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Research article

Performative Modes of Modeling the Future: A Comparison of Two Club of Rome Reports

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Abstract

Predictive models increasingly function not only as representations of possible futures but as action-guiding instruments that orient present decision-making, a point emphasized in the growing literature on modeling for policy. Building on recent calls for a hermeneutic turn in Technology Assessment–especially Grunwald's claim that models carry implicit narratives, values, and audience assumptions–this paper investigates a dimension that has received little explicit attention: the affective and motivational ways in which models seek to provide pragmatic orientation. We introduce the concept of performative modes to capture ideal-typical ways in which model-based futures are designed to intervene in their present (e.g., to warn, reassure, instill hope, or recommend action), rather than merely informing audiences. Methodologically, we develop a hermeneutic approach to model-text conglomerates and apply it comparatively to two influential reports to the Club of Rome: *The Limits to Growth* (1972) and its 50-year update *Earth for All* (2022). We reconstruct each report's structure, modeling architecture, the role of technology, and rhetorical framing, drawing on the reports' texts, contextual materials, and reception to interpret how modeled scenarios position and mobilize their readership. Our analysis shows a marked shift in performative orientation. *Limits to Growth* combines a technocratic posture with an upstirring warning mode: it foregrounds epistemic novelty and dramatizes "overshoot and collapse" to generate awareness and trigger debate, while offering comparatively abstract guidance. *Earth for All*, by contrast, largely presupposes public awareness and deploys a hopeful, action-oriented mode: it frames a "Giant Leap" as feasible, centers wellbeing metrics, personalizes futures through narrative devices, and provides concrete policy roadmaps and calls for civic mobilization – while still relying on technocratic assumptions of agency within the modeling framework. We conclude that "performative modes" are a productive heuristic for Hermeneutic Technology Assessment, revealing how models' pragmatic force depends on audience presuppositions, affective address, and the unstable boundary between neutral projection and normative intervention.

Keywords: Hermeneutic Technology Assessment; Modeling for Policy; Model-Text-Conglomerates; Limits to Growth; Earth for All; Performative Modes

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Научная статья

Перформативные способы моделирования будущего: Сравнение двух докладов Римского клуба

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Аннотация
Прогностические модели все чаще функционируют не только как представления возможных вариантов будущего, но и как инструменты, направляющие действия и определяющие процесс принятия решений в настоящем, что подчеркивается в растущей литературе по моделированию для политики. Опираясь на недавние призывы к герменевтическому повороту в оценке технологий – особенно на утверждение Грюнвальда о том, что модели несут в себе неявные нарративы, ценности и предположения аудитории, – в данной статье исследуется аспект, которому уделялось мало явного внимания: аффективные и мотивационные способы, с помощью которых модели стремятся обеспечить прагматическую ориентацию. Мы вводим концепцию перформативных режимов, чтобы описать идеальные типичные способы, с помощью которых модели будущего призваны вмешиваться в настоящее (например, предупреждать, успокаивать, вселять надежду или рекомендовать действия), а не просто информировать аудиторию. Методологически мы разрабатываем герменевтический подход к конгломератам моделей и текстов и применяем его сравнительно к двум влиятельным докладам Римскому клубу: “Пределы роста” (1972) и его 50-летнему обновлению “Земля для всех” (2022). Мы реконструируем структуру каждого отчета, архитектуру моделирования, роль технологий и риторическую структуру, опираясь на тексты отчетов, контекстные материалы и восприятие, чтобы интерпретировать, как смоделированные сценарии позиционируют и мобилизуют их читателей. Наш анализ показывает заметный сдвиг в перформативной ориентации. “Пределы роста” сочетает технократическую позицию с воодушевляющим предупреждающим режимом: он выдвигает на первый план эпистемологическую новизну и драматизирует “перерегулирование и коллапс”, чтобы привлечь внимание и инициировать дискуссию, предлагая при этом сравнительно абстрактные рекомендации. Отчет “Земля для всех”, напротив, в значительной степени предполагает общественное сознание и использует обнадеживающий, ориентированный на действия режим: он представляет “гигантский скачок” как осуществимый, ставит в центр внимания показатели благополучия, персонализирует будущее с помощью нарративных приемов и предоставляет конкретные политические планы и призывает к гражданской мобилизации – при этом по-прежнему опираясь на технократические предположения о субъектности в рамках моделирования. Мы приходим к выводу, что “перформативные режимы” являются продуктивной эвристикой для герменевтической оценки технологий, показывая, как прагматическая сила моделей зависит от предположений аудитории, эмоционального воздействия и нестабильной границы между нейтральной проекцией и нормативным вмешательством.

Ключевые слова: Герменевтическая оценка технологий; Моделирование для политики; Конгломераты “модель-текст”; Пределы роста; Земля для всех; перформативные режимы

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INTRODUCTION

Predictive models play an increasingly crucial role as practical decision-making tools in modern societies. By anticipating future developments, they orient present action: for example, by highlighting future problems, evaluating the effectiveness of possible countermeasures, and identifying likely side effects or risks. In this sense, predictive models are, following a common conceptual distinction, never merely *models of* (representations), but also *models for* (action-guiding tools).[1] From various directions, scholars have increasingly drawn attention to this pragmatic dimension of models and made it the subject of philosophical inquiry.[2] Notably, Armin Grunwald (2023) has recently emphasized this point. In the context of a broader *hermeneutic turn* in technology assessment, he argues that models should be examined not only in terms of their predictive function but also with regard to their hermeneutic dimensions. The pragmatic orientation function of models, he suggests, is permeated by hidden narratives, implicit background assumptions, non-epistemic values, and biases. Models must therefore, in Grunwald's view, be deconstructed in terms of their apparent objectivity and interrogated for their underlying narrative structures. From a hermeneutic perspective, they must be understood both as expressions of their historical moment and as performative interventions into their respective present.

In what follows, we build on this idea by examining a specific aspect that, in our view, has so far received little explicit or differentiated attention – neither in current debates on hermeneutic approaches to technology assessment nor in the philosophy of modeling. We argue that models can seek to provide pragmatic orientation in fundamentally different affective and motivational ways, which we propose to call *modes of performativity*.[3] Our aim is to introduce and explore some of these modes. This does not deny that predictive models continue to perform a prognostic function and thereby provide informational value at a fundamental level. Yet to reduce their role to this informational value alone obscures the fact that the discursive function of modeling can take on different *performative flavors*.

The general idea of different performative modes of relating to the future seems quite intuitive when we consider how we think about the future in everyday life. In our daily routines, we constantly engage with the future in different ways: we reflect on what we will, can, or must do later today, over the weekend, during the summer, or even where we might find ourselves ten years from now. The future is filled with things we strive for and aspire to, things we hope for, and things we wish to avoid or fear. At times, we indulge

[1] The distinction has probably first been introduced by Wartofsky (1979). See also Janich (2002).
[2] For an overview of current philosophical debates on the practical dimensions of models, see: Winsberg & Harvard (2024). More recently, the topic of modeling for policy has also gained increasing attention within philosophical debates, see for example Kaminski et al. (2023).
[3] The notion of performativity used here should not be conflated with what is currently discussed as the *reflexive performativity* of models, i.e. the capacity of some models to performatively alter their target (for an overview of the ethical debate around it, see, for example, Ortmann (2025)). Although the Club of Rome reports examined here arguably exhibit such performative features in this narrower sense, this is not our primary focus; rather we are interested in their pragmatic dimension more broadly.

in unrealistic but joyful imaginings of what might be. In short, if we describe our thinking about the future solely as the provision of information to guide action, important nuances with regards to their actual *meaning* for us are lost. Rather, *the future* affects us in different ways that must also be understood in their emotional and motivational dimensions.

What holds at the individual level, we argue, also applies collectively and in relation to the future visions articulated through models. Such visions can be seen as adopting different modes in order to intervene performatively in their respective present. What we call performative modes are different ideal-typical ways in which models aim to provide practical orientation to an audience. The idea is that models do not merely deliver "sober information" that audiences must then make practical sense of on their own. Rather, models already position themselves with regard to *how* that information is intended to *affect* readers emotionally, *engage* them motivationally and thereby exert practical influence. In this sense, models already carry a specific *practical meaning*: they may aim to reassure, to shock, to remind, to warn, to instill hope, to spark debate, or to recommend specific courses of action. This dimension is expressed both in specific modeling decisions about what and how to model as well as in discourses surrounding these models.

In what follows, we explore this dimension by examining the various modes of intervention that models can enact, using as a case study two reports by the Club of Rome. The first is the initial and arguably best-known report, *Limits to Growth* from 1972. The second is a more recent successor, published on the occasion of its 50th anniversary: *Earth for All* (2022). Both reports construct global scenarios that chart possible future developments with respect to critical parameters. Beyond the obvious content-related contrasts – in terms of model complexity, the parameters considered, the number and type of scenarios etc. – what stands out is that the respective models assume dramatically different roles. Each report engages in distinct *pragmatic modes of intervention* in its present, addressing both political decision-makers and the broader public.

What makes the two Club of Rome reports particularly instructive for our analysis is that they do not consist of "pure" models alone. Instead, they are *model-text-conglomerates* addressed to a broad audience. While the models themselves remain central – without them, the reports would lack informational value and argumentative force – the accompanying texts supply the interpretive framing through which narrative elements can be traced. These texts render the rhetorical framing of the model results more explicit and thereby illuminate the performative modes the reports seek to adopt.[4]

[4] It may be useful to underscore why we understand the Reports to the Club of Rome as model-text-conglomerates. Although they appear as books, the modeling efforts cannot be separated from their textual presentation for the kind of hermeneutic analysis pursued here. The following discussion examines how epistemic and rhetorical elements intertwine and how modeling choices and narrative framings mutually shape one another. In speaking of *model-text-conglomerates*, we refer to hybrid epistemic formations in which formal models and textual narration are not merely juxtaposed but mutually constitutive. Models do not simply generate results that are subsequently described in prose; rather, their assumptions, variables, and projections actively structure the narratives through which these results are rendered persuasive and politically salient. Conversely, textual framings – through choices of emphasis, metaphor, temporal horizon, problem definition and so on – stabilize the epistemic authority of the models by presenting their outputs as coherent accounts of complex realities. This includes the insight that the textual parts of model–

Moreover, supplementary texts, archived background materials on the reports' development and reviews further enrich our analysis.

