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Debate

The Case for Climate Reparations by Fossil Fuel Companies: Ethical Foundations, Monetary Estimates and Feasibility

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ABSTRACT

This contribution argues that the fossil fuel industry has played a major role in human-driven climate change and should agree to shoulder the burden of the associated damages. To this end, the article develops a responsibility-based approach to operationalize and quantify fossil fuel companies' climate reparations and locate them in the current political economy context. It explains the rationale for a responsibility-based approach to climate reparations, investigates their foundational elements and proposes a Global Climate Reparations Fund to manage them. The article continues by providing a typology of climate reparations and their operational aspects, which makes it possible to quantify the financial burden as amounting to hundreds of billions of dollars annually over the coming decades. The political economy of climate reparations, with particular attention to their feasibility, is then analysed. The article lays the groundwork for a reasoned dialogue within and between civil society and political representatives of different backgrounds on the responsibility of fossil fuel companies in the climate crisis and on their role in rectifying climate damages through reparations.

INTRODUCTION

The growing burden associated with climate change has brought into focus a question that so far has been largely marginalized: who should bear the cost of the damages caused by human-driven climate change? Up to now it is mostly states that fund, or have pledged to fund, action supporting their own citizens or other people harmed by climate impacts. But other

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agents bear substantial responsibility for climate harm and the associated damages: the companies that engage in the exploration, production, refining and distribution of fossil fuels (Grasso, 2022) and that are the flywheel of the current global capitalist model of development (Malm, 2016; Mitchell, 2011). These companies have played a major role in the escalation of the costs associated with climate change by providing enormous amounts of oil, gas and coal to the global economy while wilfully ignoring foreseeable climate harm (Heede, 2014), especially that suffered by more vulnerable peoples and communities (Watts, 2005). All the while, they have successfully shaped the public narrative on the climate crisis through disinformation, 'false solutions', lobbying and capillary infiltration in critical political, social and cultural ambits to obstruct and delay political action (Brulle et al., 2024; Supran and Oreskes, 2021). For instance, through the misleading narrative of 'green capitalism', the fossil industry has depicted corporations and markets as the only means for responding to the climate crisis. Accordingly, several fossil fuel companies, with the acquiescence of accommodating media outlets, have promoted an image of sustainability, claiming that they can adequately address the climate crisis while expanding global production of fossil fuels and shifting the blame squarely onto the shoulders of consumers for their lack of green virtues.

Such behaviour serves as evidence that fossil fuel companies — along with other agents outside the scope of this article — must rectify the damages resulting from the harm they have caused (Grasso, 2022).[1] This implies that life on the planet has the right to live in a world not harmed by the suffering, destruction and death caused by climate change. When this entitlement is not met, a 'duty of reparation' requires fossil fuel companies to pay climate reparations to rectify the damages they have generated (Grasso, 2022; Grasso and Heede, 2023). Such reparations can substantially contribute to reinvigorating current anaemic international climate finance since their order of magnitude for the top fossil fuel companies has been calculated in the hundreds of billions of dollars annually over the next decades.

This article justifies, develops, operationalizes and quantifies fossil fuel companies' climate reparations through a responsibility-based approach and then analyses their political economy and feasibility. It first provides a justification for the payment of climate reparations by fossil fuel companies, grounded in their moral responsibility. It then investigates the foundational elements of climate reparations, proposes a Global Climate Reparations Fund to manage them, and provides a typology of such reparations. Next,

1. This article understands 'rectification' as a general term that includes material (monetary and non-monetary) and non-material forms of addressing damages. I am aware that in common parlance damages are 'materially repaired' or 'financially redressed'. As better specified in the section 'Foundational elements of climate reparations', the terminology choice made in this article is based on the insightful political theory approach of Goodin (2013) on the different ways of responding to historical wrongdoing.

the article analyses the operational aspects involved and quantifies financial reparations for climate damages in the hundreds of billions of dollars annually over the coming decades. Finally, it examines the political economy of climate reparations, paying particular attention to their feasibility.

JUSTIFICATION FOR CLIMATE REPARATIONS

Through the carbon emissions associated with their processes and, especially, products — whose downstream combustion throughout the global economy produces emissions labelled 'Scope 3' — fossil fuel companies have harmed living beings and the planet and contributed to climate damages.[2] At the same time, the dominant capitalist model of socio-economic growth has created powerful entrenched interests that resist change. Fossil fuel companies, particularly the largest Western ones, are at the centre of fossil capitalism and pursue the cult of GDP, whose main unspoken assumption is that any socio-economic objective can be achieved by 'throwing more fossil fuels at it'. For decades, these companies have vigorously and consistently resisted climate policy and undermined climate action; a panel of UNFCCC and IPCC[3] experts considers opposition from them to be the main obstacle to achieving the 2°C objective (Kornek et al., 2020).

Within this carbon-centric capitalist context, fossil fuel companies' positive responsibility to rectify the harm done is rooted in their negative, general, backward-looking responsibility which results from the violation of the no-harm principle: if an agent contributes to harm in violation of their negative responsibility, it becomes their positive responsibility to redress it (Shue, 2017). Emissions are the most evident actions that determine such positive responsibility and indicate that fossil fuel companies, through their activities, have been a major contributor to climate change. Acknowledging the possibility that fossil fuel companies as collective entities bear responsibilities (Hormio, 2023), four ethically relevant facts (Grasso, 2020) can be highlighted that substantiate this claim and reinforce the argument that these companies bear moral responsibility for the climate crisis. These facts are summarized in Table 1.

The first ethically relevant fact refers to the companies' awareness: long before the problem was widely understood in the 1990s, fossil fuel companies knew that their activities were causing dangerous climate change.

2. According to the Greenhouse Gas Protocol, 'scope 3' emissions are 'all indirect emissions … that occur in the value chain of the reporting company, including both upstream and downstream emissions' (World Resources Institute & World Business Council for Sustainable Development, 2013: 28).
3. The United Nations Framework Convention on Climate (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC) are the two main UN bodies working on issues related to climate change.

Table 1. Ethically Relevant Facts

Awareness	The industry was aware of the harm caused by their products
Behaviour	The industry did not modify its behaviour
Capacity	A less carbon-intensive business was possible
Denial	Some fossil fuel companies carried out successful denial campaigns to obstruct climate action

Source: author

Ample evidence confirms that they did not disclose their knowledge about the hazards associated with climate change.[4] The second concerns the companies' behaviour: they have not changed their fossil fuel focused conduct and they do not appear to have any plans to do so. The third relates to their capacity: less carbon-intensive options were possible, but fossil fuel companies did not take meaningful measures to pursue these options to reduce the harmfulness of their activities. The fourth fact is that major international fossil fuel companies have successfully opposed political efforts to decarbonize economies and fight climate change through sophisticated campaigns of denial that have successfully obstructed climate action.

These ethically relevant facts underpin fossil fuel companies' moral responsibility: this is a strict notion of responsibility that derives from their willingness, intentions and knowledge regarding the harmfulness of their activity. Moral responsibility provides the normative basis for establishing duties — in conceptual terms, informal sanctions (Jamieson, 2015) — that compel fossil fuel companies to take specific actions. Such duties align with the core demands of climate justice movements (Newell et al., 2021) that wealthier agents, including corporations, pay back their 'climate debt', composed of an 'impacts debt' and an 'emissions debt'. The impacts debt, the focus of this contribution, implies a rectification of the damages provoked by climate change and is included in the duty of reparation: in this article, it is assumed to be fulfilled through climate reparations.

