Introduction

The Global Philosophy of the (Global) Carbon Budget

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The global management of a limited carbon budget calls for a reassessment of climate justice and responsibility. Sticking to the 1.5°C mitigation target requires the global community to nearly halve carbon dioxide (CO_2) emissions by 2030 and achieve carbon neutrality by 2050 at the latest. This in turn raises three sets of normative issues. First, in a scenario of limited future emissions (consistent with the 1.5°C target), the notion of differentiated responsibilities needs to be reframed in terms of duties of economic and technological assistance, aimed both at financing mitigation and adaptation projects in the countries most exposed to climate damage and at compensating for this damage where it can no longer be avoided. Second, the climate crisis is now so severe that the welfare of future generations will depend on how present generations manage the global carbon budget (GCB). This in turn calls for the notion of intergenerational responsibility to be fleshed out in clear decarbonisation targets. Third, unequal emission levels within countries mean that future global emissions will be unevenly appropriated across social classes. Global climate justice thus intersects with the problem of carbon inequality and individual responsibility for climate change.

1. The 1.5°C Mitigation Target and Net Zero Emissions

Scientists unequivocally agree that greenhouse gas (GHG) emissions in general and CO_2 emissions in particular are causing global warming and consequently climate change. The Industrial Revolution kick-started anthropogenic climate change, leading to a progressive increase in the concentration of CO_2 in the atmosphere, from 278 ppm in pre-industrial times to 417 ppm in 2021 (Betts 2021). The consequences of climate change are there for all to see, ranging from rising sea levels to seawater intrusion threatening coastlines, hotter summer days and bigger and more frequent wildfires, droughts causing famines, an intensification of the number and severity of abnormal weather events and so on. The economic costs of global warming are substantial. According to a recent stress test conducted by the European Central Bank (2021, 19) on 4,000 companies and 1,600 banks in the euro area, in the absence of climate mitigation policies, global warming would lead to a 10% reduction in European gross domestic product (GDP) by 2100. And the Swiss Re Institute (2021, 10) estimates that in a no-mitigation scenario, where emissions follow the current trajectory, global GDP would fall by 18% by 2050, and of course most of these losses would occur in developing countries.

A practical and communicatively powerful way to measure climate change is through the so-called (global) carbon budget – the amount of CO_2 that humanity can still emit to maintain compatibility with a given mitigation target. The carbon budget is mainly a function of two factors: the mitigation target we choose and the probability (to meet the target) we aim for (e.g., either a 50% or 66% probability that mitigation policies will achieve the desired mitigation target). For many years, the climate target endorsed by the international community has been to limit global warming to no more than 2°C above pre-industrial levels. The latter target was adopted as indicating the maximum risk that could be tolerated, which in turn was associated, at least in early scientific climate studies, with a doubling of the concentration of atmospheric CO_2 compared to pre-industrial levels (see Tschakert 2015). The first to put the spotlight on the more ambitious goal of keeping global warming below 1.5°C above pre-industrial levels was the Alliance of Small Island States (AOSIS), an intergovernmental organization founded in 1990 and representing 44 (mostly developing) countries, both islands and low-lying coastal states, which were (and unfortunately still are) at the risk of being literally submerged by rising sea levels as a consequence of global warming (see Ourbak and Magnan 2018; Bolon 2018).