Our aim, however, is not merely to provide illustrative examples of the various modes through which models can engage readers affectively and motivationally, nor simply to propose a preliminary set of categories along these lines. We also seek to demonstrate how productive it can be to treat such categories as heuristic tools for a hermeneutic engagement with future-oriented model-text-conglomerates. This approach enables us to *make explicit the assumptions embedded in the reports* – for instance, what is taken to be common knowledge or shared emotional dispositions among readers regarding future social and environmental challenges, and how politically realistic or demanding the proposed measures are portrayed by the reports. At the same time, this enquiry addresses what we regard as a blind spot in current debates on the pragmatics of models – for instance, in discussions on *modeling for policy*. While the pragmatic character of models is often acknowledged, it is usually reduced to their informative function, by which they are meant to *guide* action in a rather consequentialist manner.[5] In our view, however, the performative and affective dimensions of models open up an additional, more subtle layer of analysis.

To unfold our argument, we proceed as follows: after the introduction, we briefly outline the conceptual foundations of hermeneutic technology assessment and show how the hermeneutic shift can complement conventional approaches to evaluating technological developments and promises. We then turn to the Club of Rome and provide an overview of the two reports we aim to examine. By reconstructing the structure and context of each report, as well as the respective roles attributed to technology, we lay the groundwork for the central part of our analysis: a hermeneutic interpretation of each report's modes of performative intervention. The final section synthesizes our findings.

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text conglomerates can disclose, and in some cases explicitly articulate, the performative intent guiding the modeling decisions. In any way such a coupling is by no means specific to the Reports to the Club of Rome. Comparable configurations can be found across a wide range of contemporary policy-relevant knowledge practices, including epidemiological modeling during pandemics, climate modeling in assessments of global warming, or statistical and demographic models in social and economic reporting. Wherever models are used to analyze, aggregate, and project data, their outputs require narrative forms to be made legible and actionable for non-expert stakeholders. It is at this juncture – where modeled abstractions are translated into descriptive, prognostic, or prescriptive texts – that questions of framing and political implication arise. The Reports to the Club of Rome offer a particularly clear and analytically productive case of such model-text-conglomerates. Not only do they foreground modeling as a central epistemic resource, but the contrast between the two reports analyzed here makes especially visible how different modeling choices are accompanied by distinct narrative constructions of global futures and possible interventions.

[5] Even where the plurality of practical goals of modeling is emphasized, what is usually meant is that, depending on the specific *action* a model is intended to guide, different aspects of the world become relevant for the model and different degrees of uncertainty can be tolerated (cf., for example, Elliott & McKaughan (2014); Parker (2020)). This, however, does not address what we mean by different *performative modes* of modeling, which concern not *what* action a model guides, but the rhetorical embedding of the model that reveals *how* it aims to guide, orient, or motivate action. Winsberg & Harvard (2024, chap. 3) discuss the (ab-)use of models for rhetorical purposes. However, they also do not focus on different modes of rhetorical intervention, nor on how such modes and modeling decisions may mutually shape one another.

ENRICHING TECHNOLOGY ASSESSMENT WITH HERMENEUTICS

To situate our argument, it is helpful to briefly recall the conceptual foundations of both Technology Assessment and hermeneutics. *Technology Assessment* (TA) refers to the systematic reflection on the societal, ethical, and environmental implications of emerging technologies. From a philosophy of science and technology perspective, it rests on the insight that technological development is never value-neutral but deeply embedded in social contexts, interests and normative assumptions. TA seeks to make these dimensions visible and to support responsible decision-making under conditions of uncertainty. Interdisciplinary by nature, it functions as a practical interface between science, society, and policy by combining research, stakeholder engagement, and advisory work.[6]

Hermeneutics is a branch of philosophy concerned with the theory and practice of interpretation. It examines how understanding arises – not as the objective retrieval of facts, but through the situated interaction between interpreter and text, speech, or other forms of human expression. On this view, meaning is context-dependent and historically situated. Hermeneutics therefore resists isolating facts from their interpretive horizons and instead emphasizes the embeddedness of all understanding in historical, linguistic and cultural contexts.

Hermeneutic Technology Assessment (HTA) emerges at the intersection of these traditions. It responds to the limitations of classical consequentialist TA models – whether prognostic or scenario-based – that often struggle to provide guidance under conditions of high uncertainty and normative pluralism, as is typically the case with newly emerging sciences and technologies. Instead of attempting to assess the plausibility of future scenarios, HTA treats them as expressive *constructs rooted in the present*.[7] Its aim is to uncover the interests, needs, desires, and fears that shape how technological futures are imagined. In this way, HTA moves beyond narrow or deterministic views of technological development and instead aims at a more *self-reflective and autonomous engagement with sociotechnical possibilities*.[8]

For the sake of self-reflection, HTA considers the future as it appears in human conversations, popular culture, policy visions, calls for proposals and research applications, as well as in prototypes and proofs of principle. Its focus is on "the future" as it already exists in discourse – irrespective of whether clear paths from the present to that envisioned future can be identified. In this way, HTA aims to learn more about the

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[6] For an introductory overview of technology assessment, see Grunwald (2010).

[7] Grunwald, 2015. See also: Grunwald & Nordmann (2023); Grunwald & Mehnert (2024).

[8] Proponents of HTA typically regard it as a broad methodological framework and refrain from prescribing strict procedural guidelines. What qualifies as "hermeneutic analysis" is usually left intentionally open, allowing for interpretive flexibility and contextual sensitivity. HTA should therefore be understood less as a fixed method than as a framework for orientation. This openness also reflects the field's current exploratory stage of development. As documented in the volume *Hermeneutics, History, and Technology. The Call of the Future* (Grunwald et al., 2023), central questions and points of contention remain unresolved. Rather than indicating a deficiency, this methodological indeterminacy can be seen as expressing HTA's critical ambition: to cultivate a reflective, non-reductive approach to technological futures that remains responsive to their specific complexity (Brenneis et al., 2025).

time in which such visions are articulated than about the accuracy of their predictions. Particular attention is given to how technological advancement is characterized and how stakeholders use language and other means to advocate for or against specific developments in their respective present. This hermeneutic shift in TA further underscores that assessments and debates about technology are far from "neutral." HTA highlights how discourses on technological futures are shaped by underlying values and assumptions – whether in high-level research programs or in everyday contexts. The future thus becomes a lens through which to analyze present-day constellations of knowledge and power, emotion and vision. While adding hermeneutics, it remains technology assessment. Yet the focus shifts from technologies and their potential consequences as such to the broader picture of how aspirations and cultural settings contribute to the ways in which technologies are embedded in the world – whether in the concrete practices of research and development or in imaginaries of what might be. As such, HTA aspires to offer more than future-oriented discourse analysis by also engaging not only with discourses but equally with the technologies themselves and the visions they engender.

The emergence of HTA is closely tied to critiques of speculative future scenarios in nanoethics and of classical TA with regard to NEST, most prominently those advanced by Alfred Nordmann and Armin Grunwald (cf. Liu, 2023). They argue that such scenarios are epistemically fragile and risk distracting from more urgent present issues. Instead, they propose interpreting such scenarios as "constructs that are expressive and embedded in their present," and advocate "reclaiming the present" through hermeneutic analysis. At the heart of this approach lies the recognition that 'the future' is not a fixed referent, but "a figure of discourse which amalgamates present-day hopes and desires, fears and anxieties, aspirations and anticipations" (Grunwald et al., 2023, p. xi). This perspective helps disentangle frequently conflated questions such as: "Where are we heading?", "How shall we live?", and "How will it be once the future has changed us?" HTA thus aims "to contextualize different aspects of a vision from various angles in order to learn something about us today and most importantly to demonstrate that each vision is just a possible vision among many other alternative visions" (Liu, 2023, p. 32). An important dimension of this is the *rhetorical and epistemic positioning of the audience*. Grunwald and Nordmann argue that "'[o]ur (technological) future' is entangled […] with discursively and institutionally sedimented habits of mind" (Grunwald & Nordmann, 2023, p. 39). Accordingly, hermeneutic analysis must also ask "who are the 'readers' of technological programs or prototypes, how are they constituted and provoked to change?" Hermeneutics mobilizes the critical subject "against the implicit 'we' of institutional and symbolic orders" and "produces a critical self-understanding of human entanglement in sociotechnological systems – and it thus contributes to hermeneutic visioneering assessment" (Grunwald & Nordmann, 2023: pp. 39–40).[9] In our own analysis, we build

[9] The term "visioneering" was introduced by Patrick McCray (2013) to describe the way visionary ideas about technological futures are intertwined with concrete practices of engineering, design and research. "Visioneers", regarding to McCray, not only imagine bold futures–such as space colonization or molecular nanotechnology – but also seek to make them appear credible and attainable by producing conceptual

on this idea and examine precisely this performative engagement of the reports with their assumed readership, with particular attention to the role of models as integral elements of these model-text-conglomerates.

Since HTA is still characterized by an open-ended, exploratory approach rather than a strictly codified methodology, our own analysis remains tentative as well. This is especially true given that the kind of object we seek to examine–*model-text-conglomerates that illustrate future developments on a global scale* – has not, to our knowledge, yet been subjected to hermeneutic investigation. At the same time, the two reports we analyze appear particularly well suited to such an inquiry in the spirit of HTA. From our perspective, HTA is especially apt for examining a genre of texts that has sparked public debate and institutional response for decades: high-profile reports on the state of the world and possible futures. The most prominent and influential example of this genre is the first report to the Club of Rome, published in 1972 under the title *The Limits to Growth*. To this day, it is frequently cited in discussions of the future, ecology, resource management, and technological progress. As we will see, the report's performative intent – its ambition to engage its readership and the public at large – is striking, which makes it particularly suitable for examining different performative modes. As part of a comparative approach, we include the 50-year update *Earth for All* (2022) in order to trace shifts in how such reports are presented over time. With their *ensemble character* – combining modeling, simulation, and narrative elements – the Club of Rome reports are paradigmatic examples of how scientific, technological, and rhetorical means are fused to articulate futures.[10] They show how modeling is employed as a technology of futuring, and – most importantly for our purposes – how readers are addressed and mobilized. In both reports, different dispositions are ascribed to the intended audience. A central task of our hermeneutic analysis will therefore be to work out these differences: What can the reports reveal about the times in which they were written when read through the lens of HTA? What changed in the fifty years between the original and the update – in tone, structure, modeling, or rhetoric with respect to their engagement with readers? What kinds of shifts can be identified, and how might they be interpreted?

designs, prototypes and rhetorical frameworks that lend plausibility to their visions. In the context of HTA, "hermeneutic visioneering assessment" adapts this notion: it denotes an interpretive practice that analyzes how such visions are constructed, rhetorically framed and institutionally embedded, aiming of understanding their performative effects in the present.

