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SYMPOSIUM ARTICLE

Carbon Competence: A Primer

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Abstract
This primer essay explores the disconnect between the empirical reality of our ecological predicament and the discourse surrounding it at both mainstream and specialist levels. Broadly, it is intended to provide orientation for subsequent discussions in climate ethics and politics. More specifically, it acts as an introduction to the article "Is Democratic Theory Carbon Competent?" included in the present volume.

Keywords: climate change; planetary boundaries; climate denial; climate skepticism

Discussions around climate change in both popular and academic contexts are hindered by limited public awareness of the present ecological situation in terms of its scope, severity, and urgency. A 2024 *Nature Climate Change* paper introduces the term "carbon competence" to describe individuals' relative understanding of the causes and consequences of greenhouse gas emissions and the knock-on effects of a rapid warming trend. The study concludes that carbon competence is generally low and that this limitation inhibits meaningful mitigation efforts (Johnson et al., 2024).

The crisis of anthropogenic climate change, in other words, is matched by a complementary crisis of climate literacy. The purpose of this primer essay is to track the disconnect between the empirical reality of our ecological predicament and the discourse surrounding it at both mainstream and specialist levels. It is intended to provide orientation for subsequent discussions in climate ethics and politics, which, as we will see, too often lack specificity, up-to-dateness, and an appreciation of how late the hour has become.

Johnson et al.'s study concerns the knowledge and understanding of individuals who already have "sustainability intentions." In other words, people already concerned about climate change and interested in combating the problem are unable to do so effectively because of their misapprehension of the nature of GHG concentrations. Taking into account the full spectrum of beliefs and degrees of concern about anthropogenic climate change and environmental degradation, low carbon competence is far more prevalent and even nearly ubiquitous, especially in the United States.

According to the 2024 Yale Climate Opinion Maps (Marlon et al., 2025), only 72% of Americans believe that global warming is occurring, while only 59% believe that the observed changes are anthropogenic and only 57% confirm that most scientists agree on this issue. Before we rush to comfort at the fact that these numbers represent majorities (though hardly overwhelming), we should bear in mind that these questions only concern the most basic truth of anthropogenic climate change with no specificity in terms of scope, potential impacts, or timeline. A full 29% *deny the reality* that human activity is causing changes to the climate, while another 12% are unsure. In an even more alarming result, a 2024 survey conducted by Yale and George Mason University found that only 20% of Americans recognize that the scientific consensus on this issue is greater than 90%

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(Leiserowitz et al., 2024). When scholars like Chaudhary (2024, 23) claim that "literal climate denial" is a "non-issue," then, they are implying that the basic knowledge of four-fifths of Americans is a non-issue.

To the extent that it is defended at all, the most literal form of climate denialism is supported by low carbon competence. James Inhofe, the five-term U.S. Senator from Oklahoma, famously brought a snowball to the floor of the Senate to demonstrate that, since it was an unusually cold February day in Washington D.C., reports of record heating must be false or exaggerated (Barrett, 2015). This obviously relies on a basic misunderstanding not only of the distinction between climate and weather but also of the concept of global aggregate temperature shifts. Or consider this statement on climate policy from Senate candidate Herschel Walker in 2022:

> "Since we don't control the air, our good air decided to float over to China's bad air. So when China gets our good air, their bad air got to move. So it moves over to our good air space. And now we got to clean that back up" (quoted in Aton, 2022).

Walker confuses GHG emissions with simple air pollution and betrays a stunning misapprehension of atmospheric flows. Despite this, he still managed to achieve 48.6% in the senatorial runoff election, some 1.7 million votes.

