

THE CARBON ACCOUNTING RECKONING

Rev. 4 — Includes AFOLU (ECCC) Response, dated July 2, 2026

How Systemic Errors in Carbon Measurement Are Undermining Climate Policy, and What the Built Environment Must Confront

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Revision Notes — Revision 4 (July 2026)

This revision incorporates a formal technical review from Environment and Climate Change Canada's AFOLU (Agriculture, Forestry and Other Land Use) inventory team, received July 2, 2026, in direct response to the June 2026 edition of this paper.

Where AFOLU identified a genuine boundary, scope, or methodological clarification, that correction has been made directly within the relevant section, and is marked as a direct response. Where AFOLU's response defended the internal consistency of Canada's national reporting model without addressing how that model's outputs are represented downstream, in green building certification, procurement standards, and public communication, this paper maintains its original position. A new closing section, "A Response to AFOLU," sets out that reasoning in full.

We are grateful for AFOLU's engagement. Disagreement conducted in good faith, on the actual numbers, is exactly the reckoning this paper was written to invite.

The Central Question This Paper Asks: If forests are simultaneously our primary timber supply, our primary carbon sink, and our primary oxygen system, and all three functions draw from the same trees, how is it possible that any responsible accounting recommends cutting more of them? This paper argues that the answer lies not in science but in accounting: a system of measurement so structurally compromised by optimistic assumptions, double-counted credits, and linguistic corruption that it licenses extraction while describing it as stewardship.

Abstract

Carbon accounting is the ledger on which humanity's climate response depends. If the ledger is wrong, the response is wrong, no matter how sincere the effort. This paper argues that the systems currently governing global carbon accounting contain fundamental, structural errors that collectively overstate our progress and understate our peril. These errors are not random noise. They are directional, consistently resolving in favour of optimism: optimism about the durability of natural sinks, optimism about the permanence of material carbon stores, optimism about what short-term emissions targets mean.

Section by section, this paper examines how those errors compound: from the generational accounting blindness that treats CO₂ as a flow problem when it is a stock problem; to the

deterioration of forest and ocean sinks that policy still assumes are stable; to the materials accounting sleights of hand that inflate green building credentials; to the recycled steel alternative that honest accounting would elevate; to the linguistic corruption of stewardship that licenses extraction. The cumulative argument is simple and serious: getting the carbon math right is not a technical footnote. It is a moral obligation, and we are currently failing it.

Section I

The Generational Accounting Error

How annual carbon budgets measure the wrong dimension of the problem

Every year, governments and international bodies publish carbon accounts. Nations report their annual emissions. Sectors report their reductions. Progress is measured in megatons of CO₂ emitted this year versus last year. When the numbers improve, there is measured optimism. When they worsen, there is political pressure to do better. The accounting system provides the signal; policy responds to the signal. The logic seems sound.

It isn't. The logic contains a category error so fundamental that everything built on top of it is built, to some meaningful degree, on a false premise: annual carbon accounting measures a flow variable, the rate of emissions in a given year, and treats progress in that flow as evidence of progress against the underlying stock problem. The stock problem is the cumulative accumulation of CO₂ in the atmosphere and the consequences that accumulation drives across centuries. Flow and stock are related, but they are not the same thing. Conflating them produces accounting that is technically coherent within its own frame and structurally misleading about the actual condition of the planet.

The Atmospheric Residence Time of CO₂

The residence time of CO₂ in the atmosphere is one of the most consequential and most routinely underappreciated facts in climate science. Unlike methane, which has an atmospheric lifetime of roughly twelve years, CO₂ does not have a single clean removal timescale. It is removed by multiple processes operating across vastly different temporal scales: rapid uptake by the land biosphere and surface ocean within years to decades; slower mixing into the deep ocean over centuries; and ultimately geological weathering processes requiring tens of thousands of years to complete. The net effect is that approximately 15 to 40 percent of any pulse of CO₂ emitted today will remain in the atmosphere after 1,000 years (Archer et al., 2009; IPCC, 2013).

The CO₂ emitted in 1990 is still in the atmosphere. The CO₂ emitted in 2020 is still in the atmosphere. The CO₂ emitted yesterday will, in substantial fraction, still be in the atmosphere in the year 3026. Annual accounting books revenue and closes the ledger. The liability remains open, for longer than any accounting period we have the institutional imagination to conceive.

Why Net-Zero Pledges Don't Resolve Stock Accumulation

The global rush to net-zero commitments has produced an enormous volume of pledges structured as flow-variable targets: 'We will achieve net-zero emissions by 2050.' These are flow targets. They describe what comes out of the stack per unit time. They say nothing about the atmospheric stock that will exist at any given date, the actual cumulative concentration that determines actual radiative forcing and actual temperature trajectory.

Even a genuinely achieved net-zero annual emissions target does not reduce atmospheric CO₂ concentration. It stabilizes it. It stops the stock from growing. It does not draw it down. And crucially, the stock we have already accumulated, now surpassing 422.5 ppm as of 2024, compared to roughly 280 ppm pre-industrial, remains in the atmosphere driving warming for centuries regardless of what annual flow targets are achieved from this point forward (IEA, 2025).

The Financial Accounting Analogy

There is a useful analogy in financial accounting. Imagine a corporation that reports strong annual revenue growth while simultaneously accumulating a balance sheet liability, long-term debt, that it neither services nor discloses prominently. The income statement looks healthy. The annual report headline reads: 'Record Revenue.' But the balance sheet contains a compounding obligation that will eventually dominate the financial picture entirely.

