

Briefing

Unabated

The Carbon Capture and Storage 86 billion tonne carbon bomb aimed at derailing a fossil phase out

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ABOUT CLIMATE ANALYTICS

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Summary

The climate talks at COP28 have centred around the need for a fossil fuel phase out. But some are calling for this to be limited to 'unabated' fossil fuels. This would present two key risks:

1. **It creates the false impression that we can achieve our climate goals and maintain large-scale fossil fuel consumption enabled by carbon capture and storage (CCS).** On the contrary, pathways that achieve the Paris Agreement's 1.5°C limit in a sustainable manner show a near complete phase out of fossil fuels by around 2050 and rely to a very limited degree, if at all, on fossil CCS.
2. **If the term 'unabated' is poorly defined, it could reopen a closing door on the large-scale use of fossil fuels.** A weak definition of 'abated' – or even no definition at all – could allow poorly performing fossil CCS projects to be classed as abated. This could result in upstream and downstream emissions from fossil fuel production to go on unaddressed.

Our analysis quantifies the risk posed by restricting a phase out commitment to only 'unabated' fossil fuels. Reliance on large-scale CCS, combined with an underperformance in CCS technologies, could lead to excess greenhouse gas emissions of **86 billion tonnes between 2020 and 2050**. This would push the 1.5°C limit out of reach.

Whether 'abated' or not, fossil fuel supply and combustion needs to be phased out. The latest science shows that fossil fuel use needs to peak this decade and decline rapidly – by 40% this decade – on the way to a near-complete phase out around 2050.

The science calls for urgent and steep reductions of all fossil fuels

We identify two key risks relating to the use of the term 'abated' to refer to fossil fuels in the context of climate action. The first risk is that the term 'abated' fossil fuels suggest that large-scale continued fossil fuel production and use is compatible with limiting warming to 1.5°C. This does not align with the latest science, which shows that we need to see near-term and rapid reductions in fossil fuel production, limited reliance on fossil CCS, and a near-complete fossil phase out by around 2050.

Pathways which limit warming to 1.5°C in the most sustainable manner¹ show immediate reductions in total fossil fuel supply and use. Fossil fuel production falls between 30-40% between 2022 and 2030 in these pathways. **This would require annual cuts of up to 6% per year over this decade, and no room for new investment in expanding fossil fuel supply.**

These pathways also rely to a very limited degree on fossil carbon capture and storage (CCS) technologies.² In fact, each iteration of the IEA's net zero emissions (NZE) scenario has relied on successively less CCS, as its relative cost effectiveness has declined. The 2023 version of the scenario uses 38% less CCS than the 2021 version.³

This low CCS use is because alternatives are often cheaper and more effective at reducing emissions. For example, recent analysis has shown that a high-CCS pathway will be substantially more expensive, by about US \$1 trillion more per year up to 2050 compared to a sustainable low-CCS pathway.⁴

These pathways show rapid near-term reductions which are continued into the long-term. Recent evidence suggests that total fossil fuel production should be cut by *at least* 83% in 2050 relative to 2020 levels.⁵ Given that these pathways often neglect key factors, such as the adverse environmental, human and social costs of fossil fuel extraction, even deeper cuts could well be justified. This represents a near-complete fossil phase out by around 2050.

¹ Climate Analytics (2023). 2030 targets aligned to 1.5°C. Available at: <https://climateanalytics.org/publications/2030-targets-aligned-to-15c-evidence-from-the-latest-global-pathways>

² IPCC (2022). Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001.

³ IEA (2023). Net Zero Roadmap.

⁴ Bacilieri, A., Black, R., & Way, R. (2023). Assessing the relative costs of high-CCS and low-CCS pathways to 1.5 degrees. Oxford Smith School Working Paper 23-08.

⁵ Achakulwisut *et al* (2023) doi: 10.1038/s41467-023-41105-z

Global fossil fuel reduction pathways under different climate mitigation strategies and ambitions. 83% statistic calculated by combining the 99%, 70% and 84% reductions in coal, oil and gas from the pathway set with limited CDR.

