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FOREWORD



Climate change is the single biggest challenge our global civilisation has ever had to face up to. On any business-as-usual scenario, it is now clear to all that it is highly unlikely that humanity will survive in its present form beyond the coming few generations. The great, late Columbia University climate scientist Wally Broecker often said: "The climate system is an angry beast—and we are poking it with sticks". He pointed out in 2008 that the earth's climate was strongly dependent of the behaviour of ice at the poles. Today we know that the Arctic Circle has lost a significant portion of its summer sea ice. It is now heating up at four times the rate of the average for the whole planet and has reached 3°C above the pre-industrial average temperature. This is already causing extreme weather events around the world, with hundreds of billions of dollars' worth of loss and damage. And in the pipeline are very high sea level and temperature rises. Humanity must not wait to take all appropriate actions to deal with these challenges and create the conditions for a manageable future for us and the earth's ecosystems on which we depend.

I am therefore delighted to be asked to write this Foreword to celebrate the first publication of the Cambridge Journal of Climate Research (CJCR), which is a new initiative by the Cambridge Climate Society. I strongly applaud this important initiative.

The research presented in this journal not only illuminates the complicated mechanisms driving climate change but also offers important insights into how we can reduce the impact by changing our mode of living to one that prioritises sustainability, a circular economy with no waste, elevating kinship with nature and communal well-being. We must also adapt and build resilience in the face of these challenges. One of the journal's key strengths is its interdisciplinary approach, which brings together expertise from a broad range of disciplines to provide a comprehensive understanding of climate change and its impacts on biodiversity and society. By promoting collaboration among researchers from different fields, we are better equipped to tackle the multifaceted nature of climate change and develop innovative solutions to protect our planet and its rich diversity of life.

I commend the researchers whose work is featured in this first volume of the journal for their devotion and commitment to advancing climate research. Their insights and discoveries will undoubtedly contribute to our collective efforts to address climate change and safeguard the future of our planet for generations to come. I hope that this will inspire further collaboration and research that will pave the way for a sustainable and resilient future.

Professor Sir David King FRS FRSC FInstP HonFREng.

PRESIDENTS' LETTER





Educating and empowering people about climate change and climate justice has always been a central tenet of our mission at the Cambridge Climate Society. As this academic year began, we sought to identify how we can expand our impact on the research and academic life of Cambridge. This is where the CCS Research Team, and consequently the Cambridge Journal of Climate Research, was born.

A core tenet of the CCS Research Team, and this journal's development, is a desire to break down silos in climate research. We believe that interdisciplinarity is key to addressing an issue as broad and intersectional as the climate crisis. Cambridge is an environment with incredible, dynamic research and we hope to encourage collaboration and communication across disciplines to build connections and strengthen the impact of climate research.

Research is central to both understanding the climate crisis, and identifying solutions to deliver the just transition. This crisis is an issue involving all sections of society, and which will require innovative and creative thinking to challenge the current systems in which we operate. In an era of misinformation and fossil fuel lobbying in core international climate spaces, it is more important than ever to have reliable, meaningful and accurate information about the climate crisis to inform policy and societal changes.

The research in this journal covers a range of topics and disciplines, highlighting the breadth and scope of the climate crisis' impact on every sector in society. However, this also illustrates the potential of every sector and discipline to contribute towards achieving climate justice. Topics explored include the role of the Global North and the importance of non-Western perspectives in climate action, analysis of law and policy, the links between conflict and climate, what's being done in Cambridge, and proposals of concrete solutions. We hope to highlight the range of work done by students in Cambridge, and that readers will draw connections between the fields explored in this journal.

Ultimately, we hope to encourage collaborative work between disciplines, and to stimulate applications of this research. This journal highlights solutions, areas of concern, and areas in which to have hope. It is also crucial to increase the visibility of climate research and justice in academia, and to encourage student and youth involvement in research.

The window of time in which it is possible to halt the effects of the climate crisis, already materialising today, is quickly narrowing. While this should rightly cause concern, it is also true that many of the solutions which we need are already in existence, or are being developed. The future of climate research is the future of our planet itself, and as students and young academics enter the world, it is crucial that every field contributes to the just transition needed to mitigate this crisis, and support communities already impacted by the devastating effects of it. The just transition requires us to challenge our existing systems, reimagine how our world works, and research and develop the paths to get us there. We hope that this journal, and its subsequent editions, can play some role in that journey.

We would like to extend our sincere gratitude to the research team: Chibuzor, Kilian, Liniet, Maja and Kaden, for leading this journal and all of CCS' research initiatives this year. Our thanks also go to the Diamond Team, Peter and Agustina, for all of their support. This journal also would not have been possible without all of the contributors, and everyone who has engaged with CCS this year. Finally, we are incredibly grateful to Sir David King for his foreword to this journal and continued support of CCS.

Aman Vernekar, President, Cambridge Climate Society.
Beth Doherty, Vice-President, Cambridge Climate Society.

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INSIGHTS

In the climate research space, not all subjects are best served by a lengthy, technical disquisition. In many cases, shorter, summative pieces suffice. Our **Insights** lightly probe a compelling, often under-researched topic, and captivate the reader with their brevity and incisive reasoning.

To begin with, in an opinion-style piece, **Harveer Hallaith** muses upon the value of indigenous or non-Western perspectives and ethe in climate research. The prominence of the Western method in this space, it is argued, is detrimental to outcomes. **Anna Belinski, Vedika Mandapati** and **Beth Doherty** summarise the existing (lack of) legal protections for the Arctic and advocate for a moratorium to strengthen international norms of stewardship. **Elsie McDowell** writes a policy report on free bus travel for young Londoners, and positively evaluates its generative and socio-spatial consequences. Finally, **Mariella Hartley** introduces us to trophic rewilding and remarks upon its utility as climate policy.

Why the Future Lies in Non-Western Perspectives

Harveer Hallaith*

"What does it mean to have a reciprocal discourse on catastrophic end times and apocalyptic environmental change in a place where, over the last 500 years, Indigenous peoples faced (and face) the end of the worlds with the violent incursion of colonial ideologies and actions? What does it mean to hold, in simultaneous tension, stories of the Anthropocene in the past, present, and future?"[1]

The Elusiveness of Representation.

Nowadays, we are inundated by calls for justice and representation. An endless barrage of platitudes and buzzwords overwhelm us; diversity, inclusion, equity, equality, visibility. While this shift is welcome, it is pointless if it lacks substance. Problematically, this dominant discourse clouds our thinking. It yields an illusory spectacle where it seems that everything possible is being done. If it's spoken about so much then surely change is happening? Appearing progressive is easy and fashionable, but real change is hard, unpopular and to the detriment of the global elite. Those with disproportionate power often do not really want to undermine the status quo that benefits them. Indigenous Dene scholar Glen Coulthard would term this the 'colonial politics of recognition'. More than ever, the need for non-Western perspectives is stressed and acknowledged, and yet exploitation continues. Alternate voices are recognised but on the terms of the west, through their frameworks and understandings, thereby merely rearticulating unequal, exploitative coloniser-colonised relations. For example, Canada often proclaims to acknowledge its problematic relationship with indigenous peoples through systems like the Truth and Reconciliation Commission, which aimed to address the legacy of residential schools. However, it similarly continues to approve projects like the Coastal GasLink Pipeline on the Wet'suwet'en peoples' land without informing them. This piece reiterates the longstanding call for less performance and more action.

The Future Lies in the Past.

We irrefutably live in an era of climate apartheid, a tragic state of affairs where those least to blame have the most to lose. They will disproportionately bear the burden through no fault of their own. Movements to 'decolonise' and embrace alternatives are not metaphors, abstract discussions, or weak progressive calls for equality. This is fundamentally about life and death: who lives and who dies. The West is responsible, and thus has an ethical imperative to provide active redress. Moreover, this era requires more than finding solutions, developing new technologies, or agreeing on net zero plans; it demands a transformation of our underlying thinking. Climate change is a global issue, but it is often narrated by the West: one story is told, and so the western story becomes 'universal'. However, the world is a diverse tapestry reflecting all kinds of people and places that experience climate change differently. There *is* no single, 'universal' story. Rather, we must search for and highlight the stories of those who have been silenced. We must listen with empathy, compassion, and care. As Todd highlights, for many indigenous and non-Western peoples, this is not an unprecedented crisis, but merely an intensified repetition, another episode in the ongoing apocalypse that began with western colonialism. Therefore, we must open up the difficult histories that the Western narrative attempts to relegate to the past to protect its self-generated image as the harbinger of peace, defender of human rights and leader of the world. It may seem counter-intuitive to advocate for long-term action, but short-termism may be utilised to entrench unequal, exploitative relations, and will not address the underlying logics that have led to our current

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[1] Todd, Zoe. "Relationships." Theorizing the Contemporary, *Fieldsights*, Jan. 2016, p. 1.

predicament. Overall, to think with those who have already, and will continue to be, impacted the most is where real transformative change will emerge from. To quote Audre Lorde: "the master's tools will never dismantle the master's house".[2]

Academic, Institutional Limits.

My own background, geography, is often heralded as ostensibly progressive. However, despite the posturing it may present, my exposure to indigenous, de-colonial frameworks was minimal, with occasional and sparse engagements reflecting more of a tick box exercise rather than aiming to centre and truly understand the perspectives of others. I was left to uncover them for myself, rather than being explicitly taught. It often felt like I was uncovering histories, theories, knowledges that were hidden away. When we did explore them, it was primarily by white staff, to white students. As one of the few people of colour in the room, it was an isolating experience. After spending a year studying in Vancouver, Canada at the University of British Columbia, the comparative ethe were shocking. While it was not perfect, there was an overt focus put on engaging with others. Land acknowledgements were made at the start of lectures; I was taught by scholars of colour and / or of indigenous descent; reading lists embraced diverse thinkers. In a revelatory paper Todd, an indigenous Metis scholar, describes her experiences in the British Academy, terming it a "white public space" that has a "continued, collective reticence to address its own racist and colonial roots, and debt to Indigenous thinkers in a meaningful and structural way".[3] If our knowledge communities are structured this way, then how can we expect their research, solutions and ideas to fully attend to the diversity of the world's geographies? We must understand peoples on their own terms, in their own ways, rather than half-heartedly engaging and imposing our Western interpretive systems onto them.

Conclusion.

In Britain, we are detached from many horrifying spells of our history, and the peoples we exploited are often forgotten, silenced, and thus erased. However, they have not forgotten us. They still live with its legacies, while we continue to have lives of immense privilege. This is not a simplistic story of the West versus the rest. It is a wider call to acknowledge these histories and try to repair our relationships with other humans, as well as nature and more-than-humans in the process. I find Dwayne Donald's notion of ethical relationality poignant here. Donald urges us to meaningfully engage with each other; not to deny our differences, but to understand how we are differently positioned in relation to one another. He envisages humans as inter-connected, "rooted in reciprocal, ongoing, and dynamic relationships" with each other and nature, from which truly radical, alternative, ethical sustainable futures can be built.[4] Despite the horrors experienced by indigenous and colonised peoples, they are still here, persisting, insisting, and resisting in their post-apocalypse. Perhaps it's time to learn from them as we now face the end of our worlds.

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[2] Lorde, Audre. *Sister Outsider: Essays and Speeches*. Penguin Books, 1984, at p. 112.

[3] Todd, Zoe. "An Indigenous Feminist's Take on the Ontological Turn: 'Ontology' Is Just Another Word for Colonialism." *Journal of Historical Sociology*, vol. 29, no. 1, Mar. 2016, pp. 4-22, at 10.

[4] Donald, Dwayne Trevor. "Forts, Curriculum, and Indigenous Métissage: Imagining Decolonization of Aboriginal-Canadian Relations in Educational Contexts." *First Nations Perspectives*, 2009, pp. 1-24, at 6.

How Can the Law Protect the Arctic?

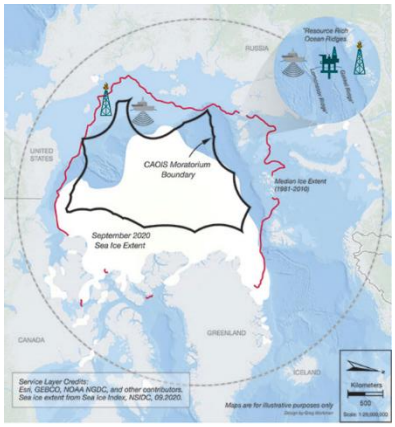
Anna Belinski,* Vedika Mandapati** and Beth Doherty***

The Central Arctic Ocean (CAO), and more specifically the Central Arctic Ocean Ice Shield (CAOIS), is a unique region of our globe ecologically, geospatially, culturally, and politically. Its integral role in regulating the global climatic system and particular vulnerability to global warming make it a canary in the coalmine to our planet's changing climate. In recognition of this, Global Choices is leading the movement to preserve this essential region by way of a precautionary pause on all exploitative activities in the CAO, as achieved through a legally binding international Moratorium.

Why is the Arctic Important?

The CAO refers to the international waters outside of the Exclusive Economic Zone boundaries of the five Arctic coastal states (Canada, United States of America, Denmark, Norway, and Russia), north of latitude 62°. This area is beyond the national jurisdiction of any state and is therefore the common heritage of humankind, mandating a collective responsibility to protect and preserve it. The CAO is home to over 21,000 species of flora and fauna, containing some of the most diverse fisheries in the world.

Though immeasurably valuable in its own right, the impact of the CAO goes far beyond its boundaries as this ecosystem functions to stabilise the entire global climate system. The CAOIS is part of the global cryosphere[1] that influences the Gulf Stream currents, Jet Stream, and global sea levels. The Arctic region is experiencing warming at a speed four times that of the global average and the Greenland ice and Antarctic ice sheets are melting much faster than anticipated. Freshwater is less dense than salt water, so as ice melts and causes an increase in freshwater in the ocean it impedes ocean current movements. This disruption will be a particular issue for the Gulf Stream that carries warm water up the eastern coast of North America and on to Western Europe, regulating global weather patterns as it moves. In tandem, the atmospheric Jet Stream, which is responsible for ensuring cool air stays in the Arctic, will destabilise as Arctic air warms. Such a change will allow cold air in the polar vortex to suddenly move south. This has far-reaching consequences for the entire global system, as the Arctic sea-ice is one of nine active climate tipping points on Earth. The loss of the Arctic is likely to trigger a cascading effect and changes in other climate systems.



Since 1979 the Arctic has lost 7.6 trillion tons of sea-ice, and scientists expect ice-free summers by 2050. The melting of the CAOIS also contributes to global sea level rise (SLR) as part of a vicious feedback cycle. Through the albedo effect, Arctic ice reflects sunlight back into the atmosphere. As reflective Arctic ice melts it causes less sunlight to be reflected back into the atmosphere and instead gets absorbed into a warming ocean. Thermal expansion resulting

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[1] The cryosphere refers to the regions of the globe where water freezes into snow or ice. It includes sea ice, glaciers, permafrost, and more.

from this also adds to SLR. Crucially, those most affected by the lack of action on Arctic global commons governance will be those communities that have least contributed to climate change. Under the current high emissions scenario, GMSL (Global Mean Sea Level Rise) is likely to exceed the upper bounds of nearly 1m by 2100 as estimated in the 6th Assessment Report of the IPCC. This is causing states like Tuvalu and the Maldives to have to take drastic measures for survival and raises questions like the legal status of a nation underwater. Other states, like Singapore, must spend billions of dollars to mitigate the inundation of sea water into freshwater systems – a problem that will soon be shared by all coastal nations and cities.

How is the Arctic Currently Protected?

Despite the knowledge that the Arctic is crucial to balancing the global climate and avoiding tragic SLR, the region is devoid of recognition in international treaties and agreements regulating the high seas and managing the global climate. The United Nations Convention on the Law of the Sea (UNCLOS), though governing the marine ecosystem for our planet in areas beyond national jurisdiction, makes no mention of the Arctic. Even the recent 2023 Agreement under the UNCLOS on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (the BBNJ) does not mention the Arctic in any form. Additionally, the UNFCCC Paris Agreement, the Convention on Biological Diversity, and the Kunming-Montreal Global Biodiversity Framework all similarly neglect to mention the Arctic. The primary mitigation measure for climate change, therefore, remains cutting emissions and keeping under 1.5 degrees of average global warming, but alongside that we need to protect what we can, while we can, of the critical ice.

Alongside this lack of meaningful recognition, countries and corporations are seeking to take advantage of the melting ice. Previously entombed in ice, the CAO has been historically spared from extensive natural resource exploitation. However, as the globe warms and ice begins to melt, State actors are seeking opportunities to exploit the Arctic's minerals and hydrocarbons, and are exploring the possibility of shipping routes and of expansion of industrial activity. In the past few years Russia, Canada, Denmark, and the United States have all submitted requests to extend their continental shelves[2] in a bid to extend their sovereignty over the sea floor in the CAO, increasing their potential access to minerals and other natural resources. Canada, Poland, and South Korea have increased icebreaker construction.[3] Norway voted to begin deep sea mining within their Exclusive Economic Zone[4] which can have destructive impacts on ecosystems. Transpolar shipping routes, which would threaten the already delicate ecosystem, are becoming more enticing as tensions continue to rise among Arctic states due in part to the Russian invasion of Ukraine. These are simply a few examples of the increased activity and interest in the CAO that are threatening the stability of this critical ecosystem. Despite the clear scientific evidence that the loss of the Arctic would be devastating for local and global climate, social, food and economic security, leaders are responding to this crisis by advocating for short-term economic gains.

The Moratorium.

It is in situations like these that civil society work becomes crucial in not only highlighting but resolving unaddressed challenges. This is why Global Choices is researching and advocating for a Moratorium—a ten-year pause on industrial activity in the Central Arctic Ocean. This call focuses on preserving our

[2] States have exclusive control over the exploration and exploitation of natural resources within their continental shelf limits. Extending its continental shelf will give a State more underwater area to explore and exploit.

[3] Icebreaker ships are special-purpose ships designed to navigate through ice-covered waters by breaking through ice sheets.

[4] States have exclusive control over their Exclusive Economic Zones, which extend 200 nautical miles off a State's coast.

existing resources rather than waiting to react to their loss retroactively.

The Moratorium has undergone extensive legal research and consultation with experts across several disciplines. This work must continue to gain traction, as strategic political interest in the CAO has never been higher. We are at a moment in time in which the Arctic can be preserved, and our global ecosystem protected from disaster. The lack of authority over the CAO, inherent to its position as an area beyond national jurisdiction (also referred to as a High Sea), paired with the rapidly melting CAOIS and tensions among key states, have put this region in a particularly vulnerable position.

Primary commercial interests in the CAO are for its rich natural resources and strategic location for shipping routes. A precautionary pause on exploitative activity in the CAO can therefore help contain the impacts of global warming and curtail the negative impacts that will come from increased human commercial activity in the region. Global Choices' proposed ten-year Moratorium on the High Seas portion of the CAO (the section not belonging to any one country) would pause oil and gas exploration, seismic surveys,[5] nuclear testing, radioactive waste dumping, deep seabed mining,[6] restrict commercial tourism and fishing as well as transpolar shipping for a decade. The Moratorium would contain an exception for scientific research. These ten years will be essential in allowing science to discover more about the region and for anthropogenic emissions to reduce at a global level while almost eliminating them at a local level in the CAO High Seas. This will also prevent damaging activities such as shipping or mining before they start or expand, minimising the threat to the ice and delicate ecosystem.

The Arctic ice cannot be recovered once it is gone, and its ecosystem is one of the most delicate in the world. When Arctic ice is broken by a ship or other industrial activity, it loses its thickness and can consequently melt even faster. Therefore, as ice-free summers become more likely, it is crucial that we take a common-sense approach and prevent industrial activity that would allow short-term gain, at the long-term expense of one of the most crucial aspects of the Earth's system. In the words of Global Choices, "we cannot plant ice".

The proposed moratorium would also build on states' existing legal obligations under the UNCLOS and multiple related agreements such as the Polar Code, Seabed Arms Control Agreement, and the Kunming-Montreal Global Biodiversity Framework. States are legally bound by the UNCLOS to protect and preserve the marine environment beyond national jurisdiction. This obligation can be applied in a unique manner through a pre-emptive Moratorium—taking a proactive approach to minimise extensive damage before it happens rather than reacting to harmful activity after its negative impacts have been consolidated.

To achieve this change, Global Choices' founders have invested significantly not only in legal and scientific research, but also in building a strong global advocacy network of women that centres youth voices and uplifts activists. This global reach is crucial to articulate the interconnectedness with which we must approach all climate change issues—each ecosystem impacts the next, and it is young people from marginalised communities that will bear the brunt of global inaction.[7]

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[5] Seismic surveys are projections of intense sound pulses that enable researchers to collect data on the ocean floor topography. The length and intensity of these seismic surveys can disrupt local marine species in their habitats.

[6] Due to the rising need for metals used in technologies like smartphones, wind turbines, and solar panels, States and companies are looking to obtain these metals via deep sea mining. However, we currently lack the knowledge to do this safely without destroying essential marine ecosystems.

[7] Global Choices is an international environmental advocacy organisation committed to science-based policy and mobilising intergenerational action for a multi-sector global response to the ice crisis.

Why London's Free Bus Travel for Under-18s Represents the Best of Climate Policy

Elsie McDowell*

Introduction.

Since 2005, people under the age of 18 in London have been able to access free bus and tram travel through the use of a Zipcard. Purchased for a small fee, it is a card that functions similarly to an adult Oyster card. This report will look at the impact that this policy has had on London since then. The impact is not only in terms of the increase in bus usage, but also in terms of creating the next generation of public transport users in the wider context of London's Ultra Low Emission Zones (ULEZ) reforms, and the socio-spatial inequalities this free bus travel alleviates. On assessing the literature about this free travel scheme, I have found little research that is directly assessing the direct impact of free bus travel for under-18s; hence, it is not only useful to evaluate this policy, but it also removes an important lacuna.

Background to the Policy.

Free bus and tram travel for all under-18s who live in London was introduced by Ken Livingstone as London Mayor in 2005. Since then, all 11–18-year-olds have also been able to access reduced fares on the London Overground and London Underground. As this policy is specifically targeted at travel to and from school, the free bus travel and discounted tube-train travel continues until the end of the school year during which a young person turns 18. In 2020, the then Prime Minister Boris Johnson required the scrapping of this policy as part of a bail out deal for TfL, but widespread backlash led to this condition being scrapped.

Why Public Transport?

It is important to remember that public transport is not by default zero emission; it still contributes to global carbon emissions. However, this is changing, not least in London, which has the largest electric bus fleet in Western Europe.[1] Even where public transport is not low or zero emissions, however, it is much less carbon intensive per person than the use of private vehicles, because of the number of individual journeys that can be combined within one vehicle. Discussions around travel-related emissions are often centred on aviation, but road travel—both cars and buses—accounts for a larger proportion (15%) of global emissions.[2] Public transport also serves a socioeconomic purpose, which I will go on to explore in this report, as it allows people who do not have the means to access private vehicles to still take the journeys that they require.

Creating the Next Generation of Public Transport Users.

One of the major successes of free public transport usage for young people, in this case buses, is that it helps to develop the next generation of public transport users. As young people increasingly come to rely on bus travel as they begin to gain independence for the first time in their lives, it creates a culture of public transport usage that continues into adulthood. By 'culture of public transport usage', I refer to a system in which people choose public transport even when other options—such as private car usage—are available to them. Furthermore, where there is a culture of public transport usage, it is not stigmatised or negatively associated with particular economic or social groups; instead, public transport is used across socioeconomic demographics.

Amongst bus users in London, 17% are 5–16-year-olds, and 13% are 17–24-year-olds.[3]

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[1] Transport for London. *Sustainability Report 2021*, 2021.

[2] Ritchie, Hannah. "Cars, Planes, Trains: Where Do CO_2 Emissions from Transport Come From?" Our World in Data, Global Change Data Lab, 6 Oct. 2020.

[3] London Travel Watch. *Who Uses the Bus?* 2021.

Though bus usage does decrease amongst young people once they begin to pay full fares, young people in London are not immediately switching to car usage. There is a trend of reduced car usage amongst young people across the UK, which is partly as a result of pandemic-related driving test backlogs, but the reduction in car usage amongst young people is much greater in London than the rest of the UK.[4] London has the highest proportion of households without access to a car, which includes 42% of households. With that said, this varies across the capital, as in outer London, where public transport access is poorer, 69% of households have access to a car or van, in comparison with the better connected 42% of households in inner London.[5] This disparity is particularly acute between 17–24-year-olds in inner and outer London. Just 25% of 17–24-year-olds in outer London have no access to a car, yet amongst inner Londoners of the same age bracket it is a much higher 58%.[6] Rather than reflecting that young people are choosing to drive instead of using public transport, this reflects that cultural change in terms of attitudes towards public usage can only occur where public transport provisions are adequate. Thus, while free bus travel for under-18s does create a system of public transport usage amongst young people as they get older, this is only one facet of public transport solutions.

However, driving is neither the only nor even the most important aspect of transport usage amongst under-18s in London. In 2012, under-24s were almost 20 percentage points more likely than Londoners as a whole to travel as a passenger in a car rather than a driver at least once a week.[7] Nonetheless, since the implementation of free bus travel for under-18s, the proportion of young people travelling by car has decreased alongside the increase in young bus passengers.[8] This demonstrates that parents are less likely to be driving their children to and from school, or to other activities, when they have access to free bus travel for their children. As outlined previously, this shift away from parents driving children to school in particular is more pronounced in inner London. However, in general it is much more difficult to get someone who is already a lifelong car user to start to use public transport than it is to encourage a culture of public transport usage amongst young people by creating the conditions in which they can easily access it from early on in their lives.

This reduction in car usage amongst young Londoners also has knock-on effects on the wider population. Data from Transport for London (TfL) clearly shows that one of the most important factors in the "competitiveness" of bus travel in comparison with other modes of transport (i.e. what makes people choose to or not to use the bus) is traffic speed.[9] In fact, the slow decline in bus usage between 2015 and 2018 was attributed to the growing impact of roadworks on London's roads, decreasing traffic speeds. If policies like free bus travel disincentivise young Londoners from switching to car travel once they are old enough to drive, in conjunction with policies like ULEZ, this can reduce traffic congestion, thus decreasing bus travel times, and making bus travel a more competitive mode of transport for all age groups.

