COLLEGE OF HUMANITIES
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A PHILOSOPHICAL ANALYSIS OF THE INFERENTIAL AND PREDICTIVE ACCURACY OF THE GREEN PARADOX

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DECLARATION

I hereby declare that except for references of works, which I have cited and duly acknowledged, this thesis is the result of my own research work produced under supervision and that no part of it was taken from materials and works that have been accepted as part of the requirement for award of any degree in in the university and elsewhere.

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ABSTRACT

This thesis investigates Sinn's Green Paradox, a theory that asserts that well-intentioned climate mitigation designs aimed at reducing carbon emissions can, paradoxically, accelerate a climate risk. By reducing the intricate web of climate realities to the rational, atomistic actions of resource owners, the Paradox potentially oversimplifies the multifaceted dynamics of climate change. In so doing, it neglects the unpredictable interplay among human, technological, and nonhuman agents, each shaping outcomes in ways that defy linear causality.

Accordingly, I contend that this reduction of agency to a mere linear sequence impoverishes both the inferential depth of the Paradox and the predictive reliability of designs derived therefrom. Reflecting upon inferential logic, I critically analyse how rationality, behavioural patterns, and technological determinism intertwine to influence the causal trajectories of climate risk. Thus, this philosophical lens illuminates the limitations inherent in the Paradox, compelling an advocacy for more nuanced, context-sensitive analyses.

Consequently, I argue that mitigation designs must transcend narrow data-driven designs by incorporating an ethical responsiveness to the lived realities of risk. To advance this argument, I employ agent-based modelling, enriched by philosophical insights from Reader's notion of the 'other side of agency,' Dempsey's articulation of nonagential agency, and Okeja's idea of deliberative agency. These theoretical perspectives collectively inform my advocacy for adaptive, participatory designs attuned to both local specificities and global exigencies.

Finally, while the Paradox foregrounds the unintended effects of designs, it does not adequately engage with the philosophical reflections necessitated by the agential complexity and radical uncertainty within the climate change spaces. My thesis, thus, situates the Paradox within an expansive existential and ethical context, urging that climate mitigation designs transcend economic reductionism to more fully account for the moral and epistemic challenges inherent in our distributed agency and entangled lifeforms, life-worlds, and physical realities.

DEDICATION

To Nothing

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CHAPTER ONE

INTRODUCTION

This chapter distils the core themes, arguments, and contributions of my work, offering a conceptual lens on climate risk mitigation. It critically examines prevailing theories with particular focus on Hans-Werner Sinn's Green Paradox and its corresponding supply-side mitigation design,[1] highlighting both their insights and limitations. Here, I situate the study by articulating the problem, framing the research objectives, and posing the guiding questions. The chapter also maps the relevant literature, outlines the methodological approach, and defines the key terms and chapters that anchor the subsequent analysis, establishing a foundation for a philosophically informed interrogation[2] of climate mitigation theories and designs.

1.0 Background of the Study

Mapping the risks linked to the changes in climate, and with regard to the asymmetric responses in the global space, I found that the history of action against climate risks is characterised by the development and use of several mitigation designs which, to a degree, have had some successes and failures (Fölster & Nyström, 2010; Galaz et al., 2021; Castro et al., 2019). For

[1] Throughout this study, the term "design" is employed interchangeably with framework, policy, and model. This usage is intended to avoid repetition and stylistic monotony, without implying substantive distinctions among these terms. Conceptually, all such terms are treated as instruments through which human and institutional agents' structure, guide, and intervene in socio-environmental systems. By framing design in this flexible manner, the work emphasises the relational and inferential character of action. It is the alignment of these structures with causal understanding, normative responsibility, and practical feasibility that determines their efficacy in addressing complex climate risks.

[2] I bring philosophical reflection into this work because climate change and risks, as claimed, touch our lives, our communities, and the ecosystems we depend on. Thinking philosophically helps me question assumptions, weigh ethical stakes, and consider the diverse and multiple agents entangled in the phenomena. It is not just about theory. It is about understanding what our choices mean, how interventions affect real lives, and ensuring that climate mitigation is responsible, just, and attentive to the world we all share.

example, in a proposal to the Stockholm physical society by Svante Arrhenius, it was advised that increased fossil fuels combustion would unsettle the global atmosphere by producing the situation now called global warming (Somerville, 2006). Also, some studies have indicated that energy systems have the potential to release CO_2 and Greenhouse Gases (GHG) which, often, contribute to anthropic climate risks (Weisser, 2007; Lehrer, 2022).

The above observations are assumed to be influenced by some changes to physio-biological structures largely in high temperatures which cannot be justified by natural variability alone, but the rising and intensities of anthropic CO_2 and GHG emissions (Rosenzweig et al., 2008). It is also the case that there has been constant scientific insights and startling intellectual shifts regarding how to tackle climate risks (Sörlin & Lane, 2018), the potentials of clean energy and sustainable development (Sörlin & Lane, 2018; United Nations, UN, Climate Change, 2021) and the demands of mitigating CO_2 emissions and rising support for green growth (OECD, 2008; Stefan et al., 2021).

Now, given the foregoing discourse on mitigation designs, natural variability, anthropic CO_2 and GHG emissions, etc., we can conclude that climate risks are becoming part, if not fully, of our everyday climate scenarios and experiences of such scenarios. As a result, a necessary attention must be paid to the theories that underpin climate mitigation designs. This is important to ensure the internal and external consistency of these designs.

I imagined that addressing climate risks requires rethinking philosophies underlying their theories and designs. Many of these theories and designs have proven greatly inconsistent with our everyday experience of climate risks. For instance, what constitutes an emerging climate risk may differ across African communities seeking clean, safe, and viable ecosystems. Surely, the constitution may also differ for individuals and groups striving to secure essential resources such as water, food, housing, health, etc. And such instances raise explicit epistemic and normative concerns. Simply, for many people in these regions, what matters most is understanding and explaining why they remain underdeveloped and how to survive. In this sense, development and the capacity to endure are critical, non-negotiable existential concerns.

I, therefore, believe that what is often subsumed under many climate risk theories and designs fail to account for the multiple agents and agential interactions[3] that shape real-world experiences of climate variability. For example, in some African countries, given the socio-cultural, economic, geopolitical, and historical factors, citizens may price resource extraction over climate-related risks, even trading potential ecological harm for development and material wealth (Cadoret & Padovano, 2016).

Moreover, while climate risk mitigation designs are often justified through impartial universally binding principles (Fölster & Nyström, 2010; Galaz et al., 2021), these principles fall short of achieving truly global climate action. They tend to remain abstract, hypothetical constructs that disconnect real agents from the concrete realities of their daily encounters with climate risks, and they inadequately separate the political and geo-economic consequences of these experiences from their epistemic and ethical dimensions.

In effect, it can be stated that most climate risk mitigation designs focus more on technical, political, security, and geoeconomic related forecasts (Sörlin & Lane, 2018; OECD, 2008).[4] It is reasonable, then, to suggest that the shortcomings of these designs stem from the theories that underpin them. In short, the character and limitations of a mitigation design are inseparable from the assumptions and objectives embedded in the theory it derives from,

[3] In this study, the terms "multiagency," "interagency," and "agentiality" are employed to refer to the presence, interaction, and intersection of multiple agential entities. This usage emphasises the relational and dynamic character of agency in complex socio-ecological systems, highlighting how overlapping actions, responsibilities, and influences among multiple agents shape outcomes. By framing agency in this way, the work situates causal and normative analysis within a networked perspective, underscoring the ethical and practical implications of coordinated and intersecting interventions in climate risk mitigation.

[4] In my view, most climate risk mitigation designs privilege abstract models, projections, and quantitative metrics over the lived realities of those most affected. By framing risks primarily in political or economic terms, they often overlook the ethical and existential dimensions of vulnerability and the complex interplay among agents. In doing so, they risk producing interventions that may be administratively efficient but feel disconnected from the everyday experiences and urgent needs of communities navigating a changing climate.

shaping what the theory seeks to describe about lifeforms and the physical world from the outset.

In order to address my claim, I will focus on Hans-Werner Sinn's theory of the Green Paradox. The theory argues that "[…] a gradually greening demand policy speeds up global warming" (Sinn, 2008, p. 382). And based on this Paradox, a corresponding supply-side climate risk mitigation design[5] was proposed. In analysing the Paradox, I found that its grounding conditions were inadequate for a robust climate mitigation design. Conceptually and practically, it ignores the diverse and interactive agents in climate variations.

Followingly, while Sinn (2012) heavily relied on a relation between two factual events: "gradual demand greening policy" (p. 382) and "accelerating global warming" (p. 382), Sinn

(i) failed to reflect wider confounding variables that could affect both the observed events and the relation between events;

(ii) inadequately reflected on the agential entities in climate change by failing to take account of the intersection between climate risks and agential entities; and

(iii) paved over essential differences in existential values that are crucial to measuring ethically correct courses of climate action in particular and complex situations.

Needless to say, the Paradox has been widely studied across different research areas. For instance, Svenn, Mohlin, Pittel & Sterner (2015) underscored its applicability and how certain factors like technological change and CO_2 leakages could affect its reality. Their thesis revealed that the factors weaken the Paradox instead of strengthening it; and they arrived at the view that the Paradox rests on fragile ground, sustained by but scarce traces of empirical proof (Svenn et al., 2015). Their conclusion reiterates the practical inadequacy of the Paradox

[5] The supply-side mitigation design will be examined further in this work. At its core, it frames climate intervention as a reactive engagement targeting production rather than merely consumption. It underscores the enduring tension between agency and structure in a sense that agents could enact measures, yet the existential systems they inhabit delimit both scope and efficacy. This perspective situates the design within ongoing debates on causality, responsibility, and the practical limits of actions vis-à-vis complex, multiagent climate risks.

to capture what Sinn seeks to describe: the acceleration of global warming. The conclusion also echoes the misrepresentation of observable variables in climate change, and why it is a weak theory for building a climate mitigation design to regulate anthropic actions.

It is clear that the above considerations make it worthwhile to undertake this philosophical trajectory of Sinn's Paradox. Therefore, my work looks at two philosophical problems:

(i) an inferential path in the Paradox – in terms of spatiotemporal contiguity and temporal precedence of events Sinn claims must exist for the Paradox to occur; and

(ii) predictive accuracy of the Paradox's corresponding mitigation design – in terms of its epistemic and normative relevance in our physical world. I ask whether it represents a complex real-world problem. This matters for determining if it can serve as a theory for designing how and why we must act in a certain way to reduce CO_2 emissions. In particular, when such designs aim to regulate the actions of multiple, diverse and interactive agents.

Realising the Paradox's challenges, I proposed an alternative design that embraces agential entities in climate change and risks. My rationale is twofold. First, Sinn's silence on agential entities undermines the Paradox and its mitigation design. Second, my work foregrounds the role of agency viz., multiagency, interagency, human and nonhuman agential entities. I base this analysis on Agent-Based Modelling. Finally, I offer orientations[6] for shaping future climate mitigation theories and designs.

[6] Although this chapter introduces the concept of orientations, their rationale and implications will be explained more fully in the concluding chapter, where they will serve as forward-looking recommendations for future climate mitigation theories and designs.

1.1 Statement of the Problem

In analysing the conditions that must be present for Sinn's Paradox to occur, I realised the inferential relation between an apparent cause and a recognised effect. The path can be represented in the following:

(i) event Y (acceleration of global warming) would not have occurred,

(ii) had the event X (gradual demand greening policy) not occurred,

(iii) given that event X did occur, event Y did happen (Causal inference).

In another sense,

(i) X is 'spatiotemporally contiguous' to Y,

(ii) X 'precedes' Y,

(iii) the occurrences of X 'are followed by' an occurrence of Y.

In this inferential relation, event X is happening in the physical world and is actually followed by event Y, which also occurs in spatiotemporal matters of fact. The Paradox, therefore, signals a relational dynamic that coexists with binary properties, rendering it both analytically and empirically approachable. In principle, X causes Y given that,

(i) X and Y are real occurrences,

(ii) Y is deduced from X.

However, grounding the inferential path on basic conditions necessary and sufficient for causality, I conceived that the events in the Paradox are circumstantial.[7] The inferentiality, I understood, is an accidental relation between X and Y, and can only occur in a restricted and nonredundant perspective. This is a clear example of the often-held mantra 'association does

[7] One must ask whether Sinn has truly not noticed this. If he has, his failure to distinguish correlation from causation amounts to a serious methodological oversight; if he has not, the lapse borders on philosophical negligence, for it collapses succession into generation and thereby obscures the very relation at stake. My own formulation, by contrast, confines itself initially to the descriptive registration of X and Y as temporally ordered and inferentially connected events, with a more comprehensive causal account. I will develop this account through counterfactual analysis, probabilistic reasoning, and the identification of operative mechanisms, reserved for Chapter 2, in order to secure both conceptual clarity and empirical rigour.

not imply causation' which makes the inferentiality to fall within the fallacy of questionable cause (non-cause for cause).

Therefore, I found two closely related philosophical objections to the Paradox which need to be resolved. First, the Paradox's inferential path does not meet the basic understanding of causality. This is because,

1. the path from X to Y is a one-way causal path from X to Y. It can also happen in a reverse causation or by a confounding result of a third event on X and Y which does not exclude the option of concurrent, and 'backwards-in-time' causation given, as Sörlin & Lane (2018) claimed, the natural variability of climate scenarios, and
2. the number of plausible interactions between the different variables which have to be considered as causes of event Y are countless, mainly when event X (an actionable policy) is a "naturally occurring attribute" (Mackenzie, 2013, p. 147). In this case, event X is unreliable because it is unclear whether event Y was due to event X or other confounding variables such as AI-technological systems and Non-State Actors (NSAs).

The second philosophical objection runs as follows: based on the first objection, if we assume, plausibly, that causal inference in everyday settings is complex and interactions of variables are pervasive, then the predictive accuracy of the Paradox's corresponding design will be lower. Here, Sinn is faced with two problems: (i) epistemic relevance concerning whether his theory should be treated as a fact in our everyday experience of climate risks, and (ii) the ethical justification of its corresponding mitigation design aimed to regulate human actions vis-à-vis the multiagency and interagency in climate crisis? That being so, the concern of whether the Paradox is to be treated as a 'fact' and a 'value' is crucial to its epistemic and normative relevance.

Arguably, striking a proper balance between fact and value remains a central challenge for climate risks based on which alone mitigation theories and designs can be epistemically and normatively relevant to society. This is because with the variations in climate, "… there *is* a significant degree of scientific dispute over many of the future potential risks" (Lehrer, 2022, para. 13). Therefore, one of the difficulties I envisaged is that Sinn's mitigation design is practically challenged with its predictive performance in our physical world given that it carries the burden of mediating effects of contexts and the worth of a Paradox which might be a hypothetical, and empirically non-verifiable kind. Sinn gives us no way of handling the epistemic and normative senses of climate risks because the Paradox imposes a simple and absolute inferential and predictive performance without cognisance to particularities of climate experiences and emerging risks.

At this point, I am inclined to think that the Paradox is only tenable when the problem of agency is resolved. In particular, Sinn's fixation on single agency (that is, the behaviour of resource owners because of greener policy) while blind to the observable agential entities in the climate crisis.

1.2 Objectives of the Study

To achieve my overarching aim, I approach this work along a philosophical-ethical line, with the central goal of defending my thesis that *Sinn's neglect of agential entities undermines the inferential logic of the Paradox and reduces the predictive accuracy of its corresponding mitigation design, even within a reasonable margin of error.*

Toward this conclusion, the following objectives will be pursued:

1. to develop a conceptual understanding of the Green Paradox and its implications for how climate risks are framed and interpreted.

2. to advance an ethical argument for extending climate risk theories and mitigation designs beyond the narrow confines of technical, political, security, and geoeconomic forecasting.
3. to analyse the distributed and multiple agencies that interact in the constitution of climate risks, and to evaluate how these interactions (i) shape both the dynamics of risk and (ii) should shape mitigation designs.

1.3 Primary Study Questions

The study recognises that climate change scholarship is gaining increasing traction across multiple domains such as public institutions, political and fiscal debates, legal frameworks, foreign policy, social practices, and academic communities (Le Treut et al., 2007; Convery & Wagner, 2015). This growing prominence is evident in current geopolitical disagreements surrounding climate conferences, the simultaneous rise of climate scepticism and activism, as well as the heightened global interest in climate financing and justice.

Against this backdrop, Sinn's claims, particularly, his articulation of the Paradox and his proposed approach to mitigation design invite further examination. To this end, the following guiding questions are posed and addressed:

1. How does the epistemic dimension of climate risks shape the meaning and implications of the Green Paradox theory?
2. To what extent should the predicate accuracy of climate mitigation designs be evaluated in relation to the lived, everyday experience of climate risks?
3. What is the role of normative theorising in climate risk mitigation, and which forms of theorising are most valuable or desirable?

4. How can different philosophical trajectories and conceptions of agency inform our understanding of climate risk mitigation options?

1.4 Justification of the Study

This study explores the promises and pitfalls of climate mitigation designs through a philosophical lens, focusing on Sinn's Green Paradox and its supply-side mitigation design. I examine how the theory's inferential logic and predictive accuracy are shaped, or constrained, by the assumptions it makes about human and nonhuman agents, multiagency, and interagency interactions. To achieve this, Sinn invokes a foundational impetus, the Paradox, framed as a theoretical construct (Sinn, 2012).

Sinn relies on *in vitro* data to explain *in vivo* phenomena, such as global warming, which, in my view, limits the applicability of his theory and weakens the predictive power of its mitigation design. His aim is to challenge the conventional demand-side approach, yet in doing so, he largely overlooks the ethical and practical entanglements of multiple agents in climate systems.

This study reflects philosophically on these concepts and practices, highlighting the ethical, conceptual, and practical implications of climate risk mitigation. By examining Sinn's assumptions, propositions, and conclusions, I seek to uncover where theory meets, or clashes with, the realities of complex, multiagent climate systems, and to inform the development of more robust, ethically grounded mitigation designs that better respond to these complexities.

1.5 Significance of the Study

Rethinking climate mitigation is no longer just a technical, political, security, and geoeconomic exercise. It is an ethical and existential task. Climate risks are experienced unevenly, shaped by competing ideologies, governance challenges, questions of justice, financing constraints, and geopolitical tensions. Standard mitigation theories often abstract these realities, privileging models and projections over the lived experiences of communities, ecosystems, and nonhuman agents intricately entwined with them.

My work argues that meaningful mitigation must begin with theories capable of capturing the full complexity of human and nonhuman agencies. By engaging critically with Sinn's Paradox and its supply-side mitigation design, I examine how assumptions about agency, causality, and risk influence both predictive accuracy and the ethical weight of interventions. Philosophical reflection allows us to see where theory may overlook the concrete consequences of climate change, particularly for the most vulnerable.

The significance of this work lies in its dual contribution. Conceptually, it foregrounds the normative and agential dimensions of climate risk, showing that human and nonhuman agents co-constitute vulnerabilities in ways often neglected by conventional models. Practically, it points toward mitigation designs that are adaptive, inclusive, and ethically grounded, accounting for the intertwined responsibilities, relational dynamics, and decision-making practices that shape both risk and response.

Ultimately, this study seeks to shift how climate risk is conceived, particularly in sub-Saharan Africa, and to chart pathways for future mitigation designs. Climate risk is not a fixed or fully apprehensible phenomenon. It is a shifting horizon, where interacting agencies produce emergent patterns of vulnerability. By integrating lived realities with philosophical insights, therefore, this work offers a conceptual and practical map to guide scholars and policymakers toward mitigations that are meaningful, just, and attuned to the complex entanglement of agential entities in our lifeworld.

1.6 Literature Review

Recent studies have acknowledged the acceleration level of human-induced climate risks regarding natural resource extractions, and related CO_2 footprints and GHG emissions (Convery & Wagner, 2015; Svenn et al., 2015; Lehrer, 2022). For instance, Fölster and Nyström (2010), in reflecting on the Green Paradox, revealed the irony that designs intended to limit CO_2 emissions have increased after the Kyoto Protocol which, according to them, underscores the fragility of rational planning in the face of self-interest and the deeper contradictions of sustainability. They argued that this can "[…] partly be blamed on accelerating world growth and on lags in policy instruments" (Fölster & Nyström, 2010, p. 223).

To a large extent, these 'lags in policy instruments' have been shared by Sinn's theory. Here, Sinn's account of climate risk exposes the Paradox at the heart of demand-side mitigation. Basically, anticipated declines in CO_2 consumption, he argues, do not reduce emissions but accelerates them (Sinn, 2008). Why and how? Because resource owners intensify extraction of fossil energy to capture rents before future regulations constrain them (Sinn, 2012). In this sense, the very prospect of mitigation design causes the trajectory of global warming, a dynamic overlooked in traditional demand-side mitigation designs (Sinn, 2015; van der Ploeg, 2015).

And though Sinn's ambition in constructing the Paradox is economical and, considerably, theoretical, the need to review it is due to the epistemic and ethical suppositions the theory engenders for mitigating an existential-climate risk like global warming. Positively, Sinn expands the debate on climate mitigation models beyond the traditional demand-side mitigation design which, he claims, is limited in mitigating a climate risk because it does not actually resolve the reduction of CO_2 emissions from fossil fuel production from extractive cartels and climate sinners (Sinn, 2008, 2012; van der Ploeg, 2015).

Practically, Sinn swings between dismissing the traditional demand-side mitigation design as ineffective and presenting his supply-side approach as self-evidently correct (Sinn, 2012). But despite his critique, the logic and predictive power of his approach are questionable. My aim here is to expose the conceptual and practical gaps in Sinn's approach.

A major problem is that Sinn largely ignores the role of agency in climate risks. His claim that X ("gradually greening demand policy") produces Y ("acceleration of global warming") oversimplifies reality, overlooking the multiple agents interacting within complex ecosystems (Svenn et al., 2015). By relying on a single causal link, his Paradox reduces the richness of real-world interactions to a broad generalisation.

To analyse the Paradox further, I turned to an alternative theory of causal inference. In doing so, I observed that the Paradox's account of causation is internally inconsistent and fails to meet the broader epistemic criteria articulated within African theories of causation, particularly Godwin Sogolo's framework. Sogolo (1998) emphasises a distinction between primary and secondary causes, underscoring the significance of marginal events as potential determinants within any causal chain, a view further elaborated by Ajei (2014). Applying this perspective, I argue that the inferential challenge of Sinn's Paradox could be addressed if we acknowledge that marginal events, often overlooked, can meaningfully contribute to the outcome Y.

However, neither conventional cause-and-effect reasoning nor Sogolo's African conception of causation aligns with the inferential assumptions underpinning Sinn's Paradox. Even when acknowledging that the theory attempts to capture unforeseen consequences of climate mitigation designs (Svenn et al., 2015), the lack of nuanced treatment of marginal events and multi-agent dynamics reveals its philosophical and practical limitations.

So, there is an understanding among scholars that Sinn's Paradox is controversial and poorly reflects facts on climate risks viz., causation, CO_2 emissions, global warming, etc., (Svenn et al., 2015; Bauer et al., 2018). For instance, if we are resolute that CO_2 and GHG emissions affect global climate space, then the Paradox's mitigation design will be difficult to apply when the effects of a climate risk are uncertain. Indeed, as Svenn, Mohlin, Pittel and Sterner's work (2015) remind us, the Paradox itself rests upon a fragile terrain of evidence as well as less a bedrock of certainty that a shifting ground where strategy, perception, and projection blur. What Sinn so narrated as necessity may, in truth, be little more than a spectral inevitability, conjured from tenuous empirical traces.

Perhaps the flaws in the Paradox are less a matter of inadequate empirical evidence, as Svenn and colleagues (2015) suggested, and more a practical reflection of Sinn's underlying economic commitments. However, I envision that examining these commitments is instructive for understanding the normative dimensions of mitigation theories and designs.

Also, by attending to the ethical and existential stakes embedded in Sinn's Paradox, we can see how assumptions about human agency, responsibility, and rationality shape both his corresponding design and the probable effectiveness of his climate mitigation design. This perspective, in particular, explains why climate mitigation efforts often struggle in the Global South where structural limitations interact with the lived experiences and agency of communities. These communities must navigate existential pressures, scarce resources, and the moral imperatives of acting responsibly within a globally interconnected system.

Moreover, the Paradox collapses once we recognise that its narrow fixation on demand-side ignores wider agential forces; event Y may well arise from natural variability, not from the mechanistic logic Sinn insists upon. Thus, Paradox, I contend, rests on a forced and artificial inference. For while Sinn assumes a forward-directed path (event X precedes that of Y), an alternative, backward-directed path (event Y precedes that of X). Put differently, the emergence of greener policies is typically a response to already manifest climate risks, and the anticipation of human-triggered change.

Further, to explain why Sinn's account of the causation of global warming falls short of inferential adequacy, I drew upon five distinct sources of insight, each offering both conceptual clarification and empirical grounding. First, I premised the events in the Paradox on the conditions of causality in a sense that, a cause (i) 'temporally precedes its effect'; (ii) is 'contiguous to its effect'; and (iii) an entity related to a particular cause is in a "like relation" to its effect. The conditions are proposed to support the idea that the Paradox fails the inferential path that should occur for it to exist. The use of conditions, for instance, is because of the idea of 'constant conjunction' which exemplifies Sinn's description of the regularity of the event causing global warming.

Second, in turning to the meditation of Sologo (1998) on causality, I sought a ground upon which the Paradox might steady its inferential claim. Yet the path proved elusive. For within the African horizon, where causality unfolds as linear succession and a layered interplay of primary and secondary forces (Sogolo, 1998), the Paradox finds no home as well. Its inferential rhythm stumbles, unable to attune itself to this relational cadence. What it offers as necessity dissolves instead into an echo without resonance, a gesture unanchored.

Third, I used the insight from Nico Bauer, Christophe Mcglade, Jérôme and Paul Ekins (2018) that in the horizon of anticipated climate resolve, divestment emerges as the more enduring path, tempering the restless logic of the Green Paradox. They argued that climate actions that impede natural resource legacies and production volumes condition the behaviour of resource owners (Bauer et al., 2018). In a sense, I concluded that resource owners' behaviour, to continue extracting or not to extract, depends on their understanding of climate mitigation models and their impacts. This, in turn, may lead the owners to diversify, depending on their exposure to mitigation and transition impacts, opportunities, and risks. Therefore, while the Paradox is thinkable, it is less significant compared to other options like the divestment effect (Bauer et al., 2018).

The fourth insight I relied on comes from Robert Cairns' (2014) work on the economics of exhaustible resources. His work points out that reasoning behind the Paradox is directly derived from the Hotelling rule[8] on the economics of non-renewable resources (Cairns, 2014), which is built on the wrong idea that production could be suspended and rearranged temporally by the producer at will (Cairns, 2014). Here, it can be assumed that for Cairns we simply cannot trust Sinn's Paradox because it is an ineffective theory in the climate change space. Sinn's reliance on a defective rule to construct his theory *de facto* questions the relevance of his theory to be used to design a mitigation framework to regulate anthropic usage of resources.

In furtherance, and as my fifth insight, I explored Joachim Funke's (2012) theory of '*komplexes Problemlösen*'[9] to explain whether what Sinn claimed as a complex problem to be solved is considerably true. Funke's theory postulated that reliable qualities of a complex problem-solving situation are demonstrable by the (i) complexity of the situation based on the sum of variables involved, (ii) a 'connectivity and mutual dependencies' of the variables, (iii) 'dynamics of the situation' given the time-based and evolutions of the system (iv) 'intransparency (in part or full)' of the variables and their present worth of the variables; and (v) 'polytely'[10], goal conflicts on multilevel analysis (Funke, 2012).

Given Funke's classification, I was left with the questions: (i) does Sinn's theory represent a complex problem like a climate risk, global warming? and (ii) is the corresponding

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[8] The rule expresses the temporal tension in resource use. That is, whether to exhaust a resource now or preserve it as future value. In equilibrium, the net price mirrors the rate of interest, embodying the logic by which time and scarcity dictate extraction.

[9] When I reflect on *komplexes problemlösen* (complex problem solving), I cannot see it only as a theory from German psychology, though that is where it began with Dietrich Dörner. At its core, the concept describes how humans confront problems that are dynamic, interconnected, and uncertain situations where no single variable can be isolated, and outcomes shift as we act. To me, however, it speaks more deeply as a philosophy of the human condition in complexity. It reminds me that my knowing is always partial and incomplete (epistemology); that my actions unfold in a world of flux, emergence, and unpredictability (ontology); that every choice I make carries consequences, both intended and unforeseen (ethics); and that to live at all is to inhabit uncertainty and vulnerability (existential).

[10] Polytely, from the Greek poly- ("many") and -*tel*- ("goal"), designates problem-solving situations where several goals coexist in tension, often conflicting, and thus compel a reflective ordering of priorities.

mitigation design capable of solving the problem? The questions are juxtaposed with emerging climate risks and new existential risks and effects as many variables interact. In my view, Sinn struggled to define a complex interactive system of existential risks and climate change understood through an intersection of interactive agents and polycrises facing the world which, as Le Treut et al., (2007) claimed, "[…] cannot be explained by natural factors alone […]. A substantial anthropogenic influence is required to best explain the observed changes" (p. 103).

Therefore, drawing on the basic conditions of causal inference, Sogolo's meditation on causality, Bauer et al.'s account of divestment, Cairns' economics of exhaustible resources, and Funke's theory, I advanced the argument that Sinn fails to exclude the prospects of (i) immediate and backwards-in-time causation, and (ii) the role of agential entities in the risks arising from climate change.

Moreover, Bauer et al.'s (2018) claim reveals an epistemic nuance within the Paradox and an ontological instability that event Y (the acceleration of global warming) is not the inevitable outcome of resource depletion, as Sinn suggest, but rather the contingent effect of the anticipatory imaginaries resource owners inhabit. In this sense, the so-called inevitability of the Paradox collapses under philosophical scrutiny, for what is at stake is not an objective law of resource economics but the mutable circulation of belief, foresight, and risk-perception within an existential field. To insist, as Sinn does, on a determinist causality between declining demand and accelerated extraction is to ignore the constitutive role of human agents as interpretive beings whose decisions are mediated by uncertainty, intersubjective exchange, and existential contestation. Simply, the Paradox is not an iron law but a fragile narrative whose plausibility rests upon a narrow economistic ontology blind to the epistemic plurality through which climate futures are actually imagined and enacted. Sinn, thus, fails to recognise these internal inconsistencies of the Paradox, and would not withstand Funke's theory, since it neglects the complex, adaptive, and problem-solving dimensions of human and institutional agency in climate-related decision-making.[11]

Overall, my work showed that once agential entities are acknowledged, the predictive accuracy required for solving the complex problem of climate risks substantially undermines Sinn's mitigation design. While predictive accuracy in mitigation design can often be enhanced by incorporating more data over time, Sinn's design remains ill-suited to the shifting dynamics of everyday climate risks. As I argued through the valuation of mitigation designs and their relation to the regulation of anthropic actions, Sinn's Paradox is inadequate and structurally incapable of capturing climate risks. Sinn treats agents as mere calculators of demand signals, and stripped them of their adaptive, interpretive, and problem-solving capacities. Yet it is precisely these capacities, shaped by uncertainty, reflexivity, and contestation, that make climate decision-making irreducible, plural, and dynamic. The Paradox, thus, reveals itself less as a rigorous account of climate matters than as a reductive fiction, a closed system incapable of accommodating the fluid, adaptive ontologies of agents who continually remake the conditions of action in the very attempt to anticipate them.

In view of the foregoing, I turned to the normative dimensions of the Paradox. To this end, I drew on the works of Thaddeus Metz and Martin Odei Ajei. Metz (2022), for instance, argues that African morality, grounded in communality, shapes how agents interact with nature-based proficiencies, while Ajei (2022) advances the thesis that African normative evaluations can help reconcile the apparent tension economic growth and environmental protection, a core dilemma of climate risks mitigation and sustainability.

[11] Sinn's version of the Green Paradox overlooks its own contradictions and does not hold up against Funke's theory. By focusing too narrowly on demand signals, it leaves out the ways people and institutions adapt, solve problems, and make decisions under uncertainty. In this sense, the Paradox is too simplistic to capture how climate action actually works in practice.

Both are instructive precisely because they underscore the mediating effects of contexts in ethical and existential evaluation. My claim, then, is that if we take seriously the ethical epistemologies of non-Western traditions, particularly African communitarianism, we can begin to reimagine the design of climate mitigation beyond Sinn's Paradox and corresponding design. By silencing the need for context-sensitive normative reasoning, Sinn locks himself into reproducing the very trajectory he critiques, that is, an unchecked escalation of fossil fuel production and the parallel rise of CO_2 and other GHG emissions. To sidestep that trajectory, an alternative imagination rooted in diverse ethical epistemologies is indispensable.

I acknowledge that the concept of agential entities is not without definitional challenges, owing to its philosophical distinctions, implications, and real-world applications. To confront these challenges, I first drew on Soran Reader's philosophical text (2007). Reader advances a capacious vision of agency that includes the familiar humanist dimensions of action, capacity, choice, and independence, but also insists upon the so-called non-agential modalities of patiency, incapability, necessity, and dependency. This broadened framework enabled me to argue that agency cannot be limited to classic human persons but must extend to organisations and other entities whose ethical liability surfaces precisely through their apparent non-agentiality.

A second resource was James Dempsey's (2013) work on corporate agency, which develops the notion of organisations as "morally significant system[s]" (p. 344). Dempsey's thesis provided conceptual grounds to treat non-agential organisations as composites of agential entities, thereby complicating the moral architecture of responsibility in contexts such as climate governance.

To this, I added Uchenna Okeja's (2022) account of deliberative agency, which offers an African perspective on agential performance in public discourse. Okeja's work proved crucial for thinking about how climate mitigation design ought to look in the future, particularly in relation to resource and power asymmetries within the climate-risk space. Taken together, Reader, Dempsey, and Okeja furnish a strong philosophical rationale for re-examining the normative dimensions of Sinn's Paradox, while simultaneously opening space to recognise nonhuman agential entities including AI-technological systems and Non-State Actors as indispensable to climate matters.

On this point, I found inspiration in van Wynsberghe and Donhauser (2018), who rethink the role of robots and autonomous systems in everyday climate realities. Their thesis presses us to take seriously the ethical and practical salience of environmental robots and AI systems as agents whose autonomous, self-learning capacities increasingly converge with human agency. The implication is clear: any credible climate mitigation framework must incorporate these entities if it is to capture the full spectrum of climate risk. Failure to do so, as Sinn's design demonstrates, risks blindness to the 'unknown risks' generated by the growing autonomy and unpredictability of intelligent systems within climate-variation landscapes.

These considerations underscore the need for forecasting tools that can accommodate extreme and confounding variables lying outside the linear schema of events X and Y in Sinn's Paradox. For this reason, I turned to Agent-Based Modelling (ABM), "a relatively new approach to modelling complex systems composed of interacting, autonomous agents" (Macal & North, 2010, p. 151). ABM provides a methodological apparatus for studying complex, adaptive systems and for simulating how diverse agents interact across environments (Macal & North 2010; Bonabeau 2002). Thus, with the ABM, I analysed the effects of confounding variables that could give rise to climate risks. I grounded the analysis on the three elements of ABM: (i) *agents* (attributes and behaviours), (ii) *relationships* (and methods of interaction), and (iii) *environments* (interaction within context) (Macal & North, 2010; Bonabeau, 2002).

My engagement with ABM was stimulated by Castro et al.'s (2019) review of 61 studies applying ABM to climate-energy policies, which concluded that ABM offers relevance, reliability, and granularity for climate policy precisely because it incorporates agent diversity. On this basis, I argue that ABM is an analytical tool and also a philosophical resource, one that substantiates the claim that future mitigation designs must be oriented around the dynamics of agency. Climate risk is not a static variable but a product of a symphony of interacting agents, whose entangled actions shape both local and global landscapes. Acknowledging this multi-agential complexity is therefore essential if mitigation design is to be both effective and future-facing.

1.7 Assumptions, Limitations and Scope of Study

Throughout this work, I assumed that, first, global warming is an example and part of the change in climate which, according to Lehrer (2022), could be an outcome of "human activity [which] likely poses the biggest environmental risk modern society faces. Its impact could be global, its long-term costs are likely to exceed those of any other environmental challenge, and its effects probably cannot be entirely averted, regardless of the choices we make" (para. 1).

