The Climate Equity Paradox

time, key pollutants and fast climate action to ensure inter-generational climate equity

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Our climate, and more specifically our atmosphere, is probably the most critical inter-generational resource upon which present and future generations depend *and will depend* on for our very existence, offering vital elements for human and ecosystems survival, including clean air, ozone protection from ultraviolet rays, benign and livable weather, freshwater supply from glacier runoff, and thriving healthy oceans, wetlands, forests, and other essential earthly ecosystems.

The debate on equity, and specifically inter-generational equity, regarding climate posits many questions about the current state of the climate in terms of who gets access to deteriorating climate resources but also who carries the burden of climate change and its escalating impacts, as the atmosphere and the general state of the climate deteriorate due to anthropogenically causes,[ii] namely carbon dioxide (CO_2) emissions and other potent greenhouse gases such as methane (CH_4), black carbon (soot) and dirty refrigerants or hydrofluorocarbons (HFCs).

The climate equity debate becomes even more critical as we push deeper into the existential climate crisis we are facing because unlike other inequities certain communities might face and have to cope with, the collapse of the climate system could bring a collapse of all of humanity along with the earth's multiple ecosystems. Science has concluded with utmost certainty that at this point in the climate crisis future generations will receive a depleted, dirtier climate than received by their ancestors. Every additional 1/10 of a degree of warming makes a significant difference in the state of the climate and for the deterioration of interrelated ecosystems.[iii]

For today's governments, policy makers and actors that can still influence the future health and resilience of our climate, and of its very survival, the severity of the current climate crisis implores us to consider not only how best to correct our climate's deterioration (if even possible) to avoid total climate failure, but also respond to the present generation's responsibility in terms of inter-generational climate justice. If we fail to urgently address imminent climate collapse, the severity and existential nature of the consequences could make any discussion over future improvements in climate equity irrelevant. Much of today's policy discussions on climate are divided into *mitigation concerns* (attempting to fix the climate problem), and *adaptation*, an effort to help climate vulnerable communities address climate impacts.

However, if we are to be successful in tackling climate change and its impacts, we must tackle the climate problem with a strategy that goes beyond this binary approach between mitigation and adaptation. We need to bring in "time" and "equity" as fundamental variables to consider in all climate action. Because climate scenarios are changing rapidly, for the worse, pushing closer to irreversible and possibly existential outcomes, all climate policy considerations and proposed solutions must be informed by and guided by the latest science, as well as what we know about climate vulnerability and

the likely evolution of demographics, which show a progressive shift towards the consolidation of Future Majority populations situated in some of the most climate-vulnerable areas of the planet.

The climate crisis is deepening, and the science is confirming that we are on a path to reach potentially catastrophic and irreversible levels of climate collapse bringing devastating consequences for much of the planet. Unless appropriate policy choices, regulations, laws and actions are taken today, *in the next few years* – and specifically before the year 2030 -- future generations may have no solutions at their disposal to correct the failure of their ancestors (the present generation and the generations before us), inheriting a world where not only the climate is deathly ill, but where the associated ecosystems that depend on that climate are also in collapse, dead, or unsustainable.

The 2030 (and not the 2100 or 2050) deadline for critical climate action is surfacing with more force in many very recent IPCC reports (the various AR6 publications in 2021 and 2022). As the planet's society (including governments, corporations, civil society and individuals) try to understand and find solutions to present an escalating climate crisis, *time* to make the right choice is running out. *Time* as a variable for decisions made today is key in climate equity considerations, both for present as well as for future generations. One of the problems we face is that many of the solutions being put forward and implemented today to solve climate change, are not properly taking into account the relevance of *time* and urgency in the viability of solutions to contain global warming.[iv] Solutions are also largely failing to tackle the inequity built into the climate problem. Failure to consider time as a function of the success of climate policy will equally impact present and future generations' ability to stop global warming and stabilize the climate.

The fundamental question we must consider as we move forward to solve the climate crisis is *how close are we to the tipping points the science is warning us about, beyond which our climate can no longer be repaired or worse, even survive*? We should be asking *if what we're doing today to avoid reaching those tipping points is enough?* And more specifically to the question of this paper, *is the present generation adequately tackling climate inequity not only to solve the problems faced today by climate vulnerable communities, but will our actions today, particularly if they fail to take into account revised temporal targets for GHG emissions reductions by 2030, help redress the climate equity problem for future generations? When we consider that future majorities will be in the most climate-vulnerable regions of the Earth, the urgency of this consideration is obvious.*

This is precisely the nature of the *climate equity paradox,* where solutions being proposed, while seemingly important to reduce climate change, may not actually resolve the problem if they are not the most effective solutions to ensure speed and relevance to tipping points.

