# Net Zero: The Final Destination?

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Consider the rate at which the phrase "net zero" has colonised the language of governments, boardrooms, and annual reports over the past decade. The United Kingdom enshrined it in law in 2019, becoming the first major economy to do so. The European Union followed with its European Climate Law. More than 140 countries, covering around 88% of global emissions, have now adopted net-zero pledges at the national level. In the corporate world, the Science Based Targets initiative recorded over 6,600 companies with validated emissions targets by late 2024, up from just 164 in 2018. Universities, cities, airlines, cement producers, shipping companies, and supermarkets have all, at some point in recent years, published a date by which they intend to reach net zero. The phrase appears with such regularity in public discourse that it has come to feel, almost by repetition, like the settled answer to climate change.

Therefore, it is worth pausing on a question that rarely gets asked in the coverage of net-zero announcements: if so many organisations are on a path to net zero, why did global greenhouse gas emissions reach a record high of 57.7 gigatonnes of carbon dioxide equivalent in 2024, a 2.6% increase on the year before? Why does the UNEP Emissions Gap Report 2025 find that the world is currently on a trajectory toward warming of 2.6 to 2.8 degrees Celsius above pre-industrial levels by the end of this century? And why does the remaining carbon budget for a 50% chance of limiting warming to 1.5 degrees stand at roughly 200 gigatonnes of carbon dioxide, a figure the world will exhaust in less than four years at current emission rates? Net zero is one of the most powerful concepts in the history of climate policy. It is also one of the most misunderstood.

**The Myth:** Once a country, company, or organisation reaches net zero, it has effectively solved its contribution to climate change.

**The Reality:** Achieving net zero does not mean eliminating emissions, eliminating environmental impacts, or reversing climate change. Instead, it represents a balance between greenhouse gas emissions and removals within a defined accounting framework. The effectiveness of net zero ultimately depends on how emissions are reduced, how residual emissions are managed, the integrity of carbon removals, and the transparency of the accounting methods used.

### What Net Zero Actually Means

Before examining where net zero falls short of its popular reputation, it is worth being precise about what the concept actually involves. "Net zero" is fundamentally an accounting balance: a state in which the quantity of greenhouse gases released into the atmosphere is matched, tonne for tonne, by the quantity removed from it. It does not mean that emissions cease. It means that whatever emissions remain are compensated for by an equivalent amount of removal, leaving the net addition to atmospheric greenhouse gas concentrations at zero.

This distinction between zero emissions and net zero matters enormously in practice. Zero emissions would mean no greenhouse gases released at all: no combustion, no industrial process emissions, no agricultural methane, no aviation fuel burn. Net zero allows for all of these to continue, provided the residual emissions are balanced by removals, whether natural, such as forests and soils, or technological, such as direct air capture. Under a net-zero framework, a steel producer might continue to emit carbon dioxide from its blast furnaces indefinitely, as long as it funds an equivalent amount of carbon removal elsewhere. Whether that removal is real, permanent, and additional is, as we will see, a separate question entirely.

It is also important to distinguish net zero from related terms that are sometimes used interchangeably. Carbon neutrality typically refers to balancing carbon dioxide emissions alone through offsets, with no requirement for emissions reductions along a defined scientific pathway. Climate neutrality is broader, referring to zero net impact on the climate system across all greenhouse gases and other climate-forcing factors, including those not captured by standard carbon accounting. Net zero, in its most rigorous form, as defined by the Intergovernmental Panel on Climate Change and the Oxford Net Zero Initiative, requires all greenhouse gases, not just carbon dioxide, to be balanced through deep cuts to actual emissions, with only genuinely unavoidable residual emissions covered by high-quality removals.

In practice, these distinctions are frequently blurred. A company announcing net zero in a press release may mean any of these things, or none of them precisely. The gap between the scientific definition and the marketing application of the term is one of the central tensions in the global net-zero landscape.