Second, inferentiality is used synonymously with causality. Thus, causality is seen as a spatiotemporal contiguity, and that an event is usually followed by another event (Abadie, 2005; Sogolo, 1998). This preceding understanding of inferentiality viz., causality, spatiotemporality, antecedence, regularity, etc., turns out to be key to the claim in the Paradox as earlier discussed, and which is further discussed, in my work.

Third, it is also assumed that the overall trajectory in considering the "cause" of the observed climate risk (that is, global warming as Sinn claimed) is uncertain. By extension, we do not know exactly what is causing climate risk, but we can all concur that the earth is increasingly becoming hotter and anthropic actions contribute to risks of the earth becoming warm because of the CO_2 and GHG emissions into the atmosphere (Lehrer, 2022; OECD, 2008; United Nations, Climate Change, 2021).

Concerning limitations, the focus of my work is philosophical-ethical, which means the methodology employed is exclusively qualitative. As such, experimental methods, typically central to the scientific analysis of the changes in climate and AI-technological systems, are not directly applicable here. However, this limitation does not undermine the value of the inquiry. On the contrary, a philosophical-ethical approach is indispensable for clarifying conceptual frameworks, interrogating ethical assumptions, and exposing the normative underpinnings of climate theories and mitigation designs like Sinn's. These dimensions cannot be captured by experimentation alone, yet they are crucial for understanding how mitigation designs are framed, justified, and applied in real-world contexts.

More so, my work acknowledges the vast body of scholarship in climate change science, including research on climate risks, mitigation designs, tipping points, and sustainability, among others. However, rather than reproducing these scientific accounts, I situate my work as complementary. I interrogate the normative, conceptual, and ethical underpinnings of how such scientific knowledge is interpreted, deployed, and acted upon. In doing so, I underscore that while scientific models and data are indispensable in forecasting and quantifying risks, they cannot by themselves resolve the ethical dilemmas, agential responsibilities, and philosophical inconsistencies that arise in the governance of climate risks. Thus, my philosophical approach adopted here fills a critical gap and provides the reflective depth necessary for assessing the limits of prevailing mitigation designs such as Sinn's Paradox. Focusing on the Paradox inevitably limited the broader considerations and recommendations I originally envisioned; however, Sinn's theory was deliberately selected because of its philosophical-ethical imports regarding the events embedded in the Paradox and the way it grounds its corresponding mitigation design in view of regulating anthropic actions.

Also, while I take climate risks such as global warming to be transnational in scope, the framing of my analysis is necessarily shaped by the asymmetries of culture, technology, and the uneven reception of climate science across contexts. In my own engagement with sub-Saharan Africa, I find that sustainability agendas often remain constrained when set against the comparatively ambitious trajectories of Western nations, particularly regarding the integration of AI-technological systems into green energy transitions and the reduction of CO_2 and GHG emissions. These differences, however, are material disparities. They point toward philosophical concerns of agency, since the very possibility of speaking of nonhuman agential entities such as AI-technological systems remains tied to the technological privileges of particular contexts. And here lies a limitation of my studies: that the horizons of agency of AI-technological systems I describe are not universally accessible but conditioned by unequal structures of technology and recognition.

Moreover, I quickly realised that working with agential considerations (Reader, 2007; Dempsey, 2013; Okeja, 2022) comes with its own epistemic and methodological challenges. These challenges were not surprising to me, since my interest has always been to explore less typical and often overlooked contexts of agency, including both human and nonhuman agents. In fact, I came to see these odds as part of the very task I had set for myself. To stay focused, I chose to frame the work as a philosophical study of agential entities, making use of elements from agent-based modelling (ABM) to guide my reflections. This choice, though limiting in scope, allowed me to think more deeply about how agency is shaped, shared, and understood, without losing sight of the complexities that first drew me into the study.

My work primarily investigated the Paradox from its inferential and predictive accuracy grounded on philosophical considerations. The Paradox was conceptualised with an economic context in mind, and this will make the philosophical context relatively new, if not completely different. It goes without saying though that Sinn made some philosophical assumptions in his assertions on intergenerational relations, global governance of natural resources, the attributed power to the UN to regulate extractive regimes, etc. (Sinn, 2012).

However, given the intersection of what the Paradox seeks to describe, and what its corresponding design seeks to resolve, it is clear that analysing the Paradox from a philosophical lens is a germane enterprise and represents an important line of future research. Specifically, my work is a philosophical reflection on the inadequacy of the Paradox as a theory and basis of designing a corresponding mitigation model when considered alongside the interpretation of risks due to the changes we see and understand about the climate vis-à-vis the effects of contextual and existential needs of development, economic growth, infrastructure, the commons, etc.

1.8 Definition of Terms

My work covers some critical terms and constructs. And though the terms and constructs are examined in detail in ensuing chapters, they are briefly presented in this section as a prelude to their application in subsequent chapters.

My work understands that exact definitions of some terms will be a subject of philosophical debate. However, in view of the subject matter, the definitions of concepts and terms are reduced to the perspectives of particular authors that have attempted to define the concepts in the literature.

The following concepts require definition at this stage:

1.8.1 Green Paradox

Hans-Werner Sinn's Green Paradox[12] makes a stimulating claim about the unintended consequences of certain climate mitigation designs. Sinn (2012) observed that many designs

[12] First presented in his 2008 book *Das Grüne Paradoxon* and later in its English edition in 2012.

aimed at reducing carbon emissions such as announcing future caps, taxes, or restrictions on fossil fuel use are designed with the long-term in mind. However, these advance signals can influence the behaviour of fossil fuel owners in the present.

The Paradox explores how CO_2 and other greenhouse gas emissions contribute to global warming and informs supply-side interventions, such as CO_2 taxes, aimed at curbing emissions. Hans-Werner Sinn (2012) famously notes that “the mere announcement of intentions to fight global warming made the world warm even faster” (p. 189). This formulation captures a paradoxical effect: policies intended to reduce fossil fuel use may inadvertently accelerate emissions if resource owners anticipate future restrictions and adjust their behaviour accordingly. By foregrounding the role of expectation, Sinn highlights how anticipatory actions can reshape present behaviour, while simultaneously raising questions about agency and the structural limitations inherent in mitigation designs.

At its core, the Paradox asserts a simple yet profound dynamic in a sense that when owners of finite resources perceive that forthcoming climate policies will reduce the future value of their assets, such as coal, oil, or gas, they are incentivised to accelerate extraction and sale (Österle, 2012; Schneider, 2022). This rush increases emissions in the short term, undermining the very mitigation strategies meant to curb them (Van der Ploeg & Withagen, 2015). Sinn frames this as a theoretical insight and an empirical claim (Österle, 2012). If historical behaviour in global resource markets reflects this anticipatory acceleration, then supply-side interventions, such as extraction taxes, coordinated international agreements, or incentives for carbon capture, are warranted. Importantly, these prescriptive measures depend on the validity of the descriptive claim: the Paradox describes the empirical reality, whereas the corresponding mitigation design constitutes a strategic response.

Philosophically, the Paradox offers a window into the nature of agency under systemic constraints. Even actions guided by reason and moral intention are embedded within feedback loops where anticipation alone can produce significant consequences. A single agent's forward-looking choices can generate cascading effects, illustrating what might be termed "moral luck," where the ethical significance of an action is revealed only through its unforeseen consequences. In this sense, the Paradox transcends economic analysis: it reflects the temporal and normative complexities of decision-making in a world where expectation, action, and responsibility are deeply entangled.

1.8.2 Agential Entities

The construct and the use of the meaning and figuration of agential entities or agentiality are implied and applied in the sense that "agency is virtually everywhere. Whenever entities enter into causal relationships, they can be said to act on each other and interact with each other, bringing about changes in each other. In this very broad sense, it is possible to identify agents and agency […] virtually everywhere" (Schlosser, 2019, para. 1). The understanding is further discussed in chapter four (4) of the work.

However, my focus on agential entities is an antithesis to what I recognised in Sinn's Paradox: preoccupation of single agency in the acceleration of climate risk. This understanding of agential entities is in relation to the countless variables that could account for the acceleration of climate risk which contrary to Sinn is caused by a single agency. To this end, in implying and applying agential entities, I assumed that which has the capacity to contribute CO_2 and GHG emissions just because of its presence in the physical world.[13]

[13] This understanding is inspired by the thinking that climate variability is already reshaping both human and non-human ecosystems, influencing community life, lifeforms, and planetary goods (Schneider, 2022; van der Ploeg, 2015). Hence, any mitigation design seeking to reduce dependence on carbon-intensive resources (Sörlin & Lane, 2018) and slow depletion of non-renewables (van der Ploeg & Withagen, 2015) must let their theories arise from empirical realities. Every climate mitigation design is therefore a fusion of descriptive science and normative aspiration, attempting to bridge what is with what ought to be. Yet this bridge is vulnerable to collapse if a design ignores the adaptive behaviours of those whose livelihoods depend on the very activities being curtailed. Ultimately, Sinn's Paradox and corresponding mitigation design force us to confront a shared truth: climate action is not only about what we do, but also about what we signal and when. To act effectively is to anticipate the anticipators and to design mitigation plans that pre-empt the rush to extract or exploit in the shadow of future regulation. This is not simply a practical challenge but an ethical one, demanding that we align the temporal

Thus, my focus on nonhuman agential entities stems from the assumption that there are other entities in the climate change space that have the capacity to contribute CO_2 and GHG emissions because they exist, actively and/or passively, in our physical world. Here, the understanding includes the representation of human, nonhuman, NSAs, and AI-technological systems (Reader, 2007; Dempsey, 2013; Wynsberghe & Donhauser, 2018; Okeja, 2022). In other words, the context within which the term agential entities is used and discussed is philosophically understood as that which could act and/or react.

1.8.3 Climate Risk

Climate risk represents a new type of existential risk given the presence of changeability and the feature of non-linearity of climate scenarios. This is what the study would refer to as climate risk. I, therefore, considered the concept, climate risk, in the sense of endogenous and exogenous sources that do not happen in isolation but are compounded in a way that it could impact the degree of exposure and vulnerability to the changes in climate.

The above understanding is premised on Sven Ove Hansson's view of risk. According to him, the term "risk" refers to conditions where there is a possibility but doubt that a desirable event may ensue (Hansson, 2004). However, in theoretical consideration, the term underscores the senses that *that* which might happen is undesirable and, thus, there is (i) a likelihood for *that* which is undesirable to happen; (ii) a probable cost of *that* which is undesirable to happen; and (iii) when a conclusion is to be made under the conditions of identified prospects of *that* which is undesirable might happen (Hansson, 2004, p. 10).

Given the above, these features of risks pose challenges for epistemic and ethical analyses, especially when the conceptual senses of risk represent philosophical issues of knowledge and uncertainty. Hence, it is asserted that given the complexity of climate risk,

horizons of human action with the long rhythms of planetary survival. Only then can the arc of climate policy bend toward genuine, not illusory, preservation.

existing theories like the Paradox and its mitigation model are unable to capture the agential entities in view of emerging climate substantial, transition and imaginary risks. For instance, we do not know how we will counter the surges in CO_2 emissions when its intensity reaches the tipping point or goes above certain points, especially when future risks could be much greater than expected because "predicting the future rate of warming on the basis of models has proven difficult" (Lehrer, 2022, para. 7).

1.9 Study Methodology and Chapter Details

To meet the overall objective of the thesis, I applied a philosophical approach to studying the Paradox and the ABM. More specifically, in my bid to shed light on the inferential and predictive accuracy of the Paradox as (i) a climate change theory and (ii) basis for climate risk mitigation model, I pulled from wider works in philosophy, climate change science, scientific works, policy frameworks and my own experience of real-life climate scenarios to analyse Sinn's theory.

My work is primarily desk research, and qualitative. Precisely, Content Analysis (CA) is employed within the scope of conceptual and relational analyses (Kolbe & Burnett, 1991; Leedy & Ormrod, 2013). Given the interpretive and naturalistic style inherent in CA (Leedy & Ormrod, 2013), new and critical issues are introduced and analysed.

To achieve the aforesaid objectives, first, I included concepts such as inferential, predictive accuracy, agential entities, risk, sustainability, etc., that have been theorised and advanced by scholars and policy makers. It is aimed at getting conceptual insight in what the Paradox is and what it entails. Defining such concepts comes with some challenges since they received different meanings and have been used in different ways over time. Thus, with the CA, I was able to review the relevant academic literature and related concepts in an attempt to have "[…] a detailed and systematic examination of the contents […] for the purpose of identifying patterns, themes, or biases" (Leedy & Ormrod, 2013, p. 155).

For instance, with the CA, I studied multiple agents (Reader, 2007; Dempsey, 2013; Okeja, 2022), complex decision-making processes, and the multiple activities (Edwards, 1954; Slovic et al., 1987) within the interactive system of climate risks (Convery & Wagner, 2015; Sörlin & Lane, 2018). In the end, the aim of the conceptual analysis is to get better insight into whether Sinn's theory of the Paradox is a matter of fact or rather a hypothetical construct which needs to be pursued in developing climate risks mitigation, or rather needs to be conceived as an obscured instigating factor of climate risks.

Second, I argued for broadening the scope of climate change theories beyond their current confinement to political and geo-economic forecasts, given the limited inferential and predictive reliability in Sinn's work and the marginalisation of voices from minority and Global South communities. I maintained that ethical reflection is unavoidable, as climate risk engages epistemic agents whose judgments and actions shape policy outcomes and the moral stakes of mitigation and adaptation.

Moreover, I argued that the conditions on which the Paradox have been constructed, induced the quest for broadening ethical scrutiny of climate risk mitigation. This is because the Paradox serves as a basis for Sinn's economic-supply-side climate risk mitigation, which has a range of ethical implications such as responsibility, autonomy, justice, etc., for both human and nonhuman agents.

Also, the predictive accuracy of the corresponding design of the Paradox may have an effect on how human agents would have to predict future climate risks such as famine, insecurity, climate refugees, pollutants, nuclear waste impacts, etc.

The idea of predictive accuracy of the Paradox's corresponding design exposes a fundamental tension, that is, human beings are driven to anticipate climate risks such as famine, insecurity, displacement, pollution, and the lasting effects of nuclear waste, yet their foresight is always constrained by the limits of imagination and knowledge. In a way, in attempting to predict the future, they encounter the wit that prediction itself both illuminates and obscures, granting glimpses of what may come while entangling them in the very uncertainty they seek to overcome.

Third, to develop an alternative paradigm in guiding the ethical reasoning in future framing of climate risks mitigation, I argued that localisation of mitigation designs offers a higher predictive accuracy to complex problems concerning climate risks. Hence, I framed my argument with the aim of expanding the frontiers of theories and mitigation designs to meet current and emerging climate risks. The objective is to find applicable moral elements in nonhuman responsibility in climate risk mitigations regarding AI-generated content and technology in resource industry and production (Cairns, 2014; Galaz et al., 20210), especially when nonhuman systems could be categorised as "morally significant systems" (Dempsey, 2013, p. 344). Here, I believe the application of CA will be a useful approach to apply philosophical analysis to concrete ethical nuances of decision making in climate risks. In all, CA would be helpful in engaging Funke's theory of complex problems solving.

My work is divided into five chapters. In considering Chapter one (1), as seen so far, I largely introduced the subject matter, offering an overview of the main themes, line of reasoning and the main contributions of the thesis.

Key words are subsequently used again in Chapter two (2). Chapter 2 captures major findings in the literature reviews and perspectives that cite the most current findings on the conceptual analysis of the Paradox based on the philosophical foundation of the inferential and predictive accuracy of the Paradox as a theory and basis for its corresponding mitigation design. Here, my work is geared towards giving a summary of unresolved issues, conflicting findings, and issues by reviewing the Paradox as a concept and a construct. The chapter examined the validity and reliability of the Paradox in our everyday experience of climate risks.

Chapter three (3) provided an overview discussion about the normative nuisances of the Paradox as well as the epistemic relevance of it. It is argued that the Paradox and its corresponding mitigation design do not meet the standard of agentive nature of climate risks, which gives rise to having expansive thinking on considering other ethical epistemologies in evaluating mitigation models, 'the commons' (natural resources), and sustainability.

In Chapter four (4), I introduced the Agent-Based Modelling (ABM). The chapter discussed the philosophical underpinnings of agential entities in the light of the works of Reader's 'other side of agency' and Dempsey's 'nonhuman agency and responsibility'. The chapter further reviewed the theoretical and applied contributions of the ABM as well as identifying ABM's constraints and prospects for climate risk mitigation designs. This will fall within the applied ethics preoccupation in my work – figuring out ways to ethically rethink the contribution and collaboration aspects of nonhuman agential entities like AI-technological systems in climate change and risks.

Chapter five (5) pointed out some orientations in developing future mitigation models. The intent of this chapter is to recast how future climate risk theories and mitigation designs should look like.[14] It does that by rethinking the possibility of looking at mediating effects of contexts, and the presence of agential entities in climate scenarios, at least, to consider localisation, hybridity and agential intersections in the design of future mitigation models. To support the orientations, the chapter also discussed two philosophical issues namely, eclectic paradigm and principle of sufficientarianism.

[14] Here, I argued that future climate risk theories and mitigation designs must move beyond narrow political and economic forecasts to account for anticipatory human and nonhuman agency, systemic feedback, and the practical consequences of policy. I contended that ethical reflection, justice, and the perspectives of historically marginalised communities are essential to ensure that mitigation efforts do not unintentionally worsen climate risks.

CHAPTER TWO

ANALYSIS ON THE INFERENTIAL AND PREDICTIVE ACCURACY

2.0 Introduction

Hans-Werner Sinn presents the Green Paradox as a way to understand why our planet is warming (Sinn, 2012; Fölster & Nyström, 2010), how the global energy system might be reshaped (Sinn, 2012), and how extractive industries and resource cartels accelerate climate change (Sinn, 2009; van der Ploeg, 2015). He traces carbon from extraction to emission, showing how supply chains, whether oil, gas, coal, or minerals, contribute to every atom of CO2 in the atmosphere (Jensen et al., 2015; van der Ploeg, 2015). To counter this Paradox, Sinn envisions a concentrated 'power' capable of enforcing a supply-side mitigation design, frustrating resource owners so that more carbon remains underground (Sinn, 2009, 2012; Bauer et al., 2018; Cairns, 2014).

In this chapter, I interrogate the philosophical claims and practical implications of the Paradox and its mitigation design. [15] I examine its assumptions, the inferential logic it relies upon, and the predictive accuracy of its proposed design. My aim is to illuminate where Sinn's thesis captures the dynamics of climate risk and where it falls short.

While the Paradox challenges conventional demand-side thinking,[16] it is conceptually and contextually narrow. By focusing on a single epistemic agent, the resource owner, and on

[15] The first limitation of the Paradox lies in its inability to fully explain how global warming, a climate risk as a causal effect, could be triggered by the anticipatory action of a single epistemic agent. The second limitation concerns the Paradox's mitigation design, which lacks empirical grounding in the diverse experiences and observable variabilities across different contexts. Conceptually and practically, therefore, both the Paradox and its proposed mitigation measures are insufficient for addressing the agential dimensions of climate risk, as well as the complex, interconnected situations that arise from climate change.

[16] This is a traditional mitigation design and still seems to be dominant among scholars and policy elites. The designs consist of "strategies targeting technology choices, consumption, behaviour, lifestyles, coupled production-consumption infrastructures and systems, service provision and associate socio-technical transitions" (Creutzig et al., 2018, p. 260). It is designed to seek the "patterns of demand for energy, mobility, food and shelter, and the associated greenhouse gas (GHG) emissions" (Creutzig et al., 2018, p. 260).

strategies to frustrate them, Sinn overlooks the multiplicity of human and nonhuman agents, their diverse experiences, and the complex, often unpredictable ways climate risks unfold. These gaps are practical; they speak to richer questions of agency, responsibility, and the lived realities of vulnerability. In both conceptual and practical terms, the Paradox risks being elegant in theory yet detached from the multifaceted world it seeks to influence.

Building on this critique, this chapter seeks to rethink climate mitigation designs through a philosophical and ethical lens. By foregrounding multiagent interactions and the roles of human and nonhuman agents, I aim to propose approaches that are analytically rigorous, ethically grounded, and responsive to the lived realities of climate risk.

2.1 The Green Paradox: A Description

As it will be indicated, variability in the climate is presently affecting both human and non-human ecosystems, personal and community lives, lifeforms, planetary goods, etc. Seemingly, what matters for climate scientists, scholars and policymakers is the impact of climate related risks viz., global CO_2 and GHG emissions (Schneider, 2022; van der Ploeg, 2015).

Seemingly, existing climate mitigation designs have been framed to reduce the dependence, if not overdependence, on products and/or by-products from natural resources and related GHGs (Sörlin & Lane, 2018). It is also the fact that existing climate mitigation designs are aimed at counteracting, if not reducing, the speeding up of extraction and consumption level of nonrenewable resources (Van der Ploeg & Withagen, 2015). Accordingly, existing mitigation designs ordinarily include guidelines to expand the performance and regulate anthropic actions.

Nevertheless, I observed that climate mitigation designs are often based on theories. These theories, in turn, are propounded based on what is happening in the physical world. Such happenings are often explainable facts. The basic assumption here is that every climate mitigation design presupposes a theory based on examination of the drivers and description of existential conditions as well as considering key agents and their interactions in the climate change space.

Correspondingly, the supply-side mitigation design as Sinn prescribed is as a result of the theory, the Green Paradox (Sinn, 2012; van der Ploeg, 2015). The Paradox emerges from finding appropriate design to mitigate the risks of climate variability (Jensen et al. 2015; Fölster & Nyström 2010).[17] The theory creates enormous concerns when we further consider unknown risks presented by emerging AI and climate 'intelligent' technologies within the scope of the unintended and unknown risks of climate change and risks (Bostrom, 2002; Torres, 2016). In this sense, the Paradox is both a theory and a warning. And though popularised among economic theorists because it crystallises a pressing reality: supply-side reactions can cause environmental policy to backfire (Jensen et al., 2015); and though often presented as a theoretical possibility, it carries immediate practical and empirical weight, especially as emerging climate-intelligent AI technologies may replicate similar unintended feedback effects, where optimisation in one domain triggers adverse outcomes in another (Bostrom, 2002; Torres, 2016). Practically considered, therefore, the Paradox, if, and only if, it is true, extends beyond fossil fuel economics into the broader governance challenge of emergent systems whose behaviour is shaped as much by our projected futures as by our present constraints.

By way of definition, the Paradox postulates that a "mere announcement of intentions to fight global warming made the world warm even faster" (Sinn, 2012, p. 189). In a self-

[17] The Green Paradox captures a counterintuitive and troubling dynamic, which is that climate policies intended to curb fossil fuel use may, paradoxically, accelerate global warming. Rooted in supply-side economics, it illustrates how expectations about the future can reshape present behaviour in ways that undermine the very objectives of environmental governance. The concept is often situated within the logic of a direct CO_2-tax regime, intended to compel major emitters, so-called climate sinners, to reduce emissions.

contradictory way, a design aimed at mitigating a climate risk essentially causes climate risk (Österle, 2012; Schneider, 2022). In other words, the acceleration of the climate risk is potentially initiated by an act of a single agent, resource owner, without which the Paradox does not occur. The probabilistic postulation of the single agent here has a significant impact, especially on the announcement of the greener policy.

As said earlier, I consider Sinn's definition as a foundational construct of the Paradox and model for the current trend of the theory (Österle, 2012; van der Ploeg, 2015). In the past decade, however, the theory has become a topical subject in the climate change and risk space. For instance, Bauer et al. (2018) and Österle (2012) asserted that the Paradox historically is popular among economic theorists and addresses the pressing behavioural and resource management challenges for the global community. Also, we can talk about the definition of Jensen, Mohline, Pittel, and Sterner (2015) which underscores the idea that the Paradox happens when a climate design "backfires and the environmental problem worsens. The culprit here is the reaction on the supply side of the fossil fuel market" (p. 246). Moreover, it has been argued that the Paradox is fundamentally a theoretical possibility but, at the same time, incites practical and empirical implications (van der Ploeg, 2015; Jensen et al., p. 2015). This has appreciably increased the appeal of the Paradox to be considered as climate theory and the bases for a climate mitigation design (Fölster & Nyström, 2010).

For our purposes, and given the large corpus of knowledge on climate change science, we may ask: what does it mean when the Paradox is implicated in the larger corpus of the consequential risks of the changes in climate? Further, when the theory is applied differently, what does Sinn mean when he claims that these two events: (i) the event of 'greener policy' and (ii) the event of 'acceleration of a climate risk', must occur to bring about the Paradox.

Considering the above question, it is imperative for us to appreciate the conceptual nuances of the Paradox. As Bauer et al. (2018) posited, it is greatly idealised, though it intersects with climate, human cultures, and ecosystems. Bauer and colleagues' (2018) position is further justified in Sinn's own assertion that his views on climate risk and mitigation design intensely integrate analysis and findings across the natural, ecological, economic, and socio-political sciences (Sinn, 2012). By extension, we cannot ignore the conceptual implication of it regarding Sinn's knowledge-claim on environmental goods, CO_2 emissions, and mitigation dynamics, power asymmetry and 'single agent problem' in climate risk mitigation.

The Paradox is conceptually straightforward. Policy announcements such as the phasing-out of petrol vehicles, bans on new coal plants, or renewable energy subsidies signal to fossil fuel producers that their reserves will lose value. Anticipating this, some accelerate extraction, converting expected future scarcity into present-day abundance. This front-loading of production forces more CO_2 into the atmosphere sooner, and, because fossil fuel markets are globally integrated, the surplus finds buyers elsewhere. Local demand may fall, but global consumption persists, eroding or even reversing gains.

2.1.1 Why the Green Paradox? Assumptions, Agents Dynamics and Practical Relevance

Seemingly, Sinn's ambition to fill a gap in demand-side design (Sinn, 2012; van der Ploeg, 2015) birthed the conceptualisation of the Paradox. Sinn argues that, although prevailing mitigation designs are intended to reduce risks associated with climate variability, in the near and medium terms they paradoxically hinder the reduction of CO_2 emissions (Sinn, 2012; van der Ploeg, 2015; Jensen et al., 2015). Surprisingly, demand-side green design rather provides a greater motive for the single agent (example, the oil resource investor) to extract more to consolidate the potential losses in the future because of the mere broadcast of greener design (Sinn, 2012; van der Ploeg, 2015). This can, obviously, be applied to other extractive activities and nonrenewable resources like gold, uranium, copper, etc., where individuals continue to extract even where the ecological harms are intense and noticeable. For that reason, Sinn claimed that the Paradox captures how the demand-side design contributes to increasing global warming (Sinn, 2012; Jensen et al., 2015). Surely, if Sinn is right, then existing and future frameworks to tackle fossil fuel should be redesigned in view of making fossil fuel production and infrastructures extremely unattractive, and climate sinners heavily paying for the CO_2 and GHG emissions (Sinn, 2012).

Here, Sinn's valuation of anthropic actions resonates with the European Union's adaptation of Polluter Pays Principle (PPP) (OECD, 2008; Stefan et al., 2021)[18] which, also, obliges climate sinners to pay for their actions (Stefan et al., 2021). However, this may appear problematic. In an extreme case, we can imagine that when it comes to spatial CO_2 leakage (van der Ploeg, 2015) and determining whether the Paradox effect is weak or strong[19] (Van der Van der Ploeg & Withagen, 2015), the Paradox is limited in explaining the multiagent and interagency in the intertemporal speeding up and in the shifting of production (Jensen et al., 2015). Particularly, the practical manifestation of the Paradox depends on spatiotemporal CO_2 leakages (Van der Ploeg & Withagen, 2015; Jensen et al., 2015; Cairns, 2014) as well as on autonomous and natural changes and the socio-ecological and evolutionary processes that drive the changes in the climate (Le Treut et al., 2007).

[18] The polluter-pays principle asserts that those responsible for environmental harm, rather than society at large, should bear the costs of preventing or remedying pollution (OECD, 2008). While control mechanisms aim to secure a pollution-free environment (OECD, 2008; Stefan et al., 2021), the principle confronts deep conceptual tensions: how should accidental pollution be addressed, or pollution that falls below the legal threshold of "allowable residual pollution?" (Stefan et al., 2021). These questions foreground the nature of causal and remedial responsibility, challenging us to consider not only who *can* act, but who *ought* to act. They further illuminate the ethical horizon of climate governance, raising enduring questions about moral obligation: how can we assign responsibility for harm that is legally permissible yet morally consequential, and how should agents be held accountable when they lack the capacity to remediate or compensate? In this light, the principle exposes the delicate interplay between normative ideals, the limits of human agency, and the ethical demands of justice in a complex and interconnected ecological world.

[19] Here, according to Gronwald et al. (2017), the weak green paradox could occur when the implementation of a green policy inadvertently accelerates ecological harm over time, while the strong green paradox could arise when such policies provoke greater ecological damage due to persistent anthropic activities. They further note the possibility of an extreme green paradox, in which poorly designed interventions reduce cumulative welfare, amplifying net ecological harm. This framework underscores a fundamental friction in climate governance: well-intentioned actions can produce unintended consequences, revealing the fragility of human agency in complex socio-environmental systems and the necessity of carefully aligning normative prescriptions with the observable dynamics of ecological and social interactions.

To some extent, we can sustain the idea that existing discussions around the Paradox have to do with whether it has enough empirical evidence to be relevant as a theory and as a basis for designing a climate mitigation model. For Jensen et al (2015), the recent discussion about the Paradox is because of what we may term as its contradictory effect. That is, the possibility for climate guidelines to bring about unintended consequences. Other valid criticisms have also been made against the Paradox, specifically, on its indicators on how we react to a delayed climate policy during a period of announcement and its implementation (Bauer et al., 2018; Sörlin & Lane, 2018). Particularly, when the logic of the Paradox, as Österle (2012) puts it, is the reaction of resource owners to climate mitigation designs.

For example, Bauer, McGlade, Hilaire, and Ekins (2018) argued that resource owners and investors consider climate mitigation designs (the period of enactment to cut back on CO_2 emissions) that impede their natural resource legacies and production volumes in the near-term by making behavioural and rational risk averse decisions. In a way, such individuals divest away from fossil fuel centred infrastructure because of profit doubt in the future due to climate designs (Schneider, 2022). Here, it can be said that despite its theoretical distinction (Sinn, 2012), the Paradox struggles to capture what a risk averse agent, for instance, could do when faced with a climate risk. For, in saying that climate change is uncertain (Convery & Wagner, 2015), we seem to be saying that it is more than, or at least not different from, what we would be saying in describing it as having clear risky and unwanted possibilities. Consequently, we can assume that there is no amount of analysis that would be enough to resolve a climate risk that needs to be mitigated without some risk aversion postulation(s) in play, especially when we consider the diverse degrees we are exposed and/or vulnerable to climate change (Trisos et al., 2022).

Consequently, contrary to Sinn's claim, Bauer et al. (2018) argued that attention should not be focused on the undesirable feedback of climate mitigation designs, such as the Paradox effect, because it emerges from "highly idealised theoretical models that agreed that near-term emissions tend to exceed baseline levels because of future climate policies" (p. 130). We should rather focus on why resource investors react to the designs that could impede their natural resource reserves and extraction volumes (Bauer et al., 2018). For them, the practical decision to extract is more of a behavioural disposition towards their investments in view of the uncertainty of the changes in climate and its risks (Bauer et al., 2018).

From the above example, we can realise that one major approach to addressing the conceptual problem in the Paradox is exploring the behavioural disposition and the concept of risk aversion. In this case, it can be said that such behavioural disposition is agentive in nature because there is a desire, choice, action, reaction, etc. For it is highly thinkable that a human agent in dealing with a complex situation like climate risk may desire to pursue proxy ambitions like reducing CO_2 emissions or diverting resources into other ventures (Bauer et al., 2018). This option is analogous to how we may generally behave in unclear conditions. Here again, the hope of the Paradox with respect to shifting production in increasingly complex and fluid environments by resources owners is challenged by Bauer and his colleagues' idea of divestment effect.

Moreover, I observed that for the Paradox to occur, as explained in the example, there is a need for a certain knowledge about what is the risk involved – whether to continue extracting or not to after the announcement of a greener policy. As such, I can assume that there must be an epistemic agent for the Paradox to occur.[20] Therefore, while the Paradox is

[20] The role of epistemic agents in the Green Paradox is not incidental. It is fundamental. Whether the Paradox depends entirely on how these agents such as policymakers, producers, and consumers interpret climate mitigation designs. Consider two hypothetical governments, each announcing a twenty-year phase-out of coal-fired power plants. In the first scenario, the government acts alone, concentrating on reducing domestic demand but neglecting supply-side measures and bypassing international coordination. Fossil fuel producers, reading this as a warning of future asset devaluation, accelerate extraction to secure profits before coal loses value. The surplus coal is exported to jurisdictions where it remains desirable and cheap. This excess depresses international prices, making coal even more attractive abroad and triggering a rise in global consumption. Domestically, emissions targets are met but globally, emissions spike in the short term. This is the Paradox in action: a policy that delivers at home while worsening the planetary problem. In the second scenario, the government implements the same phase-out but embeds it in a coordinated international framework. Both coal-producing and coal-consuming nations agree

imaginably possible, it is comparatively trivial to other options like the divestment effect (Bauer et al., 2018) and subjected to a decision by an epistemic agent for it to occur.

It is also conceivable that the discussion around the Paradox could be refocused on its conceptual and practical relevance within the global climate change space. I will therefore point out that, on conceptual and practical grounds, it relies on circumstantial conditions which raise the question of its relevance in relation to what it means to assert that global warming as a climate risk is a complex situation.

The above considerations suggest that the conditions of historical, physical, and social capacity or value-position or issues of sustainability, development, innovations, etc., and other mediating contexts, could shape the behavioural tendency of an agent. Hence, without these variables, the idea of net-zero commitments as a climate ambition, for instance, could have little, or no, influence on such agents to extract, or not to extract. In a way, when faced with decision making under uncertainty like global warming, people's reactions to mitigation designs are sometimes less from the 'perfect rationality' of *homo economicus* (Kunreuther et al., 2014, as cited in Creutzig et al., 2018, p. 260). Yet, whereas the Paradox postulates a framework of increasing intersections and often irremediable effects of climate change (Sinn, 2012), Sinn did not pay notice to such complex particularities of agential entities as well as other mediating contexts that could shape the intersection of such agential entities. Further, he fails to look at how human agency, specifically, in diverse contexts and based on degree of

to measures that restrict supply and demand in tandem: capping extraction, halting new mining licences, and compensating for leaving reserves untapped. Importing countries commit to cutting purchases while expanding renewable capacity. The result is a gradual contraction of both supply and demand. No surplus enters the global market, prices remain stable, and coal use declines worldwide. The feared extraction rush never occurs, and global emissions drop as intended. The stark difference between these outcomes is not in ambition but in foresight of an epistemic agent who could anticipate and shape behavioural and market reactions. In the first case, the policy signal unwittingly triggers the very market behaviour it aims to prevent; in the second, strategic design and international coordination turn a potential backfire into genuine climate progress. Agreeing with Sinn, if the Paradox is true, then it is not just an abstract economic curiosity but a strategic warning. It reveals that climate policy success depends on synchronising supply- and demand-side mitigation designs, securing global cooperation, and crafting signals that do not encourage premature resource extraction. Only when human foresight is fully aligned with existential necessity can climate designs translate into real-world outcomes.

susceptibility, would react to risks due to the climate variability.[21] Consequently, the conditions that informed and shaped the Paradox and its corresponding mitigation design are problematic and raise a lot of questions.

2.2 Green Paradox: On Inferential and Predictive Accuracy

From the foregoing, I suggest that the Paradox may not easily yield clear or reliable practical outcomes when applied to the lived realities of climate actions and experiences. In the messy, overlapping currents of the real world, its logic can falter, particularly, in situations of deep complexity where human choices, market behaviours, existential and ecological responses refuse to unfold neatly.

This brings me to two philosophical concerns that seem unavoidable:

(i) Inferentiality – here I reflect on the very chain of reasoning the Paradox assumes. How do the two key events it describes actually connect? Is this connection inevitable, or does it rest on habits of thought that we have simply accepted without full scrutiny?