Before proceeding, a note on the cogency of the proposed responsibility-based approach to fossil fuel companies' climate reparations is in order. I do not by any means imagine that laying out a normative framework for climate reparations will become a sort of self-fulfilling prophecy, whereby the industry will comply with recommendations simply on account of the authoritativeness of the ideas on harm and responsibility presented. I acknowledge that the framework developed is not sufficient to motivate fossil fuel companies to act. However, a responsibility-based approach to climate reparations aims at establishing ethical grounds for climate action to have a positive influence in the world. Without entering the thorny

4. See, for instance, reports by InsideClimate News on the American fossil fuel giant Exxon-Mobil's misinformation campaign; its work on this topic made InsideClimate a finalist for the 2016 Pulitzer Prize in Public Service: www.pulitzer.org/finalists/insideclimate-news (accessed 15 May 2024).

methodological debate about the capacity of ethics to achieve this objective, the approach developed refers to the 'engaged methods' of climate ethics (Green and Brandstedt, 2021). As such, it is equipped to contribute to climate action since it involves clear identification and substantial engagement with the agents of change — in this case the fossil fuel companies as 'first-order agents', and 'indirect (or second-order) agents' (e.g. political authorities at various levels, members of civil society, economic and social actors, epistemic communities, etc.), who are expected to undertake a number of tasks to ensure that first-order agents comply with their (first-order) duty of reparation (and decarbonization) (Grasso, 2022). Basing the analysis on the distinctive, structural role of first-order and indirect agents with respect to the climate crisis suggests possibilities for normative-prescriptive work that, by lessening the indeterminacy of the responsibility-based framework, can more effectively mobilize action at different levels. The outlined approach considers the political possibilities of first-order and indirect agents' actions in a situated and detailed way, thereby closing the gap between normative theorization and its real-world positive influence. This framework can serve as a useful foundation to facilitate the consolidation of emerging anti-fossil-fuel social/behavioural norms which condemn the industry for its deliberate engagement with such a harmful product and seek to force it to pay out reparations. For instance, it would enable civil society to better engage and destabilize the power of fossil fuel companies and favour the introduction of binding provisions that compel them to address past harms caused.

FOUNDATIONAL ELEMENTS OF CLIMATE REPARATIONS

To specify and implement fossil fuel companies' climate reparations, it is necessary to analyse certain aspects, namely, their bases and forms, the recipients and the possible means.

The Bases

The ethical principles that underpin and define the actions required for fossil fuel companies to rectify the damages caused by the climate harm associated with their activities form the bases of climate reparations. In general, the 'no harm principle' requires subjects to act in ways that do the least possible harm and affect the fewest human and non-human beings (Regan, 2004: 82–119). This principle is a fundamental component of climate ethics (Shue, 2011, 2017) and its primary imperative is to prevent people and other beings from suffering climate-related harm (Vanderheiden, 2011). The ethical principles analysed hereafter should therefore be understood as ways to provide an articulated justification for actions aimed at fulfilling this overarching no harm principle in relation to fossil fuel companies' duty of reparation.

Table 2. Forms of Material Rectification for Climate Harm

	Centred on victims	**Centred on perpetrators**
Centred on persons	Compensation	N.A.
Centred on objects	Restitution	Disgorgement

Source: author (adapted from Goodin, 2013)

Climate ethics literature refers to one forward-looking principle (the 'ability to pay principle' — APP) and two backward-looking principles (the 'polluter pays principle' — PPP — and the 'beneficiary pays principle' — BPP) to ethically justify rectificatory actions. These three principles together shape the (positive) responsibility of sharing the burden of rectifying the consequences of climate harm. The APP envisages an allocation of the burden associated with rectificatory actions in proportion to agents' relative ability to bear it; the PPP allocates the burden in proportion to agents' past contributions to climate harm; the BPP suggests that the proportionality of distribution depends on the benefits that agents have gained from activities that have generated climate harm. In the climate change scenario, these principles as applied to the fossil fuel industry have a different ethical relevance: for example, the PPP emphasizes fossil fuel companies' contribution to the climate crisis in terms of emissions and provides a sort of 'contributional' rationale for reparations; the backward-looking BPP strengthens the ethical cogency of reparations as it focuses on agents that benefited from actions that have generated climate harm; by the same token, the forward-looking APP justifies reparations through agents' capacities to shoulder the burden of climate harm.

These three ethical principles can be used both separately and together to operationalize and quantify climate reparations, based on the typology of the latter, the scope of the analysis, and the availability of data, as the example provided later in this article shows.

The Forms

The forms that fossil fuel companies' rectificatory actions in relation to climate harm take can either be 'non-material', such as public acknowledgments and apologies, punishment, and the creation of a truth commission (Rotberg and Thompson, 2000), in other words, not focused on an object-based rectification of historical wrongdoing (Fraser, 1995); or 'material', focusing on actual, object-based rectification. Given the urgency and 'materiality' of the climate crisis, the second kind is preferable. Different forms of material rectification exist, but in the context of climate change, the monetary form is the most viable (Grasso, 2022). As Table 2 shows, depending on the identification of the recipient of monetary rectification (the victim),

the two main forms are 'compensation' and 'disgorgement'.[5] The notion of 'restitution' — the other form of material, yet non-monetary, rectification — relates to anything else a victim has lost as a result of harmful activities, and which should be restored either to them or to their heirs: but this of course is not practicable in relation to climate change.

Compensation, as a form of reparation, means monetarily redressing the rightful owners or their legitimate heirs for the harm done, and requires identification of the victim (the rightful recipient) — although considering the complex nature of climate change, this is problematic. Given substantial temporal and spatial lags between carbon emissions and their impacts, it is virtually impossible to identify the specific victim or a legitimate heir with certainty.

Disgorgement is a more appropriate form for climate reparations since it does not require identification of victims who have suffered harm, or their legitimate heirs in the current generation, or how those victims would have fared if the past wrongdoing had not occurred; instead, it refers to the relinquishment of profits or holdings acquired through past wrongful acts — in the case of the fossil fuel companies, their tainted wealth. Disgorgement, unlike compensation, focuses on the perpetrator rather than the victim and their well-being (Goodin, 2013). The main advantage of disgorgement is that monetary rectification that cannot be given as compensation, i.e. provided to the rightful recipient, can nonetheless be effectively channelled to a valid related cause: for example, in the case of slavery, to promote equal opportunities for people of African origin, or, in the case of climate change, to lessen the distress of more vulnerable people and forms of life.[6] In brief, the fact that disgorgement does not require the identification of a specific

5. It should be clarified that by and large the reparations literature uses the term 'compensation' as synonymous with the term 'monetary rectification' employed here. However, this article, as previously noted, adopts Goodin's (2013) distinction since it is particularly useful in the intricate context of climate change: it considers compensation to be a specific form of monetary rectification that requires the identification of the victim (the recipient of the funds) with the objective of making them whole again through financial means. Monetary rectification is instead generally understood as a cash-based form of rectification. 'Rectification' alone is a broader term that includes not only material forms (monetary and non-monetary) but also non-material ones, such as recognition of blameworthiness, etc.
6. Several examples of disgorgement exist: an important case is the Nazi theft of works of art from European Jews. After World War II, when the victims of the looting had no heirs, the artworks were sold and the proceeds went to a fund to support Holocaust survivors. A much smaller and less well-known case is the slave-built Brown University's University Hall. As the slaves involved are unidentified, it is impossible to compensate their heirs; however, disgorgement offers an opportunity to provide monetary rectification for misconduct associated with the University Hall by transferring some of the university's assets to engage the (current) Rhode Island community in addressing persistent issues of inequality and injustice (Goodin, 2013).

victim or speculation about their current situation if the past wrongdoing had not occurred greatly facilitates its implementation in the context of climate change, making it the most suitable form for climate reparations to take. Disgorgement should not include all assets and benefits attributable to the historical activities of fossil fuel companies, but only those that are tainted: for example, it would not include donations to charity which are derived from fossil operations, but would include benefits that are not being used in socially productive ways, such as fossil fuel investments and financial speculation. It should be further noted that disgorgement allows non-human forms of life to be included among recipients, since they too are victims of the climate crisis.