On the eve of COP15 (Copenhagen 2009), AOSIS called upon the Potsdam Institute for Climate Impact Research to carry out a study on the consequences of a global warming of 2°C. Armed with the expectation that global warming of more than 1.5°C could result in substantial threats to the very existence of its members, AOSIS sought to draw the world’s attention to the need for more ambitious mitigation efforts by the international community (see CICERO, n.d.). Despite these efforts, both developing and developed countries largely turned a deaf ear to the demand for more robust mitigation coming from AOSIS, and thus the Copenhagen Accord stuck to the 2°C target. The parties, however, opened the door to a revision of the collective mitigation target by committing to decide by 2015 whether the 2°C target should be reduced to 1.5°C based on empirical evidence to be gathered in the meantime (UNFCCC 2009, art.12) – the same concept of periodic assessment and eventual reinforcement of the long-term mitigation target is reiterated in the Cancun Agreements (UNFCCC 2010, art.4, art.138). COP21 (which produced the 2015 Paris Agreement) is therefore the moment when the 1.5°C target enters climate negotiations alongside the 2°C target. In the famous and groundbreaking wording of the Paris Agreement, the parties committed to 'holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels' (UNFCCC 2015, art. 2). This was followed in 2018 by the Intergovernmental Panel on Climate Change (IPCC) publishing a special report on the impacts of 1.5 °C of global warming. The report's key message is that containing global warming to below 1.5°C, rather than 2°C, would substantially reduce the negative impacts of climate change on ecosystems and human well-being. The report also sets out a series of mitigation pathways that are compatible with the 1.5°C target, thus providing policymakers with practical information on how to effectively reduce greenhouse gas (GHG) emissions (IPCC 2018).

Climate science is obviously an extremely complex subject about which it is often impossible to make clear-cut statements. Even after a specific mitigation target has been identified in a given global warming threshold, it is not always possible to say with certainty how many tons of CO_2 can be emitted before the earth's thermometer exceeds this threshold; however, it is possible to define this in probabilistic terms. Accordingly, the IPCC (2021, 29) tells us that to have a 50% chance of meeting the 1.5°C target, from 2020 onwards, humanity can only emit 500 gigatons (Gt) of CO_2 – decreasing to 460 Gt beginning in 2021 if we account for global emissions in 2020 (Hausfather 2021b). If we consider that global GHG emissions were about 50 $GtCO_{2e}$ in 2021 (Climate Action Tracker 2021, 1), it is evident that under a business-as-usual scenario, humanity is going to burn literally the 1.5°C carbon budget in less than 10 years, starting from 2022 (CO_{2e} stands for 'carbon dioxide equivalent' and it is used to measure the climate effects of different greenhouse gases, by converting emissions of any other greenhouse gases into the equivalent of CO_2 emissions with the same warming potential, see Eurostat, n.d.).

This does not mean that the 1.5°C target is out of reach, but the inertia of the past certainly makes it difficult to achieve. Essentially, humanity would have to halve global CO_2 emissions every decade until emissions reach net zero in 2050 – and then bring emissions of other GHGs to net zero by 2070 at the latest (Levin et al. 2019). Net zero CO_2 emissions do not mean zero CO_2 emissions, but rather no more anthropogenic CO_2 emissions than cannot be offset by anthropogenic CO_2 removals – i.e., 'through deliberate human activities' (IPCC 2018, 555) – before they build up in the atmosphere and increase the existing CO_2 stock. Anthropogenic CO_2 removals can take place either through nature-based solutions or in a technological way (see EASAC 2018). Nature-based solutions consist of expanding so-called natural carbon sinks, such as plants and forests, which can sequester CO_2 through the process of photosynthesis – this can be done either by planting new trees in addition to existing ones or by replanting felled forests. Technological solutions range from the capture of CO_2 at the point of emission in power plants with subsequent transport and underground storage (CCS, or carbon capture and storage) to the production of energy with the combustion of biomass and subsequent storage of the CO_2 produced (BECCS, or bioenergy with carbon capture and storage). In addition, there are also geo-engineering solutions, i.e., the more or less invasive modification of the earth's natural systems by technological means to mitigate climate change (see Gardiner and McKinnon 2020). Examples range from the direct capture of CO_2 from the atmosphere (DAC, or direct air capture) to the fertilisation of the oceans (to increase their CO_2 absorption capacity), as well as artificially increasing the reflectivity of clouds so that they can reflect solar energy back into space (SRM, or solar radiation management).