[10] Of course, the Club of Rome reports are not the only documents addressing global environmental problems on the basis of scientific projections that invite hermeneutic analysis. Similar dynamics can be observed in other high-profile documents such as the IPCC Assessment Reports (1990–2023) or the transition from the Millennium Development Goals (2000–2015) to the Sustainable Development Goals (2015–2030). These texts have shaped public debate and political priorities and are therefore equally suitable for hermeneutic examination. However, unlike these examples, the two reports we analyze display their performative dimension in a particularly salient way.

TWO REPORTS TO THE CLUB OF ROME: "THE LIMITS TO GROWTH" AND "EARTH FOR ALL"

In this section, we present a brief history of the Club of Rome and the two reports that form the focus of our analysis.[11] The Club of Rome is a global think tank founded in 1968 by the Italian industrialist Aurelio Peccei and the Scottish scientist Alexander King. Its aim has been to bring together scientists, economists, and former political leaders to address complex global challenges, particularly those concerning sustainability, environmental protection, and economic development. Today, the Club's work is organized into so-called Impact Hubs, which prioritize key areas such as Climate and Planetary Emergency, Reclaiming and Reframing Economics, Rethinking Finance, Emerging New Civilizations, and Youth Leadership and Intergenerational Dialogue (Club of Rome, 2025). The Club of Rome operates as a non-profit organization, funded primarily through membership fees, donations, and partnerships with institutions and governments. Its impact lies in shaping environmental and economic discourse, influencing policymakers, and contributing to international sustainability initiatives, including the UN's Sustainable Development Goals. The organization's most influential work remains the 1972 report *The Limits to Growth* (LtG) (Meadows et al., 1972), which used system dynamics modeling to warn of the risks of unchecked economic and population growth on a planet with finite resources. While its predictions have been debated, the report played a crucial role in promoting long-term, holistic thinking about global crises. To date, more than fifty reports to the Club of Rome have been published, with *The Limits to Growth* as the first and *Earth for All* (EfA) (Dixson-Declève et al., 2022) as one of the most recent ones. Some reports operate on a global scale, while others focus on specific topics.

At the beginning of the 1970s, issues such as the nuclear threat, population growth, and environmental pollution had created a sense of urgency and the conviction that society needed to decide about its own future (cf. Weart, 2008; Seefried, 2011; Vieille Blanchard, 2015; Andersson, 2018). The Club of Rome considered computer models the appropriate means to explore possible futures and to investigate how a transition from growth to a noncritical equilibrium state might occur. LtG warned of the possibility – or even the likelihood – of ecological overshoot and societal collapse. And *"overshoot and collapse"* soon became the signature phrase associated with the report. The authors argued that if humanity continued to pursue economic growth and exponential consumption without regard for finite natural resources and environmental costs, global society would exceed Earth's physical limits and face sharp declines in food and energy availability, rising pollution, a subsequent fall in living standards, and ultimately a dramatic reduction of the human population within the first half of the twenty-first century. Ann Johnson and Johannes Lenhard summarize the discursive contribution of the report succinctly: "The message was alarming: if the growth of the economy,

[11] For this overview of the Club of Rome and its reports we draw in particular on Bardi (2011), Schmelzer (2016), von Weizsäcker & Wijkman (2018), as well as on more recent discussions of LtG and its legacy (Turner, 2008; Hall & Day, 2009; Vieille Blanchard, 2010; Randers, 2012; Meadows, 2012).

pollution, and population continues, the world system will collapse in less than a century" (Johnson & Lenhard, 2024, p. 113). And this message *resonated widely*. LtG gained particular traction because, unlike earlier doomsday warnings, it was presented as a scientific prediction – grounded in computer modeling and rhetorically framed as a sober, technical analysis. This mode of presentation was crucial for its impact: it allowed the report to attract considerable attention from a broad readership and lent authority to its warnings. The book became a bestseller, selling 12 million copies in 37 languages, and remains the top-selling environmental title ever published. It also inspired numerous follow-up studies by a growing number of modeling groups.

The analysis in LtG was based on a then-novel computer model, *World3*. It was the first attempt to use a computer model to capture the complex global dynamics of human societies on a finite planet and to explore large-scale scenarios concerning population growth, industrial output, food, pollution, and other factors.[12] Using *World3*, the authors developed twelve scenarios, grouped into three categories. The "standard run" or business-as-usual scenario assumed that the economic, social, and physical patterns observed between 1900 and 1970 would continue unchanged into the future. Six subsequent "technological scenarios" started from the same baseline but introduced advances such as increased resource availability, higher agricultural productivity, reduced pollution, or limits on population growth. The final set of five "stabilization scenarios" explored outcomes in which either population growth or industrial output was stabilized. In these "stabilized world" scenarios, human welfare improved and remained at a high level. The overall message was that decisive actions could be taken to avoid collapse. Yet, as noted above, the key takeaway that resonated in public discourse was not the possibility of stabilization but rather the prospect of overshoot and collapse.[13]

[12] The roots of scenario thinking in scientific forecasting can be traced back to early population and resource projections such as Thomas Malthus's Essay on the Principle of Population (1798) and William Stanley Jevons's The Coal Question (1865), which already formulated conditional if–then statements about possible futures. In the mid-twentieth century, scenario techniques became more systematic in military and policy contexts. At the RAND Corporation in the 1950s, they were combined with operations research, probabilistic modeling, and game theory to explore nuclear strategy and what Herman Kahn (1962) famously called "thinking the unthinkable" – that is, systematically considering catastrophic yet conceivable outcomes such as thermonuclear war in order to devise strategic options. In the 1960s, scenario approaches spread into corporate and economic planning, most prominently through the scenario method developed at Shell (cf. Wack, 1985). These developments established scenarios as a way to link qualitative assumptions about social and technological change with quantitative forms of modeling, laying the groundwork for their subsequent integration into environmental and climate science.

[13] Over the past fifty years, debate has continued as to why the media and other commentators largely ignored the stabilization scenarios and instead emphasized the threat of collapse if growth followed its traditional trajectory.