The Recipients

Who are the victims of climate harm to whom the funds rightfully disgorged through climate reparations would represent a support to a valid cause? A useful approach is to focus on those subjects who are more vulnerable to the impacts of climate change. This mainly includes peoples and communities susceptible to climate harm, climate migrants and refugees, and more fragile non-human forms of life; rightful reparations should be directed to providing them with adequate monetary means to deal with the harm suffered and financially supporting processes and initiatives of ecological restoration. Climate vulnerability is not caused only by exposure to climate impacts; it also depends on socio-economic systems' preparedness and capacity to cope with them. It thus makes sense to refer to the notion of social vulnerability, which is understood as a level of well-being that relates directly to individuals and social groups, as well as to non-human forms of life, originating not only from climate impacts, but also from social, institutional and economic weaknesses (Paavola and Adger, 2006). Subjects who are more socially vulnerable should therefore be given sufficient rectificatory means (in this case, funds) to cope with and recover from climate harm.

There is another group of vulnerable subjects who are not directly exposed to climate harm: those who might suffer a loss resulting from the decreasing financial resources that sustainability transition efforts and reparations would impose on the fossil industry. These subjects are the displaced workers in the fossil fuel industry itself and in other directly connected industries, such as petrochemicals, chemicals, transportation, shipping and suppliers, as well as communities along the fossil fuel supply chain, which would suffer in terms of job losses and/or a reduction in opportunities. The inclusion of displaced workers and affected communities among recipients expands the scope of climate reparations beyond the strict limits of monetary rectification for the harm caused by companies' fossil fuel-related activities.

The Means

A promising means to disgorge and manage the climate reparations to be made by the fossil fuel industry can be a Global Climate Reparations Fund. Its objective would be to provide financial support to the recipients indicated above. Such a fund should complement, and in any case must not be a substitute for, reparations demanded in specific locations by communities facing climate change and other forms of dispossession and historic injustices.

Binding international legal initiatives should establish this fund as an independent global legal entity to mobilize and oversee the collection and allocation of climate reparations by fossil fuel companies. Given the unidentifiable origin of these companies' contributions in terms of emissions to atmospheric greenhouse gas concentration, caused by the global range of their processes and products and indeed by the intrinsically global nature of emissions, this fund should also be global in scope. It should not consider regional/national/local/sectoral differences in terms of replenishment or disbursement of its funds. As instruments of global distributive justice (Táíwò, 2022), climate reparations must have a similarly comprehensive scope since they should aim to make the structurally unjust world system fairer.

The fund would involve different units based on the different groups of recipients involved, namely, a 'harm' unit and a 'workers and communities' unit. Additionally, it could include a third unit to finance the promotion of the low-carbon transition (the 'transition' unit), which would address the burden of transition processes, support clean technologies and projects, and so on. While the modalities of allocation are yet to be defined, a good starting point would be the social vulnerability of recipients mentioned above: the greater the vulnerability, the greater their proportional access to climate reparations should be.

TYPES OF CLIMATE REPARATIONS

Despite the acknowledged ethical superiority of other material, human-centred currencies (Nolt, 2015) of climate reparations — e.g., the broadening of the 'human climate niche',[7] or the restoration of a climate-safe planet — given their greater straightforwardness, immediacy and applicability, the focus here is on monetary climate reparations to rectify the damages caused by climate harm. They are grouped in four types — financial, welfare, mortality and displacement. As specified in Table 3, this categorization is based on: i) the ethical justification for their disgorgement (ethical rationale); ii) the climate-driven element that reflects or measures the wrongness of fossil fuel companies' climate-related actions (climate

7. That is, the areas where climate conditions — mean annual temperatures spanning from 13°C to around 27°C — are optimal for societies to thrive.

Table 3. Types of Monetary Climate Reparations

Types	Ethical rationale	Proxy	Monetary Reference	Scope of Damages	Focus
Financial	Climate harm	Carbon emissions	Financial loss	Monetary	Humans
Welfare	Climate harm	Carbon emissions	Social cost of carbon	Monetary and non-monetary	Humans and non-humans
Mortality	Human life	Carbon emissions	Mortality costs	Monetary and non-monetary	Humans
Displacement	Displaced people	Number of displaced individuals	Welfare loss	Monetary	Humans

Source: author

impacting or impacted proxy); iii) the monetary dimension employed to calculate reparations (monetary reference); iv) the kind of damages covered by reparations, which juxtaposes damages including monetary costs with damages including non-monetary costs (scope of damages); and v) the subjects/entities (victims) who, in the framework of climate reparations, suffer climate harm and become recipients of climate reparations, articulated in 'anthropocentric' reparations that consider only humans, and 'non-anthropocentric' reparations that include all forms of life (focus).

Financial Reparations

Financial reparations are based on the climate damages associated with the harm caused by fossil fuel companies' emissions, proxied by their cumulative carbon emissions, and measured through the financial loss resulting from such damages. These reparations are obtained by apportioning fossil fuel companies' cumulative operational and product-related emissions, over a specific period, proportionally to past damages (backward-looking financial reparations) or to estimates of future damages (forward-looking financial reparations). By so doing, financial reparations include only monetary damages captured by GDP while ignoring components of well-being not captured in GDP, such as the value of lost ecosystem services, extinctions, loss of human lives and livelihoods; additionally they consider only the damages suffered by humans, who would be the only recipients.

Welfare Reparations

Welfare reparations are based on the same notion of climate damages measured through the social cost of carbon (SCC) associated with their cumulative emissions and involve the application of the SCC to companies' cumulative emissions over a specified period. The SCC is a measure of

climate damages expressed as the dollar value of the overall economic impact of global warming attributed to each metric ton of carbon released into the atmosphere; it therefore gives a broader measure of climate damages than that considered by financial reparations. The calculation of the SCC integrates three types of information — socio-economic predictions, climate projections, climate benefits and costs — and specifies an appropriate social discount rate. This methodology captures the pathway through which an extra amount of emissions increases atmospheric concentrations, which then changes average global surface temperature and precipitation; this then leads to biophysical impacts, for instance, on agriculture and sea level, ultimately leading to damages to human welfare and the economy.

Mortality Reparations

Mortality reparations assume that to quantify the toll of carbon emissions, the appropriate metric is the number of human deaths caused by climate change (Nolt, 2015). A recent study shows that research in this area converges on the '1,000-ton rule', i.e., that approximately 1,000 metric tons of fossil carbon burned cause one future premature death (Pearce and Parncutt, 2023). These reparations can hence be calculated by applying the 1,000-ton rule to fossil companies' cumulative emissions and then converting the resulting number of premature deaths into monetary terms through appropriate values of a statistical life.