(ii) Predictive Accuracy – here, I ask about the epistemic weight we place on the Paradox. Does it mirror reality closely enough to guide us in the design of climate risk mitigation strategies? Or does it abstract too far from the entangled conditions in which real decisions are made?

The first concern is about a gap in thought: the logical bridge the Paradox claims to cross may not be as solid as it appears. The second is about a gap in action: even if the logic holds, can it

[21] These pressures are compounded by intersecting dynamics of unsustainable socio-economic growth, systemic injustice, and epistemic marginalization, as well as by historical and ongoing inequities, including colonial legacies, and the structures of governance through which public and private actors engage with global issues. Together, these factors reveal how climate risk is not only environmental but deeply entangled with social, political, and ethical dimensions, highlighting the need for interventions that attend simultaneously to material conditions, power asymmetries, and normative responsibility.

truly survey contact with the world of human intentions, political will, and unintended consequences?

2.2.1 Inferential Paths: Questioning the Logic of the Paradox

According to Sinn (Sinn, 2009, 2012), the connection between the two events at the heart of the Paradox, namely, a 'gradual demand greening policy' and 'acceleration of global warming' represents a regular, observable relationship between factual occurrences. The implication is that these are mutually recurring factual events which are spatially contiguous. It also suggests that one of the events temporally precedes the other. Accordingly, these events, in Sinn's valuation, are empirically defensible (Cairns, 2014; Österle, 2012). This logically opens up further debates on the empirical evidence of the Paradox.

Philosophically considered, the events provoke a concern about an inferential path in the Paradox. The argument is that the Paradox must accommodate an inferential path between the events for it to occur. In that sense, the success of it is a matter which can be inferentially settled.

The inferentiality path in the Paradox, based on the relation between a supposed cause and the recognised effect, is as follows:

(i) event Y (acceleration of global warming) would not have occurred.

(ii) had the event X (gradual demand greening policy) not occurred.

(iii) given that event X did occur, event Y did happen (Causal inference).

In another sense,

(i) X is spatiotemporally adjoining to Y,

(ii) X antecedes Y in time, and

(iii) event X is followed by event Y.

The reason for analysing the inferential habit between the two events is because the Paradox highlights the relation between the events X and Y as binary, measurable, and quantifiable in an actual world. That means that event X, like any material event occurring in the actual world, is implied to be a compendium of 'all spatiotemporal matters of facts' (Bell 2008). It is, in fact, followed by event Y, which also occurs as a spatiotemporal matter of fact. In this scenario, the sufficiency of X for Y is properly understood in a stronger sense, especially when we can easily assume, by Sinn's conclusion, that X necessitates Y. Here, it could be said that there is a constant conjunction between event X and event Y in the sense that Y is inferred from X.

To deal with inferential habits, I first use the basic view on causation.[22] What is it? The view is that X causes Y if without X, Y would not exist (Beebee, 2006). In other words, if X brings about Y, then X and Y are spatiotemporally conjoined, and X antecedes Y (Strevens, 2004).

Similarly, Sinn assumes such an inferential habit in the Paradox.[23] Fittingly, the inferential habit in the Paradox appears natural (perhaps even inevitable) as one reflects critically on Sinn's claims of why and how acceleration of global warming is caused by gradual demand greening policy (Sinn, 2009, 2012).

Be that as it may, my observation is that inferential habit in the Paradox is rather circumstantial, a mere accidental relation between X and Y. A relation that only occurs in a restricted and nonredundant way. This is because the path that is implied to exist between event

[22] The present study deliberately sets aside exegetical debates on causation, such as those of Hume and Kant, in order to focus on a basic inferential understanding: that X causes Y. This approach allows the Paradox to remain actionable, linking descriptive realities of climate risk with normative prescriptions by showing how human and institutional interventions may alter sequences of events. It also positions the epistemic agent as ethically and practically responsible: by recognizing causal chains, the agent gains a tangible basis for ethical engagement in climate mitigation. At the same time, the allowance for inferential causality acknowledges persistent uncertainties, interactions among multiple agents and stochastic factors make outcomes probabilistic rather than deterministic, reflecting the margin-of-error concerns discussed earlier. Finally, tracing causal connections strengthens normative and policy arguments for fairness and accountability, ensuring that when actions by major emitters lead to consequences for vulnerable populations, responsibility can be ethically and practically grounded. By situating causality in this way, the study connects the Paradox, the epistemic agent, uncertainty, and issues of fairness into a continuous philosophical framework that links knowledge, action, and normative evaluation.

[23] This view is used because of Sinn's claim that Paradox is scientific and logically reasonable (Sinn, 2012; Cairns, 2014; Österle, 2012).

X and event Y in the Paradox does not have causal powers, a necessary connection, and a useful relation even if we want to premise Sinn's claim of a regularity of event X prior to event Y.[24]

More so, for the inferential habit in the Paradox to make sense, some criteria have to be met. First, there must be a spatiotemporal conjoining of the event X (cause) and event Y (its effect) to exclude 'a distance causation'. That is, event X must adjoin event Y, either directly or by a string of adjoining events (Beebee, 2006). Second, since the Paradox supposes that event X causes event Y (Sinn, 2012), then event Y must not cause event X. The causation has to be unidirectional because of the time-based antecedence of X (Psillos, 2002; Strevens, 2004). In this sense, there is a temporal precedence between event X and event Y. This temporal precedence criterion negates the option for a backwards-in-time causation (Psillos, 2002; Strevens, 2004) as well as reduces the forecasts of a 'non-circular theory of time' described in causality (Beebee, 2006). Third, we expect a regularity, that is, X causes Y in every simulated situation (Strevens, 200; Abadie, 2005), especially when the events, as Sinn claims, are largely matters of facts. This implies that the inferential path from X to Y in the Paradox, since they are postulated as factual particulars, could ground the regularity of the events in every simulation. Therefore, we expect that the events in the Paradox have a regularity in a way that there can be no variation of them without a variation in their regularity. Correspondingly, we should not expect a variation in the regularity of the events in it without a change of fact of the events.

Now, the question is, does the inferential habit in the Paradox fit well with standards of spatiotemporal contiguity, temporal precedence, and regularity criteria? This question is influenced by two assumptions. One, I assume that there must be a constant conjunction between the events for the Paradox to occur. This is because the inferential habit in the Paradox

[24] I will address the question of whether Sinn's inference meets basic criteria of causal inference in the following paragraphs.

gives a singular causal relation as well as a non-circumstantial approach based on the account of causal inference I have reflected on. Two, closely related to the first assumption, Sinn assumes a non-circumstantial approach to the events in the Paradox. This approach fits well with Sinn's claim of the effect of the changes in climate and, somewhat, how the changes are liable for the rise of civilisation[25] (Sinn, 2012). Here, the Paradox naturally presupposes a singular causal relation, which rules out any circumstantial factor. In other words, the Paradox could occur anywhere and at any time when simulated. In particular, we could even describe the risk, global warming, as a potential agent that generates existential consequences which affect human agents without the consequences being intentional as such.[26] Therefore, both assumptions, namely singular causal relation and non-circumstantial factors, are critical to our understanding of the Paradox and its corresponding design. The challenge is that these assumptions could amplify the conceptual and practical gaps within the Paradox, shaping its theoretical coherence and its capacity for real-world application.

However, an unavoidable factor in theorising the Paradox is the presence of an epistemic agent.[27] Indeed, the validity of the Paradox needs an epistemic agent in the context of increasing trends of non-climatic global incidents of human and nonhuman demographic

[25] In some cases, the experience of climate risk is not abstract but catastrophic, as evident in the Sahel region's recurrent famine, the erosion of political borders and lands, and the forced migration of populations. Such collapse gestures toward what is often called a "slow violence of climate risk", where the fall of civilization is not a sudden event but a drawn-out erosion of stability. This exemplifies how climate risks expose the fragility of human institutions: existentially, by reducing communities to bare survival; and pragmatically, by undermining the very structures of governance meant to secure resilience.

[26] What Sinn assumed as anthropic action can, in many contexts, be more accurately understood as a reactive strategy of survival and risk aversion in the face of natural climate variability. This reframing destabilises the neat category of human agency by showing that "action" is often less a matter of deliberate mastery than of compelled response to existential precarity. In doing so, it mirrors the Paradox: the descriptive claim of human control dissolves into the lived reality of reactive vulnerability, highlighting again the difficulty of aligning what *is* (reaction) with what *ought* to be (responsible action).

[27] The epistemic agent can also be described as a climate risk impact agent, one who is ethically bound to act. This dual description not only fuses knowledge with responsibility but also introduces a moral quality to the discourse: to know is already to be implicated. Existentially, this suggests that human beings cannot escape the demand to respond once they recognise risk, yet such recognition may also induce alienation if the scale of action required exceeds their capacity. Pragmatically, it complicates governance, for while epistemic agents must act, the structures that coordinate their action often lag behind, creating a gap between responsibility and feasibility that mirrors the broader dilemmas of fairness and institutional legitimacy in climate governance.

shifts, unsustainable extraction of resources, biodiversity loss, ecosystem disintegration, and socio-economic disparities across different geopolitical and territorial borders. The logic of the Paradox requires this epistemic agent, the resource owner, a naturally unstable and a significant variable, to occur (Schneider, 2022). This epistemic agent makes the Paradox subjective, restrictive, and dependent. The inferential path in the Paradox, thus, becomes circumstantial, because of the potential for the epistemic agent to interfere in the regularity of the two critical events in the Paradox[28] by potentially causing other series of events.

Given that the reliance of the inferential claim on causal inference is restrictive, perhaps an alternative explanation for its inference could be suggested. And a good one could be premising event X on a probable event that Sinn might have overlooked. In doing this, let us suppose event X to be no more causally central but marginal, a probable cause. This, I believe, could be a defensible model that allows for a marginal solution to the weak inferential habit in the Paradox. To strengthen this proposal, I will turn to an African concept of secondary causation, an *a priori* inference model, as well as a conception of causation based on the assumption that a nominal quality for agency is inter- and intra-activity, and that the agential entities in climate matters are not excluded from such nominal quality.

This understanding of African secondary causation provides a probable explanation of the inferential habit in the Paradox. For the purposes of the search for such probable-marginal events, I will proceed from wondering whether the Paradox is a hypothetically unverifiable kind, given Sinn's own claim of theoretical possibility of the Paradox (Sinn, 2012). If the Paradox is of a hypothetical unverifiable kind, then Sinn's inferential habit regarding event X

[28] The inferential relation between *Event Y* (the acceleration of global warming) and *Event X* (the gradual demand for greening policies) remains circumstantial, since the epistemic agent's intervention can disrupt their apparent regularity. This interplay discloses a tension: climate history does not unfold as a fixed sequence but as a fragile balance between acceleration and delay, where human action is both a possibility and a weight. The agent stands within a field of conflicting temporalities in a sense the agent is pressed by the urgency of collapse yet drawn toward the slow rhythm of reform so that action risks becoming paralyzed when the future appears both necessary and unattainable. At the same time, the gap between rapid ecological change and incremental governance reveals the unresolved paradox of climate agency: that while action is imperative, its sufficiency can never be assured.

could be a cause in the secondary sense. Although the idea of secondary causality is clearly challenging to empirically confirm in relation to the core claim of Sinn on event X, the Paradox could avoid the problem of spurious causation and make an argument for an active inferential path that relates to a conception of causation in a complex situation like the climate risk Sinn was describing. The secondary causation alternative is inconclusive, but it is a conceivable way to remove the constraints that earlier causal consideration puts on the Paradox. This alternative is grounded on the idea that events X and Y in the Paradox are logically distinct, and they are, at least, analogical as well.

In furtherance of this search for alternative inferentiality, an interesting theory is Sologo's (1993) analysis of African concepts of inferential assertions and his arguments for a secondary level of causality (Ajei, 2014). Sogolo's thesis asserts that, to understand the concept of bringing into *being* that which was not, we have to classify the primary cause from its secondary cause. And whereas the primary cause is a metaphysical characterisation, the secondary cause is an empirical one (Sologo, 1993). In the context of the African concept of causation, however, the secondary cause is not of much interest. Applying Sologo's thesis in the context of analysing the inferentiality, his thesis of causation resonates with Jensen et al.'s (2015) hypothesis that the Paradox theory largely depicts unintended effects of climate mitigation designs. It is important to recognise that Sologo's account of causation engages an inferential habit in *a priori* reasoning (Asira & Bisong, 2015); and it is grounded on the idea of diverse inferential paths to an event (Sogolo, 1993). For instance, Sogolo (1993) illustrates this point with a fire outbreak scenario, showing that a single event can have multiple causal explanations. While different perspectives may offer distinct accounts of the same occurrence, he argues that these explanations should not be ranked hierarchically in terms of which is "better" or more valid. According to him, "the different explanations are complementary and non-mutually exclusive" (Sogolo, 1993, p. 108).

Here, Sogolo's point is that although the fire scenario can be explained in an inferential sense, it is not overtly inferential in the way that basic causal inference confines its requirements to a logical inferential structure with empirical facts (Abadie, 2005; Beebee, 2006). Simply, the idea of 'hidden' or implied cause of an event cannot be captured in the scientific causal explanation in this African conceptualisation of causality (Asira & Bisong, 2015).

It is also important to underline that Sogolo's fire scenario offers an epistemic consequence of *a priori* reasoning which is not in contrast to Descartes rationalist explanation that causation is possible within the principles that are knowable *a priori* (Copleston, 1985a) in our physical world. Having said this, it is instructive to note that the African secondary causality also has a metaphysical dimension (Ajei, 2014). And it seems undeniable that this metaphysical dimension underscores one of the ways the physical world and some occurrences in it are signified and understood.

Rightly capturing the notion of African secondary causality, within the context of climate risk, allows us to imagine that the cause of a climate risk could be more than a single variable. This will be in contraposition to the rigid inferential path in the Paradox. In a sense, there is an interaction between, or among variables, and one variable could merge with, or mutate into another, to generate a causal effect (Sogolo, 1993; Ajei, 2014), even if it is in an asymmetrical manner or a nominal quality. Of course, Sologo's African theory sees causation occurring not merely in physically and directly observable terms. He sees causality in metaphysical, non-lineal, and compounded terms: that *what is* (and whatever event we see) is inherently and unknowingly complicated in another event.

The above conceptualisation leads us to ask: in what sense is the term 'cause' used in Sogolo? In my view, his causality theory can be expanded to mean that, event X is a cause of event Y if, and only if, Y can be inferred from X in the context of another event, Z. Other events that indirectly bring about Y via X, or directly produce Y, remain probable causes. The causal link between Z and Y thus signifies an inferential path, reflecting not just objective sequences but the situated reasoning and practical engagement of agents within a complex world of interdependent actions. Here, causation indicates a succession of events in a way that the events we see sequentially cause the other, even if it is in a probable-marginable way. What this means is that several causal variables are, and could, interlink.

Understood in the foregoing sense, the Paradox can be attributed to this secondary causality theory from *a priori* reasoning. We may assume an iota of inferentiality in relation to the concrete set of events X and Y in the Paradox in a sense that with the iota of inferentiality we can explain X to be a cause of Y if, and only if, it can be inferred that Y is from X in the framework of Z.

Then again, granted the above sense is rationally conceivable, the Paradox will still struggle against the fact that there are too many variables and regularities (and irregularities) that prevail when it comes to the risks generated because of the changes in climate. This is because the analyses of the inferentiality in the Paradox reveals a reductive account of causation in respect to assumed necessary connection between the two events – a single cause and a single effect – which occurs when there is a connection between those events in terms of spatiotemporal relations. Therefore, should the argument for a secondary concept of causality be accepted, the inferential habit in the Paradox still falls apart given that Sinn's events X and Y exclude a distance causation. This is because, for Sinn, event X is adjoined to event Y in a series of contiguous events. In a way, the alternative justification for events X and Y are eliminated even if we want to reduce the inferential habit to non-causal terms.

A cogent example of the inferential deficit in the Paradox is shown in Robert Cairns' work (2014) on non-renewable natural resources. In this work, Cairns identified a link between

Sinn's Paradox and the conclusions made by the Hotelling rule on nonrenewable natural resources (Cairns, 2014). In Cairns' analysis,

> there is no reason to believe in a green Paradox if one bases the analysis on current abilities to increase supplies in response to a change in the time profile of net prices resulting from a tax. If anything, the tax may be expected to result in a reduction in production, and a reduction in emissions of greenhouse gases, since the tax may render some producing properties no longer profitable (p. 82).

Cairns, therefore, argues that the identified link between the Paradox and the rule on nonrenewable natural resources weakens the Paradox given that the rule does not consider the natural and technical structures in extraction (Cairns 2014). It is the fact that,

> it is not possible to demonstrate a green paradox given the current limitations of mathematical analysis of a complicated, multi-faceted industry. The weight of many influences discussed […] is inimical to its predictions. The paradox does not have an adequate foundation in the conditions of production in the oil industry to affect policy or the timing of policy respecting climatic change (Cairns, 2014, p. 85).

Cairns' assertion can further be supported, first, by the assertion that the "Paradox framework considers total extraction exogenous and assumes all remaining reserves profitable, […] Under these conditions, the simple version of the Green Paradox illustrated by the Hotelling rule becomes inconsistent" (Schneider, 2022, p. 5). Second, Ines Österle's (2012), in *The Logic behind the green Paradox*, observes that Sinn retained a resource extraction model based on Hotelling rule, despite the propositions that the rule is inconsistent with empirical conclusions (Österle, 2012). Based on the examples, therefore, I can assert that Sinn's dependence on the rule makes the Paradox unlikely to occur. By extension, Cairns, Schneider, and Österle arguments admittedly provide a rationale to question the Paradox and corresponding climate design to mitigate CO_2 emission.

These examples and other supporting suggestions point to a deficit of inferentiality in the Paradox. That is, Sinn's Paradox is a clear example of the often-held mantra 'association does not imply causation' (Abadie, 2005) and falls within the fallacy of questionable cause, 'non-cause for cause'. What these examples further point to is that the Paradox fails the basic inferentiality that needs to exist between events as in "an asymmetrical relation in that the occurrence of the alleged cause must be the actual event, which brings about the effect, such that the effect must not be part of the original conditions that are necessary and sufficient for its own occurrence" (Nagel 51-52 as cited in Asira & Bisong, 2015, p. 26). And it also fails the possibility of a secondary cause or *a priori* reasoning often associated with the African secondary level of causality. This, I have argued, is because Sinn's analysis of the climate risk reveals a relation between two events. The challenge, however, lies in his singular framing, for to reduce causality to the circumstantial claim that event X causes event Y is to overlook the layered, entangled, and often indeterminate ways in which climate risk truly unfolds.

2.2.2 Predictive Accuracy: Does the Paradox Mirror Reality?

So far, it has been established that an inferential deficit exists in the Paradox, and that this is because the observed inferential path between events X and Y is a one-way relation from X to Y. And it can also happen in a reverse causation or by a confounding result of multiple events on X and Y. This does not exclude backward causation given the natural variability of climate scenarios (Sörlin & Lane, 2018). Also, we realised that the number of plausible interactions between the different variables which we must consider causing event Y are countless – mainly when event X (an actionable mitigation design) is a "naturally occurring attribute" (Mackenzie, 2013, p. 147). In this case, event X is unreliable because it is unclear whether event Y was due to event X or other confounding variables (like disruptive innovation, cultural dynamics, NSAs, policy language, climate AI-technological systems, etc.).[29]

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[29] One might argue that Sinn's Paradox is straightforwardly intentional. That is, if resource owners are told that the future price of their commodity will rise (through taxes, quotas, or other policies), they will rationally choose to sell more now, and if prices are expected to fall (due to cheaper green technologies), they will also adjust their behaviour accordingly. After all, owners can make other choices, such as adjusting prices to compensate for reduced sales, so the causal link between policy signals and behaviour seems clear. And could not this underdetermination be resolved simply by asking owners how they responded to these conditions? While this reading correctly recognises the role of agency, the concern I raise is epistemic rather than intentional. Even if owners make deliberate choices, the causal connection between policy signals and behaviour is underdetermined because of systemic, socio-economic, and environmental complexities. Directly surveying owners can provide some insights, but self-reporting is subject to bias, strategic misrepresentation, and context-specific variability. Establishing intentionality does not equate to establishing a robust causal inference. The Paradox presumes a relatively direct link between expectations and action, but in reality, this link is entangled in complex feedback

Since explanations for the concept of the Paradox do not inherently lie in the claim of theoretical possibility, but also in the weak inferentiality, we may ask: is there any practical justification of it? How might we explain the practical effect of the Paradox in the daily experiences of the risks due to the variations in climate?

Correspondingly, we can somewhat agree that some governments are getting better at adaptation. This is partly because, constantly, climate change issues are becoming more included in development plans and sustainability matters. These concepts of development and sustainability reveal the reality behind our human experiences and other lifeforms; and also reveal that the world we actually experience, and its goods, have limits, therefore we have to find ways to avert the existential risks that come with our being in the world. Here, I seek to establish that although the risk that comes with the change in climate may have a global dimension, it can only be experienced on a local scale. In a sense, local communities and realities are the new frontier for mitigation of the risks with the changes in climate (Lehrer, 2015; Trisos et al., 2022). Therefore, a good conception of a climate mitigation design, it appears, contains all and only those conditions we may consider as existentially representative.

Sinn's mitigation model is subsumed under the definition of what the Paradox sets out to describe: anthropic acts and the impact of the acts on the climate. Logically, Sinn's model is an abstraction of existential representations of the perceived changes in the climate, conditions precipitating the changes and experiences of the risks because of the changes, even if it is naturally explicable. Precisely, therefore, a mitigation design is only effective when it has a higher predictive accuracy (realistic performance – objective function – reliable – external

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loops shaped by multiple interacting factors such as structural constraints, cultural norms, global market pressures, and alternative strategies available to actors. My work interrogates this gap, emphasising the need for careful empirical and conceptual scrutiny before asserting causal claims.

validity) to fairly equal an actual value of its targets (intended risks to mitigate) based on the design's predicted values (Witten et al., 2017), even within a margin of error[30].

The margin of error is included in the calculations to establish the idea that actual values may demonstrate a small deviation from predicted values. Generally, we should expect that our extraction of and overdependence on natural resources are changing the physical world. And if these activities become part of our regular lives, then we should also expect that our description of the changes (and conditions that bring about the changes) of the physical world would show some discrepancies. Given that our meaning and experience of these changes in the physical world would differ, our description of the changes would also differ. And here lies the margin of error that could occur, and influence, plus or minus, the discrepancies in our description of the physical world. The margin of error could also amplify or reduce the meaning and experience of the changes in the physical world. As a result, any design must have a higher predictive accuracy amidst the discrepancy, even if small, especially when we cannot rule out nonhuman agential entities in the changes impacting on the physical world.

Consequently, I envision that the Paradox would face two practical challenges with regards to its corresponding mitigation design:

(i) epistemic relevance viz., whether it represents a complex problem in our physical world given the uncertainty of the changes in the climate, and

(ii) normative implication viz., basis for a design to mitigate a climate risk and to regulate human actions and ambitions in the matters of climate change.[31]

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[30] The allowance for a margin of error arises from the inherent uncertainty of climatic change and from the arguments advanced regarding multiagent and interagency dynamics in shaping experiences of exposure and vulnerability. Yet this allowance exposes a tension akin to that found in the Paradox: existentially, it risks eroding trust and diminishing human agency, as uncertainty can render individuals and communities subject to risks, they cannot meaningfully anticipate or control; pragmatically, it may weaken policy design by normalizing imprecision, thereby reducing accountability and the feasibility of effective climate governance. Taken together, the margin of error and the Paradox reveal the same underlying dilemma: that the very effort to conceptualize and mitigate risk often produces a gap between what we *can* describe, what we *ought* to prescribe, and what humanity can genuinely enact without alienation or paralysis.

[31] The normative implication of the Paradox will be explored in Chapter Three, particularly in relation to the conflict between its descriptive account of climate risks and its prescriptive demand for alternative designs. As a

On epistemic relevance, the question is: does the Paradox represent a real-world experience of a climate risk? If yes, then, on what grounds? The reason for this question is that the Paradox interfaces with real-world experiences of climate risks and becomes a guide to regulating anthropic actions and future impacts of agential interactions with, and within, the physical world. We can thus imagine that knowledge of the changes in the climate is of primary weight in understanding the risks and how to mitigate the same. For the simple reason that the goals of climate designs are to help humanity make decisions in a real complex situation like global warming. Thus, any epistemic aberration because of a theory (and a design) affects how we perceive the changes and its risks and also provides a basis for a moral justification for whether we spare or reject a design which misrepresents human existential conditions and *what is* in our physical world.

Therefore, if we want to consider climate change and risks as complex problems, a major question is whether the descriptions and prescriptions of the Paradox constitutes such complexity. In considering the question, I will explore Joachim Funke's theory of 'komplexes Problemlösen' (Funke, 2012, p. 682) to explain what qualifies as a complex problem.

Funke (2012) posits that complex problem solving occurs amidst complex cognitive activities and behaviour. In this complex problem-solving situation, we expect that the initial and intended goals change over time and are partially unclear and existentially obscure (Funke 2012). It is also a fact that in any complex problem there is fine margin intersection between the person who wants to solve the problem and situational conditions based on the nature of

preliminary gesture, the Paradox insists that climate mitigation must not be confined to what *is* empirically possible but must also reckon with what *ought* to guide theoretical and ethical commitments. Yet this prescriptive force carries a dual risk: on the one hand, it may alienate human agency by projecting ideals so distant from lived capacities that they become existentially unattainable; on the other, it may weaken policy relevance by advancing aspirations that, lacking sufficient grounding in feasibility, fail to translate into workable governance strategies. In this sense, the Paradox echoes the problem raised by Torres: the difficulty of reconciling the descriptive complexity of multiple agents with the prescriptive clarity demanded by normative design.

the problem (Funke, 2012). Appropriately, what qualities as a complex problem must have some consistent features; and there must be,

(i) Complexity of the problematic situation – that, a situation is said to be complex when it is defined by the sum of variables in a particular system. Here, an individual is expected to reduce the complex variables to their basics (Funke, 2012, p. 683).

(ii) Connectivity between involved variables – the number of variables is not enough to determine whether a problem is worth solving. The connectivity is *sine qua non* to resolve the situation and to make sense of the mutual dependencies of the variables (Funke, 2012, p. 683).

(iii) Dynamics of the situation – a system has features of time and evolution. Therefore, any intervention must pay attention to the networking nature of systems. This means that an individual must be dynamic and conscious of time since a situation is a feature of variability (Funke, 2014, p. 683).

(iv) Intransparency – this is in relation to variables and goals we intend to define in the situation. And given that not every information on variables and goals are available in a complex situation, the individual must endeavour to hunt for information (Funke, 2014, p. 683).

(v) Polytely – Attaining a given goal in complex situations is challenging. And also, we expect more than a single goal in a complex situation which means that there would be conflicts. However, in such a conflicting situation given the divergence in goals, we have to form compromises and define main concerns (Funke, 2012, p.683).

Analysing Funke's work, we can assume that uncertainty, rationality, context, features of a situation, etc., are consistent qualities we need to consider in predicting how an individual will react to a complex problem like global warming. The core concern is that the more complex a problem is, the harder it is for an epistemic agent to keep up with the intersecting variables.

Similarly, we cannot ignore that Sinn's Paradox started with a claim of solving a complex problem like global warming (Sinn, 2012) because of resource extraction (Schneider, 2022), and how it intersects with the intensity of CO_2 and GHG emissions; and the intertemporal leakages because of shift of production (van der Ploeg, 2015) and spatial leakages (Jensen et al., 2015). And, therefore, he ended up proffering a solution grounded on the assumption of solving a complex problem through his climate mitigation design. In a sense, we can qualify Sinn's starting point and intended goals as indicative of a complex problem.

However, Funke's work on what qualifies to be a complex problem suggests that Sinn's Paradox and solution to a complex problem fails to appreciate the complexity of the variations in climate (and risks) and the countless variables involved in it, the connectivity between the involved variables, the dynamics of the climate situation, the intransparent situation and polytely feature of the goals in climate mitigation. In particular, when the very awareness of climate change and related risks are matters of *sui generis* epistemology. That is, in a real-world experience of climate risk, detection of the magnitude of the risks with the changes in climate could make a difference in solving them. Therefore, Funke's theory on complex problem solving and how to go about a complex situation contradict the complexity of the conditions Sinn claims to have given rise to the Paradox and the rationale of designing a mitigation framework to solve the conditions.

Moreover, when we consider the mediating effects of cultures, cognitive awareness of emerging polycrises because of climate change, and emerging existential risks and effects as many variables interact, Sinn's mitigation model will be weak in its predictive accuracy. It is also the case that if we require a controlled intervention in solving the complexity of climate risks, we have to exchange and share our knowledge of risks which, hitherto, was in a silo. Additionally, we need to have clarity on the complex particularities of the risks in question which are contingent on context effects of cultures and cognitive awareness of the risks. The foregoing considerations become more critical when we further look at the implication of human sensitivity to an event which could be contextually influenced (Jacquet et al., 2018). With these considerations, we can assert that the Paradox struggles with defining the interactive feature of variations in the climate and its risks. Partly, when climate change is (i) an intersection of interactive variables (that is, agents) and (ii) "[…] cannot be explained by natural factors alone […]. A substantial anthropogenic influence is required in order to best explain the observed changes" (Le Treut et al., 2007, p. 103).

Overall, an argument worth pursuing is that solving the complex risks due to the variations in the climate involves more than what Sinn describes and prescribes. If we agree that climate risks are complex problems, then beyond Sinn's Paradox and corresponding mitigation design, we have to consider a theory and a design that could embrace the mediating effects and cognitive awareness of specific and potential risks linked to the changes in climate. The absence of such considerations may only increase the degree of having a lower predictive accuracy when it comes to climate mitigation actions of diverse agents in climate scenarios and risks.

To support my conclusion, I will look at five arguments why the corresponding design of the Paradox will have lower predictive accuracy in relation to its practical utility as in the mitigation climate risk it sets out to solve.

i. Epistemic Limits: Questioning knowledge and Predictive claims in the Paradox

It is arguable that the matters Sinn describes and attempts to solve fall within the category of epistemology, especially regarding what is really known about climate change as well as the known and unknown risks of the change in climate. In essence, when we consider the infinitely many variables in the change, the *awareness of* climate change and risks and *awareness that* action or reaction *A* or action or reaction *B* will cause the acceleration of a climate risk is crucial to the predictive accuracy of a climate mitigation design.

The epistemology argument is that we tend to act on our beliefs about *what is actual* and *what is possible*. And since the variables in climate change and its related risks are countless probabilities, the epistemic awareness is crucial if we have to act in default of that which is known about the change in climate, in particular, when epistemic awareness of climate risks is a matter of truths and scepticism (Torres, 2016). That is, when it comes to known and unknown risks, we have conscious awareness based on a justificatory ground and/or there are facts that contribute to the justification of our belief that a risk is as a result of a change in climate, either through natural variability or anthropic actions.

Clearly, from the above, based on epistemological argument, the predictive accuracy of the Sinn's mitigation design will be lower in lessening climate risks because it is inconsistent with the already argued idea of more-than-one variable of looking at the causes of risks due to the variations in the climate. In other words, we can assign probabilities to climate risks (and even to climate change) because we recognise that there are multiple outcomes: that is, when considering climate change and risks, *it is plausible that Q may occur, while outcome R is also possible*.

Understanding this epistemic sense explains why some people accept some propositions on climate change as true and why others would not. This is because observable facts in climate change and risks signify consistent possibilities rather than necessities. Hence, a level of exposure or vulnerability *in situ* will define how one will see climate change as true or not and/or a factual possibility. This factual possibility, for instance, may also define epistemic awareness, which will, in turn, define how people make decisions in minimising a risk level in a complex situation.

It appears that when the idea of epistemic awareness is applied to the climate change context, we may have to question Sinn's claims that the Paradox is a theoretical possibility (Sinn, 2012). If the Paradox is true, then, by definition, we have to also assign probability to more-than-one propositions in the Paradox. To do that also means that we have to assign probability to another set of propositions that may occur outside the Paradox given that climate change and risks, as earlier argued, are akin to observable and numerous probabilities.

Further, when we consider the idea of epistemic awareness alongside the inferential ability to have numerous probabilities, then we could raise a lot of doubts on the claim of non-circumstantial fact of the Paradox. This is because the Paradox presents a conditional proposition to be accepted as true in order to validate its core claims. It also presupposes certain epistemic necessities regarding the events required for the Paradox to occur. In other words, Sinn does not make room for us to consider the events as factual necessities, even though climate change naturally incites factual possibilities (Le Treut et al., 2007).

Based on the epistemic argument, therefore, we can assert that the Paradox is weak, in a manner that could fundamentally affect the predictive accuracy of its corresponding design. In fact, we cannot barely and externally draw any necessary inferences in the Paradox and relate it to its corresponding design. Therefore, the Paradox appears to be a groundless premise to its corresponding design and represents inconsistent possibilities: The claim here is that the Paradox is justified simply on Sinn's claim of theoretical possibility which, we have argued, fails because of its weak inferential habit.

ii. Uncertainty and Risk Aversion in Climate Action

Given this uncertainty, then it is explainable why people are risk averse in climate risk predictions. The condition of uncertainty explains the expectation to minimise a risk, even in an irrational way. This explains why an epistemic agent will (dis)value *variable P* over *variable Q*. Perceived differently, within a certain spatiotemporal reality, why would a person abandon *variable Q* and go for *variable P* or abandon both *P* and *Q* for *variable R*. It seems that Sinn did not recognise how uncertainty can be a catalyst in decision makers, like resource owners, maximising an expected outcome to their advantage. Such decision makers are the risk averse persons (who are both epistemic and ethical agents) ready to construct a rational preference, or a proxy goal, under a condition of uncertainty (Hansson, 2004) that characterises climate change and risks, which may necessarily not occur in accordance with greening models, as Sinn held.

Specifically, the risk aversion argument hovers around the question of what and which conditions shape or reduce agential risk aversion. A good guess would be the condition of climate uncertainty. My guess may be grounded on the notion of rational behaviour under uncertainty which, according to Ruixun Zhang, Thomas Brennan and Andrew Lo (2014), makes risk aversion "one of the most fundamental properties of human behaviour" (p. 17777). Here, the authors, employing a binary-choice model, showed that risk aversion need not be a fixed trait but can emerge from ordinary uncertainties, shaped by the nonlinear and multiplicative dynamics of generative risks, such that different contexts produce distinct patterns of steady-state utility (Zhang et al., 2014). This highlights how rational preferences are contingent upon the structure and interaction of risk, rather than being purely intrinsic.

To further argue the weight of uncertainty on risk aversion in climate risks, let us employ Nick Bostrom's (2002) existential definition of risks in view of examining how both systematic and idiosyncratic risks can be influenced by uncertainty. In his definition, Bostrom asserted that a risk occurs when "adverse outcome would either annihilate Earth-originating intelligent life or permanently and drastically curtail its potential […] An existential risk is one where humankind […] is imperilled" (Bostrom, 2002, p. 2).[32] Bostrom's definition is further

[32] When I reflect on existential risk, I cannot help but feel the weight of its double meaning, that is, (i) the possibility that all of human life might be annihilated, and (ii) the possibility that even if we survive, we may live so diminished that our futures are permanently stunted. It is unsettling to realise that our entire history, such as our languages, our cultures, our songs, our failures and triumphs, could vanish without trace, like smoke dissolving

amplified by Phil Torres (2016) assertion that a climate risk is "an event that results in either total annihilation or a permanent and severe reduction in our quality of life" (p. 32).[33]

Torres, however, extends the notion of climate risks to encompass existential risks, defined by their significance (Torres, 2016). Climate change, for instance, may be understood as a contextual risk, since its "significant effects are to modulate the dangers posed by virtually every other existential risk facing humanity – including those from nature" (Torres, 2016, p. 32). This expansion highlights how uncertainty is experienced in concrete terms: preferences are not abstract but tied to what individuals or communities consider indispensable goods. In many African contexts, this translates into a prioritisation of immediate and tangible aspects of life, such as food security, stable livelihoods, or communal resilience, over speculative long-term risks. Put differently, a community struggling to secure subsistence is unlikely to trade present survival for the mitigation of a probabilistic climate threat. This does not imply indifference to climate change, but rather a rational ordering of risks where the preservation of a minimal quality of life takes precedence. Such grounding allows us to see why risk-averse behaviour under uncertainty cannot be reduced to abstract models but must be understood relative to lived conditions.