Current carbon accounting is structured analogously. Annual emissions reports are the income statement. The balance sheet, the accumulated atmospheric stock, its persistence across centuries, its inherited warming commitment, is largely absent from the primary reporting framework. Nations declare progress based on their income statement while the balance sheet liability compounds silently. By any standard that takes the full temporal scope of the problem seriously, it is deeply incomplete.

"Each generation inherits an atmospheric debt incurred by all those before it, and current accounting frameworks are designed in a way that renders that debt invisible. We are booking revenue while ignoring the balance sheet. That is not climate policy. That is climate theatre with better spreadsheets." — John Profitt, P.Eng.

Section II

The Global Carbon Balance

What we emit, what nature absorbs, and the growing gap between them

Carbon accounting's most elementary function is to measure what the human economy puts into the atmosphere, what the natural world removes, and what remains. That remainder, the net atmospheric accumulation, is the number that matters. It is the number that drives warming. It is the number that should appear, front and centre, on every climate dashboard, in every policy communiqué, in every net-zero strategy document. It rarely does.

What We Emit

Global CO₂ emissions from fossil fuels and industrial processes reached 37.8 gigatonnes (Gt CO₂) in 2024, a new record, representing a 0.8 percent increase over 2023 (IEA, 2025). When land-use change emissions, primarily deforestation and agricultural conversion, are included, the total approaches 40 Gt CO₂ per year. Despite decades of climate agreements, renewable energy deployment, and efficiency improvements, the absolute level of annual emissions in 2024 is higher than it has ever been. Progress, in this context, means a reduction in the rate of increase, not a reduction in emissions themselves.

What Nature Absorbs, and the Limits of That Subsidy

Natural carbon sinks, primarily the terrestrial biosphere and the ocean, have historically absorbed approximately 50 to 55 percent of anthropogenic CO₂ emissions, with land sinks and ocean sinks each accounting for roughly half of that total. This is a remarkable natural subsidy. Without it, atmospheric

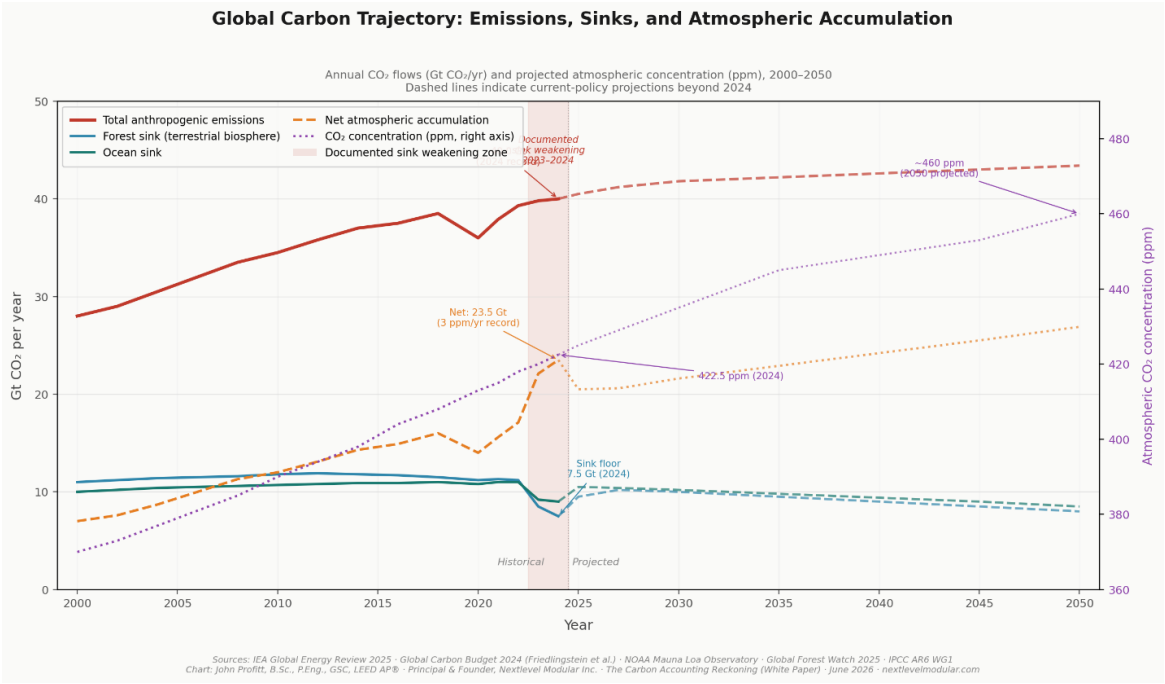
CO₂ would be rising at roughly twice its current rate. The sinks have been buying time that we have mostly not used well.

The critical question is whether these sinks are stable, growing, or declining. The evidence, examined closely, points in an uncomfortable direction, one that Sections III and IV address in detail.

The Global Carbon Balance, 2024

Component	Annual Magnitude	Trend
Total anthropogenic CO ₂ (fossil + land use)	~40 Gt CO ₂ /year (2024 record)	Rising, all-time high
Ocean sink absorption	~10–11 Gt CO ₂ /year	Weakening, 2023/2024 documented decline
Terrestrial biosphere sink	~10–12 Gt CO ₂ /year	Declining, regional reversals documented
Net atmospheric accumulation	~18–20 Gt CO ₂ /year (~2–3 ppm/yr)	GROWING, 3 ppm record in 2024
Atmospheric CO ₂ concentration (2024)	422.5 ppm, record high	+51% above pre-industrial baseline

Sources: IEA Global Energy Review 2025; Global Carbon Budget 2024 (Friedlingstein et al., 2025); NOAA Mauna Loa Observatory; Global Forest Watch 2025.