Displacement Reparations

Lenton et al. (2023) quantify the cost of climate change in terms of the number of people left outside the human climate niche (see footnote 7). From this perspective, it is possible to calculate the welfare loss suffered by climate-displaced people, as different methodological frameworks existing in the relevant literature make evident (Millock, 2015), and eventually to monetize displacement reparations.[8]

All types of climate reparations can be backward-looking (based on past damages, as 'non-climate' reparations usually are) or forward-looking (based on future estimated climate damages). In the context of climate change, forward-looking reparations are preferable for at least three reasons: i) unlike other major wrongdoings (such as slavery, wartime plundering), climate change is ongoing and will increasingly generate damages in the future; therefore, forward-looking reparations are better suited to reflect the rapidly worsening impacts of the climate crisis; ii) climate damages are

8. Both the number of casualties and the number of displaced people, when not converted into monetary metrics, can be currencies of non-monetary climate reparations in themselves.

cumulative, and their future estimates take into account a longer 'impactful life' (at least from a designated starting point); and iii) on practical grounds, forward-looking reparations ensure larger sums of money to address the enormous burden of the climate crisis more effectively.

OPERATIONALIZING FINANCIAL CLIMATE REPARATIONS

The financial climate reparations estimated in this section are only indicative, although in a rigorous, scientific manner, of the scale of the issue at stake; they by no means aim to challenge the hard numbers that only case-specific investigations can produce, but only to provide an estimate of the magnitude of the climate reparations required of individual fossil fuel companies.

It is also important to note that the funding for climate damages under the UNFCCC Green Climate Fund remains inadequate. The operationalization and the financing of the Loss and Damage fund — the only tangible outcome to date of the 2013 Warsaw International Mechanism (WIM) — was finalized at the COP 27 held in November 2022 in Sharm El Sheikh, Egypt; but the US$ 700 m eventually pledged to the Loss and Damage fund at the COP 28 in Dubai in 2023 covers less than 0.2 per cent of the climate damages developing countries are shouldering every year.

This article envisions reparations owed by the fossil fuel industry as additional and concurrent to the (largely insufficient) UNFCCC climate finance which is centred on states; moreover, such reparations are not intended to be a substitute for climate-related litigation filed in numerous jurisdictions against fossil fuel companies. A study by Grasso and Heede (2023) quantifies, for the first time, forward-looking financial climate reparations owed by major fossil fuel companies. Here I provide a different and more sophisticated quantification of this type of reparation, based on the same general methodological approach and data used by Grasso and Heede; it is also similarly grounded in the companies' violation of the no-harm principle to justify the calculation of disgorgements proportional to their historical emissions, understood as the measure of their contribution to climate harm in terms of damages.

The current exemplificatory exercise relies on an estimate by more than 700 climate economists (see Howard and Sylvan, 2021), who calculated that global economic damages to be expected from the climate crisis between 2025 and 2050 amounted to US$ 99 tn — of which fossil fuel emissions (70.3 per cent of total emissions) contributed US$ 69.6 tn. Based on the polluter pays principle, one third of these future climate damages is here attributed, perhaps conservatively, to the global fossil fuel industry, and one third each to political authorities and consumers. There is no objective basis available so far to disentangle the different proportions of the three groups (Hormio, 2023), and for the sake of simplicity, I propose that producers,

consumers and political authorities have equal one-third shares of responsibility, and thus are attributed an equal quota of climate damages. This means that the fossil fuel industry would contribute US$ 23.2 tn to the climate-related economic damages expected over the 2025–50 period, or US$ 892 bn annually.

To quantify financial climate reparations for the top 21 fossil fuel companies, the PPP is first considered based on the cumulative emissions of the period 1988–2022. Then, the role of this principle is refined and strengthened by considering the 'fair shares' of countries' remaining carbon budgets as indicated by Fanning and Hickel (2023).[9] Accordingly, fossil fuel companies' home countries are divided into three groups based on the amount of their national carbon emissions in relation to the 'just' emissions represented by their fair shares. High requirement (HR) countries are those whose emissions are more than twice as much as their fair share; low requirement (LR) countries have emissions up to twice as much as their fair share; exempted countries have emissions that are less than their fair share. Each of the three groups is then assigned a 'fair share multiplier' to be applied to the countries' fossil fuel companies: for HR countries it is 1, for LR 0.5, and for exempted countries, obviously, 0. This requires, for each country, a calculation of the ratio between its total emissions (fair share plus overshoot difference emissions) and its fair share, obtaining the country's cumulative emissions with respect to its 1.5°C fair shares. This equals 1 when a country emitted exactly its fair share, >1 when the country emitted more than its fair share (HR and LR countries), and <1 when it emitted less (exempted countries). Each fossil fuel company is then associated with its respective country's 'fair share multiplier' to obtain the reparations adjusted for fair share.

In the second step, consideration is given to the countries' average fossil fuel subsidies for the period 2015–21 as quantified by the International Monetary Fund (Parry et al., 2021).[10] The introduction of this variable responds to the ethical logic of the BPP since the companies that this approach penalizes most in terms of reparations are those that benefited most from subsidies. Fossil fuel companies' home countries are divided into three groups, according to whether their subsidies correspond to less than US$ 0.5 per litre relative to the user prices for fossil fuels, more than US$ 0.5/litre, or more than US$ 1/litre. Each of these groups is assigned a 'subsidy multiplier': 1, 1.15 and 1.3 respectively. Admittedly these are subjective values, but consistent with the logic implicit to the BPP. Each fossil fuel company is then associated with its respective country's subsidy multiplier and the

9. In particular I used the dataset that accompanies their article, available at: https://goodlife.leeds.ac.uk/related-research/atmospheric-appropriation/.
10. The data employed can be found here: www.imf.org/en/Topics/climate-change/energy-subsidies#:~:text=Globally%2C%20fossil%20fuel%20subsidies%20are,generally%20larger)%20continues%20to%20climb.

Table 4. Fair Share and Subsidy-rectified Forward-looking Financial Climate Reparations of Top 21 IOCs and SOEs, 2025–50 (billion $)

Companies	Cumulative emissions 1988–2022 ($MtCO_2e$)	Percentage of global emissions	Cumulative reparations 2025–50 (billion $, current)	Average annual reparations 2025–50 (billion $, current)
Saudi Aramco, Saudi Arabia (SOE)	53,714	4.78%	$1,443.6	$55.5
Gazprom, Russia (SOE)	50,492	4.49%	$1,357.0	$52.2
National Iranian Oil Co., Iran (SOE)	29,212	2.60%	$302.0	$11.6
Coal India, India (SOE)	26,208	2.33%	Exempted	Exempted
ExxonMobil, USA (IOC)	23,119	2.06%	$549.6	$21.1
Shell, UK (IOC)	20,487	1.82%	$423.5	$16.3
Pemex, Mexico (SOE)	18,533	1.65%	Exempted	Exempted
BP, UK (IOC)	18,214	1.62%	$376.6	$ 14.5
PetroChina, China (SOE)	18,162	1.62%	Exempted	Exempted
Chevron, USA (IOC)	16,090	1.43%	$382.5	$14.7
ADNOC, United Arab Emirates (SOE)	15,386	1.37%	$365.8	$14.1
Peabody Energy, USA (IOC)	13,777	1.23%	$327.6	$12.6
Petroleos de Venezuela (PDVSA), Venezuela (SOE)	12,898	1.15%	$173.3	$6.7
Sonatrach, Algeria (SOE)	12,070	1.07%	Exempted	Exempted
TotalEnergies, France (IOC)	11,760	1.05%	$139.8	$5.4
Kuwait Petroleum Corp., Kuwait (SOE)	11,733	1.04%	$315.3	$12.1
Rosneft, Russian Federation (SOE)	11,224	1.00%	$301.6	$11.6
Iraq National Oil Co., Iraq (SOE)	10,521	0.94%	Exempted	Exempted
ConocoPhillips, USA (IOC)	10,082	0.90%	$239.7	$9.2
Petrobras, Brazil (SOE)	9,806	0.87%	Exempted	Exempted
BHP Billiton, Australia (IOC)	9,602	0.85%	$198.5	$7,6
Total	*403,092*	*35.9%*	*5,806.3*	*223.3*