With the above account of risk aversion, it can be assumed that in any complex situation there is a "subtle combination of knowledge and uncertainty" (Hansson, 2004, p. 11). And under a condition of uncertainty, an agent must assign epistemic probability to climate

in the air. And yet, what strikes me most is not fear, but responsibility. To speak of humanity as "imperilled", as Bostrom puts it, is not only to describe a condition but to confess our role in shaping it. We are the first beings on this planet capable of seeing our own end in advance, and that knowledge is both terrifying and strangely empowering. I keep thinking, as a researcher and as a human being, of my work as part of a broader struggle for survival and meaning. Perhaps this is what makes existential risk such a profound concept. It confronts me with the fragility of life, but also with the obligation to protect the fragile so that it might grow, evolve, and create futures we cannot yet imagine. To me, this is not only a question of policy or science; it is a question of what it means to live responsibly, here and now, in the shadow of uncertainty of climate change and risk.

[33] In his work, *Agential Risks: A Comprehensive Introduction*, Torres (2016) identified a gap in existential risk research, noting that scholars have often overlooked the role of multiple agents employing technologies in ways that could generate risks with the potential to culminate in human extinction. This omission highlights the philosophical problem of agential multiplicity: the fact that risk emerges from singular acts or failures and from overlapping technologies whose collective consequences may exceed human foresight.

uncertainty to even minimise or maximise a risk. This gives rise to substantial philosophical concerns for Sinn regarding why some mitigation designs are not achieving their targets and other designs are inconsistent with factual possibilities. In this case, it stands to reason that Sinn's diagnoses of climate risk failed to identify actual activities in uncertain conditions, especially when such conditions, given their unpredictable nature, provide the context for systematic risk or idiosyncratic risk in the form of risk aversion.

Indeed, it is somewhat difficult for Sinn to account for risk averse agents. Intuitively, even within a margin of error, such agents, by act of error or terror, could contribute to climate risks. But Sinn makes no room for such a factual possibility, especially when we understand a risk to imply an undesirable happening (i) the possibility of an event that may or may not materialise; (ii) the causal factors underlying a potential adverse occurrence; (iii) the probability associated with the realisation of such an adverse event; (iv) the statistical expectation value of adverse occurrences; and (v) the condition of decision-making undertaken within a framework of known probabilities (Hansson, 2004, p. 10).

This quote defines the role of uncertainty providing the context for risk aversion. This understanding, however, poses a problem to Sinn's Paradox in those situations where a person with a capacity as a resource owner is to pre-empt a climate mitigation design just to reduce, if not avoid, the risk of losing resource investment (Bauer et al., 2018; Schneider, 2022).

Undoubtedly, Sinn may have misrepresented the risk attitudes of resource investors, as a single agent (or collective agents), whose survival depends on the use of the resources. This makes the Paradox circumstantial and contextually limited as a theoretical rationale for designing a regulation framework for countless agential entities in an attempt to reduce CO_2 and GHG emissions. The conclusion here may also explain why an analysis of agential conduct is key in understanding climate risks. This is because without such attention to agentiality it will be challenging to predict and mitigate behavioural traits of anthropic actions which we have come to accept as contributing the most to climate risks.

iii. The Climate Ombudsman: Liberty, Sovereignty and the Limits of Global Power

Given the challenges of capturing the actual cost of CO_2 and GHG emissions because of climate change, a collaboration based on a shared value of mitigating CO_2 emission would be a *conditio sine qua non* of effective mitigation design. Sinn's critique of the lapses in resource governance, supply chains and weak regulatory systems (Sinn, 2009, 2012) contributes to the unease among stakeholders when it comes to regulating CO_2 emissions. In view of that, we can assert that the intersection of climate risks and designs underscores agency alongside the power dynamics, geopolitics, resource inequalities, intergenerational injustices, etc., in shaping how people react to climate risks.

Sinn's advocacy for the United Nation (UN) to act as a 'climate ombudsman' over global resources (Sinn, 2009, 2012) makes sense in a multipolar world. He imagines that the UN, given such power, can nudge countries to do that which they would ordinarily not do (Sinn, 2012), based on a historical record of UN's power as regulator in the global space (Sinn, 2012). At least, part of Sinn's advocacy appears to offer genuine guidance to regularising the extraction industry and resource supply chain in view of reducing CO_2 emissions (Sinn, 2012) and exerting punitive action against climate sinners for noncompliance (Sinn, 2009).

The absence of a single power to regulate the resource space limits the potential of mitigation designs regarding compliance, property rights, resource reserve concessions and usage, etc. The presence of the UN offers a point of contact for regulating policies and imposing the necessary sanctions for noncompliance. Indeed, the UN could extend the inter-state trading system to a more global certificate trading system and central-planning solution for the use of fossil energy (Sinn, 2012). If this plan is achieved, "the extraction path would be set not by the resource owners but the UN. The resource owners would not be able to extricate themselves easily from the grip of the UN" (Sinn, 2012, pp. 209-210).

On the nature of power to be granted to the climate ombudsman, the picture painted by Sinn seems to mirror the notion of power which resonates with the conception of power in terms of "[…] constantly to form combinations, even without covenant and […] a distinction emerges between the causal capacity (*potentia*) and the authority (*potestas*/*imperium*) of the sovereign, where these had previously been conflated" (Field, 2014, p. 61). This makes the idea of power given to the UN partly about capacity. In a sense, Sinn assumed that the UN has that capacity to fight against the Paradox effect (Sinn, 2009), to defend the global commons against a "worldwide demand cartel" (Sinn, 2012, p. 213) and the greed that characterises the exploitation and extraction of natural resources (Sinn, 2012). Specifically, therefore, the UN can become a "joint owner of the fossil fuel […] (and) If it gives the national governments the right to sell these rationing […] then it will of course transfer its ownership rights to the national governments" (Sinn, 2009, p. 13). This is what I have earlier referred to as the climate ombudsman. Here, the power of the climate ombudsman (that is, the UN) is seen as the way to solve the continuum of controversy that illustrate the production and consumption of global commons (example, fossil fuel) and determining of the different courses of action for the global community to reduce CO_2 and GHG emissions.

Consequently, if the UN's power is understood in the sense of a control of global resources by a single agency given the "current text of heterogeneous climate commitments" (Schneider, 2022, p. 5), then it is thinkable to assert that global collaboration to mitigate CO_2 and GHG emissions can only make sense when potential collaborators find that the Paradox effect is likely to occur and disrupt other important areas of their existence considering our current dynamic open and market economies (Sinn, 2012). And, thus, the success of the collaboration under a single organisation is contingent on collaborators' desire to adjust and accept a principal enforcement organisation (as Sinn argues) to attain the ends and means of mitigating a climate risk.

The foregoing discussion raises a fundamental question for global climate governance: how can we establish a framework of ends and means to regulate anthropic actions and mitigate CO_2 emissions while minimizing disputes and contestation? Sinn proposes that the UN could serve as this central authority, empowered to control, monitor, and sanction non-compliant states, even to the extent of partially expropriating resource reserves to enforce compliance (Sinn, 2012). He acknowledges the risks inherent in such concentration of power, noting that a "power centre will grow around the UN that will try to extricate itself from democratic controls" and that nations may compete over certificate allocations (Sinn, 2012, p. 212). Yet, structurally, the feasibility of this proposal is highly questionable. The UN's decision-making is constrained by the veto power of its five permanent members, whose conflicting interests make global consensus unlikely. Moreover, proposals that require nations to relinquish sovereignty or ownership of key resources, such as oil and gas, face near-insurmountable political resistance. For countries like Ghana or Nigeria, resource revenues are central to public service provision; even where mismanagement exists, governments are unlikely to cede these assets. Thus, while Sinn's vision illustrates an idealised path for global coordination, it confronts deep structural and political headwinds that challenge its practical implementation.

Sinn's vision reads as wishful thinking, imagining that a positive outcome might emerge from inherently negative dynamics, as the pursuit of UN-issued certificates "in turn, will further strengthen the power of the UN bureaucracy" (Sinn, 2012, p. 212). This prompts a critical question: can we realistically agree on the creation of a climate ombudsman, a quasi-Leviathan authority tasked with regulating extraction, resource allocation, and related development agendas, especially in contexts where national self-interest and policy divergence prevail? Sinn's model assumes a form of Hobbesian power operating effectively within a multipolar world (Sinn, 2012), yet the structural and political constraints outlined above suggest otherwise. In addressing this question, four key tensions emerge from Sinn's advocacy for a centralized UN role in resource regulation, which must be carefully considered to evaluate the feasibility and legitimacy of such an approach.

First, the tension that arises has to do with the denial of the politics of power and power asymmetries in the multipolar world. For starters, there have been numerous global issues such as treatment of migrants and asylum seekers, threats of nuclear warfare, invasion of sovereign states, etc., under the UN's watch. With all these issues, the UN has either failed or completely lacked support from actors that could collaborate to find meaningful solutions.[34] Most often, the issues have been heightened by the clash of two historical and cultural worlds, the Global North and Global South. These polarisations have affected solutions to old and emergent issues such as shifts in rights advocacy, rise in populism, identity politics, diplomatic fissures, debt distress, etc. Thus, inasmuch as it makes sense to argue for a kind of climate ombudsman in enforcing compliance, the willingness to create a governing space to embrace solutions to complex and diverse threats is absent.

Therefore, the limitation of Sinn's climate ombudsman in matters of reception of its mitigation design squarely rests on the history of the UN in matters of power plays and asymmetries among member countries. This history may suggest that Sinn's advocacy of an ombudsman is practically naïve. The UN's history of negotiating conflicting interests in matters of power relations in the global community is daunting. For instance, it was reported

[34] A case in point is the 2024 COP29 in Baku, widely framed as the "finance COP." While the official design of the summit placed emphasis on "nationally determined contributions" and state-led commitments, its unfolding revealed an even deeper fracture: the waning authority of states to singularly dictate the terms of climate governance. The absence of key actors such as the EU leaders, Brazil, the UK, and Russia alongside Papua New Guinea's outright dismissal of the process as "a total waste of time" (Euronews Green, 2024), signalled not just geopolitical mistrust but the fragility of a state-centric model of climate negotiations. In this vacuum, NSAs, ranging from transnational corporations to civil society networks and technological coalitions, are increasingly called upon to carry the moral and practical weight of commitments. If states retreat, stall, or fracture, the ethical and strategic burden of climate responsibility migrates to NSAs, compelling us to ask: can an agency outside the state be the decisive force in shaping humanity's planetary future?

that the US tactically used foreign aid conditionality to influence votes in the UN General Assembly and the Security Council (Nieuwland, 2019). This report was supported by the alleged comments from the then US Ambassador, Nikki Hayley, on UN voting that,

> the American people pay 22 percent of the UN budget – more than the next three highest donor countries combined. In spite of this generosity, the rest of the UN voted with us only 31 percent of the time, a lower rate than in 2016. That's because we care more about being right than popular and are once again standing up for our interests and values (Kruta, 2018).[35]

In the above quote, it is obvious that the US wants to ensure that its foreign assistance must serve its own interests. In whatever way we see it the support from the US is a *quid pro quo* venture, nothing less, nothing more. Here, it is also obvious that the UN as a climate ombudsman is limited in forcing compliance. This explains further the dissatisfaction with the UN's capacity to enforce what is morally right and just in finding practical design to mitigate a global crisis like climate risk, as I will explain later in the next chapter.

Second, the tension that arises is from the normative justification of burden sharing as a result of the climate crisis and related risks along with the free pass of some jurisdictions' historic high records of CO_2 emissions. At present, the mitigation of climate risk is predicated on the reduction of CO_2 emissions which affect the global community and species. The construct of a climate ombudsman to help reduce CO_2 emissions seems to naturally give the UN the mandate to enforce compliance (Sinn, 2012) in the global space. Here we can theorise that the success of the climate ombudsman entails an equilibrium between the benefits and costs of collaboration such that all countries trust and see in practice that their involvement in

[35] This unease is further deepened by the recent return of Donald Trump to the U.S. Presidency. As BBC environment correspondent Matt McGrath (2024) noted, experts anticipate that Trump's stance, long marked by climate scepticism and the dismissal of green energy transitions as a "hoax", may undermine both CO_2 reduction strategies and financial support for developing nations. Yet, the implications extend beyond the United States alone. A climate-sceptic superpower presidency signals a political reversal and a shifting of responsibility. If states falter in their commitments, the guardianship of climate action increasingly rests with NSAs. Corporations, philanthropic funds, city alliances, and grassroots movements may find themselves compelled to accelerate independent pathways of mitigation and adaptation. Hypothetically, one could argue that Trump's return may paradoxically strengthen the moral and operational authority of NSAs, forcing them to occupy the vacuums left by hesitant states. The question becomes whether NSAs possess both the legitimacy and endurance to sustain such a burden in a fractured global order.

the mitigation ends and means leaves them surplus for development and survival. If countries cease to trust and see that in practice, they will try to measure and lighten their costs which may compromise a mitigation design in many ways.

It is obvious, therefore, that in the matter of weak governance among countries, well-intentioned agreed green strategies may harm the global ecosystem and provoke the Paradox effect (Sinn, 2012; Jensen et al., 2015; Schneider, 2022). It is also the case that we have to define the limits of the countries within which the mandate to enforce compliance applies. However, we cannot rule out the historical facts that the contributors to CO_2 and GHG emissions into the atmosphere are mostly from the Global North. So, the questions remain: why do we still give a free pass for some countries to continue increasing their emissions and others bearing the burden of the emission though they contribute less? Why do we need a climate ombudsman when we know the heavy contributors of CO_2 emissions and climate sinners, but refuse to act? Can we rely on the UN to be fair in regulating the space when the burden of mitigation ends and means lie heavily on every country?[36]

Third, the tension that arises with Sinn's model of climate ombudsman is whether the UN is able to integrate self-determining countries and independent NSAs into a single overarching community in the effort to control their resources. In matters of mutually beneficial cooperation, the climate ombudsman may have to battle as a regulator with the fact of countries and interest groups prioritising their interests (development, survival, wellbeing, etc.,) based

[36] The normative implications of these questions will be examined in the following chapter, particularly in relation to the ethics of fairness, responsibility, and institutional legitimacy in global climate governance. The very framing of these questions exposes a double bind: on the one hand, the persistence of asymmetries, where some states expand their emissions with impunity while others disproportionately bear the burden, points to the failure of existing regimes to translate responsibility into enforceable accountability; on the other, the appeal to institutions such as a climate ombudsman or the UN risks repeating the Paradox by prescribing ideals of fairness and impartiality that may remain aspirational without structural transformation. Existentially, this reveals an alienation, particularly when global governance promises equity yet delivers inequity, the trust of vulnerable communities is eroded, leaving them suspended between recognition of injustice and the impossibility of redress. This underscores the recurring problem that haunts climate governance, namely, that normative demands, no matter how compelling, risk collapsing into paralysis unless coupled with enforceable designs that bridge what *is* with what *ought* to be.

on their degree of experience and helplessness to the changes in climate. As an example, for many in sub-Saharan Africa, the main concern when it comes to climate risks continues to be development and survivability (Parker, 2014).[37] The region's desire to overcome such development deficits and to survive explain why, in recent climate debates and conferences, there are increasing disputes over clean energy, concepts of sustainability, climate justice and funding, activists versus political actors, corporations, etc., (Conley & Botwright, 2023). Indeed, the region, in practice, may accept non-compliance clauses in a mitigation design because a better share of the benefits accrued over time with the use of the global resources would leave it richer. Therefore, modelling Robert A. Dahl's (1957) concept of properties of power relation and Steven Lukes' (2015) analysis of Robert Dahl's concept of power[38], I assume that for the UN to have power as the climate ombudsman,

(i) that "*A* can hardly be said to have power over *a* unless A's power attempts precede *a*'s responses" (Dahl, 1957, p. 204). In the context of climate mitigation risks, it means that the UN's power ought to precede member countries' reactions to climate mitigation design which has a mark of power relations regarding the existence of "a time lag, however small, from the actions of the

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[37] This concern also extends to the question of climate funding, where the global conversation has taken a significant turn. At the 2024 UN climate meeting (COP29) in Baku, Azerbaijan, negotiators, particularly, from the Global South debated the adequacy of the long-standing pledge by developed countries to mobilize 100 billion USD annually in support of developing countries' climate action. That pledge, widely criticized for being a political commitment rather than a needs-based framework, is now set to be replaced by a "New Collective Quantified Goal on Climate Finance" (NCQG) (James, 2024; Alayza et al., 2024). Unlike the earlier arrangement, the NCQG is designed to be more responsive to the real priorities and financing needs of developing countries, with discussions pointing toward a scale of climate finance exceeding one trillion USD by 2030 (Alayza et al., 2024). Considerably, this shift reflects a rethinking of responsibility and justice in the climate era. It challenges the notion of climate finance as a charitable gesture from the Global North, reframing it instead as an ethical obligation grounded in historical accountability and distributive fairness. The NCQG signals a movement away from symbolic pledges toward a more needs-based conception of global solidarity, where funding is about meeting numerical targets and recognising the asymmetry of vulnerability and capacity across nations. In this light, the debate is not only about trillions of dollars but about what constitutes justice between generations, regions, and ways of life in a climate-fractured world.

[38] Lukes's (2015) analysis of power, building on Dahl, reveals that collapsing influence and authority into a single metric risk overlooks the intricate interplay between actors' dispositions, values, and interests, as well as the latent capacities embedded in social structures. In this light, power is relational or coercive, and an existentially and practically mediated phenomenon, inseparable from the moral responsibilities, reflective deliberations, and interpretive acts through which agents continuously shape, contest, and reconstruct social realities and collective possibilities.

actor (UN) who is said to exert power to the responses of the respondent (countries)" (Dahl, 1957, p. 204);

(ii) there must be a connection between the UN and member countries (Lukes 2015) since there cannot be "action at a distance" (Dahl, 1957, p. 204). In this case, "in looking for a flow of influence, control, or power from **A** to *a* [UN to country], one must always find out whether there is a connection, and if there is not, then one need to proceed no further" (Dahl, 1957, p. 204); and

(iii) there must be a positive effort by *A* [UN] to get *a* [countries] to do what otherwise *a* [they] would ordinarily not do (Lukes, 2015), which is a necessary condition of power relation (Dahl, 1957).

Following the above synthesis of power relations regarding the function of climate ombudsman, it is conceivable that for Sinn's climate ombudsman to work there is the need for a subsisting relationship and mutual consent between UN and countries as well as the UN and NSAs[39]. However, given the model of Sinn's approach to the UN's power, there are practical problems to consider. In practice, it is self-evident that the matters of power relation cannot be separated from matters of inequality and unfairness. These matters are further deepened considering the fact that conditions precipitating climate risks are more complex than that of granting a single organisation the power to govern, especially when that organisation has to also battle with self-determining interests of countries when it comes to the natural resources.

A fourth issue raised by Sinn's model of the climate ombudsman concerns the paradox of constructing a single authority to regulate the conduct of individuals and states in matters of climate change. From the outset, the very idea of regulating the vast plurality of human aspirations and interests under a single construct is ethically and politically fraught. To assume

[39] The NSAs will be dealt with in subsequent sections of this chapter. However, for starters, in "a more divided and contested global landscape, less adaptable state institutions, and greater capability and resourcing available outside governments are giving NSAs greater influence in and across multiple global domains" (NIC, 2023, p. 1).

that diverse actors would willingly surrender their sovereignty, and their right to self-determination over natural resources, to a construct and a supranational authority, and then allow that such construct to dictate the modalities of extraction and use, seems both practically untenable and normatively problematic.

What Sinn envisions might function only under the conditions of mutual consent and reciprocal advantage among a coalition of compliant states. In that limited sense, the United Nations could act within the bounds of legitimacy, exercising authority only insofar as it is permitted by the sovereign will of its members. Yet, if such consent collapses, the UN's power contracts to the extent of its recognition. And an authority without compliance becomes authority without force. Here lies rather the paradox of authority, that is, the UN would be asked to compel precisely those states whose sovereignty it cannot override. The outcome, as Sinn warns, risks disintegration into laissez-faire, with supply chains and emission controls unravelling in the absence of binding oversight.

This leads to the thicker question: is it desirable, or even coherent, to vest such authority in the UN or in any ombudsman-like body? To do so would require resolving the tension between sovereignty and legitimacy and between the self-rule of states and the moral imperative of global stewardship. Sinn attributes the confusion of climate governance to the dispersion of power across states, such that no single actor possesses the legitimacy or capacity to confront climate sinners (Sinn, 2012). But whether a supranational climate ombudsman could overcome this dispersion without lapsing into illegitimacy remains an open, and perhaps insoluble, question.

Considering the four tensions, Sinn's advocacy for a climate ombudsman (Sinn, 2009) would inherently be problematic in practice. For instance, the tensions demonstrate the threat that Sinn's model could pose to the principle of liberality.[40] It is unclear how liberalism would subsist given Sinn's demands for compliance to the climate emergency. Therefore, we may ask: what does Sinn's relinquishing of liberal goals mean for the climate ombudsman in view of the mediating effects of contexts and within the dynamics of multipolarity of the world as well as concerning the degrees of exposure and vulnerability to the changes in climate?

For Mark Coeckelbergh (2021), the strain between liberalism and climate emergency in our democratic societies today seems to demand some fundamental measures that may lead to authoritarianism because they could affect the freedom of sovereign countries. They may also lead to directing countries, and their governments (and individuals) to reduce CO_2 emission, even if not reducing it is key to their development and survivability. This may further go against the sovereignty – the acquired legitimacy of a country to exist on the basis of its self-identity (and determination), based on inherent rights and duties acquired through independence (Fagothey, 1976).

In conclusion, Sinn's approach to the climate ombudsman may only create a divided body politic in our desire to have global collaboration and compliance in mitigating climate risk in an active way. Sarcastically, his solution would not be a problem if we choose to place survival first and destroy freedom, democracy, and sovereignty, or if the sovereignty of a country is less valuable compared to risks and climate uncertainty.

Unquestionably, however, by the norms of international law, no country can be denied its right to sovereignty, if its aspirations infringe on the sovereignty of another (Shaw, 2008). Such sovereignty is a postulate of moral law and natural rights (Fagothey, 1976; Copleston, 1985 a, 1985 b) – the source, it can be assumed, from which the power of the climate

[40] Sinn alluded to the challenges that we may have if we do not relinquish some liberal goals in the fight against climate risk like global warming. According to him, decision makers are torn between the Scylla and Charybdis and the monster that often ate sailors who try to cross the strait of Messina which is a reminder of Hobbes's Leviathan and acts of greedy states (Sinn, 2012). In a sense, for Sinn, for us to mitigate the climate risk we must let go of some liberal goals so that we may avoid the whirlpool of navigating the struggles with global warming (Sinn, 2012, p. 213).

ombudsman to exist ought to flow as well. Therefore, if Sinn's advocacy for a climate ombudsman is to count for anything, it must include the right of each country to decide for itself what is morally right to its development and survivability. Otherwise, Sinn may simply be advocating for a policy of power rather than a genuine mitigation design.

Moreover, no global resource regulation, in the way Sinn advocates, will make sense if natural rights inherent in the governing subjects are undermined by an exogenic single power via their domestic political government. The UN's limited capacity to address pressing challenges in today's multipolar order is evident in its ability to resolve conflicts such as the Russian-Ukraine war, the invasions of Libya and Iraq invasions, Sudan conflicts, and the protracted Israel-Palestinian crisis. Hence, its role in the global regulation of extraction and resource supply chain may only be another example of a superficial governance that paves the way for a potential hijacking of another country's right, authority, juridical and political space to determine how they want to develop and what goes into such development. The assumption underscores the reasoning behind the consideration of the normative dimensions of the Paradox.[41] Therefore, Sinn's concept of UN's power is far from making the predictive accuracy higher and the mitigating option realistic.

iv. Framing Climate Action: Language, Meaning, and the Epistemic dimensions of Design

Agreeably, in designing guidelines to regulate activities regarding a complex phenomenon like climate variability, we could project that the framers will purposely address the impacts and externality of climate risks (Hoeben et al., 2023). Here, a common-sense approach would be that the guidelines must be designed to lessen the risks while envisioning new mitigation forecasts in a way that the ordinary person on the street would understand and end-users would appreciate. Therefore, the significance of climate mitigation designs is premised on a reasoning

[41] The normative aspects of the foregoing discussion would be explored more in the subsequent chapter.

that climate risks are global problems; and, if so, then designs are to fulfil the requirement of stimulating universal cooperation and ratification (Centre for Sustainable Systems, 2022). Thus, designing ought to have a global feature with a common objective, so to say, of reducing the high-level emissions of CO_2 and GHG which threaten lifeforms, planetary boundaries, and climate organisms (UNFCCC, 1992).

From the above, it can be presumed that climate mitigation designs begin with identifying a global risk. After identification, a solution is designed to address the identified risk. In this sense, the design will be prescriptive (or prognostic) but based on the descriptive (diagnostic) account of what is identified as a risk and precipitating conditions for the risk to be addressed. The design ought to be persuasive enough to convince its target group, which in this case is the global multipolar world. This leads to two critical components that need to be underscored in a design. The first component is the evidence to support the criticality of the situation identified. Here, we are concerned with how guidelines are made based on political, economic, and social issues, and how global agenda could affect local opportunities or otherwise (Front Matter, 2017; Gibbons & Evans, 2023). A yet stronger concern is whether the 'about-to' design is existentially and morally better than existing designs because, as earlier said, the guidelines can be influenced by biases and irrational impulses given that guidelines are not impartial and not diverted from self-interest.

The second component is the linguistic framework to express the concepts and categories, and relationships between the concepts and categories and potential variables in the situation. In the language component, there is the need to highlight how dissemination of climate science findings and regulatory guidelines are constructed and consumed (Front Matter, 2017; Gibbons & Evans, 2023). The linguistic consideration is grounded on Bernardo Mueller's (2020) work on informational and epistemological limitations of public policies and how such limitations make policies fail. This failure, Mueller claims, is because of the 'pathology' of the complex nature of policies (Mueller, 2020). This is because policies are entropic, lacks equilibria, less predictable, 'evolve and coevolve', are open to rational preferences, are prone to reactivity and can be affected based on the Lucas critique[42] (Mueller, 2020; Frey, 2017).[43]

A linguistic framework as described is often overlooked in designing climate mitigation designs. This oversight inheres in the fact that we often assume that everyone shares the same concepts and categories of what makes a climate risk; and that it is easier to make a choice for the mitigation design because of the pretext that climate risk is a global phenomenon. However, even if we can define a risk that needs a global intervention, any design not framed in a linguistic framework which a targeted group can associate with, is highly likely to fail. The supposition here is based on the work of Bardach and Patashnik (2020) on analysing a policy. According to them, if we want to predict an outcome, we need to make a distinction between evaluative criteria and practical criteria regarding legality and political suitability (Bardach & Patashnik, 2020). In the context of climate mitigation design, thus, we need to look at the efficiency and fairness of the climate design and practical ways they fit into the legal and political framework of targeted groups. If Bardach and Patashnik's criteria are accepted, then we can easily assume that the criteria also depend on how the language of designs are framed regarding real-life experiences, terminologies, political tones, etc. In a sense, the nature of the language will either narrow or expand the scope of a mitigation design.

It follows that a climate design could be influenced and/or induced by a spatiotemporal reality[44]; and language as an example of a spatiotemporal reality could constrain and enable

[42] The Lucas Critique is a form of fallacy of tradition, people use in the attempt to predict the effects of a change in policy on how people will behave by relying on the connections of data we have seen in the past (Mueller, 2020).
[43] In the reactivity, Mueller explained that policy fails when targeted agents of a policy realise that they are being misled or used and aimfully react (Mueller, 2020).
[44] Language is a typical example of mediating effects of contexts.

the success of design. For instance, when it comes to informational constraint in policy, Mueller (2020) postulated that,

> information in the form of culture, beliefs, institutions, norms and technologies, also changes through a process of variation, selection and replication. Public policies are crucially determined by culture, beliefs, institutions, norms and technologies, so if these things evolve according to the specific algorithm of variation-selection-replication, this affects which public policies arise, how they operate and the impact they have (Mueller, 2020, p. 316).

This implies that a linguistic framework is crucial for a design to be predictable, controllable, and understandable (Mueller, 2020; Gibbons & Evans, 2023). It is also vital to filter out irrelevant data and to isolate guidelines that oblige action. This explains how elusive a design for global consumption can be within today's complex systems coupled with dynamics in society, attitudes, traditions, technologies, etc., (Mueller, 2020).

Given that a climate design has a certain linguistic meaning for its target groups, we may ask: under what conditions are we justified in saying that a language used for constructing a mitigation design has the same sense in other given existential contexts? What are the ways in which the meaning of an expression may be vague in constructing a mitigation design? Are the linguistic forms of designs a matter of semantics or of epistemology? These are some of the philosophical caveats Sinn did not pay attention to – that, a linguistic framework of a mitigation design predisposes how an intervention is conceived, relevant and relatable *in situ*.

Irrespective of the questions raised, further considerations can be given to the intersection of language and mitigation design. We can begin with the argument that, where possible, the conceptual analysis of linguistic value of a mitigation design is as crucial as the practical implications of the design. This is because a design's novelty lies in how it explains a problem and how it solves it. However, the novelty is irrelevant unless the information we have about the problem is detailed, understood, and thereby made meaningful. The point I make here is that language practically affects choices and behaviours. This reveals a basic value of acquiring or presenting information. This also reveals the importance of making sense of the information – to be aware and then decide whether to act or not.

Sörlin and Lane (2018) identify two drifts in historicising climate change that carry significant implications for the philosophy of mitigation design. The first drift frames the climate variability as an occurrence approached largely as an intellectual account and pursued primarily within scientific and policy communities:

> to understand climate change as a scientific, political, and cultural phenomenon. To put it crudely, it is an attempt to establish an intellectual history of the climate issue and by implication it is by and large a late modern history, rarely more than a century long, but clearly with innovative exceptions, […] Its main practitioners are in historical and other humanities and (some) social sciences, although, clearly, there are many instances of collaboration with scientists and policy (Sörlin & Lane, 2018, p. 6).

The second drift shifts focus to the material agency of climate itself, emphasising the proof of anthropological weight on environmental systems and the reciprocal impact of these systems on societies. Here, Sörlin & Lane (2018), noted that:

> […] an attempt to give historical agency to climate, albeit in many instances a climate affected by humans. The object of historical research here is material; it is in the records of climate change and in the evidence of human influence of that climate and its influence on humans and their societies. This evidence privileges the methodologies of archaeologists, paleo-ecologists, geoscientists, and biophysical experts. Intellectual changes are in the background, although they sometimes play a role. The time depth of this historicizing enterprise is typically much longer […] (p. 6).

Rationally, these drifts underscore the intertwined epistemic and ethical stakes in mitigation design: our capacity to act responsibly depends both on conceptual clarity and on careful attention to material realities, historical contingencies, and the asymmetric vulnerabilities of human and nonhuman actors. Mitigation is, thus, a practical or policy challenge. It is an exercise in discerning how knowledge, power, and agency intersect across temporal and ecological scales, shaping what can be considered just, effective, and possible in the governance of climate risk.

Building on Sörlin and Lane's (2018) reflections, we can further argue that mitigation designs are not neutral instruments but necessary constructs whose composition, inference, and application, whether theoretical, historical, social, or representational, are shaped by dominant philosophies and geopolitical structures. Such designs are products of multiple semantic and epistemic commitments, which profoundly influence both their construction and use. This insight aligns with Wittgenstein's critique of the misuse of language as a source of philosophical confusion (Miles, 1994; Anat & Anat, 2018).

This consideration underscores the complexity of mitigation designs across different measures and contexts and highlights the centrality of language in determining their effectiveness. Because every design is mediated through language, it inevitably intersects with broader social, cultural, and political commitments: whether gendered, racially inflected, or epistemically hegemonic. To assume that the language of a design is neutral or free from such intersections is a serious oversight, one Sinn does not appear to address.

Hypothetically, if a design is intended as a reflective instrument within a framework[45], its success depends on how target populations respond to it under varying stimuli and existential conditions (Mueller, 2020). Any design is therefore inevitably entwined with worldviews that may regard other contexts as rationally strange or epistemically marginal. In this sense, a mitigation design is a construct of knowledge-claims that intersects with diverse identities, socio-political and religious structures, economic realities, psychological frameworks, and epistemic frontiers.

Consequently, when considering global warming as a critical climate risk, it is essential to reflect on how it shapes self-understanding and how different communities interpret and articulate such risks through language. The legitimacy of a design, that is, what it seeks to achieve, why it exists, who shapes it, and how it operates, is inseparable from linguistic framing. Designs are, in effect, expressions of collective identity, codifying which voices are

[45] The use of the term framework is an allusion to Phil Torres's (2016) distinction of existential-context conditions as instigating factors for decision making.

central and which are peripheral. Across history, linguistic frameworks have amplified certain perspectives while marginalizing others, often privileging Western epistemic traditions in global interventions. This linguistic dominance can reinforce hegemonic assumptions, misrepresent non-Western knowledge, and instrumentalise language to direct behaviour in ways that may produce unintended consequences elsewhere (Kidd et al., 2017; Dahl, 1957).

2.3 Chapter Summary

It was clear in this chapter that the Paradox arises only when event X (demand for greener policies) and event Y (acceleration of global warming) both occur, with these events intertwined through spatial and intertemporal CO_2 leakages driven by human action. The key to addressing the Paradox lies in curbing the anthropic behaviour of climate sinners through supply-side mitigation designs that leave fossil resources underground. While CO_2 and GHG accumulation is undeniably a causal factor in global warming, the shifting of production across space (spatial leakage) or time (intertemporal leakage) reveals that global warming encompasses multiple interacting agential facts, far beyond what Sinn assumes.

Consequently, although the Paradox hinges on the relationship between X and Y, it fails to (i) account for the wider compounding variables that influence these events and their inferential connection, and (ii) consider how climate risks intersect with multiple agents and how these agents respond. These gaps highlight the conceptual and practical limitations of the Paradox in identifying ethically and operationally sound mitigation strategies.

Moreover, the Paradox rests on limited evidence regarding why risk-averse fossil fuel investors might accelerate extraction now to extract less later, and it underestimates the existential and contextual constraints that shape climate risks. The inadequacy of this evidence reduces the Paradox's predictive reliability, as it neglects both full causal explanation and the complex interactive systems within which the events occur. As a result, the current formulation of the Paradox is theoretically and practically less compelling for understanding real-world climate risks and informing effective mitigation designs.

CHAPTER THREE

THE GREEN PARADOX: NORMATIVE PROBLEMS

3.0 Introduction

To this point, I have made the argument that the inferentiality in the Paradox rests on complex and countless variables which make the Paradox an unreliable theory in relation to what it sets out to describe: human lifeworld and physical world. Consequently, the Paradox and its climate mitigation design face conceptual and practical difficulties for the reasons that,

(i) it is difficult to predict a single outcome when countless variables interact;

(ii) there are irregularities of variables given the unpredictability of human behaviours;

(iii) there would be a lower performance regarding the predictive accuracy needed for a climate mitigation design in view of the countless interaction and irregularities of variables in climate scenarios, especially when the variables could emerge in multiples and not simply one at a time.

In my analysis of the Green Paradox, I examined practical factors that run counter to its corresponding mitigation design. These factors, I argued, stem from the behaviour of the epistemic and ethical agent who acts, or refrains from acting, based on perceived susceptibility to climate change. My emphasis lay on the epistemic implications, particularly the inferential habit: the reasoning pathways from event X to event Y. I showed that even if the conditions or primary variables required for the Paradox to occur are indeed present, the justifications for its corresponding design constrain that design's predictive accuracy. Consequently, these practical factors limit the design's capacity to function as intended.