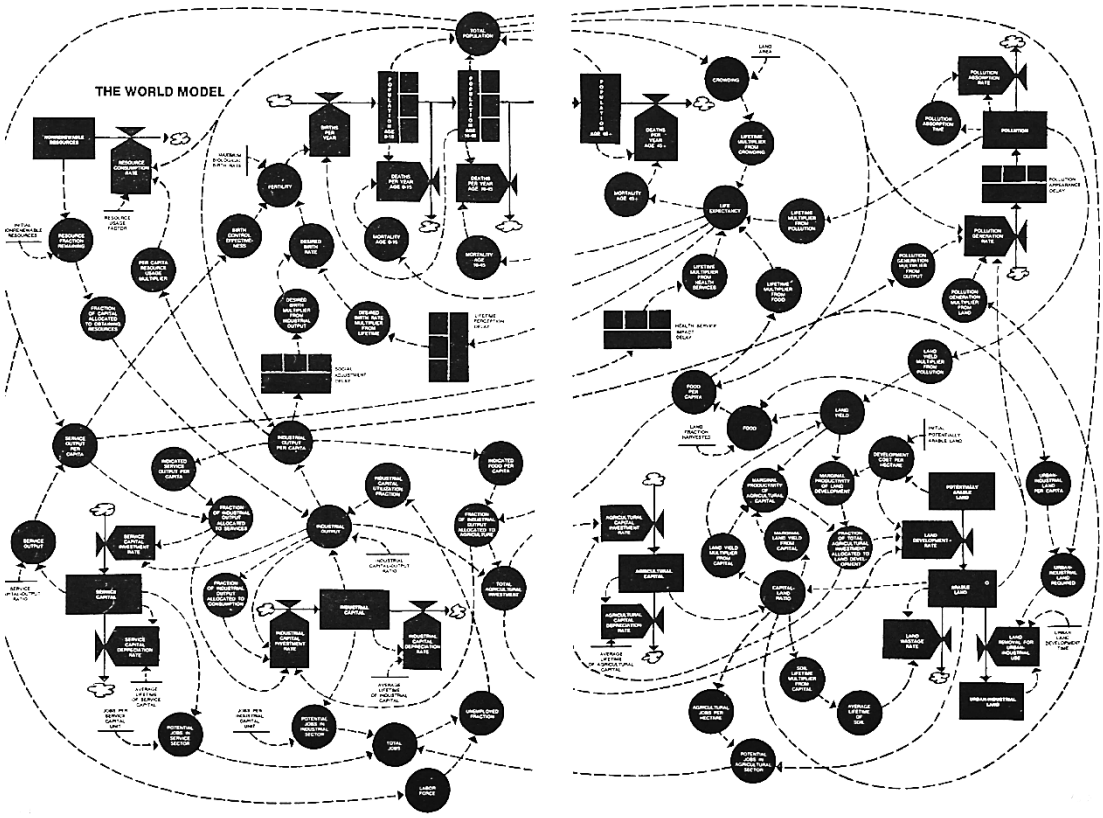

Figure 1: The World Model from World3 (Meadows et al., 1972, pp. 102–103

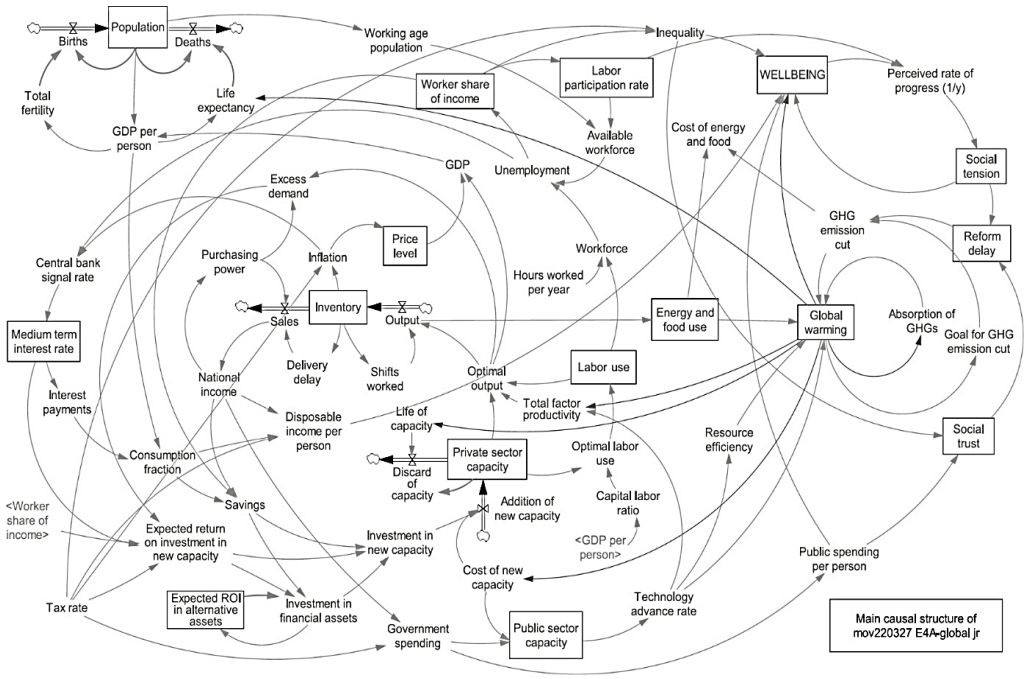

Figure 2: Main causal structure of Earth4All (Dixson-Declève et al., 2022, p. 178)

In 2022, the *Earth for All* (EfA) report was published as a 50-year update to LtG. Its central message is that the long-term potential of humanity depends on the ability of global civilization to achieve five extraordinary turnarounds within the coming decades. The report's main goal is to demonstrate that the kind of systemic transformation required within this short time span is indeed possible. One key difference from LtG lies in the number of scenarios. Whereas LtG explored a wide range of alternatives, EfA illustrates only two. The first, called "Too Little Too Late," assumes that societies respond to future challenges in the same incremental manner as in the past, through limited policy adjustments. The second, "Giant Leap," assumes that societies recognize the interconnected crises and initiate immediate, extraordinary action in five key areas. These extraordinary actions are presented as the "five turnarounds" and are explained in dedicated chapters, supported by insights from the underlying simulation model.

The EfA model – *Earth4All* (or: E4A) – itself is an elaborated version of *World3* and belongs to the family of system dynamics models. Its primary role is to provide consistent pictures of possible futures. Unlike *World3*, however, *Earth4All* incorporates additional "social" parameters such as wellbeing, social tension, and social trust. The authors employ the model to evaluate the potential consequences of alternative decisions, to identify which systemic changes are likely to have major effects and which will make only a minor impact, and to estimate the costs and levels of investment required to achieve certain wellbeing outcomes by specific points in time. At its core, the *Earth4All* model explores how to improve human wellbeing throughout the twenty-first century.[14] Its ambition is to chart a path toward a world in which wellbeing is higher than it would be without extraordinary action. To this end, the authors introduce an "Average Wellbeing Index" (AWI), which integrates five components into a single measure. The AWI increases with disposable income, public spending, and perceived progress, while it decreases with rising inequality and higher global temperatures. This *focus on wellbeing* is the defining feature of EfA and a central difference from LtG. Wellbeing serves as the pivotal reference point for the two scenarios derived from the model and presented in the book. The authors summarize them as follows:

> Too Little Too Late reflects our current trajectory, where societies keep boasting and bumbling about 'sustainability' while muddling through. In Too Little Too Late, most countries make piecemeal, incremental progress toward ending poverty and stabilizing the climate, but do not really deal with the elephant in the room: inequality. […] In this scenario, social trust declines as the richest 10% and bottom 50% continue diverging, while societies and nations turn against each other, competing for resources. There is too little collective action to limit the immense pressure on nature. Earth's life-supporting systems like forests, rivers, soil, and

[14] The authors of EfA and E4A emphasize the transparency of the model and make it accessible for scientific scrutiny (cf. Earth4All, 2025). Whereas LtG devotes an entire chapter to a detailed description of *World3* (Meadows et al., 1972, pp. 88–128), EfA presents the technical details of *Earth4All* only briefly in the main publication (Dixson-Declève et al., 2022, pp. 175–180) and refers readers to additional publications (cf., for example, Collste & Randers, 2022). Since its publication, *Earth4All* has been taken up and discussed in a number of scholarly contributions (cf. Crescenzi et al., 2024; Feder et al., 2024; Stoknes et al., 2025).

> climate keep deteriorating, and some systems move closer or cross irreversible tipping points. For those in poverty, Indigenous peoples, and wildlife, this is a steady 'stairway to hell.'
> As our second scenario, we chose Giant Leap, which illustrates the effects of the powerful and immediate implementation of the five extraordinary policy turnarounds. Its passage through the century is driven not by tinkering at the fringes but by fundamentally reconfiguring economies, energy systems, and food systems. It's a major upgrade. A reset. An essential reboot of civilization's guiding rules before the system crashes. Due to inertia in economies and in the climate, the main impacts of any action taken today are often not seen for years in economies and decades or centuries in the climate. We believe that nothing less than a 'giant leap' now is needed if humanity is serious about turning around from the current trajectory and getting on a new track to a sustainable world by 2050. The Giant Leap scenario spells out the details of a new type of economy fit for the Anthropocene – an economy that removes poverty, promotes social and environmental wellbeing, and measures its progress by how well people and the planet thrive." (Dixson-Declève et al., 2022, pp. 28–29)

As the ambition of the EfA project is to promote a (political) program that is intended to improve human wellbeing during the next 50 years, the focus of the book is on "5 Turnarounds" – transformational changes in the interconnected fields of poverty, inequality, empowerment, food, and energy. For each turnaround, the report lists three *socioeconomic levers as solutions for achieving a transformation* towards "wellbeing economies." The three levers differ according to their transformative impact and, at the same time, their likelihood – since more substantial changes in policies and lifestyles compared to current approaches appear less likely, as they must overcome stronger forces of inertia and resistance. It is quite remarkable how the EfA project is presented in a highly symmetric manner: the entire report follows a systematic structure, presumably developed in advance, to achieve rhetorical force and persuade its audience.[15] This *rhetorical strategy* is reinforced through narrative elements that accompany the scenarios and the approaches to the five turnarounds. Most prominently, the report tells the stories of four fictive girls living in different parts of the world, whose life trajectories are traced along a timeline spanning the 80 years till the year 2100.[16] These narratives personalize

[15] The rhetorical effect of structuring arguments or scenarios symmetrically – through an equal number of theses, categories, or points of reference – is well established. In classical rhetoric this is described as isocolon or, more generally, as parallelism, where balanced forms enhance clarity, memorability, and persuasive force (cf. Lausberg, 1998, pp. 320–321).

[16] Dixson-Declève et al., 2022, pp. 32–33: "To make these two scenarios tangible, we developed four characters – all girls, born on the same day in early August 2020 – and imagined their trajectory through each one. Shu was born in the Chinese city of Changsha; Samiha in Dhaka, Bangladesh; Ayotola in Lagos, Nigeria; and Carla in the United States. These are not real people but more like avatars that highlight what it is like to live in the Too Little Too Late and Giant Leap worlds. We chose four girls in order to better compare across regions, scenarios, and opportunities. Like 1.4 billion other people on Earth, Samiha and Ayotola were born into vulnerable informal settlements in their cities. And like 3 to 4 billion people on Earth, their families exist on less than $4 per day. Shu and Carla's families are better-off economically.

the abstract scenarios and exemplify, in concrete terms, how global transformations might affect individual lives – an approach that contrasts with LtG, which relied less on narrative illustration. In line with this progressive agenda, EfA also positions itself as a campaign. The main publication was launched with numerous endorsements and has been accompanied by a wide range of additional activities. Among them are deep-dive papers that elaborate on issues raised in the book, as well as country reports that address specific challenges and solutions in national contexts. Since 2022, such supplementary publications have been released continuously, providing a growing database for further discussion.[17]

In general, both reports are based on simulations derived from computer models and aim to convey complex messages about the state of the natural and social world to a broad public. Yet the models, as well as the overall ambitions, differ considerably. Whereas LtG devoted most of its pages to the presentation of scenarios, EfA frames itself as a scientific–political program centered on the five turnarounds.

THE ROLE OF TECHNOLOGY IN THE CLUB OF ROME REPORTS

Technology plays a double role in the reports to the Club of Rome: it is both a means of producing knowledge about possible futures and a central object within those futures themselves.

Firstly, the reports use *technologies of futuring, specifically simulation models*, to explore the dynamics between key parameters and to construct future scenarios. The models – *World3* in LtG and *Earth4All* in EfA – function as epistemic devices that organize existing knowledge and map out potential trajectories. Through modeling, they provide structured visions of how different pathways – ranging from collapse to sustainable transformation – might unfold depending on societal choices. Structurally, these computational models are embedded in the epistemic assumptions of their time. They encode contemporary understandings of system dynamics, economic growth, ecological limits, and intervention strategies. In doing so, they transform data and assumptions into coherent scenario narratives. To become meaningful within the reports, however, these modeled outcomes must be explained and embedded within broader argumentations. The reports thus extend the models' outputs into narratives that contextualize the scenarios and articulate their implications, thus leading to what we call model-text-conglomerates. By simulating interactions between population growth, resource use, technological change, and environmental degradation, the models generate a structured solution space for political deliberation and action. Modeling thus becomes a technique for opening up possibilities and confronting societies with the consequences

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Shu's mother is a teacher and her father an accountant in Changsha. Carla's parents moved to California from Colombia for the economic opportunities in the United States. Her mother stays at home to look after the three children, and her father works in the restaurant industry. We will follow their journeys from 2020."