Source: 1988–2022 fossil fuel companies' cumulative emissions are taken from the Carbon Majors Database (https://carbonmajors.org/Downloads). Reparations calculated by the author with the support of Andrea Calgaro.

fair share and subsidy multipliers are applied to fossil fuel companies' 1988–2022 cumulative emissions to obtain financial climate reparations. The results are reported in Table 4 where fossil fuel companies — classified as either International Oil Companies (IOCs) or State-owned Enterprises (SOEs) — are listed, starting from the largest cumulative emitters.[11]

11. IOCs are privately owned companies based in Europe and the USA, whose business operations traditionally cover the full fossil fuel cycle worldwide. SOEs, by and large, have a similar structure but they are wholly or largely owned by a state government and they are generally based — apart from some European cases — in non-Western countries, both fossil fuel-rich and not.

The top 21 companies in terms of 1988–2022 cumulative emissions owe US$ 223 bn in annual climate reparations — roughly US$ 6 tn over the period 2025–50 — to compensate for the damages their activities generated. SOEs Saudi Aramco, Gazprom and ADNOC, and IOCs ExxonMobil, Shell and BP should be paying the largest climate reparations. These companies could afford the reparations: for instance, Saudi Aramco, the company with the largest amount of reparations, would owe US$ 56 bn annually — equivalent to just over a quarter of its 2022 profits; ExxonMobil would owe US$ 21 bn in annual reparations, compared with record profits of US$ 56 bn in 2022; European oil giants Shell and BP, which together made US$ 68 bn for shareholders in 2022, would be collectively responsible for US$ 30.8 bn in annual climate reparations.

It is acknowledged that an abrupt dissolution of fossil fuel companies would be the most effective option to prevent future harm; however, this would at the same time deprive victims of climate change of the industry's climate reparations as a form of fair rectification for the damages suffered. This scenario would also jeopardize some of the fossil fuel companies' more vulnerable shareholders, such as pension funds and their individual investors, and would not be functional from the point of view of climate reparations. More generally, the abrupt dissolution of the fossil industry would be a sword of Damocles: given the still huge overall market capitalization of fossil fuel companies, their financial contraction should be carefully managed to avoid the crash of the entire financial system. This is why a gradual transition, whereby the phasing out of fossil fuel operations and products should proceed progressively, is preferable to an abrupt one, which would see an immediate dissolution of fossil fuel related activities and thus of the industry as a whole.

The option of phasing fossil fuels out of operations and products more gradually, in a matter of decades, would certainly be less punitive and more feasible than a comprehensive industry shut-down for the fossil fuel dependent global socio-economic system, including the interests of some countries (especially in the case of SOEs of fossil fuel dependent countries) and other businesses that rely on fossil fuels (such as the chemical or automotive industries). Nevertheless, a 'progressive phasing out' scenario should be strengthened by provisions designed to speed up the companies' exit from fossil fuels — for instance, the industry must not invest in new fossil projects and must aim at minimal absolute emissions and offsets by mid-century — and to impede them from leveraging reparations though their financialization. By the same token, fossil fuel companies should stop paying dividends to their shareholders. As an incentive to early action, companies should be eligible for reduced reparations if they achieve aggressive targets that will diminish production faster than required to achieve net zero by 2050.

CLIMATE REPARATIONS AND THE POLITICAL ECONOMY OF CLIMATE CHANGE

Climate change originates from the same cultural and political history of resource dispossession and over-extraction, among other things, as colonialism, slavery and racial injustice; its explosive development occurred in the same capitalist political economy context, and it poses challenges of similar scale and scope. The legacies of these historical phenomena have meant that many vulnerable communities, especially in the Global South, are particularly exposed and/or more susceptible to the impacts of climate change. However, given the scale of climate impacts and the pervasiveness and depth of the crisis, climate reparations are different from the other forms of reparations associated with colonialism, slavery, etc.: they are not just a 'wealth transfer' but should rather be aimed at promoting a fairer approach to climate change and its policy. In this vein, climate reparations should ideally be considered a historically informed account of global distributive justice that contribute through societal transformations to building a new and fairer future (Táíwò, 2022).

Compelling fossil fuel companies to disgorge climate reparations has major implications for the political economy of climate change. Climate reparations would very likely whip up a storm in the already turbulent worlds of climate policy and politics, given the role that fossil fuel companies' carbon-centric framings, visions and narratives play (Nasiritousi, 2017). At the same time, however, reparations would contribute to freeing the general discourse on climate change from the 'territorial trap' of geographic determinism (Agnew, 1994). In fact, fossil fuel companies' reparations would alter the usual North–South approaches to rectification of climate damages and the related distribution of burdens and benefits, influence the patterns of well-being among agents, and change the flows of significant resources across peoples and generations.

A number of political questions arise. The first relates to the acknowledgment, general perception and self-perception of fossil fuel companies as the business entities primarily responsible for the climate crisis, which are therefore bound to pay climate reparations. Pre-philosophical, commonsense justice would suggest that other industries (such as the petrochemical, automotive, chemical, or transport industries) should also share responsibility for climate change and consequently bear climate reparations, as they did not abandon fossil fuels when the harmfulness of carbon emissions became widely known. But fossil fuel companies have a particular moral responsibility for the climate crisis, as the ethically relevant facts outlined above demonstrate. They have dictated the 'rules of the game' to other industries in terms of the latter's dependency on fossil fuels and the need to organize their business models around them. Reparations could only be assigned to industries which are dependent on supplies from the fossil fuel industry after the 'game-makers' (i.e., fossil fuel companies

themselves) have fulfilled their obligations. Recognition of the fossil fuel industry as a distinct agent with a unique moral responsibility and a consequent duty to bear climate reparations should lead to the emergence of a new social/behavioural norm that delegitimizes their conduct. In the past, the delegitimization of practices and conducts that were once deeply rooted in society (such as slavery, tobacco) started by changing social/behavioural norms.

A second major issue is the challenge that assigning climate reparations to fossil fuel companies would pose to the dominant state-centrism of current climate policy, given that states have been the principal agents of climate change since the beginning of the phenomenon's associated international politics and policy. Within this context, corporate agents' climate accountability typically falls under the jurisdiction of national and international courts; acknowledging the moral responsibility and the duty of reparation of fossil fuel companies would thus set a precedent potentially disruptive to the international status quo. The Global Climate Reparations Fund outlined above would, furthermore, raise issues of distributive and procedural justice, as well as of legitimacy, and pose questions about the nature of participation and the extent of the obligations and rights of private and public corporate agents. Additionally, the imposition of restrictions and conditions on corporations would also challenge the prevailing paradigms about the role and function of the state and of supranational institutions. In fact, there might be resistance to the idea of states and supranational institutions imposing the requirement that some of the world's most powerful global corporations share substantial parts of their wealth for ethical reasons.

A third political/economic challenge refers to the blurred line between private and national interests; companies' ownership structures — whether they are IOCs or SOEs — complicate matters as fossil fuel revenues significantly impact the welfare and development of several natural resource dependent economies, such as the Gulf States, Russia, Venezuela, Algeria and Nigeria. Any attempt to penalize a corporation (typically an SOE) that is the main — and sometimes the only — source of economic growth and tax revenue would inevitably provoke opposition, as it would directly endanger the wealth and growth of these countries.