From this, I concluded that the inferential structure underlying the Paradox is weaker than its theoretical elegance suggests, and that its mitigation design delivers low predictive accuracy even allowing for margins of error. This supports Schneider's (2022,) observation that "the work on the Green Paradox is conflicting. While this hypothesis displays robust theoretical mechanisms, its practical relevance remains eroded in the context of climate change." (p. 9). Sinn's claim that greener policy quickens global warming (Sinn, 2012) is undermined when one accounts for varying degrees of climate change susceptibility and how these differences shape the risk experiences of agents. His account falters both in its conceptual framing of the scientific phenomena we label "global warming" and in its treatment of real-world effects that his mitigation design seeks to address.

Moreover, the theory's weakness becomes more pronounced when considering the observable multiagency and interagency dynamics that drive global warming. These dynamics are often shaped by countless variables and differing degrees of exposure and vulnerability to the change in climate. This highlights a critical philosophical issue: the Paradox cannot be fully understood without distinguishing matters of fact (empirical climate dynamics, extraction rates, emission levels) from matters of value (moral responsibility, justice, and the ethics of policy signalling).

Having analysed the Paradox in both conceptual and practical terms, I now turn to it from a normative perspective. My concerns centre on Sinn's treatment of anthropic-factual possibilities – descriptions of human action alongside prescriptive designs to regulate those actions. If a mitigation design lacks a morally acceptable foundation, I remain sceptical about decisions built on ethically charged issues such as justice, climate responsibility, and compensation, especially in a crisis whose impacts vary considerably by geography, development level, economic status, and contextual mediators. Such scepticism also extends to the validity of designs that presume they can effectively regulate human behaviour and sanction human action. From a philosophical standpoint, this raises questions about the adequacy of consequentialist reasoning in climate mitigation designs, the deontological duties to prevent foreseeable harm, and the virtues such as prudence, foresight, and ecological responsibility, etc., that policymakers must cultivate to navigate uncertainty.

Two motivations drive this normative inquiry. First is the question of agency in climate risk, particularly the agency of resource owners whose behaviour, per Sinn, accelerates climate change. From a moral standpoint, an individual resource owner is, by definition, a moral agent. Collectively, corporations or groups can likewise be treated as moral agents insofar as they comprise individual moral agents (Dempsey, 2013). This dual consideration of agency invites reflection on intergenerational ethics: current actions reverberate across time, creating moral obligations toward future populations whose vulnerability and exposure may differ from present actors.

The second motivation concerns the agency of Artificial Intelligence (AI) and "climate-intelligent" technologies, and how such agency intersects with variables in CO_2 and GHG emissions and their mitigation. If the agency of AI-technological systems can be justified, then the critique of Sinn's design grows stronger: the inclusion of nonhuman agency[46] further complicates the already delicate predictive structure of his theory. It also underscores the epistemic limits of climate knowledge: uncertainty in modelling, unforeseen interactions, and emergent systemic properties challenge the assumption that mitigation designs can reliably translate intention into global outcomes. This becomes especially relevant in the context of developing a "framework that can endure beyond the electoral cycle and that can bridge the

[46] This can be discerned in relation to nonhuman agents, such as emerging AI-technological systems, whose participation extends beyond mere instrumentality to an active shaping of cultural norms, social practices, and collective decision-making. The fact remains that their physical and operational presence bears the imprint of human intentions and conditions, yet in turn they refract those very intentions and conditions back upon us in a way of altering economic trajectories, unsettling ecological balances, reconfiguring socio-cultural forms, and redirecting political outcomes. In this sense, they stand as mirrors and mediators, that is, born of human design, yet capable of generating unforeseen worlds that exceed the horizons of their creators. This further raises questions about agency, responsibility, and moral consideration. In a sense, if nonhuman systems can alter systemic dynamics, how do we attribute causality, accountability, and ethical oversight? Moreover, it highlights the interdependence of human and nonhuman agents in complex adaptive systems, suggesting that technological agency is entangled with societal evolution in ways that challenge traditional anthropocentric mitigation designs. A more detailed explanation of these dynamics, and their implications for future orientations on mitigation designs, will be offered in the next chapter.

large temporal and geographical distances between greenhouse gas emissions and climate change impacts" (Reisinger & Larsen, 2010, p. 117).

Finally, framing the Paradox within complex systems reinforces its philosophical depth: human and nonhuman agents co-exist in networks of interdependence and feedback. The Paradox, thus, exemplifies the limitations of predictive accuracy, and the ethical complexity of mitigation designs, where facts, values, and anticipatory behaviour intersect in ways that challenge conventional notions of responsibility and efficacy.

3.1 The Green Paradox: Normative Dimensions of the Paradox and Mitigation Design

From the above-stated concerns, I will examine how the Paradox and its corresponding design diffuse into general ethical matters, even if Sinn did not explicitly set out to consider the normative problems his theory and design pose. This invites reflection on the broader interplay between empirical theories and normative reasoning: even a theory grounded in facts inevitably generates moral and practical questions when it informs action in complex human and nonhuman systems. Specifically, the Paradox practically nudges us to take climate risks seriously, highlighting that we ought to scrutinise our current and future approaches to the production of CO_2 and GHGs stemming from natural resource consumption. What this means is that the causal conditions the Paradox describes, and the design prescribed to resolve them, are practical and ethically loaded as well as socially consequential.

Why is the Paradox ethically problematic? First, the normative problem stems from a question of relevance: why are we designing climate mitigation frameworks at all? At the core of this question are further inquiries: are there moral decisions that can be taken within the climate change space independent of formal mitigation designs? Can we rely on Sinn's work given the emergent risks posed by nonhuman agents, such as AI-technological systems? Will

Sinn's mitigation design treat small-scale CO_2 producers equitably relative to larger producers? Should mitigation designs aspire to universality, or must they be context-sensitive? What role must individuals and groups play in defining and shaping the pace of climate mitigation, given their differing experiences, capacities, and liabilities in relation to climate impacts?

One would realise that these questions focus on the 'what', 'why', 'how', 'where', and 'when' of the Paradox within the broader discourse on climate change and its attendant risks. In other words, these questions link the Paradox to fundamental issues of rule-guided design, where duties are imposed on individual and collective agents and on the "rule-maker" responsible for crafting the framework. This raises classic questions about justice, authority, and intergenerational responsibility: who decides the rules that reconcile present needs with obligations to future generations? If we assume that the Paradox entails a rule-guided design, then we must ask: what is the content of this design? Who determines it, particularly given the tension between present and future generations?

Moreover, if the Paradox rests on a fault-based responsibility rule [47], how should we construct a framework to allocate accountability, especially when actions and consequences

[47] The reasoning behind the rule is that a victim is liable for his or her losses unless the person who caused the losses is strictly at fault (Coleman, 2002). This rule reflects a foundational moral intuition: accountability arises when an agent's intentional or negligent action produces harm, linking causality with moral and legal responsibility. In a sense, we can justify imposing liability for an action and awarding compensation to victims of that action. According to scholars like Cane and Goudkamp (2018), the rule can be criticised from social and practical perspectives, particularly in relation to the dynamics of compensating a victim of personal injuries inflicted by another. From a normative perspective, this raises questions about fairness, distributive justice, and the moral limits of assigning responsibility when harm arises within complex social interactions. Scholars like Deffains and Fluet (2014), comparing strict liability and fault-based rules, argue that fault-based regimes send "a stronger signal about one's character than a strict liability offence. Fault-based regimes will therefore often perform better in harnessing reputational concerns for the purpose of inducing socially appropriate behaviour. However, the result does not always follow because the social meaning of legal sanctions depends on the frequency of detected offences. This in turn will depend on the underlying situation, the enforcement policy and the legal regime" (pp. 26 – 27). My observation here underscores the interplay between individual moral agency and the social construction of accountability: the efficacy of rules depends not only on formal design but also on societal recognition, enforcement practices, and shared moral norms. In all accounts, the basic elements in determining fault-based responsibility rules hinge on the questions: "how do we hold A responsible for an act, not B?" and "why is A liable, not B?" These questions reveal epistemic and ethical considerations about knowledge, evidence, and intention: establishing responsibility requires more than causal connection – it demands sufficient proof of morally and legally significant fault. Furthermore, there is a concern over capacity and the standard of proof, beyond a reasonable doubt and sufficiently clear and convincing, to ensure that the rule can be appropriately implied and applied. This introduces a philosophical tension between certainty and moral responsibility: how do

are distributed across multiple agents, both human and nonhuman? It is in this sense that the first normative problem emerges: the Paradox inherently intersects with real-life, perceptible challenges for all agents involved.

Second, the normative problem naturally extends from deliberations about what ought to be done to counteract the Paradox's effects, assuming it accurately represents conditions precipitating accelerated climate risk. For Sinn, the problem is the anticipatory extraction behaviour of resource owners in response to greener policy signals. Consequently, he recommends prioritising CO_2 emissions allocations to balance domestic and global governance of resource reserves. Here, Sinn's recommendations can be seen as a preliminary ethical sketch, offering a framework for what ought to be done to regulate human and collective behaviour within ecological thresholds. Logically, this raises questions about trade-offs, prudential governance, and the moral weight of anticipatory action in complex systems.

Considering these two ethical concerns, we can conclude that the normative problems of the Paradox revolve around: (i) expectations about how agents, individually or collectively, ought to act in view of CO_2 and GHG emission thresholds, and (ii) evaluating whether the corresponding design is actionable, justifiable, and morally defensible in light of climate change's unpredictable risks, including emergent nonhuman agents. In short, the Paradox serves as a lens for examining the intersection of empirical facts, human and nonhuman agency, and normative obligations in designing mitigation strategies that are both effective and ethically coherent.

Consequently, to frame the normative problems, I shall suggest here five themes for consideration.

we reconcile imperfect knowledge with the ethical imperative to hold agents accountable, particularly in cases where multiple agents or systemic factors contribute to harm?

3.1.1 The Moral Tension of Climate Risk and Human Action

Climate risks are, at their core, the outcomes of human actions, which can be interpreted as morally significant, potentially good or harmful. From this perspective, the design of Sinn's mitigation plan aims at practical correction and guiding human behaviour through rules that prevent the repetition of harmful acts or mitigate their consequences. In this context, Sinn proposes a framework of counteractions specifically intended to disrupt the conditions that give rise to destructive behaviours, for example, creating incentives for resource owners to leave certain resources unextracted. By doing so, Sinn offers more than a policy prescription: he opens a space for reflecting on the moral and causal dimensions of human acts and invites us to consider how rule-guided pathways might shape ethically responsible and sustainable climate initiatives for the future.

A normative challenge emerges because Sinn conceptualises the pre- and post-conditions of the Paradox as human acts that carry consequences extending into the future. This framing transforms the Paradox from a problem confined to present-day activities into a question about the ethical implications of actions across time, highlighting the moral weight of decisions that affect both current and future lifeworld. Here, profound questions of intergenerational justice, sustainability, and moral responsibility arise, that is, how can present generations fulfil their legitimate needs while simultaneously honouring the claims and interests of posterity? Moreover, it compels us to interrogate the ethical foundations of ownership and stewardship – what grounds our use of resources as "ours," and under what principles do we acknowledge responsibilities toward what might be called "theirs"?

The philosophical question, therefore, is: how do we determine which human actions are morally acceptable amid the complexities of multi-agent actions and varying experiences of climate variability?[48] Is a resource owner's action morally justifiable if intended to generate wealth for the common good, or to mitigate risk for a community, even if it involves pre-emptive extraction? Sinn, however, interprets these actions as self-interested, driven by the greed of cartels controlling extraction and supply chains (Sinn, 2009).[49] He concludes that such self-interest contradicts the common good because it is fuelled by greed and "fundamentally unable to extract the resources in a conservative manner" (Sinn, 2012, p. 163).

This position reflects a utilitarian lens, prioritising 'the greatest good for the greatest number' (Copleston, 1985) and assumes that aligning resource management with utilitarian principles can prevent the Paradox effect if we guarantee that our climate actions resonate with the 'greatest good for the greatest number' by frustrating a few greedy cartels (Sinn, 2012). Here, tension rises between individual rationality and collective welfare in a way that we see the limits of moral reasoning when private incentives conflict with socio-ecological goods.

Another perspective on human action and the normative problem of the Paradox is Sinn's reasoning that climate risk acceleration results from intended actions, specifically, resource owners pre-empting greener policies (Sinn, 2012). Sinn suggests that such choices are not risk-neutral; they should be evaluated across comparable choices over time and space. This introduces a further ethical concern regarding capacity: agents' ability to act responsibly

[48] A natural follow-up question arises: by what criteria can we determine whether the actions of an individual or a group are ethically better or worse than alternative courses of action? How do we meaningfully evaluate our present decisions against past practices to assess whether they constitute the right actions for future generations? This inquiry highlights the inherently comparative and temporal nature of moral judgment in sustainable futures, revealing that ethical evaluation is not static but must account for historical context, foreseeable consequences, and the evolving needs of those yet to come.

[49] In discussing cartel activities, Sinn likens their behaviour to that of rogue nations, highlighting associated climate risks. I contend, however, that it is more accurate to view these activities through the lens of private-sector capitalistic drives, which inherently shape extraction practices. While such drives face challenges, they are not as inherently negative as Sinn suggests. The accelerating dynamics of climate change, in fact, demand collaborative efforts and capital investment that cannot be left solely to national governments. Consequently, a broader perspective is required, one that considers how business leaders can actively drive climate reforms and action. Building global pathways for climate mitigation is no longer the task of any single entity, particularly given the pressing issues of financing, reversing biodiversity loss, and addressing equity in emissions and mitigation costs. Ensuring that less endowed communities gain access to capital and technological systems for clean energy transitions and sustainable economies is central to this expanded approach.

depends on their knowledge, autonomy, fiscal resources, and production power. Ethical evaluation of actions must therefore account for disparities in capacity among agents.

The idea of capacity can also be understood in relation to the principle of 'finders keepers,' which suggests that a person who obtains a piece of property is its rightful owner if there is no proof to the contrary (MacMillan, 1995).[50] Logically, this principle raises questions about natural resource ethics: does the mere ability to extract confer moral permission, or must extraction be assessed against collective and intergenerational responsibilities? Consequently, the justification to extract the commons, whether for private or public purposes, cannot rely solely on capacity; moral and social considerations must inform action.

Properly considered, Sinn's analysis of human action in relation to choice and capacity touches on the enduring question: why do we do what we do? Why should resource owners continue to extract resources even when aware that their actions accelerate global warming and CO_2 emissions? Sinn's depiction of the Paradox, therefore, exemplifies human action at its worst. It is ethically nuanced. For instance, in his discussion of intergenerational wealth, Sinn implicitly engages with intergenerational justice, highlighting how past and present consumption of the commons affects future resource wealth (Sinn, 2012). He critiques what might be termed Nirvana ethics (altruistic action towards future generations) as inadequate, arguing that conflict between present and future consumption is unavoidable. This underscores the tension between prudence, self-interest, and ethical obligation across generations. This, he claims, is because,

> the conflict between our present consumption and the consumption of future generations is unavoidable. But precisely because that is so, present generations should aim at extracting the highest possible gain out of relinquishing consumption in favour of future generations, regardless of how much consumption they are ready to forgo.

[50] Sinn's argument for a climate ombudsman appears unsustainable if we accept this principle. His position rests on the claim that such centralized oversight, including control over natural reserves, cannot accommodate the inherent dynamics of the market-economic system, which he regards as potentially antithetical to universal resource governance. In his own words, the market "often seems rather erratic" (Sinn, 2012, p. 166), and evaluating market behaviour from a welfare economics perspective requires establishing a normative benchmark first: "we first need a norm" (Sinn, 2012, p. 167).

> This is a weak social norm, but one that everyone should be able to accept (Sinn, 2012, p. 167).

This approach assumes a relatively expansive understanding of human greed,[51] linking current consumption to intergenerational consequences. Ethically, it highlights the challenge of balancing present and future interests within limits imposed by ecological thresholds. Therefore, based on the Pareto efficiency[52], Sinn offered a solution to this human greed: balancing consumption levels without making ourselves worse off or better off than future generations. In other words, we can help "future generations – an improvement that costs us nothing" (Sinn, 2012, p. 169), and adjust "the composition of wealth we bequeath to future generations without changing the size of the bequest" (Sinn, 2012, p. 169).

Here, the tension between human selfishness and ethical obligation is central to understanding the dynamics of intergenerational justice and climate mitigation design. Future generations, who have no agency in present decisions, are disproportionately affected by the self-interested behaviour of current actors. The ethical question becomes: how can mitigation designs reconcile the human tendency toward partiality with the moral imperative to protect distant beneficiaries? This is a theoretical concern. It directly informs the design of mitigation strategies. For instance, designs that fail to capture agents in climate change and risks may fail

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[51] The implied meaning is that, fundamentally, people are capable of caring for others, including future generations, and that it is rational to strive to do 'the right thing' to exercise fairness in the use of resources and benevolence toward those who also rely on them for their wellbeing. This introduces an ethical dimension, suggesting that moral virtues such as selflessness are abstract ideals and practical necessities in the discourse on climate risk, playing a vital role in mitigating harm and ensuring collective resilience. Regarding selfishness, Sinn argues that it is profoundly limiting: the capacity for genuine altruism toward generations beyond one's own is often compromised by the narrow scope of self-interest. Resource owners' apparent altruism, he observes, is typically oriented toward their immediate heirs rather than the broader human community: "If they leave carbon underground, they do it with a view of leaving it to their offspring" (Sinn, 2012, p. 164). This highlights a tension between partiality and universal ethical responsibility, raising questions about the scope of moral concern and the extent to which self-interest inherently constrains our ability to act justly toward distant or future beneficiaries.

[52] Pareto efficiency describes a condition where no one can be made better off without rendering another worse off, a principle that, while valuable as a benchmark of efficiency, remains silent on questions of fairness. In the context of climate risk and CO_2 emissions, this silence becomes ethically troubling: an allocation can be Pareto efficient yet still perpetuate vast inequalities between high-emitting nations and vulnerable communities that bear disproportionate burdens of climate harm. This reveals an existential paradox, an arrangement can be "efficient" in a technical sense while unjust in the human sense, privileging stability in the distribution of harm over the moral demand to redistribute responsibility. The challenge, then, is not about how to avoid waste in the abstract, but how to confront the extreme injustice of efficiency that preserves privilege at the expense of survival.

because they underestimate the strength of self-interest in shaping behaviour during a climate risk.

Climate mitigation design, therefore, must account for the interplay between ethical obligation and self-interest. Rule-guided frameworks, such as those suggested by Sinn. However, without embedding ethical considerations that recognises duties to future generations, fairness in resource distribution, and mechanisms to curb narrow self-interest risk either partial effectiveness or unintended consequences.

This tension also elucidates the normative limits of utilitarian reasoning in climate mitigation designs. Even if a design maximises the aggregate "greatest good for the greatest number," it may fail to prevent harm if self-interest skews agents' behaviour in ways that disproportionately burden future or distant populations. Ethical obligation, then, must stand alongside economic and practical design, for intergenerational justice calls not only for foresight but also for structures that bind individual and collective pursuits to moral responsibilities that reach beyond the confines of immediate self-interest.

Ultimately, the tension between selfishness and ethical obligation discloses a critical insight, for climate mitigation cannot be disentangled from moral reasoning. Moreover, while the Paradox may describe a physical phenomenon, it also signals an ethical truth that human inclinations toward partiality and short-sighted self-interest threaten to erode even the most rational interventions. Therefore, integrating ethical foresight into mitigation design becomes not optional but necessary, since only by grounding design in intergenerational justice can we hope to arrest the accelerating risks of climate change.

It is clear that Sinn's argument for intergenerational justice addresses how anthropic actions affect the resource fortunes of future generations. However, when intergenerational justice is considered in light of consumption thresholds and unequal access to resources, the argument must be extended to account for spatial-temporal disparities: some communities, especially in the majority world, are worse off because they share natural resources but consume less, while others disproportionately benefit. Logically, this points to structural inequities and the limitations of Pareto-based solutions in addressing distributive justice and ecological stewardship.

In my view, while Sinn's framework attempts to overcome inefficiencies in intertemporal resource allocation, it fails to address discrepancies in the distribution of costs and benefits from resource depletion, including the related spatial and temporal leakages of CO_2 and GHG emissions. This underscores a broader ethical and philosophical challenge: effective climate policy must integrate considerations of fairness, capacity, intergenerational equity, and systemic impacts, rather than relying solely on utilitarian calculations or self-interest mitigation designs.

3.1.2 Sinn's Paradox and the Normative Dialectic: Fact or Value?

A central preliminary reasoning in engaging with Sinn's Paradox is to determine whether the conditions, as grounds for the Paradox and corresponding mitigation design, are circumstantial. I imagine that drawing a distinction is particularly pressing given the nature of the change in climate and its associated risks, where a key philosophical concern is whether the changes in climate are matters of empirical realities or normative commitments. My working assumption is that clarifying this boundary provides both an epistemological foundation and a practical orientation for deciding which future-oriented designs ought to be adopted or adapted in mitigating climate risk. At present, however, as Sinn's Paradox rests on a conceptual possibility, we are thus required to act under conditions of both possibility and climate uncertainty. That is ethically tense.

The above reasoning is subsumed within the debates on climate change which are often pivoted on an implicit yet crucial distinction: whether its phenomena and associated risks are to be treated as matters of fact or as matters of value. This distinction is not trivial. It shapes both the epistemic status of our claims about the changes in climate and the practical orientation of our mitigation responses. While much discussion gravitates toward defending one pole over the other, my concern here, as earlier stated, is with Sinn's Paradox, and how its consistency depends on this very distinction.

A first step in analysing the Paradox is to clarify whether the conditions it describes are empirical facts or value-laden constructs. [53] In the context of climate change, this classification matters because facts invite empirical verification and predictive modelling, while values anchor responses in normative commitments such as justice, responsibility, or care as well as belief and ideological systems. My working assumption is that this distinction provides both an epistemological and a practical foundation for determining which mitigation strategies to adopt or adapt in light of climate risk.

Sinn presents the Paradox as a factual matter grounded in observable, measurable conditions (Sinn, 2009, 2012). On this view, the Paradox could, in principle, be simulated across contexts, even with some margin of error. However, climate science is marked by "a significant degree of scientific dispute over many of the future potential risks" (Lehrer, 2022, para. 13). In a sense climate science remains marked by substantial dispute, in particular, around future risks such tipping events, geoengineering interventions, etc. The implication here is that while we may assume that core phenomena like rising temperatures are well recorded, much about how and how severely the climate system will respond remains contested and uncertain.[54] Correspondingly, the empirical grounding of the Paradox is therefore unstable.

[53] The values considered here are the moral evaluation of persons, actions, objects and conditions in a climate change and its risks.

[54] It is obvious, in my estimation, that climate science involves multiple layers of uncertainty stemming from incomplete knowledge of complex Earth systems, feedback loops, natural variability, measurement limitations, and scenario-dependent human behaviour. My estimation falls in line with Renée Cho (2023), in quoting the World Resources Institute noted that, "in the climate change field, with its countless socioecological factors and interdependent systems, its known unknowns and unknown unknowns, deep uncertainty abounds." This general uncertainty undercuts assured projections of climate risks mitigation designs like Sinn's design. It is also clear that even as designs improve, we still have to contend with how to accurately capture processes such as tipping points, local variability, or coupled small-scale occurrences. For instance, regarding climate tipping points, a study recently conducted revealed significant gaps because of limited model resolution and inadequate process

Indeed, its conditions appear circumstantial and insufficiently generalisable to model the complex and open-ended systems in which climate risks emerge.

An alternative is to treat the Paradox as value-based. However, doing so implies confirming that it lacks sufficient empirical evidence, and to discredit its real force as the basis for its corresponding mitigation design. This alternative weakens Sinn's scientific claim, but Sinn's Paradox would then be understood as prescribing what ought to be done in the face of climate risk, guided by values such as equity or stewardship. However, this shift also introduces its own dangers. I envision that value-based framings of the Paradox, while ethically compelling, risk collapsing like the climate change debates into moral brawls, geopolitics, economic securities, or sociocultural partiality. And as climate changes and related risks can obscure empirical baselines, making it harder to measure change, evaluate mitigations, or secure cross-context action, so also the Paradox, in many respects, appears to exhibit these vulnerabilities if it is value-based.

A further risk is that framing the Paradox primarily in value terms can erode the sense of urgency in decision-making when moral priorities differ or conflict. Competing value systems may delay consensus on mitigation strategies, as debate on climate change, as it appears, is not simply what should be done but also whose values should prevail. Applied to the Paradox, this could weaken the predictive power of its mitigation design: if agreement on the underlying values is absent, the Paradox's proposed mitigation design could become an object of negotiation rather than a catalyst for timely action. In such cases, the urgency embedded in climate risk could be lost in the inertia of moral contestation.

understanding: "a broad consensus on tipping elements, tipping points, HILL events, and climate surprises in general, in short 'tipping points (*sensu lato*),' is not yet present in the scientific community" (Stocker et al., 2024, p. 435). Similarly, another analysis underscores that climate science's complexity, epistemic limits, and the inherently subjective nature of uncertainty challenge its empirical decisiveness. In furtherance, and more practically, scientific disagreement extends to potential interventions and that there is no scientific consensus on whether interventions are justified or safe.

In furtherance, the fact-value distinction also explains a profound structural problem. If the conditions of the Paradox are factual, but the proposed climate mitigation design is value-laden, then Sinn seems to have violated the is/ought divide. He appears to move from descriptive premises to prescriptive conclusions without sufficient justificatory bridge. Conversely, if the Paradox were framed entirely in values, its design would be coherent, but its applicability to empirical climate scenarios would be diminished.

Thus, the epistemic and normative status of the Paradox remains unsettled. As a construct, it is empirically non-verifiable and context-contingent, relying on an epistemic agent who is also an ethical agent and often acts in self-interest. While this does not strip the Paradox of all relevance in climate matters, it does render it ill-equipped to capture the complexity of evolving ecosystems and the unpredictability of mediating contexts. Any climate mitigation design inspired by it must therefore reckon with this dual vulnerability: the instability of its empirical claims and the fragility of its value commitments. In short, when fact collapses into uncertainty and value into argument, the Paradox risks standing on ground too unstable to guide action in the urgency-bound realities of climate change and related risks.

3.1.3 The Ethics and Limits of a Climate Ombudsman

One of the most distinctive elements of Sinn's work is his proposal for a *climate ombudsman*. It is a construct of a supranational body tasked with safeguarding the interests of those yet to come into the climate change story, and the unborn inheritors of our choices in managing the global commons. The rationale is intuitively compelling: the welfare of those yet unborn, the reasonable allocation of our finite resources, and the prevention of exploitative power dynamics all point toward the need for an impartial arbiter. At its best, such a construct could mediate conflicts of interest and counterbalance the exploitative tendencies of resource cartels (Sinn, 2009).

On this narrow point, I concur with Sinn. My agreement stems from a deep mistrust of the ability, and often, the willingness, of many national governments to make decisions with long-term planetary stewardship in mind. As Sinn (2012) incisively asks: who should be entrusted with the "correct measure" (p. 165) of resource use for the sake of future generations? Governments, whose leaders are bound by the short electoral cycle and beholden to the present generation's interests, are ill-suited to this task. Philosophers committed to intergenerational justice might seem like an alternative, but they would need powers so sweeping that they would override democratic mandates, a move that would likely be condemned as utopian "nirvana ethics," detached from the real politics of democratic governance (Sinn, 2012).

Sinn's scepticism toward political governance resonates strongly when examined through the lens of Sub-Saharan Africa, where the Sahel region presents a telling example of resource abundance coupled with environmental fragility and political instability (SIPRI, 2020).[55] Here, the so-called resource curse[56] is vividly illustrated: states rich in both renewable and non-renewable resources frequently suffer from underdevelopment, mismanagement, and weak governance (Humphreys et al., 2007; Jensen & Wantchekon, 2004; Hodler, 2006). It simply maintains that while, in principle, we might expect better development after discovering natural resources, some countries tend to have political instability, among other problems, compared to non-resource-rich countries (Humphreys et al., 2007; Jensen & Wantchekon, 2004). In such contexts, the argument for an external oversight body seems more than reasonable. Indeed, the climate ombudsman's proposed powers over licensing, contractual agreements, and extraction oversight could, in theory, help counteract nationalistic and short-termist tendencies in climate governance.[57]

[55] SIPRI is an institute known for its research in security, arms control, conflict, and armaments. The institute is based in Sweden.
[56] This theory is also known among practitioners as the *Paradox of plenty*.
[57] Sinn's Paradox has made me confront how even stable nations, through short-sighted choices, can imperil both present and future life, underscoring the need for a climate ombudsman to mediate the entanglement of human and nonhuman agency, moral responsibility, and the ripple effects of our collective actions.

Yet, this idealism confronts a fundamental obstacle: domestic politics. The legitimacy of a climate ombudsman[58] is inescapably tied to the political will of states, and domestic priorities often conflict with global obligations. While collaborative governance of the commons is morally sound, it becomes fragile when local populations perceive themselves as disadvantaged or excluded from decision-making. The tension is sharpened when we recall that governments, under the social contract, are expected to manage natural resources primarily for their own citizens. Handing this managerial authority to an external body without direct experiential knowledge of the existential threats faced by local communities' risks undermining both sovereignty and public trust.

Correspondingly, while it is morally reasonable to have an engagement between domestic and global communities, it is also morally reasonable that both communities make sure that their priorities are recognised, and their real needs met. The point here is that domestic politics can restrict the ombudsman's oversight role. In a sense, domestic politics shapes the intensity of trade-offs in global matters and integration. This reveals, in my estimation, a puzzle, for if "the realm of politics is beyond ethical assessment, or that what is demanded by political realities has to be accepted ethically" (Provis, 2007, p. 25), then politics seems to both resist and require moral justification. In addition, when "the vocation of politics somehow rightly requires its practitioners to violate important moral standards which prevail outside politics" (Coady, 1991, p. 373), it becomes evident that politics is caught in a tension where ethical transgression is simultaneously condemned and legitimised.

This leads to the first major ethical gap in Sinn's proposal: the absence of a framework for reconciling global equity with historical asymmetries in resource use and emissions. As the European Environmental Bureau (Bolger et al., 2021) notes, the EU alone consumes between

[58] The legitimacy, according to Sinn, is the oversight power of the UN to control global resource reserves and supply chain.

70% and 97% of the world's "safe operating space" (Bolger et al., 2021, p. 2) for resource use effectively pushing planetary systems toward destabilisation (Bolger et al., 2021). A climate ombudsman that fails to address such disproportionate impacts risks functioning as a moral fig leaf for the very powers most responsible for ecological degradation. [59]

The second ethical gap is more subtle but equally serious: Sinn's framework neglects the mediating effects of context. Not all existential challenges can be neatly classified as injustices or justices, especially when emerging phenomena such as AI-technological extractivism, space debris, or the geopolitical scramble for critical minerals are factored in. In a multipolar world, an effective arbiter must navigate diverse and sometimes conflicting moral, cultural, and existential priorities. Therefore, by oversimplifying human relationships and treating justice as a static, universal metric, Sinn underestimates the complexity of climate governance.

The ethical gap under consideration extends to the domain of international law, specifically *Ius inter civitates et gentes*, the legal principles governing relations among states to promote equity and justice in a global community (Shaw, 2006; Fagothey, 1976). In the same spirit, Sinn proposes the UN as the primary authority for global governance of CO_2 production. This suggestion aligns superficially with existing climate protocols such as the Rio de Janeiro commitments, Tokyo key targets, and the Paris Agreement (Sörlin & Lane, 2018; Fölster & Nyström, 2010; Jensen et al., 2015). Yet, the burden of CO_2 production and environmental exploitation continues to fall disproportionately on developing economies, while developed countries largely control both emissions and regulatory frameworks.

[59] A focus on the disparities in historical and cumulative CO_2 emissions and total and per capita emissions reveals that states such as Ghana and Fiji which are statistically at the bottom of CO_2 emission per capita (Vigna & Friedrich 2023) are rather struggling to deal with hidden costs of CO_2 emissions. This is a matter of equity and justice given that those who have caused most of the existing climate problems and have the resources to fund mitigation strategies do not. They continue to emit more. And the UN's incapacity or failure in dealing with such matters of equity and justice is ethically problematic if we allow it to assume the role of a climate ombudsman.

This raises a critical normative question: How can climate mitigation frameworks be structured so that governance of the global commons does not become a façade for national or bloc self-interest? The gap emerges because Sinn's model does not adequately address (i) the mediating effects of local and domestic contexts, nor (ii) provide concrete strategies to engage with emerging climate imaginaries and NSAs. These actors include participants in green extractivism, private space ventures like SpaceX and Blue Origin, and potential cosmic risks such as black hole eruptions, comet or asteroid collisions (Torres, 2016). In short, the Paradox under Sinn's framework underestimates the multiplicity and dynamism of actors shaping global climate risk, leaving a normative and practical blind spot in international climate governance.

In my observation, Sinn's proposal wanes both conceptually and empirically. Conceptually, it assumes that a single authority can wield decisive power in a world defined by plural sovereignties and entrenched self-interest (Dahl, 1957; Heywood, 2007; Lukes, 2015). Empirically, it overlooks the fact that climate risks rarely exist in isolation; for many states, more immediate existential threats, from economic instability to natural disasters, take precedence. A viable governing system must compel multiple agents to alter behaviour within the realities of their respective contexts. By this measure, the climate ombudsman as envisioned by Sinn is normatively fragile and practically unviable.

In the end, the uncertainties of climate change do not simply demand a single, top-down authority; they require a governance model that can hold together a mosaic of legitimate but divergent existential needs. Without this pluralistic grounding, any singular agency, however well-intentioned, risks becoming another layer of bureaucracy that speaks in the language of justice but acts in the interests of power.

3.1.4 The Commons, Sustainability and Normative Imperatives

In the context of normative problems with Sinn's Paradox, it is inevitable to examine the conceptual framing of *the commons* and the value of ecological sustainability. This discussion gains urgency in the light of the multiplicity of agents pursuing self-interest, the rise of activism and public concern, and the increasingly complex interplay of political and corporate action and/or reaction to the change in climate, each shaping the practical and moral landscape of climate mitigation approach and sustainability imperatives.

Conceptually, *the commons* is grounded in Garret Hardin's thesis (1986), where "the commons," understood as communal feeding spaces or shared resources, are vulnerable to exploitation by individuals pursuing their own interests, resulting in cumulative ecological destruction. Hardin warned that "ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom in a common brings ruin to all" (Hardin, 1986, p. 162). Similarly, Sinn's framing of natural resource reserves and the climate ombudsman can be interpreted as a response to the "tragedy of the commons," where self-regarding priorities undermine collective responsibility for protecting shared ecosystems. In essence, the Paradox presumes human action oriented toward individual gain, often neglecting the long-term sustainability of the shared atmosphere and ecological commons.

From an Aristotelian perspective, the commons can be understood in terms of the ethical ideal of distributive justice. Aristotle argued that shared resources should be used according to the principles of fairness and proportionality, where each individual's consumption is balanced against the common good (Aristotle, *Nicomachean Ethics*, Book V). In other words, sustainable management of the commons requires both moral virtue in the actors and institutional arrangements that prevent overuse, highlighting that ethical conduct and governance are inseparable in maintaining ecological stability.

Regarding ecological sustainability, the Paradox gestures toward maintaining the thresholds of the commons while pursuing human flourishing. Growing recognition of sustainability emphasises environmental protection legislation and global regulatory frameworks, and Sinn acknowledges the ecological stakes, arguing that demand-side measures alone are insufficient, hence advocating for a climate ombudsman to oversee resources reserves and extraction certificates (Sinn, 2009, 2012).

Thus, given the magnitude of climate risks, the practical and normative values of ecological sustainability within the "triple bottom line", society, ecology, and economy, become critical for analysing the Paradox. Sustainability ideally requires the integration of community well-being, environmental integrity, and economic prosperity (Henriques & Richardson, 2004). In practice, however, these pillars often conflict, raising questions about both the theoretical and operational viability of sustainability as a framework (Akao, 2023).

Correspondingly, from an African philosophical lens, Martin Ajei (2022) argues that conventional sustainability frameworks are normatively inconsistent because they often force a choice between economic growth and ecological protection. Western interpretations, following an *either…or…* logic, tend to exacerbate social inequities while undermining ecological goods. Ajei (2022) suggests that a truly sustainable framework should allow the pursuit of one pillar, such as economic growth, without sacrificing the integrity of society or the environment. This perspective deepens the normative critique of Sinn's Paradox, highlighting the challenges in implementing a regulator like the climate ombudsman when multiple agents interact with shared resources in ways that may conflict with global or local sustainability goals.