The broader climate denialist discourse makes use of various other spurious (and often contradictory) arguments and claims: that no warming trend has been observed, that the observed warming trend can be attributed to natural cycles, or that a cooling trend has actually been observed. It is also frequently and falsely claimed that climate science is unreliable and unsettled or that there is widespread disagreement within the scientific community (Busch & Judick, 2021; Coan et al., 2021; McKie, 2019). It is important to note that low carbon competence is not simply a matter of ignorance in a negative sense, that is, a *lack* of knowledge or understanding. It also involves patently wrong beliefs about the state of the scientific consensus, the nature of the greenhouse effect, or, indeed, logical inference (e.g., "the Earth's climate has changed before; therefore, *this* change is non-anthropogenic").

We can extend our notion of carbon competence still further. Theorists of climate denial have suggested an expanded conception of denialism capable of accounting for more implicit and subtle forms (Ekberg et al. 2023; Mann & Toles, 2016). In an influential account, Norgaard (2011) follows Stanley Cohen in distinguishing between "literal denial," which straightforwardly gainsays empirical reality, "interpretive denial," which distorts the meaning or significance of this reality, and "implicatory denial," which minimizes or ignores "the psychological, political, or moral implications that conventionally follow" (10–11). Before proceeding, we should clarify what a competent understanding of the meaning or significance of anthropogenic climate change would entail, along with the implications that should "conventionally follow."

According to the World Meteorological Organization, GHG concentrations are at their highest point in 800,000 years, with 2024 setting records for GHG concentrations, rate of increase in concentrations, and global temperature relative to a pre-industrial baseline; 2015–2025 are the 11 hottest years on record, with 2025 landing as the second or third hottest (WMO, 2026). Future warming depends on future representative concentration pathways (RCPs), but a high rate of emissions is compatible with 3–5 °C of warming by 2100 (Hébert et al., 2021). More optimistic projections (i.e., lower RCPs) rely on two closely related assumptions: that the policies outlined by the 2015 Paris Agreement will be implemented, and that negative emissions technologies (NETs) like BECCS (bioenergy with carbon capture and storage) can be massively scaled up along with terrestrial carbon sinks (Rogelj et al., 2019; Vuuren et al., 2018).

Regarding the first assumption, it is worth noting that no country is on track to meet its Paris pledges (Schumer et al., 2025). Furthermore, a 2025 UNEP report concludes that *even if* the Paris targets are fully realized, the planet would still warm within a likely range of 2.3 °C—2.5 °C by century's end, with *current policies* leading to a mean estimate of 2.8 °C—with 4.6 °C as a possible

outlier scenario (UNEP, 2025, xiii). NETs, on the other hand, are speculative and untested at scale (Larkin et al., 2018). They also carry intense land, energy, and raw materials burdens of their own (Cooper et al., 2022; Creutzig et al., 2021; Guenther, 2024, 149–154; Lane et al., 2021; Prütz et al., 2026; Rostami et al., 2024; Smith et al., 2016). Even terrestrial carbon sinks are threatened by increased warming (Friedlingstein et al. 2026; Kou-Giesbrecht et al., 2025; Rodríguez-Veiga et al., 2025; Wu et al., 2026); extreme temperatures limit the ability of forests and oceans to absorb CO_2 (Ke et al., 2024) and animal extinctions constrain the ability of forests to regenerate (Fricke et al., 2025).

If we are tracking cumulative emissions and concentration trends, dropping the unnecessarily optimistic assumptions mentioned above, a high RCP is not a distant possibility (Hansen et al., 2023; Schwalm et al., 2020).[1] A 2021 survey of 92 IPCC authors conducted by *Nature* found that over half of the respondents predicted 3 °C of warming or more by the end of the century (Tollefson, 2021); a more recent *Guardian* survey of 380 IPCC scientists was slightly more hopeful, with only 42% predicting warming exceeding 3 °C and another 34% landing at 2.5 °C (Carrington, 2024).