We have without doubt, already *irreversibly* destined future generations to unavoidable atmospheric and climate deficits that will negatively condition their lives in many profound ways. No matter how successful we are today to slow, stop or even reverse climate change, we will *not* be able to restore it to a state as it was before industrialization began, at least not in a reasonable human time scale.[v] To a certain extent, the *climate equity paradox*, in terms of restituting climate to achieve climate equity between present and future generations, is simply not resolvable.

Assuming for a moment that through science and related policy, laws, regulations, programs, and climate actions, we *are* able to stabilize our climate soon and keep it from getting even worse, we are not necessarily addressing the problem of the inequitable burden certain communities face because of climate change. This important dimension of the climate equity paradox plays out in two different time scenarios, the present and the future. We may be able to address some climate inequities in present and existing climate-vulnerable populations, but can we do so for future generations? We can certainly address climate impact burden inequity in present generations, by restituting climate

resources or providing climate protection to communities that suffer current climate impacts, however if we fail to stop climate change in time before surpassing tipping points, not only will climate impacts to present climate-vulnerable communities intensify, but we may not have viable solutions for future generations since once irreversible climate tipping points are surpassed, the deepening of the climate crisis can rapidly become catastrophic.

At a global scale, most countries have come around to the idea that they need to decarbonize their economies, move away from fossil fuels, and reduce CO_2 emissions. This is because CO_2 traps heat in the atmosphere which results in global warming. Reduce CO_2, and theoretically we solve the climate crisis. The problem with this strategy is that even if we were able to slash all CO_2 emissions to zero, today, and never emit any more carbon into the atmosphere, we unfortunately would *not* solve the current climate crisis. This is a sobering reality that few policy experts fully understand or want to admit. CO_2 remains in the atmosphere for a long time, for hundreds and even thousands of years. All of the CO_2 that we have already emitted will *continue* to warm the climate,[vi] so reducing CO_2 emissions in the short term, *does not* solve the climate crisis we have today, and it won't for several centuries, in fact, if we surpass irreversible climate tipping points before CO_2 reductions have noticeable effects, it will never solve climate change, at least within a reasonable human timescale.

The Intergovernmental Panel on Climate Change (a collective of the world's leading climate scientists) has told us that we should not let the planet warm by more than 1.5C degrees above pre-industrial levels (the early 18th century climate) or we will surpass critical and irreversible climate tipping points beyond which the climate fails and there is no return.[vii] Since industrialization began, the planet has already warmed by 1.1C, and the latest IPCC report (published just weeks ago) indicates that we're off target, and that we may surpass 1.5C in the next few years or decades.[viii] If the CO_2 we've already emitted will keep warming the planet no matter what we do, how do we stop global warming from reaching 1.5C in the next few years? We need a faster solution.

The key to not breaching certain short-term irreversible climate tipping points and to keeping on the 1.5C pathway is to press on with decarbonization (which is a necessary long term target) but simultaneously cut certain non-CO_2 *super pollutant*[ix] gases that can stop and even reverse climate change trends in the near term (within decades). These gases include methane (CH_4), black carbon, and Hydrofluorocarbons (HFCs), among others. Methane for example is 86 times more potent as a greenhouse gas than CO_2 on a 20-year time scale. HFCs (dirty refrigerants) can be up to 1000s of times more potent than CO_2 in terms of climate impacts. These gases, unlike CO_2, have a shorter lifespan in the atmosphere, which is why they're called short-lived climate pollutants (SLCPs). Super pollutants remain in the atmosphere for a very short time, and are eliminated in mere days, months, years, or as little as decades, but not in centuries or millennia like CO_2. Because they are so powerful in terms of global warming potential for the short time they are in the atmosphere, removing these gases from the atmosphere has immediate benefits, now, today, this month, this year.

Super pollutants like methane and the associated gases that are co-emitted with methane occur in sectors like energy, or black carbon (soot emitted from incomplete burning) for example in wood stoves or from diesel engines, also cause serious human health impacts including severe respiratory diseases such as asthma, premature death and cancer. Millions of lives are lost each year to air quality problems caused by super pollutant emissions,[x] which is why reducing them is fundamental to addressing the climate equity and climate impact burden issue for climate-vulnerable communities.