[17] The project thus presents itself as an ongoing and evolving endeavor rather than as the one-time publication of a report. This campaign-like character is also reflected on the EfA website, which hosts a variety of activities and resources – including suggestions for setting up book clubs and even a printable card game designed to spark local debate on transformation priorities.

of different political, economic, and technological pathways (cf. Edenhofer & Kowarsch, 2015, pp. 58–61). This constitutes the epistemic–technical dimension of technology's role. Moreover, the *interplay between modeling and text* is crucial, as both elements mutually reinforce one another. These model-text-conglomerates function as rhetorically – and thus pragmatically – shaped instruments of discourse, in which the scientifically grounded construction of the model and its narrative embedding can amplify each other's epistemic and persuasive force.[18]

Secondly, technology itself is an explicit *element within the modeled futures*. The reports incorporate assumptions about how technological systems might evolve over time, treating technological change not as an external variable but as an endogenous and socially shaped process. In LtG, for instance, technological progress is recognized as capable of delaying or mitigating collapse tendencies, yet ultimately insufficient without broader systemic transformations (cf. Meadows et al., 1972, esp. pp. 129–155). EfA similarly stresses the importance of renewable energy, agricultural innovation, and digital infrastructures, while highlighting that these alone cannot ensure sustainable outcomes without corresponding shifts in governance, values, and economic practices (cf. Dixson-Declève et al., 2022, p. 7–8, p. 168).[19] In this way, the scenarios show technology as both a driver of global challenges and a potential means of addressing them – a double-edged sword that can accelerate ecological decline or enable sustainable transitions, depending on how it is governed (cf. Vieille Blanchard, 2015).

Thus, technology operates on two interconnected levels within the reports: as a modeling tool that structures the exploration of futures, and as a dynamic factor within the scenarios that shapes the range of possible societal developments. In both respects, the reports illustrate that technological futures are neither neutral nor deterministic but contingent on political priorities and cultural imaginaries. The modeling approaches themselves form an integral part of this futuring practice: they do not merely represent external realities but are woven into the reports' agendas of raising awareness and fostering change. This is a point we seek to foreground with empirical material: The authority attributed to modeling derives from the transparency of its parameters, assumptions, and computational structures, which frames it as scientific and ostensibly "objective". Yet at the same time this "objectivity" is itself value-laden: decisions about system boundaries, variable selection, and causal linkages embody interpretive flexibilities that align the models with particular normative orientations. By considering these entanglements of modeling and futuring – particularly with regard to how the reports present their findings – we show that the Club of Rome reports are not simply scientific forecasting exercises but complex *assemblages of scientific modeling,*

[18] Because such conglomerates – at least when addressed to a broader public – are inevitably rhetorical constructions, a hermeneutic analysis can help identify where epistemic and rhetorical dimensions genuinely reinforce one another and where they risk devolving into mere strategies of influence aimed at shaping audience perceptions. Although this dimension is not examined in depth here, it is nonetheless directly related to the question of performative modes of modeling the future.

[19] While EfA acknowledges the importance of technological developments for most of the proposed turnarounds, its primary focus nevertheless lies on economic changes (cf. Dixson-Declève et al., 2022, pp. 163–164).

technological visioning, and normative orientation. They mobilize technologies of futuring to reflect on the conditions and possibilities of sociotechnical transformation – and, ultimately, to prompt political action. Understanding this entanglement requires a hermeneutic analysis capable of uncovering the tacit value commitments and narrative framings that shape the models' construction and interpretation. Such an analysis performs a hermeneutic disclosure: it reveals how ostensibly technical modeling practices are intertwined with imaginaries of desirable futures, thereby demonstrating how epistemic and normative dimensions co-constitute the reports' overall futuring work.[20] In the following section, we examine how a hermeneutic analysis can reveal the mechanisms through which the two reports construct and communicate their visions of possible futures, and how performative modes of presentation shape the projects.

THE HERMENEUTICAL ANALYSIS OF THE CLUB OF ROME REPORTS

A substantial body of scholarship has been written on LtG, and we can thus draw on a rich corpus of secondary literature for its contextualization. This is not the case for EfA. On the one hand, this is of course due to the simple fact that the report is fifty years younger, and only a limited number of academic engagements have emerged in the brief period since its publication. On the other hand – and this aligns with our broader argument – the context in which EfA appeared differs fundamentally from that of LtG: not only with respect to the global situation and the factors shaping the modeled scenarios, but also regarding communication environments, public discourse, and attention economies. It is precisely here, so our hermeneutic hypothesis, that an analysis of the intended performativity of modeling practices becomes analytically fruitful, as it allows us to understand how each report seeks to intervene in its respective historical moment.

It is important to note that a hermeneutic analysis of the two reports can take a variety of aspects into account. It can highlight many differences between the reports and what each reveals about its respective present – such as the different scenarios and parameters they select, the metaphors they employ, the narrative strategies they pursue, the authorities they cite, and so on. As we have indicated above, we concentrate on one particular dimension of the reports: their *different modes of performative intervention*, which we aim to work out in greater detail. To do so, we approach the reports as communicative acts directed toward the public (or specific segments of it) and demonstrate how they assume different purposes regarding what they intend to communicate and how they seek to communicate it. At a fundamental level, both reports – and the way they construct scenarios – can be understood as situated within the same existential condition. Each grapples with a central tension: on the one hand, the future is radically open, in the sense that it is not yet present and remains malleable. As Hannah

[20] Although in this paper we focus on the presentation of modeling results, one could also emphasize how modeling decisions are justified. Such analyses are typically constrained by the transparency with which modelers disclose their assumptions, as illustrated by the "Technical Note" on the Earth4All model (Collste & Randers, 2022).

Arendt (1951, 1958) famously pointed out, predictions of the future can suppress the possibility of change and thus risk becoming totalitarian forces. At the same time, this openness does not imply that all outcomes are equally probable; certain trajectories can simply be more plausible than others. There are epistemic reasons to favor some scenarios over others. This is also assumed in future scenarios like the two Club of Rome reports. In this sense, they both reject a naïve "anything goes" perspective. There are two basic dimensions in which both reports *restrict the radical openness of the future*.

(1) *Within each scenario*, the reports follow a (quasi-)deterministic if–then logic: if parameters treated as exogenous (x, y, etc.) develop in a certain way, then dependent variables (a, b, etc.) will unfold accordingly. While both reports acknowledge uncertainties and possible errors – and have been criticized for underestimating them – the structure of the scenarios nonetheless presupposes an underlying causal logic: if x, then y (cf. Grunwald, 2023, p. 175). These statements are not arbitrary; they are grounded in evidence generated through computer-based modeling. Thus, even where uncertainties are emphasized, the reports assume that sufficient epistemic reasons exist to justify their conditional estimates, thereby narrowing the full openness of the future in a reasoned and model-based manner.

(2) At the same time, the reports do not commit to a fully deterministic view, as they present a *spectrum* of *possible* futures. This scenario-based architecture preserves a degree of openness and malleability, since the *independent variables* – such as population growth or technological development in Limits to Growth – are explicitly treated as *changeable*. In this respect, the reports reflect a broader transformation in futures studies during the 1960s: a shift from forecasting a single future to constructing multiple alternative futures (cf. Andersson, 2018, p. 215).

Yet in doing so, the reports necessarily make choices: which scenarios to include and which possibilities to *exclude*. Through these choices, certain options for action are treated as so unrealistic that they are not considered further – even though, in principle, they could be altered through human decisions. As Andersson aptly notes, scenario selection is always a "problem of closed doors" (Andersson, 2018, p. 218). Such decisions are not merely technical but carry a profound existential dimension: "What was considered in the model as static or dynamic was not a mere technical issue but continued to reflect existential notions, as it put the searchlight on the question of what was changeable and not in the world system, and moreover, on what was the core variable of future change – human value change, technology, or the finite nature of resources in a planetary system" (Andersson, 2018, 185). It is precisely in this "existential" regard that LtG was heavily criticized for being overly deterministic and for underestimating society's capacity for adaptation (cf. Cassen & Cointe, 2022, p. 614). A substantial part of the criticism targeted the report's alleged underestimation of the positive potential of technological progress (cf. Vieille Blanchard, 2015, p. 107).[21] Moreover, critics objected

[21] A prominent critic was the American economist William Nordhaus, whose work led to the construction of an alternative model Dynamic Integrated Climate-Economy (DICE) in 1992. The model included much more optimistic assumptions about technological development. Among other things, Nordhaus postulated

that in all scenarios certain factors were treated as fixed and not acknowledged in their potential malleability. Sociologists and economists pointed out that the report neglected the possibility of immaterial changes within political and societal systems (cf. Hahn, 2006, p. 111). Karl Deutsch was among the most prominent critics of the missing societal dynamics in LtG (Deutsch et al., 1977, p. 27). For this reason, comparisons with Thomas Robert Malthus's underestimations of technological and societal development were common (Samuelson in Oltmans, 1974). Perhaps the most blunt expression of this type of criticism regarding the report's insufficient openness came from Ronald Reagan in his second inauguration speech in 1985, when he proclaimed: "There are no limits to growth and human progress when men and women are free to follow their dreams." (Reagan, 1985)

This points to a general tension that modelers must navigate when their models include developments that can be altered by human decisions and behavior within the target system: human action is, in principle, free and capable of taking unforeseen directions.[22] At the same time, one should not assume naïvely that all developments are equally possible. Given that both reports must make such "existential" choices, they inevitably display a constructive dimension. They construct images of the future by delimiting the field of possible developments and excluding others. Crucially, they do so with performative intent: their aim is to demonstrate likely future developments and, on that basis, to *motivate* certain forms of action. In this respect, the reports differ from earlier strands of futurology that were primarily concerned with utopian visions. Instead, they exemplify a shift in futurology between 1945 and 1955 toward scenario-building as a practice carrying a practical imperative. As Andersson puts it, such scenarios are "interventions into the present and attempts to shape coming times … designed to push human beings to act for the future in various ways" (Andersson, 2018, pp. 4–5). Bearing in mind that modeling decisions can themselves influence how people behave – and thereby form or change the model's own target system – only increases the complexity of such decisions. This is what makes the two reports a distinctive type of text: they do not merely offer epistemic claims about what will (conditionally) *happen* in the future, but also present themselves as normative interventions in the present *intended to shape* that future. Both position themselves as *scientific texts animated by normative imperatives*.

It is therefore reasonable that both reports rely on a similar basic model architecture: scenario-building that examines how changes in certain independent variables causally affect dependent variables within a complex system – where at least some independent

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the invention of a "backstop technology" by 2010 which would make it possible to produce an unlimited supply of pollution-free energy (cf. Vieille Blanchard, 2015, pp. 109–110).

