Is Net Zero Enough for the Material Production Sector?

Analysing the decarbonisation pathways for key material sectors and their ability to meet global carbon budgets

Executive Summary

November 2022

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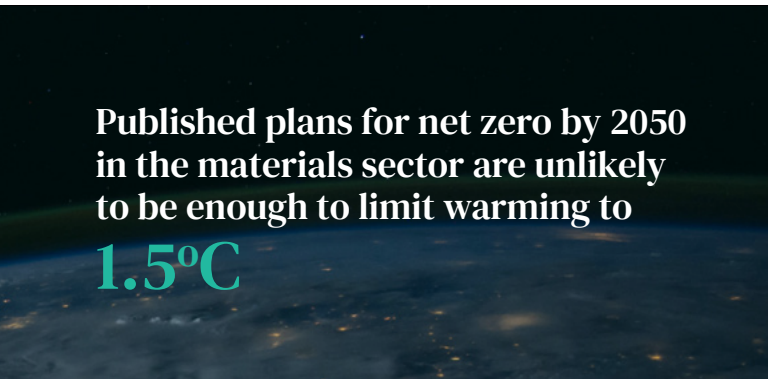
The IPCC's 2021 Sixth Assessment Report (AR6) estimates that there is a 67% chance of global warming staying within 1.5°C of pre-industrial levels if cumulative global greenhouse gas (GHG) emissions stay below 400 $GtCO_2e$.[i] Current trajectories suggest that this budget will be depleted within the next 10 years if growth rates are maintained. Whilst the IPCC has also stated there is a need for global emissions to reach net zero by 2050—and many organisations throughout the world are working towards this—the concept of a 'carbon budget' has yet to gain as much recognition.

Emissions from the material production sector – resource extraction and processing of raw materials – currently comprise approximately 25% of global emissions, and are therefore of significant importance in reducing emissions in line with this global carbon budget. Current production and consumption trajectories indicate global material use is predicted to double from 2015 to 2060; hence, mitigating the GHG emissions from these sectors is likely to present a significant challenge.



The industries with the highest contribution to this sector are **aluminium, concrete, steel and plastics**. The production of these four materials alone is currently responsible for 78% of GHG emissions from the material production sector. Some of these industries have produced a net zero pathway to meet net zero by 2050 and this report has reviewed each industry's pathway, and modelled whether these will reduce emissions quickly and deeply enough to stay within this budget.

When considering the urgency of reducing GHG emissions there is a possibility that, despite the aims of the net zero pathways, the cumulative carbon emissions budget will be exceeded due to the risks associated with deploying unproven technologies in some sectors. This research aims to allocate a risk factor associated with each intervention and quantify how this influences the likelihood of overshooting the remaining carbon budget. It also attempts to determine whether the overshoot can be reduced by accelerating the adoption model deployed for technological interventions.

[i] The carbon budgets in the IPCC's AR6 refer to CO_2 emissions only, but account for the global warming effect of non-CO_2 emissions. Therefore, this report uses a unit of CO_2e.

Results

The main conclusion of this research is that **published plans for net zero by 2050 in the materials sector are unlikely to be enough to limit warming to 1.5°C.** Likely trajectories show that the result could be as high as 2°C.

More specifically, **the impact of deploying abatement technologies after 2030 is substantially less effective than more near-term, widespread, commercial deployment.**

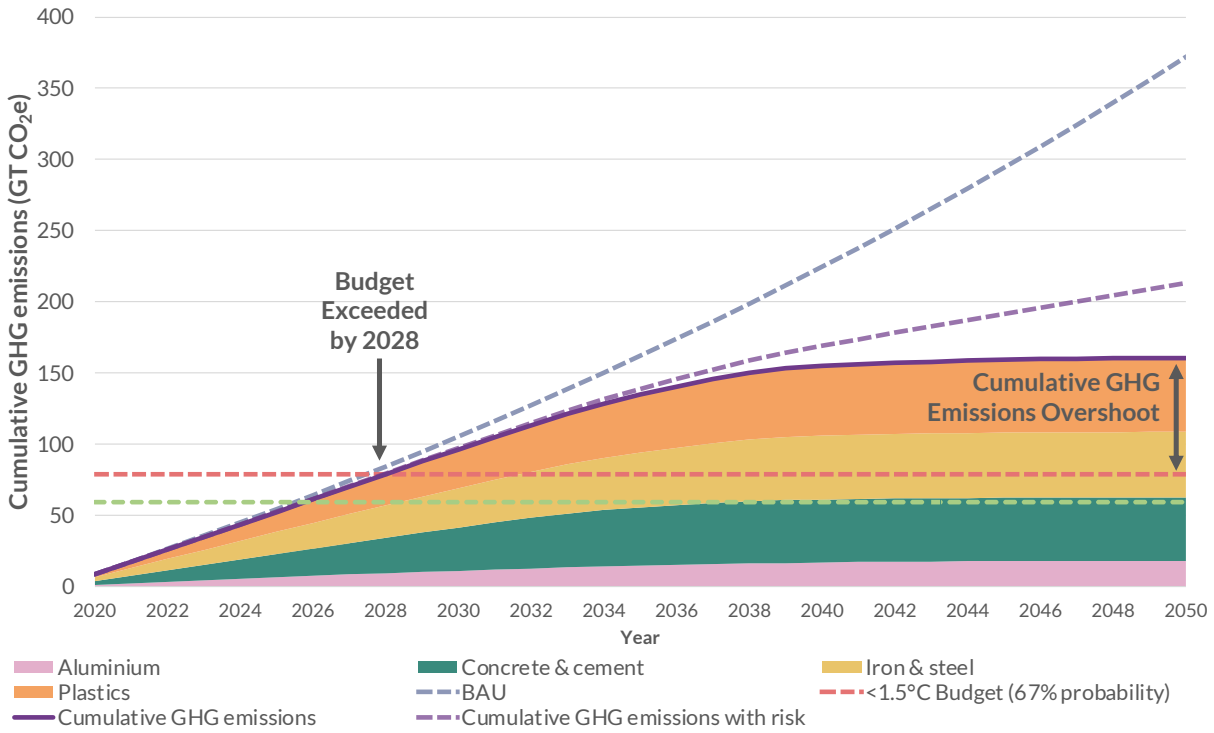
Taking a Business as Usual (BAU) approach to materials production will lead to exceeding the budget by almost five times and result in a trajectory towards warming of 2.5°C. For the plastics industry alone, this could be as high as 3.5°C. Current industry net zero roadmaps bring the difference to double the budget and a warming of around 1.7°C – although with technological risk factored in, this could be as high as 2°C. The plastics industry currently does not have a roadmap to net zero, but projections for this study suggest that a trajectory of 2.2°C is possible even with aggressive decarbonisation.

