C requires immediate CO_2 reductions in all sectors during this decade to achieve global net zero emissions by 2050 or 2070, respectively. In this sense, and since other mitigation options such as afforestation or production of biomass crops can have adverse socioeconomic and environmental impacts if implemented at large scales, global mitigation pathways reaching net zero CO_2 and greenhouse gas emissions give great prominence to the transition from fossil fuels without carbon capture and storage to very low- or zero-carbon energy sources,

such as renewables or fossil fuels, with carbon capture and storage complementing CO_2 removal methods (IPCC, 2023).

Nevertheless, only a small number of globally modelled pathways limit global warming to 1.5°C by 2100. If warming exceeds 1.5°C, it could gradually be reduced by carrying out net negative global CO_2 emissions – or positive environmental externalities – which would require the additional deployment of CO_2 removal (IPCC, 2023) or atmospheric CO_2 capture.

Taking that into consideration, this book calls for a disruptive shift in business models towards a regenerative strategy capable of reversing the current climate emergency. For that purpose, it is essential to provide scientific evidence and convince business leaders, governments and policy-makers, as well as global citizens, of the need for immediate, proactive and globally coordinated action. As the latest IPCC report (2023) advises, there is a rapidly closing window of opportunity to secure a liveable and sustainable future for all. Mitigation and regenerative strategies require increased international cooperation among the business sphere, civil society and governments, particularly in vulnerable countries and industries. A planetary green deal includes coordinated political actions, laws and regulations in well-aligned multilevel governance, as well as access to finance and climate science technologies. Immediate coordinated action is mandatory because the decisions made during this decade will have impacts now and for thousands of years.

However, some questions arise: Why is it so difficult to address the climate emergency? Is it technically feasible? Economically? The next section aims to provide some answers to these questions.

1.2 The Tragedy of the Commons and the Climate Crisis

In the context of the natural environment, the tragedy of the commons is a well-known situation in which individuals who have open access to a natural good or resource, unhampered by shared social structures or formal laws and regulations that control access and use, act independently, according to their own self-interest, in an uncoordinated way, do not take into account the common good of all users and ultimately cause resource depletion. Hardin (1968) links this problem to a technological solution and a fundamental change in human morality. Coined by the British economist William Forster Lloyd (1833) to

explain the hypothetical effects of unregulated grazing on common lands – termed 'the commons' in Britain – the tragedy of the commons encapsulates Aristotle's thought: 'that which is common to the greatest number gets the least amount of care'.

The climate emergency can be framed as an extreme consequence of the tragedy of the commons (Hardin, 1968). For traditional capitalism, human selfishness – individual incentives – and the existence of environmental externalities are inherent to business and economic development and prosperity, whereby companies, citizens, governments and countries pollute the air – the commons – due to different human activities and in an uncoordinated way, leading to the current climate emergency. However, atmospheric pollution, especially CO_2 air concentration, is distributed around the globe, conferring special complexities to creating an effective response due to the inexistence of atmospheric national borders and extreme difficulties in fostering worldwide coordinated action to address the climate emergency.

Concerning environmental degradation and pollution, although the tragedy of the commons is shared by soils and spring water, rivers and lakes, in ocean degradation and especially atmospheric pollution, the tragedy of the commons manifests in its maximum expression because the atmosphere belongs to the whole population on Earth, without any national borders.

In Hardin's (1968) analysis of the tragedy of the commons, applied to population growth or nuclear war problems, he advises that these dilemmas had no technical solution but required a fundamental extension of human morality. Currently, in the twenty-first century, climate science-based solutions, as previously noted regarding atmospheric decarbonisation, can help address the climate emergency; however, as Hardin reminds us, a planetary joint solution guided by a 'human green or natural' morality is needed; that is, changing this way humans behave towards the natural environment. This is precisely the core of our regenerative strategy concept and the difficult path to regeneration we aim to illustrate with the pioneering Canadian company Carbon Engineering. This requires two main complementary elements.

First, a science-technical solution is atmosphere decarbonisation through CO_2 air capture and utilisation, such as Carbon Engineering's Direct Air Capture and CO_2-based synthetic fuel AIR TO FUELS™ cutting-edge technology and other technologies. The latest scientific evidence (Schäppi et al., 2022) has confirmed the technical and

economic feasibility of atmospheric CO_2-based synthetic fuels. Both technologies, according to the latest IPCC report (2023), are new, disruptive solutions that can effectively address the grand climate emergency, achieving net zero and even net negative emissions, which are necessary to stop climate warming in an immediate and planetary way. These are technical and economically feasible solutions, ready to be adopted right now and compatible with the existing gas and oil, industrial and transportation infrastructures; more importantly, they are ready for the immense majority of nations, industries and the world population, especially affordable in developing countries and the Global South (Hart, 1995) to address the grand challenge of sustainable development.