According to Victor et al. (2012b: 899, Figure 20.3.c), SOEs may have different levels of burdens in terms of the provision of social and public goods (burdens that benefit society at large) and private goods (burdens that benefit narrow groups). For instance, Mexico's Pemex has a high burden in terms of social and public goods (high taxes providing government revenue which is used for broad public purposes) and an upper-middle burden in terms of private goods (patronage to labour unions); Brazil's Petrobras has a lower-middle burden in terms of public and social goods and a low private goods burden. Therefore, the Brazilian SOE, being less constrained and financially limited than Pemex, should in principle be more

forcefully compelled to shoulder climate reparations. Malaysia's Petronas — on the lower end of the scale of burdens with only a lower-middle private goods burden as private banker and political tool for the prime minister — should be expected to react even more swiftly in its payments once society lays the groundwork for the enactment of legal provisions for climate reparations.

Fourth, the chance of success of climate reparations depends critically on the disablement of the industry's fossil-friendly narratives, currently implemented through greenwashing practices, corporate symbolic environmentalism, technological optimism and fossil fuel solutionism (Supran and Oreskes, 2021). To achieve this, a broad societal effort is required to generate, foster and maintain social and behavioural norms, values, principles, perceptions and practices that denaturalize the use of fossil fuels, decarbonize imaginaries (Green, 2018; Jamieson, 2017; Wilson et al., 2017) and encourage the transition to a low-carbon world.

Fifth, climate reparations could increase the effectiveness of climate change policy. The persistent carbon intensity of our socio-economic systems is largely ascribable to the fossil industry's resistance to phasing out fossil fuels (Brulle et al., 2024; Paterson, 2021). Currently, the industry is investing hundreds of billions of dollars in 425 'carbon bombs' — fossil fuel projects planned or in operation that will, over their lifetime, release more than 1 bn tons of carbon dioxide emissions each. If fully exploited, these projects would emit a total of 646 bn tons of CO_2 — twice as much as the global carbon budget that must not be exceeded if we are to keep global warming at +1.5°C (Kühne et al., 2022). To make a sustainable future possible, the fossil fuel industry's resistance must be challenged and eroded (Ford and Newell, 2021; Levy and Newell, 2002) by targeting it directly (Lazarus and van Asselt, 2018; Scott et al., 2022). To this end, it is necessary to complement consumption-side measures of climate policy with supply-side instruments aimed at limiting the production of fossil fuels (Green and Dennis, 2018). Supply-side measures constrain and/or influence the production of fossil fuels whose downstream consumption causes carbon emissions; they have distinctive political and economic advantages over demand-side instruments (Green and Dennis, 2018; Lazarus and van Asselt, 2018; Le Billon and Kristoffersen, 2020). The bottom line is that through climate reparations, fossil fuel companies would become major agents in the much-needed supply-side climate policy.

THE FEASIBILITY OF CLIMATE REPARATIONS

The political feasibility of fosclimate reparations is a thorny issue since they reflect an explicit set of societal expectations and interests that diverge from those of fossil fuel companies, which therefore do not have endogenous

motivations to honour them. This section focuses on two aspects of feasibility.

The Need for Exogenous Action

It is indeed possible, and to a great extent even likely, that in the (near) future, some fossil fuel companies, finding themselves with their backs to the wall, cornered by increasingly confrontational public opinion, might decide to disburse funds to monetarily rectify some climate damages. By the same token, it is possible that these companies' moral responsibility will provide the necessary trigger to hold them legally liable, with courts ordering them to undertake appropriate rectifications for their faulty actions. In fact, the number of lawsuits against fossil fuel companies has skyrocketed worldwide in the last couple of years: on 31 December 2022 there were 2,180, of which 114 in the Global South (Burger and Tigre, 2023). However, unlike other behaviours that should be ethically required of fossil fuel companies, such as the progressive decarbonization of their business, climate reparations do not have any 'side benefits'. This deficiency, coupled with the lack of a mandate and incentives for disbursing funds to rectify the damages suffered by external, unrelated subjects, would almost certainly limit companies' voluntary actions to pay reparations.

Exogenous action therefore seems unavoidable and should be enabled by the emergence of social/behavioural norms that prepare the way for society to accept and acknowledge the future inadmissibility of fossil fuels, as mentioned above. On this fertile terrain, political authorities, at various levels, will feel more empowered and legitimized to introduce the legal provisions necessary to ensure that fossil fuel companies agree to monetarily rectify climate damages. For the legal option to gain momentum and, especially, have a global effect across sovereign states, a declaration or similar arrangement could be conceived and agreed upon by governments and the relevant international governmental and non-governmental organizations; it should outline non-binding principles to formulate how climate reparations owed by fossil fuel companies should be disgorged. An initiative of this sort would, for instance, be in line with the 1998 Washington Conference on Holocaust Era Assets which endorsed a set of principles — known as the Washington Principles on Nazi-Confiscated Art and sometimes referred to as the Washington Declaration — to promote the restitution of art confiscated from the Jewish population in Germany by the Nazi regime before and during World War II, and to help the heirs of Jewish legitimate owners recover Nazi-looted art. Although the duty imposed by the Washington Declaration is not in the form of disgorgement, but rather of restitution, the important point here is the underlying logic of the approach. In other words, fossil fuel companies can be induced to pay climate reparations through a similar concerted international effort, where states and international governmental and

non-governmental organizations agree to the terms for disgorging funds, possibly in concord with the companies themselves.

IOCs and SOEs

A finer-grained analysis of the feasibility of climate reparations should look at the circumstances of fossil fuel companies and take account of the politics, societal context and institutional capacity of their home states and the international situation. To this end, it is useful to distinguish between privately owned IOCs and publicly owned SOEs, since they differ substantially in terms of socio-political context, strategies and objectives, among other things. Currently, SOEs are the largest group of fossil fuel companies in terms of assets, production, revenues and resources; substantively, they differ from IOCs (as noted above) in terms of their engagement in the provision of public services and the promotion of national social welfare, especially through educational programmes, infrastructure development, local procurement, and new private sector business development. SOEs provide capital for the development of the economy and society, ensure national energy security, support national policies, redistribute social wealth, and create employment; IOCs, by and large, are focused on profits.

Nonetheless, IOCs and SOEs' climate reparations share similar feasibility issues since both type of fossil fuel companies face common economic, socio-political and ethical factors. First, despite the enormous revenues and profits of the last few years, the economic outlook of the fossil fuel business might be uncertain. Driven by the very rapid growth in renewable energy, peak oil should occur somewhere between the second half of the 2020s and the end of the 2030s. Even IOCs, which handle the production of complex asset classes at a lower cost, fear that some of their resources will get stranded; SOEs — which have comparatively higher structural costs and show less ability, overall, to leverage innovative field and business technologies — are at great risk of seeing their reserves become worthless. This scenario can be disruptive for global markets, as they become increasingly competitive, and for major fossil fuel producing countries, as they reform and adjust their economies for an age in which they can no longer rely on profuse fossil fuel revenues. In short, it seems that fossil fuel companies will be deeply affected by mounting pressure that targets the supply side of climate policy.