Moreover, a proportion of the difference between the 5–16- and 17–24-year-old age groups in terms of bus travel can also be attributed to young people shifting to other types of public transport, such as the London Overground or Underground. As the price difference evens out between bus travel and other means of public transport, especially with the use of a 16-25 railcard on the London Underground, the bus and other forms of public transport begin to become more comparably attractive options in terms of cost. Whereas just 11% of 0–11-year-olds—who are able to travel

[4] Chatterjee, Kiron, et al. *Young People's Travel - What's Changed and Why? Review and Analysis*. 2018.
[5] Transport for London. *Understanding the Travel Needs of London's Diverse Communities - Young People*. 2012.
[6] Transport for London. *London Travel Demand Survey*. 2020.
[7] Transport for London (n 5) *supra*.
[8] Edwards, Phil, et al. "Health Impacts of Free Bus Travel for Young People: Evaluation of a Natural Experiment in London." *Journal of Epidemiology and Community Health*, vol. 67, no. 8, 2013, pp. 641-647.
[9] Transport for London. *Travel in London: Report 10*. 2017.

free of charge on all TfL services—use the London Underground once a week, 50% of 16–24-year-olds do. Although, as outlined previously, under-24s are much more likely to be car passengers than other Londoners, this is again concentrated amongst 0–11-year-olds, which shows that as young people begin to make travel decisions for themselves, they are increasingly choosing public transport.[10]

Ultimately, free bus travel for under-18s has a substantial impact in facilitating a culture of public transport usage amongst young Londoners that extends into adulthood. This is reflected in lower car usage amongst 16–24-year-olds in London than amongst 0–11-year-olds. Where their parents belonged to a generation that promoted a culture of car usage, incentives to use public transport mean that young Londoners increasingly use public transport long after it stops being free. Moreover, if young people are less likely to drive, thus reducing London's congestion, bus travel will become more attractive for Londoners across all age demographics.

Reducing Socio-Spatial Inequalities.

The free under-18s bus travel has evidently helped create a generation of young public transport users. However, all good climate policies solve other social issues too, not only because these policies are more likely to enjoy wider popularity and thus be implemented, but also because the impact of the climate crisis disproportionately affects already marginalised groups. Despite this, many climate policies, such as carbon taxes, can hit these same marginalised groups hardest, rather than those who are the main perpetrators of the climate crisis. In this section, I will look at how free bus travel for under-18s in London has helped to tackle socio-spatial inequalities within the capital. Here, socio-spatial inequalities refer to social inequalities that occur because access to resources is not evenly distributed across an area. I will assess this across two metrics in particular: access to educational opportunities and access to cultural opportunities.

Generally, economically disadvantaged areas tend to have poorer access to services like schools or hospitals. Following the suggested removal of free bus travel in 2020, 43.8% of young Londoners said that the loss of free bus travel would change the school they go to, and 30.4% would not go to areas outside of their own borough.[11] Generally, the higher Ofsted rating a school receives, the more likely it is to be located in an area with a higher Index of Multiple Deprivation.[12] Though the link between these two factors is less pronounced in London than in the rest of the UK, free bus travel makes it much easier for economically disadvantaged young people to travel to better performing schools outside their local area. Across London as a whole, one third of all bus journeys are taken by people living in households earning under £20,000 annually,[13] and only 35% of households in this income bracket have access to a car.[14] Evidently, it is the poorest Londoners who have to rely on public transport the most, meaning that in the absence of this free bus travel it is children from the most economically disadvantaged backgrounds who would have the fewest alternatives in terms of home-to-school travel. In fact, the removal of the free bus travel for under-18s would have cost an additional £37 million for parents across the capital just in terms of home-to-school travel.[15]

The free bus travel also has a cultural element to it. A majority of young Londoners said that in the absence of free transport, they would no longer visit art galleries (52.8%), museums (49.4%), or sports clubs (37.5%).[16] Similarly to education, these cultural activities tend to be concentrated in wealthier areas. Cultural capital—

[10] Transport for London (n 5) *supra*.
[11] Walsham, Matthew. "*Free Travel Means Everything to Me": Understanding the Impact of the Suspension of Free Travel on Under-18s.* Partnership for Young London, July 2020.
[12] Trust for London. *School Performance and Income Deprivation*. 2023.
[13] London Travel Watch (n 3) *supra*.
[14] Transport for London (n 6) *supra*.
[15] Transport for London (n 1) *supra*.
[16] London Travel Watch (n 3) *supra*.

the familiarity an individual has with so-called 'high culture' such as visiting art galleries—is an important driver of social inequalities within the UK. Though policies such as making museums and art galleries free are an important step towards redressing this, they mean little if individuals are unable to access their location. Free bus travel enables young people to travel to these institutions and access cultural capital they would not have been otherwise able to. Considering that some 64% of young Londoners would worry how their parents would make ends meet without free bus travel,[17] cultural activities such as these would likely be the first cutbacks parents would make in the absence of free bus travel.

In an ideal world, all public transport would be free regardless of age. However, in cities as large as London this is financially challenging. The largest city to introduce free public transport for residents thus far is Dunkirk,[18] but it has only 200,000 inhabitants on London's almost 9,000,000. Therefore, it is important to target those who would have the most financial barriers to accessing public transport in the first place. Given that 33% of London's children live in poverty, young people are an important group to target with policies such as these, not only because their attitudes towards public transport shape the future cultures of public transport usage but also because they are often the demographic that rely on it the most.

Conclusion.

There are many lessons that policymakers can draw from the success of London's free bus travel for under-18s. By creating the next generation of public transport users, policies like these shape a culture of public transport usage that lasts long into adulthood. Not only does this policy increase public transport usage and disincentivise driving, but it also helps to tackle London's socio-spatial inequalities. By allowing young Londoners to access opportunities outside of their immediate locality, we are taking a step towards reducing the inequality between the capital's most disadvantaged young people and their more privileged counterparts. That said, there is a clear disparity between inner and outer Londoners in terms of the public transport that they can access, showing that there ultimately needs to be public transport links available to all. The best climate policies do not shift the burden of the climate crisis onto those who are already most likely to be disproportionately affected by it. Instead, they help tackle the inequalities that climate change will only exacerbate, just as how free bus travel for young people in London has, in addition to curbing carbon emissions.

[17] ibid.

[18] Symons, Angela. "This European City is Making Public Transport Free for All Citizens Free from December." *Euronews*, 21 Dec. 2023.

The Trophic Rewilding of Large Terrestrial Herbivores as a Climate Change Mitigation Strategy

Mariella Hartley*

Rewilding is a conservation tool that involves the (re)introduction of fauna and / or flora species into an area to create a self-sustaining ecosystem. It is often used to increase biodiversity and protect endangered species, by reinstating areas of wilderness that can operate without human management. However, it is also being increasingly considered as a climate change mitigation and adaptation tool, since it can increase an ecosystem's resilience and carbon storage capacity. Because of this, it can be argued that leading authorities should use rewilding in their fight against the climate emergency, in tandem with other approaches and without ignoring rewilding's importance as a conservation tool. The Global Rewilding Alliance suggests that carbon uptake (i.e. sequestration of carbon from the atmosphere) can be increased by 1.5 to 12.5 times by the rewilding and conservation of vertebrate and invertebrate species worldwide.

There are multiple approaches to rewilding, from differences in basic ideologies to species and location choice, largely dependent on the rewilding initiative's purpose. The literature that exists on the (relatively new idea of) use rewilding as a climate change mitigation tool largely focuses on the potential of the trophic rewilding of large terrestrial herbivores.[1]

Trophic rewilding involves the restoration of an ecosystem's trophic (i.e. food-web) interactions, encouraging the return of their associated ecosystem functions and services. Large herbivores are keystone species that play an important role in the trophic web of ecosystems worldwide, with impacts on all aspects of their environment, including those influencing climate change such as carbon storage, surface albedo, and wildfire regimes. For instance, following a fire in 2003 that caused widespread damage to Faia Brava (Portugal's first private reserve), the reserve's founders Transhumance and Nature Association opted to begin rewilding the ecosystem with large herbivores, such as Garrano ponies and Maronesa cattle. These species cleared flammable forest material from the area, and helped to restore the ecosystem's ecological processes,[2] making the reserve more self-managing. Thus, introducing specific species of large herbivores in carefully calculated population sizes to certain environments can have a positive climate change mitigation potential. And, alongside the climate-positive benefits, such populations will make ecosystems more self-managing, which is key for successful species conservation.[3]

Yet, there are risks due to the (often hidden) complexity of large herbivores' ecosystem impacts, and if done incorrectly then rewilding can lead to unexpected negative consequences. There are also barriers to the successful implementation of rewilding,

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[1] *see*, e.g., Svenning, Jens-Christian, et al. "Trophic Rewilding: Ecological Restoration of Top-down Trophic Interactions to Promote Self-Regulating Biodiverse Ecosystems." *Rewilding*, Jan. 2019, pp. 73-98, or Bakker, Elisabeth S., and Jens-Christian Svenning. "Trophic Rewilding: Impact on Ecosystems under Global Change." *Philosophical Transactions of the Royal Society B: Biological Sciences*, vol. 373, no. 1761, Oct. 2018, p. 20170432, or Schmitz, Oswald J., et al. "Trophic Rewilding Can Expand Natural Climate Solutions." *Nature Climate Change*, vol. 13, no. 4, Apr. 2023, pp. 324-33.

[2] "Rewilding – the Natural Way to Minimise Wildfire Risk." *Rewilding Europe*, 24 Aug. 2020.

[3] It is key for species conservation that habitat management must not be generic or static (Sandom, Chris. "Rewilding – Implications for Nature Conservation." *ECOS*, vol. 37, no. 2, 2016, pp. 24–28; Webb, J. R., et al., "Natural England Research Report NERR024 Managing for Species: Integrating the Needs of England's Priority Species into Habitat Management." Part 1 Report. *Natural England Research Reports*, 15 Jan. 2010), and restoring ecological processes helps create these conditions in a self-managing way.

concerning the feasibility of performing it safely and sustainably on a scale with significant impact. For example, for an environment to be "truly" rewilded, it should function independent of human support, and so in this case would require the natural control of herbivore populations through the introduction of carnivores: an idea to which there is usually public reluctance.

Promisingly, interest in both rewilding and the effects of large herbivores on climate change are rapidly increasing. Rewilding groups are working together internationally, through collaborations such as the Global Rewilding Alliance, and with support from organisations like the United Nations during their Decade on Ecosystem Restoration. Rewilding has applications in the public health (from positively affecting mental well-being[4] to disease prevention[5]) and economic sectors,[6] and these perspectives may gather more funding and support than a conservationist approach alone. Trophic rewilding is a natural climate solution with the ability to drive negative carbon emissions and sustain them for over 100 years, as is necessary to prevent a 1.5-2°C rise in global mean temperature.[7]

[4] Svenning, Jens-Christian. "Rewilding Should Be Central to Global Restoration Efforts." *One Earth*, vol. 3, no. 6, Dec. 2020, pp. 657-60.

[5] Mills, Jacob G., et al. "Urban Habitat Restoration Provides a Human Health Benefit through Microbiome Rewilding: The Microbiome Rewilding Hypothesis." *Restoration Ecology*, vol. 25, no. 6, Oct. 2017, pp. 866-72.

[6] Lorimer, Jamie, et al. "Rewilding: Science, Practice, and Politics." *Annual Review of Environment and Resources*, vol. 40, no. 1, Nov. 2015, pp. 39-62.

[7] Schmitz (n 1) *supra*.

ARTICLES

Our **Articles** are our longer, academic pieces, designed to present a thorough overview of an important area of research or investigation in the climate space.

Emily Goniea opens with a fascinating dissection of the psychological aspects of climate policy; in particular, of failing to meet targets. As it is concluded rather openly, the reader is encouraged to make their own determinations on the evidence presented. **Ben Chester Cheong** delves into the carbon credits scheme in Singapore and compares its efficacy with other similar systems and with alternatives. Ultimately, the evaluation is an ambivalent one; the scheme is a useful first step, but issues remain. **Kaden Pradhan** explores the recent company law case of *ClientEarth v Shell & Ors* and explains that the case was essentially doomed to fail due to the unspoken Business Judgement Rule. For environmental law organisations, a broader strategy with non-litigative elements is recommended. **Serra Okumuş** undertakes the complex and inherently interdisciplinary task of assessing green policies from a social transition perspective, which integrates economic, sociological, and political scholarship. Whilst **Xiaoyang Du** focuses on the global stage, querying the climate responsibility of lower-income nations particularly through international trade and capital, **Pasha Taylor** explores climate action much closer to home, analytically reviewing Cambridge climate organisations and their value. **Jenna Goldblatt** discusses mineral mining and its connection to the green energy transition, specifically through the lens of coltan mining in Venezuela. **Lara Peralta** reports on a scientific investigation conducted into socio-architectural initiatives in rural villages in Pakistan. Finally, **Kilian Bartsch** compares the quantified climate impact of different forms of passenger transit and maps this to required individualised emissions reduction targets.

Emotional and Behavioural Implications of Overshooting 1.5°C

Emily Goniea*

Looming above Union Square in downtown Manhattan, a clock is ticking. The Climate Clock, a project of artists Gan Golan and Andrew Boyd, is counting down the time before the effects of global climate change become irreversible. This deadly deadline is defined by projections of when the planet is set to hit 1.5°C of warming above pre-industrial levels. A bit like the target it portends, the Climate Clock implores urgency and attention without directly delineating what one might do to stop the timer in its tracks. Passersby may glance nervously at the countdown and see an anxious call to action, or they may see just another reminder that so much of the world lately seems doomed and out of our control. The targets to limit global warming below 1.5 and 2 degrees celsius mark crucial tipping points in climate change and provide broad goalposts for emission cuts. They have become the global shorthand for everything that needs to be done to face the climate crisis and all that we are failing to accomplish. These targets represent both a motivational instrument and a menacing omen. But what happens when the very information meant to motivate change leaves us feeling like there is nothing to be done?

In the 2015, 195 nations signed the Paris Agreement, a treaty pledging to "pursue efforts" to keep global warming below 1.5 degrees celsius (2.7 degrees Fahrenheit) and limit warming to "well below" 2 degrees celsius (3.6 degrees Fahrenheit) by the year 2100. These degree targets are measured based on the average global surface temperature over a ten-year period, as compared with pre-industrial levels. The targets were determined based on assessments of the global effects of climate change at different degrees of global warming.

The purpose of these thresholds has been to provide a universal goal post for national and global efforts to limit global warming. Aiming for such an ambitious target in such a limited timeframe would ideally drive swift, dramatic changes in emissions and energy consumption. Some meaningful legislation, such as the 2022 Inflation Reduction Act in the U.S.,[1] has already been passed in attempts to adhere to the guidelines of the Paris Agreement. However, it is no secret that the 1.5°C and 2°C targets, along with decades of other urgent warnings, have failed to prompt sufficient action and many scientists now believe it may already be too late.

A recent report by climate and social scientists declares that overshooting the 1.5°C target is "fast becoming inevitable."[2] According to the UN's 2023 Emissions Gap report, we are currently on track to hit 3°C of warming by the end of this century.[3] While certain individuals, communities, and countries have made significant changes to meet the Paris Agreement's goals, the level of collective response needed

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[1] United States Congress. Public Law 117-169.

[2] Bustamante, Mercedes, et al. "Ten New Insights in Climate Science 2023/2024." *Global Sustainability*, 1 Dec. 2023, pp. 1-58.

[3] United Nations Environment Programme. "Emissions Gap Report 2023: Broken Record – Temperatures Hit New Highs, yet World Fails to Cut Emissions (Again)." *Knowledge Repository*. UNEP. 2023.

to realistically maintain a global temperature within the desired range has not yet been achieved. As a result, behavioural psychologists have begun to assess how these targets, and our looming inability to meet them, might influence individual and collective actions as the climate crisis continues.

In a 2022 paper on rule-governed responses to climate change, Cynthia Pietras outlines a wide variety of ways that guidelines like those of the Paris Agreement may be causing us to miss the mark.[4] By viewing climate warnings, reports, and models as rules, in that they describe what might happen if certain actions are carried out, Pietras applies behavioural analysis to current climate responses. One possible cause of insufficient action she identifies is a rule's "incompleteness." To be considered complete, a rule must clearly outline the problem in need of addressing, the behaviour needed to fix that problem, and the consequences of either performing or not performing that behaviour. While the Paris Agreement's target temperatures define the problem and its consequences, it fails to clearly identify what meaningful actions must be taken and by whom. In short, the intentional vagueness of the Paris Agreement's goals, which allow it to apply to all of its ensigned countries, may be one culprit of the current failure to sufficiently respond. The global nature of the goal allows it to apply to everyone, but in applying to everyone, it disperses the responsibility to a degree that individuals often feel little direct impetus to act.

According to Pietras, other contributors to poor rule following in the face of global warming could include lack of media acknowledgement and lack of public understanding of the rules and their meanings. With each tenth of a degree that the global temperature increases, the impacts felt around the world will become increasingly severe.[5] As a result, climate issues may march farther toward the forefront of global discourses. However, the acknowledgment of global warming and the prevention of further warming are two different things, and the effects of climate change may be felt too late in industrialised nations for adequate action to take place. Therefore, the 1.5°C and 2°C targets encourage us to reconcile the differences between what is possible and what is plausible. From a practical perspective, the kinds of change necessary to avoid passing 1.5°C would likely require cultural and societal shifts in key polluting nations that are not considered feasible. Hence, if these targets are possible but not plausible—if, as many argue, we are already doomed to fail—the question becomes what this failure will mean in the context of continued action.

The physical repercussions of overshooting our targets have already been modelled and explained by groups like the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, overshooting 1.5°C would mean losing 70-90% of the world's coral reefs, a steep increase in extreme weather like storms and heat waves, and 1 to 3 feet of sea level rise threatening coastal communities across the globe.[6] The projected consequences for overshooting our goals are dire, but what remains to be seen is what the psychological and emotional impacts of overshoot could be.

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[4] Pietras, Cynthia. "Rule-Governed Behavior and Climate Change: Why Climate Warnings Fail to Motivate Sufficient Action." *Behavior and Social Issues*, vol. 31, 2022, pp. 373-417.

[5] IPCC. "Summary for Policymakers." *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H. Lee and J. Romero, 2023, pp. 1-34.

[6] IPCC. "Summary for Policymakers." *Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-Industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Cambridge University Press, 2022, pp. 1-24.

Along with the stress of embodied impacts of global warming, an apocalyptic mindset can alienate members of the public, leading them to shut out climate information rather than taking it more seriously. In the present, the seeming inevitability of overshooting the only global climate targets that have been set can prompt feelings of hopelessness that stop individuals from engaging with climate issues. In the future, missing these targets might further resign people to the idea that climate change is a lost cause, particularly individuals in industrialised countries who will not feel the impacts of global warming as keenly or immediately as more vulnerable groups. For the nations whose very survival is threatened even by the 1.5°C target, the privilege of giving up hope is not an option, and these targets need to remain the guiding star for global efforts in spite of the shrinking odds of success.

The ambitious yet ambiguous goal of limiting global warming within these targets does more than provide a deadline for disaster. It also outlines what metrics we use to measure the progress of climate change. Global temperature is a useful tool for indicating the scale and urgency of the issue. However, framing the climate crisis based on an amorphous global measurement can alienate and disempower individuals, provide space for governments to shirk blame, and contribute to a sense of despair that, while understandable, can only be seen as counterproductive. The targets also situate climate change temporally with a cutoff date of 2100. Some scientists have argued for a need to expand the timeline on which we consider climate change, accounting for the changes that might occur up to the year 2500 to adequately show the long-term impacts at stake.[7]

The current targets place valuable focus on the need for preventative efforts, but to the public they may obfuscate the hard work of adaptation that will no doubt be necessary if overshoot does occur. In a 2010 paper on climate change evidence and possible solutions, Lonnie Thompson identified three possible human responses to climate change: prevention, adaptation, or suffering.[8] The goal of the Paris Agreement degree targets falls under prevention, stopping the disastrous impacts of global warming from happening in the first place. However, if the current temperature goals cannot be met, it will be crucial to adapt and prevent as much suffering as possible.

The solution to current inaction can take various forms, and the severity of inaction's consequences warrant taking on multiple approaches at once. First, the goals of the climate thresholds can be made as complete as possible by outlining specific high-impact actions and who needs to take them. Pietras proposes an improvement of specificity in describing and prioritising actions, along with improving communications about how climate rules can be followed.[9] But while we bolster global efforts at prevention, contingency plans must be made for maintaining hope even past the point of no return. By pairing global prevention targets with local adaptation goals, and no longer sounding the alarm without also explaining steps we can take to put out the fire, the productive panic required to continue acting can remain within reach.

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[7] Lyon, Christopher, et al. "Climate Change Research and Action Must Look Beyond 2100." *Global Change Biology*, vol. 28, no. 2, 24 Sept. 2021, pp. 349-361.
[8] Thompson, Lonnie G. "Climate Change: The Evidence and Our Options." *The Behavior Analyst*, vol. 33, no. 2, Oct. 2010, pp. 153-170.
[9] Pietras (n 4) *supra*.

Hope is perhaps the most valuable tool individuals can harness in the fight against global warming. Hope defends against complacency. Without it, we erase the possibility of prevention or adaptation and resign ourselves and others to suffering. A key aspect of maintaining the effectiveness of these threshold targets lies in our ability to hold two competing truths at once: that the outlook is bleak and that there is still reason to hope and, most importantly, to act. As the deadline for global warming approaches, hope that acknowledges the pressure of the targets at stake, but also persists beyond the clock striking zero, will have to become our behaviour of choice.

Analysing Singapore's Recent Carbon Credits Initiative

Ben Chester Cheong*

As the world wrestles with the existential threat of climate change, innovative solutions are desperately sought. Singapore has stepped onto the global stage with its ambitious carbon credit regime. This system, introduced in November 2022 alongside a rising carbon tax, allows companies to offset up to 5% of their taxable emissions by purchasing internationally recognised carbon credits.[1] From a legal perspective, Singapore's carbon credit regime creates an interesting yet intricate landscape that presents both opportunities and challenges.

The cornerstone of the regime is the International Carbon Credit (ICC) Framework, which has been drafted to uphold high environmental integrity. Credits must meet stringent criteria outlined in Article 6 of the Paris Agreement,[2] ensuring genuine emissions reductions or removals.[3] To further bolster this integrity, Singapore established an International Advisory Panel for Carbon Credits, seeking expertise from diverse stakeholder groups. Additionally, partnership with established carbon credit programs like the Gold Standard and Verra's Verified Carbon Standard announced in December 2023 would be aimed at assisting nations in maximising the benefits of carbon crediting programs to meet their Nationally Determined Contributions (NDCs) under the Paris Agreement. The collaboration will involve creating a guide that presents uniform and efficient operational guidelines for countries to enhance their utilisation of current carbon crediting programs, thereby helping them to fulfil and surpass their NDC targets.[4]

This deliberate emphasis on integrity is crucial, considering the checkered history of carbon markets. Past schemes have been marred by accusations of 'greenwashing' and double counting, where doubtful credits offset non-existent emissions or were claimed by multiple entities.[5] Singapore's stringent framework seeks to avoid these pitfalls, providing much-needed assurance for a market requiring credibility.

However, the legal implications of this framework cannot be overlooked. The intricate web of eligibility criteria, validation procedures, and international trade regulations create a complex legal environment. Companies navigating this space must possess a deep understanding of both domestic and international

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[1] Tan, Cheryl. "Companies Looking to Offset Carbon Tax Will Have to Wait Some Time More for Worthy Projects." *The Straits Times*, 15 Jan. 2024.

[2] United Nations. The Paris Agreement, 2015.

[3] National Environmental Agency. "Singapore Sets Out Eligibility Criteria for International Carbon Credits Under the Carbon Tax Regime." *NEA*, 4 Oct. 2023.

[4] Verra. "Joint Press Release: Singapore, Verra and Gold Standard Partner to Develop Playbook for Carbon Crediting Under the Paris Agreement." 11 Dec. 2023.

[5] Betz, Regina, et al. *The Carbon Market Challenge: Preventing Abuse Through Effective Governance*. Cambridge University Press, 2022; Sovacool, Benjamin K. "Four Problems with Global Carbon Markets: A Critical Review." *Energy & Environment*, vol. 22, no. 6, 2011, pp. 681-694.

carbon-related laws, potentially increasing compliance costs. Moreover, legal disputes arising from fraudulent credits or non-compliance could further complicate the system.[6]

I. Supervisory Body under Article 6.4 of the Paris Agreement.

While Singapore's focus on integrity is commendable, its effectiveness hinges on the global response. The success of the ICC Framework relies heavily on other nations implementing similar standards and adopting an internationally harmonised approach to carbon crediting. Hence, a positive development in this area is that Article 6.4 of the Paris Agreement introduced a fresh global carbon crediting system. This mechanism involves a 'Supervisory Body' responsible for creating and overseeing the necessary procedures to put this initiative into action. This encompasses formulating or endorsing methodologies, recording activities, accrediting third party verification entities, and administering the Article 6.4 Registry.[7] Fragmentation in legal frameworks and varying levels of scrutiny could undermine the entire system, raising concerns about market distortions and environmental integrity.

In this context, international cooperation and legal coherence remain important. Collaborative efforts amongst national authorities and carbon credit program developers are crucial in establishing robust verification and compliance mechanisms. Further, multilateral agreements on standardised protocols and legal frameworks would foster a more transparent and efficient global carbon market.

II. Blockchain Technology.

There is a possibility of using blockchain technology and distributed ledger systems for carbon credit verification and tracking.[8] Blockchain creates a tamper-proof, publicly accessible record of all carbon credit transactions. This can help to mitigate fraud and double counting, which are major problems in the current carbon credit market.