A 2017 *PNAS* article describes 1.5 °C of warming as "dangerous," 3 °C as "catastrophic," and 5 °C as "unknown, implying beyond catastrophic, including existential threats." The report notes that "unchecked emissions" could lead to "high-impact…warming becoming catastrophic by 2050" (Xu & Ramanathan, 2017). Business as usual without a technological *deus ex machina*, therefore, condemns 2100 to somewhere between approaching "catastrophic" and "beyond catastrophic" conditions, with the upper limit of "dangerous" as an optimistic alternative. To make matters worse, a 2026 *Nature* study found that many of the "worst case scenario" outcomes projected in 3 °C or 4 °C model scenarios—including proliferations of breadbasket droughts and forest fires—may already occur at 2 °C (Bevacqua et al., 2026).

The reigning strategy among geopolitical elites is "overshoot," that is, allowing GHG concentrations to exceed a level consistent with 2 °C of warming and then drawing this level down later with proliferated NETs and carbon sinks (Malm & Carton, 2024, 88–96). In addition to the technological limits described above, this approach crucially ignores the reality of tipping points, or critical thresholds of warming that trigger abrupt and irreversible changes (Schleussner et al., 2024). A 2025 *Earth System Dynamics* study finds "the warming trajectory expected from current policies….unsafe with regard to triggering climate tipping points" (Boers et al., 2025; Brovkin et al., 2021; Deutloff et al., 2025; Kaufhold et al., 2025; Lenton et al., 2025; McKay et al., 2022; see also Ripple et al., 2026). Another study pinpoints the shutdown of the AMOC ocean current as a "point of no return" with regard to climate tipping points—including an unavoidable sea level rise of several meters—and dates this shutdown as "likely within the next 20–30 years" if warming is not arrested and reversed (Hansen et al., 2025; Portmann et al., 2026; see also Westen et al., 2025).

While there is no space to catalogue the enormous and nonlinear negative consequences of 2 °C, 3 °C, or 4 °C of warming (see Lynas, 2020), it is worth dwelling on one potential impact: human mortality. Considering only extreme heat, a landmark 2021 paper calculated that every additional 4.4 K metric tons of CO_2 in the atmosphere (the lifetime emissions of 3.5 average Americans) will cause one "excess death" between 2020 and 2100 (Bressler, 2021). Other studies of the "mortality cost" of carbon yield somewhat different results, depending on what factors are considered.[2] One puts the ratio of the average American's lifetime emissions to a future climate fatality at 1.2 to 1, concluding that warming of 2.7 °C could jeopardize the habitability of areas currently occupied by one third of the human population (Lenton et al., 2023; see also Lizana et al., 2026; Xu et al., 2020).

[1] A recent study (Van Vuuren et al., 2026a) suggesting that RCP 8.5 be retired from climate modeling garnered much media attention (interestingly, much more so than most other studies cited in this essay). It is worth noting—almost none of the media coverage did—that the model adopted by this study still makes use of a "high emissions scenario" that projects between 3 °C and 4 °C of warming by 2100 and between 4 °C and 5 °C by 2140.

[2] See also Masselot et al. (2025) and Rees (2023). Nolt (2011) represents an early—and remarkably prescient—example of this approach.

Another puts the ratio of CO_2 tonnage to human death at 1 K to 1, a figure that implies 1 billion fatalities from climate change by 2100 (Pearce & Parncutt, 2023). Yet another predicts a quadrupling of the attributable mortality rate to 30 million people per year by the same time (Pozzer et al., 2024). A child born in 2020 will face somewhere between double and septuple the rate of deadly extreme weather events compared to one born in 1960 (Thiery et al., 2021). Under a high warming scenario, climate-induced wildfire smoke alone could kill 1.9 million Americans by 2055 (Qiu et al., 2025). None of these studies consider fatalities from the military conflicts likely to unfold as resources dwindle and regions become uninhabitable (Chaturvedi & Doyle, 2016; Dyer, 2011; Klare, 2019; Parenti, 2011; Welzer, 2012). Bearing all of this in mind, framing climate change as a concern exclusively for "future generations" should be retired—it is not carbon competent (Romanello et al., 2025; Steel et al., 2024).