	Share of primary energy from fossil fuels with CCS in 2030 / 2050 (%)	Fossil CO ₂ sequestration in 2050 (GtCO ₂) ⁶	Fossil fuel reductions 2022-2030 (%)
Median of 1.5°C pathways (filtered to meet sustainability constraints) ⁷	0.4% / 5%	1.2	38%
IEA NZE	1% / 6%	2.1	28%

Table 1: Fossil CCS deployment and the rate of reduction in fossil fuel production and use in key 1.5°C compatible scenarios.

The idea that we can continue to use fossil fuels is strongly linked to the idea that their emissions could be ‘abated’. The idea of abating emissions from fossil fuel use has grown in prominence recently and found its way also in political declarations that speak to the need of only phasing out (or down) ‘unabated’ fossil fuel use.⁸

A commitment to only phase out ‘unabated’ fossil fuels implies that fossil fuels still have a future – if they are ‘abated’. This could send a dangerous and incorrect signal to investors that CCS can enable continual large-scale fossil fuel consumption without busting through climate goals.

If the fossil fuel industry remains a heavily subsidised one, and a global agreement is only limited to phasing out ‘unabated’ fossil fuels, the industry is likely to fail to reign in production, with claims that high levels of CCS will keep emissions in check. This would be dangerous for many reasons, including the risks to health and the environment from fossil fuel production, as well as the environmental impacts and costs of CCS. On top of those are the risks to climate from the unaddressed upstream and downstream emissions from production and use and the ongoing failure to achieve high CO₂ capture rates.

A political push without an agreed definition

This brings us to the second risk of using the term ‘abated’ in relation to the future of fossil fuels: there is no agreed definition of the concept of abatement. This is a major

⁶ We calculate the level of carbon sequestration from fossil CCS by applying emissions factors for coal, oil and gas to scenario data on the use of these fuels with CCS. We then assume that 95% of these emissions are captured. This is therefore an estimate of the level of fossil CO₂ captured by CCS in the scenarios, rather than a directly reported value.

⁷ Climate Analytics (2023). 2030 targets aligned to 1.5°C. Available at: <https://climateanalytics.org/publications/2030-targets-aligned-to-15c-evidence-from-the-latest-global-pathways>

⁸ Council of the European Union, 14825/23 (2023). Available at: <https://data.consilium.europa.eu/doc/document/ST-14285-2023-INIT/en/pdf>

problem. The IPCC AR6 Working Group III report states “abatement refers to human interventions that reduce the amount of greenhouse gases that are released from fossil fuel infrastructure to the atmosphere.”

This general definition unfortunately is very weak, but the standard applied in the IPCC’s latest report is much stricter. The WG III report states that abated fossil fuel use implies ‘substantially reducing the amount of GHG emitted throughout the life cycle; for example, capturing around 90% or more CO₂ from power plants, or 50–80% of fugitive methane emissions from energy supply.’⁹

A study by IPCC authors leading on these questions recommends that the term ‘abated’ be reserved for instances where ongoing fossil fuel use emissions are reduced 90-95%+ and upstream fugitive emissions are less than 0.5% of equivalent fossil gas production. Furthermore, ‘abated’ fossil fuels should assume perfect and permanent storage of carbon underground.¹⁰

There is no guarantee that these standards would be adhered to. The available evidence indicates otherwise. Existing flagship CCS schemes worldwide have either failed entirely or have captured far less CO₂ than expected (IEEFA 2022).¹¹

It is also important to note that these standards can never be met for distributed fossil fuel combustion, for example, oil and gas in transport, where fitting CCS is not possible (see section on uncaptured emissions).

Any definition of what constitutes ‘abated’ or ‘unabated’ fossil fuels under the UNFCCC would need to meet standards of a near total capture rate of all greenhouse gas emissions associated with fossil fuel production and combustion. Without such an agreed definition, there is a high risk that the term ‘abated’ would be applied to fossil fuels with capture rates much lower than the IPCC assumes, limited or no action to cut upstream methane emissions, or to fossil fuels where CCS is only used for part of the production and combustion process.

Unaddressed upstream and downstream emissions from production and use, combined with incomplete CO₂ capture rates, means fossil fuels, even if adhering to the highest standards of ‘abatement,’ will never be zero emissions. Therefore, on top of this, there is a need for readily available carbon dioxide removal technologies to make up for any residual emissions. These must not be relied upon to allow continued fossil fuel use, but rather are needed on top of stringent fossil fuel reductions.