**Why it is So Valued**

Acknowledging the limitations of net zero is not an argument against it. It is among the most valuable frameworks that climate science and policy have produced, and the reasons for this are grounded in physics and economics, not aspiration.

The fundamental insight behind net zero is that global temperature is determined by the cumulative stock of greenhouse gases in the atmosphere, not by the annual flow of emissions in any given year. This means that temperature stabilisation requires not just reduced emissions but ultimately net zero emissions: as long as humans are adding any net greenhouse gases to the atmosphere, concentrations continue to rise, and temperatures continue to increase. The IPCC has been clear on this point since its Fifth Assessment Report: achieving any given level of temperature stabilisation requires global net carbon dioxide emissions to decline to zero and stay there. Net zero is not one option among many for limiting warming. It is a physical necessity.

The framework also provides something of enormous practical value: a measurable, comparable target. Different countries, companies, and sectors can set net-zero dates, measure their trajectories, and be held accountable for their progress. This has created an infrastructure of climate commitment and monitoring, from the Science Based Targets initiative to the Net Zero Asset Managers initiative to the Glasgow Financial Alliance for Net Zero, that would not exist without the concept. As at June 2024, 101 parties representing around 82% of global greenhouse

gas emissions had adopted net-zero pledges in law, policy documents, or official government announcements.

The carbon budget concept gives these targets their urgency. According to the UNEP Emissions Gap Report 2024, the remaining carbon budget to limit warming to 1.5 degrees Celsius with 50% probability stands at approximately 200 gigatonnes of carbon dioxide. At 2024 emission levels, that budget is exhausted in under four years. For 2 degrees Celsius, the remaining budget is around 900 gigatonnes, equivalent to roughly fifteen years at current rates. These numbers make the case for rapid progress toward net zero more forcefully than any policy argument could. Every year of delay does not simply push a target back: it consumes a larger share of what little budget remains.

**The Accounting Challenge**

If net zero is so important, why does so much confusion surround it? Part of the answer lies in the accounting frameworks through which emissions are measured and attributed.

Greenhouse gas inventories are constructed using a series of methodological choices that can profoundly affect the numbers they produce. The most widely used framework distinguishes between three categories of emissions. Scope 1 covers direct emissions from sources owned or controlled by an organisation: the furnaces it operates, the vehicles it fuels, the processes it runs. Scope 2 covers indirect emissions from purchased energy, primarily electricity and heat. Scope 3 covers everything else in the value chain: emissions from the materials a company purchases, the logistics it uses, the products its customers consume. For most companies, Scope 3 emissions account for more than 70% of their total climate footprint.

The problem is that Scope 3 is also the hardest to measure, verify, and control. A car manufacturer's Scope 3 emissions include all the carbon dioxide emitted by every car it sells over its entire lifetime. A bank's Scope 3 emissions include the climate impact of every loan and investment it makes. An airline's Scope 3 emissions include the manufacturing of its aircraft. These are real and significant impacts, but they are also impacts that the reporting organisation does not directly produce and often cannot directly address. A 2024 SBTi report found that approximately half of participating companies identified Scope 3 complexity as their primary obstacle to setting science-aligned net-zero targets.

There is also a fundamental difference between production-based and consumption-based emissions accounting. A country that manufactures goods for export will report the emissions from that manufacturing in its national inventory, even though those goods are consumed elsewhere. A country that imports manufactured goods will appear relatively low-emissions in its production-based accounts, even though it is effectively outsourcing its carbon footprint to its trading partners. The United Kingdom, for example, has reduced its territorial carbon dioxide emissions by over 50% since 1990. Its consumption-based footprint, which includes the emissions embedded in imported goods and services, has fallen by considerably less. The choice of accounting boundary shapes the story that the numbers tell.

None of this makes accounting frameworks worthless. They are essential tools without which no meaningful comparison or accountability is possible. But it does mean that a net-zero claim needs to be interrogated: what is being measured, over what boundary, against what baseline, and with how much of the gap being covered by offsets rather than actual emission reductions?