By streamlining the verification and tracking process, blockchain can make it easier and faster for businesses and individuals to buy and sell carbon credits. This could lead to a more efficient and liquid carbon market. It can also ensure the accuracy and integrity of carbon credit data, making it easier for all stakeholders to track the impact of carbon offset projects.

Blockchain can make it easier for smaller carbon offset projects to participate in the market, as it reduces the need for intermediaries and traditional verification processes. It can also enable the creation of new financial instruments based on carbon credits, such as tokenised credits or carbon futures. This could attract new investors and further boost the liquidity of the market.[9]

However, the potential downside is that implementing and maintaining a blockchain-based carbon credit system can be technically complex and expensive. Some blockchain implementations can be energy-

[6] ISDA. "Legal Implications of Voluntary Carbon Credits." Dec. 2021.
[7] UN Climate Change. "Article 6.4 Supervisory Body."
[8] Woo, Jung-Woong, et al. "Applying Blockchain Technology for Building Energy Performance Measurement, Reporting, and Verification (MRV) and the Carbon Credit Market: A Review of the Literature." *Building and Environment*, vol. 205, Nov. 2021.
[9] Widholm, Barbara, et al. "The Tokenisation of Carbon Assets." *State Street*, Jul. 2023

intensive, which could contradict the environmental goals of the carbon credit system. The development and application of blockchain for carbon credits will need to be carefully governed and regulated to ensure the system's integrity and effectiveness.

Overall, blockchain technology has the potential to revolutionise the carbon credit market by improving transparency, efficiency, and data quality. However, there are also significant challenges that need to be addressed before blockchain can be widely adopted in this context.[10]

III. Case Studies.

Other initiatives to reduce greenhouse gas emissions include the California Compliance Offset Program.[11] As of 2020, the California Air Resources Board has issued over 200 million offset credits.[12] However, there are concerns about double counting and offsets from outside North America. Critics argue some offsets do not deliver real emission reductions.[13]

The REDD+ Initiative[14] has contributed to deforestation reduction in several countries and improved forest management practices. However, there are complex governance structure and challenges in ensuring carbon benefits reach local communities. There are also concerns about displacement and social impacts.[15]

The Gold Standard[16] provides for a rigorous and transparent verification process. It is focussed on sustainability and co-benefits for local communities. However, it is limited in scope compared to larger programs and results in higher transaction costs for project developers.[17]

CarbonPlan[18] develops and applies rigorous scientific methods for verifying carbon removal projects, like direct air capture. However, carbon removal technologies are still nascent and expensive and requires significant investment for scaling up.[19]

The Singapore approach seems to be focussed on reducing carbon emissions, like the California Compliance Offset Program, and ensuring a robust verification process, like the Gold Standard. However, analysing the effectiveness of these initiatives with the Singapore carbon credit regime may require

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[10] Cheong, Ben Chester. "Application of Blockchain-Enabled Technology: Regulating Non-Fungible Tokens (NFTs) in Singapore." *Singapore Law Gazette*, Jan. 2022.
[11] California Air Resources Board. "Compliance Offset Program."
[12] California Air Resources Board. "Compliance Offsets Protocol Task Force Initial Draft Recommendations." 7 Oct. 2020.
[13] Stapp, Jared, et al., "Little Evidence of Management Change in California's Forest Offset Program." *Communications Earth & Environment*, vol. 4, no. 331, 2023, pp 1-10.
[14] United Nations Environment Programme. "REDD+."
[15] Guizar-Coutino, Alejandro, et al. "A Global Evaluation of the Effectiveness of Voluntary REDD+ Projects at Reducing Deforestation and Degradation in the Moist Tropics." *Conservation Biology*, vol. 36, no. 6, 2022, pp 1-13.
[16] Gold Standard. "Gold Standard for the Global Goals."
[17] Lou, Jiehong, et al., "Integrating Sustainability into Climate Finance by Quantifying the Co-Benefits and Market Impact of Carbon Projects." *Communications Earth & Environment*, vol. 3, no. 137, 2022.
[18] CarbonPlan. "About CarbonPlan.".
[19] Fankhauser, Sam, et al., "The Meaning of Net Zero and How to Get It Right." *Nature Climate Change*, vol. 12, no. 15-21, 2022.

some more time as 'high-quality projects that truly benefit the climate have yet to become available'.[20] Singapore currently only has a carbon trade agreement with Papua New Guinea. It is necessary for an agreement to be in place between a buyer country and the host country of the carbon project to allow the transfer of emissions removal from a carbon project.[21]

A report by Carbon Direct produced in 2022 observed that there are very few carbon removal credits available in the four largest voluntary market registries, namely, the American Carbon Registry, Climate Action Reserve, Gold Standard, and Verra.[22] The report notes that none of the carbon removal credits available in these registries are considered durable. This means that the carbon removal projects that generated these credits may not be able to maintain the carbon removal benefits over time.[23] Hence, there is still a lot of work to be done in the carbon market.

IV. Possible Problems with Carbon Credits.

Critics argue that companies can use carbon offsets to appear climate conscious without reducing their own emissions.[24] This can lead to complacency and divert attention from necessary internal transformations. Furthermore, ensuring offsets represent genuine emission reductions beyond business-as-usual practices is challenging. Double counting, where the same reduction is claimed multiple times, can undermine the system's effectiveness. Some worry that carbon credit projects could displace indigenous communities or harm biodiversity, while focusing on low-cost offsets in developing countries may neglect local environmental and social needs.[25]

Singapore's ICC Framework aligns with rigorous international standards like Article 6 of the Paris Agreement, potentially enhancing credibility compared to programs criticised for weak verification or double counting. Robust validation procedures and international partnerships with established programs (Gold Standard, Verra) aim to ensure reliable credits. Singapore's success hinges on international cooperation and legal harmonisation, and presents similar challenges faced by the nascent carbon removal verification field.

V. Singapore's Carbon Tax as an Additional Lever.

In Singapore, the carbon tax rate was established at S$5 per ton of CO_2 equivalent for the initial five years beginning in 2019, allowing emitters to adapt during this transitional phase. In alignment with its net zero objective, the carbon tax will be increased to S$25 per ton of CO_2 equivalent in 2024 and 2025, followed by a raise to S$45 per ton of CO_2 equivalent in 2026 and 2027, aiming to reach a range from S$50-80 per ton of CO_2 equivalent by 2030.[26]

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[20] Tan (n 1) *supra*.
[21] ibid.
[22] Macfarlane, Micah. "Assessing the State of the Voluntary Carbon Market in 2022." *Carbon Direct Blog*, 6 May 2022.
[23] ibid.
[24] Ghussain, Alia Al. "The Biggest Problem with Carbon Offsetting Is that It Doesn't Really Work." *Greenpeace*, 26 May 2020.
[25] Dunne, Daisy, et al. "Mapped: The Impacts of Carbon-Offset Projects Around the World." *Carbon Brief*, 20 Jan. 2024.
[26] National Climate Change Secretariat of Singapore. "Carbon Tax."

The carbon tax results in higher costs for businesses, encouraging them to reduce emissions through improved efficiency, fuel switching, and adoption of cleaner technologies. The policy sends a clear signal to investors and consumers that Singapore is serious about climate action, potentially influencing business decisions and consumer behaviour towards low-carbon options.

However, the current tax rate (S$25 per ton of CO_2 in 2024) might be insufficient to drive significant emissions reduction in the short term. Industries subject to the tax might shift production to countries with less stringent regulations, causing emissions to move but not decrease globally. Implementing and managing the carbon tax and credit scheme can be complex and resource-intensive for both the government and businesses. The tax might disproportionately burden certain industries or communities, requiring additional support measures to ensure fairness. Accurately monitoring and verifying emissions and carbon credits is crucial for the scheme's effectiveness.

VI. Conclusion.

Several key questions remain. Will the stringent ICC Framework attract sufficient investment and ensure the credibility of the market? Can international legal harmonisation keep pace with the evolving system? And most importantly, will this scheme ultimately contribute to tangible emissions reductions, fulfilling its role in the global fight against climate change?

The legal and logistical hurdles ahead are substantial, but if overcome, Singapore's model could offer a crucial stepping stone towards a sustainable future. Singapore's carbon credit regime possesses promising strengths in its focus on integrity and openness to innovation. However, concerns regarding limited scope, potential equity issues, and dependence on international collaboration remain. Its success will ultimately depend on addressing these challenges and navigating the uncertainties of the global carbon market.

Strategic Errors in Climate Litigation: *ClientEarth v Shell Plc & Others*

Kaden Pradhan*

I. Introduction.

A company is a legal person.[1] Hence, when a company has been wronged, only the company itself has the standing to bring a claim against those who wronged it.[2] Of course, a company is not a sentient being in the way that a human person is. The decision to file a lawsuit will be taken in accordance with the managerial structure of the corporation—and ordinarily such a commitment must be approved by the board of directors.[3] What, then, is to be done when the wrongdoers *are* the directors? If the interests of a company could be irreparably harmed, and the malefactors had the ability to prevent any legal recourse, then "the law would fail in its purpose. Injustice would be done without redress."[4]

This is the basis for what is known as the 'derivative claim', a legal action now codified in ss.260-264 of the Companies Act 2006. Under this scheme, any shareholder may seek to 'derive' the right of a company to protect its interests from wrongdoers where the company cannot do so itself; that is, they seek the ability to exercise that right on the company's behalf. In doing so, however, the shareholder must first establish a '*prima facie* case' for the claim—that is, a possibility of success at first consideration, which a court must endorse.[5] This includes showing that their cause of action is rooted in a director's act or omission, either actual or proposed, which constitutes negligence, default, breach of duty, or breach of trust.[6] At this preliminary stage, there is no burden on the company to provide evidence.[7]

On February 9th, 2023, ClientEarth, a minor shareholder in Shell plc, filed for a derivative claim in the High Court.[8] They argued that the directors' "failure to set an appropriate emissions target", their "strategy as regards the management of climate risk", and their lack of "a plan to ensure timely compliance" with a Dutch court order compelling them to reduce their emissions by 45% by 2030 each represented breaches both of the board's s.172 duty to act in the best interests of the corporation and ensure its long-run viability and of their s.174 duty to exercise reasonable care, skill, and diligence.[9] As such, ClientEarth sought to derive the company's cause of action against its directors and to procure an injunction from

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[1] *Salomon v A Salomon & Co Ltd* [1896] UKHL 1, [1897] AC 22.

[2] *Foss v Harbottle* [1843] 2 Hare 461, 67 ER 189.

[3] *see*, e.g., *Breckland Group Holdings v London and Suffolk Properties* [1989] 4 BCC 542 (Ch).

[4] *Wallersteiner v Moir (No. 2)* [1975] QB 373 at 390. This case used to contain the rules for derivative claims, which are now formalised in the Companies Act.

[5] Companies Act 2006 s.261.

[6] *Iesini v Westrip Holdings Limited* [2009] EWHC 2526 (Ch) at [78], citing *Prudential Assurance Co Ltd v Newman Industries Ltd (No. 2)* [1982] Ch 204 at 222A.

[7] *ClientEarth v Shell Plc & Others* [2023] EWHC 1897 (Ch) at [9], citing the Civil Procedure Rules 19.15(3).

[8] ibid.

[9] ibid at [39]. Note that the Dutch court order comes from an earlier case against Shell, *Milieudefensie v Royal Dutch Shell plc* ECLI:NL:RBDHA:2021:5339.

the court that the board "(a) adopt and implement a strategy to manage climate risk in compliance with its statutory duties and (b) comply immediately with the Dutch Order".[10]

Mr Justice Trower ruled that ClientEarth failed to demonstrate a *prima facie* case for a breach of either duty.[11] This is particularly startling given that it is the first case where such a failure has occurred.[12] The bar for establishing a *prima facie* case is "not a high one",[13] and so the High Court's decision is especially damning in this regard and reflects very poorly on ClientEarth's submissions. Where did things go wrong?

II. Statutory Duties and the *Prime Facie* Case.

The Companies Act 2006 s.172 requires that directors must act in a way which they decide in good faith would "promote the success of the company for the benefit of its members as a whole".[14] In doing so, they must have regard to a list of six considerations, one of which is "the impact of the company's operations on the community and the environment".[15] There is no requirement, however, that their resulting determinations be accurate or reasonable; as long as they are taken under a good faith belief that they are in the best interests of the company.[16]

This duty stems from a notion of 'shareholder primacy', whereby the board must act in a way which prioritises the financial welfare of the company's shareholders.[17] The need for long-run viability, which is a crucial part of this principle, is elucidated in the six considerations. The Act, however, does not impose any substantive requirements on the directors to address those factors. As long as they are weighed in good faith, and reported,[18] that is sufficient.

In respect of the s.172 duty, ClientEarth destroyed its own argument. Operating under the misapprehension that these considerations were in fact subject to a reasonableness qualification,[19] they

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[10] ibid at [81].
[11] ibid at [84].
[12] Or, at least, the first reported case under the Companies Act scheme. Gibbs-Kneller, David, and Chidiebere Ogbonnaya. "Empirical Analysis of the Statutory Derivative Claim: De Facto Application and the Sine Quibus Non." *Journal of Corporate Law Studies*, vol. 19, no. 2, Oct. 2018, pp. 303-32 at 319: "The amount of claims that have demonstrated a *prima facie* case has risen from 55.6% to 100% under statute."
[13] *McGaughey v Universities Superannuation Scheme Ltd* [2022] EWHC 565 (Ch) at [12].
[14] Companies Act 2006 s.172.
[15] ibid s.172(d).
[16] *TMO Renewables Ltd v Yeo & Others* [2021] EWHC 2033 (Ch) at [389]-[390], citing *Re Smith & Fawcett Ltd* [1942] Ch 304 and *Regentcrest Plc v Cohen* [2001] 2 BCLC 319. Note that, in the instant case, Trower J qualifies the pure subjectivity of the test by stating that "ClientEarth must show a *prima facie* case that there is no basis on which the Directors could reasonably have come to the conclusion that the actions they have taken have been in the interests of Shell." But Smith J in *TMO Renewables* at [391] maintains that such an objective test only applies where the company verges on, or is in fact in, a state of insolvency, which Shell is quite certainly not. Otherwise, it seems that the objective aspect is only utilised in cases of bad faith or if the interests of the company are disregarded entirely: *see* Arnold, Mark, and Marcus Haywood. "Duty to Promote the Success of the Company." *Company Directors: Duties, Liabilities, and Remedies*, edited by Simon Mortimore, Oxford University Press, 9 Mar. 2019, pp. 282–286. *TMO Renewables*, as a High Court case, does not bind Trower J, but he seems nonetheless to have misinterpreted Smith J's directive: *ClientEarth* at [38]. Such a difference would only be resolved on appeal, which the EWCA has declined to hear.
[17] *see*, e.g., Benjamin, Lisa. "The Responsibilities of Carbon Major Companies: Are They (and Is the Law) Doing Enough?" *Transnational Environmental Law*, vol. 5, no. 2, Oct. 2016, pp. 353-378, at 358-359.
[18] As required by The Companies (Miscellaneous Reporting) Regulations 2018, SI 2018/860 s.4.
[19] *ClientEarth* at [38]; *see* further Arnold & Haywood (n 16) *supra*.

adduced evidence which demonstrated the directors' weighing of the environmental consideration; namely, the climate risk strategy itself.[20] Since the s.172 duty essentially sets out a procedural requirement,[21] ClientEarth's strategy—to cite the climate risk strategy and then argue it is inadequate or unreasonable—was self-defeating.

In fact, the reason that ClientEarth failed to show a *prima facie* case for a breach of the second duty is much the same. The 2006 Act in s.174 requires directors to take "reasonable care, skill and diligence" in the exercise of their duties.[22] This essentially compels the board to properly inform themselves about the risks that might face their business and weigh those risks.[23] The mere fact that a climate risk strategy exists in the first instance is sufficient to meet that duty. Further, unlike the s.172 duty, s.174 does contain a reasonableness element, which entails asking "whether the decision falls outside the range of decisions reasonably available to the Directors at the time".[24] Mr Justice Trower holds that there is no "universally accepted methodology" for how best to respond to the climate risks identified, and this means that it is impossible to determine that "no reasonable board of directors could properly conclude that the pathway to achievement is the one they have adopted".[25] In other words, the fact that there is no universal consensus on how companies should achieve their climate objectives means that, absent further evidence specific to Shell and its strategies, their approach cannot be held to be unreasonable, and is therefore not in breach of their s.174 duty.

Mr Justice Trower's criticisms, however, do not end there. On the question of duties, two further points are made: (i) that ClientEarth's evidence is not expert testimony and the Court cannot "properly rely" on it,[26] and (ii) that even though the climate risk strategy itself demonstrates s.172 compliance, ClientEarth was unable to explain why "the Directors have gone so wrong in the balancing of … competing considerations" such as profit-related concerns as to constitute a breach of s.174.[27] Finally, on the point of the Dutch court order, he refers to an excerpt from the ruling which grants Shell the freedom to shape its corporate policy however it sees fit so as to meet the reduction obligation, which is consistent, and in this regard coextensive, with the s.172 duty.[28]

In its derivative claim, ClientEarth sought an injunction requiring the company to implement a new, compliant climate strategy and to observe the Dutch court order—but the judge held that such a request is "too imprecise to be suitable for enforcement, and for that reason alone is an order which a court would

[20] ibid at [65].
[21] Good faith is the only substantive condition. A lack of good faith would be evidenced through, for example, dishonesty or fraud: *see McGaughey* (n 13) *supra* at [192]-[196]. ClientEarth would likely have been able to prove neither.
[22] Companies Act 2006 s.174.
[23] This was the position at common law, before the statutory scheme was in place: *Re Baring Plc & Others (No. 5)* [2000] 1 BCLC 523 at 536A. The same approach is applied now: *Lexi Holdings Plc v Luqman & Others* [2009] EWCA Civ 117.
[24] *ClientEarth* at [32], citing *Sharp v Blank & Others* [2020] EWHC 1870 (Ch). Trower J does not treat the two duties with clear separation, which makes the division between the subjective test for s.172 and the objective test for s.174 more confused: *see* (n 16) *supra*. Presumably at [32] he was referring to the s.174 duty.
[25] ibid at [64].
[26] ibid at [59]-[63].
[27] ibid at [65]-[68].
[28] ibid at [73].

be most unlikely to make."[29] Indeed, with some irony, he remarks that such an injunction would likely disrupt Shell's business activities to such an extent that it would adversely affect the interests of shareholders, which is exactly what a derivative action is designed to avoid in the first place.[30] ClientEarth also requested a declaration that the directors were in breach of their duty, but "it is difficult to see what legitimate purpose the grant of a declaration would fulfil … It is not the court's function to express views as to the Directors' conduct which have no substantive effect and which fulfil no legally relevant purpose."[31]

Thus, a *prima facie* case for breach was not established, and no remedy was offered. Both the character and the content of the judgment indicate a deeper issue with ClientEarth's case. It was, in essence, entirely inappropriate for them to attempt to pursue a climate lawsuit through British company law, because the company law regime is associated with greater judicial conservatism than other fields. ClientEarth's approach was not "groundbreaking" in any way;[32] it was a failure of strategy.

III. The Business Judgement Rule and Litigation Strategy.

It is worth first considering patterns of language in Mr Justice Trower's ruling. It is a "basic principle of company law that it is for the directors themselves to determine the weight to be attached to the non-exhaustive list of factors referred to in s.172";[33] "if the court should not interfere with the commercial question of the strategy to be adopted, the same principle of restraint should be applied to the means by which that strategy is to be implemented";[34] "The weighing of all these considerations [as set out in s.172] is essentially a commercial decision, which the court is ill-equipped to take, except in a clear case".[35] These quotations reflect longstanding principles in company law that the judiciary is, by and large, not well-placed to question decisions taken by a board of directors as to the lawful operation of a company; as Keay and Loughry explain, "the courts have often refrained from holding directors liable for alleged breaches of the duties, instead deferring to directors' judgments. Courts have simply not been willing to substitute their judgment for that of directors."[36] This approach is, in other jurisdictions, termed the Business Judgement Rule, and although no such principle has been formally expounded by the British courts, it remains the case that the spirit of the Rule is frequently adopted.[37]

The practical effect of this is that the circumstances under which a board can be said to have breached their duties is very limited. It is generally restricted to cases of fraud or dishonesty,[38] perverse intentions,[39]

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[29] ibid at [81].
[30] ibid.
[31] ibid at [83].
[32] As they themselves claimed: ClientEarth. "We're Taking Legal Action against Shell's Board for Mismanaging Climate Risk."
[33] *ClientEarth* (n 7) *supra* at [25].
[34] ibid at [26].
[35] ibid at [28], quoting *Iesini* (n 6) *supra* at [85]. The substance is repeated in ibid at [32].
[36] Keay, Andrew, and Joan Loughrey. "The Concept of Business Judgment." *Legal Studies*, vol. 39, no. 1, 11 Dec. 2018, pp. 36-55.
[37] ibid. The authors cite *Howard Smith v Ampol Petroleum* [1974] 1 All ER 821 at 835, *Devlin v Slough Estates Ltd* [1983] BCLC 497 at 503–504, and *Birdi v Specsavers Optical Group Ltd* [2015] EWHC 2870 (Ch) at [246].
[38] *see* (n 21) *supra*.
[39] For instance, when a director sets up a company pension for their partner: *Re W&M Roith Ltd* [1967] 1 WLR 432.

or demonstrable gross irrationality. In the instant case, Mr Justice Trower was happy to acknowledge that ClientEarth's evidence represented their "genuinely held" beliefs, but also that those beliefs constituted nothing more than a difference of opinion.[40] Paradigmatically, judges will defer to the board's decisions unless they meet one of the special cases above; *ClientEarth* is no exception.

The decision to pursue a claim in company law is, then, an error of strategy. *Pace* Dr Iglesias- Rodríguez, who contends that the *ClientEarth* decision will precipitate a number of positive sociopolitical changes,[41] I argue that the more plausible outcome is that climate-destructive companies operating under English law will find greater confidence in relying on their own models, predictions, and reports to substantiate their decision-making, which will further skew the underlying forces driving their activities away from the long-run common good and towards the short-run profit motive. The High Court's scathing rejection of every single one of ClientEarth's submissions bolsters the *de facto* directorial immunity from judicial interference inherent in the Business Judgement Rule and reproduces this unspoken cornerstone of English company law. Such derivative actions may find a better foothold in other jurisdictions,[42] but it is at least arguable that this type of argument was doomed to failure.[43]

Evidently, this is open to the criticism that someone must pioneer a certain line of reasoning and thereby set the first precedent.[44] This is true, of course, but it does not bear upon the importance of strategy in such matters. Even in landmark cases that transform the law, there is often some kind of foretoken—*obiter* comments in prior judgements,[45] unwelcome application of the existing precedent,[46] or other signals of a general sense amongst the judiciary that a change is necessary.[47] Before pursuing a case,

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[40] *ClientEarth* (n 7) *supra* at [59].

[41] Iglesias-Rodríguez, Pablo. "ClientEarth v Shell Plc and the (Un)Suitability of UK Company Law and Litigation to Pursue Climate-Related Goals." *Journal of Environmental Law*, vol. 35, no. 3, 28 Aug. 2023, pp. 445-454.

[42] For remarks on the potential of claims in the US under Delaware law, *see* Tigre, Maria Antonia, and Cynthia Hanawalt "The Fiduciary Duty of Directors to Manage Climate Risk: An Expansion of Corporate Liability through Litigation?" *Climate Law Blog*, 15 Feb. 2023. According to Brady-Banzet, Lall & Assereto, "Climate-related derivative claims are on the rise in the United States", although no evidence of such claims is offered: Brady-Banzet, James, et al. "Derivative Claims in ESG Litigation against Directors—Q&A." *INSIGHTS*, vol. 37, no. 7, July 2023, pp. 17-20. The outlook is perhaps more doubtful in France: *see* Colombet, Astrid Mignon, and Alfred Reboul. "Justice Climatique : Les Limites Du Name and Shame." *Esprit*, 2023, no. 10, 2 Oct. 2023, pp. 10-13.

[43] It has been argued that "derivative litigation challenging strategy on climate risk may … not be worth powder in shot" because, amongst other things, even if a *prima facie* case for a breach can be made, "it is unlikely that [directors] will be unable to come up with at least one principled reason for the court to exercise their discretion to refuse permission for such allegations. This will then leave the claimant shareholder liable for costs, as they are allocated on English-rule loser pays …": Gibbs-Kneller, David. "Corporate Strategy on Climate Risk in the Courtroom: Not Worth Powder in Shot." *Environmental Law Review*, vol. 25, no. 4, 1 Dec. 2023, pp. 326–335 at p. 330. There is a glimmer of a chance, however small, in *McGaughey* (n 13) *supra* at [90], where, on appeal, Lord Justice Asplin left open the possibility of climate-related beneficiary derivative claims, which are rooted in the law of trusts.

[44] If Walter Leechman had advised May Donoghue that, based on the precedent of *Mullen v AG Barr & Co Ltd* [1929] SC 461, a writ against David Stevenson would fail, we would never have had *Donoghue v Stevenson* [1932] AC 562.

[45] Consider *Hedley Byrne & Co Ltd v Heller & Partners Ltd* [1964] AC 465, in which the House of Lords cited *obiter* remarks in an earlier case, *Candler v Crane, Christmas & Co* [1951] 2 KB 164.

[46] In *Murphy v Brentwood District Council* [1991] 1 AC 398, the House of Lords overruled an earlier transformative judgment, *Anns v Merton LBC* [1978] AC 728, in part because of how the expansive negligence liability principles in *Anns* were giving rise to difficult decisions such as *McLoughlin v O'Brien* [1982] 2 All ER 298.

[47] Especially indications of reluctance to follow precedent: *see*, e.g., Goff LJ in *Elliott v C* [1983] 1 WLR 939, who was bound by the test set in *R v Caldwell* [1982] AC 341: "I agree with the conclusion reached by Glidewell J, but I do so simply because I

especially within the novel domain of climate litigation, these factors need to be carefully evaluated to gain a better sense of the prospects of success. In a case like *ClientEarth*, where there was ultimately no indication that the courts would diverge from well-established company law principles, such prospects were minimal.