Global Carbon Trajectory: Emissions, Sinks, and Atmospheric Accumulation (2000–2050)

Sink Credit Inflation: The Accounting Fiction

One of the most consequential errors embedded in mainstream carbon accounting is the systematic assumption, baked into national carbon inventories and IPCC scenarios alike, that natural sinks will continue to absorb emissions at current or improving rates into the future. This assumption is not defended on empirical grounds; it is adopted as a modelling convenience, a default setting that survives more by inertia than by evidence.

Many of the IPCC's emissions scenarios that show plausible pathways to 1.5°C or 2°C depend critically on continued strong sink performance. Some of the most optimistic scenarios require not just sink stability but enhanced sink capacity. These projections conflict with the observed trajectory of both

terrestrial and oceanic sinks, which are showing clear signs of stress, regional reversal, and declining efficiency. Sink credit inflation makes the remaining carbon budget appear larger than it is and makes the required pace of emissions reductions appear less severe than it is. That is not a conservative error. It is a directional one, and it reduces the political urgency that accurate accounting would generate.

Section III

Forest Sink Decline

The terrestrial system that climate policy assumed was permanent is dissolving

For decades, forests occupied a particular role in the collective imagination: the lungs of the Earth, the great metabolic counterweight to industrial emission. This characterization contained enough truth to be useful. Forests are genuine, substantial carbon sinks. The terrestrial biosphere absorbs billions of tonnes of CO₂ annually. That absorption has bought time.

The question that matters now is not whether forests were good carbon sinks in the past. They were. The question is whether they will continue to be, and at what scale, under the climate and land-use conditions that the coming decades will bring. The evidence that has accumulated over the past decade is not reassuring.

Before examining sink dynamics, one statistic must be placed on the table plainly, because it reframes everything that follows: harvested timber accounts for less than 10 to 15 percent of global forest carbon loss. Most of the forest carbon is lost to deforestation for agriculture, to wildfire, to pest infestation, and to drought-induced die-off, none of which is controlled by timber certification schemes. Yet the mass timber lobby presents its product as a climate solution that depends on continued harvesting of the same trees that constitute our primary terrestrial carbon sink. The accounting that permits this framing is the subject of Section V.

The Amazon: From Sink to Source

The most alarming and most clearly documented case is the Amazon basin. Research by Gatti et al. (2021), published in *Nature*, found that the eastern Amazon is now a net source of CO₂ to the atmosphere, a structural shift driven by the combined effects of deforestation and warming-induced moisture stress. The Brazilian Amazon as a whole, across the period 2001–2020, has become a net carbon source, emitting an estimated 3,600 million tonnes of CO₂ equivalent, more than what it absorbed over that twenty-year period (Harris et al., 2021; Gatti et al., 2021). This is not a weather event. It is the predictable consequence of crossing thresholds that scientists have been warning about for decades.

Boreal Forests and Wildfire: A New Baseline

Boreal forests, the vast coniferous band stretching across Canada, Russia, Scandinavia, and Alaska, contain not just above-ground biomass carbon but enormous stocks of below-ground organic matter accumulated over thousands of years in peatlands and permafrost soils. These forests are under compounding stress from bark beetle infestations, drought, and warming temperatures amplified at two to four times the global average in boreal and Arctic regions.

Wildfire has moved from ecological process to structural threat. When fire frequency and severity increase beyond the historical baseline, forests burn more often than they can regrow, and the net

carbon balance of fire-prone landscapes shifts toward net emission. The Canadian wildfire season of 2023 burned over 18 million hectares, more than double the previous record, releasing an estimated 480 to 650 megatonnes of CO₂, equivalent to roughly 25 percent of Canada's average annual total emissions from all other sources combined (van der Werf et al., 2023; Global Fire Emissions Database). Global Forest Watch data confirms that Canada's 2023–2025 wildfire-driven forest loss was nearly five times the 2001–2022 annual average, and that repeated fires may be permanently modifying northern forest ecosystems, including those of British Columbia.

Direct response to AFOLU (July 2, 2026):

AFOLU's review correctly notes that the 480–650 Mt CO₂ global estimate above and Canada's National Inventory Report figure of approximately 1 Gt CO₂ for the same 2023 wildfire season are not directly comparable: the NIR figure applies to roughly 15 million hectares of managed land, while the estimate above covers approximately 18 million hectares of total area burned. Both figures are retained here because the distinction is instructive rather than disqualifying. A reporting boundary drawn around “managed land” necessarily excludes a meaningful share of actual combustion, which is precisely the kind of scope-narrowing this paper is concerned with: two true numbers, describing the same fire season, that produce two very different headline impressions depending on where the boundary is drawn. We thank AFOLU for the correction and have represented it here in full rather than adjusting the original figure without comment.

Section IV

Ocean Sink Weakening

The silent absorber is reaching its limits

The world's oceans have, since the industrial revolution, absorbed approximately 25 to 30 percent of all anthropogenic CO₂ emissions and approximately 90 percent of the excess heat generated by the greenhouse effect. That is an extraordinary planetary service, performed by a system that receives almost no direct political attention. The ocean has been the silent absorber of our consequences, without complaint, without negotiation, and without limit until, increasingly, it is showing its limits.