We must also acknowledge that climate change is only one of the "planetary boundaries" currently being transgressed by unsustainable production and consumption patterns. Though interrelated, emissions reduction would not on its own address disruptions to the phosphorous and nitrogen cycles, freshwater shortages,[3] or the collapse of biodiversity[4] (Ceballos & Ehrlich, 2023; Higgs, 2024; Richardson et al., 2023; Stenzel et al., 2025; Vuuren et al., 2025). According to the Planetary Boundaries Science project's 2025 "planetary health check" report, seven of nine planetary boundaries are currently being breached, and "our planet's vital signs are flashing red" (Planetary Boundaries Science, 2025).

Considering the possibility of 5 °C of warming within a century, compounded by the transgression of other planetary boundaries and potential unforeseen positive feedback loops, the talking point that climate change represents an "existential threat" to organized human civilization is neither exaggerated nor misleading (Davidson & Kemp, 2024; Huggel et al., 2022; Kemp et al., 2022; Steel et al., 2022). The 2024 "State of the Climate Report" published by *BioScience* expresses this with a few succinct sentences: "We are on the brink of an irreversible climate disaster. This is a global emergency beyond any doubt. Much of the very fabric of life on Earth is imperiled. We are stepping into a critical and unpredictable new phase of the climate crisis" (see also Fletcher et al., 2024; Ripple et al., 2024).[5]

The IPCC estimates that a >50% chance of staying below 1.5 °C demands that net zero be achieved by 2050, with "deep" and "immediate reductions" necessary this decade (IPCC, 2023). A 2023 *Nature Communications* study reports that if NETs are constrained in their efficacy at scale, coal, oil, and gas consumption would need to decline by 99%, 70%, and 84%, respectively, by 2050 to keep warming within 1.5 °C (Achakulwisut et al., 2023). The same year, a *Nature Climate Change* study estimated that the remaining 1.5 °C carbon budget was equal to roughly 6 years of present emissions (Lamboll et al., 2023). Even more alarmingly, a 2025 report signals that 1.5 °C is far too warm to maintain polar ice sheets, and that even sustained warming of 1.2 °C (which has already occurred) is likely to cause "extensive loss and damage to coastal populations" (Stokes et al., 2025; see also Abram et al., 2025). There is no safe and stable future without rapid decarbonization.

[3]Jones et al. (2024) suggest that 66% of the global population could face 1 month per year of clean water scarcity by 2100. Steinert et al. (2025) find that more than 1.8 billion people could face permanently altered water availability if 1.5 °C is overshot. Ravinandrasana & Christian (2025) conclude that many regions may face "drought-driven water scarcity events" as early as the 2020s or 30s, with urban populations particularly effected. Chandanpurkar et al. (2025) report on unprecedented "continental drying" since 2002 and conclude that "urgent action is required to prepare for the major impacts of results presented." Given this situation, Madani (2026) suggests that "water bankruptcy" is a more apt term than "water shortage."

[4]Climate change alone could wipe out *one third* of all species by 2100 (Urban, 2024).

[5]The 2025 Report (Ripple et al., 2025), which appeared late in the production of this article, begins with this sentence: "We are hurtling toward climate chaos." It goes on to say that "the window to prevent the worst outcomes is rapidly closing" and that "recent developments…mark the beginning of a grim new chapter for life on Earth."

The disconnect between this empirical reality and the public discourse around climate change is palpable.[6] First of all, the degree of popular attention and media exposure is dramatically incongruent with the nature of the problem in its scope, severity, and urgency. Only 36% of the Yale Climate Opinion respondents reported discussing global warming "at least occasionally," while 28% said that they hear about climate change in the media at least once a week (a result consistent in the Yale/GMU survey). This relative dearth of exposure and consciousness already suggests a broadly diffused denialism at the interpretive and implicatory levels. But when it *is* discussed in public fora, there is little carbon competence to be found. Studies consistently demonstrate that mainstream media outlets give denialist or "contrarian" discourses at least equal weight, and in many cases outsized exposure, compared to minimally scientifically literate perspectives (Antilla, 2005; Boykoff & Boykoff, 2004; Painter et al., 2023; Petersen et al., 2019; Wetts, 2020). This is frequently justified in the name of journalistic neutrality and respect for "both sides" of a debate.