This shows that any definition of ‘abated’ fossil fuels must apply strict guardrails to avoid undermining the critical need for rapid cuts in emissions in line with 1.5°C. Today,

⁹ IPCC, 2022: Summary for Policymakers In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001.

¹⁰ Bataille, Chris, et al. (2023) "A Paris Agreement Compliant Definition for "Abated Fossil Fuels". Available at SSRN.

¹¹ IEEFA (2022). The carbon capture crux: lessons learned. Available at: <https://ieefa.org/resources/carbon-capture-crux-lessons-learned>

there are many examples of so-called 'abated' fossil fuels which fall woefully short of these standards.¹² The Gorgon project, for example, is the largest CCS capture plant in the IEA's database, but it doesn't work anywhere near the claimed capacity - and there is no sign of this being fixed. The banner 'abated' is already serving as a trojan horse, allowing fossil fuel projects with underperforming capture rates and limited action to cut upstream production emissions to proceed.

In the following sections, we quantify the additional emissions a vague or weak definition of 'abated' fossil fuels could result in, if fossil CCS projects fail to meet the IPCC authors recommended standards for abated fossil fuels.

A multi-gigatonne gamble

As part of the full assessment, the IPCC AR6 also explores potential futures that rely on extremely high deployment rates of fossil CCS developments. These pathways rely on massive upscaling of CCS with very high captures rates, as discussed above. Here we look at a high CCS pathway - selected as from the IPCC's AR6 database as the 1.5°C low overshoot pathway with the largest deployment of fossil CCS - to quantify the risk that CCS is not as effective at abatement as industry claims.

We use this scenario as an illustration of what could happen if governments only agree to phase out 'unabated' fossil fuels and bet heavily on fossil CCS to enable large-scale continued fossil fuel production. We compare this with the IEA NZE, a pathway which still deploys CCS to capture emissions from fossil fuels, but to a lesser extent.

For each pathway we estimate how many additional emissions would occur if CO₂ capture rates were reduced from an optimistic level (95%) to the level seen in plants operating today (~50%). Similarly, we revert the assumed capture rates of fugitive methane to less optimistic levels, from 80% to 30%.

Our results are shown in Table 2 below. While fossil fuels with CCS make up a small share of primary energy in each scenario, the risk of excess emissions from poor capture rates is high - as much as 86 GtCO₂e in the scenario with high fossil CCS reliance. This represents over 30% of the remaining global carbon budget for 1.5°C estimated to be around 275 GtCO₂ from January 2024 (central estimate).¹³ The remaining carbon budget is subject to large uncertainties, but an underperformance to this extent would fatally undermine the 1.5°C goal.

Even the IEA NZE, which has more limited fossil CCS use, risks 16 GtCO₂e of additional emissions if underperforming fossil CCS is deployed under the banner of 'abatement.' This shows that reducing CCS deployment also reduces the risk of CCS underperformance and implies that CCS reliance should be minimised. At the same time, even in a 'low-CCS' scenario, the risk of underperforming carbon capture projects

¹² IEEFA (2022). The carbon capture crux: lessons learned. Available at: <https://ieefa.org/resources/carbon-capture-crux-lessons-learned>

¹³ Global Carbon Project (2023). Available at: <https://essd.copernicus.org/articles/15/5301/2023/>

remains significant, so the need for a clear definition and high standard for ‘abated’ fossil fuels remains essential.

	% primary energy from fossil CCS in 2030 / 2050	Fossil CO ₂ sequestration in 2050, assuming 95% capture rates ¹⁴ (GtCO ₂ /yr)	Additional cumulative CO ₂ under weak capture rate (GtCO ₂)	Additional cumulative CH ₄ under weak upstream abatement	Total cumulative additional GHG emissions risk
IEA NZE	1% / 6%	2.1	14.7	1.7	16.4
1.5°C high CCS	10% / 39%	11.9	76.1	10.1	86.3

Table 2: CO₂ and CH₄ emissions that are at risk over the 2020-2050 period if poorly defined ‘abated’ fossil fuels are allowed to be deployed.