Perhaps it is disingenuous to criticise the approach in *ClientEarth* without offering a strategically superior alternative. The unfortunate truth, however, is that there does not appear to be one. There is a broader underlying aversion towards issuing climate-positive decisions in British courts, because such a decision would ordinarily be seen as trespassing on the province of the executive.[48] Exceptions to this only arise if the legislative will can be invoked.[49] Further, in the absence of a codified constitution which would set out with clarity the role of the courts to safeguard the citizenry in certain specific ways, an *Urgenda*[50]-style case based on the European Convention on Human Rights would also likely fail, given that the relationship between climate change and the fundamental rights that the ECHR protects is not so clear and unambiguous as to overcome the basic principle that the courts defer to the sovereign Parliament on such matters of policy.[51]

In the end, then, the correct strategy is something of a waiting game—at least for the UK. The judicial restraint prevalent in these fields might be slowly relaxed if persuasive precedent in other common-law jurisdictions (Australia, New Zealand, South Africa, and the United States especially) is built over time, until it constitutes an overwhelming case for a change in position. Alternatively, certain statutory proposals involve empowering the courts to exercise greater oversight on climate issues.[52] In either case, a major shift in judicial or legislative position would be required. Currently, without such a shift, fertile

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believe myself constrained to do so by authority. I feel moreover that I would be lacking in candour if I were to conceal my unhappiness about the conclusion which I feel compelled to reach." Not more than two decades later, the test was overturned: *R v G and Another* [2003] UKHL 50, [2004] AC 1034. Alternatively, especially in the US, the 'general sense' can stem not from the judiciary, but from the public—*see* Bassok, Or. "The Supreme Court's New Source of Legitimacy." *University of Pennsylvania Journal of Constitutional Law*, vol. 16, no. 1, Oct. 2013, pp. 153–99.

[48] *see*, e.g., *R (Friends of the Earth & Others) v Heathrow Airport Ltd* [2020] UKSC 52 at [144]: "The authority must be free to form a reasonable view of its own on the nature and amount of information required, with the specified considerations in mind … A standard more intense than that would risk the court being invited, in effect, to substitute its own view on the nature and amount of information included in environmental reports for that of the decision-maker itself. This would exceed the proper remit of the court."

[49] *see*, e.g., *R (Friends of the Earth & Others) v SoS for Business, Energy, and Industrial Strategy* [2022] EWHC 1841 (Admin) at [239]: "The defendant's narrower interpretation of the scope of s.14 is not supported by the expert role given by the CCA 2008 to the CCC. On the contrary. The legislation requires Parliament to be provided with statements each year by the Secretary of State … Those proposals and policies are the central focus of the methods laid down in the statutory scheme for meeting the carbon budgets and the 2050 target."

[50] *State of the Netherlands v Urgenda Foundation* ECLI:NL:HR:2019:2006. This case is the first successful instance of climate litigation which engaged with the ECHR.

[51] The most a senior court could do in relation to primary legislation is to issue a 'declaration of incompatibility' with the ECHR, but this is unlikely given the constitutional severity of such a declaration and the legally tangential connection between climate change and human rights. A positive obligation might be imposed on the executive in the face of inaction, but this is also unlikely in light of the Climate Change Act 2008, which displaces the court's role in this area.

[52] Including in company law: *see*, e.g., the proposed Better Business Act, which would amend s.172 to include an obligation that a company operates "in a manner that also—(a) benefits wider society and the environment in a manner commensurate with the size of the company and the nature of its operations; and (b) reduces harms the company creates or costs it imposes on wider society or the environment, with the goal of eliminating any such harm or costs" *The Better Business Act*. Such an enactment would be revolutionary by compelling courts to depart from the Business Judgement Rule more frequently.

options for potential British climate litigants are few and far between. One small region that has seen success is greenwashing and the regulation of advertising campaigns; in October 2022, for instance, the Advertising Standards Authority ruled that HSBC posters which misrepresented their contribution to the climate crisis were misleading, and HSBC was barred from promoting similar materials.[53]

It must also be noted that litigation does not exist in a vacuum. A holistic strategy for an organisation like ClientEarth ought to also include lobbying for statutory reform, supporting academic work on environmental law, assisting with advocacy, influencing judicial reasoning through *amicus* briefs, and supporting public awareness through the dissemination of educational material. All these elements help build a framework which might eventually precipitate a shift in popular and social values so great that the relationship between the law and the climate is generally re-evaluated. This, in turn, creates the foundation for effective future litigation. Encouragingly, ClientEarth recently submitted an *amicus* brief at the Inter-American Court of Human Rights as it considers how climate-related obligations interact with the human rights framework in the Americas.[54]

ClientEarth was a strategic error, but perhaps ultimately the decision to litigate cannot be condemned. The vast majority of climate-based cases under British law suffer from the same judicial predilection for restraint. Until we arrive at a broader recasting of the judiciary's role in regulating climate change, litigation strategy needs to be construed more broadly, and should involve some of the non-litigative components listed above. That way, organisations like ClientEarth set the stage for an explosion in successful climate cases once such a recasting occurs. British courts, in turn, must consider whether it is right to continually defer to the legislature, or if the climate crisis is such a gross and fundamental threat to the nation and the world that they, as an organ of the state, have a higher duty—both ethical and constitutional—to ensure that the hubris and inaction of the other elements of government does not engender our collective downfall.

IV. Conclusion.

ClientEarth is a non-profit organisation, and a registered charity. It ought to use the funds it raises appropriately and avoid cases such as this, where a cursory examination of the precedent and of the general principles governing company law would have disclosed a near-zero chance of success. This is not unique to this area of law, and a paradigm shift is required for climate lawsuits in the UK to see greater success—as such, the institutional strategy of British climate litigation charities should be broadened to include non-litigative elements. Globally, the efforts of such groups are to be commended, and more successful rulings are being handed down.[55] As *ClientEarth* shows, however, attempts to trailblaze, especially in branches of law checked by judicial restraint, are liable to misfire.

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[53] *ASA Ruling on HSBC UK Bank Plc*, 19 October 2022. As per *Friends of the Earth* (n 49) *supra*, challenges can also succeed where executive action clearly violates a provision in an Act of Parliament, but the near-total control exercised by the Government over Parliamentary lawmaking renders such violations infrequent.

[54] "*Amicus Curiae* Brief: On the Issues in the Request for an Advisory Opinion on the Climate Emergency and Human Rights." *ClientEarth*, https://www.clientearth.org/media/uoxeopoj/iacthr_ce_final.pdf.

[55] In the British context, *see ASA Ruling* (n 53) and *Friends of the Earth* (n 49) *supra*. More generally, *see* Tigre, Maria Antonia, and Margaret Barry. "Climate Change in the Courts: A 2023 Retrospective." *Sabin Center for Climate Change Law: Publications*, Dec. 2023.

Reforming Social Protection in Support of the Green Transition

Serra Okumuş*

I. Introduction.

Despite the global consensus on the need to address climate change, governments have failed to enact sufficiently transformative policies to offset current trends.[1] Following the transboundary framing of the climate crisis, conjectures on the policymaking gap have pointed to a collective action problem, compounded by concerns around less-environmentally conscious states "freeriding" on the costly efforts of others to curb global emissions.[2] Accordingly, the democratic sensibilities and legislative capacities of individual states have been relegated to a secondary role in seeking a global and ecologically sustainable *modus operandi*.[3]

A growing body of literature is now recognizing the role of the state, through its domestic facilities, to address climate issues. According to Meadowcroft, the environment has become intertwined with the modern state: involvement in climate matters is 'understood as an essential part of what legitimate states do' and the environment is now an avenue for political contestation.[4] He argues that these elements point to the emergence of the 'ecological state,' albeit 'weakly institutionally embedded' in its contemporary form, whereby state functions such as economic growth, welfare provisions, and security have taken on environmental functions.[5]

Keeping with the body of social sciences scholarship that has shifted focus from global to national policy solutions for addressing climate change, this article considers the relationship between the "eco-welfare state" and its democratic constituency in the context of liberal democracies. The risk of economic and social disenfranchisement that decarbonization poses to voter bases has been illustrated as a determinant of democratic backlash to climate policies.[6] Informed by these findings, I discuss the extent to and the mechanism through which the state can garner political support for a green transition. This

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[1] *see*, e.g., the wealth of literature published by the UNFCCC.

[2] Ostrom, Elinor. "Polycentric Systems for Coping with Collective Action and Global Environmental Change." *Global Environmental Change*, vol. 20, no. 4, Oct. 2010, pp. 550-57; Stern, Nicholas. The Economics of Climate Change: The Stern Review. Cambridge University Press, 2007, cited in Colantone, Italo, et al. "The Political Consequences of Green Policies: Evidence from Italy." *The American Political Science Review*, vol. 118, no. 1, Feb. 2024, pp. 108-26.

[3] Colantone et al. (n 2) *supra*.

[4] Gough, Ian, et al. "JESP Symposium: Climate Change and Social Policy." *Journal of European Social Policy*, vol. 18, no. 4, Nov. 2008, pp. 311

[5] ibid.

[6] Bechtel, Michael M., et al. "Interests, Norms and Support for the Provision of Global Public Goods: The Case of Climate Co-Operation." *British Journal of Political Science*, vol. 49, no. 4, Oct. 2019, pp. 1333-55; Bergquist, Parrish, et al. "Combining Climate, Economic, and Social Policy Builds Public Support for Climate Action in the US." *Environmental Research Letters*, vol. 15, no. 5, May 2020, p. 054019; Meckling, Jonas, et al. "Winning Coalitions for Climate Policy: Green Industrial Policy Builds Support for Carbon Regulation." *Science*, vol. 349, no. 6253, 2015, pp. 1170-71; Kono, Daniel Yuichi. "Compensating for the Climate: Unemployment Insurance and Climate Change Votes." *Political Studies*, vol. 68, no. 1, Feb. 2020, pp. 167-86; Gaikwad, Nikhar, et al. "Creating Climate Coalitions: Mass Preferences for Compensating Vulnerability in the World's Two Largest Democracies." *The American Political Science Review*, vol. 116, no. 4, Nov. 2022, pp. 1165-83.

article thus marries the logics of the welfare state and the ecostate to explore the specific policy mechanisms that can alleviate any losses that domestic constituents may incur in the "postgrowth context".[7]

II. The Eco-Welfare State in a Postgrowth Context.

The need for an ecologically sustainable form of capitalism can be articulated by problematizing the capitalist conceptualization of nature. A valuable framework in this regard is posited by Polanyi, which characterizes the modern economic system as a "market economy" governed entirely by prices.[8] Elements of production and distribution, which Polanyi delineates as goods, labour, land, and money, are thus regarded as "having been produced for sale", subject to a "self-regulating mechanism" of supply and demand.[9] This dynamic, Polanyi notes, is highly problematic. Just as labour is "only another name for a human activity which goes with life itself", Polanyi emphasizes that land is not in fact produced for sale, instead, it is "another name for nature, which is not produced by man" at all.[10]

The problem of labour—that is, of attempting to reconcile the needs of the market with the needs of the individual—occupied modern states in the 19th and 20th centuries, dictating the extent to which the state must provide protection for citizens against the free market. This dynamic led to the emergence of what Esping-Andersen terms "welfare capitalism," whereby regimes are classified according to the level of decommodification they offer citizens.[11] Here, decommodification reflects the extent to which citizens can sustain a standard of living without having to rely exclusively on market mechanisms; achieved through state-provided welfare provisions in the fields of 'social security, health, education and training, and housing', among others.[12] Keeping within this paradigm, Gough investigates the role of social protection in relation to climate change. Applying Polanyi's commodification of land to the logic of welfare capitalism, he asks whether the nature question can "foster the rise of the eco-state", just as the labour question has led to the emergence of the welfare state in the 20th century.[13] Within this framework, the eco-state would seek to implement policies that can "decommodify" nature, parallel to how the welfare state has sought to decommodify labour through social protection.[14]

But how can nature be decommodified? This question highlights a key contradiction in environmental policymaking in welfare states. The mechanism of welfare provision relies on economic growth, which determines the state's fiscal capacity to enact social protection policies.[15] For instance, in OECD

[7] Hirvilammi, Tuuli, and Max Koch. "Sustainable Welfare beyond Growth." *Sustainability*, vol. 12, no. 5, 5, Jan. 2020, p. 1824.
[8] Polanyi, Karl. *Great Transformation: The Political and Economic Origins of Our Time*. Beacon Press, 2001.
[9] ibid at 72; 75.
[10] ibid.
[11] Esping-Andersen, Gøsta. "The Three Political Economies of the Welfare State." *International Journal of Sociology*, vol. 20, no. 3, 1990, pp. 92-123.
[12] ibid; Gough, Ian. *The Political Economy of the Welfare State*. Houndmills-Macmillan, 1979, p. 3.
[13] Gough et al. (n 4) *supra* at 327.
[14] Gough et al. (n 4) *supra*; Esping-Andersen (n 11) *supra*.
[15] Hirvilammi, Tuuli, et al. "Social Policy in a Climate Emergency Context: Towards an Ecosocial Research Agenda." *Journal of Social Policy*, vol. 52, no. 1, Jan. 2023, pp. 1-23.

countries, government spending on old-age pensions is estimated to reach 9.4% of GDP by 2050.[16] This is a huge proportion, which underlines that welfare states are "growth-dependent" in supplying social services.[17] However, continuous growth is antithetical to the demands of a green transition. In fact, environmental policies seek to curb greenhouse gas emissions, which point to the phasing out of traditionally growth-driving industries such as energy and manufacturing. Just as the decommodification of labour can be achieved through protecting the labour force, i.e., citizens, against social risks, then the decommodification of land necessitates a reconfiguration of the political and economic systems to minimize the exploitation of natural resources. Accordingly, an "eco-welfare state" model must provide welfare provisions while foregoing continuous economic growth, even as slowed growth has traditionally implied a retrenchment of social protections.[18] This conflict of interest between social and environmental policy indicates that an ecologically sustainable form of capitalism can only be achieved in a 'postgrowth' context, whereby the provision of social protection is decoupled from carbon-intensive growth models.[19]

Ruggie's embedded liberalism thesis offers a viable mechanism for fostering democratic support for this decoupling.[20] In the traditional conceptualization of embedded liberalism, the state takes up a "mediating role between market and society" to mitigate "socially disruptive domestic adjustment costs" and economic "vulnerabilities" that might result from the globalization of trade.[21] In international trade literature, this paradigm gave rise to the compensation thesis, which posits that increased social spending fosters domestic support for free trade and globalization.[22] Applying this logic to the green transition, we can conjecture that the state must likewise mitigate, through social protection, socioeconomic costs associated with phasing out carbon-intensive sectors in order to contribute to and benefit from multilateral climate action at a global level. Therefore, the state can offer domestic compensation for the "losers" of green policies as a way to reconcile protection for individuals and the environment.

III. Can Compensation Through Social Protection Garner Support for Green Policies?

Informed by the preceding theoretical discussion, this section of the article examines empirical support for the extent to which compensation in the form of social protection impacts democratic support for climate policies. This relationship can be illustrated by reactions to Milan's Area B policy, enacted in July 2018 by the social democratic mayor. The policy, aimed at reducing air pollution in the city, limited the circulation of certain types of vehicles for twelve hours a day in an area "where 97% of the city population

[16] OECD. *Pensions at a Glance 2019: OECD and G20 Indicators*, cited in Corlet Walker, Christine, et al. "Welfare Systems without Economic Growth: A Review of the Challenges and next Steps for the Field." *Ecological Economics*, vol. 186, Aug. 2021, p. 3.
[17] Tuuli and Koch (n 7) *supra*.
[18] ibid.
[19] ibid at 448.
[20] Ruggie, John Gerard. "International Regimes, Transactions, and Change: Embedded Liberalism in the Postwar Economic Order." *International Organization*, vol. 36, no. 2, 1982, pp. 379-415. I return to the viability of this decoupling in the final section. The current focus is simply on fostering democratic support for the transition.
[21] ibid at 392; 399.
[22] Cameron, David R. "The Expansion of the Public Economy: A Comparative Analysis." *The American Political Science Review*, vol. 72, no. 4, 1978, pp. 1243-61; Rodrik, Dani. "Why Do More Open Economies Have Bigger Governments?" *Journal of Political Economy*, vol. 106, no. 5, 1998, pp. 997-1032; Hays, Jude C., et al. "Government Spending and Public Support for Trade in the OECD: An Empirical Test of the Embedded Liberalism Thesis." *International Organization*, vol. 59, no. 2, 2005, pp. 473-94.

resides."[23] Although the ban was directed at vehicles that did not meet the European Union's emission standards, it effectively limited the circulation of older vehicles, acutely impacting the mobility of lower-income citizens around the city.[24] A compensation scheme was subsequently rolled out, whereby affected residents could receive monetary assistance to buy emission standard-compliant vehicles or public transport passes. According to Colantone et al., the average incentives distributed by the city of Milan were €2,328 in 2019 and €3,557 in 2020, close to the €3,750 median loss estimated to have been incurred by the ban; in other words, the compensation nearly nullified the (fiscal) impact of the policy.[25] Regarding the relationship between compensation and democratic backlash, the authors found that the individuals affected by the ban were 13.5% more likely to change their voting preferences in favour of the populist Lega party in the 2019 European Parliament elections.[26] Crucially, however, individuals who applied for and received compensation for their financial losses did not exhibit a higher likelihood of shifting their support to Lega compared to unaffected car owners.[27] Although the authors point out that it is not possible to speak conclusively of a causal relationship, their findings nonetheless illustrate a link between democratic support and compensation for disenfranchised groups.

Support for green policies is correlated with increased welfare provisions at a more systemic level, as well. Bergquist, Mildenberger, and Stokes find that public support for climate policies in the United States increases if bundled with welfare provisions. They estimate that the inclusion of affordable housing, $15 minimum wage, health insurance, and free college tuition increases support for the policy by 11% compared to if no social policies were present.[28] There is also empirical support that compensation can lead to democratic support for green policies not only from the public opinion side, but also among legislators. Kono posits the notion that resistance to decarbonization policies from carbon-intensive industries can be overcome through unemployment insurance. Analysing voting patterns for the 2009 American Clean Energy and Security Act, which sought to establish a cap-and-trade mechanism for GHG emissions, he finds that generous unemployment insurance for those who stand to lose their jobs "makes it easier" for legislators to vote in favour of climate bills in the US Congress.[29] This is because insurance can supply workers in carbon-intensive industries with monetary support while searching for a new job, which can, "at the margins, make workers less resistant to climate change legislation."[30]

These findings further support that the existence of compensation can foster support for climate policies, but the composition of compensatory mechanisms is also relevant. Climate policy creates "long-term benefits" with intangible, arguably marginal impacts on an individual basis while materially and immediately "[hurting] certain groups."[31] As these "concentrated losses" can jeopardize overall gains,

[23] Colantone et al. (n 2) *supra*.
[24] ibid at 4.
[25] ibid.
[26] ibid at 2.
[27] ibid.
[28] Bergquist at al. (n 6) *supra* at 3.
[29] Kono (n 6) *supra* at 174; 182.
[30] ibid at 173.
[31] ibid at 172.

compensation should take the form of targeted social protection policies that specifically mitigate opposition from the groups that might experience adverse effects.[32]

We can thus turn our focus to specific policy compositions that can appeal to communities that are "sensitive to the material costs of addressing climate change."[33] Keeping with existing scholarship, I will discuss social protection mechanisms in the context of energy-intensive industries. These industries are highly influential in climate policy, as their size and domestic prominence can determine the reach of carbon-reduction measures.[34] Furthermore, communities comprising 'mono-industry economies', which fossil fuel sectors tend to foster, stand to incur disproportionate losses if decarbonization policies are enacted, making their policy preferences a valuable case study.[35]

In order to determine which compensation mechanisms can 'activate policy buy-in,' Gaikwad et al. test support for various policy compositions among 'climate-policy vulnerable' communities: direct transfers to individuals likely to lose their jobs due to decarbonization, carbon tax rebates, investments in adaptation infrastructure, and investments in green energy.[36] They find that in fossil fuel-dependent regions, which are not tangibly affected by climate change, policy-vulnerable groups prefer direct transfers to workers at risk, and value adaptation investment or tax rebates less.[37] When other determinants are introduced, however, compensation preferences change. Specifically, if disenfranchised groups live in areas threatened by climate change, members tend to value higher government expenditure for 'broad-based instruments', such as infrastructure investments, thus indicating that both material costs from employment loss and physical climate risks inform policy preferences.[38]

Gaikwad et al.'s findings highlight two further points. First, they demonstrate that the deployment of the policy mechanism—whether compensation is directed at individual households or broader communities—is also relevant. The authors attribute this to the fact that "both material and nonmaterial factors are important determinants of climate policy" in communities where "group affiliation" and identity are politically salient.[39] Second, their findings indicate that constituents are guided by considerations other than self-interest vis-à-vis climate policy. They observe that the average voter in both the United States and India is "willing to allocate meaningful funds for transfers to fossil fuel workers and for infrastructural investments in climate-vulnerable communities."[40] This finding is consistent with

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[32] Gaikwad et al. (n 6) *supra* at 1180; Colantone et al. (n 2) *supra*.
[33] Gaikwad et al. (n 6) *supra* at 1165.
[34] Hughes, Llewelyn, and Johannes Urpelainen. "Interests, Institutions, and Climate Policy: Explaining the Choice of Policy Instruments for the Energy Sector." *Environmental Science & Policy*, vol. 54, Dec. 2015, pp. 52-63; Steves, Franklin, and Alexander Teytelboym. "Political Economy of Climate Change Policy." *SSRN Electronic Journal*, 2013; Ward, Hugh, and Xun Cao. "Domestic and International Influences on Green Taxation." *Comparative Political Studies*, vol. 45, no. 9, Sept. 2012, pp. 1075-103.
[35] Carley, Sanya, et al. "Adaptation, Culture, and the Energy Transition in American Coal Country." Energy Research & Social Science, vol. 37, Mar. 2018, pp. 133–39; Gaikwad et al.; Bergquist et al.
[36] Gaikwad et al. (n 6) *supra* at 1165.
[37] ibid.
[38] ibid at 1166.
[39] ibid at 1177.
[40] ibid at 1166.

the "just transition" framework, and indicates that garnering democratic support for green policies can benefit from appeals to principles of equity and fairness.[41] Taken together, these auxiliary observations carry important implications for green policymaking. In particular, they demonstrate that non-material elements informed by policy preferences might support, alongside eco-social policies themselves, the green transition.

Overall, social sciences scholarship points to empirical backing for the claim that social protection policies can foster democratic support for climate policies by compensating constituents against potential risks. The evidence discussed also emphasizes that the specific policy composition and deployment mechanisms can function as determinants of democratic support. Before considering the implications of these findings for the transition to an ecologically sustainable form of capitalism, a caveat is appropriate. There is a dearth of scholarship on the exact link between social protection and democratic support for the eco-transition. Taking the relationship between support for trade openness and domestic compensation as a model, I have compiled evidence for compensation with that for social protection in my discussion to bridge this gap. In particular, I have grouped one-off compensatory awards (monetary support for purchasing vehicles and occasional carbon tax rebates), long-winded risk mitigation policies (climate adaptation infrastructure and investments in green energy technologies), and more traditional welfare schemes (unemployment insurance, affordable housing, $15 minimum wage, health insurance, free college tuition) as social protection. I do not consider this to be a conceptual leap, as these mechanisms, whether directly framed as 'social protection' or not, are aimed at mitigating any eco-social losses that can be incurred in the transition to an ecologically sustainable economic model. Moreover, they can alleviate democratic backlash by cultivating the government's credibility that it will protect its constituents against risks that climate policies might bring about in a postgrowth context.[42] As such, I maintain that the semantic conflation I have engaged in regarding different policy mechanisms does not lead to a blurring of theoretical boundaries, and the relationship between 'social protection' and democratic support for the green transition is still demonstrable.

IV. Is Social Protection Reform Sufficient for the Green Transition?

An ecologically sustainable form of capitalism necessitates a postgrowth logic that simultaneously decommodifies nature and guards constituents against potential socioeconomic losses of the transition. The problem remains, however, of delivering increasing social protection while decoupling welfare from GDP growth. As established, targeted compensation mechanisms, accounting for the 'uneven costs' of green policies, are crucial for garnering political support for this paradigm shift.[43] The discussion so far, however, has not taken on the mechanics of reconciling *the dependence of welfare provisions on growth* with *the dependence of green policies on degrowth* (or postgrowth), although I posit this is necessary for the decommodification of nature. This omittance is intentional; I have focused only on the question of garnering support for the eco-welfare state, not on the viability of enacting an institutionally embedded eco-welfare state. I leave this question to those more apt at economic policymaking. Nevertheless, I will

[41] ibid at 1173.
[42] Autor, David H., et al. "Trade Adjustment: Worker-Level Evidence." *The Quarterly Journal of Economics*, vol. 129, no. 4, Nov. 2014.
[43] Colantone et al. (n 2) *supra*.

touch upon potential hindrances that the realities of governance pose to the compensation thesis in the climate context.

In the absence of an effective mechanism for increasing social spending without GDP growth, the government will conceivably rely on tax revenue. The link between high taxation and welfare provisions is conclusively established by Esping-Andersen.[44] However, a government that reverts to tax raises "is bound to face opposition unless the benefits are sufficiently tangible."[45] And for climate policies, the benefits—clean air, biodiversity, reduction in heat-aggravated diseases, "greater energy security", etc.—are elusive, intangible benefits to constituents in developed countries. Gaikwad et al. find that the average voter is "is willing to divert a nonnegligible proportion of funds collected from increased household energy costs to compensate job losses in the fossil fuel industry", indicating the possibility of appealing to a solidarity-based policy framework.[46] On the whole, however, reactions to "carbon taxes" have been mixed, generally characterized by opposition.[47] The question thus remains whether the compensation provided against the losses to be incurred through decarbonization would be sufficient to appease public opposition against the increased taxes arising from such compensatory mechanisms.