If the other ~75% of the global GHG emissions from non-material sectors (primarily from energy use in transport and buildings) can remain within budget, the material sector alone would be responsible for reaching 1.6°C under the expected deployment scenario. It is therefore important to also understand the interconnectedness across all global GHG emissions for carbon budgeting to be explored in more detail.

The risk level associated with the realisation of decarbonisation interventions (factoring in the uncertainty around technological innovations) also make it possible that the emissions reductions achieved in practice will be less than predicted, and therefore the chance of overshooting the remaining carbon budget becomes more likely (Figure E.1.1).

The risk level varies by industry. For the aluminium sector, a rapid adoption of existing technologies may bring the sector close to achieving the carbon budget but would involve reversing a trend towards fossil fuel use. The cement and plastics industries respectively rely on the rapid deployment of CCUS and a fundamental shift to bio-based feedstocks; examples of high risk, structurally disruptive interventions that are not currently transitioning rapidly enough. Equally, the steel industry will be reliant on hydrogen, which is not only yet to be produced at scale but will also be highly sought after within other industries.

Figure E.1.1: Cumulative GHG Emissions for the Four Sectors



Recommendations

Following on from the realisation that net zero by 2050 is not likely to be enough to limit warming to 1.5°C, is the requirement for policy mechanisms to promote the implementation of sector-specific measures to accelerate reductions in GHG emissions. Key to this is the recognition that:

- net zero targets should be replaced with 1.5°C – aligned carbon budgets – the setting of these in an equitable way will be a key part of the challenge here;
- it is important to encourage rapid, near-term investment by industry to adjust their current projected timelines. This means that alongside the drive for increasing circularity, reducing primary GHG emissions should be a priority as well;
- there will be a need to drive increased investment in research, development and deployment of electrified processes, green hydrogen, and CCUS; and,
- faster action will be required. By 2040, most if not all interventions must have reached maturity and market saturation across all material sectors. This will likely mean that any significant policies that will drive these changes should be in place by 2030 at the latest.

However, these policies only serve to amend the current business model of continued material production, which is inherently unsustainable. Therefore, these policies need to be supplemented to reduce the risk of under-delivering on GHG emission reductions and improve the likelihood of remaining within the carbon budget. To further reduce the risk of overshooting the global carbon budget, **the rate of increase in material consumption needs not only to be reduced but, in all sectors, reversed.** Key policy interventions should consequently focus on measures that;

- reduce material consumption; and/or,
- drive a shift in material consumption to less carbon-intensive sectors.

High recycling rates and circularity at the material level has its limitations – when *material circularity* reaches its limits, *product circularity* should be the focus which must also go beyond waste prevention as a metric for success. This will likely be in the form of greatly increased reuse, which is why **it is imperative that policies related to resource use are integrated with those on waste, recycling and product design.**

Finally, some consideration also needs to be given to material switching, and the extent to which this may be linked to an increase in demand for materials that are grown, rather than extracted from the ground. Timber as an alternative to concrete, plastics being replaced by paper products, or the move towards bio-based feedstocks are common actions— **this means that, from a policy perspective, there will need to be an increasing overlap between material resources and the bioeconomy.** Addressing one without consideration of the other will lead to unintentional trade-offs. Competition for land use in the future between resources for materials, fuels and food whilst focusing on habitat protection is a key issue that needs to be discussed holistically rather than compartmentalised. Policy makers need to be aware of these interlinkages when designing measures to accelerate the path to net zero.

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