Once carbon neutrality is achieved, by balancing anthropogenic CO_2 (and more generally GHG) emissions with negative emissions, global warming will stop, and the earth's temperature will gradually stabilize (Hausfather 2021a). This is also because, we must not forget, part of the CO_2 emitted by human beings is absorbed naturally by the biosphere through the carbon cycle. Therefore, once anthropogenic emissions become net zero, carbon sinks such as land and ocean will not have to compensate for the anthropogenic flux of emissions (which will have been reduced to zero) and they will be able to gradually reduce the stock of CO_2 in the atmosphere, which is the result of past emissions (IPCC 2018, 159). Obviously, the greater the margin of negative emissions, not least through the development and refinement of technologies that have been pioneering to date, the greater the chances of meeting the 1.5°C mitigation target. This is for two main reasons. One is that some GHG emissions cannot be abated, either because – at least for now – there is no valid green substitute, such as in the case of aircraft engines, or because they are linked to biological activities that are difficult if not impossible to modify, such as methane emitted by grazing animals. The other reason is that we are not sure that we will achieve net zero emissions within 30 years, and if we miss the target negative emissions will give us a chance, in a sense, to go back and correct the mistake by eliminating the part of the CO_2 stock in the atmosphere that exceeds the 1.5°C global carbon budget.

2. The Three Pillars of Global Climate Justice

While effective and equitable mitigation would initially have been sufficient to ensure climate justice, this is no longer the case. Climate change is happening, has already caused widespread harm and will continue to do so in the years to come. Accordingly, on the one hand, there is a need to invest in adaptation, i.e., in modifying or, if you like, strengthening ecological and socio-economic systems in order to increase their resilience to climate threats (see Baatz 2018; Boran and Heat 2016). Examples of adaptation are changes in agricultural practices or even the adoption of climate-resistant crops, constructing buildings that are insulated against excessive heat and/or able to withstand flooding and/or can capture rainwater and make it available in times of drought, strengthening urban infrastructure against abnormal weather phenomena, but also industrial policies such as economic diversification and so on (see Acevedo et al. 2020; Sloat et al. 2020; UNEP 2021a; Steuteville 2021). Where neither mitigation nor adaptation succeed, however, environmental harms become unavoidable, and then the complex issue of compensation for loss and damage arises, especially where the economically most fragile individuals are hit the hardest (see Mechler et al. 2020; Pidcock and Yeo 2017; Page and Heyward 2017).

Moreover, the normative research on climate mitigation has progressively changed its focus. Initially, scholars applied both backward-looking claims, focused on the responsibility for past actions, and forward-looking claims, based on distributive principles (e.g., equality), directly to the distribution of the carbon budget among countries (see Gajevic Sayegh 2017, 344-350). That is, the idea was that the main normative challenge raised by climate change consisted in the allocation of future permissions to emit. The responsibility for the past mattered as long as you believed that someone’s future permits to emit were to be assigned by what they and their compatriots had emitted in the past. And even those who considered global wealth inequality as sufficient justification for a differentiated allocation of climate burdens focused mainly on the question of ‘differentiation in mitigation’ (Gajevic Sayegh 2017, 345; see Caney 2021). This was because there was, at least in the 2000s, relative optimism about the success of climate mitigation, and it was believed that once a mitigation target had been set, there was still room for those who had polluted less in the past to pollute more in the future.

Today, however, the mitigation challenge is so pressing that the distributive issue concerning the remaining share of the carbon budget has become secondary (see also Robinson and Shine 2018; Prattico 2019). Mitigation requires an immediate and rapid reduction in the levels of global CO_2 emissions, which in turn takes the form of a series of intermediate decarbonisation targets – the ultimate goal being to add no more CO_2 to the atmosphere after 2050. In short, the global emissions gap, i.e., the difference between the current emission trend and the one we should follow to successfully mitigate climate change, is so large that every country is called upon to swiftly reduce GHG emissions (UNEP 2021b, 3). Furthermore, until the last decade green technologies were not yet at an advanced stage of application (think of recent developments in the electricity and renewable energy markets), so it was difficult to imagine that meeting a number of basic needs, especially in poorer countries, could be done without GHG emissions. Now, however, it is clear that energy demand can be met without polluting – provided, of course, that the economic resources are available to do so (see Shue 2014, 6–9; Argyriou 2017).