What Is Happening to Ocean Sink Capacity

As CO₂ dissolves in seawater it forms carbonic acid, reducing the ocean's pH, a process known as acidification. The ocean's natural alkalinity has allowed it to absorb far more CO₂ than simple physical dissolution would permit. But that buffer has a capacity. As more CO₂ is absorbed, alkalinity is consumed and the ocean's future capacity to absorb additional CO₂ is reduced. The ocean is being used up as a carbon sink by the very emissions it is absorbing.

Acidification disrupts the biological carbon pump, the chain through which phytoplankton fix dissolved CO₂, organic matter sinks toward the seafloor, and carbon is buried in deep sediments on geological timescales. As key marine organisms decline under acidification and warming stress, less biological carbon is exported to depth. As sea surface temperatures rise, increased thermal stratification reduces vertical mixing between surface and deep water, slowing the transport of CO₂-laden surface water to depth and reducing the ocean's overall uptake efficiency.

Documented Weakening: 2023 and 2024

Research from ETH Zurich (2025) found that the global ocean absorbed significantly less CO₂ than anticipated in 2023, as unprecedented marine heatwaves, particularly in the North Atlantic, where monthly temperature anomalies in some regions reached 3 to 5°C above the long-term average, drove

CO₂ outgassing in precisely the zones that are normally among the most productive uptake regions. Global Forest Watch analysis confirms that in 2023 and 2024, forests absorbed only approximately one quarter of the carbon dioxide they absorb in an average year. The two primary planetary sinks weakened simultaneously, in the same years, while emissions reached record highs. The net atmospheric accumulation rate hit 3 ppm in 2024, the highest single-year increase on record.

The Asymmetry That Should Concentrate Every Mind

There is a cruel asymmetry at the heart of ocean sink dynamics: the ocean's capacity to absorb CO₂ is reduced by two primary forces, warming and acidification, both of which are themselves products of the CO₂ the ocean has already absorbed and the warming it has already buffered. The ocean's sink efficiency is being degraded by its own prior service. The more it has helped us, the less capable it becomes of helping us further. Projections that assume stable or growing ocean sink capacity under continued warming are not conservatively wrong; they are systematically wrong in the direction that makes our situation look better than it is.

“The ocean has absorbed the consequences of our choices for two centuries. It is now being chemically transformed by that service in ways that are reducing its capacity to go on absorbing them. We are degrading the mechanism that has been saving us from ourselves, and our accounting systems are not telling us clearly enough that this is happening.”

Section V

Mass Timber and the Double-Counting Problem

The carbon accounting of engineered wood contains an inflation mechanism that is rarely examined honestly

The question the mass timber industry does not answer: If forests are simultaneously our primary timber supply, our primary carbon sink, and our primary oxygen system, and all three functions draw from the same trees, how is it possible that any responsible accounting recommends cutting more of them? Harvested timber accounts for less than 10–15% of global forest carbon loss. Yet the mass timber lobby presents continued harvesting as a climate solution, on the basis of accounting that double counts the carbon benefits of the same trees.

Mass timber, cross-laminated timber (CLT), glulam, laminated veneer lumber, and related structural products, has emerged as one of the most enthusiastically promoted climate solutions in the built environment sector. The basic argument is intuitive: trees absorb CO₂ as they grow; when harvested and converted into durable building products, that carbon remains stored; buildings last a long time; therefore, mass timber construction represents a long-term sequestration strategy that substitutes for high-emission materials like concrete and steel.

This argument is not altogether wrong. Wood does store carbon. The carbon stored in a mass timber building is genuinely not in the atmosphere while the building stands. The problem is that the accounting systems deployed in practice regularly inflate these genuine benefits through two specific mechanisms, in ways that overstate the climate benefit of harvested wood products and understate their risks.

The Double-Credit Problem

Under IPCC guidelines for national greenhouse gas inventories, carbon stored in harvested wood products (HWP) is tracked in a dedicated HWP pool. When timber is harvested and converted into

long-lived products, the carbon is credited as ‘stored’ in the national inventory. Simultaneously, the forest from which that timber was harvested is credited in land-use accounting as a managed forest that is recovering, regrowing, and re-sequestering CO₂.

The problem arises when both streams are credited simultaneously for the same carbon cycle. If the carbon fixed by a tree is credited to the HWP pool when the tree is harvested and converted to CLT, and the regrowth of that forest is also credited as a new carbon sink in land-use accounting, one physical carbon cycle, one set of carbon atoms, has generated two accounting credits. The IPCC has acknowledged the complexity of HWP accounting and the risk of inconsistent boundary treatment. But acknowledgment in technical guidance documents is not the same as correction in actual national inventories. Countries with large forest estates and active timber industries have strong incentives to adopt frameworks that maximise their credited carbon stores.

Direct response to AFOLU (July 2, 2026):

AFOLU pushed back directly on this characterization, and the correction deserves to be represented accurately rather than summarized away. Canada's national Carbon Budget Model (CBM) tracks harvested sites as net carbon sources for an initial 15 to 30 years before they transition back to sinks as regrowth exceeds decomposition, and AFOLU characterizes the temporal overlap between HWP carbon and regrowth crediting during that window as an accurate representation of real, overlapping carbon dynamics, not double counting. On the internal consistency of that specific model, we accept the correction: the CBM framework is more carefully bounded than our original framing credited it for, and this section has been revised accordingly.