The IPCC has told us in recent reports that the only pathway to avoid surpassing irreversible climate tipping points before the midpoint of the century (2050) or even sooner, is to immediately reduce emissions of these super pollutants as rapidly as possible.[xi] To be clear, this is not an *either-or option*. We *must* decarbonize (reduce CO_2 emissions) over the long term (centuries to millennia) in order to

stabilize the climate for future generations, while also removing non-CO_2 gases today so that we can achieve immediate climate cooling for present generations. This helps ensure that we do not surpass irreversible tipping points, and avoid certain climate collapse for future generations.

Measures are available that governments, corporations, and people can put in motion in the next days, weeks, and in the next year or two that will have noticeable benefits before the end of the decade (the year 2030), and that will help present climate-vulnerable communities by quickly reducing warming. Up to 0.6C degree of warming can be avoided through super pollutant phaseouts before mid-century.[xii] Recall that the planet has already warmed by 1.1C of the 1.5C that scientists tell us is the point of no return. A strategy that helps us hold back global warming by 0.5C hence in the very near term, *should not and cannot be ignored*. It is fundamental to our climate's survival.

It is imperative for governments to act quickly to promote fast climate mitigation strategies grounded on super pollutant phaseouts alongside CO_2 emissions reductions. This is perhaps the most significant climate urgency and opportunity that governments have before them, particularly because there are proven and tested viable actions and solutions available in the key super pollutant arenas.

Reducing methane emissions and associated gases in the oil and gas sector, which currently has extremely high methane leak rates, is an example of a critical strategy that not only tackles climate change in the short and long term, but also helps improve the health of local communities that get sick from associated gas emissions from oil and gas production. Methane gas also mixes with other gases to produce tropospheric ozone (O_3), resulting in life-threatening health impacts in fence-line communities, thereby tackling the climate burden inequity. If we can reduce black carbon emissions by reducing burning of organic matter (deriving from forest fires, from soot emitted from diesel engines, from shipping or from wood burning from stoves, just to name a few examples) we can reduce soot deposit on glaciers which results in more global heat absorption and accelerated melt which in turn causes additional global warming as well as sea level rise, an identified threat across generations. Reducing black carbon emissions has immediate effects on the climate but also immediately helps improve air quality, which has added human health benefits for climate vulnerable communities, again, tackling the climate inequity problem.

Many policy choices and regulatory decisions guide industry and consumer choice helping define short- and long-term climate impacts of those choices. Mandating leak detection and repair for key emitting industries like oil/gas or the waste sector can rapidly reduce super pollutant emissions in the near term. Incentivizing the purchase of zero emission vehicles today can significantly reduce transportation emissions for many years. Mandating cleaner air-conditioning technology has immediate and multi-decade climate benefits. Requiring more energy-efficient buildings can help cool and heat with less energy. Banning natural gas connections in homes reduces years of dirty emissions. Governments must be proactive guiding businesses and consumers to make immediate multi-decade-relevant decisions that help curb the GHG emissions curve by 2030, before it's too late.

The *climate equity paradox* can and must be addressed today, urgently, by pushing for short term solutions that curb global warming as soon as possible, and before 2030, because if we fail to do this, irreversible climate tipping points will be reached before mid-century, greatly exacerbating the climate crisis and climate inequity experienced by present generations, but that will be suffered more severely by future generations. If short-term policy and action decisions today are not spot-on in terms of which pollutants must be phased out first *and more aggressively* in the next few years and decades, the question of future climate equity may become moot in what may be an unavoidable existential climate collapse. The science is clear and fortunately we have at our disposal viable and cost-effective measures to adequately address the climate crisis. There is no time to waste.

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[ii] Romanello M., *et al.* (2021) *The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future*, The Lancet 398(10311): 1619–1662, 1619–1620 ("The 44 indicators of this report expose an unabated rise in the health impacts of climate change and the current health consequences of the delayed and inconsistent response of countries around the globe—providing a clear imperative for accelerated action that puts the health of people and planet above all else.... Through these effects, rising average temperatures, and altered rainfall patterns, climate change is beginning to reverse years of progress in tackling the food and water insecurity that still affects the most underserved populations around the world, denying them an essential aspect of good health.").

[iii] *Discussed in* Borenstein S. (28 February 2022) *UN Climate report: 'Atlas of human suffering' worse, bigger*, AP News.