The global justice discourse regarding mitigation has therefore shifted from the allocation of future emission permits to the global redistribution of wealth and technology, with the aim of supporting those with fewer economic resources and less technology to undertake climate mitigation (Shankar 2021; Delgado 2021). This is obviously accompanied by a similar concern about supporting developing countries in adapting to climate change and about offsetting loss and damage (see also Light and Taraska 2014; Baatz 2018; Gajevic Sayegh 2017, 350–361). As a result, much of global climate justice is now played out, within international negotiations, in terms of climate finance. At COP15 (Copenhagen 2009), developed countries made the historic pledge to provide $100 billion per year to developing countries to finance mitigation and adaptation activities beginning in 2020. Climate finance is to be understood as ‘new and additional resources’ coming ‘from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance’ (UNFCCC 2009, art. 8). To date, the $100 billion pledge has been breached, which is especially shameful considering the extra resources developed countries were able to inject in their own economies (about $20 trillion) in response to the Covid-19 pandemic (see Sachs 2021). At COP26 (in Glasgow, UK), the parties acknowledged their regret for this failure and went so far as to promise almost $96 billion per year by 2022, with the idea of relaunching more ambitious targets after 2025 (see Mountfor et al. 2021). This is obviously not enough. On the one hand, the costs of adaptation in developing countries could be much higher than previously thought, at about $300 billion in 2030 and $500 billion in 2050 (UNCTAD 2021). On the other hand, more than half of climate finance continues to be directed to mitigation projects, which are more profitable for lenders, rather than to adaptation, and less than a third of public climate finance is given as grants, while almost all the rest is given as loans (OECD 2021, 7-8; see also Sheridan and Jafry 2019; Timperley 2021).

3. The Normative Implications of the Global Carbon Budget

The positive emissions (i.e., those emissions exceeding the counterbalancing capacity of anthropogenic negative emissions) that humanity can still afford compatibly with the 1.5°C mitigation target, and which are exemplified in the global carbon budget (GCB), are a set of scarce, rival, not easily excludable, global and intergenerational goods. Why the GCB is a set of scarce and rival goods is obvious. Each emission erodes a share of the GCB that cannot be appropriated by another person. The non-excludability, or rather the difficult excludability, derives from the fact that every person continuously emits GHGs, even when breathing, and it is very complicated if not impossible to regulate all access to the GCB through bans, quotas or sanctions. The GCB is global because every emission, regardless of where it occurs, consumes a part of it. The GCB is intergenerational both because its current size is the result of emission-generating activities that took place in the past, including by people who are no longer with us, and because the fate of future generations depends on its management. All of this poses a number of normative issues, which we hope to address at least in part in this volume.

The first range of normative issues interweaves global and backward-looking intergenerational concerns. Developing countries are subject to double climate disadvantage. On the one hand, they are usually more exposed to the negative effects of climate change, both for geographical and economic reasons. On the other hand, they are being asked to forego industrialisation driven by fossil fuels – which are currently cheaper and often available in large quantities in developing countries. Both disadvantages are the direct consequence of past emissions, which have caused the climate change we are experiencing today and determined the magnitude of the current 1.5°C GCB. It needs to be explained whether and to what extent current duties of climate justice are a function of past emissions, even in the face of two non-trivial theoretical problems: people who emitted in the past, at least until the end of the twentieth century, were generally unaware of the effects that pollution was having on global warming; moreover, many past polluters are no longer around (see Moss and Robyn 2019; García-Portela 2019; Bell 2011; Gosseries 2004). Obviously, some of the benefits of past emissions have accrued to people in the present, i.e., emissions have helped to reinforce global inequalities, so many believe that it is unjust enrichment (where unjust can mean either that it has caused intergenerational harm or that it has been achieved by appropriating an excessive share of the GCB) that drives current duties of climate justice (see Page 2012). Still others believe that it is the ability to contribute, regardless of past responsibility, that should give us the measure of how much developed countries owe to developing countries in terms of climate justice (see Caney 2010).

There are, furthermore, two technical issues relating to emission accounting methods that have significant ethical implications, at least at the global level. First, when we say that a given country is responsible for *X* quantity of emissions in the period $t - t_1$, we are normally referring to data that account for the total emissions that occurred in that country in that time segment.