Secondly, the success of any social protection mechanism ultimately depends on constituents' belief that the government will guard them against risks. For traditional welfare schemes, the feedback loop can function quickly, allowing the government to adjust and signal its credibility and commitment to constituents. For climate policy, however, especially for adaptation-focused investments, the effects of successful provisions can manifest across generations. This can both exacerbate constituents' limited level of trust that the government will credibly redistribute gains, and disincentive incumbents to invest in long-term schemes in a democratic context with short term times.[48] In other words, policymakers must be keenly aware of the "political trade-offs" that green policies entail.[49]

Put simply, there is a case to be made that democratic support for green policies can be fostered through compensation in the form of social protection. Whether this is sufficient for a transition to an ecologically sustainable form of capitalism, however, is unclear. The latter would depend both on a complete reordering of welfare mechanisms to decouple the mitigation of eco-social risks from GDP growth, and on adjusting constituents' expectations for receiving tangible benefits in a relatively limited time span from climate policies. This is no easy feat.

V. Conclusions.

This article has delved into the intricacies of domestic green policymaking, emphasizing the importance of social protection reform in garnering democratic support for climate policies within liberal

[44] Esping-Andersen (n 11) *supra* at 111.
[45] Gaikwad et al. (n 6) *supra* at 1181.
[46] Ibid.
[47] Ewald, Jens, et al. "Understanding the Resistance to Carbon Taxes: Drivers and Barriers among the General Public and Fuel-Tax Protesters." *Resource and Energy Economics*, vol. 70, Nov. 2022, p. 101331.
[48] Ostrom (n 1) *supra*; Gazmararian, Alexander F., and Dustin Tingley. *Uncertain Futures: How to Unlock the Climate Impasse*. Cambridge University Press, 2023.
[49] Colantone et al (n 2) *supra*.

democracies. By drawing on theoretical frameworks proposed by Polanyi, Esping-Andersen, and Ruggie, it has elucidated the need for an 'eco-welfare state' that balances economic growth with environmental sustainability while safeguarding constituents against potential socioeconomic losses. The empirical evidence presented underscores the significance of compensation mechanisms in alleviating democratic backlash and fostering support for climate initiatives, particularly when tailored to address the specific needs and concerns of affected communities.

However, this article also highlights the complexities and challenges inherent in implementing social protection reforms within the context of climate policy. The tension between increasing welfare provisions and decoupling them from GDP growth poses significant hurdles, as does the necessity of convincing constituents of the long-term benefits of climate action amidst immediate economic costs. Moreover, the practical realities of governance, including opposition to tax increases and the time lag between policy implementation and tangible outcomes, further complicate the equation.

While social protection reform holds promise as a means of facilitating the transition to an ecologically sustainable form of capitalism, it is clear that it alone may not be sufficient. Achieving such a transition will require not only a reordering of welfare mechanisms but also a fundamental shift in constituents' expectations and policymakers' approaches to governance. In navigating these challenges, policymakers must remain cognizant of the political trade-offs involved and work towards building a consensus that prioritizes both environmental stewardship and social equity in the face of climate change's existential threat.

Do Developing Countries Have a Responsibility for Sustainable Development?

Xiaoyang Du*

Sustainable development, as defined by the Brundtland Commission, is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.[1] The 21st century has seen the rapid development of many parts of the world including many economies in the continents of Asia, South America, and Africa. However, such unprecedented economic growth in large portions of the world further exacerbates the threat of catastrophe. With developed countries having already undergone significant portions of their industrialisation throughout history, should these countries aim to use their wide resources to encourage sustainable growth, or should it be the responsibility of developing countries to ensure that they grow towards a future that exists?

I. Climate Change and Trade Policy.

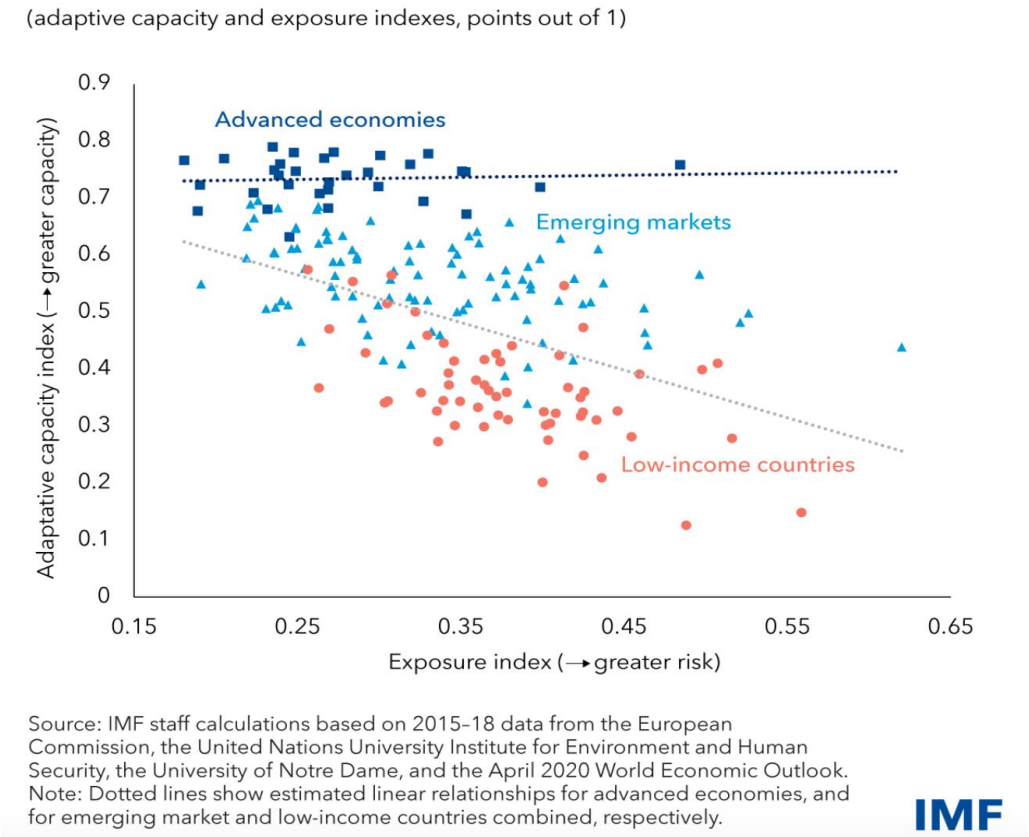


Figure 1: Unequal Costs of Climate Change (Source: Georgieva, 2020).

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[1] World Commission on Environment and Development. "Our Common Future." 1987.

Climate change has disproportionately affected the developing world, with a severe exposure to extreme weather events (Figure 1), whereas for the developed world, climate change will not have such major economic effects, with the USA predicted to spend at most 3% of their GDP by the end of the 21st century.[2] Developed nations are fortunately positioned in terms of their geography, as well as having the necessary monetary and technical resources to combat potential significant long-term damages brought about by climate change. It is imperative that they take the initiative to provide solutions such as by absorbing climate refugees.

It could nevertheless be argued that each country is responsible for their own economic well-being, and there are consequences to developing countries that decide to undergo rapid industrialisation without considering the costs of their growth. Therefore, developing countries have a responsibility to sustainability grow, and the sustainability of their own growth will directly affect their long-term economic performance. If it were the case that developing countries placed the burden of sustainable growth on developed economies, then a moral hazard might occur such that the developing country overproduces in an unsustainable manner and expects the developed world to clean up after their economic inefficiencies through methods such as solar geoengineering and carbon removal.[3]

This, however, is an unconvincing argument. First, even though developing countries are undergoing a period of significant industrialisation, developed economies continue to grow at exponential rates, and they are still the greatest consumers of energy per capita.[4] Second, the constraint on growth that could occur from placing sustainability measures on developing economies may prevent them from creating economic circumstances closer to the level of developed countries, as these developed countries underwent industrialisation periods much earlier than the existing developing countries without any such constraints. With sustainability measures in place, there might be persistent economic inequality between the developed and developing world. For example, Bangladesh has been banned from constructing a natural gas fertiliser factory due to the need for transformation to renewable energy, while ignoring the fact that this project could triple net productive output, undermining both energy and food security.[5] Third, developing economies are only undergoing their first period of industrialisation, and do not have sufficiently mature tertiary and quaternary sectors to invest in research in order to develop the technologies that could bring about sustainability such as renewable energy and waste minimisation systems. For these reasons, it is both unfair and implausible to ask developing economies to grow and to develop sustainable production methods simultaneously.

Nonetheless, in some countries in the middle of development, this unification may be feasible. The rapid industrialisation of Asia has meant that these economies have capable economic production methods to create sustainable solutions. China owns five of the world's six largest solar manufacturing companies

[2] Mulholland, D. "Quantifying the Multiple Benefits of Energy Efficiency and Renewable Energy: A Guide for State and Local Governments." *United States Environmental Protection Agency*. 2018.
[3] Wagner, Gernot, and Daniel Zizzamia. "Green Moral hazards." *Ethics, Policy & Environment* vol. 25, no.3, 2022, pp. 264-280.
[4] Goldstein, B., Gounaridis, D., & Newell, J. P. "The Carbon Footprint of Household Energy Use in the United States." *Proceedings of the National Academy of Sciences*, vol. 117, no. 32, pp. 19122-19130.
[5] Tongia, Rahul. "It is Unfair to Push Poor Countries to Reach Zero Carbon Emissions Too Tarly." *The Brookings Institute*, 26 Oct. 2022.

and the world's largest wind turbine manufacturer.[6] Due to significant levels of economic growth, these economies have already been affected by the local externalities of production. Developing countries in later stages of industrialisation, notably some Asian economies, have both the technological capabilities to produce sustainable solutions and face the direct environmental consequences of rapid economic growth. Sustainable technologies may not be developed in a form of preventative treatment, but only once the issues have arisen, and these nations will inevitably solve externality issues such as air pollution and natural resource degradation, as the effect on their own economies is significant. For example, in 2013, localised air pollution cost China $535 billion dollars (6.5% of GDP) due to losses in labour productivity associated with this externality.[7]

This has developed in a similar fashion to historical Western industrialisation. A quick rate of industrialisation led to the cholera pandemic in the UK in the 19th century, as a result of the high levels of waste and water pollution.[8] Such an urgent issue accelerated the construction of the sewage system, which still functions in London and has been upgraded to accommodate the city's growing population. This demonstrates that sustainability can be implemented once an economy has started to see the negative consequences of growth on a local level, yet preceding negative consequences on a global level. A local solution will aid the global economy given that the solution is shared with other countries even if the general global economy does not face the problem yet. In the 1970s, with Beijing experiencing severe air pollution, the Chinese government decided to construct a subway system to ease traffic and rising ozone concentration. Beijing now operates ten subway lines which transport more than 3 billion passengers annually.[9] Additional government policies have included energy infrastructure optimisation, coal-fired pollution control and vehicle emission controls.[10]

However, these localised negative externalities are not only caused by the level of production for the domestic economies of these developing countries, but also to meet the needs of the developed world. Per capita, the developed world is the largest consumer of energy, goods, and services. Since the primary and secondary sectors are still mainly located in the developing world, although the calculation of carbon emissions can be balanced by accounting for trade, the burden of manufacturing for the whole world rests in the developing world (Figure 2). For developing economies undergoing industrialisation, such as India, China and Bangladesh, their GDP per capita does not reflect the quantity of air pollution that is being locally emitted. Their GDP per capita is comparatively low compared to the developed world, but their air quality index is several standard deviations below the rest of the world.

[6] Buckley, T., and Nicholas S. "China's Global Renewable Energy Expansion." *Institute for Energy Economics and Financial Analysis*. 2017.
[7] Chiu, Dominic. "The East is Green: China's Global Leadership in Renewable Energy." *New Perspectives in Foreign Policy*, vol. 13, 2017, pp. 3-12.
[8] Evans, Richard J. "Epidemics and Revolutions: Cholera in Nineteenth-Century Europe." *Past & Present*, vol. 120, 1988, pp. 123-146.
[9] "GEF-6 China Sustainable Cities Integrated Approach Pilot Project Quarterly Newsletter." *World Bank*, 2021.
[10] He, Kebin, et al. "A Review of 20 Years' Air Pollution Control in Beijing." United Nations. 2019.

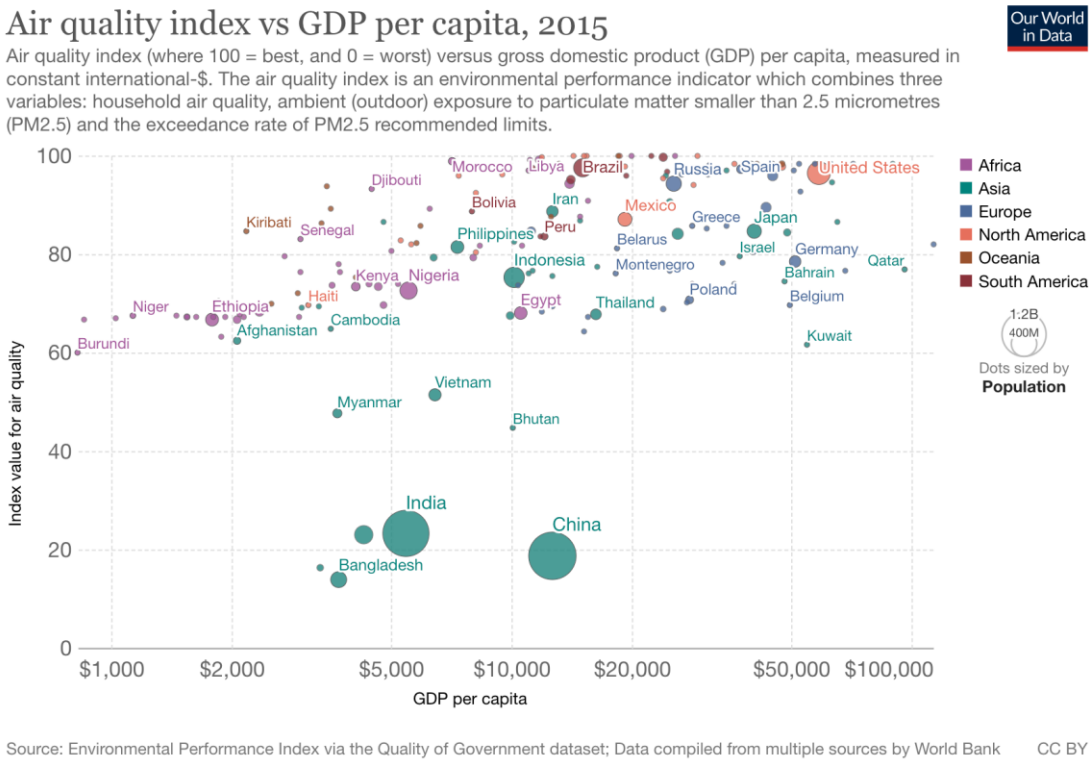


Figure 2: Air Quality index vs GDP per Capita (Source: World Bank, 2015).

A potential riposte is that protectionism policies should be encouraged to punish and prevent carbon transfer to the developing world. Through a protectionist policy such as increasing export prices by developing countries, this could potentially bring in greater tax revenues so that governments can develop sustainable solutions more rapidly, or alternatively depending on the price elasticity of demand of such products, may allow countries to reduce their focus on producing for the developed world, and instead focus on the development of their domestic economies. For developed countries, they can adjust for the effect of production in developing countries by proactively attaching a price to the emission. For example, the EU is implementing a Carbon Border Adjustment Mechanism to give fair prices on the emission outside the EU. This form of protectionism does create an incentive to reduce lifecycle emissions.

II. Resource Depletion and the Second-Hand Market.

Beyond just climate change and negative externalities, a significant focus of sustainability is ensuring that future generations have a sufficient quantity of natural resources for production. Efficiency is defined as the maximum output created with the minimum input of natural resources and at the lowest cost. An economy would ideally like to maintain or increase the quantity of raw materials that can be used for production so that future generations can satisfy their economic needs. According to Thomas Malthus, an exponential growth in population could be observed alongside a linear growth in output.[11]

[11] Malthus, Thomas Robert. "An Essay on the Principle of Population." *The Works of Thomas Robert Malthus*, London, Pickering & Chatto Publishers, 1986, pp. 1-39.

The population might eventually exceed the output that could fulfil the needs of the population. Therefore, it is necessary to come up with solutions that allow for more efficient production due to potential future resource constraints.

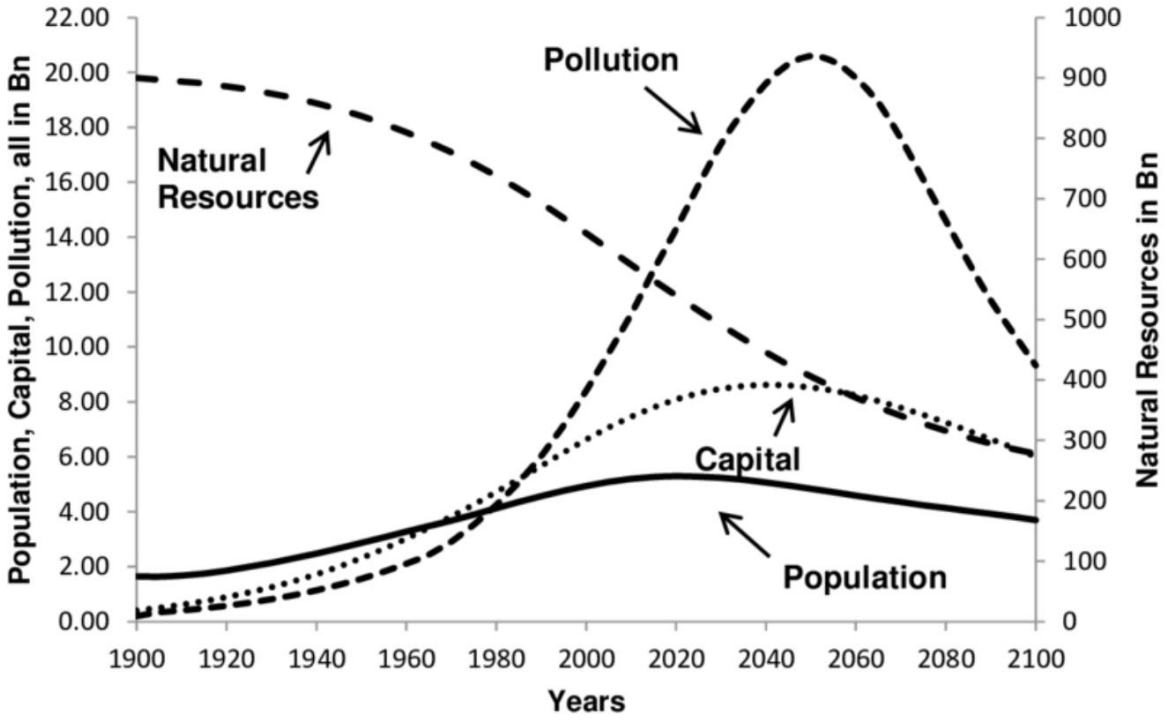


Figure 3: World Dynamical System across Standardised Key Variables: Population, Capital, Natural Resources and Pollution (Source: Schoenenburger, 2014).

Contrary to Malthus, the population is not expected to grow exponentially, but instead face a peak and then a slow decline across the 21st century. However, Malthus' interpretation suggests that key variables that have led to this potential decline in population are due to a depletion of the global store of natural resources. Once natural resources have declined significantly enough, this may cause a decline in the global quantity of capital (Figure 3).

It is beneficial for developing countries to develop efficient infrastructure in order to minimise costs that occur from their unprecedented rapid growth. The 21st century faces economic growth which is much faster than economic growth during the industrial revolution. For example, the UK from 1700 until 1918 grew to $222 billion in GDP,[12] whereas China grew from $150 billion in 1978 to $8.2 trillion in 2012, with some projections suggesting the developing world will grow even faster in the 21st century, predicting a rise of the GDP of Africa from $2 trillion to $29 trillion by 2050.[13] This means that developing countries will face greater depreciation of capital and should seek sustainable production methods to avoid

[12] Broadberry, Stephen, et al. *British Economic Growth, 1270–1870*. Cambridge University Press, 2015.
[13] Signé, L., and Ameenah Gurib-Fakim. "The High Growth Promise of an Integrated Africa." *Project Syndicate*. 2019.

increased costs.[14] For example, throughout the economic rise of China, despite enjoying one of the highest amounts of investment into their domestic economy, the nation has faced relatively low returns due to the inefficient use of capital, which further incentivises excessive and unnecessary public investment.[15] In the long run, in this era of environmental uncertainty, economies must be ready to continue to efficiently produce whilst absorbing potential exogenous shocks such as natural resource depletion; an example of this is being able to switch energy sources from fossil fuels to other more renewable methods in case of fossil fuel shortages—this is a form of energy source diversification.[16] With such rapid rates of economic growth in developing countries, there is a necessity to build efficiently in order to prevent both short-term and long-term negative consequences.

Developed countries may need to focus on sustainable use of natural resources since they are the countries that could be negatively affected if resource depletion becomes a serious issue. Protectionism is likely to occur if there is a sign of significant resource depletion, because developing countries have an incentive to stop the exportation to conserve resources for domestic growth. Since most manufacturing and agricultural products are in developing countries with comparative advantages in natural endowments,[17] developed countries are expecting to avoid protectionism in order to consume those products with lowest opportunity costs. In this case, the responsibility for resource conservation should be assigned to the developed world.

Furthermore, it is also efficient on a global level when the responsibility is assigned to developed nations. On the one hand, developed economies have more stable growth rates and are moving away from physical production to tertiary and quaternary sectors, which provides them with a technical basis for sustainability. On the other hand, they want to prevent developing countries from overconsuming or else protectionism would occur, which means that they would share the knowledge of sustainable solutions to the developing countries, and worldwide sustainability is achieved with least inputs.

To achieve efficient and sustainable production, another important consideration is to minimise the quantity of obsolete capital, which is the capital that is either not used or cannot be transformed into new forms of capital. Projected trends in the life of capital after usage demonstrates that the percentage of capital wasted into landfills will be a persistent issue in the 21st century (Figure 4). This is compounded by the fact that waste is projected to increase throughout the globe, particularly in the developed world, with countries such as the USA's current waste per person currently being 1,800 pounds per person, growing on average 2.2% annually.[18]

[14] Bai, Chong-En, Chang-Tai Hsieh, and Yingyi Qian. "The Return to Capital in China." 2006.
[15] Editors of The Economist. "Should China Spend More on Infrastructure?" *The Economist*. 2020.
[16] Mulholland (n 2) *supra*.
[17] Custers, R. "Africa's Natural Resources in a Global Context." *International Peach Information Services*. 2009.
[18] Global Market Insights. "Municipal Solid Waste Management Market Growth in the US." 2020.

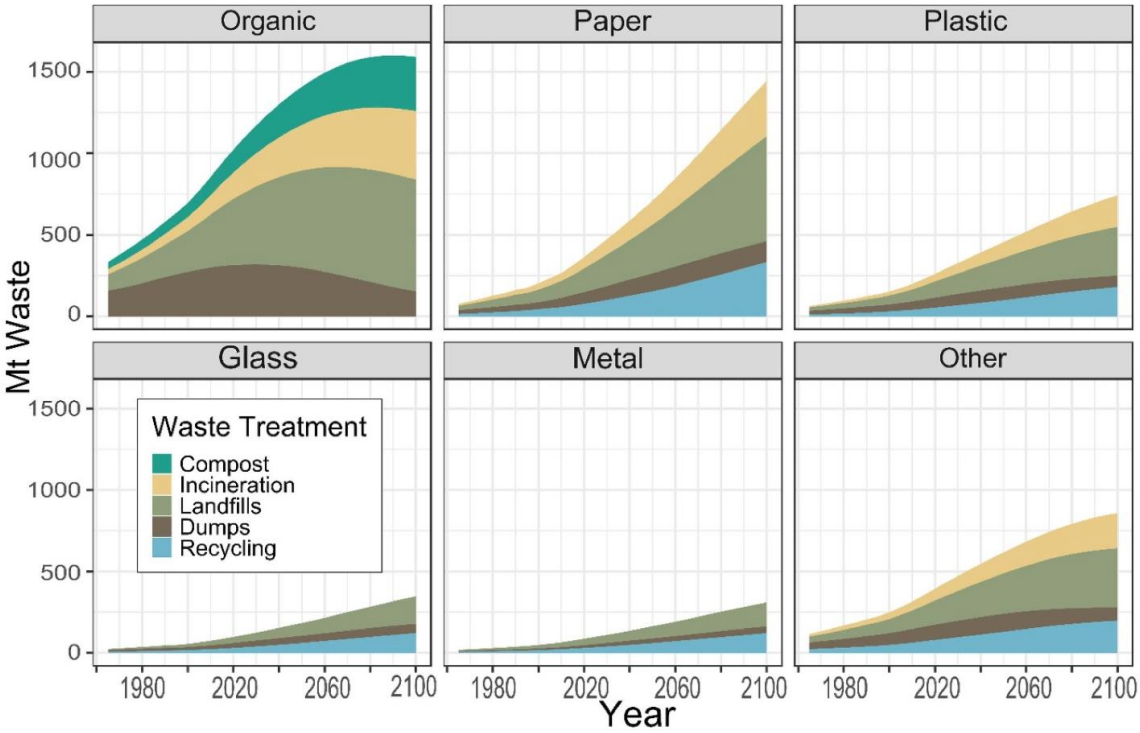


Figure 4: Materials Used in Production of Capital and Post-Product Treatment (Source: Chen et al, 2020).