**The Nature of Carbon Offsets**

No question in the net-zero debate is more contested than the role of carbon offsets. Offsets allow an organisation to claim that emissions it cannot yet eliminate are being compensated for by equivalent reductions or removals happening somewhere else. In principle, this is a coherent and scientifically valid approach to managing residual emissions that cannot be immediately eliminated with current technology. In practice, the quality and integrity of the offset market have become the subject of significant concern.

A 2024 study published in Nature Communications examined the carbon offset purchasing behaviour of the twenty largest corporate buyers between 2020 and 2023. It found that 87% of the offsets purchased carried a high risk of not representing real and additional emissions reductions. Most were avoidance credits, projects that claimed to prevent emissions that might otherwise have occurred, such as protecting forests from deforestation. Only 2.5% were removal credits, representing actual extraction of carbon dioxide from the atmosphere. The appeal of avoidance credits is partly economic: they trade at one to five dollars per tonne, compared to eight to sixteen dollars per tonne for afforestation credits and several hundred dollars per tonne for direct air capture.

A systematic review by the Annual Reviews journal found that the most widely used offset programmes have consistently overestimated their climate impact, often by a factor of five to ten or more. The fundamental problems, which have persisted despite repeated attempts at reform, are additionality, the requirement that an offset project produces reductions that would not have happened without it; permanence, the requirement that the carbon removed or avoided stays out of the atmosphere; and leakage, the risk that emissions displaced from one location simply move to another. A forest protection project, for example, cannot guarantee that the logging activities it prevents will not simply shift to a nearby unprotected area.

The market has not been without genuine successes. High-quality removal credits, particularly those from direct air capture facilities and enhanced weathering projects, do represent verified, durable, and additional reductions. Norway's Government Pension Fund and a growing number of institutional investors are beginning to require verification standards that distinguish genuine removal from poorly quantified avoidance. The Integrity Council for the Voluntary Carbon Market has issued new standards, known as Core Carbon Principles, aimed at improving credit quality across the market. These are positive developments.

The risk is that offsets, in their current predominantly low-quality form, allow organisations to present themselves as making progress toward net zero while continuing to expand emissions-intensive operations. When a claim of climate neutrality rests on cheap avoidance credits rather than actual emission reductions, the label obscures more than it reveals. That risk is

not hypothetical: lawsuits against companies including Delta Airlines and Adidas over carbon-neutrality claims grounded in offset purchases have been filed in multiple jurisdictions. The accounting may balance. The climate arithmetic may not.

**Net Zero is not Zero Environmental Impact**

Even setting aside the integrity questions around offsets, there is a broader misconception embedded in the popular understanding of net zero: that achieving it resolves an organisation's environmental impact. It does not.

Climate change is one of the most urgent environmental crises humanity faces, but it is not the only one. The IPCC's Sixth Assessment Report identifies five interconnected planetary boundaries, of which climate change is only one: the others include biosphere integrity, land-system change, freshwater change, and biogeochemical flows. An organisation that achieves net zero on its greenhouse gas balance sheet may simultaneously be contributing to biodiversity loss through habitat destruction, water scarcity through extraction from stressed aquifers, ocean acidification through plastic pollution, soil degradation through intensive agriculture, and air pollution through particulate emissions that are not captured in any carbon accounting framework.

Some of these interactions are direct. Afforestation projects planted to generate carbon credits have, in documented cases, contributed to biodiversity loss when non-native monocultures replaced ecologically rich grasslands or peatlands. Biomass energy, which features prominently in many net-zero scenarios as a source of ostensibly carbon-neutral power when paired with carbon capture, requires significant land and water inputs and can create tensions with food security and ecosystem preservation. Battery production for the energy transition requires intensive mining of lithium, cobalt, and nickel, often with significant local environmental impacts that a carbon accounting framework does not capture.