However, not all emissions in a country go to meet domestic demand. Many emissions are used to make products or services that are then exported. Thus, on the one hand, a country may give the impression that it is reducing its emissions, simply because it is not producing as much as before, while on the other hand, its emission consumption is increasing through imports (see Helm 2020, 58-81). And of course, where it is the emissions produced that count, there is a strong incentive for companies to move production abroad and then import (so-called ‘carbon leakage’). This is, for example, one of the reasons why the European Commission (2021) proposed the introduction of a carbon border adjustment mechanism (i.e., a carbon tax at the EU border) as part of the “Fit for 55” climate-policy package and the European Parliament (2022) recently voted to bring it into force from 2027 for fuller implementation in 2032. On the other hand, production-based accounting relieves the moral responsibility of net CO_2-importing countries and inflates the responsibility of citizens in exporting countries (see Duus-Otterström and Hjorthen 2019; Grasso 2016). The same applies to the second technical issue, i.e., calculation of total vs. per capita emissions. If you only look at the total emissions of a country, you do not take into account how many people have received the economic benefits of these emissions.

To simplify, we could say that combining production-based accounting with total emissions favours western countries at the expense of eastern ones. Countries such as Russia, Kazakhstan, Vietnam, China, India and Mongolia are net exporters of CO_2, i.e., they consume less CO_2 than they produce. China, for example, exports about 10% of its domestic emissions, while India exports more than 8% and Russia almost 15%. The United States, on the other hand, imports 7% of the emissions they produce, while countries like Italy, Spain and Austria import more than 30% (see Ritchie 2020). At the same time, China’s total emissions are almost double those of the United States (US), but the US’s per capita emissions are almost double those of China.

The second range of normative issues are intergenerational in a forward-looking respect. Global warming projections for the end of the twenty-first century depend on climate policy choices in the present. In other words, depending on how effectively people living now mitigate climate change, people born between the end of the twenty-first and the beginning of the twenty-second century will find themselves living on a warmer or cooler planet, with all the consequences that will follow. At the moment, we are already experiencing global warming of 1.2°C above pre-industrial levels – which in turn is a direct consequence of the increase in the concentration of CO_2 in the atmosphere. All the climate policies currently in place in the world will lead to a warming of around 2.7°C by the end of the twenty-first century. If all countries were to meet their mid-term (2030) mitigation targets, taking updated nationally determined contributions (NDCs) at COP26 (Glasgow 2021) as a reference point, global warming at the end of the century would be 2.4°C. Only in the optimistic, and therefore unlikely scenario in which all countries not only implemented submitted and binding long-term targets but also announced ones would global warming be limited to 1.8°C. A message that encapsulates the urgency of raising the bar on climate commitments is this: the climate pledges for 2030 collected at COP26 would lead us to emit more than twice as much in 2030 as would be needed to stay in line with a 1.5°C consistent mitigation pathway (Climate Action Tracker 2021).

To understand the extent of the economic damage that sub-optimal mitigation would cause to future generations, it is useful to consider a recent stress-test analysis by the Swiss Re Institute (2021). It analyses the effects of global warming of 2.6°C by mid-century – which would occur in the absence of any mitigation policy, and which comes close to the global warming we would have by the end of the century as a result of the mitigation policies that are currently implemented in the world. Under a 2.6°C global warming scenario in 2050, global GDP would fall by about 14% (during the peak of the Covid-19 pandemic, global GDP contracted by 3.5% – see Levy Yeyati and Filippini 2021), and for some countries such as China (18%), Malaysia (36%), Indonesia (30%) and Singapore (35%) the loss would even be higher (Swiss Re Institute 2021, 11).

It is evident that radical mitigation consistent with the 1.5°C target is optimal in a diachronic perspective because the future costs of global warming above 2°C are greater than the costs we would face, starting now, to avoid it. But it is also true that radical mitigation implies that people living now make investments and in some cases economic sacrifices to yield net benefits that will be enjoyed mainly by future people (see Burke et al. 2018). This requires a redefinition of the concept of intergenerational responsibility to match the climate challenge we face. This also means clarifying whether and what the present generation owes to future, not necessarily overlapping, generations in terms of climate justice and why intergenerational duties of climate justice are of no less normative relevance than intra-generational duties of socio-economic justice (see Mulgan 2018; Caney 2014; Gardiner 2011).