[22] Closely related is the more recently discussed issue of the performativity of models. This refers to the phenomenon that models can affect their own target system by altering people's behavior in response to model predictions – something akin to a self-fulfilling prophecy. A precondition for such effects is that the model makes claims about human behavior that are not strictly deterministic but allow for change. The additional possibility that human behavior may change because of a model's prediction introduces a further layer of complexity: it raises new questions about how such potential feedback effects should inform decisions about model construction and scenario design (cf. Ortman, 2025).

variables are assumed to be subject to human influence. However, the reports *differ significantly in the specific pragmatic roles their models are meant to perform*. It is this performative dimension of the two reports that we will examine in the following, in order to introduce several distinct performative modes. Of course, one could also conduct a hermeneutic analysis of the two reports with respect to differences in their content – that is, the different selection of scenarios and the different choices concerning independent and variable parameters. This, however, is not our focus here. Instead, we will address questions such as: *What does each report seek to accomplish by presenting certain "futures" to its audience? And how does it pursue this aim?*

The practical efforts of each report differ in kind: each is embedded in a distinct horizon of meaning, makes different assumptions about its audience, and operates with different expectations regarding how it can affect that audience. They make different assumptions about what their readership already knows, what it needs to be informed about, and how it imagines and emotionally responds to ecological future scenarios. Accordingly, each report engages its readership in a different manner. It is this underlying dimension that we aim to explore in the following, and which we seek to render more explicit.[23]

COMPARISON REGARDING PERFORMATIVE MODES OF THE CLUB OF ROME REPORTS

We can start our analysis by citing the following central passages that capture nicely the *difference in tone and general intention of the two reports*. The following passage is quite illustrative in this regard for the LtG report:

> The project was not intended as a piece of futurology. It was intended to be, and is, an analysis of current trends, of their influence on each other, and of their possible outcomes. Our goal was to provide warnings of potential world crisis if these trends are allowed to continue, and thus offer an opportunity to make changes in our political, economic, and social systems to ensure that these crises do not take place. (Meadows et al., 1972, pp. 185–186)

The following two passages capture the tone and ambition of the more recent EfA report:

[23] Of course, it would neither be easy nor fruitful to separate the representative and performative dimensions of the two reports too strictly. Quite the contrary, it is plausible to assume that the two are intertwined. Not only do the results of the model runs affect what is performatively reasonable to pursue; the performative intent also shapes the role of the model itself and, consequently, modeling choices – especially regarding which scenarios are considered and what is assumed about the development of future parameters that are not merely uncertain but also depend on voluntary human decisions (cf. Winsberg & Harvard, 2024, esp. pp. 42–43). At the very least, the performative orientation of a report will influence where its authors place emphasis, how they frame future developments, and which aspects they highlight (cf. Oltman, 2025). Yet even though these two dimensions do not operate independently, our focus here will be on the performative dimension.

> This is a path of possibility, infused with stubborn, urgent optimism. Earth for All does not gloss over the facts or current context, nor does it offer a utopian vision for the future. What this book shows is that it is possible to avoid risking social tensions, human suffering, and environmental destruction by making five extraordinary turnarounds...” (Dixson-Declève et al., 2022, p. xvii)
>
> […] these extraordinary turnarounds can be achieved by 2050, within a single generation. But action needs to start now. Our future will be vastly more peaceful, more prosperous, and more secure if we do everything in our power to stabilize Earth this decade than if we do not.“ (Dixson-Declève et al., 2022, p. 7)

These two quotes already convey quite effectively some of the key differences between the two reports. In a nutshell, we would highlight that LtG refers to future scenarios in order to:

(1) Increase public awareness of potential and problematic future developments
(2) Warn of potentially catastrophic outcomes
(3) Initiate public debate and political action to shape future trajectories

LtG basically sets out to issue a stark warning about global development that, at the time, was not widely recognized. At the same time, it offered abstract guidance on the general directions that should be pursued to prevent the looming catastrophes it projected. In this way, as we would like to emphasize, the report overall combines a technocratic perspective with an effort to raise public awareness – a somewhat curious mixture of expert authority and public mobilization. By contrast, the EfA report strikes a rather different tone and, consequently, its model plays a fundamentally different performative role. Its reference to future scenarios is embedded in a distinct communicative context, aiming primarily to:

(1) Confirm, elaborate, and emphasize findings on future developments
(2) Generate hope regarding the feasibility of positive future scenarios
(3) Provide specific, action-oriented guidance for both policy-makers and the broader public

While it can be assumed that LtG saw the main problem in a lack of public awareness or belief in the projected problems, EfA appears to take such general awareness largely for granted. We argue that therefore the model fulfils a different practical function and suggest that, like LtG, EfA also has a technocratic side–albeit one that differs in several important respects. More than LtG, EfA seeks to mobilize a broader audience, not just policy-makers, toward concrete action. At the same time, EfA demonstrates a stronger sensitivity to the emotional disposition of its audience, particularly to an assumed sense of despair in light of the political obstacles to realizing the proposed policy initiatives – a difficulty of which the report’s authors seem acutely aware. It is important to note that this is only a rough characterization. For instance, EfA is not devoid of informative elements, nor does LtG refrain from offering broad policy suggestions or occasionally adopting a hopeful tone. Nonetheless, the two reports clearly place their primary emphasis on different aspects. In the following sections we flesh out these differences in more detail and situate them in their historical context.

THE LIMITS TO GROWTH REPORT: TECHNOCRATIC AND UPSTIRRING

A general impression of what LtG and its authors sought to achieve is effectively captured in the subtitle of a review published in the German weekly *Die Zeit*, which described the report as a "bomb in paperback format" (von Randow, 1972, our translation). Its main goal was to raise broad public awareness of what it presented as a global existential problem. And, judging by its impact and the reactions it provoked, it is fair to say that it succeeded. This mode of intervention can, at a basic level, be understood as an effort to inform the audience about realistically possible future developments. The report was widely perceived – and also frames itself – as providing substantial informational value; that is, it was regarded as delivering highly novel and relevant insights. Of course, the core diagnosis was not entirely new: earlier discussions had already warned of population growth, including the idea of a "population bomb," the title of Paul Ehrlich's bestselling 1968 book. The 1960s also witnessed the emergence of early critiques of economic growth and the rise of modern environmentalism (cf. Seefried, 2011, pp. 8–9; Vieille Blanchard, 2015, p. 100).

What LtG presented as relatively new, however, were insights into how the complex interactions among various factors of the world system could unfold in the future. This enabled the authors to offer quantitative estimates of the scale of the problems the world was heading toward and of the extent of change required to avert catastrophe. LtG was the first report to *draw strikingly unambiguous conclusions on the basis of the most extensive system analysis available* at the time (Hahn, 2006, p. 102; Vieille Blanchard, 2015, p. 103). As the report itself emphasizes, these novel findings were made possible by "*new* information processing tools" (Meadows et al., 1972, p. 21, own emphasis)–namely, the systems dynamics approach and the use of computer models–which allowed the authors to "gain *insight* into the limits of our world system" (Meadows et al., 1972, p. 185, our emphasis).[24] That the authors understood their work as informing the public about something genuinely new is evident throughout the report. They speak of "insights" and new "knowledge" they had gained and felt compelled to share. Unsurprisingly, this self-understanding is reflected in how the report was received. Even though it was heavily contested and its assumptions sharply criticized, the predominant tone of the reception praised its informational value. Political scientists Jänicke et al. referred to it as "the most dramatic and, for environmental politics, most influential information event" (Jäckel et al., 1999, as quoted in Hahn, 2006, p. 7). It is therefore

[24] Indeed, as Ann Johnson and Johannes Lenhard argue, "Limits to Growth is an exemplar of a newly emerging culture of prediction that has both an iterative and a numerical character" (Johnson & Lenhard, 2024, p. 113). It had only one prominent predecessor in Forrester's "World Dynamics" (1971; cf. Johnson & Lenhard, 2024, pp. 122–124), yet the approach was not widely known in detail outside expert circles. While LtG models the subcomponents of the world system in greater detail, its main tendencies broadly coincide with those of Forrester's more coarse-grained model. The relative novelty of this methodology – and the fact that its standards of validity had not yet been firmly established – was one important dimension along which the report became contested (cf. Johnson & Lenhard, 2024, p. 115; Vieille Blanchard, 2015, p. 106).

hardly surprising that the report generated widespread resonance and had the tangible effect of prompting large parts of the public to engage more seriously with environmental policy issues. In this sense, LtG also serves as a prime example of the dual function that simulations can fulfill: they are instruments for generating new knowledge and, at the same time, means for illustrating and communicating that knowledge (cf. Scheer, 2017). By fulfilling this dual role, the report seeks to raise the audience's awareness of possible futures – not just any futures, but ones that are epistemically grounded. The informational value of the report lies centrally in the causal if–then logic that it systematically pursues within each scenario, as outlined above.

On a further level, the report does not simply provide information; rather, it provides information about what it explicitly frames as a serious global problem. Above all, it serves as a *strong warning*. While it presents twelve scenarios – some of which lead to a positive outcome, a "stabilized world" – its emphasis clearly lies on negative outcomes, particularly the "standard run" scenario, in which the world continues its current path and ultimately faces "overshoot" and "collapse."[25] The warning tone pervades the entire report, especially its introduction and conclusion, where negative future scenarios serve to depict a catastrophic future if "trends are allowed to continue" (Meadows et al., 1972, p. 186). As Club of Rome founder Aurelio Peccei emphasized as a main motivation for the study: "What we needed was a stronger tool of communication to move men of the planet out of their ingrained habits. This is the reason for the MIT study and the book. Its conclusions are preliminary, but it is a key which permits every layman to enter the labyrinth of the fantastic problems towering over mankind" (quoted in Vieille Blanchard, 2015, p. 106). In this sense, the main future projection in LtG is constructed as a warning. The future is depicted as increasingly bleak if current trends persist, and is presented in a way that *appeals to the audience to relate to it consciously and actively*. Here, the future becomes a looming threat associated with "doing nothing," calling on the audience to act rather than remain locked into present behavioral patterns. To achieve this, the warning scenario is constructed as following a seemingly "natural" trajectory – one that emerges directly from existing trends – while at the same time remaining open to intervention. This approach stands in sharp contrast to the tradition of "futurology," which the report explicitly rejects.[26]

It is therefore not surprising that LtG was primarily received as a warning as well, regardless of whether individual reviews were favorable or critical. This emerged from an assessment commissioned by the *Volkswagen Foundation* of international press reactions (Hahn, 2006, p. 106). To cite just one example, *Die Zeit* published a positive review in 1972 that emphasized the report's pessimistic tone as marking a broader shift in scientific thinking about the future: "In the past, futures researchers mainly occupied

[25] This was also regarded as the most robust outcome of the model simulations. As Johnson and Lenhard explain: "This is exactly what Forrester and the LtG study highlighted: with exponential population growth, a collapse will happen, quite independently from data about other parts of the dynamics that are not available anyway. From the start, the robustness of this behavior was taken for granted" (Johnson & Lenhard, 2024, p. 129).