But AFOLU's own response draws a distinction worth holding onto: between limitations in the quantification frameworks themselves, and limitations in how their outputs are used and interpreted once they leave the inventory and enter procurement decisions, green certification standards, and public communication. Our concern was never primarily with the CBM's internal bookkeeping. It is with what happens the moment a mass timber project markets “sequestered carbon” to a developer or a certifying body without carrying forward the 15-to-30-year net-source window, the half-life decay curve, or the disposal-pathway uncertainty that AFOLU's own model builds in. A framework can be internally sound and still be systematically misrepresented by everyone downstream with an incentive to quote its most favourable output in isolation. That gap, not the CBM itself, is the double standard this paper is naming, and AFOLU's response does not resolve it. It clarifies exactly where the fault line sits.

The Permanence Assumption

The carbon stored in a CLT building is credited as sequestered for the life of the building. This assumption is fragile in ways that the accounting frameworks that deploy it typically do not acknowledge. Buildings burn. In 2023 alone, the United States experienced over 340,000 structure fires, many of them in wood-frame construction (NFPA, 2023). When a mass timber building burns, the carbon stored in its structure, credited as sequestered, is released to the atmosphere in hours. The accounting credit evaporates with the building. The atmospheric CO₂ is permanent on any policy-relevant timescale.

Buildings are also demolished. The commercial building lifespan in many markets is 40 to 60 years before demolition or major renovation. When a mass timber building is demolished, if the wood is incinerated, as much construction waste is, the carbon is immediately released. Consider this: the permanence of carbon storage in standing old-growth vastly exceeds the permanence of carbon storage in any built structure. Carbon that remains in a standing, unharvested old-growth forest sequesters indefinitely, contingent only on the forest remaining intact. A building cannot make that claim. A certified lumber yard cannot make that claim. Only the living forest can.

Direct response to AFOLU (July 2, 2026):

AFOLU's review notes, correctly, that Canada's reporting framework does not assume permanence: harvested wood products are modelled on a half-life basis, roughly 15 to 40 years for long-lived construction products and 1 to 3 years for short-lived consumables, and a product's exit from the HWP pool is recorded as a modelled loss rather than an assumption that its carbon has necessarily returned to the atmosphere on that exact date. That is a fair and useful correction to the technical record, and we make it here directly.

It does not change the built-environment-facing problem this section was written to describe. A half-life model acknowledges eventual, probabilistic release. A green building certification, a developer's marketing material, and a mass timber industry association's public messaging routinely do not. They describe carbon as "stored," full stop, for "the life of the building," without the decay curve, the disposal-pathway uncertainty, or the fire and demolition statistics cited above ever entering the conversation the buyer or policymaker actually has. AFOLU models permanence honestly, as a probability distribution. The building sector routinely sells it as a fact. That distinction survives AFOLU's correction fully intact.

What Honest Accounting Would Require

A fair analysis would recognize that CLT and glulam can substitute for structurally equivalent quantities of concrete and steel, whose production is carbon intensive. That substitution benefit is real. But honest accounting would require: transparent treatment of HWP credits that avoids double-counting; explicit acknowledgment and quantification of end-of-life carbon release risks; a rigorous comparison against the counterfactual of leaving forests standing rather than harvesting them; and a clear distinction between timber sourced from managed plantations and timber sourced from old-growth or high-carbon-stock forests, where the harvesting decision represents a permanent net carbon release rather than a delayed one. Mass timber may well deserve its moment. But it deserves it on accurate numbers, not inflated ones.

Section VI

The Recycled Steel Reservoir

The underdog of the materials carbon conversation deserves the rigorous accounting credit it rarely receives

Steel has a reputation problem in the climate conversation. Primary steelmaking via the blast furnace-basic oxygen furnace (BF-BOF) route, the dominant global process, accounting for roughly 70 percent of production, emits approximately 2.2 to 2.32 tonnes of CO₂ per tonne of steel produced. To understand where that carbon footprint lands, it helps to know who is consuming the steel. Construction is by far the largest end-use sector, accounting for approximately 49 percent of global steel consumption in 2024, encompassing structural steel and reinforcing bar for buildings, bridges, and infrastructure. Mechanical engineering and industrial machinery account for roughly 16 percent. Automotive accounts for approximately 12 percent. Shipbuilding, rail, and other transport combined account for around 7 percent. Military and defence applications represent less than 2 percent globally. This distribution matters: nearly half of all steel, and therefore nearly half of all BF-BOF carbon emissions attributable to steel, flows directly into the built environment. The construction sector, more than any other, has both the scale and the moral obligation to demand the shift from BF-BOF to EAF production.

That assumption is, at best, a dramatic oversimplification. At worst, it is an error being embedded into building policy, procurement guidelines, and green certification frameworks in ways that will

shape materials flows for decades. The reality is more textured, and the full picture strongly favours recycled steel in ways that the prevailing discourse almost entirely ignores.

The Emissions Arithmetic of Recycling

The difference in carbon intensity between primary and secondary steelmaking is substantial and well-documented. Electric arc furnace (EAF) steelmaking, which uses recycled scrap as its primary feedstock, produces approximately 0.3 to 0.8 tonnes of CO₂ per tonne of steel, with the exact figure depending on the carbon intensity of the electricity supply. On a renewable-powered grid, EAF steelmaking emissions approach near zero (Global Energy Monitor, 2024).