Moreover, considering sustainability in global climate contexts, Ajei's insights compel a rethinking of what qualities a viable climate mitigation design should possess. The lapses in traditional sustainability models reveal that anthropogenic actions must be assessed in terms of their consequences for future generations and ecological integrity, emphasising a both/and logic rather than an either/or framework. This approach resonates with African ethical epistemologies, where interdependence and relationality guide moral reasoning.

At this point, I will also note that in considering the values of sustainability that appeal to larger global contexts vis-à-vis climate change and associated risk, as Sinn described and attempted to resolve, Ajei's conclusion provokes a rethinking of qualities we should expect from viable design in mitigating climate risk. A completely reasonable analysis of the lapses in the traditional understanding of sustainability reveals that the question of anthropic actions in view of future generations must be reconceptualised to fit into emerging climate risks. Suffice it to say as well that in pursuit of one pillar we do not have to risk the other one or two pillars. Here, it is not about *either…or…,* but *both … and…* logic which is often a regular feature of some ethical epistemologies, especially found in Africa.

Thus, it is evident that a critical relationship exists between the commons and ecological sustainability, which directly informs the normative dimensions of Sinn's Paradox. This relationship becomes particularly salient when considering the normative imperative: what ought we do, given that our actions, or inactions, "have the potential to cause significant harm to ourselves, future generations, [and nonhuman species]" (Boston et al., 2010, pp. 8 – 9).

3.1.5 Nonhuman and Distributed Agency: Expanding Climate Ethics

With the foregoing, it is clear that the Paradox and its corresponding design must be understood in light of the normative role of nonhuman agential entities, approached through an African lens of relationality that conceives all agents as fundamentally interconnected.

From an African relational perspective, moral value is attributed to something in proportion to its capacity to participate in a "communal relationship" (Metz, 2022). Metz's account of relationality addresses the long-standing philosophical question of what unifies morally right actions, and how they differ from competing moral theories. He argues that the central notions of harmony and friendliness, as understood through relationality, provide a compelling answer, one that Western tradition grounded in utility or the ideal of autonomy have struggled to match (Metz, 2022).

Taking Metz's insight into the potential for a thing to bear moral attributions, we might press the idea further to include nonhuman agential entities. After all, it is not difficult to imagine two agents, whether human or not, dwelling in the same space, moving through it, and in that movement, touching one another's worlds. In the African relational vision, such shared dwelling is not an accident but a condition of life itself. Thus, in the great commons of the climate ecosystem, human and nonhuman agents are fated to overlap. And where capabilities meet, moral regard cannot be far behind.

Based on Metz's thesis, therefore, we can extrapolate that moral significance emerges not from an entity's isolated existence, but from its capacity to participate in meaningful relationships within a community and an existential space. An agent, whether human or nonhuman, is morally considerable insofar as it can interact, respond, and harmonise within a shared environment, contributing to mutual flourishing. Extending this ethics, nonhuman agential entities, such as AI-technological systems, can also be seen as agents in relational networks. Though they do not possess all that we may consider as solely human, these systems exhibit responsiveness, adaptation, and influence in a way that they could monitor environmental conditions, adjust outputs, and thereby shape outcomes for other agents within the climate ecosystem.

Moreover, co-existence between humans and nonhuman agents is ethically grounded when understood as relational co-activity. Within the shared fabric of the physical world, humans and nonhuman agents at once act upon one another and remain mutually shaped by the very relations they generate. This relational engagement implies that agency could be distributed per actions, consequences, and responsibilities which are interwoven across human and nonhuman agents. Consequently, the design and deployment of AI-technological systems is not ethically neutral. By fostering systems that act in harmony with humans, ecological processes, and broader social networks, we enable co-existence that respects the agency of all participants while promoting sustainability and mitigating climate risk.

In this sense, the ethics of relationality allows us to reconceptualise climate mitigation as co-existence, a matter of spatial proximity and active relational participation. Thus, humans and AI-technological systems share responsibilities within a network of interactions, where each agent's capacity to influence and respond carries normative weight. Recognising this distributed agency provides a philosophically robust basis for designing mitigation strategies that account for both human and nonhuman contributions to ecological and climatic outcomes.

My reasoning is also inspired by what Horta (2014) calls the "argument from marginal cases". That is, the unsettling realisation that we cannot, without contradiction, affirm moral status for human agents while denying it entirely to nonhuman ones. If a nonhuman agent shares certain basic capacities with a human, its exclusion cannot be justified merely by pointing to differences of genetic lineage, taxonomic category, or the fulfilment of select criteria (Horta, 2014). Such distinctions, whether grounded in biology, classification, or thresholds of ability, do not dissolve a substantive question that if moral worth is real, can it be rationed only to those who fit a certain mould? Even Metz (2022) reminds us that moral status is not a monolith but a spectrum, and to place beings upon it demands a humility that recognises both kinship and difference.

In light of the foregoing, the Paradox must widen its gaze beyond the narrow circle of human agency in accelerating climate risks. The principle of relationality calls us to acknowledge that the climate ecosystem is not the stage for a single agent but a web of interdependent beings, human and nonhuman alike, each bearing the potential to shape the unfolding drama of our planetary future.

It is perhaps here that Sinn's Paradox reveals its blind spot: in giving little, if any, regard to the agency of nonhuman entities in the emergence of climate risks. Yet, if we accept the relational view, we must also accept that the mitigation of climate risk is not a good belonging solely to humans, but a shared good for all who dwell within the biosphere. This means our designs, conceptual and existential, must be capacious enough to register the nonhuman not as a passive background, but as a factual and active participant in both the causes and the solutions of climate peril.

Let us consider, as an example, a greenhouse not simply as a technological structure, but as a nonhuman agent within a relational ecology. Its purpose is to provide "favourable environmental conditions to the plants" (Pandey & Pandey, 2015, p. 1), shielding them from wind, rain, extreme temperatures, disease, and predation (Kooten et al., 2008; Karanisa et al., 2022). Yet, in doing so, the greenhouse enacts a form of agency: it regulates CO_2, humidity, light, and temperature, orchestrating a delicate balance that sustains life (Jingdong & Qingning, 2023). Unexpectedly, the very existence of this agency viz., its irrigation systems, climate controls, materials, and human caretakers, generates CO_2 and other greenhouse gases, subtly contributing to the risks it was meant to reduce (Pandey & Pandey, 2015; Karanisa et al., 2022). In this example, the greenhouse exemplifies a moral and ecological tension: even interventions designed to nurture life are embedded in webs of cause and effect, highlighting that agency is never isolated from the broader consequences of action.

Yet in the Anthropocene, where human activity itself destabilises the planet's climate, these assistive, AI-driven greenhouse systems become more than agricultural conveniences. They assume the status of ethical necessities, compelling action as a choice and a response to the entanglement of agency and the unfolding consequences of climate risk. This is because they embody our collective will to adapt, to produce food of higher quality with fewer resources, and to steward the commons with intelligence and care. In this sense, assistive greenhouse technologies are not just tools of production; they are companions in the human struggle for sustainability, a *sine qua non* for our shared future.

However, what is often ignored is that the path to building the very greenhouse technologies intended to safeguard the planet is itself paved with the stones of extraction. The critical raw materials required for their physical infrastructures, those peculiar and intricate components enabling climate regulation, pest and disease control, and optimal energy use, must be drawn from the commons. In a strange and unsettling irony, we must wound the earth in order to heal it, taking from the shared inheritance of all life in order to preserve it for that same life.

Here we might recall Aristotle's insight on the commons: that what is held by everyone tends to be cared for by no one, for the hand that tills it is also the hand that may exhaust it. If the commons lack deliberate stewardship, they can fall prey to a quiet tragedy, not through neglect alone, but through the very zeal of those who seek to use them for the common good.

We may then ask: what if the opportunity cost of such extraction is outweighed by the benefits of deploying the technology? Could the taking be justified if it shields us from a far greater loss? The question becomes even more pressing when we consider so-called *backstop technologies*, designed to replace exhaustible resources. Would they, perhaps, herald a worthy sustainability practice?

The answer might be yes, but only if we could guarantee that these solutions would indeed secure a lasting balance, and that their appetite for natural resources would not open the door to a new age of extraction. History warns us that the industrial era's promise of progress was shadowed by slavery, exploitation, and colonial domination. Without vigilance, sustainability could become merely another chapter in that same story. Thus, the intersection of sustainability and extraction is both a practical and ethical challenge given that it forces us, in a sense, to confront a Western narrative of sustainability that, in practice, too often mirrors the very extractive logic it claims to transcend.

The argument presents an ethical dialectic between advancing ecological sustainability through emerging technologies and the inevitable exploitation of shared environmental resources. In practical terms, sustaining ecosystems using such technologies often requires, at least for now, extracting and utilising common resources for human purposes – an issue central to the Paradox and its conceptual design. Two underlying assumptions frame this intersection. First, the technologies in question can create satisfactory artificial ecological conditions for plant ecosystems. This assumption aligns with the view that "at least some stocks of environmental assets [must] be prevented from rising above or falling below certain threshold levels" (Perring, 1991, p. 275). Put differently, achieving ecologically sustainable plant systems requires technological intervention to maintain those thresholds. Second, these technologies serve as viable alternatives to mitigate the adverse effects and constraints posed by ecologically unsustainable natural environments for plants (Jingdong & Qingning, 2023; Karanisa et al., 2022).

Seemingly, the very act of creating these AI-technological systems draws us intensely into the well of the ecological commons, requiring the extraction of critical raw materials. This need is amplified by the growing faith in such systems to accelerate human pursuits – industrialisation, transportation, and the seamless movement of goods from production to end users. Yet, with every new demand for these technologies comes an equal, if not greater, demand for the materials that make them possible. In this way, greenhouse technologies and ecological sustainability meet at crossroads: the commons are both the resource that sustains human innovation and the very ground we risk exhausting in our pursuit of it.

The assumptions inevitably give rise to an immeasurable set of questions: Can the commons endure under the weight of our unrelenting anthropic activities? And if not, what truly needs to change – the way we draw upon the commons, or the very nature of these human activities themselves?

From a philosophical standpoint, there can be no pretence of ethical neutrality here. It is contradictory, perhaps even disingenuous, to advocate for greenhouse technologies as the emblem of ecological sustainability (and, by extension, social and human flourishing) while permitting the quiet erosion of the commons, those shared resources upon which life itself depends.

This dialectic recalls the ancient insight that the good cannot be pursued in isolation from the just. For if the foundations upon which we build our so-called solutions are themselves being dismantled, then the very logic of our pursuit collapses. In this light, the debate is about technological potential and moral coherence about whether we can, in good faith, claim to act sustainably while our methods sow the seeds of depletion.

Just as in all anthropic endeavours, technology here is not a neutral instrument but a participant in a web of causation, agency, and uncertainty, forces that both propel and destabilise our collective climate future. The ethical query, then, is whether we can align these forces with the preservation of the commons, or whether our ingenuity will continue to work, paradoxically, against the very survival it seeks to ensure.

Consequently, the normative dimensions of the Paradox and its corresponding design cannot be avoided. The risks linked to the crisis observed in the climate cannot be attributed to only human agential entities when there are other agential entities that could also contribute, directly and indirectly, to these risks. This seems to be, at least, reasonable arguments in raising the normative issue regarding what the Paradox seeks to describe and what the corresponding design seeks to solve.

Consequently, we cannot sidestep the moral and ethical dimensions of the Paradox, nor the intentions embedded in its design. The climate crisis is not a drama with a single human agent; other forms of agency, such as nonhuman agential entities like AI-technological systems, play their part, weaving threads of influence both visible and hidden. To acknowledge this is to recognise that responsibility is not linear, nor neatly apportioned. It becomes reasonable, even necessary to question: what, in truth, does the Paradox aim to clarify, and what is the precise nature of the problem its design aspires to resolve?

3.2 Chapter Summary

To say the least, Sinn's description of what is right action from what is wrong action in dealing with global warming is a normative problem. Thus, we cannot philosophically fail to see the ethical principles of utility, which grounds his description and prescription to stop human action as shown by resource investors. Put simply, such human action raises the fundamental questions about what constitutes right or wrong action, and what is considered good or bad within the climate space? How do we achieve justice in the climate space? How do we explain the action of groups of individuals, corporations, state and NSAs, etc.? Ironically, though the Paradox touches on these normative problems, it fails to admit that, in many contexts of climate risks, there are distinctive and conflicting experiences. And, sometimes, there are intersecting and reinforcing ethical rationales underpinning 'why people do the things that they do' when faced with climate uncertainty.

CHAPTER FOUR

AGENTIAL ENTITIES IN CLIMATE CHANGE AND RISKS

4.0 Introduction

As discussed in earlier chapters, the Green Paradox presents itself as a climate risk theory that elevates its own mitigation design above all else, its framework entirely shaped around countering the risks Sinn attributes to a singular, self-contained epistemic and ethical agent. While this has earned the theory considerable attention in climate change discourse, especially among economists, its philosophical grounding is far less secure. Sinn's framing of agency erodes both the logical basis of the Paradox and the predictive credibility of its proposed climate mitigation design, even when we are generous about margins of error. The Paradox rests on empirical assumptions that are, as we have seen, too narrow and conditional to make it (and its mitigation blueprint) a wholly reliable instrument for addressing climate risk.

This thesis has, therefore, been an opportunity to interrogate the normative core of Sinn's thinking, asking what principles should, and should not, guide the design of climate mitigation. By introducing an African philosophical perspective of relationality, I have brought forward a moral dimension often absent in standard accounts: the potential moral and normative standing of nonhuman agents within the climate ecosystem, particularly in contexts where multiple overlapping agencies interact to shape risk. This view challenges the human-centric exclusivity of Sinn's theory and design and reimagines climate mitigation as a multidimensional practice grounded in ethical pluralism.

If the normative critique developed in chapter three is sound, then the present chapter extends it. I argue for the recognition of agential entities in climate risk that go beyond Sinn's single, human-centred agent. To do so, I draw on the philosophical insights of Soran Reader (2007) and James Dempsey (2013), which provide a conceptual basis for my use of Agent-

Based Modelling (ABM) in this context. ABM, I suggest, offers a richer way of understanding the diverse agents, human and nonhuman, that shape climate risks.

This framework allows for a philosophical analysis of nonhuman agents, particularly AI-technological systems and Non-State Actors (NSAs). Within the contours of emerging AI-technological systems, for instance, my argument engages with the present epoch of technological optimism, which is a belief that emerging systems will, in time, solve "all our problems," including climate change and risks. While I acknowledge the genuine contributions these systems can make to sustainability and human flourishing, I also confront the costs that optimism tends to overlook. The cost of environmental footprint from critical mineral extraction, the fossil-fuel energy used in training and running large models, and the CO_2 emissions over the full lifecycle of such technologies (Belkhir and Elmeligi, 2018; van Wynsberghe, 2021). These material realities suggest that AI-technological systems may fail to solve the climate problem and rather accelerate certain risks.

This risk-based argument strengthens my broader claim: Sinn's neglect of multiagent and interagency dynamics, whether human or nonhuman, renders the Paradox weaker, both conceptually and in terms of mitigation design. A more robust climate risk framework must move beyond the narrow focus on a singular agent, as Sinn's resource-owner model does, and instead embrace the complexity of interacting agencies. In this light, the acceleration of global warming may arise not simply from the economic behaviour of resource owners under greener policy regimes, but equally from the unintended consequences of nonhuman agents like AI-technological systems whose role in the climate equation is both real and growing.

4.1 Agents Everywhere: Moral Responsibility Beyond Humans in Climate Risk

The term, agential entities, has been a recurring feature in my work. In the context of climate risks, I use it in a broad sense to describe anything capable, at the very least, of acting or reacting autonomously and engaging both in and with a climate ecosystem. This capacity includes the ability to act in a non-deterministic way within a given context (Reader, 2007; Okeja, 2022). By extension, an agential entity can be understood as anything that has the power to bring about a change (Setiya, 2007) or initiate an act, and that which could remain alterable through "an open flow of interaction" (Schlosser, 2019) within a shared ecosystem. Thus, philosophically speaking, an agential entity is one that, by its very nature, can act either from its own impulse or in responsive effect when acted upon whether through "the instigation of an act by an agent" (Schlosser, 2019) or through "motion with a source or origin in an agent" (Schlosser, 2019).

In relation to climate risks, and in considering the CO_2 footprint, I take the view that the natural and physical world often shapes how agents act, when they act, and what forms their agency takes. Here, I contend that nonhuman agential entities may include systems capable of agency even in a minimal or instrumental sense. This means that the conceptual reach of climate theories and mitigation designs should be widened to include other factual possibilities. The complexity of CO_2 and GHG emissions both in their generation and their impact cannot be fully understood without recognising the interplay of multiple agents and overlapping agencies. Accordingly, Schlosser (2019) hinted that:

> agency is virtually everywhere. Whenever entities enter into causal relationships, they can be said to act on each other and interact with each other, bringing about changes in each other. In this very broad sense, it is possible to identify agents and agency, and patients and patiency, virtually everywhere (para. 1).

Adopting this expansive lens immediately reveals that the landscape of potential agential entities in climate change and climate risk is far richer and more intricate than Sinn's account allows. They include, but are not limited to, nonhuman agents such as livestock, certain plant species, and even nature itself. To ignore this is to overlook the unpredictability woven into the fabric of existential interrelations. Sinn's Paradox, in reducing the problem to the projected choice of a single agent, flattens this complexity, failing to grasp the emergent and interactive dynamics that characterise multiple agents. Thus, when we turn toward nonhuman agency, new ontological and practical challenges arise, unsettling the very assumptions that underpin the Paradox and its mitigation design. Sinn's framework abstracts away the particularities of diverse agents and ignores the intense reality that nonhuman forces are not passive backdrop but active agents, shaping climate risk in ways both subtle and profound.

From this perspective, the meaning of agential entities within climate risk is layered and complex. Contrary to the Paradox's narrow framing, there are countless real-world examples of nonhuman activities that directly contribute to, or indirectly collaborate in, the generation of climate risk. This suggests that the CO_2 footprint of nonhuman agencies should be treated as a central consideration in any climate mitigation design. Here, the idea of nonhuman agency is not a mere abstraction; it points to tangible realities embedded in the physical world.

To deepen this view, we may turn to the argument of Soran Reader (2007) that while human agency is usually defined by action, capacity, choice, rationality, freedom, and independence, there is another, often neglected dimension. Persons are agents who act, and embody forms of agency shaped by passion, constraint, necessity, contingency, and dependency. These so-called "negative" qualities are limitations. They are, in Reader's view, necessarily presupposed by the "positive" features of agency (Reader, 2007). This is because "persons are beings that act [… and] distinguished not merely by action, which animals and even machines may also be capable of, but by specifically personal kinds of action…" (Reader, 2007, p. 583). This broader framing, therefore, allows us to see that agency, even when extended beyond the human, can include these interdependent and context-bound qualities.

Applied to climate risks, Reader's thesis opens the conceptual space for recognising the *other sides* of agency. Take AI-technological systems, for example, such systems are capable of navigating and interacting with the physical lifeworld and, in some cases, modifying it.[60] If we define agency to include meaningful engagement with other agents, even when performed syntactically without conscious reasoning (Schlosser, 2019), then AI-technological systems fit the profile. Further, following Silberstein and Chemero (2011), we can even speculate that an agent does not require mental representation to act. The ability of nonhuman agents to interact intelligently means they can both contribute to CO_2 and GHG emissions and participate in climate risk mitigation. A robotic simulation, in this context, could count as an instance of agency. This warrants a broader philosophical attribution of agency to AI-technological systems within the climate ecosystem.

Another perspective on nonhuman agency comes from James Dempsey (2013) on the agency of a collective entity. He challenges the assumption that moral agency is a prerequisite for moral responsibility; and that certain nonhuman agents such as corporations can be "morally significant systems" (Dempsey, 2013, p. 344) when they act as complex collectives created and operated by human agents. In this sense, their moral significance derives from the moral agency of their creators. Central to this idea is the concept of collective intentionality, that is, the capacity for minds to be jointly directed towards goals, facts, or values. This includes purposive agency, intersubjective focus, communal normative assent, and shared affective resonance (Schweikard & Schmid, 2021). Historically, this is akin to Aristotle's *koinonia*,

[60] These examples illuminate the ethical terrain of AI-technological systems when framed through the categories of responsibility, trustworthiness, and goodness. To invoke these categories is not to employ mere metaphors borrowed from human morality, but to suggest that AI-technological systems participate in a form of agency that interacts with, and even reshapes, the natural and social world. In this sense, their operations cannot be ethically neutral: they alter relations, redistribute risks, and introduce new loci of accountability. If such systems act within a field of human values and consequences, then their agency necessarily entails moral weight, demanding that responsibility and trustworthiness be conceived as aspirations and categories of lived ethical practice.

common striving, or Rousseau's *volonté Générale*, collective will, (Schweikard & Schmid, 2021, p. 6).[61]

Under Dempsey's framework, corporations, especially extractive industries, bear causal and remedial responsibilities for climate risks. They should be held morally accountable as deserving subjects of praise or blame for their role in accelerating CO_2 emissions. For a system to qualify as morally responsible, Dempsey (2013) proposes that it must:

1. "consist in both procedural and substantive rules that set out what constitutes a legitimate corporate decision (within a certain domain) and how such decisions should be implemented" (pp. 244-245),
2. be "sufficiently complex to generate a remainder of responsibility that cannot be properly assigned to the creators and operators of that system" (p. 345), and
3. "be the product of the actions of moral agents, is clearly fulfilled in the case of the systems upon which corporations are based" (p. 345).

Dempsey's argument invites us to consider that agency, and with it, moral responsibility, need not be confined to individual humans. Non-state actors (NSAs) whose operations contribute to CO_2 emissions exemplify systems whose actions ripple across ecological and social domains. When such systems satisfy the conditions for moral significance, they emerge as legitimate bearers of ethical accountability for the climate risks they help engender. Here, we can argue that responsibility is derived from the discrete actions of individuals, the structural and relational properties of a system itself as well as the social ontology and the manifested

[61] This kind of shared purpose echoes Aristotle's idea of *koinonia*, which he used to describe a form of partnership or community where people strive together for a common good. For Aristotle, a healthy society was one in which citizens did not just live side by side they actively worked together toward shared moral and political aims. Rousseau took a similar but slightly different approach with his *volonté générale*, or "general will." This was the idea that a society could have a shared will that represents what is best for the whole community, even if individuals sometimes want different things. The 'general will' is not simply the sum of everyone's private preferences; it's what the community would choose if everyone were thinking about the common good rather than just personal gain. When you combine these ideas with Dempsey's argument, you get a picture of how even nonhuman systems like corporations, governments, or AI-driven organisations can act in ways that carry moral significance. They "inherit" this from the human capacity to think, decide, and feel together, which Aristotle and Rousseau saw as essential to how communities' function.

collective agency. As Dempsey observes, these entities are "[…] susceptible to ascriptions of moral responsibility for outcomes that they have occasioned, provided that the core systems upon which they are based satisfy the conditions for being morally significant systems" (2013, p. 346). Therefore, in acknowledging the moral weight of collective and even nonhuman agency, I am compelled to rethink traditional ethical frameworks that locate responsibility exclusively within individual human agents, expanding climate ethics to embrace the intertwined agency of humans, institutions, and nonhuman forces alike.

4.2 Agent-Based Modelling (ABM): Simulating Human and Nonhuman Agency in Complex Climate Systems

Leif Gustafsson and Mikael Sternad (2010) describe ABM as a way of simulating what happens when many different "agents" (which could be people, machines, animals, or even corporations) act, react, and interact at the same time. Think of it like setting up a miniature world on your computer and letting different characters, each with their own rules, habits, and limitations, move around, make decisions, and respond to one another. By watching what happens, you can start to see patterns, predict possible outcomes, and understand how in the delicate weave of existence, even the smallest shift in one strand reverberates across the whole, setting in motion consequences far greater than their humble beginnings. What appears as a minor alteration in one corner of the system may, by hidden pathways of interconnection, unfold into transformations that reshape the entire order.

In my research, I examine various agential entities within the specific temporal and spatial contexts. These entities may act actively, through decision-making and purposeful action, or passively, by their mere existence, which nonetheless produces tangible outcomes. Thus, looking at climate change and its risks through the lens of ABM helps me see why this approach is often more useful for designing climate risk mitigation designs than Sinn's theory and design. The main point here is that Sinn's Paradox does not really account for *who* or *what* the agents are, especially nonhuman agents, and that gap makes its predictions weaker.

ABM is not limited to climate work. It's been used in everything from conflict management to mathematics, physics, biology, ecology, social sciences, and computer technology (Castro et al., 2020). It also goes by other names like "multi-agent systems" (Heckbert et al., 2010), "complex adaptive systems" (Miller & Page, 2007), or "individual-based models" (Grimm & Railsback, 2005), but the underlying idea is the same: you simulate how many different parts of a system interact, especially when each part (or agent) is different from the others even in awareness, epistemology, goals, and decision-making rules. Properly, ABM "simulates the dynamics of complex systems based on describing the continuous interaction of agents who are heterogeneous in terms of information and decision rules" (Castro et al., 2020, p. 3).

Additionally, recent research has even applied ABM to energy transition strategies. For example, Balint et al. (2017) show that ABM can help us model how diverse agents, each with their own learning capacity and environmental impact, might respond to the shift toward a low-CO_2 economy. However, most ABM studies still focus heavily on human agents: reducing CO_2 emissions, adjusting market variables, responding to taxes, or introducing energy-saving technologies. In doing so, the function of nonhuman agents in climate scenarios often gets reduced to a mere commodity value, something to be priced or traded, rather than a source of agency in their own right (Castro et al., 2020).

But ABM can, and should, be used to model more than just human behaviour. It is a powerful tool for studying how agents interact based on local conditions, social networks, organisational structures, personal inclinations, and "bounded rationality", meaning decision-making within limited knowledge and resources rationality (De Grauwe, 2011). It can integrate both market and non-market relationships in one framework (Castro et al., 2020). That means you can use it to model a village adapting to new rainfall patterns and the global trade networks affecting that same village all in one system.

Eric Bonabeau (2002) puts it nicely, ABM is "a mindset more than a technology" (p. 7280) and includes "describing a system from the perspective of its constituent units" (Bonabeau, 2002, p. 7280). It is not just about programming software; it is about approaching a problem by looking at how its smallest parts behave and interact. According to Bonabeau, ABM has three main strengths:

1. Capturing emergent phenomena – showing how big patterns emerge from many small actions, especially when behaviour is nonlinear and hard to predict. This is because "behaviour is nonlinear and can be characterised by thresholds, if-then rules, or nonlinear coupling [… and] agent interactions are heterogeneous and can generate network effects […]" (Bonabeau, 2002, pp. 7280 – 7281).
2. Providing a natural description of a system – describing a system in terms of agents' activities, rather than abstract equations, which becomes especially useful when behaviour is complex. And this is based on the idea that, "individual behaviour is complex. Everything can be done with equations, in principle, but the complexity of differential equations increases exponentially as the complexity of behaviour increases […] activities are a more natural way of describing the system than processes" (Bonabeau, 2002, p. 7281).
3. Flexibility – allowing you to adjust the agents' rules, decision-making, and learning abilities without needing to rebuild the whole model. This allows for "a natural framework for tuning the complexity of the agents: behaviour, degree of rationality, ability to learn and evolve, and rules of interactions." (Bonabeau, 2002, p. 7281).

Focusing on flexibility, for instance, it is crucial for climate risk mitigation because climate-related agents, human and nonhuman, experience and respond to change in different ways. ABM lets you model systems when you do not know exactly how complex they need to be, experimenting with different levels of detail until the picture becomes clearer.

In climate contexts, this matters because interactions are rarely straightforward. Agents, whether they are farmers, governments, AI-powered logistics systems, or polluting factories, do not all behave the same way. Their interactions can be sudden, nonlinear, and deeply affected by space (where they are located) and heterogeneity (how different they are from each other). ABM helps us simulate and understand this messy reality, showing that nonhuman agents, such as AI-technological systems, can influence climate risks in ways that alter other agents' behaviour (Bonabeau, 2002), shift rational priorities, or even reshape how we think about climate knowledge itself.

This has a big implication: if we only focus on human agency in climate risk modelling, we miss the real costs and consequences of ignoring nonhuman agents. Nonhuman agents can worsen risks (for example, AI-driven industrial processes increasing emissions) or help mitigate them (like automated systems optimising renewable energy grids). Either way, they are part of the climate change and risk story.

For me, this is why ABM offers a more practical and inclusive approach to climate risk analysis than Sinn's Paradox. This is because ABM is a better option to "easily play with aggregate agents, sub-groups of agents, and single agents, with different levels of description coexisting in a given model [especially] when the appropriate level of description or complexity is not known ahead of time and finding it requires some tinkering." (Bonabeau, 2002, p. 7281). And it highlights the fact that agential entities "are complex, nonlinear, discontinuous, or discrete (for example, when the behaviour of an agent can be altered dramatically, even discontinuously, by other agents) […]. space is crucial and the agents' positions are not fixed…the population is heterogeneous, when each individual is (potentially) different […]" (Bonabeau, 2002, p. 7287). We can conclude that the use of ABM demonstrates that the "topology of the interactions is heterogeneous and complex […] the agents exhibit complex behaviour, including learning and adaptation" (Bonabeau, 2002, p. 7287). Here, ABM allows us to design models that include all relevant agents while capturing the complexity of their interactions. It shifts our perspective from a simple human-versus-nature frame to a richer picture where agency is distributed across many kinds of actors across space and time. And in a world where climate risks are accelerating, this broader lens is not just helpful. It is necessary.

4.3 Distributed Agency in Climate Risks: An ABM Lens

So far, we have realised that climate risks are not simply the outcome of human actions and/or reactions. They arise from a complex web of interacting agents, human and nonhuman alike. Seemingly, ABM offers a lens to explain these interactions, revealing patterns that are often nonlinear, emergent, and unpredictable, and how they shape CO_2 emissions and climate outcomes.

It is clear that AI-technological systems are active agents in this network. From data centres and industrial automation to robotics and software infrastructures, the systems consume energy, require critical materials, and leave measurable ecological footprints.[62] Yet, the

[62] On the underwater data centers and servers, it is clear that they, whether in Microsoft's Project Natick or in the less-known experiments scattered across oceans, remind us that the infrastructures of digital life are not abstractions but deeply embodied presences. They provide a glimpse into the future of a rapidly evolving industry where submerged oceanic facilities help support and connect underserved communities around the world. Project Natick, for instance, is the most visible of these efforts, placing the *cloud* into the *ocean*, while other initiatives experiment with distinct strategies for expanding digital infrastructure beneath the waves. Yet such engineering feats cannot be understood merely as achievements. They expose, in a striking way, the paradox of human innovation: the more we seek permanence, the more we encounter our own fragility. To submerge servers in the sea is not to transcend material limits but to reveal them, our digital architectures are as vulnerable to entropy, ecology, and time as the bodies that design them. The cloud is not an ethereal elsewhere; it is earth and water, bound up in the same finitude. From this recognition follows a philosophical responsibility. Technologies cannot be imagined as detachable from the environments that host them. Underwater data centers mark the necessity of designing with ecological systems rather than against them. They are symbols of entanglement, instructing us that

systems also hold the capacity to coordinate adaptive responses, optimise resource use, and influence the behaviour of other agents, making them both potential contributors to risk and enablers of mitigation.

Concerning Non-State Actors (NSAs), such as individuals, corporations, NGOs, and informal networks, a further complexity is introduced, particularly, in the global governance of climate matters. NSAs decisions ripple across communities, sometimes fostering sustainability, other times amplifying risk.

In this section, therefore, I explore the distributed agency of climate risks focusing on AI-technological systems and NSAs. By examining how these agential entities act, interact, and shape our common futures. I argue that understanding climate risk requires 'more-than-human' logic by recognising the entangled agents in the climate systems.

4.3.1 Do Artificial Intelligence-Technological Systems bear Agency?

To be clear, nonhuman agency is not only reduced to Artificial Intelligence (AI); here, it is also used in relation to other technological systems, reflecting the interplay and overlap between the domains of AI and technological systems. In this framing, AI encompasses both its intangible or soft side (e.g., algorithms, models, and data) and its tangible or physical components (e.g., servers, processors, robotics, and other hardware). Technological systems, more broadly, refers to all technological artefacts, particularly in light of their observable presence in our physical world. This includes AI-related digital infrastructure and non-AI ICT hardware, manufacturing systems, industrial automation, and even so-called green technologies such as wind turbines, electric vehicles, and solar panels which, despite their sustainable branding, can have hidden CO_2 and ecological costs in their designs, modelling,

innovation must be accountable not only to efficiency and connectivity but also to planetary care. The credo is clear: we must resist the fantasy of escape and instead cultivate the ethics of remaining. To build responsibly is to admit dependency, to acknowledge that every infrastructure is ecological infrastructure, and to design as though the generations who inherit both our machines and our oceans matter.

testing, production, transportation, maintenance, and end-of-life disposal. Therefore, in imploring the notion of nonhuman agency, I refer to entities that are non-anthropogenic in origin yet act as either collaborators or contributors to the risks surrounding climate mitigation. This conception of extended agency, as previously discussed, calls for a reimaging of how such agents influence CO_2 and other greenhouse gas emissions as well as the ways in which they shape and, at times, threaten the dynamics of climate matters.

Of interest to me, however, are the emissions and threats posed by AI-technological systems. This includes the unsustainability of their agentiality from the anatomy of AI to the multiplying and upgrading of AI materiality, to the e-waste generated alongside the constant demand for energy sources, which currently rely heavily on fossil fuels. Here, the risks also extend to the socio-ecological dimension: the mining of critical raw materials which often results in deforestation, water depletion, biodiversity loss, and the exploitation of vulnerable labour forces in resource-rich but economically fragile regions. These harms occur in parallel to the direct CO_2 and GHG impacts.

Considering the risks posed by AI-technological systems, therefore, I will explore categories of agency that such systems may take in climate risks contexts. These categories are:

1. a contributor to risks, given their CO_2 footprints during their lifecycle; and
2. a collaborator in climate risk mitigation and adaptation (Unwin, 2020; van Wynsberghe, 2021).[63]

[63] On the collaborative front, AI-driven technologies whether, in the form of systems, products, or services, are increasingly instrumental in mitigating climate risks. Yet this agency is often understated, particularly in light of Sinn's (2012) scepticism about the feasibility of 'leaving more fossil fuel reserves in the ground' through technological means. Such doubt risks overlooking the capacity of emerging technologies to support reverse-engineering processes, including the reinjection of unused or excess gases back into the ground, made possible through the convergence of climate-oriented innovations. These technologies carry significant implications for planetary boundaries and climate stability (Coeckelbergh, 2021; van Wynsberghe & Donhauser, 2017). Today, climate-focused AI systems are already applied across diverse human and ecological domains: predicting rain patterns, enhancing crop yields, responding to natural disasters, and even assisting migratory birds in adapting to shifting climatic conditions (Davitt, 2023). For nonhuman agents such as these birds, AI functions as a kind of adaptive partner, extending capacities to survive in altered environments. At the same time, philosophical

In advancing the case for recognising nonhuman agency in CO_2 emissions and climate risks, my emphasis will be on the contributive role of AI-technological systems and the ways in which their agency intersects with existential systems. I contend that the uncertain nature of how such systems engage with the physical world creates space for unforeseen and unverified situations. These are situations that could generate new risks or amplify existing risks under conditions of climate change. This view is informed by Thorsten Schmidt and Silja Voeneky's (2022) argument on the implications of expanding AI models into the realm of superhuman systems and the resulting shifts in risk dynamics. As they observed, such an expansion can give rise to "dynamically unstable systems," (Schmidt & Voeneky, 2022, p. 126), making it "increasingly easy for smarter systems to make themselves smarter," (Schmidt & Voeneky, 2022, p. 126), until that point where "it is impossible for us to make reliable predictions" (Schmidt & Voeneky, 2022, p. 126).