A second group of mostly socio-political factors that threatens the industry relates to its ongoing delegitimization, given the reputational cost deriving from its increasingly acknowledged role in causing and perpetuating the climate crisis. This is currently more worrisome for IOCs, which could even see their social licence to operate called into question, and their financial stability shattered by the various divestment initiatives and by the rapidly increasing number of climate lawsuits; SOEs, at least in the short term, do not seem to face the same risks. However, despite the latter being

somewhat sheltered by protective governments and not exposed to pressure by pugnacious public opinion, it is likely that a rising global tide of social delegitimization will eventually endanger their operations, both at home and abroad. Additionally, general ethical concerns — besides those specifically related to fossil fuel companies' moral responsibility for climate change — are becoming crucial. To promote the feasibility of climate reparations, ethical considerations should be applied that will protect more vulnerable peoples, groups and communities, including future generations, from climate impacts, and encourage the larger transformative process needed to achieve a fair, low-carbon society (Patterson et al., 2018).

It can be assumed that the feasibility of climate reparations for IOCs and SOEs is strongly influenced by economic, socio-political and ethical factors of this nature. Four broad determinants for the feasibility of climate reparations that include these factors can be identified. The first is the societal context of the country in which the company is headquartered, in other words, the social, cultural and ethical issues that condemn, obstruct and/or halt the use of fossil fuels. These might include, for instance, the emergence of anti-fossil fuel norms, or even the establishment of a fossil fuel non-proliferation treaty (Newell and Simms, 2020), the existence of a coalition that supports renewables, the presence of counter-hegemonic forces (MacNeil and Paterson, 2020), an adequate awareness of the role of the fossil fuel industry in climate change, and so on. The more numerous these threads within the social fabric, the more likely action for establishing climate reparations becomes.

Since climate reparations require an active role for political authorities, a second determinant is the institutional strength of the home country: the stronger the institutional context, the greater the likelihood that a fossil fuel company will satisfy climate reparations. The third determinant refers to the economic and political situation of the home country of the company: the richer and the less dependent on fossil fuel revenues it is, the less vital the fossil company's contribution to government expenditure will be, and the greater its chances to meet its reparations more freely. Related to this is the scope of autonomy and the mandate that governments give to SOEs, which tend to be more limited in authoritarian countries (Victor et al., 2012a).

The fourth determinant relates to whether the company is market-seeking or resource-seeking. It is easier for market-seeking companies to shoulder climate reparations since they have a valuable asset with which to meet such financial obligations (at least in the short to medium term, before their resources risk getting stranded). Resource availability typically involves technological and infrastructure lock-in — that is, the tendency of carbon-intensive systems to persist over time, despite the possibility of valid, less carbon-intensive alternatives — given the long life of and investments already made in fossil fuel technologies and infrastructures (Unruh, 2000).

A useful interpretation emerging from these considerations juxtaposes IOCs and SOEs with regard to the feasibility of climate reparations. IOCs have a greater likelihood of fulfilling climate reparations as their internal political, social, cultural and economic circumstances are more favourable to compliance with the requirements. Only the fourth point, related to the domestic availability of fossil fuels, indicates a different pattern: by and large, Western IOCs are resource-seekers, or have fewer reserves than market-seeking SOEs, meaning they would be less able to rely on their fossil fuel resources to honour their reparations. By contrast, SOEs' resource availability should facilitate the execution of their reparations.

All in all, it seems safe to claim that climate reparations in the immediate future should be a more stringent avenue of supply-side climate policy for targeting IOCs. Only after reparations have been fulfilled by investor-owned companies from the richer world should they be extended to SOEs and to non-Western countries. In the latter regions, the introduction of climate reparations should be coupled with, and supported by, the development of social, cultural, political and ethical policies that are able to forge a more favourable context, as discussed above. Finally, it is worth recalling that, despite these stylized interpretations, the feasibility of fossil fuel companies' climate reparations in light of the determinants indicated must be examined case by case.

CONCLUSION

Broadening the perspective of climate policy and politics from states to fossil fuel companies opens up new possibilities for these companies to become part of the solution rather than, at best, being passive bystanders that continue to profit from unremitting climate disruption, or, at worst, actively obstructing any steps taken to remediate the situation in order to safeguard their profits. At the same time, the social condemnation of fossil fuels and the prospect of escaping the current carbon lock-ins are greatly advanced if fossil fuel companies are recognized as primary agents in climate change with a specific moral responsibility that substantiates their climate reparations.

This article established a responsibility-based justification for fossil fuel companies' climate reparations, analysed their foundational elements, and proposed a Global Climate Reparations Fund to manage them. It then put forward a typology of climate reparations, investigated their operational aspects, calculated financial reparations for the top 21 oil, gas and coal behemoths for the period 2025–50 and, finally, focused on the political economy and feasibility of reparations. The arguments developed in this article aim to help establish the inadequacy of the dominant socio-economic practices of the fossil fuel industry within a trajectory of moral progress for

humanity (Jamieson, 2017). The recognition of the ethical unacceptability of these companies' business-as-usual activities could lead to the delegitimization of their current fossil fuel centred behaviour, as has happened for other practices once deeply ingrained and apparently unchallengeable on economic grounds, such as slavery (Finnemore and Sikkink, 1998), and has direct relevance for global climate politics and policy.

This lays the groundwork for a reasoned dialogue within and between civil society and political representatives of different backgrounds on the responsibility of fossil fuel companies in the climate crisis and on their role in rectifying climate damages through reparations. In this vein climate reparations can help close the gap and ease the contrast between 'the rich' and 'the poor' worlds, which still hinders climate action. They would also promote a fairer distribution of the burden of addressing climate change among the various responsible agents, while at the same time providing necessary funding to promote sustainability transitions, fund adaptation, and compensate subjects more vulnerable to climate damages such as climate migrants and refugees, indigenous peoples, racial and ethnic minority communities, people with disabilities, and people who are socially and economically disadvantaged.

REFERENCES

Agnew, J. (1994) 'The Territorial Trap: The Geographical Assumptions of International Relations Theory', *Review of International Political Economy* 1(1): 53–80.

Brulle, R., J.T. Roberts and M. Spencer (eds) (2024) *Climate Obstruction across Europe*. Oxford: Oxford University Press.

Burger M. and M.A. Tigre (2023) 'Global Climate Litigation Report: 2023 Status Review'. Nairobi: United Nations Environment Programme in association with Sabin Center for Climate Change Law, Columbia Law School. https://www.unep.org/resources/report/global-climate-litigation-report-2023-status-review (accessed 15 May 2024).

Fanning, A.L. and J. Hickel (2023) 'Compensation for Atmospheric Appropriation', *Nature Sustainability* 6: 1077–186.

Finnemore, M. and K. Sikkink (1998) 'International Norm Dynamics and Political Change', *International Organization* 52(4): 887–917.

Ford, A. and P. Newell (2021) 'Regime Resistance and Accommodation: Toward a Neo-Gramscian Perspective on Energy Transitions', *Energy Research & Social Science* 79: 102163.

Fraser, N. (1995) 'From Redistribution to Recognition: Dilemmas of Justice in a "Post-Socialist" Age', *New Left Review* 212: 68–73.

Goodin, R.E. (2013) 'Disgorging the Fruits of Historical Wrongdoing', *American Political Science Review* 107(3): 478–91.

Grasso, M. (2020) 'Towards a Broader Climate Ethics: Confronting the Oil Industry with Morally Relevant Facts', *Energy Research & Social Science* 62: 101383.

Grasso, M. (2022) *From Big Oil to Big Green. Holding the Oil Industry to Account for the Climate Crisis*. Cambridge, MA: MIT Press.

Grasso, M. and R. Heede (2023) 'Time to Pay the Piper: Fossil Fuel Companies' Reparations for Climate Damages', *One Earth* 6(5): 459–63.

Green, F. (2018) 'Anti-fossil Fuel Norms', *Climatic Change* 150: 103–16.