Second, there is a new human morality, where value is conceptualised beyond its economic nature, recognising both social and ecological values and restraining the view of individualistic, selfish and indulgent benevolent affections as the perfection of human nature, harmonising human sentiments and passions, just as Adam Smith analysed in his pioneering book *The Theory of Moral Sentiments* (1790). A new green deal where people intrinsically recognise this natural value is what we encapsulate in the emerging concept of 'eco-emotional wealth', a necessary driver of environmental entrepreneurs, managers and investors, allowing a regenerative strategy that implies three main disruptive changes in business models: (1) a new emphasis on transparent environmental performance and a company's contribution to 'systemic socioecological resilience', the resilience of our planet as a whole; (2) new and wider stakeholder engagement, including market and fringe stakeholders (Sharma & Vredenburgh, 1998) – communities, the natural environment, and so on; and (3) a very long-term perspective, which includes future generations.

1.3 General Approach in This Book

This book aims to present the reader with a comprehensive and realistic view of the climate emergency we are facing from the point of view of management science and business practice. In this sense, it shows how scientific evidence has been pointing to the existence of the climate crisis for decades and elaborates the responses that scholars in the field and firms have provided to the problem.

To address the climate emergency, the work clearly advocates the development of regenerative strategies by firms in which the corporate purpose is redefined (with an emphasis on a humanistic conception), where other stakeholders that were not taken into account until now (e.g. the natural environment itself) are taken into consideration, and where a very long-term vision is adopted. All of this is driven by cutting-edge climate science and disruptive technology.

The concept of a regenerative strategy aims to provide a realistic and balanced view of the focal problem. This is a balanced position because on the one hand, it shows evidence that technology alone will not solve the problem – there are no magic solutions – and on the other hand, it indicates that unfortunately, neither society nor companies are willing to drastically change their living standards today. This requires a lot of education and time, which are precisely what we do not have.

Thanks to science, we know that the climate emergency is rooted in the energy-intensive nature of our societies and based on the increasingly intensive consumption of fossil fuels; therefore, regenerative strategies aim to facilitate the transition to the economy of the future, where companies are embedded in the natural environment in which they operate and adapt their activity to the regenerative capacity of socioecological systems.

However, achieving the ideal of regenerative strategies cannot be done in the short term, as this is a radical change that requires drastic modifications not only in a company but also in society (through environmental education, for example, as we show in the last part of the book), under the premise that it is neither possible nor desirable to pursue indefinite growth, because the planet's resources are limited.

In this book, we also offer a clear example of how difficult it is to put the ideals of regenerative strategies into practice through the case of the Canadian company Carbon Engineering.

Carbon Engineering is a unique company that develops cutting-edge technologies that enable carbon removal and carbon capture and sequestration on a large scale, thereby eliminating the greenhouse gases that cause global warming. These advances in themselves are relevant enough, but they are not the only ones. Carbon Engineering has also developed a technology that makes it possible to create synthetic fuel from captured carbon, which could allow a qualitative leap in the fight against the climate emergency, with truly significant implications

for some important sectors on a global scale. It is, then, a company that is perfectly equipped to develop regenerative strategies into their ultimate consequences.

However, the challenge of regeneration is not simple. Along with technological capabilities, it is necessary to make a series of decisions involving risks and uncertainties that may jeopardise the company's core business, preventing it from realising its full regenerative potential.

Carbon Engineering thus faces a dilemma: to bet everything on technologies close to its core business – generating immediate profits – or to leapfrog, to use its technological advantage to truly and fully adopt the regenerative strategy. In this book, the reader will be able to assess the nature of this dilemma, illustrated through the case of Carbon Engineering, and will also be able to see how in these times of climate emergency, the decisive impulse of the public initiative and governments – which could allow companies to make qualitative leaps in the field of regenerative strategies – is more necessary than ever.

1.4 Book Structure

The book is structured in two distinct blocks. The first block, which includes Chapters 1–5, elaborates the context of the climate emergency we are experiencing and the extant responses from academia and business practice. This first block of content serves as a starting point for addressing what constitutes the key concept of our proposal: regenerative strategies.

Therefore, in the second block, which includes Chapters 6–8, regenerative strategies are addressed in depth, both from a theoretical and from a practical point of view through a case study. This block concludes with an analysis of the elements that must accompany regenerative strategies to achieve their full realisation. Both blocks are described in more detail next.