Finally, the third range of normative issues concern individuals, as consumers, investors and/or entrepreneurs. For climate mitigation to be effective, everyone needs to do their bit by reducing individual emissions, at least the superfluous ones – i.e., those related to activities that can be carried out without polluting or polluting less. However, two major problems arise. One is related to carbon inequality. A small minority of people have emitted and continue to emit more than everyone else. Of all the CO_2 emitted from 1990 to 2015, more than half is attributable to the activities of the richest 10%

of the world's population, while more than 15% of CO_2 was emitted by the richest 1%. Given that the largest emissions in history occurred from 1990 onwards, this implies that the richest 10% of the world's population has appropriated 31% of the 1.5°C GCB in just 25 years, while the richest 1% has appropriated 9% of it (Oxfam 2020, 2). A figure that epitomises the relevance of carbon inequality not only in terms of moral responsibility for past emissions but also for the effectiveness of mitigation is the following: if the richest 10% of the world's population continued to emit at current levels, while the emissions of the remaining 90% of the world's population magically became zero from now, the 1.5°C GCB would be consumed shortly after 2030 (Oxfam 2020, 2). Furthermore, since 1990 the emissions of the super-rich, the richest 0.01% of the world's population, have increased by 110%, while those of the middle 40% of the global class (people who are neither part of the poorest 50% nor the richest 10%) have only increased by 4%, and those of the poorest 50% have increased by 32%, mainly due to their being lifted out of poverty (Chancel 2021, 17; see also Kenner 2019). Add to this the responsibility of companies, especially oil producers. It is estimated, for example, that 35% of methane and CO_2 emissions over the last 50 years are attributable to the production and consumption of fossil fuel products coming from just 20 companies (Taylor and Watts 2019; see also Grasso 2022).

Carbon inequality leads to two major concerns. Firstly, since climate change is common knowledge, the rich have been emitting far more than the middle and lower classes, and they have obviously also been making large profits from emission-generating activities – one only has to look at data on growing intra-country inequality to see that carbon inequality and income inequality go hand in hand. This raises the question of whether and to what extent the rich have a greater duty to compensate the victims of climate change than the middle and lower classes. Of course, the concept of class responsibility does not replace that of country responsibility, but in a sense contributes to specifying it. When we say, for example, that the United States has appropriated a certain share of the GBC in a certain historical period, we may state that the US has a duty, as an international actor, to transfer resources to those who are damaged by climate change and/or forced to give up an equivalent share of the GCB. The concept of class responsibility, on the other hand, can indicate how the global climate duties of the US should be translated into domestic tax burdens, to be distributed among the different social classes, not least in relation to their respective climate responsibility. Secondly, radical carbon inequality, such as we now have at a global level, means that for climate mitigation to succeed, decarbonisation efforts by the richest worldwide must be disproportionately greater than that of the rest of the world's population. And this clearly implies that we need to think about public policies that target the richest and prompt them to change their lifestyle and investment choices (see Otto et al. 2019; Benoit 2020).

The second normative problem related to the individual dimension of climate change concerns the moral link between individual emissions and climate harms. Stephen Gardiner (2011, 45–48) famously defined 'moral corruption' as the tendency for individuals to hide somewhat behind the empirical complexities of climate change in order to distort the way one should approach the phenomenon and shrug off moral responsibility for one's emissions, thus not taking the issue seriously, neither privately nor politically. Climate change has, in a certain sense, posed a novel challenge to the philosophical concept of moral responsibility, where the relationship between cause and effect extends both across a global geographical scale and across a timeframe extending into the future as far as linking generations that are not overlapping (see also Jamieson 2007; Persson 2016). Climate mitigation, as we have seen, requires everyone to reduce their carbon footprint, but for this to happen people need to be motivated to do so (see Peeters et al. 2019). On the one hand, it is necessary to defend a genuinely cosmopolitan and intergenerational ethos, which inspires individuals to take on part of the climate-transition burden in the interests of individuals they will never meet, whether because they live in distant places or have not yet been born (see Meyer 2021). On the other hand, reasons must be given why everyone is called upon to play their part, even in the face of such a complex and wide-ranging problem that no one person, company, city or state can solve alone, and in respect to which every individual contribution seems to be irrelevant if taken on its own (see Broome 2019; Banks 2013; Nolt 2011).