Every tonne of scrap steel fed into an EAF avoids the production of a tonne of primary steel, and with it, avoids approximately 1.4 to 1.8 tonnes of CO₂ that would have been emitted by the BF-BOF route. Global steel recycling rates are approximately 85 percent for construction and infrastructure steel. The global scrap steel market processes hundreds of millions of tonnes annually. These avoided emissions are real. They are large in aggregate. And they receive comparatively little attention in life-cycle analyses, procurement frameworks, and green building standards.

Green Steel: The Technology the Conversation Has Not Caught Up To

The mass timber discourse is, as this paper argues, operating on a carbon narrative that was formed a decade ago. The steel conversation has moved significantly further than that narrative acknowledges. Hydrogen-based direct reduced iron (DRI) steelmaking, in which green hydrogen replaces coking coal as the reducing agent, produces near-zero-emission primary steel without requiring scrap feedstock. Several commercial-scale plants are now operational or in advanced construction in Sweden, Germany, and the United States. When combined with renewable electricity, the full production chain approaches carbon neutrality at the primary steelmaking stage.

The implication is significant: the steel industry is on a credible decarbonisation trajectory that does not require the destruction of any forest. The same cannot be said of mass timber, whose climate case depends on continued harvesting of trees that serve simultaneously as carbon sinks, oxygen sources, and biodiversity systems. The technology argument, that mass timber is the forward-looking material choice, is increasingly difficult to sustain against the green steel evidence.

One Hundred Years of Recoverable Steel

There is a dimension of the steel carbon story that is almost never discussed in built environment materials discourse: the extraordinary stock of steel already in existence. Over the past century, the global economy has produced and deployed an enormous reservoir of structural steel, in buildings, bridges, rail infrastructure, ships, and industrial facilities. Much of this steel is approaching the end of its first service life. All of it is recoverable. All of it is recyclable. And the carbon cost of its original production, the CO₂ that was emitted to create it, has already been paid.

When that steel is recovered and recycled through EAF production, it generates near-zero-emission structural material at a fraction of the original carbon cost, using energy that is itself rapidly decarbonising. We are not starting from zero with recycled steel. We are drawing on a century of accumulated material investment, at a point in time when the energy system needed to process it is becoming clean. That is a compounding carbon dividend, and it is systematically invisible in the procurement frameworks and green certification standards that currently favour mass timber.

The Accounting Gap

Life-cycle assessment frameworks most used in building and procurement contexts assess embodied carbon on a ‘cradle to gate’ or ‘cradle to practical completion’ basis. This means they count the emissions involved in producing the material and delivering it to site, but they do not credit the avoided emissions from recycled content at the production stage, and they do not credit the future avoided emissions from end-of-life recycling. A building specified in mass timber because it appears to have better embodied carbon than steel, based on a point-of-production LCA that ignores recycled content, avoided emissions, and end-of-life recyclability, may not actually deliver the carbon benefit it claims. And the steel alternative it rejected may have delivered more genuine, durable, and verifiable carbon performance, if the accounting had been honest.

Section VII

The Language of Stewardship

How the vocabulary of care has been co-opted to license extraction

Every discipline has its load-bearing words, terms that carry so much moral weight that they shape what can be thought within the discipline and what cannot. In environmental policy and carbon markets, one of those words is stewardship. It appears in forest certification standards, in national land-use policy documents, in the mission statements of logging companies, and in the marketing materials of carbon offset providers. It is, in almost every one of these contexts, invoked as a term of approval, an indicator that the entity using it has a responsible, custodial relationship with the resource in question.

The word deserves examination. At its etymological root, a steward is someone who manages another's property, not an owner, but a custodian, accountable to the true owner for the condition of what is placed in their care. The steward does not own the estate; the steward manages it on behalf of someone else, with the obligation to return it in the condition it was received, or better. That is a demanding definition. It is also, in the context of contemporary forest and land management, almost entirely disconnected from how the word is actually used.

Stewardship as Managed Use

In practice, stewardship has been operationalized to mean ‘managed use’, a framing that shifts the moral weight from custodial obligation to optimised extraction. A logging company that practises stewardship, in the prevailing industry usage, is one that logs according to a plan, maintains buffer zones, replants after harvest, and complies with applicable regulations. These are constraints on how extraction is conducted, not on whether extraction serves the purpose for which stewardship exists. The frame has been subtly inverted: instead of asking ‘what does this forest need, and are we providing it?’, the operative question is ‘how can we extract from this forest while retaining the vocabulary of care?’ These are profoundly different questions. The first is ecological. The second is rhetorical.

Carbon Markets and the Language of Conservation

Voluntary carbon markets have amplified this linguistic drift. A significant portion of the offsets sold through voluntary markets are ‘forestry’ offsets, generated by claiming that a forest that might otherwise have been logged has been preserved, or that a degraded forest is being restored. The vocabulary surrounding these credits is saturated with stewardship language: protection,

conservation, enhancement, restoration. The accounting behind that vocabulary has, in many documented cases, been far less beautiful. Investigative journalism and academic research have repeatedly found that ‘avoided deforestation’ credits have been issued for forests that were never credibly at risk of being logged, and that ‘restoration’ credits have been issued for monoculture plantations that do not meaningfully restore ecosystem function (West et al., 2020; Guizar-Coutiño et al., 2022).