This does not mean that net zero targets are misguided. It means that they address one dimension of environmental performance. A company or country that reaches net zero on carbon while accelerating biodiversity loss, depleting freshwater resources, or generating hazardous waste has improved one metric at the possible expense of others. The label net zero is a carbon accounting designation, not a certificate of environmental sustainability. Recognising this distinction is essential for anyone trying to evaluate whether an organisation's overall relationship with the natural world is moving in the right direction.

**The Timing Challenge**

Perhaps the most systemically important limitation of the net-zero framework, and the one that receives the least public attention, is timing. Not all net-zero pathways are equal from the perspective of the climate, even if they produce the same endpoint. When emissions occur, and when removals occur, matters as much as whether the final balance is achieved.

The reason comes back to cumulative emissions. Every tonne of carbon dioxide emitted today adds to the atmospheric stock and contributes to warming that will persist for centuries. Every year that substantial emissions continue while net zero is deferred pushes the world further through its remaining carbon budget. A pathway that reaches net zero by 2040 through rapid, deep emission cuts in this decade allows far less cumulative warming than one that reaches net zero by 2040 through continued high emissions followed by a rapid deployment of carbon removal technology in the 2030s. Both are nominally "net zero by 2040." Their climate consequences are different.

The UNEP Emissions Gap Report 2024 quantified this with characteristic precision. It found that delaying meaningful action until 2030, even under optimistic scenarios, would require annual emission reductions of 15% every year between 2030 and 2035 to maintain the possibility of a 1.5-degree pathway. Acting now would require a comparatively modest 7.5% per year. Every year of delay does not just narrow the window: it steepens the slope required of the years that follow, making the transition progressively harder and more expensive. As of 2025, the world's emission trajectory suggests that the 1.5 degree limit will almost certainly be temporarily exceeded, with only a 21% chance of staying below it even if all current net-zero pledges are fully honoured.

There is also a temporal mismatch embedded in many corporate net-zero strategies: emissions that occur today, often from activities whose climate impact is well understood, are balanced against removals that will not happen for years or decades, through technologies or ecosystems that may or may not perform as expected. Direct air capture is real and improving, but it remains expensive, energy-intensive, and operating at a fraction of the scale needed. Forests planted today to generate offset credits may be harvested or burned before they deliver their projected carbon storage. Relying heavily on future removal to balance present emissions is not the same as reducing those emissions now.

**How the Concept Performs in Practice**

Abstract concerns about accounting and timing become clearer when examined through specific cases. The following examples illustrate both the genuine progress that net-zero frameworks are enabling and the limitations that remain.

The United Kingdom set the first legally binding net-zero target among major economies with its Climate Change Act amendment in 2019. The progress since has been real: coal has been entirely retired from electricity generation, renewables overtook fossil fuels in electricity production in 2024, and the UK met its fourth carbon budget ahead of schedule. The climate governance architecture, centred on the independent Climate Change Committee, provides a model of accountability that many countries have emulated. Yet two separate High Court rulings, in 2022 and 2024, found that the government's official climate implementation plans were legally inadequate, lacking sufficient detail on how stated targets would actually be met. Transport and building heating remain the two most intractable domestic emission sources, and the gap between headline ambition and sector-specific policy remains significant.

Sweden offers a study in both the power of early commitment and the fragility of political will. Adopting its net-zero legislation in 2017, Sweden was a pioneer in enshrining the target in law with interim milestones and the requirement that at least 85% of reductions be achieved within the country's own borders. Its per capita emissions reached 4.4 tonnes of carbon dioxide equivalent in 2023, well below the EU average of 7.2 tonnes. Yet in 2024, Sweden's Environmental Protection Agency concluded that the country will miss every national climate target for the next two decades. The current government rolled back a biofuel blending mandate, cancelled 13 of 14 offshore wind projects for national security reasons, and abolished a flight tax. The Climate Change Performance Index dropped Sweden from fourth to forty-first in its global ranking between 2021 and 2024. The legislation is intact; the trajectory is not.