4. The Book's Objective and Why Now

The book *Global Climate Justice: Theory and Practice* has two main purposes, dictated by the historical (and climatic) moment we are living. On the one hand, the book aims to propose a series of reflections on the distributive aspects of global climate justice, in its three components mentioned above, for the post-COP26 period. The hope that has been pinned on COP26 (Glasgow 2021) was to keep the 1.5°C mitigation target alive. To understand whether this has been achieved, it will be necessary to see whether the decarbonisation commitments and announcements are translated into concrete action. What is important to emphasise, however, is that we are going through a crucial phase in the history of humankind, in which we must decide whether we will take the earth beyond irreversible climate risk thresholds or stop short of the cliff. Global CO_2 emissions have been on a steeply rising curve since 1950, increasing from just over 5 Gt per year to over 36 Gt in the immediate pre-Covid-19 period (Ritchie and Roser 2020). Effective climate mitigation requires this curve to take the shape of a bell between now and the next 30 years. We are now at the top of this hypothetical bell. We need ethical and political theories to guide us on the way down.

The second objective of the book is to trigger a series of parallel and complementary normative reflections on the climate neutrality ambition. Decarbonising the world's economy, and doing so in a just way, requires a series of significant social and political interventions. Perhaps the most obvious case concerns food and agriculture. Current styles of food consumption are simply incompatible with medium- and long-term climate mitigation goals. It is therefore essential to rethink both the production and consumption of many foods, red meat being one example. Obviously, this could have major social consequences, as well as encountering the obvious implementation hurdles that arise when people are called upon to change deep-rooted habits (see Murdock and Noll 215). Another key issue is gender. Women are often the most vulnerable to climate damage, especially in developing countries, both because they are usually in charge of providing food and water for their families, which climate change puts at risk, and because they have fewer socio-economic means to adapt to climate shocks. But they are also potential climate mitigation actors, especially in those social contexts where they play a key decision-making role in household energy choices. It is therefore clear that climate policies, be they aimed at mitigation, adaptation or compensation, need to be made gender-sensitive for them to be fair and effective (see Jafry 2016; Perkins 2019).

Another major challenge is the social responsibility of companies with respect to the goal of net zero emissions by 2050, especially companies that have contributed and still contribute the most to GHG emissions. On the one hand, companies are called upon to rethink their productive activities in order to limit their environmental footprint without negatively impacting their stakeholders (primarily their workers), and on the other hand, they have to account for the climate damage they have caused so far and from which they have gained considerable profits (Benjamin 2021, 20–45; Grasso 2022). Alongside the moral responsibility of polluters there arises the normative problem of stranded assets. To achieve climate neutrality by 2050, humanity will need to keep about 60% of gas and oil and 90% of coal underground (Welsby et al. 2021). This will mean, for those who control access to these energy assets, giving up conspicuous profits and liquidating the relevant infrastructure earlier than planned when it was built. The losers will not only be the companies but also the savers who have (more or less wittingly) invested in these companies and, of course, the workers. This raises both the issue of protecting the most vulnerable and whether and under what circumstances the winners of the climate transition owe something to the losers (see Caldecott et al. 2021). Finally, national and international legal systems are faced with a pressing challenge, i.e., to account for the rights of future individuals, who are the main victims of climate change, and also to reconceptualise the rights of non-human living beings vis-à-vis an existential threat such as climate change (see González-Ricoy and Gosseries 2016; Di Paola and Jamieson 2018).

We consider it useful to try to pursue both objectives in the same volume, despite the limited number of pages available, because the distributive challenge of climate justice inevitably intersects with a series of ethical, political and legal issues concerning the role of consumers, companies, policymakers and technology in the global undertaking towards long-term sustainability and carbon neutrality. At the same time, part of the upshot of the transition to a fossil-fuel free society depends on how the different components of climate distributive justice, in particular the aspects of effectiveness and equity, are combined.

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