Take a typical example. In 2023, *Reason* magazine published an opinion piece titled "Yes, the Government is Coming for Your Gas Stove." The author, Christian Britschgi, supports his opposition to a gas stove ban by claiming that "people know their own needs best" and that "people who care about price and efficiency may prefer gas" (Britschgi 2023). He does not mention that annual methane leakage from gas-powered stoves has a climate impact comparable to the carbon emissions of half a million gas-powered cars (Lebel et al., 2022). While he does point out that electricity generation is presently carbon intensive, the article fails to note that electricity can in principle be decarbonized (while natural gas cannot). In this argument, there is no straightforward denial of anthropogenic climate change; there is only the implication that, whatever the impacts of climate change, consumer sovereignty is more important and government mandates more frightening. This is consonant with a broader shift in the opposition literature focusing less on the science *per se* and more on the threat decarbonization poses to individual freedom and economic choice (Antonio & Brulle, 2011; Cann & Raymond, 2018).

The values marshaled against radical climate action vary. In 2021, Donald Kochan penned an op-ed in *The Hill* titled "There's No Climate Change Exception to Free Speech." Expressly defending the legal right of the fossil fuel industry to disseminate misinformation about climate change, he argues that the first amendment is too important to be sacrificed in the name of an environmental emergency. He writes (displaying little *historical* competence) that "we have never allowed the government to choose who is worthy to speak and who is not" (Kochan 2021). Like Britschgi, Kochan does not deny the reality of anthropogenic climate change, but he implicitly denies its gravity.

The arguments in these pieces depend upon omission. Climate change *not otherwise specified* is positioned against a particular value, that is, the right to buy a gas stove or freedom of speech. The full implications of continually rising GHG emissions—the probability of 3 °C of warming by 2100, the danger of tipping points, the overshooting of other planetary boundaries, the existential risk involved, and a potential mortality cost in the billions—go unmentioned. If this empirical reality is fully accounted for, the stated arguments are less compelling.[7] These articles do not say "granted, unabated GHG emissions will likely be responsible for the death of a billion people and may render human civilization unsustainable, but consumer sovereignty and freedom of speech are more important. Better dead than green." That rightly sounds indefensible.

In this genre, the meaning and the moral hazards of climate change are implicitly minimized, rendering the interventions denialist in interpretive and implicatory registers. Giving Britschgi and Kochan the benefit of the doubt with regard to basic moral compunction, they display low carbon competence. Perhaps they would say that other strategies for rapid decarbonization should be

[6]Lu (2021) cites a litany of surveys indicating that "the public" wants action on climate change (4–5). But such surveys mean little unless those surveyed understand the full exigencies of the problem as detailed here. It is one thing to want unspecified "action" on climate change; it is quite another to realize the urgency and radical implications of achieving net zero by midcentury.

[7]Cf. Lavik (2016), who argues that climate denial should not be protected speech even according to constitutional precedents.

pursued, strategies that would ostensibly not require any constraints on consumer sovereignty or freedom of expression. But they do not articulate any alternative pathways, nor even acknowledge the necessity of rapid decarbonization. The obvious retort to their positions—that there is no future "freedom" for anyone if "the very fabric of life on Earth is imperiled"—is neutralized by never accounting for or acknowledging the fact that the very fabric of life on Earth is imperiled.