[26] For an overview on the scholarship on future studies and the concept of "futurology" cf. Gidley (2017, pp. 63–81) and Gidley (2021).

themselves with issuing optimistic forecasts about unimaginable prosperity, an excess of leisure, and victory over old age and disease. Today, their prognoses are mainly gloomy" (von Randow, 1972, our translation). Frequently, however, the report was misread not simply as a warning but as a "harbinger of the apocalypse" (Andersson, 2018, p. 177)– that is, as presenting an overly deterministic vision of an inevitable future. A particularly sarcastic review in *Der Spiegel*, entitled "Doomsday Visions from the Computer," referred to the authors as "Cassandra-like figures" who proclaim that "the end of the world is near" (Der Spiegel, 1972, our translation). Although such interpretations exaggerate the report's claims and overlook the fact that it explicitly presents multiple scenarios rather than a single prediction, it is telling that the report was often read this way.[27]

As described above, the report can be regarded as a performative intervention in its present. It issues a warning about impending catastrophe with the aim of initiating preventive action. At the same time, it offers broad indications of what must be done to avoid the catastrophic scenarios it outlines. Yet the *practical guidance* it provides remains relatively abstract, pointing only in general directions – such as curbing population growth or fostering technological improvements – measures that follow directly from the scenario results. Both recommendations are framed, as Andersson notes, as "new tools of a technocratic world management" (Andersson, 2018, p. 186). Beyond these broad orientations, the proposed steps remain largely preliminary and do not include concrete policy measures. For example, in the concluding commentary, the Executive Committee of the Club of Rome calls for "the creation of a world forum where states, men, policy-makers, and scientists can discuss the dangers and hopes for the future global system" and coordinate "joint long-term planning" (Meadows et al., 1972, pp. 194, 196). The *abstractness of these proposals* aligns with the report's primary function as a warning: its main aim is to highlight a looming threat in order to spark debate and stimulate political action. Had detailed, ready-made solutions already been provided, the term predicament in the subtitle would have been less apt. The reception of the report reinforces this impression. As historian Elke Seefried (2011) has shown, LtG was cited across a wide political spectrum – from leftist groups to Christian conservatives – each drawing very different conclusions and policy proposals from it. The Conservation Society in Great Britain, for instance, invoked the report to support calls to limit consumption and advocated for "sharing and rationing of the scarcer nonrenewable resources" (Seefried, 2011, p. 21). Meanwhile, economists and politicians from both Social Democratic and Christian Democratic parties used LtG to critique the paradigm of quantitative economic growth, instead promoting a more qualitative, sustainable understanding of growth. What many of these proposals shared, however, was – as Seefried notes – a distinctly

[27] In fact, the authors of the study could have made different modeling decisions and treated the robustness of the projected dynamics of "overshoot and collapse" less rigidly. They might, for instance, have constructed more optimistic scenarios – ones that, while perhaps not highly probable, would nevertheless not have been impossible, even without assuming major technological breakthroughs. There was conceptual room for such alternatives. However – and this must remain speculative – these more optimistic scenarios might have weakened the report's communicative force by diluting its central warning message.

technocratic conception of planning, that is, an approach that treated societal problems as if they were technical ones and their solutions as if they were technical solutions requiring specialist knowledge and an elitist group to implement them.

Interestingly, the report can be read as *simultaneously addressing two audiences*. On the one hand, it appears to speak directly to policymakers, informing them about the nature of the problem and roughly outlining measures to be taken. On the other hand, it also addresses a broader public – presumably in an effort to foster public understanding and, in doing so, help legitimize potential political action.[28] Through two of its central performative aims – raising awareness of a looming problem through warning, and offering guidance on how that problem might be addressed by manipulating key parameters (such as population growth) – the report invokes the "future" in a double sense. A concise characterization of its performative dimension might therefore be: it is both technocratic and up-stirring at the same time.

THE EARTH FOR ALL REPORT: HOPEFUL AND ACTION-ORIENTED

Fifty years later, the EfA report follows the same basic logic as LtG, in that its scenario-based "futures" must also be understood as performative interventions in the present. Yet the nature of this performative effort differs considerably. A first striking feature is that EfA presents its scenarios far less as groundbreaking or revelatory. Regarding the problems it addresses, the report does not claim to offer *surprising* new insights. As it states, "We know the pain points" (Dixon-Declève et al., 2022, p. 1). Rather than introducing unknown risks, the report synthesizes a wide range of already public data and studies, serving primarily to frame an urgent problem that is assumed to be at least partly familiar to its audience. Even in terms of proposed measures – the "five turnarounds" – the authors acknowledge: "These five turnarounds are not particularly new […]. But what we have attempted through Earth4All is to connect them up in one dynamic system, to assess if *together* they can create sufficient economic momentum to push the global economy off the destructive course" (Dixon-Declève et al., 2022, p. 5–6, original emphasis).

The future scenarios presented in EfA are thus situated within a context of already well-known mechanisms and trends. By 2022, the challenges it addresses can no longer be assumed to be unfamiliar, nor does the report aim to create public awareness of a previously unrecognized problem. Epistemologically, its scenarios appear to serve three main functions: (a) to corroborate already known developments and proposed measures, (b) to provide greater detail regarding the magnitude of specific problems and the potential effectiveness of coordinated responses, and (c) to keep well-known issues on the public and political agenda by presenting them within a coherent, systemically

[28] Legitimizing potential political action is another pragmatic function of models we will only name here in passing. But one might even argue that it is this dimension of pragmatic rhetorics where the framing of the report as a report to policymakers can build some tension an create a sense of urgency, with readers being fully aware that its primary addressees are those in positions of authority.

integrated framework. This third function is crucial: although the turnarounds themselves are not radically new, the report adds value by bringing them "together" to assemble dispersed knowledge into a unified and actionable narrative, thereby reaffirming the urgency of sustained political commitment.[29]

In contrast to LtG, EfA adopts a distinctly more *hopeful tone*. This manifests in two key ways: first, the report places far greater emphasis on the possibility of a positive developmental trajectory; and second, it consistently conveys that such positive scenarios are not mere aspirations but are, in fact, *realistically achievable*. The future is thus not presented as a set of abstract alternatives but explicitly framed as a range of viable options. The authors describe the turnarounds as "as policy road maps" and "not an attempt to create some impossible-to-reach utopia" (Dixson-Declève et al., 2022, p. 5). This difference is underscored by the reports' respective subtitles. While LtG appeared under the subtitle *The Predicament of Mankind* – also the title of the project from which it emerged – EfA carries the more action-oriented and reassuring subtitle *A Survival Guide for Humanity*. What was the most prominently discussed and received scenario in LtG – the "standard run" leading to overshoot and collapse – finds its counterpart in EfA's "Giant Leap" scenario, the reports central scenario. Rather than highlighting inevitable catastrophe, it focuses on the measures required and the positive outcomes that could result. It is presented in the greatest detail and, as noted earlier, is accompanied by the life stories of four imagined girls, thereby creating a vivid, emotionally accessible vision of a desirable future.[30]

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[29] One may hypothesize that this reduced informational novelty – combined with a more saturated public discourse on global ecological crises – helps explain why later reports by the Club of Rome, including EfA, have attracted significantly less public attention than the original LtG.

[30] The contrast becomes evident when the two scenarios are compared directly. With regard to the "Too Little, Too Late" scenario, the authors present the following visions for the year 2050: „Shu, Samiha, Ayotola, and Carla celebrate their thirtieth birthdays in 2050. Shu is now a hydrology engineer working on major projects to protect China's water supply, but floods are frequent in some areas and droughts in others. This threatens food security and the economic security of hundreds of millions of people. Mass migration in mid-century creates a housing, employment, and food crisis that escalates into a conflict. Carla is an office manager in a successful architecture business but decided to leave the extreme heat of southern California and moved north to Seattle. But she now feels the fires and heat are following her. Her brother has the same job and qualifications yet is paid much more than her. Because of her six-figure student loans and expensive rent, she lives paycheck to paycheck. In Bangladesh, Samiha has three children but lost her job in the clothes factory as the city of Dhaka is progressively being abandoned to the flash floods by the people with the means to move inland. Means or not, Samiha knows that she will also soon have no choice, and will have to try to escape the increasingly frequent floods and heatwaves. She often wonders where she will be in a year. Ayotola left school at fourteen and married the son of a family friend. They have four children, but can only afford to send the boy to school. Ayotola does some sewing at home to make money for fish, meat, or beans to go with their ugali. The women have no experience of living on a planet without climate extremes." (Dixson-Declève et al., 2022, pp. 40–41) The "Giant Leap" scenario, by contrast, adopts a markedly different vision, tone, and rhetoric: "Shu, Samiha, Ayotola, and Carla are now thirty years old. They have all finished university degrees and are at the early stages of their careers. They do not expect to have the same career throughout their lives. Instead, they see opportunities to have several careers in different sectors. They'll retrain when they need to or want to, supported by an active state. Every month they receive a universal basic dividend. This provides a level of economic security that allows them to take more risks. Thanks to a government relocation program and her universal basic dividend, Ayotola and her

Die Zeit again identifies this shift as part of a broader cultural development. According to a recent review, the more hopeful orientation in EfA reflects "a broader shift in the current zeitgeist, influenced by psychological findings that constant predictions of catastrophe tend to paralyze people" (Pinzler, 2022, our translation) – often discussed under the notion of apocalypse fatigue or climate fatigue (cf. for example Nordhaus & Shellenberger, 2009). Beyond these psychological considerations, this shift can also be traced to developments within futures studies beginning in the 1980s and 1990s. During this time, predictive techniques came to be understood not only as rational instruments for informing decisions but also as "aids to the imagination, as they seemed to allow for concrete representation of possible world futures, and they could be used therefore in subversive manner" (Andersson, 2018, p. 182). This hopeful orientation comprises not only a focus on positive possible outcomes but also an emphasis on their *realizability*. "Our goal with Earth for All is to show you that this [systemic transformation] is indeed fully possible" (Dixson-Declève et al., 2022, p. 1). We suggest that this emphasis on hope should be read as a response to an assumed sense of hopelessness – one that was not apparent in LtG. Unlike its predecessor, EfA repeatedly addresses what it assumes to be fears and doubts within its audience, as reflected in a passage framed by rhetorical questions: "Why are actions to prevent pandemics or climate disruptions so shockingly inadequate? Are economic systems driving industrial societies in a direction that's impossible to change?... Is societal collapse inevitable? Or can we find a way to value and invest in our collective future here on Earth?" (Dixson-Declève et al., 2022, p. 2).