To maximise production, an economy must maximise the efficiency of real capital from daily used objects to various inputs of production. One method to achieve both economic efficiency and sustainability is to recycle to reduce the quantity of obsolete capital. Another method is to improve the quality of the capital to reduce the rate of depreciation and ultimately to extend the lifespan of capital which could enable a greater sharing economy of capital. Globalisation enables the sale of capital not used in developed countries to the developing countries, catalysing a large second-hand market and a model of reusable consumption.[19] Those who could not afford newly produced capital may now be able to afford second-hand products. New value is found in the old-form capital imported from developed countries by another person in developing economies. Generally, a second-hand market ensures a closed system where people can continue increasing consumption whilst reducing the quantity of production. Without inputting extra resources, the developing countries could grow through the use of existing capital, which is an efficient outcome for the economy. Economies have set targets to this end, such as the European Parliament proposing to reach 10-20% share of reused products.[20]

The elimination of obsolete capital catalyses both economic growth and improvement in sustainability, and the establishment of a global second-hand market and a recycling mechanism is vital to achieve this. However, a recycling mechanism is not illegally outsourcing the waste and shifting the responsibility, but a win-win strategy. For developed countries, this can utilise the remaining economic value of obsolete

[19] "Future of Reusable Consumption Model." *World Economic Forum*, 2021.
[20] ibid.

capital. For developing countries, they can satisfy their essential needs at more affordable prices. It is also worth mentioning that a complete and compliant recycling process is a prerequisite for all of this. The international community should establish regulations and standards for the export of second-hand goods to ensure that such trade is fair and with good quality, rather than simply treating developing countries as a 'dumping ground'.

When it comes to the question of whether high export prices or the global second-hand market should be adopted through international cooperation, the two are not necessarily contradictory. Free trade allows for more capital to be efficiently allocated, whilst protectionist measures should be in place to prevent unnecessary consumption from the developed world that produce high negative externalities particularly for developing countries, since the high exportation price internalises the cost of carbon emissions and prevents carbon transfer to ensure a fair division of responsibility.[21] Therefore, the two global measures could be used simultaneously, i.e., there are tariffs on newly produced goods, but tariff-free trade on second-hand goods.

Admittedly, this article cannot draw a full picture for sustainability. It selects climate change and resource depletion as two most important issues related to the environment, while putting aside biodiversity, land degradation, and the practicability in ecology and chemistry. Furthermore, just like Thomas Malthus failed to predict industrialisation and its effects to productivity and sustainability, this article is also limited in its long-term vision, as human creativity, non-linear growth in population and technology advances may break the assumptions and real-world situations that this thesis is based on.

[21] Azarnert, Leonid V. "Trade, Luxury Goods, and a Growth-Enhancing Tariff." *Macroeconomic Dynamics*, vol. 22, no. 6, 2018, pp. 1462-1474.

Green Society Proliferation: How are Cambridge Organisations Meaningfully Addressing the Climate Crisis?

Pasha Taylor*

I. Introduction.

"Human-induced climate change is the largest, most pervasive threat to the natural environment and societies the world has ever experienced."[1] Wealthy countries and large corporations are disproportionately responsible for the climate crisis, with much of their economic success being linked to environmental malpractice. Under the current neoliberal economic world order, it becomes apparent that global actors and key contributors to atmospheric pollution will not naturally sway towards environmentally friendly operations. However, the consequences of a warming planet are increasingly affecting our physical health, ability to grow food, housing, safety, and work.[2] Additionally, climate change is increasingly affecting people's mental health. 'Eco-anxiety' is a growing problem, describing the rising sentiment of hopelessness and helplessness regarding the state of our planet and what a single person can do.[3] There needs to be a revolutionary 'green transition' away from 'business as usual' to achieve some form of environmental security and justice. But how should people mobilise against climate change and what impact can individuals have?

Globally, a diverse range of social mobilisations have arisen, operating across different spatial scales, and with different approaches to climate-induced issues. This article uses the Cambridge Climate Society (CCS) societies directory to outline the variation of green societies within Cambridge, categorising them by spatial scope and broad purpose—that is, whether the society operates at the college, university, or regional level, and whether the society is connective, action-based, educational, or research-based. This article focuses on three 'action-based' organisations: Clare Goes Green, Plant-Based Cambridge and Circular Cambridge. The attributes and impacts of these organisations will be assessed and used to support a general discussion regarding green societies.

II. Context.

Cambridge, as an institution, a collection of colleges, and a city, has a responsibility to respond to the climate crisis. Cambridge is a city in the county of Cambridgeshire, in East England, built on the bank of the river Cam. It is known for being the 'home of Cambridge University'. In 2022/23, the city's total emissions were 556,800 tCO_2e,[4] of which the University operational estate location and market-based scope 1 and 2 energy and fuel use accounted for 73,919 tCO_2e.[5] The Cambridge City Council outlines its

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[1] Office of the High Commissioner for Human Rights. "Climate Change the Greatest Threat the World Has Ever Faced, UN Expert Warns." 21 October 2022.

[2] United Nations. "What Is Climate Change?"

[3] Lowe, Sarah, and Anthony Leiserowitz. "Yale Experts Explain Climate Anxiety." *Yale Sustainability*, 13 Mar. 2023.

[4] National Atmospheric Emissions Inventory. *Local Authority GHG Map*.

[5] Cambridge University. *2022-23 Highlights*. 2024.

commitment to reduce its direct carbon emissions (scope 1) to net zero by 2030.[6] Meanwhile Cambridge University is more ambitious in scope but more sparing with time, with the main target of reaching net zero greenhouse gas emissions across its entire investment portfolio by 2038 and becoming absolute carbon zero on all energy-related emissions (scope 1 and 2) by 2048. As separate structural entities, the University and Council have different paths to reduce their respective impacts on the environment. The pursuit of decarbonisation and sustainability are also supported by several grassroot 'green societies' and individual environmentalists.

III. Cambridge Climate Society (CCS).

Cambridge Climate Society (CCS) describe themselves as "the student hub for all things climate at Cambridge." They organise events to raise awareness of climate research and policy and run educational programs, such as the Academy Programme and mentoring sessions. They also coordinate campaigns and support green efforts across colleges through their new Action and Community teams. For the purposes of this analysis, CCS can be categorised as a 'connective' organisation (further explained below). CCS maintains a database of Cambridge organisations relevant to the climate crisis, with 95 organisations currently listed. These come under several sub-headings, focusing on topics ranging from green technology to plant-based food.

IV. Methods.

The societies in the CCS database can be categorised into four general roles: research, education, action, (directly tackling impacts or contributions to climate change), and connection (facilitating communication to accelerate and strengthen responses). They can also be divided by the scale at which they operate: at the college-scale, the university-scale or Cambridge-wide.

Many societies transcend spatial or functional boundaries. For example, the CCS itself is a connective, action-based and educational organisation. Hence, there is some subjectivity in terms of grouping and labelling organisations; keyword analysis has been undertaken to increase the accuracy of this process. The methodology of coding qualitative data from the mission statements of registered climate organisations, has allowed for the 'connective' categorisation of the society, as there are greater references to connectivity over education or action.

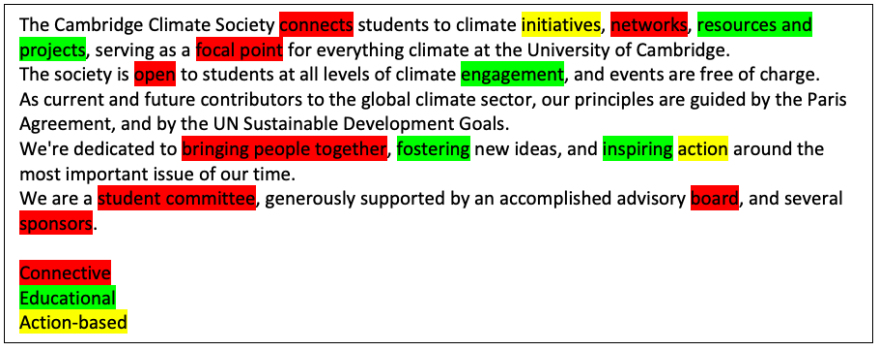


Figure 1: Methodology.

[6] Cambridge City Council. *Cambridge City Council Climate Change Strategy 2021-2026*. n.d.

The modal, overarching categories have been identified for the following societies:

Category	Meaning	Key words in mission statement	Organisations
Connective	Organisations that provide social infrastructure, sharing ideas about climate change. These societies may also facilitate inter-disciplinary interaction. Societies in this category allow for the mobilisation of individuals under a collective group, an essential precursor for effective action.	'people', 'relationships', 'transfer', 'exchange', 'platform', 'bridges', 'Forum', 'interface', 'interdisciplinary', 'gateway', 'events', 'networking', 'sharing', 'co-ordinate'	(College) Green Society of Wolfson College Homerton College Environmental Society (University wide) Cambridge University Science Policy Exchange (CUSPE) Cambridge University Energy Technology Society (CUETS) Cambridge Centre for Social Innovation Center for Sustainable Finance Cambridge Food Security Forum Cambridge University Vegan Society Cambridge Institute for Sustainable Leadership CambPlants Hub Cambridge University Environmental Consulting Society Cambridge Climate & Sustainability Forum Cambridge Hub Cambridge University Energy Network Engineers Without Borders Cambridge Center for Global Equality (Regional) Cambridge Nature Network Cambridge Doughnut Economics Action Group Cambridge SDG Hub Cambridge Young Greens CoFarm Cambridge Six Degrees Cambridge KCL Environment Society (EcoSoc) Hughes Hall Centre For Climate Engagement Fauna and Flora Institute (Cambridge) The Carbon Challenge Write for the Earth Cambridge Climate Society
Action-based	Organisations which promote and enforce resistance to conventional business, political, social or education practices or that directly tackle the immediate and distant impacts of climate change. For example, organisations which advocate for reducing consumption and waste, or organisations which hold public demonstrations to drive top-down changes, would fit into this category.	'project', 'initiative', 'agenda', 'impact', 'service', 'waste-reduction', 'transformative', , 'initiative', 'solutions', 'ethical', 'just', 'community', 'equality', 'justice', verbs: 'grow', 'refill', 'reduce', 'accelerate', 'campaign', 'boycott', 'eradicate', 'community-led', 'campaign', 'develop', 'create'	(College) Clare Goes Green SCOOP Cambridge Zero Waste Shop Cambridge Edible Garden Student Switch Off (SSO) Newnham Environmental Justice Society Christ's Climate Justice Society (University wide) Plant-Based Universities Cambridge Cambridge Conservation Initiative The Equipment Sharing Project Cambridge Green Challenge Engage For Change Cambridge University Wildlife Conservation Society Ethical Affairs (CUSU) Cambridge Climate Justice Boycott Banks' Destruction (Oxbridge) Green Impact Challenge Cambridge Zero Cambridge Development Initiative Smart Cambridge Cambridge Climate Justice (Regional) Coton Busway Action Group Friends of the Cam Food Cycle On The Verge Eco Church Working Group Camcycle Cambridge Refill Circular Cambridge WARPit: reuse platform Cambridge Reuse Cambridge Refill Cambridge FoodCycle Extinction Rebellion Cambridge Organic Food Company Cambridge Food Hub Carbon Neutral Cambridge Cambridge Conservation Volunteers
Education	Organisations which increase public awareness of climate change. This can	'Raise-awareness', 'knowledge', 'learning', 'training',	N/A (University wide) Centre for Climate Repair Cambridge Natural History Society (CNHS) Effective Climate Change Mitigation Cambridge Department of Land Economy Center for Sustainable Development Conservation Internship Scheme

	enable mitigative action on a greater scale and pressure institutions to address the issue.	'internships', 'consulting'	Voiz (Regional) Cambridge Carbon Literacy Project The Switch Healthy Planet Cambridge Cambridge Carbon Footprint
Research-based	Organisations which facilitate or develop climate research. Research helps us better understand and predict climate change. This knowledge is crucial. For example, we can evaluate the stability of certain systems (e.g. agriculture), such that we can adapt to potential to risks.	'academics', 'scholars', 'find solutions', 'mechanisms', 'access', 'policy', 'influence', 'inform', 'alternatives', 'data'	(College) Wolfson College Interdisciplinary Research Hub in Sustainability & Conservation (University wide) Energy Interdisciplinary Research Centre Conservation Research Institute Cambridge University Marine Conservation Society Cambridge Nuclear Energy Center Cambridge Center for Alternative Finance Winton Programme for the Physics of Sustainability Strategic Network for Sensor Research at Cambridge University Climate Change and Earth-Ocean-Atmosphere Systems AI for Environmental Risk (AI4ER) Centre for Risk Studies Energy Efficient Cities Initiative Center for the Study of Existential Risk Cambridge Centre for Climate Science Department of Earth Sciences Cambridge Living Laboratory Cambridge Global Food Security (regional) Cambridge Circular Plastics Centre Pesticide-Free Cambridge Transition Cambridge Crop Science Centre

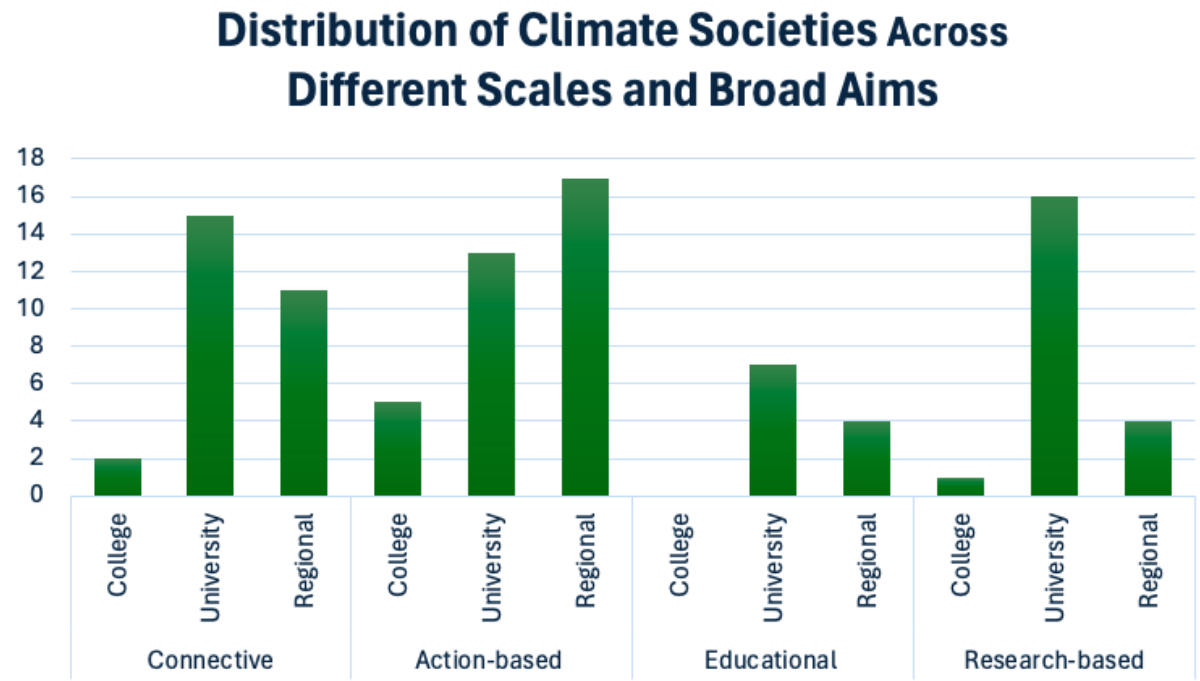


Figure 2: Results.

V. Discussion and Results.

The data acquired from this coding methodology suggests that connective, educational, and research-based societies are most likely to operate at the University scale, drawing on the human, financial and technological resources of Cambridge University. The organisations that take direct action against the impacts and causes of climate change are dominant at a regional scale. This suggests recognition of the significance of mass mobilisation for meaningful change. Seeing as Cambridge University is embedded within the region, there is often cooperation and collaboration with the University to enhance regional efforts, presenting scales of overlap. The intersectionality between scales and categories of aims presents a limitation in this methodology.

Only seven of the thirty-one Cambridge Colleges have an established climate society. However, due to the smaller scale of operations, it is likely that many college-based societies are not mentioned in the CCS database. On a similar note, climate societies often fluctuate in terms of their cohesiveness and ability to create action, such that of the mentioned societies, some may be redundant. This presents a clear limitation to using this database, to which a solution would involve further inquiry into college-based initiatives. It would be a useful exercise for CCS to conduct another society audit to update this information.

VI. Scale and Perceived Impact.

When assessing the sheer amount of climate organisations, it is difficult to evaluate whether quantity has overshadowed quality. Given the diverse aims and operations of each society, there is no collective indicator which can be used to assess an organisation's impact or effect in addressing climate change. By comparing the targets, methods, media and institutional recognition, and scope of organisations, we can demonstrate the diversity both amongst, and in some cases, within these societies. The following table demonstrates an analytical breakdown of three action-based societies, Clare Goes Green, Plant-Based Cambridge and Circular Cambridge, operating at the collegiate, institutional, and regional scale. These organisations are largely perceived as successful in carrying out their aims. In part they have been chosen for their up-to-date presence on social media and online.

	Targets	**Methods and Examples**	**Recognition of Impact**	**Scope**
Clare Goes Green	Creating a space for climate engagement and learning. Reducing Clare's environmental impact and carbon footprint. Key areas in which this can be tackled is through: - removing ruminants from the buttery. - composting - heating reductions	(1) Social media campaigns (2) Society representative in attendance of college staff meetings (3) Student campaigning, e.g.: environmental posters (4) Challenges, e.g.- January 'VeganuClarey Challenge' (5) Events to improve educational awareness (6) Project to monitor energy use (7) Participating in the Pesticides Free Cambridge Campaign.	(1) Helped the college win the University's Green Impact Competition (2) Played a role in Clare's receipt of the Platinum Cambridge Green Impact Award.	Collegiate and individual level Affiliated with Clare Growers Association Long term aim to create University-wide impact. Helping to set up green societies at other colleges.

Plant-Based Cambridge	For the University to switch to plant-based catering to reduce the environmental impact of catering across the University and divest from animal agriculture.	(1) Policy motions and dialogue at the University, College, and departmental scale. (2) Panel events (3) Film screenings, e.g.: 'The Smell of Money' + Q&A with Writer / Producer Jamie Berger (4) Works with colleges to plan plant-based menus (5) Student campaigns and lobbying (6) Open letters addressed to universities (7) Plant-based formals	Plant-based Universities campaign was nominated for an Earthshot Prize by Generation Vegan. It has also been shortlisted under Campaign Impact by the Cambridge Students' Awards 2023. International media recognition with interviews on local and national TV.	Plant-based Universities Cambridge works with the central Plant-Based Universities campaign and is supported by Animal Rising. It works with the Student Union (SU), college caterers, university departments and hopes to work with the University endowment fund.
Circular Cambridge	The reduction of 'throw-away culture' in order to decrease individuals' carbon footprints. The organisation targets waste and consumption through promoting repairing and recycling goods. It also serves as a creative and social forum with social and educational events.	(1) Repair Café, at various places within the region, such as Trumpington, Ely, Newnham, and St Ives. (2) Educational events and training. For example, they have thermal imaging training and online training on 'How to run a Swish'. (3) Events such as 'the fix fest' and a sustainable fashion show. (4) Information sessions. Eg: in November 2023 there was a session for 'Local Leaders and Local Government' (5) Directory of places in the Cambridge region where people can access reduced waste shopping, repairers, second hand goods and skills exchanges. There are multiple events a week, demonstrating organisational commitment to making an impact.	Media recognition of the organisation, for example, in 2019 alone, representatives wrote articles in Cambridge Independent and South Cambs Magazine, and spoken on the radio and in BBC podcasts such as 'Shop Well for Less'	Circular Cambridge is a project of the local charity Cambridge Carbon Footprint. The charity operates other projects such as Net Zero Now and Open Eco Homes which have more refined aims. Active participation in consultation and forums.

VII. Discussion.

The outlined societies all target different things and carry out their efforts using different mechanisms. Across the three organisations, similarities lie in recognising the importance of social events and community engagement. There is evidence of communication beyond the co-ordination of climate-based action, demonstrating the importance of the 'social' as a means to address the 'environmental'. Campaigning is also a common method used, highlighting the grassroots nature of green societies and the emphasis placed on engaging with policy makers to enforce top-down change through bottom-up action. A notable aspect about these three chosen organisations is that as the scale increases, from operating within a college to across a region, so too does the specificity of the aims of the society. Clare Goes Green has a broad target of reducing the college's carbon footprint, which can include a wide variety of emissions. This is addressed through a similarly large range of projects and initiatives, from composting to menu alterations. Meanwhile, Plant-Based Cambridge and Circular Cambridge have more refined operations in terms of prioritising single issues, of meat consumption and waste.

VIII. College-Level.

One of the key things that has enabled the success of Clare Goes Green is the access the society has had to statistical findings regarding the emissions of their college. This is through the work of Joey Bream, who highlighted the short and long-term changes that can be made in the college, with the respective impacts these changes could have. By knowing what to focus on, the society can set principal targets and direct their campaigning efforts to achieve maximum impact. This allows for focus within the overarching aims of the society.

Bream has expanded the scope of his work, beyond Clare College, creating a more general College Carbon Impact estimation tool. He calculates that a 25 tCO_2e saving would lower a college's carbon emissions by 1%.[7]

Such quantified impact reports are extremely useful. For example, electrifying heating was found to be 100 times more effective at reducing emissions than removing tumble dryers. One proposed emission reduction tactic would be to do online interviews to avoid the carbon cost of travelling to the college for a face-to-face interview, as well as otherwise disincentivising students from taking flights. Even more surprisingly, this could have the same high impact as electrifying heating, despite costing significantly less. This information can be useful to college-based green societies, providing guidance on what to prioritise in terms of campaigning and mobilising action at this scale. Colleges do have decarbonisation plans and data on their emissions, although they are not in the public domain. Students must request this information in order to integrate it into their strategy as a green organisation. This is reliant on the engagement and commitment of the student-body, and as individuals continue through their University course, continuity of the Green Society requires the participation of the next cohort. Other contingent factors include the financial situation of each college and the structure of the board, as some Green Societies face bureaucratic blocks when trying to gain funding or legitimacy.

[7] Bream, Joey. *Scope B: College Carbon Impact Estimation Tool*. 3 May 2023.

Clare Goes Green advocates for greater college-level Green Organisations, which could coordinate intercollegiate movements to prompt a university-wide response. The society believes that starting at the college level is important in that it creates spaces of climate engagement, where students can grasp the scope of the crisis without leaving their familiar environment. By adopting a bottom-up approach at the college-scale, students can impact operations, which if done by all colleges, can result in significant University-wide change. Clare is therefore organising workshops and events to help other colleges establish Green Organisations.

IX. Larger-Scale.

Plant-Based Cambridge is effective in creating support for the campaign, as proved by the successful lobbying efforts made last year which resulted in the Student Union voting in favour of supporting a transition of the University Catering Services in 2023. The group's efficacy can be attributed to the organisation's singular focus. Similarly, Circular Cambridge also prioritises a single aspect of human consumption which is contributing to the climate crisis. By celebrating "progressive ways to design, manufacture, access, repair and reuse," the organisation aims to reduce demand for resources by extending the life cycle of goods and therefore minimise environmental impacts.

There appears to be a trade-off between the expanse of aims and the scale of operation, in which successful climate societies at a college level can afford to be more inclusive in terms of what they want to achieve. Impactful action-based initiatives at a university or regional scale society, in this case, are seen to commit to a more specific approach under a larger umbrella organisation. (Circular Cambridge is a branch of the Cambridge Carbon Footprint charity and Plant Based Universities is a campaign under Animal Rebellion).

Another reason for the size-specificity trade-off could be that smaller sized colleges may be less bureaucratic and allow societies to have a greater stake in general operations. Furthermore, at larger scales it may be more administratively effective and efficient if projects have a clear and defined aim.

X. Conclusion.

This article has presented a broad exploration into the green initiatives operating in Cambridge. It has highlighted that what makes an effective green society is highly dependent on the scale of operation and the issues of importance to the members. College initiatives present an opportunity to address a wide range of components which make up their systematic functioning, while societies operating at a greater scale tend to consist of specific projects or campaigns which target singular issues, demonstrating a 'divide and conquer' approach toward the causes and effects of climate change. The overarching aims of projects usually align with a broader organisational target, such as the net-zero aims of the University and the Council or the Plant Based Universities campaign.

Having divided societies into four main categories: action-based, connective, research-based and educational, one can argue that action-based societies create the most tangible impact in terms of directly addressing the climate crisis. However, there is a need for organisations across the four categories to coordinate an effective climate response. Research is needed to improve knowledge and

awareness of the crisis and to deduce the best ways to approach adaptation and mitigation efforts. Education is needed to fuel action as people become aware of the technicalities of climate change. Connective organisations provide a forum for people to discover each of these opportunities.

Participation in Green Societies is beneficial regardless of the scale or particular aim. Collaboration of individuals towards a common interest of climate change has formative impacts which can have implications on the rest of an individual's life. Being part of a greater movement can help ease eco-anxiety and benefit mental and physical health. Therefore, quantifying the impact that Green Societies have is next to impossible, such that any mobilisation of interest in the environment should be encouraged.

The CCS Directory is a useful resource for discovering these societies and could benefit from an update. However, it is a valid argument that the large number of societies across Cambridge could be overwhelming, particularly to the large number of incoming students. It is difficult to assess the issues which each society targets, and indeed whether they are active or effective. A good next step would be to develop a more focused introduction to the organisations around Cambridge.

Conflict and Dependence in Mineral Mining: The Case of Venezuela

Jenna Goldblatt*

I. Introduction.

Human conflict and environmental problems often precipitate one another, yet their relationship is complex and interdependent. When considering the causes of international conflict, many turn to blame political instability due to authoritarian rule and ethnic conflict. Although political unrest fuels conflict, this instability can be directly linked to resource extraction and environmental degradation in the country. The global economy and future development depend on resource extraction, especially rare minerals like coltan, which are essential for developing technological capacitors used in computers, planes, wind turbines, and even military missiles. Developing nations often rely on resource extraction of minerals like coltan to aid development. In contrast, developed states rely on these exports to improve and increase the competitiveness of their industries. Coltan, given its relevance to technology, is one of the most in-demand resources of the 21st century, and its reserves are currently worth trillions of dollars. There is a significant power struggle for control over the reserves and profit, causing widespread violence within nations, regions, and international communities. Coltan mining in Venezuela exemplifies this dilemma.