They further noted the limits which a transition to superhuman AI systems could affect prediction. By extension, one can argue that the presence of nonhuman agential entities like AI-technological systems could precipitate unexpected, lasting ecological shifts and critical disruptions to CO_2 thresholds. This is because "in the context of uncertainty and 'uncertain futures', it is possible that predictions could fail and risks arise from these developments faster than expected or in an unexpected fashion" (Schmidt & Silja, 2022, p. 126). Hence, Schmidt & Silja (2022) would instruct that, "superhuman AI can be seen as a low probability, high impact scenario [hence we should] not ignore the risks of superhuman AI when drafting rules concerning AI governance" (p. 126). Taken together, the perspectives of Schmidt & Voeneky (2022) and Schmidt & Silja (2022) thus point us toward the unsettling recognition that AI-

reflection urges caution. These systems interact with complex ecologies whose risks we do not yet fully understand, raising profound questions about how to measure long-term consequences, particularly, with environmental robots and the unpredictable trajectories of AI functions (van Wynsberghe & Donhauser, 2017; Bostrom, 2002). Thus, their influence on climate change and its associated risks, whether beneficial or detrimental, demands careful attention in the design of future mitigation models.

technological systems disclose an ontological risk: an opening onto futures that resist mastery, destabilize the lifeworld, and reconfigure the fragile mesh of human and nonhuman agencies within the planetary order.

For instance, one risk is presented by the increasing technological optimism among end-users. As users multiply and evolve, production and consumption levels also multiply and evolve. This could be only one aspect of the larger existential effects of AI-technologies' CO_2 footprints. This optimism is further complicated by the rebound effect (or a sort of Jevons paradox), in which improvements in the energy efficiency or performance of AI-technological systems unexpectedly lead to greater total emissions because efficiency gains encourage wider adoption and heavier use. I acknowledge that this stands in contrast to the optimism surrounding AI-technologies as shaping a "sustainable future for all", especially when much of the literature suggests that AI-technological systems can sustain natural reserves.[64] And on the basis of such perceived benefits, optimism remains in mitigating the risks associated with such technologies, even in spite of their practical risks to the climate given their CO_2 footprints.

Another example is how AI-technologies are contextualised and instrumentalised differently from their original design intentions, as end-users may misapply the technology (Brundage et al., 2018). Misapplication could pose risks and become an existential threat to personal and communal lives. As Brundage and colleagues argue, as the capabilities of AI-technological systems grow, they become more potent, widespread, and adaptable (Brundage

[64] We might imagine a scenario in which a critical policy decision hinges on the capacity of AI-technological systems to both maximise the sustainable use of natural reserves and minimise the risks associated with their exploration. Yet, practical realities complicate this vision. For instance, a friend's experience in Canada's far North illustrates the limits of certain "green" technologies: electric cars perform poorly in extreme cold and become impractical in such environments. Heating homes still requires large amounts of fossil fuel. Heat pumps, often installed as state-of-the-art solutions, also struggle under extreme conditions. My friend's unit is rated to 30°C, yet northern winters can drop to 40°C or 50°C, rendering them unreliable. Compounding the challenge, these regions endure months without sunlight, though they often benefit from abundant wind. Small nuclear reactors might, at present, offer the most viable energy alternative for such remote, frigid climates. However, they too carry significant challenges, not least the need for highly trained operators. The implication is sobering: after some time, even with advances in AI-technological systems, the demand for fossil fuels in certain contexts may persist. In light of this, it is clear that sustainable ambitions may still rely on unsustainable means.

et al., 2018). This conclusion offers a novel lens to analyse the threat these systems pose to the climate: increasing present threats, creating new ones, and altering the features of threats in ways that can "impact how we construct and manage digital infrastructure as well as how we design and distribute AI systems" (Brundage et al., 2018, p. 10).

A further example concerns the carbon footprint of AI-technological systems, a matter that resonates with environmental science and intense ethical questions. As Lotfi Belkhir and Ahmed Elmeligi (2018) point out, such systems'

> GHGE contribution relative to worldwide footprint will roughly double from 1 to 1.6% in 2007 to 3 – 3.6% […]. Assuming a continued annual relative growth ranging from 5.6 to 6.9%, ICT's relative contribution would exceed 14% of the 2016-level worldwide GHGE by 2040. Including the contribution of smart phones, we somewhat surprisingly found that smart phones would contribute about 11% to the total ICT footprint by 2020, exceeding the individual contributions of desktops (6%), laptops (7%) and displays (7%). The lion share of the emissions were found however to be generated by the ICT infrastructure with data centers being the largest culprit (45%), followed by communication networks (24%). Furthermore, we offered some actionable policy and managerial recommendations on how to mitigate and curb the ICT explosive GHGE footprint, through a combination of renewable energy use, tax policies, and alternative business models. Finally, we pointed out some directions for future work such as filling some of the obvious gaps of this study, and perhaps more importantly research the impact of novel and emerging digital activities such as the Internet of Things (IoT) and cryptocurrencies (p. 461).

Focusing on the 14% emission projection, we can also estimate that the materiality of AI-technologies – physical infrastructure, hardware, robots, data servers, microchips, cables, batteries, computing devices, etc. – as well as their reliance on critical minerals like lithium and cobalt for their construction are considerable sources of CO_2 and GHG emissions.

This reliance will not cease soon, as extraction is inevitable in the AI industry. Furthermore, the rising ideology of AI-technological solutionism[65] implies more design, production, and deployment, which will increase extraction and material sourcing of critical,

[65] When it comes to AI-technological solutionism, major tech corporations such as Google, Microsoft, Amazon, and Apple increasingly promote the narrative that "clean tech" can address the risks of climate change. For example, Google and Apple both claim CO_2 neutrality through the purchase of emissions credits, while Microsoft projects achieving negative CO_2 emissions by 2030 (Crawford, 2021). However, the pursuit and optimisation of such clean technologies inherently drive greater demand for AI-technological systems, demands that, in turn, escalate the need for resource extraction and raw material sourcing.

cheaper, and strategic minerals. Assessing these impacts requires a full lifecycle analysis from raw material extraction, manufacturing, and software development, through model training and deployment, to post-use disposal and recycling to fully capture their climate risk profile.

The preceding examples substantiate the contributive agency of AI-technological systems in climate risks due to their CO_2 footprint. Increased reliance on fossil-powered energy sources should be expected. This reinforces the point that although the green energy transition is central to mitigation strategies, the demand for cheaper energy sources and "smart" ecological technologies could paradoxically lead to greater CO_2 and GHG emissions because of the extraction required for the transition. The communities where critical minerals occur, often in poorer regions, bear the greatest burdens of such risks. Designers and end-users alike will, for a long time, depend on critical raw materials for producing, training, and deploying AI models. These systems reinforce one another (van Wynsberghe & Donhauser, 2017) and interact with climate scenarios throughout their lifecycle (Coeckelbergh, 2021). It is worth noting that these environmental interactions also feed into climate feedback loops. For instance, we can talk about how AI-driven energy consumption contributes to warming that accelerates permafrost melt, forest dieback, or other tipping points, which in turn could damage the very infrastructure these systems depend on.

Consequently, AI-technological systems as contributive agencies highlight that insofar as their production and disposal lead to increased extraction and material sourcing, as well as greater demand for fossil-powered energy, we cannot discount nonhuman agential entities in climate change and climate risk. While the risks posed may vary, their near- and long-term effects must be considered in mitigation designs, particularly given the evidence of increased existing threats, new threats, and shifting threat patterns due to climate change.

So far, my analysis shows that while the actual risks of AI-technological systems' intersection with the human lifeworld vary across societies, their role as contributive agents in climate risks is undeniable. Sinn's Paradox fails to acknowledge these externalities, particularly the significant CO_2 and GHG emissions of AI-technological systems, which directly exacerbate the very sustainability challenges it seeks to model. This omission creates an ethical blind spot, undermining both the integrity and the normative relevance of the Paradox. By overlooking the planetary consequences of AI's environmental footprint, the Paradox risks misrepresenting the full scope of harm and producing mitigation designs that are misaligned with reality. Ultimately, the agency of AI-technological systems, and the ways in which this agency intersects with other existential domains, is central to the philosophical analysis of the Paradox's inferential and predictive accuracy. Without integrating these ecological and cross-domain interactions, both the robustness of Sinn's Paradox and corresponding mitigation design it informs will remain critically incomplete and ethically compromised.

4.3.2 Distributed Authority: Non-State Actors in Fragile Climate Governance

For many real-world applications, the predictive accuracy of any mitigation design depends on the *Recognition* and *Representation* of all potential agents. *Recognition* speaks to the diverse degrees of exposure and liability to climate risks, while *Representation* reflects the multiagency, interagency, and overlapping entanglements of actors in matters of CO_2 and GHG emissions.

This assertion is not without reason. It stems from the observation that existential demands often push agents to find alternative ways of mitigating their risks when confronted with the susceptibility of a climate crisis. For example, let us consider sub-Saharan Africa. Here, existential pressures include inadequate development and infrastructure, the absence of humane amenities, political instability, fiscal distress, trade imbalances, widespread poverty, and persistent food and water insecurity. These conditions are not peripheral; they form part of the identity and lived reality of communities. They shape how people perceive climate risks and anchor how they act in response. And similar concerns arise in many other existential contexts.

When applied to NSAs, these existential demands elucidate the complex structures of conditions that influence how individuals and groups choose whom to align with in climate matters. They also reveal that climate risk is epistemologically constructed and purposely constructed to serve particular needs which are needs born of both agents' inability to mitigate risk (whether prior or ongoing) and their pattern of beliefs and desires. This epistemological framing helps explain why communities may choose to associate with NSAs over national governments when mitigating risks. In fragile contexts, for instance, NSAs often demonstrate greater functionality across multiple areas, wield stronger influence in international systems, and command more resources than weak or failing state institutions.

This perspective is reinforced by the United States' National Intelligence Council (NIC) memorandum (2023),[66] which underscores the expanding role of NSAs in governance and international affairs. According to NIC's (2023) report,

> increasing capability and influence of NSAs in international and national affairs – particularly those involved with key technologies or critical infrastructure – […] have made them a more direct target of states looking for a strategic advantage, making their protection from such threats another key factor in the global order and great power competition (p. 1).

The memorandum indicates that NSAs have assumed functions that we may refer to as *placeholder roles*. These are roles once reserved for governments, a shift that both exposes the fragility of state and global institutions and highlights the fluid nature of power, which gravitates toward those capable of addressing urgent challenges and public demands (NIC, 2023). As the NIC observes: "State-controlled institutions in every region and every

[66] This memorandum, officially released on 18 May 2024 by DNI Haines, underscores a disclosure of intelligence and recognition of the shifting gravitational pull of NSAs in the global order. By situating NSAs within the discourse of governance and strategic competition, the release highlights how these actors are no longer peripheral but constitutive agents of international life. The sanctioning of such information signals that the vulnerabilities and capacities of NSAs, whether in technology, infrastructure, or influence, are not minor, but structurally implicated in the balance of power itself. In this sense, the memorandum is an acknowledgment of NSAs demand ethical, political, and ontological consideration as agents in their own right, whose existence reshapes the contours of statehood and global governance.

government type are facing greater challenges meeting the expectations of their populations […] a particularly strong trend in weak or failed states. Publics globally now trust businesses and NGOs more than governments" (p. 2).

This placeholder role played by NSAs is particularly salient in the realm of climate mitigation, where fragile states falter under existential deficits. NSAs have increasingly exercised far-reaching functions in both domestic and global affairs, filling gaps left by underperforming states. It is clear that there have been instances where "companies and high-profile public figures [able to acquire] sufficient economic power and international reach to influence both social and geopolitical issues worldwide" (NIC, 2023, p. 4).

From this perspective, NSAs may be classified into two broad significations:

1. Positive Signification – NSAs act as tacit, parallel, and alternative agents, providing resources and legitimacy where state institutions fail. In many cases, they become trusted actors in advancing development and climate adaptation, thereby compensating for deficits in state capacity.
2. Negative Signification – NSAs can also accumulate cartel-like power. As Sinn (2012) and the NIC (2023) note, corporations and prominent individuals may accumulate economic strength and global influence to the point where they transcend participation, becoming architects of social and geopolitical realities, disclosing the erosion of established authority and the shifting currents of power. In this role, they may undermine national sovereignty and complicate or distort the design of future climate mitigation strategies.

Thus, while NSAs can act as enablers of resilience in vulnerable contexts, they can also operate as power blocs with interests misaligned to the common good. Their ambivalence, both necessary and dangerous, makes them indispensable actors whose agency must be critically integrated into any predictive design of climate mitigation.

i. Positive Signification of Non-State Actors

It is my conviction that development is not just a parallel concern but the very precondition for addressing climate risks. To argue otherwise is to overlook the existential threats that underdevelopment itself generates. Many resource-rich African economies, for instance, are structurally tied to oil and gas extraction as their backbone for "fiscal revenues, foreign exchange, and economic growth" (The Firma Advisory, 2024, para. 3). Yet, these same economies are increasingly pressed by global climate matters that call for rapid decarbonisation, while at the same time facing uncertainty about "the availability of appropriate and sustainable sources of capital for oil & gas and energy projects in the short, medium, and long term" (The Firma Advisory, 2024, para. 3).

Here lies the contradiction: fragile economies cannot be expected to 'transition' when their very survival depends on extractive revenues. Afreximbank's insights only underscore my conviction that development is *sine qua non* for climate resilience. To pretend that climate mitigation can be pursued in isolation from development is to impose an impossible burden, one that risks deepening poverty, exacerbating vulnerability, and ultimately undermining both climate and human security in most Sub-Saharan African states.

What this framing brings into focus is that, for fragile economies, underdevelopment is itself a climate risk. Until this contradiction is confronted head-on, climate mitigation design like Sinn's will remain aspirational rhetoric, detached from the lived realities of those who bear the brunt of climate shocks. Hence, climate mitigation design divorced from development is impractical. It is also a form of structural injustice that risks locking the fragile economies into perpetual vulnerability while others consolidate their gains.[67]

[67] Relatedly, I cannot in any way defend *galamsey*; its devastation of land, rivers, and farms is undeniable. Yet I cannot ignore the human story that underlies it. Those who turn to this practice rarely do so out of malice toward the environment but out of desperation, the absence of work, the frustration of exclusion, and the sheer weight of survival. To condemn them without grasping this struggle risks moral blindness. The challenge, then, is to hold two truths at once: that, galamsey is destructive and, that, it is also a symptom of wounds of underdevelopment. This is often where Western-led climate discourses falter, for they tend to frame the issue only in terms of

My conviction amounts to the presupposition that it is difficult to replace development in mitigating climate risk in certain, if not all, cases. In a sense, as cited in Creutzig et al., (2018), "human needs are particularly suited for developing countries, where demand is increasing quickly but where poverty eradication remains a central issue and is closely associated with providing decent housing and services" (p. 262). Therefore, the question is not about misuse of resources or the commons.[68] It is about the trade-off between resource utility for development in view of increasing the capacity to mitigate a climate risk and leaving the resources untapped because of potential climate risks that it may accelerate.

This trade-off is not purely abstract but embodies a fact: resource extraction simultaneously intensifies emissions and ecological precarity, even as it furnishes states with the fiscal and institutional capacities to invest in adaptation, infrastructure, and governance. In certain contexts, development through extraction may expand the very means by which communities are enabled to endure climate risk. Yet this fact is historically entangled with asymmetries of power and dependency. As Bolger and colleagues (2021) remind us in their report to the European Environmental Bureau, "European economies were built, in large part, through the colonisation of the Global South, channeling natural resources towards Europe.

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environmental harm while overlooking the structural inequalities and lived constraints that drive it. Any honest response must therefore reach beyond regulation or punishment; it must reckon with the realities of those whose choices are narrowed by poverty and exclusion. Hence, my recommendation for future mitigation designs, developed more fully in the next chapter, emphasises localisation and the critical role of communities in shaping sustainable solutions.

[68] This point is central to grasping why certain communities and regions persist in extracting from the commons as a way of consolidating their developmental aspirations. A striking example lies in the proposed establishment of an African Energy Bank, framed as an institutional anchor for Africa's economic transformation. The conceptual design of the initiative makes its purpose explicit: to channel investments into large-scale energy projects and thereby drive the development of Africa's hydrocarbon system (The Firma Advisory, 2024, para. 3). Behind this lies a revealing paradox. While global debates warn of the climate consequences of fossil fuel dependency, the proposal insists on the meaningfulness of Africa's energy sovereignty by invoking abundance to the extent that beneath the earth lie 125 billion barrels of assured oil and untold trillions of cubic feet of gas, and vast stores of energy that testify both to abundance and to the finite nature of what we consume (The Firma Advisory, 2024, para. 3). The case illustrates how agency is exercised in negotiating the commons. Africa, long positioned at the margins of global extraction regimes, asserts a form of developmental authorship insisting that the act of drawing from its reserves is not mere exploitation but a claim to existential and economic significance. In this light, the African Energy Bank does not simply administer resources; it embodies the tension between planetary responsibility and local meaningfulness, between the universal call to preserve the commons and the particular urgency of communities striving to convert potential into lived well-being.

The EU continues to extract and exploit resources and labour from poorer countries and regions today" (p. 2). The persistence of this extractive order renders climate governance a site of profound ethical clash, which generates the question: can systems of adaptation truly serve justice when the very resources that sustain them remain bound to histories of dispossession and unequal exchange?

The positive signification of NSAs can, therefore, be explained in light of the utility of 'the commons'[69] for the development. This suggests that what counts as "positive" is historically contingent – the same logics of extraction that once entrenched inequalities are now reframed by Global South governments as instruments of self-determination and resilience-building. And this understanding, according to Bolger et al. (2021), is hardly surprising given that Europe has "been consuming more than its fair share, and beyond ecological limits, for decades. The EU's material footprint […] is currently 14.5 tonnes per capita, well over the global average, and about double what is considered a sustainable and just limit. Imports from outside the EU account for 20% of this […]" (p. 2).

The foregoing discussion highlights how economies have expanded by drawing heavily on the commons. Yet what comes to light here is not simply an economic asymmetry but a

[69] The notion of the commons, though formally coined in 1832 by William Forster Lloyd in response to the visible destruction of publicly shared grazing lands in England, reflects a much older philosophical anxiety about the fate of what is held in common. Lloyd's observation that cattle on the commons appeared underdeveloped and the land itself barren compared to privately managed plots was an agricultural concern and a meditation on agency without restraint: when many agents act freely but without coordination, the very ground of their flourishing collapses (Ostrom, 1990; Coeckelbergh, 2021). Yet Lloyd was hardly the first to sense this paradox. Aristotle had already captured the logic of neglect in his warning that "what is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest" (Politics, Book II, ch. 3). Likewise, Hobbes's "state of nature" may be read not only as a tale of perpetual conflict but also as a thought experiment on what happens when human agency is stripped of shared meaning, each agent seeking their good, but in doing so, negating the conditions that sustain the collective (Copleston, 1985). These reflections converge on a central question: can the commons exist meaningfully if each agent interprets their freedom only as self-maximisation? Hypothetically, imagine a community where all agents, while rational, treat the commons as infinitely resilient. Such a community may prosper briefly, but its assumption denies the finite character of the commons itself; destruction becomes inevitable. Conversely, imagine another community where each agent acts out of self-interest and from an awareness that their agency is bound up with the flourishing of others. In this case, the commons ceases to be a site of depletion and instead becomes a field of shared possibility. The philosophical thread running from Aristotle to Hobbes and Lloyd suggests that the commons is never simply a resource but a mirror of agency itself. When meaning is located in isolation, the commons disintegrates; when meaning is located in relationality, the commons becomes the ground for durable forms of life.

puzzle at the heart of the global climate order. The Global North persists in its excess, drawing more than its share from the planetary commons, while the Global South is chastised for aspiring to the very developmental arc that the North itself has already exhausted. This reveals a conflict between justice and responsibility: the moral imperative to reduce fossil fuel dependency is universalised, yet the historical burden of overconsumption remains unevenly carried. Climate frameworks impress upon governments the urgency of reduction targets and the avoidance of stranded assets, but in the same gesture, EU and other Global North states remain entangled in fossil fuel production. Thus, the architecture of climate governance risks becoming self-contradictory: demanding restraint from the vulnerable while permitting indulgence to the powerful.

Consequently, for many Global South governments, the emergence of NSAs signifies an intrusion into the governance of the commons and an opening, a fissure in the otherwise constraining architecture of global order. In partnering with NSAs, governments find not simply a pragmatic means of accessing financial resources and experts but also a reconfiguration of sovereignty itself. These agents become more than partners of convenience; they are enablers of existential possibility, allowing states to circumvent the disciplinary grip of Global North institutions that have long dictated the terms of access to capital and development. In this sense, NSAs function as mediators: they embody the very forces of globalisation that constrain poorer states, while simultaneously furnishing those states with the instruments to resist, appropriate, and reassert their place in the governance of the commons.

We may, thus, deduce that the trust accorded to NSAs arises less from a naïve optimism than from their demonstrated capacity to provide what states increasingly struggle to guarantee: "societal services, intelligence, security, […] governance that at times place them in direct competition with state institutions, to addressing transnational challenges and in so doing, helping to shape norms, values, and standards that give them prominence apart from states"

(NIC, 2023, p. 1). In this light, NSAs, particularly the super-empowered individuals (NIC, 2023), appear as the lesser evil: entities whose mobility across the thresholds of state and market, public and private, enables them to instrumentalise the commons in ways that appear more effectual than the old structures of geopolitical blocs such as the European Union, or the entrenched financial orthodoxy of the IMF and World Bank. Yet herein lies the irony: the very agents who seem to rescue states from impotence are also those who unsettle the very grounds of political legitimacy, revealing that what is at stake is about governance of the commons and the redefinition of sovereignty itself.

Therefore, to justify the positive signification, I will look at two considerations. The first consideration is what I will term as 'indigenous renaissance on articulating self-determination' in relation to the use of the commons. This renaissance is symbolic but manifests in political claims, civil society mobilisations, and scholarly critiques of climate governance architectures perceived as reproducing colonial hierarchies.

This consideration focuses on the historical emissions of CO_2 and GHG. I proceed from the view that most states in the Global South are aware of imperial exploitation and early modern colonisation vis-à-vis a rational desire for self-determination in the utility of the commons. Hence, many NSAs in both academic and research institutions and civil society entities, are unable to decouple the past of imperial exploitation, looting, extractivism, etc., from the current trends of climate mitigation designs. In this light, calls for equitable burden-sharing are as much about redressing historical injustice as they are about ensuring practical feasibility of climate transitions in developing economies.

If we envision that states ought to aim for the radical phasing out and reduction of oil, gas, and coal productions, then the states should also have an equitable share of the burdens that come with the production of it. Contrary, proponents of mitigation designs are also those with high levels of historical emissions of CO_2 and GHG. The equitable share of the burden is also particularly underscored when we observe how developing economies (example, the sub-Saharan African states) with a low historical emission of CO_2 and GHG are relatively stressed with emerging risks and threats due to changes in climate (World Meteorological Organisation, 2021).

The second consideration has to do with the offsetting of debt. Indeed, Africa's debt today is often attributed to unfair loan conditions, and inequitable economic and trade systems pioneered by mostly states and groups from the Global North (Reinhart & Rogoff, 2011; Gayou, 2017; African Development Bank, 2018). Thus, for most African states it makes sense to offset such debt by renting out natural resources to other actors or exchanging the extracted raw materials for repayment or compensation for the debt.

This reflects a pragmatic, if contentious, approach. That is, development is financed not in spite of extractivism but through it, embedding fossil-fuel dependence in the very structures of debt relief and fiscal stability. Logically, it is a good option for most African states and developing economies strained by debt repayments and historical debts.

The third consideration is the capability of NSAs to be participational agents[70] in domestic social practices. Regarding this, I would show how citizens' preference for NSAs in

[70] Human action and willingness can be understood as isolated behaviours or mechanistic responses, and as a "meaningful engagement in the world" in which the felt significance of activity is central to experience (Yanchar, 2011). This framing resists reducing human activity to utilitarian calculation or instinctual drive; instead, it interprets action as always already infused with meaning. Yanchar (2011) clarifies this through four interrelated themes: "situated participation, existential concern, dispositional action, and narrative orientation". Taken philosophically, these themes gesture toward a structure of human agency. Situated participation reminds us that no act occurs in abstraction; every engagement is embedded within contexts, social, cultural, ecological, that both enable and constrain possibility. Existential concern suggests that beneath action lies an orientation toward finitude, vulnerability, and purpose: we act not only to survive, but to matter. Dispositional action highlights that agency is not improvised at each instant, but shaped by habits, embodied tendencies, and cultivated virtues or vices. Finally, narrative orientation insists that our actions are never singular but become intelligible within a larger story that ties past, present, and future into a trajectory of meaning. Hypothetically, imagine two agents confronted with the same practical task, say, tending a communal field. For the first, action is viewed as mere obligation: a mechanistic carrying out of labour without reflection. For the second, the same act is situated in a narrative of care for family, a concern for collective survival, and a personal sense of identity as one who sustains life. Though both agents "act," the second transforms the act into meaningful engagement, where willing and doing converge with significance. The implication here is profound: agency is not reducible to the mere execution of choice but must be understood through the lived texture of meaningfulness. This challenges perspectives that treat human action as detached rationality or raw instinct. Instead, it locates action within the horizon of meaning, where participation, concern, disposition, and narrative make human willingness inseparable from the world in which it unfolds.

most states in the sub-Saharan African region is based on the participational agency of NSAs in their domestic activities. For many in the region, some NSAs are "like us" in our existential struggles, shared aspirations, and disputed interests. The agency of NSAs as "like us" appears to be a reasonable response to historical unfair conception of justice in trade and supply chains in the global community. This "like us" framing captures the affective dimension of legitimacy. Here, NSAs gain traction through capacity and through resonance with local identity and lived experience.

Thus, while some NSAs are predominantly interested in corporate and commercial bonds[71] and profit-making enterprises, other NSAs choose not to interfere in the domestic and sociopolitical affairs and are ready to offer aid without extreme conditions. Correspondingly, it is obvious that many poorer states will go for the designs which their citizens identify with, and that give meaning to their collective experiences and expectations. This, however, leaves open the problem of how the agency of NSAs' impact on climate mitigation design.

In my view, since citizens' expectations provide a valuable motive for analysing why a political regime or a state government would comply with a design or not, what Sinn refers to as 'demand cartel' (Sinn, 2012) is rather placeholders for state governments and bodies of both domestic and international systems. This is because I assume that NSA "with such influence traditionally have functioned as distinct actors with a clear organisational structure, increasingly more diffuse collectives and even individuals lacking a distinct hierarchy or formal operational network are wielding influence at larger scales" (NIC, 2023, p. 3) than most governments and political regimes.

[71] This does not imply the absence of exploitation altogether. Rather, it signals that what binds the parties is a relational contract grounded in the pursuit of mutual benefit. The very terms and conditions of such a bond emerge not as fixed impositions but as negotiated realities, contingent on the situated capacities and vulnerabilities of those involved. Exploitation may still be possible, yet it is refracted through the interplay of consent, reciprocity, and asymmetry. Thus, the bond is not reducible to domination, nor is it entirely free from power; it exists as a dynamic negotiation of advantage, responsibility, and survival.

Understanding these diffuse, fluid, and at times opaque structures of influence complicates attempts to slot NSAs neatly into governance frameworks, yet it also explains their adaptive appeal in volatile political economies. Hence, considering such influence and operational system could explain why citizens would collectively define NSAs as placeholders in providing unique insights into what they believe good mitigation design entails, and where and why they believe it would fail.

With the three considerations of looking at the positive signification, we could argue that the functions of such actors in most developing economies and states endowed with natural resources pose a practical challenge to the Paradox and its mitigation design. And this challenge is obvious in how states which have assured to attain net-zero emissions and to launch plans to decrease CO_2 and GHG emissions and fossil fuel production, still fail to fulfil the assurance to 1.5°C (Guterres, 2023). The persistence of this gap underscores how extractivism, while recognised as a colonial legacy, remains a structural necessity in many development trajectories, reproducing frictions between climate ambition and economic survival.

The considerations, therefore, underscore the practical problem of extractivism – a colonial legacy which testifies to policy ambivalence alongside unfair trade and supply chains systems. For instance, according to the 2021 European Environment Bureau's report by Bolger et al. (2021),

> import tariffs from EU […] countries on raw materials are very low compared to export taxes by resource-rich producers. World Trade Organisation (WTO) obligations restrict the ability for these countries to raise import tariffs, yet export taxes are not subject to the same WTO obligations for exporting countries (p. 16).

The report from Bolger et al. reflects policy ambivalence with regards to taxation which affects resource-rich states mostly from the Global South and growing economies but not those who benefit from the raw materials. This policy ambivalence could be attributed to NSA like the WTO which, with its geopolitical influence, could restrict actions of national-level governments.

It is a fact that though we recognise that the impact of extractivism could lead to climate risks, the need for it is something that blinds the risks of CO_2 emission and planetary health. To an extent, even consumer trends and economic activities of the richer states and pioneers of mitigation designs seem to support the inevitable demand and supply of raw materials. Thus, climate risks and extractivist needs are locked in a feedback loop, where global consumption patterns in wealthy states sustain pressures for continued extraction in poorer states, undermining mitigation pledges. In a way that,

> 1.2 billion poorest people account for just 1% of the world's consumption, while the one billion richest accounts for 72% [...] High-income countries, which include most EU member states, are responsible for a material consumption that is 13 times greater than that of low-income countries, and 1.6 times greater than upper-middle income countries (Bolger et al., 2021, p. 6).

Taken together, resource-rich states in the Global South may strategically align themselves with NSAs whose "sufficient economic power and international reach [allow them] to influence both social and geopolitical issues worldwide" (NIC, 2023, p. 4). Such partnerships, while ostensibly pragmatic, reveal an ambivalence at the heart of the global climate order. On the one hand, they offer a means for states to assert agency within an architecture historically weighted against them. On the other hand, they threaten to fracture collective designs for mitigation, producing asymmetries that undermine globally coordinated responses (Heffron & Haynes, 2014). This irony becomes particularly acute in fragile states, which risk becoming the 'weak spots' through which predatory NSAs, driven by revenue, ideology, or a fusion of both (NIC, 2023), may penetrate, extracting value under the guise of empowerment. What emerges, then, is a tragic irony: the very alliances that promise emancipation may deepen dependency, revealing how sovereignty in the Global South is continually negotiated between the desire for autonomy and the peril of exploitation.

Consequently, the argument that "we either temporarily refrain from extracting carbon from the ground, or we stuff it back into the ground after having extracted its energy" (Sinn, 2009, p. 10) appears untenable. In fragile contexts, the extractive imperative consistently eclipses abstract commitments to mitigation, rendering Sinn's design a technocratic abstraction detached from the material and political economies of survival. The lived reality in sub-Saharan Africa illustrates this starkly. Here, developmental agendas are bound to resource exploitation, not as a matter of choice but of necessity, shaped by histories of dispossession, monopolistic extraction, and the enduring weight of dependency. The region's entanglement with foreign actors, whether states or individuals or corporations, compounds this logic, as extractivism becomes less a policy option than an imposed condition.

Moreover, the failure of Global North states to assume full responsibility for their historical emissions delegitimises the calls for restraint, exposing a profound asymmetry in the moral economy of climate politics. Under these conditions, the appeal of partnering with NSAs lies less in their normative commitments and more in their capacities: their influence, their resources, and their ability to bypass stagnant global mechanisms. For poorer states, then, the calculus is not one of idealised mitigation but of pragmatic survival – where alliances with NSAs offer, at least, the possibility of immediate gains, even at the cost of reinforcing long-term vulnerabilities.

ii. Negative Signification of Non-State Actors

Wijninga et al. (2014) cautioned against allowing NSAs to eclipse the power of national governments in shaping CO_2 futures, arguing that "with such a variety of actors, many of which have ties to state authorities, it becomes difficult to ascertain or even compare their impact on state authority" (p. 143). This observation highlights a central danger: the presence of multiple actors with competing, overlapping, or opaque interests complicates the shared pursuit of climate mitigation. NSAs, far from neutral agents, often act from positions of profit, ideology, or hybrid motivations, and in some cases intentionally operate outside the legal and normative structures of society (NIC, 2023). As the National Intelligence Council (2023) warns, such entities can include criminal enterprises and opportunistic organizations exploiting regulatory gaps in emerging sectors.

One particularly troubling negative signification is the emergence of NSAs as *enthusiasts* – actors whose ideological or religious convictions shape their climate engagements in ways that resist scientific consensus or pragmatic policy. For example, some are swayed by biblical anthropocentrism, which portrays human beings as superior to other creatures, divinely authorised to exercise dominion over nature (Genesis 1: 26 – 28, NRSV; Psalms 8:4 – 8, NRSV). Others, by contrast, align with eco-centred or eschatological visions that see humanity as neither privileged nor permanent, and interpret climate disasters as signs of divine or cosmic inevitability (Taylor, 2009; Torres, 2016). The reasoning behind the former often invokes rationality, stewardship, or divine viceroys; the latter rests on beliefs in the sacredness of nature, apocalyptic certainty, or the futility of human intervention (Taylor, 2009).

The risks here lie in how these competing frameworks of meaning displace scientific or pragmatic action. For such actors, the phenomena of climate change, uninsurable futures, accelerating extinctions, melting glaciers, the depletion of commons, or cascading climatic events such as droughts, famine, and disease, are not explanatory ends but interpretive signs. Climate becomes symbolic rather than empirical. In this way, agency itself becomes reoriented: actors do not seek to mitigate risk but instead to fulfil a divine, ideological, or eschatological mission.

The danger is twofold. First, NSAs can resist or undermine mitigation efforts, obstructing collective attempts to secure resilience. Second, they can actively accelerate risks by framing climate catastrophe as *opus Dei* or as an inevitable apocalypse. Bron Taylor's (2009) notion of *dark green religion* illustrates how spiritualised environmental ideologies can mobilise radical forms of resistance, sometimes overlapping with ecoterrorism. Similarly, Torres (2016) reminds us that the unpredictability of global catastrophe scenarios makes it possible for "non-existential terror to slide into existential error" (p. 40). That is, actors motivated by symbolic or ideological ends may unleash consequences far beyond their intentions, destabilising global systems.

Yet, even in their negative signification, NSAs reveal something philosophically important about agency and the commons. They demonstrate that climate risk is never merely existential; it is always mediated by systems of meaning. Whether through religious belief, profit-driven ambition, or criminal opportunism, NSAs embody the fact that engagement with the commons is filtered through narratives of significance. Their agency, in other words, is hermeneutical as much as material.

Accordingly, we must acknowledge the fact that NSAs simultaneously embody profound risks and necessary potential. They wield soft power through networks, resources, legitimacy, and reputation (Wijninga et al., 2014; NIC, 2023), allowing them to reshape decisions and reimagine political actions in today's multipolar world. In a sense, even when their influence is uncertain or ambiguous, their role in climate matters, whether positive or negative, cannot be overlooked. Thus, though it is unclear how much influence NSAs will have in CO_2 futures, it is fairly certain that they have shown, and may continue to show, a weighty position in climate change, risks, and mitigation plans either in the positive or negative significations. In whatever way we look at the significations, it is my view that the agency of such actors in climate matters cannot be overlooked.

Consequently, the real philosophical question is not whether NSAs will act for or against the commons, but how their agency is to be situated, interpreted, and rendered accountable within an already fractured global order. Their interventions are never neutral: they enter the stage of climate politics as both bearers of capacity and carriers of particular interests. Consider, for instance, the World Economic Forum's (2024) roadmap to finance and act on nature, an initiative that projects itself as indispensable to the mobilisation of the $700 billion annual investment deemed necessary to arrest ecological decline and foster renewal by 2030. At one level, such initiatives reveal the irreplaceable capacities of NSAs to mobilise capital, expertise, and influence at a scale governments and states alone often cannot. At another, they exemplify the ambiguous logic of power in which ecological stewardship becomes entangled with profit motives, ideological framings, and the reproduction of structural asymmetries.