Among corporations, Orsted stands out as one of the most credible large-scale transformations on record. The Danish energy company reduced its Scope 1 and 2 emissions intensity by over 87% between 2006 and 2023 by divesting from coal and oil and building one of the world's largest portfolios of offshore wind projects. It has committed to a 98% reduction in Scope 1 and 2 intensity by 2025. This is not greenwashing: it is structural business model transformation. The challenge Orsted acknowledges is Scope 3, the supply chain and customer emissions over which a company has influence but not direct control, and which represent the hardest part of any corporate net-zero pathway.

Microsoft presents a more complex picture. The company has made serious commitments, including a pledge to be carbon negative by 2030 and to remove its historical carbon footprint by 2050. It has invested heavily in carbon removal contracts and renewable energy procurement. Yet its own sustainability reports reveal that total emissions grew by 29% between 2020 and 2023, driven primarily by the energy demands of its rapidly expanding AI infrastructure. Its SBTi long-term net-zero commitment was removed in 2024. This is not a failure of intention. It is an illustration of what happens when the scale of a new business activity grows faster than the decarbonisation of its supply chain.

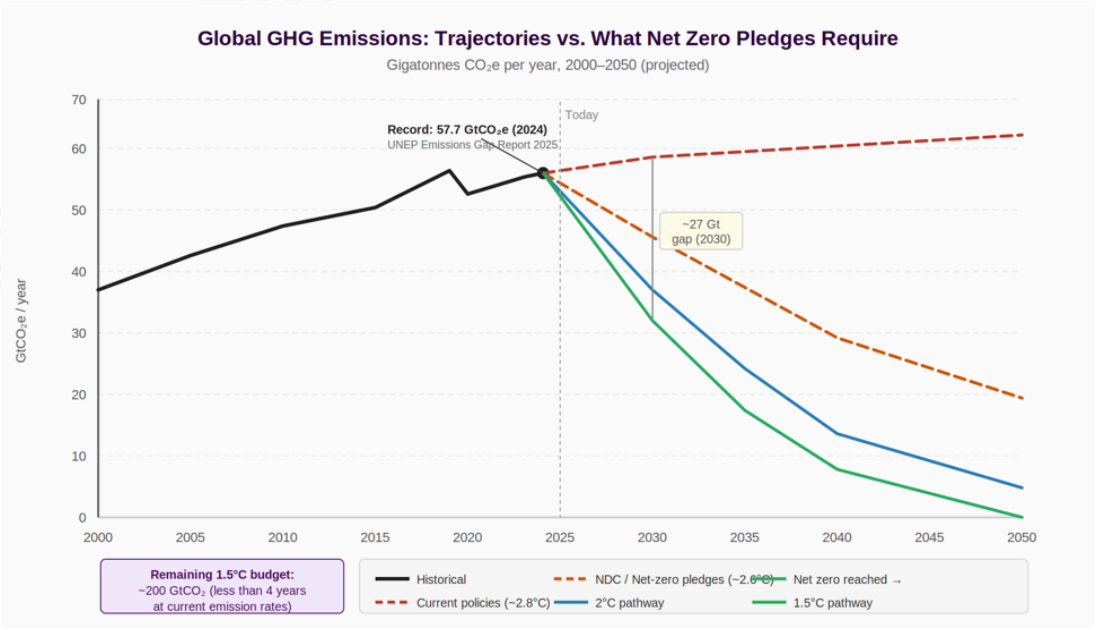

*Figure 1: Global greenhouse gas emission trajectories from 2000 to 2050. The chart illustrates the divergence between current policy trajectories (projected ~2.8°C of warming), pledged national net-zero commitments (~2.6°C), and the science-based pathways required to limit warming to 2°C and 1.5°C, respectively. The record of 57.7 $GtCO_2e$ in 2024 is shown against a remaining 1.5°C carbon budget of approximately 200 $GtCO_2$, sufficient for less than four years at current emission rates. Sources: UNEP Emissions Gap Reports 2024 and 2025; IPCC AR6 WG3 (2022); IEA Net Zero Roadmap (2023). Projected values represent scenario ranges, not exact forecasts.*