[iv] *See* Institute for Governance & Sustainable Development (2021) THE NEED FOR FAST NEAR-TERM CLIMATE MITIGATION TO SLOW FEEDBACKS AND TIPPING POINTS: *Critical Role of Short-lived Super Climate Pollutants in the Climate Emergency*, Background Note (available upon request).

[v] Planetary climate cycles come and go in periods of about 100,000 – 120,000 years, influenced by the Earths position relative to the sun and resulting changes to the temperature fluctuations, the making and melting of ice ages, which all affect atmospheric chemical composition. It takes about 80,000 – 100,000 years to form an ice age, and about 20,000 to melt one away. We're now in a period between ice ages that produces a very moderate and livable inter-glacial living environment. The problem is that anthropogenic emissions are destabilizing the natural climate cycle and spiraling the Earth's climate into an accelerated warming phase that could become unlivable for humans and for natural ecosystems broadly. We might be able to wait around for the Earth's climate cycle to reset and return to where we started accelerating it, but it will be a long journey for the human race to endure. The people alive today will undoubtedly never see our planetary climate return to how it was just a few centuries ago. Even our grandchildren's grandchildren will not see this climate re-composition.

One thousand years (which is only 1/100th of an ice age cycle) is equivalent to about 40 generations. Twenty thousand years hence is about 800 generations, and a full ice age cycle or about 100,000 years is more than 4,000 generations. That's longer than recorded human history (which is only about 5,000 years or 200 generations). That means that another 4,000 or so generations will have to pass before we can return to the stage of the planetary climate cycle that we had just before industrialization took hold about 200 years ago. That's a lot of grandchildren between now and resetting the climate. We also face the risk, if we cannot contain global warming soon, of pushing the Earth's climate into an unlivable conditions, where humanity cannot thrive and where most of the Earth's ecosystems cannot survive.

[vi] Ramanathan V. & Feng Y. (2008) *On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead*, PROC. NAT'L. ACAD. SCI. 105(38): 14245–14250, 14248 ("Switching from coal to "cleaner" natural gas will reduce CO_2 emission and thus would be effective in minimizing future increases in the committed warming. However, because it also reduces air pollution and thus the ABC [Atmospheric Brown Cloud] masking effect, it may speed up the approach to the committed warming of 2.4°C (1.4–4.3°C).")

[vii] *See* Arias P. A., *et al.* (2021) *Technical Summary*, *in* CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS, Masson-Delmotte V., *et al.* (eds.), Intergovernmental Panel on Climate Change, TS-71–TS-72

[viii] *See* Intergovernmental Panel on Climate Change (2022) *Summary for Policymakers in* CLIMATE CHANGE 2022: MITIGATION OF CLIMATE CHANGE, Skea J., *et al* (eds.) SPM-15 ("Global GHG emissions in 2030 associated with the implementation of nationally determined contributions (NDCs) announced prior to COP26 [FOOTNOTE 24] would make it *likely* that warming will exceed 1.5°C during the 21st century.")

[ix] These gases are generally referred to a short-lived climate pollutants, or SLCPs. The term "super pollutant" is a term that is utilized here to simplify the terminology for GHG non-experts, with the superlative "super" utilized because of the significant intensity of these pollutants to warm the climate, far greater than CO_2.

[x] *See* United Nations Environment Programme & World Meteorological Organization (2011) INTEGRATED ASSESSMENT OF BLACK CARBON AND TROPOSPHERIC OZONE

[xi] *See* Intergovernmental Panel on Climate Change (2022) *Summary for Policymakers in* CLIMATE CHANGE 2022: MITIGATION OF CLIMATE CHANGE, Skea J., *et al* (eds.) SPM-22 ("In pathways that limit warming to 1.5°C (>50%) with no or limited overshoot global net CO2 emissions are reduced compared to modelled 2019 emissions by 48% [36–69%] in 2030 and by 80% [61-109%] in 2040; and global CH4 emissions are reduced by 34% [21–57%] in 2030 and 44% [31-63%] in 2040.")

[xii] Xu Y. & Ramanathan V. (2017) *Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes*, PROC. NAT'L. ACAD. SCI. 114(39): 10315–10323, 10321 ("The SP [super pollutant] lever targets SLCPs. Reducing SLCP emissions thins the SP blanket within few decades, given the shorter lifetimes of SLCPs (weeks for BC to about 15 years for HFCs). The mitigation potential of the SP lever with a maximum deployment of current technologies ... is about 0.6 °C by 2050 and 1.2 °C by 2100 (SI Appendix, Fig. S5B and Table S1).").