We encounter low carbon competence across the political spectrum. In 2022, *The New York Times* published an article by Ezra Klein called "Your Kids are Not Doomed." Arguing against recent interventions that question the ethics of having children as the planet warms, he claims—without citation—that "no mainstream climate models suggest a return to a world as bad as the one we had in 1950, to say nothing of 1150." The studies of carbon's "morality cost," some of which were available when this piece was published, tell a different story. Klein, however, does not deny that runaway warming would be catastrophic. But he denies that the warming trend is running away:

> "many credible estimates from a decade ago put us on track for the average global temperature to increase 4 or even 5 degrees Celsius from preindustrial levels by 2100. That would be cataclysmic. But the falling cost of clean energy and the rising ambition of climate policy have changed that. The Climate Action tracker puts our current policy path at about 2.7 degrees of warming by 2100. If the commitments world governments have made since the Paris climate accord hold, we're on track for a rise of 2 degrees or even less" (Klein, 2022).

First of all, the 2.7 °C figure Klein references is a *mean* estimate; the Climate Action Tracker he cites gives *3.3* °C as the high end of the possible range based on current policies (Climate Action Tracker, 2025). Where he says "or even less," saying "or even more" would be equally warranted. Assuming policies do not worsen (hardly a warranted assumption), then, warming will be somewhere between extremely "dangerous" and "catastrophic" by 2100. Klein likewise points to the Paris accords, but as mentioned above and as the Climate Action tracker itself shows, no signatory's policies are currently compatible with meeting its pledges and targets. While this already blunts the edge of Klein's critique, it still does not address the realities discussed above: barriers to NETs at scale, tipping points, other planetary boundaries, and so forth He also leaves out the fact that "the falling cost of clean energy" has not resulted in a contraction of fossil fuel consumption (Christophers, 2024). Even the bastion of respectable liberal opinion is not innocent of interpretive denial, implicatory denial, and low carbon competence.

Academic scholars are not innocent, either. In his book *Growth: A Reckoning*, Daniel Susskind argues against the notion that economic growth is incompatible with sustainability. With technological innovation, increased efficiency, and a bit of imagination, he claims that growth could continue without a negative ecological impact (Susskind, 2024, 138–141). Advocates of degrowth, however, cite a barrage of empirical evidence indicating a nearly perfect correlation between economic growth and GHG emissions at a global level, hard limits to "decoupling" economic growth from material throughput in an absolute way, and the extreme unlikelihood of achieving this decoupling on the timescale necessary for decarbonization (Acheampong et al., 2021; Freire-González et al., 2024; Haberl et al., 2020; Hickel & Kallis, 2019; Hubacek et al., 2021; Mardani et al., 2019; Moriarty & Honnery, 2023; Parrique et al., 2019; Segovia-Martin et al., 2023; Simbi et al., 2024; Vadén et al., 2020; Vázquez et al., 2023; Vogel & Hickel, 2023). Surveys of climate policy researchers consistently find skepticism about the potential of "green growth" (King et al., 2023; Koskimäki, 2023). Even *BioScience*'s State of the Climate Report says that "in a world with finite resources, unlimited growth is a perilous illusion" and names a "post-growth economics framework" as imperative (Ripple et al., 2024).

This is particularly clear if we adopt a holistic view: a transition to renewable energy faces steep obstacles concerning raw material shortages (UNEP, 2024, xiv; Wei et al., 2025; Zeng et al., 2022) as well as the impact of mineral mining on biodiversity (Lamb et al., 2024; Sonter et al., 2020) and human conflict (Walter et al., 2025). This does *not* imply that a habitable future would involve reducing the world to sackcloth and ash; it is possible to deliver a decent standard of living to the global population while remaining within planetary boundaries, albeit with a mostly vegan diet and

a dramatic reduction in single-use products, if urgent action is taken (Kallis et al., 2025; O'Neill et al., 2018; Schlesier et al., 2024; Stoknes et al., 2025; Vuuren et al., 2025). None of this extensive literature is referenced, discussed, or rebutted in Susskind's book. It is simply ignored.