The Language We Actually Need

Stewardship, in a meaningful sense, requires a standard of care defined relative to the needs of the thing being stewarded, not relative to the preferences of the entity doing the stewarding. It requires a comparison against the counterfactual: what would this forest look like if we had not intervened? And it requires accountability to those who have no voice in the transaction: future generations who will inherit the ecosystems we manage, non-human species whose survival depends on ecosystem integrity, and human communities whose subsistence and safety are tied to landscapes they do not own. Carbon accounting that takes language seriously would require that terms like ‘sustainable,’ ‘certified,’ and ‘stewardship’ be backed by outcome measurements rather than process certifications. Until that happens, stewardship language in carbon markets and forest policy should be read as a rhetorical gesture first and a verified claim second, if at all.

Section VIII

The Moral Argument

Carbon accounting errors are not merely technical failures. They are moral ones.

Every section of this paper to this point has been, in some sense, a technical argument. But the technical is not morally neutral. The way carbon accounting errors resolve, which direction they consistently point, whose interests they consistently serve, whose costs they consistently obscure, reveals the moral content of what appears to be merely a measurement problem.

The Moral Equivalence of Financial Fraud

Consider systemic financial accounting fraud. Enron. Wirecard. The pattern is consistent: an entity misrepresents its liabilities, inflates its apparent performance, generates external confidence on the basis of false figures, and defers the reckoning to a later period. The harm of financial fraud is not merely that the numbers were wrong. The harm is that the false numbers changed behaviour, investors made decisions, employees made career choices, creditors extended capital, on the basis of representations that were not true, and that the costs of the eventual correction fell not primarily on those who falsified the accounts, but on those who relied on them.

Carbon accounting operates the same way, with a longer lag and larger consequences. When a nation reports that it has met its emissions targets partly on the basis of inflated sink credits from managed forests; when a corporation claims carbon neutrality partly on the basis of offset credits that research has demonstrated are not additional; when a building developer claims green status on the basis of mass timber marketing that represents sequestration as banked twice, across the forest and the HWP pool, without carrying forward the net-source transition period the underlying national models actually apply, these are not neutral technical transactions. They are representations about the state of the climate ledger that influence behaviour: investment decisions, policy priorities, public perception of urgency.

Who Benefits, Who Bears the Cost

The beneficiaries of directionally biased carbon accounting are identifiable: nations with large forest estates that maximise credited sink performance; industrial emitters that purchase low-quality offsets rather than requiring operational change; developers and architects whose mass timber specifications gain certification advantages that depend on accounting representations that do not always reflect physical reality.

The costs are borne by those who had no seat at the table when the accounting rules were written. Future generations will receive the warming, the sea level rise, the destabilised weather patterns, the degraded ecosystems generated by every additional tonne of atmospheric CO₂ that was either emitted and not counted or counted as offset by a credit that did not represent real sequestration. Climate-frontline nations, small island developing states, low-lying coastal nations, Sub-Saharan African countries facing intensified drought, emit negligibly relative to the historical emission record of industrialised countries. They bear, already, disproportionate consequences. And non-human ecosystems constitute a third category of cost-bearer that the accounting frameworks do not acknowledge at all, because they have no recognised standing in any measurement system.

“Imprecision that consistently errs in the direction of making emitters look better than they are, is not neutral imprecision. It is a form of structural dishonesty that has real victims, victims who are not in the room when the accounting conventions are set, and who will not be born when the consequences arrive. That is the moral core of this paper, and it is not a technical footnote.”

Section IX

Conclusion

What honest accounting would require, and why it matters beyond the technical

This paper has argued, section by section, that the carbon accounting systems currently governing global climate policy contain systemic, directional errors that consistently resolve in the direction of optimism, reducing our ability to understand our actual trajectory and therefore our ability to course-correct in time. Let me trace the chain one more time, because the errors compound each other in ways that their individual documentation obscures.

The Chain of Compounding Errors

We begin with the generational accounting error: the use of annual flow metrics as the primary signal of climate progress in a problem that is fundamentally about atmospheric stock accumulation across centuries. Within that truncated frame, the global carbon balance is distorted by sink credit inflation, the assumption that natural sinks will absorb emissions at stable or improving rates, even as observed data show those sinks under mounting stress. The atmosphere accumulated at record pace in 2024, 3 ppm in a single year, but the projection frameworks that governments use to evaluate policy sufficiency were built on sink assumptions that do not reflect this trajectory.

Those assumptions are then falsified by the documented reality of forest and ocean sink decline. The Amazon's eastern regions are net emitters. Boreal forests are being converted by beetle, fire, and thaw. Ocean sink efficiency declined in 2023 and 2024 under record warming. The sinks that policy assumed would be there are diminishing, not catastrophically, not uniformly, but directionally, and with feedback that accelerate the deterioration. On the materials side, the downstream marketing of mass timber HWP credits, presented without the temporal nuance the underlying national models

apply, alongside the systematic undervaluation of recycled steel avoided emissions, mean that the comparative carbon performance of built environment materials is being evaluated on false numbers. Investment and policy are flowing toward solutions whose climate benefits are overstated and away from alternatives whose benefits are understated.

What Honest Accounting Would Require

WHAT HONEST ACCOUNTING WOULD REQUIRE

First: generational time horizons. Carbon accounting must adopt balance sheet visibility for cumulative atmospheric stock, not as a replacement for annual flow data, but as a required parallel disclosure.

Second: sink verification rather than assumption. Natural sink contributions must be verified against observed data rather than modelled assumptions. Where sinks are declining or showing stress, that decline must be reflected in the accounting in real time.