Uncaptured emissions

This analysis focuses on the risk that underperforming CCS projects are greenlit as ‘abated’ fossil fuels due to a weak or vague definition of abatement under the UNFCCC process. This is a risk for CCS projects which are applied at the end of the fossil fuel value chain (i.e. combustion to provide energy).¹⁵ However, there is another risk, that CCS is applied during the *production* of fossil fuels only, and the emissions released upon combustion are not captured. For example, this would apply to ‘abated’ oil used in cars or buses, or LNG produced with CCS used to heat homes – emissions from burning these fuels cannot be captured.

Again, if there is a weak or vague definition of what constitutes ‘abated’ fossil fuels, some may claim that such products, if produced with CCS facilities attached or with action to cut methane emissions, could be referred to as ‘abated’ and therefore not be phased out. The oil and gas industry is already heavily promoting abatement in the form of carbon capture storage for upstream emissions from the production of fossil fuels, as well addressing fugitive methane emission reductions.

However, upstream emissions from gas and all production are only 5 to 10% of the total emissions from the combustion and/or use of oil and gas. This means that claims that oil and gas production is ‘abated’ essentially greenwashes the larger bulk of emissions from the use of these fossil fuels. These latter emissions are often referred to by industry as ‘Scope 3’ and are very often not covered by proposals to ‘abate’ oil and gas production.

¹⁴ We calculate the level of carbon sequestration from fossil CCS by applying emissions factors for coal, oil and gas to scenario data on the use of these fuels with CCS. We then assume that 95% of these emissions are captured. This is therefore an estimate of the level of fossil CO₂ captured by CCS in the scenarios, rather than a directly reported value.

¹⁵ This would also cover the use of fossil fuels for non-energy purposes where CO₂ is emitted as part of the process, such as using fossil gas as a feedstock for hydrogen production.

We see this already today with claims of ‘carbon neutral’ LNG. Upstream CO₂ emissions might be captured, fugitive emissions might be reduced, but the large bulk of emissions are not abated or mitigated in any way, but simply offset.¹⁶ Only 10% of the emissions occur upstream in production and manufacture of LNG, while around 90% occur in the combustion of LNG by the end user. With LNG production plans growing, these misleading claims represent a major risk to our ability to limit warming to 1.5°C.

What is needed?

Leaving the door open to continued long-term fossil fuel use via reliance on poorly defined ‘abatement’ options presents serious risks to our ability to ensure the safest possible future. A clear commitment to phase out fossil fuel production and use starting now is important to ensure we can peak emissions before 2025 and rapidly bring them down over this decade in line with the science.

The IEA’s NZE shows fossil fuel supply falling by 28% from 2022 to 2030, and just over 80% by 2050. Recent analysis of IPCC pathways has suggested that fossil fuel demand should fall 38% from 2022 to 2030, if we are to limit warming to 1.5°C in the most sustainable manner. And IPCC pathways that meet expert-based limits for sustainable carbon dioxide removal (CDR) reliance show declines in coal, oil and gas of 99%, 70% and 84% by 2050, compared to 2020 levels – equivalent to cutting fossil fuel use by *at least* 83% by mid-century.

A number of considerations suggest an even faster phase out by mid-century is needed:

1. CCS and CDR may not scale as quickly as assumed in these scenarios, which would require even faster reductions in fossil fuel production and use.
2. There are still uncertainties in the climate system. This includes the possibility that we need to reach net-negative CO₂ emissions to halt warming, rather than net zero CO₂ emissions.¹⁷ In such a world, residual emissions would need to be minimised as much as possible, requiring deeper cuts to fossil fuels.
3. These pathways do not consider the significant adverse environmental, human and social costs of fossil fuel production and combustion.
4. The path dependency of the energy transition means that renewables and storage will get cheaper as they scale, while fossil fuels are likely to get more expensive as global supply chains become scarcer and high abatement costs are added.

An even faster reduction towards a near-complete phase out of fossil fuels around 2050 would therefore be the safest option.

¹⁶ <https://www.woodmac.com/news/opinion/what-is-carbon-neutral-lng/>

¹⁷ Palazzo-Corner et al. (2023). The Zero Emissions Commitment and climate stabilization. Available at: <https://www.frontiersin.org/journals/science/articles/10.3389/fsoci.2023.1170744/full>