Ordinarily, if a vast body of literature has developed around an empirical question—like whether "decoupling" economic growth from resource intensity is possible or feasible—it is incumbent upon an academic scholar publishing on this topic to respond to or engage with this literature. But Susskind proceeds with his argument as if this is not the case. His intervention exists in isolation from this evidence, in an alternate world no more real than Walker's. Joseph Schumpeter famously said that "the typical citizen drops down to a lower level of mental performance as soon as he enters the political field" (Schumpeter, 1950, 262). We may say by analogy that even the typical educated, informed, and otherwise rational citizen drops down to a low level of cognitive functioning as soon as the topic of climate change is broached.

As a final example, consider the work of William Nordhaus, a Yale economist and Nobel laureate known for developing the IAM (integrated-assessment model) called DICE (dynamic integrated climate-economy). While his specific recommendations have fluctuated throughout his career, Nordhaus has consistently claimed that the opportunity cost of rapid decarbonization will outweigh the benefits; he advocates a small and gradually increasing carbon tax, letting warming overshoot recommended IPCC targets (past even 3 °C and beyond) so as not to sacrifice the benefits of carbon-intensive economic growth for minimal environmental gains (see, e.g., Nordhaus, 2018).

While Nordhaus's approach is enormously influential in climate change economics, Clive Spash notes that his work "has from the start employed unbelievably naïve and unrealistic models that have ignored major ecosystem and health impacts" (Spash, 2024, 22). Genevieve Guenther details some of this unrealism:

> [Nordhaus] assumes the cost of climate damages will be low…He sustains [this assumption] by omitting from DICE some of the damages that climate scientists have identified as "the impacts" of global heating. He omits climate damages to labor productivity or to buildings or other infrastructure. He omits damages to manufacturing, transportation, non-coastal real estate, finance, insurance, retail or wholesale trade, communication, and government services. He omits damages caused by climate-influenced wars, coups, or social upheavals. And, finally, he omits damages caused by climate-system tipping points and unlikely but possible civilization-threatening events that could be spurred by societal responses to ecosystem collapse (Guenther, 2024, 56).

The DICE model, in other words, shows that the damage from climate change will be minimal if we set aside much of the damage it is likely to cause.[8] In fact, as J. Paul Kelleher notes, *no* major IAM "attempts to incorporate the biodiversity-, human migration-, or wildfire-related impacts of climate change," thus "completely ignoring these important impact categories and their upshot for the life prospects of people around the world and across generations" (Kelleher, 2025, 6).

The framework is even worse than this, however. Steve Keen points out that Nordhaus's model assumes that economic activity will be unaffected by climate change *if that activity takes place indoors* (2021, 1152–1153). Beyond relying on the folk confusion between climate and weather, this model and those influenced by it also take for granted that disruptions to agricultural yields will have minimal negative impact—because agriculture accounts for only a small portion of GDP (Guenther, 2024, 96, 99; Malm & Carton, 2024, 57–60; Spash, 2024, 22).[9] This is an extreme form of

[8]See also Wagner and Weitzman (2015), esp. 48–79) for an account of how DICE and other IAMs ignore or distort the "fat tail" risks of climate change.

[9]Hultgren et al. (2025) find that every 1 °C of warming will result in reduced crop yields equivalent to 4.4% of every living human's daily recommended caloric intake, while only modest offsetting through adaptation is feasible. What crops do remain will become less calorie dense and nutritious with increased warming (Haar et al., 2025).

interpretive denial. Indeed, a *Nature Climate Change* review of DICE and other IAMs found that they demonstrated "outdated scientific understanding" (Diaz & Moore, 2017; see also Masini, 2021; Vuuren et al., 2026b). We can likewise understand why a 2022 *Climate* study included "mainstream economic thinking" among the "key barriers to climate mitigation," noting that overshooting 2 °C of warming implies "an intensified disruption in the human-climate system" (Santos et al., 2022; see also Jones, 2025, 229–235).[10]