This duality, NSAs as both potential saboteurs and indispensable collaborators, expresses more than a pragmatic dilemma; it gestures toward an existential puzzle at the heart of the commons itself. The commons, once conceived as a shared space of belonging, is now dispersed across states, corporations, NGOs, and competing imaginaries. What emerges is a fractured ontology of responsibility, where the very entities capable of sustaining life on Earth are simultaneously implicated in its undoing. To think the commons in this context is to accept its instability: not as a singular ground of ethical consensus, but as an arena where the struggle over meaning, responsibility, and justice is perpetually reopened.

4.4 Chapter summary

The practical presence of nonhuman agential entities in climate change and climate risks reveals a profound philosophical truth: the world is not a simple, linear system reducible to one model of cause and effect, but a dynamic common of entangled agencies. We live within a globally interconnected field where both human and nonhuman agents ranging from AI-driven logistics systems and automated energy markets to transnational corporations, NGOs, and even ecosystems themselves shape outcomes in ways that are neither fully predictable nor fully controllable. Any serious attempt at climate mitigation that ignores this ontological plurality risks collapsing into abstraction rather than grappling with reality.

What this chapter demonstrates is that climate risks are patterns of interagency interaction. AI-technological systems operate with forms of delegated, distributed rationality that affect trade, extraction, and energy infrastructures. NSAs, from corporations to multilateral banks, embody institutional agency that restructures incentives, capital flows, and governance regimes. Ecological systems, whether forests, oceans, or carbon cycles, exert agency by way of feedback loops that resist, redirect, or amplify human interventions. To reduce this complexity into the behaviour of a single rational agent, as Sinn's Paradox does, is to miss the essential insight: climate governance is a theatre of multiagent entanglement.

Sinn's Paradox is instructive precisely because of its limits. It foregrounds how a single agent might accelerate extraction in anticipation of climate policy, yet it cannot explain how such behaviour multiplies, intersects, or is mediated through wider social ontologies, institutions, infrastructures, and networks, that sustain or destabilize entire systems. What Sinn overlooked is a practical miscalculation and a practical denial of ontological heterogeneity in agency. The failure lies in assuming that agency is uniform and reducible, when in fact it is plural, relational, and distributed across both human and nonhuman domains.

The lesson is clear. Climate risks, by their very dynamics, urge us toward an acknowledgment of agential diversity. A machine-learning algorithm that redirects global shipping routes, a multinational bank financing oil exploration, and a mangrove forest absorbing carbon all exercise agency in ways that are different yet deeply interlinked. These entanglements demonstrate that agency is not simply a human monopoly but a shared, distributed capacity that manifests across domains of life, technology, and institutional power.

In conclusion, the philosophical arc of this chapter suggests that future climate mitigation cannot remain anthropocentric. It must embrace the spectrum of agents, human and nonhuman alike, whose capacities, vulnerabilities, and motivations co-constitute climate realities. Incorporating nonhuman agency, from autonomous systems to ecological processes, is not a matter of theoretical elegance but of existential necessity. Without such an expanded ontology of agency, our mitigation designs will remain partial, blind to the very forces that shape the commons we all inhabit.

CHAPTER FIVE

CONCLUSION: ORIENTATIONS TOWARD FUTURE CLIMATE MITIGATION DESIGNS

5.0 Introduction

Sinn's Green Paradox offers a valuable insight: supply-side climate policy must create systems that open pathways for mitigating climate risks such as global warming. He rightly emphasises managing resource extraction and emissions as central to protecting the global commons. Yet he concedes, without resolving, that sustaining these commons for future generations provokes conflicts rooted in economic competition, geopolitical rivalry, and cultural disagreement over what sustainability entails.

Framing the commons as intergenerational legacies rather than present-day assets could enable more effective measurement and management of fossil fuel extraction and CO_2 emissions. But here Sinn's theory and mitigation design weakens: it does not adequately account for the agential entities,[72] human and nonhuman, that actively shape emissions today and will determine the scope and design of future mitigation strategies. Agency, both as a starting point and an end result of climate processes, is missing from his analysis.

As I have argued, accurately describing a climate risk like global warming requires attention to multiagency and interagency dynamics: how diverse agents with distinct capabilities, motives, and constraints interact within complex systems. Sinn underestimates these dynamics and the agentive nature of climate variation and risk, particularly the role of

[72] I previously introduced the concept of nonhuman agential entities to examine the philosophical implications of their intersection with human agency in the context of climate change and risk. Here, nonhuman agency encompasses emerging AI-technological systems, which operate as both active and passive agents within climate and ecological systems. These systems become especially significant when interacting with human actors in the consumption of natural resources and in contributing to CO_2 emissions.

nonhuman agents such as AI-driven energy systems, autonomous industrial processes, or ecological actors like invasive species, all of which can accelerate climate risks.

This omission is analytical and normative. Ignoring agency, especially as human decision-making becomes entwined with AI-technological systems, weakens the ethical foundations of climate mitigation designs.[73] Communities whose ethics of relationality recognise the intrinsic value of nonhuman agents offer alternative frameworks that should inform CO_2 reduction strategies.

An effective alternative to Sinn's design must give equal weight to human and nonhuman agency. This means recognising the adaptive, context-specific capacities of marginalised communities with grassroots mitigation practices, as well as incorporating complex nonhuman agents, AI-technological systems, automated energy grids, ecological feedback loops, into design and decision-making frameworks.

Such a design would treat climate mitigation as a science of decision-making under complexity: regulating behaviour, offering actionable guidance, and anticipating diverse agents' influence even within a margin of error. It would embed both anticipatory and responsive features, ensuring adaptability across contexts.

What makes this approach strong is its heterogeneity, the capacity to integrate multiagency and interagency principles alongside values of justice, pluriversality, grassroots knowledge, and existential awareness. This is because I envisioned that a successful design would anchor itself in everyday lived experiences, represent heterogeneous agency, and incorporate diverse ethical epistemologies into climate strategies.

[73] I recognise that introducing nonhuman agency, such as AI-technological systems, inevitably raises questions of machine ethics, specifically, what kind of entities artificial moral agents are, and whether they can justifiably be ascribed the moral principles that govern human social life. This inquiry becomes especially urgent in the climate context, where AI systems increasingly participate in environmental decision-making, resource management, and emissions forecasting. If such systems influence or even determine how resources are consumed and carbon is emitted, then the question is whether they can act morally, and whether we must hold them, and their human designers, accountable as moral actors within the shared responsibility of safeguarding planetary ecosystems.

This concluding chapter therefore pursues three interrelated aims:

1. to argue why human and nonhuman agential entities must be recognised as central to understanding and shaping climate theory and mitigation design;
2. to articulate the key features that effective, multiagent climate mitigation designs should embody; and
3. to propose philosophical and practical orientations for guiding the development of future climate theories and mitigation designs.

5.1 Beyond Humans: Multiagent Perspectives on Climate Risk

In Chapter four, I argued that the philosophical foundation of Agent-Based Modelling (ABM) lies in its capacity to capture the complexity, capabilities, and trajectories of diverse agents, as well as the intricate interactions between those agents and their ecosystems. Using ABM as a conceptual frame, I advanced the case for recognising agential entities in analysing climate change and its associated risks.

Why must we include such entities in climate theories and designs? I offer three interconnected reasons.

First, climate mitigation cannot be reduced to the regulation of human actions alone. If, as I have shown, natural variability and nonhuman agents are empirically observable drivers of climate change, then any design that focuses exclusively on human behaviour is incomplete. This follows from my earlier critique of Sinn's Paradox: the causal chain of climate risks is more-than-human. Climate change is not solely a product of anthropogenic forces; it emerges from the entanglement of human and nonhuman agencies.

Second, the empirical case for recognising agential entities rests on their relevance to real-world climate risk management. An operationally effective design must integrate nonhuman agents and their potential to mitigate climate risks as a result of their CO_2 footprints. This is because as reliance on these agents deepens in everyday life, a credible mitigation framework demands a 360° assessment, a design that reflects interagency, and the interplay of multiple agent types in shaping climate trajectories.

Third, the philosophical argument turns on the deliberative character of agency. Human agency cannot be reduced to mere instrumentality; it is essentially deliberative, grounded in the capacity to exercise shared control over actions and decisions within a community. Following Okeja's (2022) political philosophy, deliberation emerges not as a procedural accessory but as a constitutive value of political life itself: genuine agency requires that all voices are formally included and substantively heard, and that participation in the public sphere is meaningful rather than symbolic.

Transposed into the register of climate governance, this principle entails that mitigation designs cannot be dictated exclusively by technocratic models or external imperatives. Instead, they must be shaped through dialogue with diverse communities, recognising the validity of local epistemologies and making space for climate pathways that are culturally and contextually attuned. To deliberate is thus to decide; it is to open climate governance to plurality, to resist epistemic domination, and to allow justice to emerge from the encounter of many worlds rather than the imposition of a single one.

Therefore, why must we include such entities in climate theories and designs? The three interconnected reasons, I have advanced so far, oblige us to recognise agential entities in climate governance, not as abstract or disembodied agents, but as interlocutors in a shared dialogue on climate risk and its unfolding consequences. To deliberate here, for instance, is to exchange positions; it is to recognise that agency is situated within histories of asymmetry and vulnerability. The distribution of benefits and burdens has never been neutral: some have amassed wealth from the relentless exploitation of the commons, while others, often those already pushed to the margins of political and economic visibility, have borne the disproportionate weight of CO_2 emissions, ecological degradation, and dispossession.

If such asymmetries remain unacknowledged, they will persist and deepen, driven by the spiral forces of self-interest, protectionism, and global isolationism. Climate governance, then, cannot simply be a technocratic calculus of emissions and trade-offs. It must be an architecture of justice, one that embeds inclusivity and the heterogeneity of agency into its very design. [74] In this light, climate deliberation becomes a site where plural worlds encounter one another, where the fractures of inequality are not concealed but addressed, and where governance itself is transformed into a practice of responsibility to those who have been rendered most vulnerable by its absence.

5.2 Situational Ethics and Multiagent Design in Climate Mitigation

What should climate theories and designs look like, and how should we approach them? I propose that they must be situational, attentive to the local facts, ideas, beliefs, and experiences of diverse communities. Effective mitigation designs must integrate these situational perspectives because communities experience and respond to climate risks differently, shaped by their relation to observable realities and socio-ecological contexts.

[74] It is my observation that the very controversies that beset climate theories and designs stem from empirical disagreements and a neglect of the ethical orientations and value-commitments that underwrite them. Climate theories are never neutral instruments of calculation; they are saturated with the human and the nonhuman, entangled with how we think, feel, and remember. They are bound to the sedimented wealth of geography, history, ecology, and culture that shapes the life-worlds of individuals and communities. To imagine climate regulation as separable from the values that animate it is already to misrecognize its essence. This may explain why disputes persist over the hidden costs of CO_2 emissions, why responsibilities for causation and remediation remain contested, and why intergenerational justice fractures along lines of power and vulnerability. The principles that ostensibly guide us, such as "ability to pay," "beneficiary pays," "polluter pays", are themselves ethical imaginaries, each privileges a particular account of justice, responsibility, and obligation. They do not settle the matter; they disclose its irresolvable character. The puzzle is that in invoking justice, we multiply its interpretations, and in seeking fairness, we confront the abyss of competing values.

A situational approach also ethically creates space for *human agents to contribute perspectives on sustainable mitigation*. For example, Europe's shift away from Russian fossil fuels prioritises community welfare and survivability over short-term economic gain. Yet such decisions may inadvertently increase CO_2 emissions and delay green transitions, highlighting the importance of designs that recognise trade-offs and agentive complexities in mitigation. In short, predictive accuracy and domestic support require designs that account for both human and nonhuman agent behaviours.

Another feature is *inclusion of ethical epistemologies*. Mitigation frameworks must consider local understandings of welfare, subsistence, and existential spaces, allowing communities to participate meaningfully in the distribution of benefits and burdens from the commons and CO_2 emissions. Ethical epistemologies enable grassroots engagement, foster equity, and facilitate epistemic exchange across cultures, reflecting diverse experiences of climate exposure and vulnerability. Even constrained communities are active sense-makers, not passive recipients of policy; thus, effective design translates local ethics and epistemologies into actionable regulations.

A further essential feature is recognition of the *mediating effects of contexts*. Sinn's Paradox largely ignores such contextual variation, yet climate mitigation cannot rely solely on formal regulations. Communities without well-documented climate designs often possess practical risk-reducing practices and ethical frameworks. For instance, the African concept of ubuntu, as Le Grange (2019) interprets it, bridges human, ecological, and cosmic relationality: caring for oneself, others, and the environment are inseparable, illustrating how ethical epistemologies guide mitigation while respecting multiagent interactions.

Situational design and contextual sensitivity demonstrate that climate mitigation must account for multiagency, including emerging AI-technological systems, human communities, and ecological actors. By providing resource thresholds and supporting welfare in lessresourced communities, such designs enhance both human survivability and system resilience. These considerations directly challenge the single-agent assumptions of Sinn's Paradox and highlight the necessity of incorporating diverse agential entities into climate theory and design, especially amid competing commons use and tipping-point risks.

5.3 Philosophical Orientations for Designing Future Climate Mitigation[75]

What we have considered so far aligns with the philosophical appreciation of multiagency and interagency in climate change and risks. It also foregrounds the differential degrees of exposure and vulnerability to climatic shifts and their related risks.

In seeking a design that can embrace multiagency and interagency, I have assumed that any real-world mitigation framework must reflect the complex, multidirectional, and multidimensional interactions between intra- and inter-human agencies as well as human and nonhuman agents. This raises two normative questions:

1. How do mitigation designs influence agency?
2. Whose normative interests are prioritised in climate deliberations, especially when some agents demand to be seen, heard, and included?

Sinn's model, however, downplays the role of nonhuman agency and neglects the mediating effects of contexts, thereby obscuring alternative ethical epistemologies and the lived experiences of climate change, risks, and mitigation strategies. This suggests that Sinn either underestimated the complexity of climate change or oversimplified the risks and their design implications.

[75] The orientations offered here represent my recommendations for future climate mitigation designs, grounded in a relational view that recognises the co-constitution of human and nonhuman agencies. Effective mitigation must account for the ethical and practical entanglements of multi-agent systems, where responsibility, causality, and sustainability emerge through complex interactions rather than isolated interventions.

From this critique emerges my proposal: an alternative to the Paradox and its corresponding design, one that defines and integrates diverse agents in climate risk mitigation. I frame this alternative around three philosophical orientations:

1. Localisation and Meaning
2. Hybridity
3. Agential intersection

These orientations are analysed through the lens of multiagency and interagency in climate change and risks, with attention to differential experiences and impacts of climate change; substantial CO_2 and GHG contributions from nonhuman agents such as AI-technological systems; and shifting capacity dynamics between human and nonhuman agency, particularly as AI interpenetrates human decision-making in the physical world.

Unlike Sinn's single-approach design, these orientations seek to rethink ethical epistemologies and foreground contextual mediation, drawing on diverse experiences to construct future-proof climate mitigation designs. Such designs would enable policymakers and researchers to incorporate varied ethical frameworks and conceptual models more intentionally, thereby avoiding marginalisation, inequality, and exclusion of agents, human or otherwise most at risk.

In my reasoning, only an agentially inclusive, globally sensitive design can produce accurate, real-world mitigation strategies while addressing the existential structures, processes, drivers, and norms that sustain harmful climate behaviours. These orientations serve as practical suggestions and philosophical provocations, challenging the resilience deficits in global and domestic systems and interrogating the uncertain but escalating influence of nonhuman agency in the evolving climate landscape.

5.3.1 Localisation and Meaning[76]: Grounded Mitigation

A fundamental difficulty with Sinn's climate design lies both in its end goal and in the pathway it proposes to reach. While Sinn insightfully analyses the global conditions that hinder control over natural resources, culminating in the Paradox effect, he leaves unexamined the domestic drivers that shape resource use, influence CO_2 emissions, and affect the viability of mitigation measures. In many domestic contexts, the reception of climate mitigation designs is filtered through existential or historical narratives. Some communities, for example, may interpret climate warnings as exaggerated alarmism or as covert forms of neo-colonial intervention[77]. In a sense, the disconnect between global frameworks and the lived realities, cultural interpretations, and community understandings of people, whether real or perceived, reveals a challenge of translation between abstract design and lived context. Consequently, climate designs that lack contextual grounding risk becoming unintelligible or even unacceptable to those expected to adopt them.

By focusing on a single, globalised agency, Sinn's model overlooks the "more-than-human" and "more-than-one" character of climate risk. His proposal fails to address the layered interactivity between human and nonhuman agents, as well as the mediating effects of existential contexts. This omission produces two key weaknesses: first, it underestimates the

[76] My use of the terms localisation and meaning can be analogised with the Catholic theological notions of *inculturation* and *indigenisation*. These notions clarify the persistent tension between the universal and the particular, a tension that is equally present in the design of climate mitigation. *Inculturation* signifies the adaptation of faith and practice to the textures of concrete cultural worlds, while *indigenisation* emphasises the cultivation of leadership and traditions that arise organically from within those worlds (for example, the celebration of the Catholic Mass in vernacular languages). Both affirm the inherent worth of local cultures, yet they simultaneously disclose a profound philosophical and existential dilemma. How, indeed, can that which lays claim to timelessness and universality genuinely inhabit the contingent and perishable narratives of human history without diminishing its transcendent character? And conversely, how can the particular preserve its singular voice without dissolving into an abstract universality? This dialectic resonates deeply within climate mitigation design, where effective responses must be nourished by the soil of lived experience while also remaining accountable to the planetary horizon that embraces us all. In this regard, related concepts such as *glocalisation* and *vernacular expression*, though not identical with localisation, nonetheless provoke an enlarged reflection. They invite us to reflect on how human beings discern transcendence within finitude, navigate the fragile interplay of rootedness and universality, and take up responsibility for a common home that is simultaneously bounded and universal, mortal yet inscribed with an imperative of care that reaches beyond itself.

[77] In a sense of how we are to explore our own natural resources and the trajectory of our development in view of green growth and the use of clean energy.

interpretive diversity of climate concepts such as sustainability, planetary boundaries, or CO_2 thresholds; and second, it ignores the ethical necessity of making climate designs explainable and meaningful to the communities in which they are to operate. A one-size-fits-all design, even if globally enforceable, will be riddled with conceptual and practical gaps once it encounters the realities of local contexts.

I, therefore, advance the localisation orientation as a necessary minimum for effective climate design. Localisation demands that mitigation frameworks be globally coherent and domestically intelligible designed with "local contents and markers" that make sense within the lived experiences of diverse communities. Such an approach fosters collaboration between local agents, global institutions, and transnational governance systems, creating conditions in which climate actions are both meaningful and actionable at every scale. It resists the top-down imposition of climate policy by embedding accountability and responsibility within local social structures, while also ensuring that global responses remain sensitive to domestic existential risks.

The rationale for localisation rests on what I term the particularisation of meaning. Drawing on Leclercq and Depraetere's (2021) account of modality and actualisation, meaning is not an abstract universal but is mediated by semantic-pragmatic contexts. Climate concepts, whether tipping points, sustainability, or planetary boundaries, acquire their significance only through the socio-cultural, political, and ecological conditions in which they are deployed. This implies that every agent, whether human or nonhuman, interprets and applies such concepts differently depending on their degree of exposure, vulnerability, and value orientation.[78]

[78] Though it is not part of my preoccupation in this section, localisation is used in a way that could also be applied to the idea of innovation. In a way, localisation can promote innovation in the climate mitigation designs in relation to the need to find a solution that reflects the real needs of individuals and communities. In this case, we can say that with localisation, mitigation designs could ethically be seen from the perspective that from the onset the designs have the end-users in mind, it is collaborative, participatory, and it is as a result of an existing ecosystem of participatory. The reasoning here is that innovation in climate mitigation design is possible because we are designing with, not for, other people who are locally experiencing the risks.

The particularisation of meaning, therefore, highlights the meaning and figuration diverse agents would give to a climate change concept based, for example, on the degree of exposure and vulnerability to the changes. Particularisation of meaning challenges a global characterisation of mitigation design, especially when there is no way as to the extent to which mediating effects of contexts can have influence on the behaviour towards, and acceptability of, a mitigation design. For instance, we expect that in the meaning and figuration of sustainability, there should be no self-interest action given the risk of CO_2 threshold on planetary boundaries. In other words, on a more philosophical level, the concept of sustainability requires, in practice, a fulfilment of its tripartite goods of social, economy and ecology so long as the fulfilment is rational and creates drive for mitigating particular challenges and potential risks of the goods. From this standpoint, Sinn's single-agency model is incomplete, and epistemically inadequate, as it ignores the ontological reality that meaning itself is situated and context-dependent. A philosophical commitment to localisation therefore recognises that climate ethics must be both relational and pluralistic, embracing the multiplicity of agents and the diversity of their interpretive worlds.

Operationalising localisation and meaning implies designing mitigation measures that can be deliberated upon and adapted by multiagent networks at the domestic level. This includes incorporating gender-based perspectives to address power imbalances, recognising indigenous governance systems in resource management, and aligning CO_2 reduction strategies with local traditions for mediating environmental risks. Localisation transforms climate mitigation designs into a shared enterprise: it becomes a template for multiagent cooperation that is responsive to varying degrees of exposure and vulnerability. In this way, the localisation orientation does not dilute the urgency of global climate action; rather, it strengthens it by ensuring that global designs are grounded in the existential realities of those most affected. By embedding meaning, accountability, and agency into local contexts, we create mitigation designs that are theoretically sound as well as pragmatically resilient against the challenges of a multipolar, more-than-human climate future.

5.3.2 Hybridity in Climate Mitigation: Embracing Multiagency

A central limitation of Sinn's Paradox lies in its narrow conception of agency in climate risk. By privileging a single-agent perspective, Sinn overlooks the multiplicity of agents, particularly nonhuman agents, that actively shape climate outcomes. Climate risk emerges from a hybrid constellation of activities, actions, and reactions, both intentional and unintentional, active and passive, that rarely operate in isolation. These interactions unfold in complex, often unpredictable patterns, generating compound mitigation loops that challenge linear or one-dimensional governance frameworks.

Sinn's framework, by excluding nonhuman agency, leaves a conceptual blind spot. It fails to account for how AI-technological systems and other emerging autonomous entities intersect with human agency in the physical world, shaping both the emergence and trajectory of climate risks. In reality, climate change is inherently a multiagency and interagency phenomenon, demanding a perspective attuned to hybridity rather than homogeneity.

To address this, I propose a future-oriented climate mitigation design grounded in hybridity – an approach that acknowledges the intertwined capacities, materialities, and modes of action of both human and nonhuman agents. Such a design would be responsive to the plurality of agents that influence climate risk at local, domestic, and global levels, and it would support multi-level governance that is both adaptable and culturally sensitive.

The philosophical grounding for this approach draws on three key perspectives. One, Camilleri and Kapsali (2020) argue that human existence is increasingly hybrid, shaped by entanglements with tools, technologies, and nonhuman materiality, exemplified in concepts such as the cyborg and the posthuman. When we apply this argument to climate mitigation designs, we can advance the idea of a co-constitutive relationship between human and nonhuman agents in existential spaces.

In the above sense, AI-technological systems are not mere instruments but active agents in shaping outcomes, mediating agency, and distributing responsibility. Recognising this hybridity enables an ethical reflection on how power, accountability and influence are exercised across our existential spaces and networks, revealing, at least, the complex entanglements that underlie effective and just climate mitigation design.

Two, Kraidy (2006) situates hybridity within the cultural logic of globalisation, emphasising critical transculturalism as a framework for understanding the intersections of culture, language, and positionality in transnational interaction. From a philosophical standpoint, this hybridity seemed to signal the presence of distributed agency where agents within transnational networks, whether individuals, communities, or institutions, exercise influence, resist domination, and reinterpret norms in ways that reflect both ethical deliberation and strategic positioning.

Consequently, just as hybridity captures the fluid intersections of culture, language, and positionality, an inclusive mitigation design involves multiple agents such as states, corporations, NGOs, and AI-technological systems, whose agency, ethical commitments, and power are mutually constitutive.

Critical transculturalism, in this sense, also provides a lens to understand how authority and legitimacy are negotiated across these overlapping networks, highlighting the ethical tensions that arise in mitigation designs that may affect diverse contexts. By reconceptualising climate mitigation as a space of hybridized agency, we can better account for the co-existence of human and nonhuman actors, the differential capacities for influence, and the paradoxical dynamics of power and responsibility in achieving effective and just global climate outcomes.

Three, Essmann and Mueller (2022) advance the notion of distributed agency, highlighting how human and technological capacities co-emerge through complex biological, social, psychological, and political processes. Collectively, these perspectives define hybridity as the intimate fusion of human and machinic agency, compelling us to rethink both the theoretical and practical contours of climate mitigation.

When we consider the foregoing notion of distributed agency in the context of climate mitigation, hybridity challenges conventional assumptions about responsibility, causation, and ethical intervention. Such a view compels a reconsideration of both the theoretical and practical designs of the Paradox, highlighting that effective theory and design emerge not from isolated agent but from the relational dynamics of complex, multiagent systems.

Applied to climate design, a hybridity-oriented framework integrates global governance mechanisms with localised cultural, legal, and material systems, accommodating both human and nonhuman interactivity. This approach transforms climate governance into a dynamic, multi-level, and context-sensitive enterprise, formative, transformative, and performative, capable of addressing complex, cross-border risks such as CO_2 emissions. By embracing hybridity, mitigation strategies can more accurately reflect the multi-agential realities of the Anthropocene, while fostering coordinated and inclusive responses that span domestic and global spheres.

5.3.3 Agential Intersectionality in Climate Mitigation: Human, Nonhuman, and Material Convergences

The challenge of mitigating CO_2 and GHG emissions, alongside the overconsumption of natural resources, extends beyond regulating human behaviour or existential choices. Climate mitigation cannot meaningfully address the overdependence on the commons without acknowledging the agency of nonhuman agents such as animals, AI-technological systems, and other entities that compete for the same ecological space. Given the scale and temporal persistence of emissions, many variables remain unaccounted for in current mitigation designs, making it exceptionally difficult to oversee and harmonise agential behaviour across multiple domains. To construct a truly impactful global mitigation framework, it is therefore essential to measure human impacts and the CO_2 footprint and associated environmental consequences of nonhuman agencies.

As demonstrated in preceding chapters, dynamic interfaces emerge across human and nonhuman agents, producing intersections of agency that are critical to understanding climate risk. Ignoring these intersections undermines the predictive and practical efficacy of mitigation designs, as they fail to reflect the lived realities of climate change. In particular, focusing exclusively on human agency without integrating nonhuman contributions risks a long-term inadequacy in climate governance, especially in light of the complexity and unpredictability of automated systems and AI-technologies. These systems are not simply tools; their materiality and embedded capacities converge with other agents in the climate ecosystem, producing effects that cannot be captured solely through human-centred metrics.

Consider, for example, artificial nighttime lighting systems, central to the development of smart cities and the green energy transition. These systems alter natural nocturnal patterns, affecting humans, wildlife, and broader ecological networks (Gaston et al., 2015; Bliss-Ketchum et al., 2016; Jiang et al., 2020; Wang et al., 2023). Prevailing literature often foregrounds the benefits and ecological costs of light pollution, yet the hidden ecological costs stemming from material extraction, fabrication, and deployment are frequently overlooked. The materiality of these systems is inseparable from their impacts, and their continued expansion implies intensified extraction of critical raw materials, amplified energy use, and increased CO_2 emissions.

This convergence of human and nonhuman agency illustrates the broader phenomenon of agential intersection. The interplay between artificial systems, human activity, and other nonhuman agents generates compound effects on ecosystems, urban environments, and climate dynamics. As demand for these systems grows, so too does the environmental and social burden, particularly on poorer and less industrialised communities, which often bear the costs of resource extraction while enjoying minimal benefits. Such dynamics expose the inequities embedded in the global design, deployment, and governance of technological systems, highlighting the need for mitigation frameworks that account for the full spectrum of intersecting agencies.

Philosophically, the materiality of artificial lighting systems underscores the interdependence of human and nonhuman agents in shaping climate risk. These systems have existential consequences, influencing CO_2 emissions, ecosystem integrity, and intra- and inter-agential relations (Jolkkonen et al., 2023; Gaston et al., 2015). Even if these systems are celebrated as solutions for smart city frameworks (Mohandas et al., 2019), precautionary approaches are necessary to ensure environmental sustainability, cultural relevance, and agential inclusivity. The implications extend beyond efficiency and functionality to encompass ethical and social responsibilities: the systems must be evaluated for their intended utility and unintended consequences across temporal, spatial, and existential scales.

Moreover, artificial nighttime lighting exemplifies the tensions inherent in modern urban design, as the desire to accommodate expanding human agency intersects with nonhuman and material realities. The persistent need for such systems drives extractivist practices and energy consumption, reinforcing global inequalities and deepening climate risks. Each stage of the system's lifecycle, that is, from design and fabrication to deployment and adaptation, leaves a CO_2 footprint that reverberates across multiple communities, sometimes far from the original site of implementation. The multigenerational and cross-contextual impacts of such intersections reveal the inadequacy of mitigation strategies that fail to integrate multiagency perspectives.

Ultimately, the agential intersections highlighted by artificial nighttime lighting systems compel us to reconceptualise climate mitigation. Effective design must account for the entanglement of human, nonhuman, and material agents, recognising that each intervention produces ripple effects across ecosystems, societies, and global commons. The challenge here lies in technological optimisation and in creating frameworks that are context-sensitive, ethically grounded, and capable of navigating the intricate, overlapping realities of inter- and intra-agential activity. Only through such an approach can climate mitigation aspire to be both effective and just.

5.4 Philosophical Foundation for Localised, Hybrid, and Intersecting Climate Designs

To support the orientations, I draw on eclecticism and sufficientarianism, providing conceptual and ethical grounds for rethinking climate mitigation beyond Sinn's Paradox.

5.4.1 Eclectic Paradigm

In analysing the limitations of Sinn's Paradox and its corresponding mitigation design, it becomes evident that predictive accuracy suffers because multiagency and interagency dynamics are neglected. The neutrality of autonomous artificial agents cannot guarantee the absence of climate catastrophe, particularly given the convergence of emerging AI-technological systems with human lifeworld, their materiality, and interrelations across multiple levels. Before crafting a mitigation framework, it is therefore crucial to apprehend agents in their full complexity, including their diverse orientations, capacities, and interactions.

Within this agential framework, the three orientations provide a conceptual and practical foundation that Sinn's design overlooks. Eclecticism, as a paradigm, supports these orientations precisely because it permits the integration of multiple mitigation strategies and techniques inherent in specific agential contexts. By recognising and deliberating across various ethical epistemologies and practical frameworks, eclecticism allows the designer to account for the multiagency and interagency dynamics of climate risk.

Etymologically, eclecticism signifies the act of choosing or selecting (McClellan, 2003) among competing frameworks. Philosophically, it enables the incorporation of values from diverse systems without treating them as absolute or canonical. Applied to climate mitigation, eclecticism provides the flexibility to integrate local contents and markers, justify hybridity in designs, and account for complex agential intersections. It is particularly valuable when no single ethical framework or practical experience suffices to address existential vulnerabilities or the cascading risks of climate change.

5.4.2 The Principle of Sufficientarianism

Sufficientarianism offers a complementary philosophical justification for the orientations, rooted in Harry Frankfurt's insight that "what is important from the point of view of morality is not that everyone should have the same but that each should have enough" (Frankfurt, 1987, pp. 21 – 22). This principle provides a lens to evaluate thresholds of natural resources, distributive justice, and strategic social policy, particularly in contexts where global CO_2 emissions and resource inequality complicate mitigation.

Applying Frankfurt's reasoning to climate mitigation suggests that resources should be distributed such that all agents reach a sufficient threshold necessary to participate meaningfully in risk reduction (Frankfurt, 1987). In other words, rather than enforcing compliance through a global climate ombudsman or imposing uniform resource governance, sufficientarianism prioritises securing "enough" for those who lack it before extending further benefits. Bossert et al. (2022) define sufficientarianism as assigning absolute priority to those below a minimally acceptable standard of well-being, while Axel Gosseries (2011) emphasises achieving a threshold of sufficiency as a moral imperative.

Timmer (2022) elaborates three propositions of sufficientarianism further by stating that: (i) it is morally valuable to ensure that individuals have enough (positive thesis); (ii) once sufficiency is achieved, no additional distributive criteria apply (negative thesis); and (iii) once sufficiency is attained, reasons for further benefit may shift (shift thesis). These propositions are underpinned by claims regarding priority, continuum, and deficiency in a sense that benefits should be prioritised for those in lower ranges on a continuum of well-being, reflecting the greater moral urgency to address insufficiency (Timmer, 2022, p. 299).

In the context of climate mitigation, these principles imply that Global South states, often below the threshold of resource capacity compared to Global North states, should receive priority in resource allocation, expertise, and technological support, particularly given historical inequities in CO_2 emissions and extractive practices. Sufficientarianism, thus, provides a pragmatic ethical foundation for evaluating the social good of mitigation designs across borders, mediating competing interests and ensuring that there is equity in the shared apportioning of climate action's gifts and its weight, its promises and its sacrifices.

Ultimately, sufficientarian reasoning supports the orientations proposed here by emphasising the moral imperative to prioritise agents, communities, and states below the sufficiency threshold. This approach justifies committing resources to mitigate CO_2 emissions and associated climate risks, for as Frankfurt (1987) observes, "if everyone had enough, it would be of no moral consequence whether some had more than others" (p. 21).

5.5 Conclusion

So far, every thread of my discussion has converged on a desirable agent-based model for understanding climate change and its associated risks. I have approached climate risk philosophically from both a multiagency and interagency perspective, in both senses of *agency*, human and nonhuman. This reflection gave rise to my philosophical thesis of three guiding orientations for future climate mitigation design: localisation, hybridity, and agential intersection. Each orientation serves as a conceptual signpost toward grasping the full complexity of multiagency and interagency in climate change, as well as the possibility of unknown risks posed by nonhuman agents, particularly emerging AI-technological systems. These orientations, I have argued, are absent from Sinn's Paradox and its corresponding mitigation design, yet, if purposefully applied, could substantially enhance future mitigation frameworks.

My conclusion emerged from a philosophical analysis of the inferential and predictive limitations of Sinn's Paradox and from a consideration of how its underlying suppositions influence diverse agents and the futures of climate mitigation. The Paradox begins with the claim that a single human action can cause global warming, and from that follows a supply-side mitigation design intended to regulate such action. At a glance, this appears as common sense: any agential act, in whatever form, renders a mitigation design necessary, implied, and applicable. Yet, as my analysis revealed, every climate scenario emerges not from a single locus of agency but from a pattern of interacting agencies. Climate risk, even when attributable in part to natural variability, cannot be faithfully described within the single-agency paradigm assumed by the Paradox; it is, rather, a risk fundamentally agentive in nature.

Every normative implication that flows from the Paradox's single-agency assumption, such as the claim that a lone act of resource ownership could accelerate global warming, demands ethical scrutiny. To pursue mitigation while ignoring these normative problems is, as I have put it, "ethically repugnant." The moral dimension of the Paradox is not optional, because what it seeks to describe preconditions for climate risk, and what its design seeks to accomplish regulation of human actions, restructuring of resource use, and behavioural governance through a climate ombudsman, are inherently ethical undertakings. A purely instrumental reading leaves the most significant dimension unexamined: the ethical commitments that must be satisfied in any credible climate mitigation effort.

Serious engagement with these normative problems inevitably opens onto a more encompassing recognition: the vital role of nonhuman agents, the agency of emerging AI-technological systems and Non-State Actors in shaping climate change and risk. Too often, discourse on climate agency remains anthropocentric, deflating or ignoring the capacities of nonhuman systems. Yet the hidden costs of nonhuman agency have moved from speculative concern to observable fact in the physical world. This reality undermines the Paradox's reliance on single-agency causality, for the presence of nonhuman agents compels us to recast climate mitigation futures in light of genuinely distributed agency.

Argument from the perspective of nonhuman agency strengthens the case for a multiagency and interagency context for understanding the change in climate. It exposes the fragility of the inferential assumptions embedded in the Paradox and demonstrates how its predictive accuracy diminishes when emerging, complex risks are considered. Such recognition calls not for the abandonment of mitigation design, but for its philosophical reorientation, one that is attuned to the diversity of agents, the intersections of their actions, and the moral obligations that such complexity entails.

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