As many observers note, contemporary attitudes toward climate change and other global social and environmental problems are marked by a pervasive sense of hopelessness. This pessimism does not stem from a lack of knowledge or awareness–an absence that LtG arguably took to be central[31]–nor from the belief that the challenges are technically insurmountable. Rather, it arises from the perception that meaningful systemic change is politically unattainable. What dominates is a form of fatigue and powerlessness. It is precisely this affective disposition that EfA seeks to address through its optimistic tone. The report must therefore be understood as speaking to an audience that is intellectually engaged and emotionally invested yet simultaneously prone to resignation or doubt regarding the possibility of meaningful change.

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parents were able to move away from Lagos, threatened by the floods and rising waters. She works as an accountant, specializing in wellbeing indicators, and has decided to have one child. In Seattle, Carla has trained as an architect and designs passive homes for community housing, while her partner is a corruption analyst. Samiha is now a food engineer, developing saltwater-resistant grains to increase yields. In her free time, she tutors children at the community center. Shu has chosen not to have kids, expending her time on social networks, and busy with the marketing and managing of huge fleets of shared electric carpools. Floods and storms are a regular occurrence, but measures have been taken to mitigate their effects – green spaces and trees in strategic locations – and new urban and sewage infrastructure make the city livable." (Dixson-Declève et al., 2022, pp. 49–50) Comparable visions are outlined for the years 2080 and 2100, which highlight an even more pronounced contrast (cf. Dixson-Declève et al., 2022, pp. 45, 53).

[31] Additionally, early systems-dynamics models emerged in a period marked by comparatively optimistic views of global change, when future-oriented science was often imagined as a kind of "midwife" helping to deliver a better future (Andersson, 2018, p. 17).

Naturally linked to its more optimistic tone, the E4A report is also significantly more action-oriented than LtG, offering *specific steps for achieving the systemic turnarounds* it advocates. This marks a broader trend observable in later reports following LtG. While LtG primarily sought to spark public debate and deliberately refrained from specifying concrete policy measures, EfA aims to present a clear roadmap for "rebooting" the global economic system – an ambition underscored by its subtitle, *A Survival Guide for Humanity*. In this context, the report's future scenarios are explicitly *constructed around policy options*, which function as independent variables in the modeling process. The scenarios serve not only to illustrate potential outcomes but also to test and validate actionable policy pathways. In this way, the logic of scenario construction shifts from raising awareness of problems to evaluating the feasibility of measures intended to address them. The report thus seeks to reduce the radical openness of the future by *outlining a realizable and desirable trajectory* for global development. This guiding dimension is closely tied to the report's hope-generating thrust. The proposed measures are not merely presented as necessary steps; in presenting them, the report also communicates that these steps are indeed achievable. Hope is produced not simply by depicting positive outcomes but by demonstrating their *practical attainability*.

At this point, it is useful to examine more closely how EfA constructs agency regarding the future. Within its scenario descriptions, the report frequently presupposes the existence of a collective agent capable of taking action. This agent is most often identified with governments, but at times more ambiguously with "nations," or with an abstract "we" presumed to be responsible for implementing the proposed measures.[32] In depicting its scenarios, the report often frames the realization of policy options as a matter of decision or will. One passage makes this especially explicit: "Now we understand that governments can adjust the stocks and flows on the gameboard – *if they want to* activate the five extraordinary turnarounds we describe in this book" (Dixson-Declève et al., 2022, p. 2, our emphasis). Such metaphors – "gameboard," "lever" – imply that the levers of change merely need to be pulled, rendering agency as something readily available.

This construction of agency follows the internal logic of the modeling framework, in which policy interventions are treated as independent variables that can be adjusted at will. From the modeler's perspective, such variables are easily manipulated, which can obscure the real-world difficulties of implementing them. It is therefore not surprising that the report rhetorically assumes a collective agent that is already capable of acting – especially within the context of its scenario-building. In this sense, despite its affective

[32] The final chapter – "A Call to Action" – identifies four forces that may help trigger social tipping points conducive to the proposed transformation: social movements, a new economic logic, technological developments, and political action. Two passages from this chapter vividly illustrate how EfA engages with its readers' potential sense of powerlessness and seeks to cultivate hope: "If you feel the scale of the transformation is daunting, join the club. Perhaps you feel it is like pushing a boulder up a hill. Well, here we have some good news. You will have to push a boulder, for sure, but what if you have to push the boulder downhill instead of uphill? What if we just need to get the damn thing moving and the force of gravity will help us after that?" "Given these social tipping points, the boulder we need to push may only require a large shove to really get it moving, with its own unstoppable momentum. And when we push the boulder, we may have a lot of hands pushing with us." (Dixson-Declève et al., 2022, pp. 167, 169)

orientation toward hope and engagement, the report also exhibits a technocratic outlook. At the same time, this technocratic assumption of agency is complicated when the report moves beyond scenario presentation to reflect on the structural and political conditions that hinder implementation. Here, the authors explicitly acknowledge that they do not wish to adopt a tone of naïve optimism. They identify significant "barriers" to the realization of the proposed turnarounds and openly address the question of why the metaphorical "lever" is not being pulled.[33] In these passages, the report adopts a markedly different tone, acknowledging the "daunting challenges" of overcoming what it describes as a collective action problem in "turning around our economy" (Dixson-Declève et al., 2022, p. 29).

This problem dimension – absent in LtG in this explicit form – is continually reflected upon throughout EfA. It culminates in an explicit call for action, in which the authors urge the broader public to help generate political pressure. Among the measures proposed are joining social movements, voting for supportive political parties, and demanding citizens' assemblies dedicated to economic system transformation (Dixson-Declève et al., 2022, pp. 167–170). In this respect, EfA is considerably more activist in its intended mode of intervention. Like its hopeful tone, this activist thrust is shaped by an awareness of political inertia and societal fatigue. The report seeks to counter these forces by *fostering public hope and mobilizing civic engagement as a form of political leverage*. For this reason, EfA frequently oscillates between contrasting tones – hopeful and cautionary – within its discussion of future challenges, a dynamic not found in LtG in the same way. This contrast, however, should not be understood as a contradiction. Rather, it reflects the report's effort to operate on two distinct levels: on the one hand, to describe positive and realizable future scenarios, and on the other, to acknowledge the structural and political barriers that make their realization difficult.

CONCLUSIONS

Modeling is a human practice carried out with specific practical aims in mind. Models are built to have an effect – they are intended to intervene in the world – and these intended effects shape not only the modeling decisions themselves but also the ways in which model results are presented and communicated. Questions such as which scenarios receive emphasis, what is omitted, and how results are framed are closely tied to a model's pragmatic function. As Armin Grunwald has argued, models may carry an "unrecognized semantic overflow, a 'meaning in disguise' to be undisclosed" (Grunwald, 2023, pp. 184–185). In this paper, we have sought to highlight one aspect of this potentially hidden meaning beyond the mere informational content of models: their performative modes – that is, the ways in which they are designed or communicated as performative interventions. Models can operate through a variety of performative modes: they may

[33] For several of the turnarounds, the report also discusses barriers to the proposed solutions. This is the case for the poverty turnaround (Dixson-Declève et al., 2022, pp. 69–71), the equality levers (ibid.: 90–91), the transformation of the food system to benefit both people and the planet and the energy turnaround (Dixson-Declève et al., 2022, pp. 121–123, 137–144).

raise awareness, issue warnings, generate hope, or guide action. This list is by no means exhaustive, and further modes could certainly be identified.

The two Club of Rome reports we examined – *Limits to Growth* and *Earth for All* – served as case studies for exploring these performative dimensions. These particular cases are especially suitable for such analysis because their models are embedded within extensive accompanying texts that explicitly articulate the underlying performative intentions and explain how the modeling results contribute to the messages conveyed in the reports. In other contexts, where such textual framing is absent, interpretive efforts must be more speculative and rely more heavily on reconstructing the model construction process itself. This applies not only to future-oriented models but also more broadly to scientific discourses on future developments. One may assume, for example, that performative intent plays a role in organizing and framing scientific reports such as those by the IPCC, although it certainly is much less prominent. Attending to the performative orientation of these reports also brought into focus the assumptions they make about their audiences. What emotional or affective dispositions do the modelers presuppose? How do they seek to influence, motivate, or mobilize their readers? Describing such models merely as "informative" tools masks these nuances and fails to capture the full range of their pragmatic and rhetorical functions.

Certainly, this also raises questions of modeling ethics that relate more generally to how scientists should frame future scenarios. Should scientific authorities aim for a maximally sober and neutral dissemination of mere information to remain neutral? Or do they have an obligation to engage the public more performatively, for example by explicitly issuing warnings? These are questions that have long been asked in the realm of science communication.[34] There are no straightforward answers to them. What the hermeneutical analysis of the two reports has shown, however, is that the distinction between description and projection, or analysis and narration is often difficult to sustain in practice. Precisely in contexts where models are mobilized to render uncertain futures intelligible and actionable, epistemic claims and rhetorical strategies become closely intertwined, making the boundary between neutral information and performative intervention inherently unstable.

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[34]See, for instance, Pielke (2007) for an important point of reference.

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