Attempts to quantify the economic damage of climate change without relying on Nordhaus's "naïve and unrealistic models" come to drastically different conclusions. While Nordhaus has priced the "social cost of carbon" at $31 per ton and growing at about $3 per year starting in 2015 (Nordhaus, 2017), a 2022 *Nature* paper argued that $185 per ton is a more realistic price tag (Rennert et al., 2022). More recently, a report that takes into account *global mean temperature* puts the figure at more than $1,200 per ton, estimating that 1 °C of warming reduces world GDP by 20% in the long run (Bilal & Känzig, 2026); this result is consistent with a new *Environmental Research Letters* piece which points out that, remarkably, IAMs "assume that weather impacting a single country is all that affects the economy of that country" (Neal et al., 2025). Another study tracks the economic damage done already, concluding that emissions linked to *one* company (Chevron) "very likely caused between $791 billion and $3.6 trillion in heat-related losses over the period 1991–2020," disproportionately in regions least responsible for warming (Abrams et al., 2026; Callahan & Mankin, 2025; see also Semenova, 2024; Usman et al., 2025).

Low carbon competence, then, is not limited to patent climate deniers. Misestimation of the potential and forecasted effects of anthropogenic climate change is common even among those who should know better—including Nobel laureates. Between Inhofe's assertion that cold weather disproves global warming and Nordhaus's assumption that climate impacts will not be felt indoors, there is only a difference in degree. This cognitive failure is not morally neutral: "discourses of delay" actively undermine public support for strong climate policies and sustainable lifestyle shifts (Cherry et al., 2024; Lamb et al., 2020), while climate literacy increases support for effective mitigation behaviors (Goldwert et al., 2025).

At the risk of belaboring the point, it is worth dwelling on the implications of the various arguments just considered. To say that Walker's mental picture of atmospheric flows belongs in the realm of science fiction would be to give it too much credit: it belongs in the realm of fantasy. We can, therefore, understand why some critics have described climate denial—including the interpretive and implicatory denial common in mainstream discourse—as a form of psychopathology (Malm, 2023; Mann & Toles, 2016; Robinson, 2023). Malm and Carton (2024), 24) are blunt: this "monumental failure to adjust to reality" is "not merely moral madness" but "madness without qualifier."

Without denying this justifiable conclusion, we must also point out that climate denial (in all registers) and carbon incompetent discourses are intentionally disseminated by a broad network of right-wing think tanks supported by wealthy and corporate benefactors (Brulle, 2014; Dunlap & McCright, 2015; Farrell, 2016; Kramer, 2020, 84–124; Oreskes & Conway, 2011). In fact, the greatest predictor of denialist beliefs is "system justification motivation," that is, the extent to which an individual is committed to defending the current socioeconomic arrangement (Feygina et al., 2010; see also Haas 2023; Heath & Gifford, 2006; Jylhä & Akrami, 2015). To quote Malm and Carton again: "allegiance to the status quo is maintained at the cost of a break with reality" (2024, 80). In other words, low carbon competence is not strictly a matter of cognitive failure (although it is certainly that): it is *ideologically* motivated (Busk 2021; Busk and Krieger, 2024; Gunderson, 2017; Gunderson et al., 2018).

[10]Franta (2022) notes that Nordhaus participated in drafting a National Academy of Science report on climate change in 1983. Already there was a disconnect between the physical scientists and the economists who worked on the project: "While the scientists' warnings were supported by decades of research, the economists' reassurances were closer to hopeful guesses" (557).

A robust and generalized carbon competence is a condition for the possibility of meaningful discussions concerning the ethical and political challenges of climate change. At the moment, this condition does not obtain in either popular or academic contexts. The struggle for ecological justice must therefore first and foremost be a struggle for ecological education. Given the moving nature of this target, it is an educational process that will never be complete: a rigorously informed perspective from, say, 2015 is already woefully anachronistic. As the environmental crisis moves into the second quarter of the twenty-first century, it is imperative that we move with it.

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