### Comparative Data Analysis: Net Zero in Policy vs Practice

The table below draws on UNEP, IPCC, IEA, SBTi, and peer-reviewed sources to compare net-zero strategies across national and corporate actors, placing pledges alongside progress and remaining gaps.

| Institution | Net Zero Target | Progress | Gaps |
|---|---|---|---|
| United Kingdom (nation) | 2050 (Climate Change Act 2008) | Renewables overtook fossil fuels in 2024; coal fully retired from the grid; 4th carbon budget met ahead of schedule | Transport and heating remain high-carbon; two High Court rulings found official climate plans unlawful (2022, 2024) |
| Sweden (nation) | 2045 (Climate Act 2017); net-negative thereafter | Per capita emissions 4.4t carbon dioxide in 2023, far below EU average; first country to introduce carbon pricing | Swedish EPA projects country will miss all national climate targets for next 20 years; transport sector emissions projected to rise in 2024 after biofuel mandate rollback |
| Orsted (energy company) | Net-zero by 2040; 98% Scope 1+2 intensity reduction by 2025 | Transformed from coal-heavy utility to global offshore wind leader; renewable share of generation exceeded 90% | Scope 3 (supply chain and end-use) emissions remain a challenge; absolute Scope 3 harder to control than Scope 1-2 intensity |
| Microsoft (technology company) | Carbon negative by 2030; remove all historical emissions by 2050 | Renewable energy procurement at 100% for operations; aggressive carbon removal investment including DAC | Total emissions rose 29% between 2020-2023 due to AI-driven data centre expansion; SBTi long-term target removed in 2024; Scope 3 gap remains large |
| Aviation sector (global) | Net zero by 2050 (IATA) | Sustainable Aviation Fuel (SAF) production increasing; efficiency per passenger-km improving | SAF accounted for less than 0.5% of total jet fuel in 2023; sector's absolute emissions near pre-COVID peak; demand growth outpacing efficiency gains |

| | | | |
|---|---|---|---|
| Cement sector (global) | Multiple industry pledges toward net-zero by 2050 | Low-carbon cement chemistries (SCMs, geopolymers) reducing intensity; some CCUS pilots underway | Sector responsible for ~8% of global carbon dioxide; calcination process emits carbon dioxide chemically, not only from energy; CCUS at scale not commercially deployed |
| Voluntary carbon market (global) | Underpins many corporate net-zero claims | High-quality removal credits (DAC, biochar) expanding; new integrity standards (ICVCM) emerging | 87% of offsets purchased by top 20 buyers assessed as high-risk for real reductions (Nature Communications 2024); most credits are avoidance not removal; overcrediting by factor of 4-10 documented |

*Table 1: Comparative assessment of net-zero strategies across national governments and major corporations. Sources: UNEP Emissions Gap Reports 2024 and 2025; IPCC AR6; IEA Net Zero by 2050 Roadmap 2023; CCC Progress Report 2025; OECD Environmental Performance Review Sweden 2025; Nature Communications (Trencher et al., 2024); Annual Reviews (2025); SBTi transparency data; Georgia Tech Analysis (2024); Inside Climate News (2025).*

The pattern that emerges across this table parallels the findings of every previous issue in this series. Progress is real and visible in specific actors and sectors. The UK's electricity sector, Orsted's transformation, Sweden's structural decarbonisation across waste and industry: these are genuine achievements that would not have occurred without net-zero frameworks creating direction, accountability, and investment incentives. They matter.

But in each case, a gap separates the headline commitment from the on-the-ground reality. Scope 3 emissions remain underaddressed. Policy reversals can erode legislative targets. Corporate emission totals can rise even as per-unit intensity falls. The voluntary carbon market continues to deliver credits that, at scale, do not represent genuine atmospheric reductions. And the global emissions trajectory, which is the only number that ultimately determines how much the atmosphere warms, reached a new record in 2024 despite over a decade of net-zero commitments multiplying across governments and corporations.