1.4.1 First Block of Content

First, following this brief introduction in Chapter 1 where we set out the reasons for writing this book, the nature of the climate challenge we face and the general approach we apply, in Chapter 2 we outline the early scientific evidence on climate change and the impact of this

evidence on both academic and business discourse. In Chapter 3, we delve into the academy's responses to the problem of the climate emergency through the concept of environmental strategy. Thus, from a longitudinal perspective, we analyse the evolution of that term and deconstruct environmental strategies, differentiating conventional or business-as-usual strategies from the regenerative strategies that are the central element in our book.

In Chapter 4, we move from strategy to capturing and delivering value in the context of the climate emergency. Thus, starting from the business model concept, we analyse social and environmental business models to demonstrate that both these models are embedded in the logic of the regenerative strategies already discussed. Chapter 5 delves into the relationship between humans and the natural environment, paying particular attention to the concept of the Anthropocene, the reason for its popularity and significance, and to the effects of intensive human intervention on the biosphere.

1.4.2 *Second Block of Content*

In Chapter 6, we address in depth the concept of the regenerative strategy, highlighting its main characteristics via a special emphasis on technology foresight and the more humanistic aspect of this type of

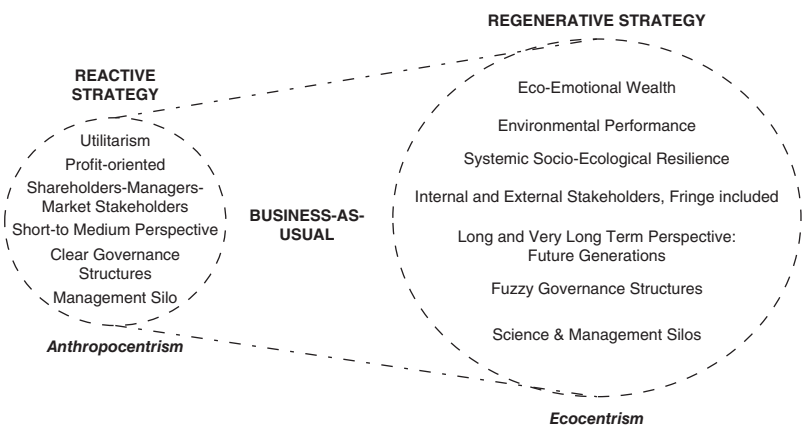

Figure 1.1 Anthropocentrism versus ecocentrism: the regenerative strategy's main features
Source: Authors' own elaboration

strategy in relation to the redefinition of firms' purpose and a new way of understanding not only their relationship with stakeholders, but also their time horizon. In Figure 1.1 we illustrate the main features of regenerative strategies.

In Chapter 7, we put the theory of regenerative strategies into practice by discussing the pioneering case of Carbon Engineering, which, as already mentioned, is developing cutting-edge technologies such as Direct Air Capture and AIR TO FUELS, capturing, sequestering and, most importantly, applying the captured CO_2 in the production of synthetic fuel.

Finally, in Chapter 8 we address some key aspects that are necessary to bring regenerative strategies to their full potential: on the one hand, the environmental and value-based education of future generations of business leaders – offering concrete examples of good practices; on the other hand, the essential role of public initiative in addressing global problems, among which the climate emergency is certainly prominent.

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2 *Assessing the Response to the Climate Grand Challenge*
Institutions, Governments, Business Practice and Management Research

You will achieve a good reputation by striving to be what you want to look like.

Attributed to Socrates

2.1 Introduction

Since the 1980s, climate science has alerted us, with data and evidence, to the serious effects that human intervention is having on the climate. The intensive use of the resources that the planet offers and a continuous obsession with growth at all costs, above all via fossil fuels, has placed the advancement of civilisation before the grand challenge of climate change. This grand challenge constitutes 'a global problem that can be plausibly addressed through coordinated and collaborative effort' (George et al., 2016:1880); its solution requires the decisive involvement of governments, supranational institutions, companies and, of course, management academics, who must provide solutions and alternatives that help companies face a challenge of such magnitude.

In the following sections, we first address how climate science sent the first warning signals of the problem of climate change and how multinational institutions and governments initially perceived the problem.

We then delve into the reaction of industry to this evidence, paying special attention to the fossil fuel industry because of the visibility given to it by its prominent role in the generation of greenhouse gases. Finally, we analyse the role of academia in addressing this challenge. In particular, we show the role played by academics dedicated to the organisation and natural environment field.