Green, F. and E. Brandstedt (2021) 'Engaged Climate Ethics', *The Journal of Political Philosophy* 29(4): 539–63.
Green, F. and R. Dennis (2018) 'Cutting with Both Arms of the Scissors: The Economic and Political Case for Restrictive Supply-side Climate Policies', *Climatic Change* 150: 73–87.
Heede, R. (2014) 'Tracing Anthropogenic Carbon Dioxide and Methane Emissions to Fossil Fuel and Cement Producers, 1854–2010', *Climatic Change* 122: 229–41.
Hormio, S. (2023) 'Collective Responsibility for Climate Change', *Wiley Interdisciplinary Reviews: Climate Change* 14(4): e830.
Howard, P. and D. Sylvan (2021) '*Gauging Economic Consensus on Climate Change*'. New York: Institute for Policy Integrity, New York University School of Law. https://policyintegrity.org/files/publications/Economic_Consensus_on_Climate.pdf (accessed 15 May 2024).
Jamieson, D. (2015) 'Responsibility and Climate Change', *Global Justice: Theory Practice Rhetoric* 8(2): 23–42.
Jamieson, D. (2017) 'Slavery, Carbon, and Moral Progress', *Ethical Theory and Moral Practice* 20(1): 169–83.
Kornek, U., C. Kardish, C. Flachsland, S. Levi and O. Edenhofer (2020) 'What Is Important for Achieving 2°C? UNFCCC and IPCC Expert Perceptions on Obstacles and Response Options for Climate Change Mitigation', *Environmental Research Letters* 15(2): 024005.
Kühne, K., N. Bartsch, R.D. Tate, J. Higson and A. Habet (2022) 'Carbon Bombs: Mapping Key Fossil Fuel Projects', *Energy Policy* 66: 112950.
Lazarus, M. and H. van Asselt (2018) 'Fossil Fuel Supply and Climate Policy: Exploring the Road Less Taken', *Climatic Change* 150: 1–13.
Le Billon, P. and B. Kristoffersen (2020) 'Just Cuts for Fossil Fuels? Supply-side Carbon Constraints and Energy Transition', *Environment and Planning A* 52(6): 1072–92.
Lenton, T.M. et al. (2023) 'Quantifying the Human Cost of Global Warming', *Nature Sustainability* 6: 1237–47.
Levy, D.L. and P. Newell (2002) 'Business Strategy and International Environmental Governance: Toward a Neo-Gramscian Synthesis', *Global Environmental Politics* 2(4): 84–101.
MacNeil, R. and M. Paterson (2020) 'Trump, Climate Politics, and the Evolving Pattern of Global Climate Governance', *Global Change, Peace & Security* 32(1): 1–18.
Malm, A. (2016) *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming*. London and New York: Verso Books.
Millock, K. (2015) 'Migration and Environment', *Annual Review of Environment and Resources* 7(1): 35–60.
Mitchell, T. (2011) *Carbon Democracy: Political Power in the Age of Oil*. London: Verso.
Nasiritousi, N. (2017) 'Fossil Fuel Emitters and Climate Change: Unpacking the Governance Activities of Large Oil and Gas Companies', *Environmental Politics* 26(4): 621–47.
Newell, P. and A. Simms (2020) 'Towards a Fossil Fuel Non-proliferation Treaty', *Climate Policy* 20(8): 1043–54.
Newell, P., S. Srivastava, L.O. Naess, G.A. Torres Contreras and R. Price (2021) 'Toward Transformative Climate Justice: An Emerging Research Agenda', *Wiley Interdisciplinary Reviews: Climate Change* 12(6): e733.
Nolt, J. (2015) 'Casualties as a Moral Measure of Climate Change', *Climatic Change* 130: 347–58.
Paavola, J. and W.N. Adger (2006) 'Fair Adaptation to Climate Change', *Ecological Economics* 56(4): 594–609.
Parry, I., S. Black and N. Vernon (2021) 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies'. IMF Working Paper No. WP/21/236. Washington, DC: International Monetary Fund.
Paterson, M. (2021) 'The End of the Fossil Fuel Age? Discourse Politics and Climate Change Political Economy', *New Political Economy* 26: 923–36.

Patterson, J.J. et al. (2018) 'Political Feasibility of 1.5°C Societal Transformations: The Role of Social Justice', *Current Opinion in Environmental Sustainability* 31: 1–9.
Pearce, J.M. and R. Parncutt (2023) 'Quantifying Global Greenhouse Gas Emissions in Human Deaths to Guide Energy Policy', *Energies* 16(16): 6074.
Regan, T. (2004) *A Case for Animal Rights* (rev edn). Berkeley, CA: University of California Press.
Rotberg, R.I. and D. Thompson (eds) (2000) *Truth v. Justice: The Morality of Truth Commissions*. Princeton, NJ: Princeton University Press.
Scott, K., C.J. Smith, J.A. Lowe and L. Garcia-Carreras (2022) 'Demand vs. Supply-side Approaches to Mitigation: What Final Energy Demand Assumptions Are Made to Meet 1.5 and 2°C Targets?', *Global Environmental Change* 72: 102448.
Shue, H. (2011) 'Human Rights, Climate Change, and the Trillionth Ton', in D.G. Arnold (ed.) *The Ethics of Global Climate Change*, pp. 292–314. Cambridge: Cambridge University Press.
Shue, H. (2017) 'Responsible for What? Carbon Producer CO_2 Contributions and the Energy Transition', *Climatic Change* 144: 591–96.
Supran, G. and N. Oreskes (2021) 'Rhetoric and Frame Analysis of ExxonMobil's Climate Change Communications', *One Earth* 4: 696–719.
Táíwò, O.O. (2022) *Reconsidering Reparations*. Oxford: Oxford University Press.
Unruh, G.C. (2000) 'Understanding Carbon Lock-in', *Energy Policy* 28(12): 817–30.
Vanderheiden, S. (2011) 'Globalizing Responsibility for Climate Change', *Ethics & International Affairs* 25(1): 65–84.
Victor, D.G., D.H. Hults and M.C. Thurber (2012a) 'Introduction and Overview', in D.G. Victor, D.H. Hults and M.C. Thurber (eds) *Oil and Governance*, pp. 3–32. Cambridge: Cambridge University Press.
Victor, D.G., D.H. Hults and M.C. Thurber (2012b) 'Major Conclusions and Implications for the Future of the Oil Industry', in D.G. Victor, D.H. Hults and M.C. Thurber (eds) *Oil and Governance*, pp. 887–928. Cambridge: Cambridge University Press.
Watts, M.J. (2005) 'Righteous Oil? Human Rights, the Oil Complex, and Corporate Social Responsibility', *Annual Review of Environment and Resources* 30: 373–407.
Wilson, S., I. Szeman and A. Carlson (2017) 'On Petrocultures: Or, Why We Need to Understand Oil to Understand Everything Else', in S. Wilson, A. Carlson and I. Szeman (eds) *Petrocultures: Oil, Politics, Culture*, pp. 3–19. Montreal and London: McGill-Queen's University Press.
World Resources Institute & World Business Council for Sustainable Development (2013) 'Greenhouse Gas Protocol. Technical Guidance for Calculating Scope 3 Emissions. Supplement to the Corporate Value Chain (Scope 3) Accounting & Reporting Standard'. Washington, DC: World Resources Institute & World Business Council for Sustainable Development. https://ghgprotocol.org/sites/default/files/2023-03/Scope3_Calculation_Guidance_0%5B1%5D.pdf (accessed 15 May 2024).

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