**Conclusion**

The net-zero concept does not deserve to be dismissed. It has reorganised global climate policy in ways that would have seemed extraordinary twenty years ago. It has given investors, governments, and citizens a common language for discussing climate ambition and a framework for accountability that, imperfect as it is, has driven real changes in energy systems, investment flows, and corporate strategy. The physical argument for net zero remains as sound as it ever was: atmospheric temperature stabilisation requires net emissions to reach zero, and the remaining carbon budget to do so at manageable temperatures is narrowing every year.

What the concept does not do, and was never designed to do, is eliminate emissions, reverse past warming, or guarantee that the actions taken in its name are proportionate to the challenge. A net-zero target met primarily through low-quality offsets is not the same as one met through

structural decarbonisation. A net-zero pathway that delays deep emission cuts in favour of future removal is not the same as one that acts immediately. A national net-zero pledge that is not backed by binding sectoral policies, implementation plans, and governance mechanisms is not the same as one that is.

The philosophy that runs through every issue of Eco-Mythbusters holds here: powerful concepts become misleading when reduced to slogans. Net zero is a rigorous scientific and policy framework. It becomes dangerous when deployed as a substitute for the hard work of actually eliminating emissions, rather than as a framework for organising and measuring that work. The question to ask of any net-zero commitment is not simply whether the number on the balance sheet reaches zero. It is how emissions are being reduced, how fast, how transparently, and whether the removals being counted are real, durable, and genuinely additional to what would have happened anyway.

Sustainability, in the end, is not a label that organisations adopt or a date they announce. It is the sum of the decisions made in the years between the announcement and the deadline: the emissions not released, the removals genuinely achieved, the accounting done honestly, and the hard sectors decarbonised despite the difficulty and cost. Net zero provides the destination. The integrity of the journey is what determines whether the world actually gets there.

**When Net Zero is Genuinely Meaningful:**

- When net-zero targets are grounded in rapid, science-aligned emission reductions across all scopes, with offsets reserved for genuinely unavoidable residual emissions and drawn from high-quality, verified removal projects rather than cheap avoidance credits.
- When the accounting framework is transparent, covering all greenhouse gases and including Scope 3 emissions measured against credible methodologies, so that the balance sheet reflects a real-world trajectory rather than a carefully chosen accounting boundary.
- When interim milestones are legally binding rather than aspirational, with independent governance structures and regular public reporting that allow progress to be verified and shortfalls to trigger corrective action before targets are missed.
- When achieving net zero on carbon is complemented by parallel attention to biodiversity, water, land use, and other environmental dimensions, recognising that carbon balance and ecological sustainability, while related, are not identical.

**When it Isn't:**

- When net-zero claims are supported primarily by cheap avoidance offsets purchased in a voluntary carbon market where overcrediting by factors of five to ten has been repeatedly documented, allowing organisations to present balanced accounts without structural decarbonisation.
- When long-dated net-zero targets are used to justify continued expansion of emissions-intensive activities in the present, with deep cuts deferred to a future decade when the technologies and policies required are assumed to be available, consuming the carbon budget that immediate action would have preserved.

- When the accounting boundary is drawn to exclude the most significant part of an organisation's emissions, particularly Scope 3, so that the net-zero label applies to a controlled portion of the footprint while the larger supply chain and value-chain impacts continue unaddressed.
- When policy reversals or political changes erode the credibility of legally enshrined targets, demonstrating that the legislation exists but the trajectory does not, and allowing governments to claim legal commitment to net zero while actively weakening the policies required to achieve it.
- When the label net zero is equated, in public communication or investor reporting, with having solved a company's or country's contribution to climate change, leading stakeholders to believe that the environmental problem has been resolved when the accounting balance, not the atmospheric chemistry, has simply been reorganised.

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