II. Literature Review.

The United States Securities and Exchange Commission defines 3TG, or conflict minerals, as "the metals tantalum (and niobium), tin, tungsten, and gold, which are the extracts of the minerals cassiterite, columbite-tantalite, and wolframite, respectively."[1] In this paper, the sole focus will be on columbite-tantalite, commonly known as coltan or tantalum. For clarity, I will solely refer to the mineral as coltan. Coltan becomes metallic tantalum and niobium, two metals widely used in electronics when refined. Specifically, the minerals are used to create tantalum capacitors, which are used in most electronic devices, including smartphones, computers, airplanes, military goods, and more. The European Commission on Trade defines these minerals as "conflict minerals" because "in politically unstable areas, armed groups often use forced labor to mine minerals. They then sell those minerals to fund their activities, for example to buy weapons."[2]

In many ways, Coltan mining is a culmination of the need for minerals and the problems they create. Coltan also uniquely defines much of the international and domestic conflict and threatens the stability of the entire renewables industry. Although the industry has existed since the 17th century, the recent practical increase has correlated to a significant increase in literature around the issue. Its expansion underscores the relevance of this area. Despite being a relatively modern matter, the depth and extent of the existing literature indicate how applicable the dilemma of coltan mining is to historical and contemporary examples of similar extraction discussed previously, such as coal.

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[1] United States Securities and Exchange Commission. *Conflict Minerals Report*. 2023.

[2] European Commission. *Conflict Minerals Regulation: The Regulation Explained*. 2024.

In 2000, demand for the coltan industry peaked, and it became an essential part of technological development. The mineral was used in new electronic devices such as mobile phones and video game consoles since it is crucial to making computer capacitors. When Sony introduced the PlayStation II, the market value of coltan skyrocketed, as there was a global demand and shortage of the mineral.[3] Within a year, the price increased over 12x, skyrocketing from $30 to $400/ per pound. Across Africa and Latin America, people migrated to mining regions in a phenomenon known as the "Coltan Fever".[4] However, this also drew the attention of rebel groups, militias, and other armed groups for its potential to fund their ongoing military plans.

Coltan reserves are limited and only found in certain parts of the world, notably Central Africa, Australia, and South America.[5] The primary way coltan is extracted is through pit mining.[6] Miners dig large wells into the ground and then sluice the sediment to extract the mineral ore.[7] Given the relatively simplistic process and extremely high demand, the industry employs thousands of workers. Although in many extraction host countries like the DRC and Brazil, the wage is competitive at $10-20 per week, workers make an extremely small portion of the total profit, especially considering the risk associated with their work. The demand for coltan is growing because of the increase in demand for technology, including the use of green energy like solar panels. Therefore, it is improbable that the coltan industry will cease to operate, as eliminating coltan extraction would significantly limit society's ability to move away from non-renewable resources like gas and oil.

III. Case Study: Venezuela.

Venezuela's historical patterns of exploitation and conflict have directly influenced current mining practices. Venezuela faces an acute humanitarian emergency as millions of citizens do not have access to fundamental human rights such as healthcare, food, and clean drinking water.[8] The crisis has led to over 7 million (20% of the population) Venezuelan refugees and migrants since 2014, the largest in history.[9] The country is fighting to gain stability and international political power as it has experienced "democratic backsliding" (a return to an authoritarian state) and humanitarian emergencies.[10] This crisis is largely rooted in its colonial legacy and tumultuous political transitions.

Although not a comprehensive history of the country, it is essential to recognize the influence of Spanish colonization of Venezuela for its rich natural stores of precious metals and minerals and military

[3] Totolo, E. "Coltan and Conflict in the DRC - Democratic Republic of the Congo." *ReliefWeb*, 2009.
[4] ibid.
[5] Bleischwitz, R., Dittrich, M. and Pierdicca, C. "Coltan from Central Africa, International Trade and Implications for Any Certification." *Resources Policy*, vol. 37, no. 1, 2012, pp.19-29.
[6] ibid.
[7] Totolo (n 3) *supra*.
[8] Roth, Clare. "How Gold Mining in Brazil Is Connected to Hundreds of Deaths." *Deutsche Welle*, 27 Jan. 2023.
[9] Salas-Wright, C. P., Maldonado-Molina, M. M., Pérez-Gómez, A., Trujillo, J. M. and Schwartz, S. J. "The Venezuelan Diaspora: Migration-Related Experiences and Mental Health. *Current Opinion in Psychology*, vol. 47, 2022, p.101430.
[10] Penfold, Michael A. "Democratization in Venezuela: Thoughts on a New Path." *Wilson Center: Venezuela Working Group*. 2021.

dictatorships following independence in the 19th century.[11] Venezuela experienced a period of democracy with the election of Romulo Bentancourt, the 'Father of Venezuelan Democracy', in 1958 with a strong oil-dependent economy.[12] However, corruption grew rapidly, and in 1989, the current president, Carlos Andres Perez, implemented a series of free-market reforms designed to solve the economic crisis.[13] As gas prices continued to skyrocket, the national military brutally ended civilian riots across the country.[14] As Venezuela was plunged back into a state of social unrest and military crackdown, Hugo Chavez, a former military officer, began to rise to power.

Between 1990 and 1994, Venezuela encountered five recessions, creating deep social fissures, and increasing anger. Chávez nationalized industries such as oil, ended international partnerships, and reconfigured the electoral system to favour his candidacy.[15] By 2010, high crime rates, food insecurity, and record-breaking inflation challenged his popularity and legitimacy. By 2014, South America began to face economic collapse, and Venezuela's GDP faced an extreme decrease (sharper than that of the Great Depression).[16] In 2023, Venezuela was experiencing an ongoing hyperinflation crisis, with inflation at over 200%.[17]

Venezuela has significant coltan reserves with extremely high commercial value, commonly known as 'blue gold' due to its bluish color.[18] In response to the aforementioned political and economic instability, in 2009 Chávez attempted to compensate for this financial downturn through mineral extraction.[19] Chávez announced the "discovery" of coltan in Western Venezuela. Although coltan mines were already legally operating, Chávez marketed this discovery as a turning point for Venezuelan industry.

In 2018, Venezuela began legally exporting the mineral and started building the largest and first coltan concentration plant, set to produce 160 MT annually.[20] The reserve is located in Bolivar and is jointly controlled by the Venezuelan government and state power consortium. Most of Venezuela's mines are owned by the government or state firms, allowing the country to use the trillions of dollars in reserves for national development and improved stability.[21]

As attention to the mineral and international pressures increases, so do smuggling and displacement. The mineral poses a security threat to the region's stability and larger international alliances and trade

[11] Sanoja Obediente, Mario. "The Venezuelan Colonial Way of Life." *Revista de Arqueología Americana*, no. 2, 1990, pp. 157-67.
[12] Council on Foreign Relations. "Venezuela's Chavez Era." 2022.
[13] ibid.
[14] ibid.
[15] ibid.
[16] Kiger, Patrick. "Why Venezuela Is in Crisis." *How Venezuela Fell from the Richest Country in South America into Crisis*, History, May 2019.
[17] Armas, Mayela. "'The Boom Is Over': Venezuelans Lament End of Brief Dollarization Boost." *Reuters*, 1 Sept. 2023.
[18] Rendon, Moises. "Illegal Mining in Venezuela: Death and Devastation in the Amazonas and Orinoco Regions." *Center for Strategic and International Studies*, 16 Apr. 2020.
[19] ibid.
[20] "Venezuela Opens Country's First-Ever Coltan Concentration Plant." *Venezuelanalysis*, 22 Oct. 2018.
[21] ibid.

deals. Coltan's impact is directly felt in the country as exhibited by the extreme state violence and fight to control the mining industry.

The Orinoco Mining Arc is a large territory along the Orinoco River Basil, just under the Orinoco Oil Belt, as seen in Figure 1.[22] The Orinoco Oil Belt holds the largest petroleum deposits, while the Orinoco Mining Arc holds rich mineral deposits. The territory makes up over 12% of Venezuela and includes states such as the Amazonas and Delta Amacuro.[23] The Venezuelan government estimates that the region holds "$100 billion in coltan reserves … as well as three billion carats in diamonds, and at least 300,000 metric tons of rare earth elements."[24] However, the region is also very rich in biodiversity, with five national parks. For example, Canaima National Park, a UNESCO World Heritage with unique mountain ranges and flora and fauna, is at risk of being used for mining.

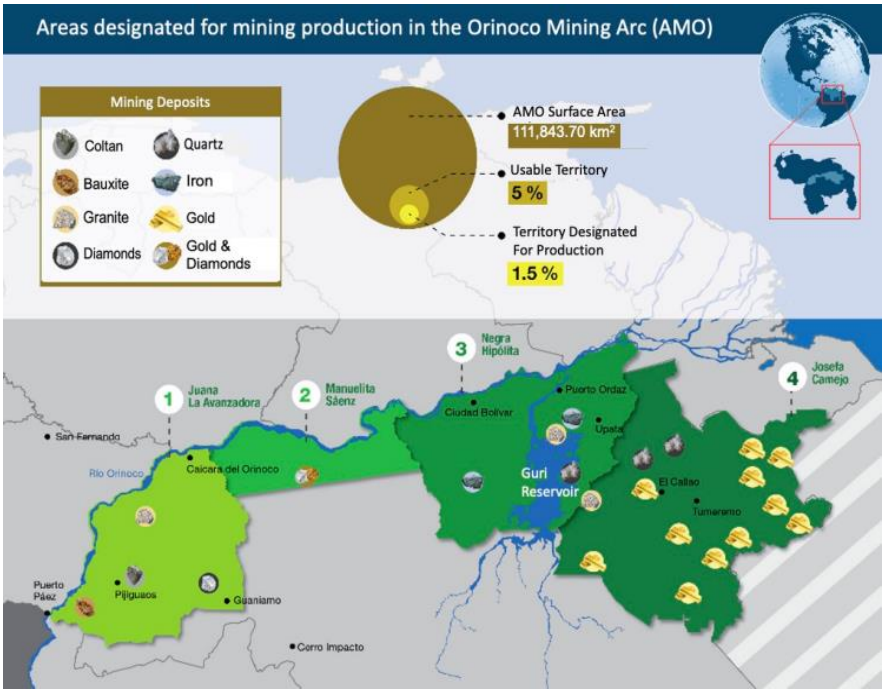


Figure 1: Map of Venezuela's Mineral Mines (Source: SOS Orinoco).

IV. Analysis.

The wealth of natural resources in Venezuela has traditionally funded ongoing wars and armed conflicts, as well as state development in the wake of destruction and violence. Armed groups such as official state forces and rebel groups have fought to control the coltan mines. The mines are highly profitable because of the valuable resources and cheap, easily extorted labor force. Additionally, the smuggling of minerals is rapidly growing as the smuggled minerals avoid fines, certifications, and taxes. Moreover, given the

[22] "Predatory Mining in Venezuela: The Orinoco Mining Arc, Enclave Economies and the National Mining." *World Rainforest Movement*.
[23] Ebus, Bram. "Arc of Desperation." *Earth Island Journal*, 2017.
[24] ibid.

widespread political corruption, bribery is often used to reduce regulation and policy enforcement of the mines. Therefore, the mining process often funds Venezuela's ongoing internal and external conflicts. However, it also aggravates conflict by exacerbating ideological divides, displacing large groups, degrading the environment, causing health problems, violating human rights, and threatening national security. This then necessitates mining expansion to fund the growing conflict, creating a never-ending, unregulated cycle of conflict expansion.

From a human rights perspective, coltan damages miners' and surrounding communities' health, safety, and prosperity. While mining practices constantly evolve, miners primarily extract coltan using an unrefined and undeveloped process. However, developing more advanced processing plants introduces new issues, as they remain largely unregulated. Since the industry is expanding rapidly and holds potential for immediate financial gain, Venezuelan populations are easily exploited for cheap labor. As regulations become less clear, the already informal industry can abuse and exploit workers with few consequences. The lack of reinvestment from mining profits greatly hurts the protection of workers. Although the coltan mines are extremely profitable, smugglers and militias privately pocket most of the profits. Little money is used to develop national infrastructure and social services like hospitals and schools.

As seen with the migration crisis, civilians are severely suffering. For example, child labor is a cheap source of labor for the largely unregulated industry. The unregulated and informal opportunities in the extractive industry provide a pathway for mines to use vulnerable children as cheap labor. Moreover, children often work in especially hazardous conditions with washers and diggers and are directly exposed to toxic material and unsafe conditions since they are cheap and easily replaceable.[25] Much of Venezuela's coltan development is based on Brazilian mining practices where child labor is a significant issue, especially in Bolivar.[26] The Brazilian government has attempted to improve working conditions and end child labor in the mines. However, similar to Venezuela, political instability and corruption make it challenging to enforce these policies.

Coltan extraction exacerbates ideological divides and social cleavages while worsening economic inequality and heightening resource competition. Given that TNCs and foreign companies own the majority of coltan mines, the financial gains from coltan mining are highly concentrated and largely inaccessible to the majority of the population. To build these mines, many groups, especially indigenous people and rural communities, are being displaced from their homes. The increased development of the Orinoco Mining Arc threatens to displace significant portions of the 1.6 million inhabitants of the region, or 5% of Venezuela's population.[27] This is problematic because it destroys ancestral lands, disrupts settlement structures, and drives people into Venezuela's already highly concentrated urban areas,

[25] "Venezuela Emerges as New Source of 'Conflict' Minerals." *International Consortium of Investigative Journalists*, 4 Mar. 2012.
[26] Rendon (n 18) *supra*.
[27] Gutiérrez Torres, Jeanfreddy. "Thirst for Coltan, Gold Threatens Venezuelan Forests, Indigenous Lands." *Mongabay Environmental News*, 31 Oct. 2016.

further destroying indigenous practices and forcing assimilation.[28] According to the Center for Strategic & International Studies (CSIS), the expansion of the mining industry has affected land in the Alto Orinoco-Casiquiare Biosphere Reserve, the protected home of the Yanomami people and other indigenous people. 34 indigenous groups that live in this region of Southern Venezuela have been heavily affected and deeply involved in the policy regarding mining. However, the Maduro regime failed to consult them before "implementing public policies to promote mining in the region."[29] These conditions have endangered "approximately 500,000 workers [who] are involved in illegal mining operations, many of them from local indigenous communities who have been coerced into working through threats of violence or due to economic necessity. These miners mostly are impoverished Venezuelans, and an estimated 45 percent are underage."[30] Despite indigenous resistance, they have faced violent repression and been forced to "flee their ancestral homes."[31]

Furthermore, the human displacement in Venezuela is also contributing to massive land degradation and disruption of ecosystems. Coltan mining destroys many natural ecosystems, wildlife habitats, and habitable land for humans. Locations for coltan mining are picked unsystematically, and often, miners devastate forested areas and national parks. Also, the chemicals involved in the coltan extraction and processing leach into the ground and water sources, polluting freshwater resources and harming animals and plants. Expanding coltan mines leads to increased flooding, degraded soil, plantation systems, draining groundwater reservoirs, and increased runoff– all of which further disrupt the water cycle.[32] Between draining local water supplies and causing the natural production of less water in the area, water is less available and the quality has decreased significantly. Local water sources went from clear and widely safe to drink to a dark, murky mud color, filled with dirt and debris.[33] Overall, the extraction of coltan damages the natural water cycle, forever changing an area's landscape even after a mine has been closed.[34]



Figure 2: Mines in the Orinoco Arc (Source: AirPano).

[28] "Indigenous Peoples' Right to Adequate Housing." *United Nations Human Settlements Programme (UN-HABITAT) & Office of the High Commissioner for Human Rights (OHCHR)*. 2005.
[29] Rendon (n 18) *supra*.
[30] ibid.
[31] ibid.
[32] Reetsch, Aneeka. *Effects of Coltan Mining on Properties and Quality of Soils of the Open-Cast Mining District Gatumba, Rwanda*. 2008.
[33] ibid.
[34] ibid.

Although coltan mining has not been active for a long enough time to understand long-term health effects, the health of workers and local communities is already suffering. At the immediate local level, miners are often crushing and processing mineral ore, exposing them to damaging dust particles in the air which often leads to respiratory problems.[35] Handling these minerals and processing chemicals can also expose individuals to large amounts of radiation, causing physical ailments such as rashes and burns.[36] Workers are also exposed to radioactive materials such as radon, uranium, and thorium daily which is linked to causing cancer, especially lung cancer.[37] There is also the risk of exposure to chemicals, including cadmium, which is known for affecting reproductive health and fertility as well as causing birth defects.[38]

The mining also presents significant regional threats. Extraction and production of minerals are extremely fossil fuel intensive, and the techniques directly degrade soil, air quality, and water sources. Over time, the mining also leaches toxic metals into the water and soil, creating a buildup of toxins and killing plants, animals, and humans. Although unknown, the long-term environmental impacts are estimated to be devastating.[39] For example, mercury has seeped into soil and water systems, which has already affected indigenous populations and exposed them to dangerous levels of the chemical element. In the Venezuelan Cauri river basin, a tributary to the Orinoco, "92% of indigenous women had elevated levels of mercury, which could damage the kidney and brain and impede fetal development".[40]

In Venezuela, mining groups present serious threats to national security. At the local level guerrilla forces and "mafia networks" present a significant threat to state stability. For example, Colombian guerrilla forces control the Parguaza region[41]. While they illegally expand into protected areas such as Los Gallitos, these forces purchase Venezuelan coltan at a significantly lower rate than the international trade rate[42]. However, the Venezuelan military often ignores illegal activities. It protects these forces for financial participation in the schemes and has developed "'institutional' pacts with Colombian guerrilla groups" such as The Revolutionary Armed Forces of Colombia (FARC) and National Liberation Army (ELN).[43]

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[35] Leon-Kabamba, Ngombe, et al. "Respiratory Health of Dust-Exposed Congolese Coltan Miners." *International Archives of Occupational and Environmental Health*, vol. 91, no. 7, 2018, pp. 859-864.
[36] Mustapha, A. O., et al. "Occupational Radiation Exposures of Artisans Mining Columbite-Tantalite in the Eastern Democratic Republic of Congo." *Journal of Radiological Protection*, vol. 27, no.2, 2007, pp. 187-95.
[37] Lubin, J. H., et al. "Lung Cancer in Radon-Exposed Miners and Estimation of Risk from Indoor Exposure." *Journal of the National Cancer Institute*, vol. 87, no. 11, 1995, pp. 817-27.
[38] Zava, Theodore. "Cadmium's Connection to Infertility and Reproduction." *ZRT Laboratory*, June 2018.
[39] "Mining Arc Threatens Majestic Lands of Southern Venezuela." *Interamerican Association for Environmental Defense*, 24 Jan. 2019.
[40] Rendon (n 18) *supra*.
[41] Walker, Summer, et al. "Illicit Economies and Armed Conflict: Ten Dynamics that Drive Instability." *Global Initiative Against Transnational Organized Crime.* 2022.
[42] ibid.
[43] "Coltan: The Venezuelan Regime's Smuggling of 'Blue Gold.'" *SOS Orinoco*.



Figure 3: Mineral Smuggling Out of Venezuela (Source: Insight Crime).

As coltan travels across countries, it causes tension between state governments and armed groups. Given the lack of clear borders in some mines and the widespread smuggling, "the transnational nature of organized crime or of illegal exploitation of natural resources is another clear example of how local realities can be affected by regional and global Dynamics".[44] Venezuela's coltan reserves are expansive. However, national governments, foreign developers, and militant groups are all fighting to access the same limited resources. Therefore, "International competition for scarce resources in general, and for coltan in particular, is a key factor in the lack of state stability and the continuation of war".[45]

Given the plethora of ethical and practical concerns over coltan mining, there have been legislative attempts to rectify the issues and implement sustainable practices. Notably, the U.S. imposed sanctions in the late 2010s on political elites to curb human rights abuses, corruption, and breakdown of democracy. The U.S. then increased sanctions during the 2019 Venezuelan presidential crisis to target political illegitimacy. However, these economic sanctions were targeted at industries, including mining, which has had devastating effects on Venezuelans. As reported by The Washington Office on Latin America, instead of strengthening democracy, these sanctions have largely strengthened President Maduro's position and made citizens more reliant on the corrupt government.[46] Both legislative attempts to curb the abuse that comes with coltan mining have had unforeseen and devastating impacts on vulnerable communities. These "solutions" fail to target the root causes of the problems, such as lack of infrastructure and consumer demands.

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[44] Donati, Marco, et al. *The Role of United Nations Peacekeeping Operations in Addressing Local Conflicts*. 2017.
[45] Montague, Dena. "Stolen Goods: Coltan and Conflict in the Democratic Republic of Congo." *SAIS Review (1989-2003)*, vol. 22, no. 1, 2002, pp. 103-18.
[46] Oliveros, Luis. "New Report Documents How U.S. Sanctions Have Directly Aggravated Venezuela's Economic Crisis." *WOLA*, 29 Oct. 2020.

V. Conclusion.

As demonstrated through coltan mining in Venezuela, natural resource extraction, particularly of rare finite minerals, instigates and perpetuates conflict. This conflict also maintains cycles of dependence. Although coltan extraction is similar to other cases, such as diamonds or oil, it presents a unique and paradoxical challenge as it is necessary for technological development. Although we depend on resources like oil, there are alternatives. With coltan, we not only lack alternatives, but the options for other exploitative resources like wind and solar depend on coltan.

This dilemma presents a plethora of questions to be explored in the future. How can nations achieve development sustainably? Whose responsibility is it to ensure coltan is consumed ethically? Is it possible to balance good governance and autonomy? As companies like Meta and Apple claim they only use sustainable sourcing, which, as illuminated in this study, is not possible, what metrics hold them responsible? What are ways to remedy the violence and damage done by the conflict cycle in Venezuela and beyond?

As seen by this case study analysis and questions for the future, resource extraction is a multidimensional problem that will require specific solutions in tandem with a shift in social norms. Given the increasing necessity for technology as a tool to reduce global conflict, states must commit to transparent policy-making and consumption while working to establish global standards.

Natural Disaster Resilience and Resource Depletion: Bamboo Construction in Eco Villages, Pakistan

Lara Peralta*

When developing disaster relief mitigation and response strategies, it is not often that the Westernized world looks towards the impoverished as pioneers in resilience and 'green' innovation. However, embarking on ten days volunteering in Pakistan's Sindh rural regions, it is the varied applications of zero carbon materials and consequent community resilience which became a key takeaway. Emphasizing the *process* by which humane, resistant, and zero-carbon buildings might actually be achieved and sustained in the long-term, rather than individually importing externally engineered solutions, could signal a path forward towards greater global climate resilience. Thus, I will follow a focused investigation based on primary data from two villages, PONO Colony and Kewal Kohli, considering Dr Yasmeen Lari's 'four zeros' methodology to achieving sustainable and inclusive spatial development: 'zero carbon, zero waste, zero cost, leading to zero poverty.' Lari is the pioneering humanitarian architect responsible for the Heritage Foundation of Pakistan, which currently sustains the implementation of new approaches to disaster relief and mitigation I was involved in and was thus central to my experience and perspective. The grassroots model I will be overviewing concerns her 'Zero Donor Villages', which were developed in place of the increasingly unsustainable 'international colonial charity model' conventionally applied to developing countries, and widespread in response to the devastating 2005 Kashmir earthquake and 2022 monsoonal floods and landslides. Although this is a specific investigation concerning developing rural communities, the overarching relevance of zero-carbon, co-creation approaches to climate resilience is significant in a contemporary climate of increasingly frequent natural disaster induced humanitarian crises. As we face a global turning point in climate action the disastrous consequences felt by Pakistan were echoed at COP27 by Spain and Nigeria, fellow nations most impacted by climate change in the form of drought, rising temperatures and violent floods, respectively. I approach my analysis through the perspective of zero-carbon materiality and successful local-resource urbanisation, with the aim of understanding the efficacy of 'barefoot social architecture' in action: community self-empowerment and education-oriented initiatives for longer-lasting resistance in developing areas.

Discourse will begin through a consideration of Lari's flood resistant housing designs and their direct impact on rural communities' climate vulnerability as the core basis of her grassroots model. Here, a bamboo frame, raised 0.5 metres off the ground on a compacted earth base is easily pre-produced in flat panels, rendered in earth and lime, and protected from above with traditionally thatched roofing. The 'Women's Centre' in PONO Village similarly adapts local housing typologies through materiality, form, and roofing—raised on stilts for flood avoidance. An informal shaded open-air space is created on the raised ground floor in addition to an enclosed room and balcony space on the first floor. Macha structures—small scale, open-air, roofed platforms raised circa three metres from the ground—allow for continuation of daily tasks in dry safety regardless of flooding below. Importantly, developed as a

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response to the thirty-three million displaced persons from the 2022 flooding disasters, the structures aim to reduce immediate dislocation, allowing life to continue as normal during flooding. Through qualitative interviews with nearby villagers, it was established that residents had previously had to move onto the road where they lived for two months until the water receded. The inherent functional advantages of Lari's adapted vernacular designs for increased flood resilience successfully reduce post-disaster recovery timescales by decreasing vulnerability to flooding effects in the first place.



Figure 1: Hand-Painted Houses in PONO Eco Village Following Dr Yasmeen Lari's Vernacular-Based Flood Resistant Designs.