Third: materials-specific lifecycle rigour. Life-cycle assessment frameworks for building materials must adopt consistent, full-cycle scope, including recycled content credit, end-of-life recyclability credit, and explicit end-of-life release risk disclosure. The truncated 'cradle to gate' scopes that currently dominate procurement comparisons systematically misrepresent the relative carbon performance of materials.

Fourth: language reform. Stewardship, sustainability, and related terms should carry operational definitions within accounting and certification frameworks, definitions that specify what evidence is required to substantiate the claim and what comparison baseline is required to demonstrate genuine benefit.

A Personal Statement of Purpose

I should say something about why I wrote this paper, because I think the reason matters to how it should be read. I did not write it as an indictment of individuals or as a polemic against any sector. I wrote it because I believe that clarity is a prerequisite for action, and that the systems we have built to provide clarity about our climate position are failing at that function in ways that consistently reduce the pressure to move faster, to do more, to confront the distance between the trajectory we are on and the trajectory we need to be on.

I have spent nearly four decades in the field, in reconnaissance geology across two continents, in construction management at infrastructure scale, in the development of modular building systems designed to reduce the waste embedded in how we build. What I have learned from that work is that you cannot solve a problem you cannot see clearly. You cannot navigate by a map that shows the destination you want rather than the terrain you are crossing. And you cannot build an honest industry on an accounting system that is designed to show you something more comfortable than what is there.

The forests are not an abstraction. They are a physical system, oxygen, carbon, water, that human civilisation depends on absolutely. The oceans are not an abstraction. They are the thermal and chemical buffer that has been absorbing the consequences of our choices for two centuries, at a cost to their own function that we have not yet fully reckoned with. The carbon in the atmosphere is not an abstraction. It is a cumulative stock, inherited from two centuries of industrial emission, that will remain in the atmosphere for centuries more regardless of what annual pledges are made from this point forward.

Getting the math right is not a prerequisite to caring about the future. But it is a prerequisite to doing something useful about it. That is why the accounting matters. That is why it has always mattered. And that is why the failure to get it right, year after year, budget cycle after budget cycle, is not a technical regret. It is a moral one, compounding daily, inherited by everyone who had no say in the numbers.

“We will not solve a problem we cannot see clearly. And we cannot see it clearly while the systems designed to measure it are systematically inclined to show us something more comfortable than what is there.” — John Profitt, P.Eng.

Section X

A Response to AFOLU

Why this revision changes what it changes, and holds firm on what it holds

On July 2, 2026, this paper received a formal technical review from Environment and Climate Change Canada's AFOLU (Agriculture, Forestry and Other Land Use) inventory team. It was a substantive, good-faith response, and it deserves a substantive, good-faith reply rather than a summary dismissal or a quiet retraction. This section is that reply.

Where We Have Revised

AFOLU identified three points where our original framing did not accurately represent the technical detail of Canada's national reporting model, and we have corrected each directly within the relevant section rather than only here: the scope mismatch between global and NIR-reported wildfire emissions (Section III); the mischaracterization of HWP and forest-regrowth crediting as double counting, when Canada's Carbon Budget Model in fact tracks a documented 15-to-30-year net-source transition period that AFOLU characterizes as accurate, non-duplicative temporal modelling (Section V); and the mischaracterization of HWP accounting as assuming permanence, when the framework in fact applies a half-life decay model rather than a fixed assumption (Section V). On all three, the correction is fair, and we have made it in full.

Where We Have Not Moved

AFOLU's response closes with an observation that we think is, in fact, the most important sentence in the entire exchange: that many of the concerns raised in this paper combine two distinct issues, limitations in the carbon quantification frameworks themselves, and limitations in how their outputs are used and interpreted outside that methodological context. We agree entirely that this is the correct diagnosis. We disagree that it resolves the concern.

If the frameworks are technically sound, as AFOLU defends, and the misuse happens entirely downstream, in green certification, in procurement standards, in mass timber marketing, in political communication of record investment without corresponding disclosure of record emissions, then the technical soundness of the inventory is not, by itself, protecting the atmosphere from anything. A well-modelled uncertainty, left undisclosed at the point where a building gets specified, a credit gets sold, or a policy gets announced, does exactly the same damage as a poorly modelled one. The rigour lives inside the model. The optimism gets sold in the marketplace. That gap is not a footnote to this paper's argument. It is the argument.

AFOLU is also correct that documented uncertainty is not, by itself, structural error, and we withdraw any language in the June 2026 edition of this paper that implied Canada's national inventory

methodology is dishonest in its internal construction. It is not. But a documented uncertainty that is never disclosed at the point of commercial or political decision-making functions, in practice, identically to an undisclosed one. This paper's concern was never that the scientists modelling Canada's carbon budget are getting the mathematics wrong. It is that 'we have always modelled it this way, and the documentation exists if you know where to look' is not an adequate answer to the question this paper actually asks: whether the built environment, and the public it answers to, currently has honest visibility into a carbon ledger it is being asked to trust.

On that question, this revision changes nothing. Precision at the modelling layer does not, by itself, produce honesty at the marketplace layer, and a paper written to close that particular gap cannot responsibly treat a defence of the modelling layer as an answer to it. We remain grateful for a response this substantive. We remain unconvinced that it resolves what this paper was written to name.

"We do not want to side with industrial optimism because the accounting protocols happen to be less than tight. 'We have always done it this way' is not a defence. It is only another opportunity for the capitalization of uncertainty." — John Profitt, P.Eng.

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