The achievement of a virtual 'zero-cost' rebound from natural disasters is a further key advantage of local material sourcing. At a period where we face external donor fatigue in parallel with intense climate breakdown, the ability to maintain substantial resilience despite minimal external funding is necessary in developing economies. Local material-use decreases transport and manufacturing labour time, emissions-related and economic costs, as well as contributing to the wider motion towards ceasing resource depletion. Importantly, longer term 'zero-cost' also extends to physical external aid, such that the Pakistani villages' resilience is increased by local material sourcing due to the opportunities this proximity provides for the communities' autonomy and self-education. During our stay, the 'women's centre' acted as a central community hub within the urban fabric where the primary socialising, education, knowledge sharing and skill developing activities took place. Capitalising on its pioneering role, its industry specialty has now become one of education, where the residents of the eco-village are able to earn a living through teaching skills to other villages whose specialties may comprise fishing, agriculture, or bamboo. In aid of self-sufficiency, specialised construction techniques in Lari's designs are used where there is already local familiarity, such as the fish mouth, hole, and angle bamboo joints. The

simplicity and vernacular outline increase efficiency and quality in production by maximising skills that can be readily taught. Locals' empowerment consequently results in community's added security in the knowledge that they can reconstruct their home with, 'their own hands' after potential future natural disasters, without substantial external aid implementing unfamiliar recovery measures.



Figure 2: Women's Centre in PONO Eco Village as Seen from the Ground, Alongside a Prototype Floating Teahouse Structure.



Figure 3: Bamboo Structural System under the Women's Centre in PONO Eco Village.

The importance of materiality as a resilience factor was further understood through the primary project we undertook as volunteers. An architectural brief was set to design and construct a floating public teahouse and home, both of bamboo. This signals towards a potential future direction for domestic flood resilience, where displacement at any flood severity could be avoided, without a water level limit for disaster relief as is currently present in static raised bases, for standstill water. The challenge in the case of PONO Colony was the duality of designing a base able to float stably with a dry pocket margin above the water level, without drifting with currents which would lead to potential damage when lowered onto uneven ground, whilst remaining practical in its un-floating state standing on dry land. Proposed structures constituted a 'base' floating mechanism based on recycled bottles, others made use of the naturally formed bamboo drums to increase surface area and exploit rising water buoyancy, whereas some focused on the form of the inhabited structure itself and mitigation through adaptations to its form during a flood disaster. Upon critical reflection, it could be argued that development of the design proposals prior to arrival and learning of local techniques or vernacular goes against core principles of designing to fit the context, instead introducing an external substance, and enforcing contextual adherence. However, I would argue that the undertaking of the process from conceptualisation to constructed completion revealed the practical onsite and experiential consequences of this same fact, serving as a valuable educational opportunity. As the initial challenge was added to by limitations in material availability and time, a combination of proposals was voted upon by locals, and consequently followed by live form experimentation and alterations to fit resource parameters and site context.

Following the smaller fishing village case study of Kewal Kohli expands the discourse on increased resilience from local materials and knowledge-sharing to the possibility of scaling up flood resistance and improving living standards on a provincial, even nationwide level through cross-community co-operation. The settlement, built following the 2022 floods and currently unseen on digital satellite imagery, was analysed in comparison to nearby villages. Primary quantitative and qualitative data collection constituted measuring infrastructural dimensions, urban spatial layout and land topography through photography and diagrams. Live translated interviews with the local population were also carried out regarding post-disaster recovery and perceived protection. With an established local understanding of water and drainage, Kewal Kohli's settlement plan is uniquely structured around clusters of circa five homes placed on raised 'compounds', upon which shared, raised cooking, cleaning, and dining areas are also found—allowing for the continuation of daily life patterns where otherwise even comparatively minimal flood levels would devastate living spaces. The ground level in between, used only for cattle storage, acts as drainage pathways to further encourage the natural ground flow towards the lakes and out of the village. Additionally, a dug channel leads to a nearby canal to further drain water levels. In presentations to leaders of other villages, it is this specialised knowledge that was passed on to settlements with similar parameters but less specialised understanding of the same drainage principles. However, inter-settlement advice was multidirectional, as despite drainage efficiency, where this village made use of twig and reed barriers for mitigating violent flood penetration, another implements a more effective bamboo plastered with mud and lime boundary defence line. By combining the most effective features from multiple villages, we aided in realising steps towards larger scale regional urban resilience, through the sharing of knowledge and expertise *between different communities themselves,* rather than only drawing from one source for inspiration.



Figure 4: Macha Structure and Raised Housing Compound for Flood Resilience in Kewal Kohli Village.

It is notable that sustainability, through using local zero-carbon materials is inbuilt into the rural village's cultures, as can be seen through the practical applications of their crafts. As part of the volunteering programme in Pono village, locals, particularly the women, generously shared their expertise in local crafts: Ralli stitching—a handmade Sindhi quilt of scrap fabrics and bold patterns—local clay pottery, reed matting, natural paint mixing, and Chulah decorating. The revolutionary Chulah is an example of zero carbon design itself, constructed with compacted earth and decorated with natural dye paints mixed with lime. Introduced by Lari to replace dangerous open flames in homes, it is an open air stove whose introduction brought a major improvement for quality of life for women. Chulah decorating amongst locals revealed the importance placed on creating art as an expression of local pride. Locals shared their hand painted home interiors, custom technicolour exteriors and displayed an unrivalled generosity in gifts of their brightly patterned textiles, forming an additional case for the importance of community pride as a major driver in resilience from a sociological perspective, through morale, hope and mutual support. Thus, it was involvement in smaller scale elements of the village life which ultimately served to bring both sides of existing grassroots discourse: that of materiality and community involvement, together to understand the extent of the community's natural disaster resilience and ensuring its future resilience.



Figure 5: Chulah Stove Decorated with Natural Blue Dye Paints Mixed with Lime in PONO Village.

Resource resilience is driven by local sourcing of vernacular materials—namely, bamboo—and by reducing transportation and production costs and emissions. Vernacular materials also allow for Lari's 'barefoot social architecture' model to be established, as it is due to the familiar materiality that existing traditional expertise can be built upon, driving construction efficiency and innovation. The solution to maximising resilience is not designed in isolation, but rather founds its basis on increasing the safety and strength measures of adapted traditional techniques, often already familiar to locals. I briefly outlined wider implications of the village's specific bamboo materiality, as an upcoming global zero-carbon material with great structural potential. Shifting attention towards communities where its use in the vernacular is successful and widespread could serve as a starting point in material investigation, potential or contextual knowledge. However, I would argue that the greatest impact this material has on overall resilience, albeit a more abstract observation, is the implications on the community's social resilience. Community empowerment was evident in both Pono Village and Kewal Kohli at all scales of locals' daily life. Within villages, widespread use of zero-carbon Chulah stoves establishes sustainability and materiality as central to their culture, but it is their decoration and expression of art which signals pride and drive to innovate and construct more. On a larger scale, data collection from neighbouring villages demonstrates the 'regional' stage 'barefoot social architecture' finds itself in, and its consequent accelerating pace in knowledge-sharing between communities. Hence, it is the community's self-empowerment, self-education and knowledge-sharing encouraged by the Heritage Foundation and bamboo material familiarity which will be most important for these communities to establish greater resilience moving forwards.

The Climate Impact of Passenger Transport: Cars, Trains, and Planes

Kilian Bartsch*

The carbon footprint was born as a public relations tool of the oil industry.[1] Determining individual impact should not demoralise or paralyze but rather accompany bigger institutional changes in our organisations and countries, similarly to the labelling of calories on restaurant menus; the first objective should not be to shame, but to inform. In the calories example, the predominant change does not come from the conscious consumers, but rather from the chefs (or policymakers) who adapt the offering.[2] In this article, the climate impact of travelling by car, train and airplane will be quantified and explained. This will be contextualised in terms of an understandable and relatable metric: the reduction targets per person per month from the UK's carbon budgets.

I. Cars: Electric vs Combustion.

Electric cars have a lower climate impact than combustion equivalents. The small additional battery manufacturing emissions and associated material extraction only slightly decreases the lifetime benefits of electrifying.[3] For a medium average UK car in 2023, a petrol vehicle emits 228 gCO_{2eq}/km travelled, whereas a battery electric equivalent emits 64 gCO_{2eq}/km.[4] Another useful metric in the car context is the distance or duration needed to be driven to tip the lifetime emissions in favour of the electric car. For a battery produced in China driven for ever on the electricity produced in 2022, this would be 48,000km in the UK or 37,000km in France[5] (or 2-3 years of driving of the author's parent's car). After that turning point, every additional kilometre has an even greater impact differential. Importantly, the emissions associated with operating an electric car decrease every year more renewable electricity generation is built (UK 2010 485, 2019 270 gCO_{2eq}/kWh[6]), while the carbon efficiency of the combustion car is frozen for its life.

To fairly compare two cars over their lifetime, choosing similar capability and technology (year of manufacture) is important. When considering modes of transport that are purchased per journey, or when considering the transport needs of a whole country, comparisons are based on passenger-kilometres (pkm) transported (3 passengers travelling 50 km is 150 pkm).

II. Rail Climate Impact.

Trains have a substantially lower climate impact than combustion engine cars and flights on equivalent journeys. The difference can be broken down in terms of operational advantage and electrification. The

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[1] Kaufman, Mark. "The Carbon Footprint Sham." *Mashable*.

[2] Rutherford, Dan. "Science-Based Aviation Regulation." *Aerospace Ambition*, Episode 17, 19 April 2024.

[3] Jolly, Jasper. "EV Mythbusters: Do Electric Cars Really Produce Fewer Carbon Emissions than Petrol or Diesel Vehicles?" *The Guardian*, 23 Dec. 2023.

[4] DESNZ. "Greenhouse Gas Conversion Factors 2023: Full Set", 28 June 2023.

[5] Miotti, Marco, et al. "Personal Vehicles Evaluated against Climate Change Mitigation Targets." *CarbonCounter*, 27 Sept. 2016.

[6] Ritchie, Hannah, et al. "Data Page: Carbon intensity of electricity generation", *Our World in Data*, 2023. *see* 2022 values for China: 534, UK: 261, France: 85 gCO_{2eq}/kWh.

operational advantage of a diesel train over petrol cars comes from multiple factors that are hard to disentangle: higher occupancy (UK cars have 1.6 passengers on average),[7] less acceleration, and bigger engines. Electrification provides a further climate advantage as large fractions of the electricity are produced from non-fossil sources. Not all tracks are electrified: the numbers differ even in Western European countries (38% in the UK, 74% in the Netherlands, 100% of France's high-speed network and 66% of the remaining French network), but as the busiest lines are most economical to electrify, a high fraction of journeys occur on electrified tracks (72% of 2019 carriage-km in the UK).[8] The main reason why certain tracks are not yet electrified is due to high upfront costs and longer returns due to low usage. Certain countries have clear electrification goals and progress like Germany and France, progress in the UK has been more sporadic.

The following figure on train travel shows the emissions per passenger kilometre of a selection of European trains in 2019, adjusted from national and company reports to a consistent set of electricity production emissions. The main takeaway is that combustion cars emit more than diesel trains, and diesel trains have a larger climate impact than electric equivalents – even in countries with high carbon intensity of electricity like the Netherlands (2019 average: 455 gCO_{2eq}/kWh[9]).

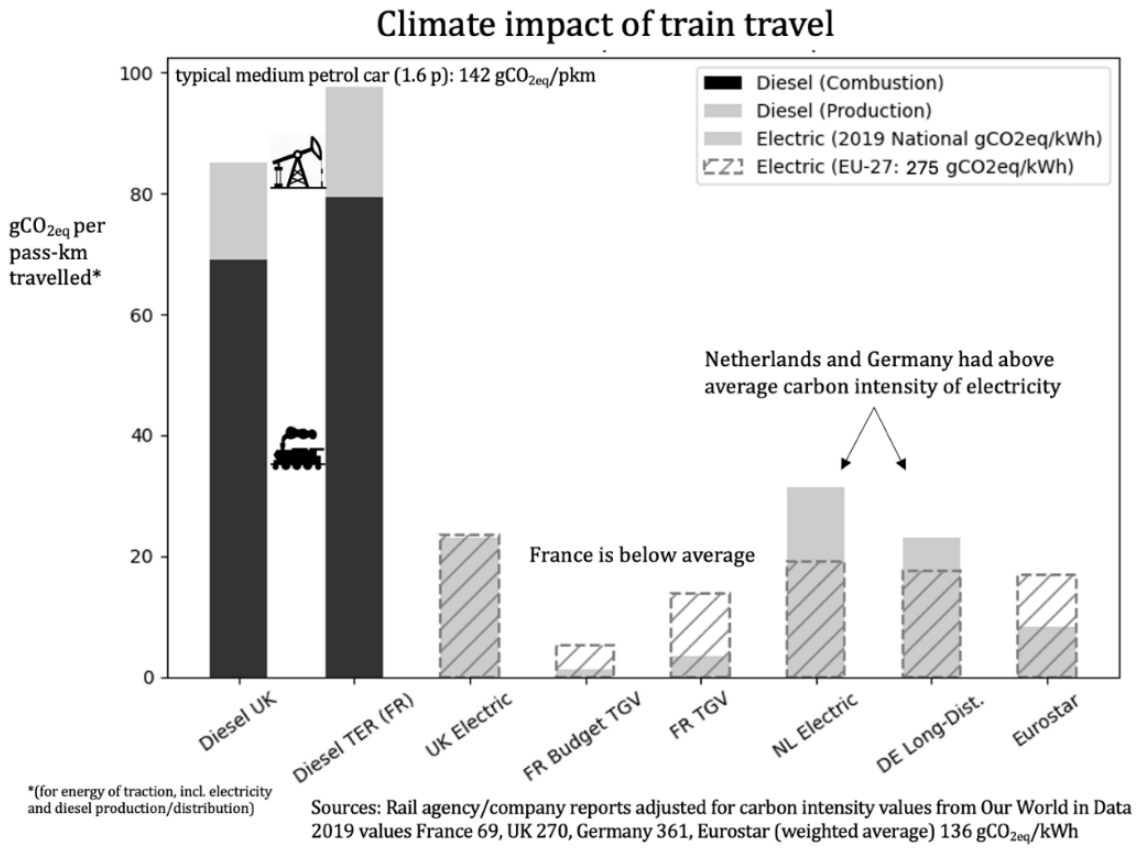


Figure 1: Climate Impact of Traction Energy for a Selection of European Trains.

[7] Department for Transport. "Transport Statistics Great Britain: 2019 Tables." 17 Dec. 2019.
[8] Office of Rail and Road. "Rail Emissions Data Tables." 14 Nov. 2023.
[9] Richie, Hannah et al. (n 6) *supra*.

The differences between trains using the same fuel can be attributed to different seat densities and load factors (the average number of passengers per seat). For example: TGVs have two floors, packing more seats per length of train than single deck Eurostar or German High-Speed trains. The French TGV OUIGO, a budget equivalent to the normal TGV INOUI, achieves even higher seat densities.

Rail companies can be the biggest single electricity consumer in the country. In climate conscious countries with carbon intense electricity, they therefore buy renewable power purchase agreements (PPA). PPAs lead to operators in Germany, Netherlands, and Eurostar to boast lower emissions than depicted (the French do so by using a lower factor for nuclear electricity than global averages).

When considering rail from a long-term policy perspective, infrastructure emissions also become relevant: just like roads, the construction of train tracks result in significant climate impact. Several studies have attempted to quantify the impact: it depends on the number of tunnels and bridges, but bringing it back to a value per pkm also greatly depends on the lifetime of the tracks and the number of trains/passengers that use it.[10] Busy, well-maintained train tracks are very much worth the climate investment. A detailed analysis of a section of French high-speed rail found that the up-front impact was compensated by the passengers now travelling by train that would have used a car/plane after 12 years[11] (well-maintained tracks can be used for well over 50 years). Finally, the tracks and roads may also be used by freight transport, which must be accounted for when fully attributing the climate impact.

III. Aviation Climate Impact.

Airplanes have a large climate impact for the same reason why aviation has made the world smaller: large distances can be covered quickly. This is not captured when normalising per kilometre. Many of the carbon calculators that allow journey-to-journey comparisons use an average emission factor for air travel:[12] distinguishing between short-, medium- and long-haul flights at arbitrary cut-offs. Typical values for economy flights from the UK are 194 (domestic), 130 (short haul) and 143 gCO_{2eq}/pkm (long haul).[13]

The main variation within these categories is due to the aircraft (engine) type and age, how dense or luxurious the seating arrangement is, how full the seats are, how much cargo is being carried, and how far the aircraft is being flown. For the B787-8, a modern long-haul aircraft that entered service in 2011 and accounts for about 10% of long-haul travel to and from the UK, Figure 2 shows the trends of these dependencies.

At very short ranges, the B787-8 needs a large fraction of fuel and emissions to reach cruising altitude (Climb), whereas at long ranges, the aircraft must carry enough fuel to finish the flight, increasing the average weight (Tankering). Budget airlines put more seats in the same aircraft, achieving lower per

[10] International Union of Railways. "Carbon Footprint of Railway Infrastructure." 12 July 2016.
[11] SNCF, ADEME, RFF. "La Ligne à Grande Vitesse Rhin-Rhône au Service d'une Europe Durable: Life Cycle Assessment of the Rhin-Rhone High Speed Track." 2011.
[12] Pellas, Chiara et al. "Lowtrip, a Web App to Compute CO_{2eq} for Different Modes of Transportation Worldwide." Mar. 2024; ADEME, "Base Empreinte", 2024.
[13] DESNZ (n 4) *supra.*

passenger-km impact, but are the source of most of the growth and the consequent increase in total climate impact of the sector. In the years following the pandemic, flying behaviours substantially changed, making it harder for airlines to predict demand or fill seats by managing prices; this resulted in occupancy rates or load factors below 60% (compared to pre-pandemic and 2023 values exceeding 80%).

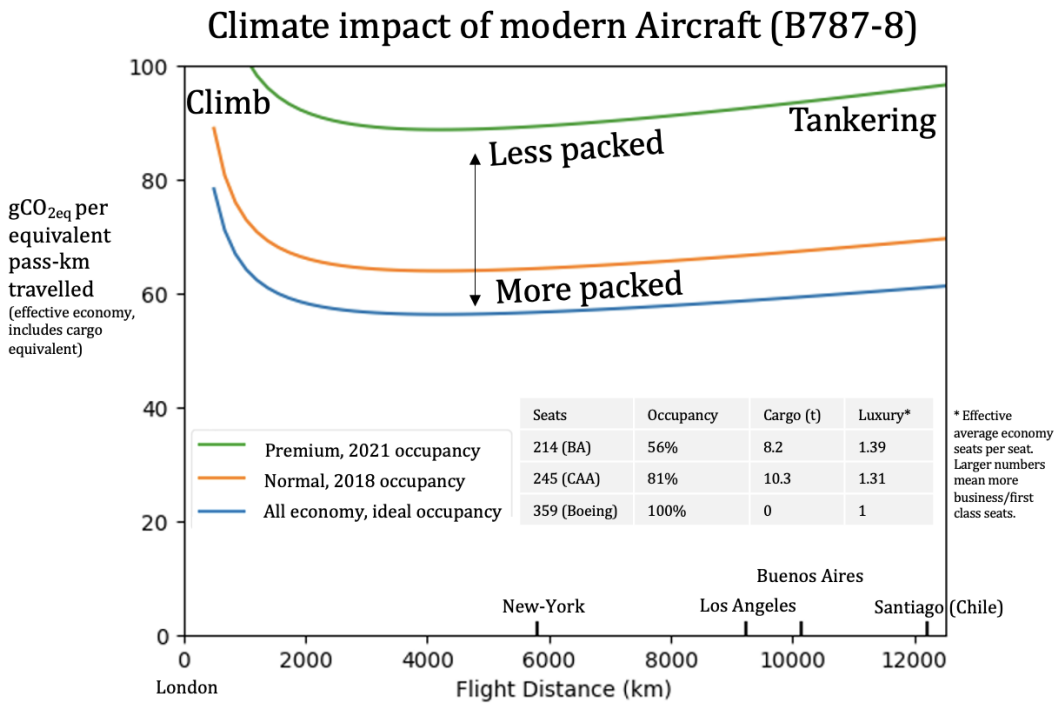


Figure 2: Climate Impact of Modern Long-Haul Aircraft.

Contrails, the long white condensation trails seen in the sky, have intentionally not been included in the previous numbers and figure. Their climate impact is very large and estimated to be of the same magnitude as all other climate impacts of aviation—and should further increase the urgency to minimise distance flown. However, less than 5% of flights cause >90% of the impact from warming contrails.[14] Regulators, airlines, and operators are already planning how to avoid these harmful contrails, and in the coming years there will hopefully be adequate management to address a rapid decrease in this short-lived climate forcer. Unlike CO_2, which stays in the atmosphere for centuries, contrails last less than a day, which means that when we stop flying or fly without producing them, the consequence on the climate is felt immediately. It is therefore a rapid method to achieve a reduction in warming (like reducing methane leaks).

The most accurate public carbon calculator for airplanes' CO_{2eq} impact is the Travel Impact Model,[15] which is behind the estimates of many online booking platforms. Global contrail coverage can be seen in

[14] Teoh, Roger, et al. "Global Aviation Climate Effects from 2019 to 2021", *EGU-Sphere Pre-Print*, 10 Oct. 2023.
[15] Rutherford, Dan. "Flight Emissions Calculator." *Travel Impact Model*.

near real-time on a Breakthrough Energy's contrail map and can be reported via their accompanying mobile application.[16]

IV. Understanding CO_2 Equivalents in the Context of UK's Carbon Budgets.

Climate impact and kilograms of CO_{2eq} can be contextualised in terms of numbers of trees planted or compared to the emissions of another activity like a flight between London or Paris and New York. The UK's pioneering carbon budgets on a per person per month basis can provide a new lens through which to understand kg CO_{2eq}. In the figure below the UK's historical emissions are presented per inhabitant.[17] In the most recently legislated budget for 2035, international aviation and shipping (as measured by UK refuelling) has been included for the first time.[18] The next step will be to include embedded emissions from imports consumed in the UK.[19]

The reductions to date have primarily come from transitioning from coal electricity production to gas, and more recently from the expansion of offshore wind energy. Further reductions will be achieved by expanding renewable electricity production and transmission. But as future reductions will involve increasingly active participation of individuals, the framing in terms of a monthly emission budget can help to inform decisions. 5 years to reduce by 300 kg CO_{2eq} and 15 years to reduce by a further 300 kg CO_{2eq} can be mapped to personal decisions like buying an electric car, hob, or heat pump, eating less meat or dairy, or installing solar panels.

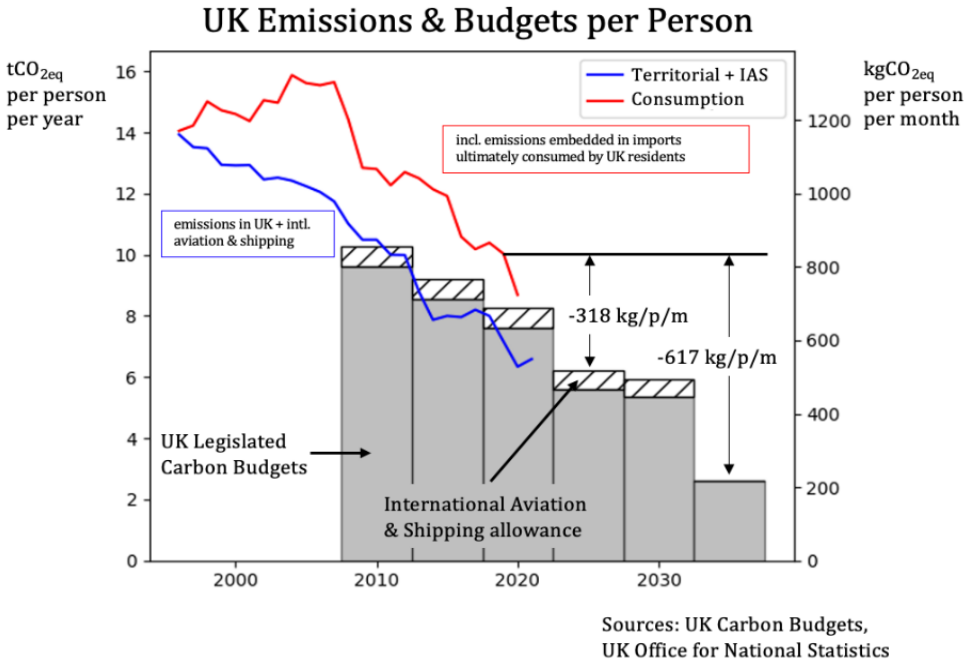


Figure 3: UK Carbon Budgets and Historical Emissions per Person.

[16] Reviate. "Contrail Map" *Breakthrough Energy*. *see* the 'Contrails Observer' mobile application.
[17] DESNZ, BEIS. "UK Territorial Greenhouse Gas Emissions National Statistics." 28 Mar. 2024.
[18] UK Government. "UK Enshrines New Target in Law to Slash Emissions by 78% by 2035", 20 Apr. 2021.
[19] DEFRA. "Carbon Footprint for the UK and England to 2020" 19 Jan. 2024.

In terms of transport, some quantified orders of magnitude are given as examples: long distance or regular trips have the most reduction potential. Replacing three return flights per year between London and Munich would change the average climate impact by -40 $kgCO_{2eq}$/month. Going only once every two years to Chicago would amount to -44 kg/m or replacing it entirely with a yearly trip to Dublin -78 kg/m. Rather than driving 240 days a year 2x15 km to work and back, using an electric car would bring -98 kg/m, or an electric bike -130 kg/m.[20] Working from home 2 days per week would be -55 kg/m.

V. Conclusion.

Transport is a major contributor to global warming, and one where the emissions are very tangible and easy to quantify. As the climate crisis worsens, our habits of how we move around are going to change, by choice or legislated incentives. A quantified understanding of the differences between different transport modes coupled with a clear reduction guideline can help guide individual choices and policy. The macroeconomic UK carbon budgets were brought down to an average monthly budget per person, which can be useful to contextualise the results of any microeconomic carbon footprint estimation and decisions. From a baseline (including embedded emissions in imports) of 836 $kgCO_{2eq}$ per person per month in 2019, average reductions of 318 $kgCO_{2eq}$/p/m are needed to meet the budget of 2025 and a further 299 $kgCO_{2eq}$/p/m for the budget of 2035.

[20] Using 11 gCO_{2eq}/km for an electric bike, including manufacture, from the ADEME database.


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