CLIMATE ANALYTICS

Submission

Roadmap on the Transition Away from Fossil Fuels in a Just, Orderly and Equitable Manner

Input by Climate Analytics gGmbH to inform the initiative by the Presidency of COP 30

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The importance of making national actions consistent with the global perspective to limit 1.5°C overshoot

The 1.5°C limit is the enduring, legally significant temperature goal of the Paris Agreement. Alongside the requirement to achieve net zero greenhouse gas emissions in the second half of the century, the 1.5°C limit sets the legal framework for understanding the level of ambition Parties have committed to under the Paris Agreement.

The 1.5°C limit also represents an ethical and moral boundary established to avoid the most dangerous impacts of climate change. Since its adoption in 2015, the science underpinning the necessity of this limit has only grown more conclusive. Exceeding it would significantly increase the likelihood of severe, widespread, and irreversible, climate impacts and damages.

However, due to the lack of ambition and delays in achieving deep emission cuts, it is likely that long-term average global temperature increase will exceed 1.5°C by the early 2030. Even if 2025 emissions are halved by 2030, we would likely still breach this warming level.

Recent analysis that removes the influence of natural variability finds a statistically significant acceleration in global warming since around 2015, with the underlying warming rate over the past decade substantially higher than in previous decades. If this elevated rate persists, the 1.5°C limit will likely be exceeded in the early 2030s.[1]

Rather than reaching a peak and falling by 22% between 2019-2025, GHG emissions (excluding LULUCF) have risen by about 6-7% over this period. In 2025, fossil fuel emissions are estimated continue to increase at about 1.1% per annum and reach the highest level ever at ~39 GtCO2 or 10% higher than when the Paris Agreement was adopted in 2015. [2]

If emissions are reduced quickly enough, then overshoot can be limited and the dangers of the carbon cycle and other feedbacks be limited. The current focus of action must be on the extremely urgent need for emission reductions to minimise the magnitude and duration of overshoot. Recent scenarios suggest that, providing the magnitude of overshoot is strictly limited, it remains possible to return global warming to well below the Paris limit by 2100 as summarized in the table below.

[1] https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2025GL118804

[2] Data estimated using a combination of sources which include the Global Carbon Budget and the Indicators of Global Climate Change.

Scenario	Source	Peak warming	Warming by 2100	Time for net zero CO_2	Time for net zero GHG	Overshoot duration
C1a[3]	IPCC, AR6	<1.6ºC. [1.4-1.6]	1.2°C	~2050	~2070	~30 years
Highest Possible Ambition (HPA)[4]	Climate Analytics/ Potsdam Institute for Climate Impact Research	1.7°C	1.2°C	2045	2060	~40 years
Net Zero Emissions by 2050[5]	International Energy Agency	1.65°C	1.45°C	2050	~2100	~Several decades

Exceeding 1.5°C of warming with even a temporary overshoot would result in more irreversible losses and adverse impacts, including species extinctions, the loss of ecosystems and the services that they provide, and damage to mountain and coastal ecosystems:

- **Irreversible impacts:** Some overshoot effects—such as ice sheet and glacier melt, biodiversity loss and sea-level rise—cannot be reversed, meaning the world cannot fully return to its previous state even if temperatures later decline.
- **Increasing loss and damage:** Even small increases in global warming significantly raise climate impacts worldwide, with the greatest effects on vulnerable regions such as Small Island Developing States (SIDS) and Least Developed Countries (LDCs).
- **Adaptation limits:** Peak warming during overshoot may temporarily or permanently eliminate adaptation options, for example when ecosystems that support adaptation are destroyed.
- **Higher tipping point risks:** Each additional fraction of warming above 1.5 °C increases the likelihood of climate tipping points, such as coral reef collapse, Amazon dieback, and loss of Arctic and Greenland ice sheets.

[3] https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Annex-III.pdf
[4] https://climateanalytics.org/publications/rescuing-1-5c
[5] https://www.iea.org/reports/global-energy-and-climate-model/net-zero-emissions-by-2050-scenario-nze

We would like to emphasize the escalating—and potentially irreversible—risks associated with sea level rise, including the loss of coastal ecosystems and their services, groundwater salinisation, increased flooding, and damage to coastal infrastructure. These impacts, in turn, threaten livelihoods, settlements, health and well-being, as well as food and water security and cultural values. Current levels of ambition imply an increase of about 60 cm in sea levels by 2100, while longer-term risks include multi-meter increases by 2300 if ice sheet tipping points are crossed .

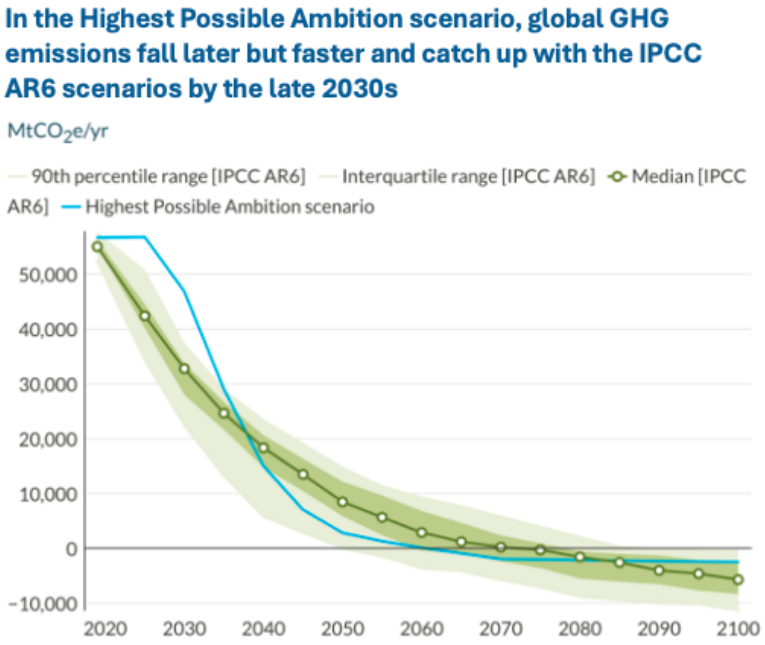
Only by ensuring that any overshoot is temporary and small would the risks associated with crossing these climate tipping points be reduced. Overshooting 1.5°C does not mean we need change the Paris Agreement's goals, but rather double down on their implementation. 1.5°C was chosen for good reason. Roadmaps and strategies to phase to fossil fuel must therefore be developed with the aim of delivering the agreement reached in Paris.

Fossil fuel phase out pathways

Climate Analytics, in cooperation with the Potsdam institute for Climate (PIK), has developed a new global and regional mitigation scenario called Highest Possible Ambition (HPA).[6] This scenario departs from today's emission levels and considers latest energy market dynamics to demonstrate that it is possible to steeply reduce emissions to below zero and bring temperatures down after a short period of 1.5°C overshoot, thereby securing that global warming will return to well below 1.5°C by 2100.

Under the HPA, global emissions would need to fall by 17% by 2030 from 2019 levels, 73% by 2040, and 95% by 2050. Starting later and at a higher level makes 2030 reductions slower than in IPCC scenarios; however, they become significantly steeper than most IPCC scenarios after 2030 (see figure below). Net zero CO2 emissions are achieved before 2050, and net zero GHG emissions by the early 2060s. These milestones are key to stopping warming and then driving temperatures back down to below 1.5°C pre-2100.

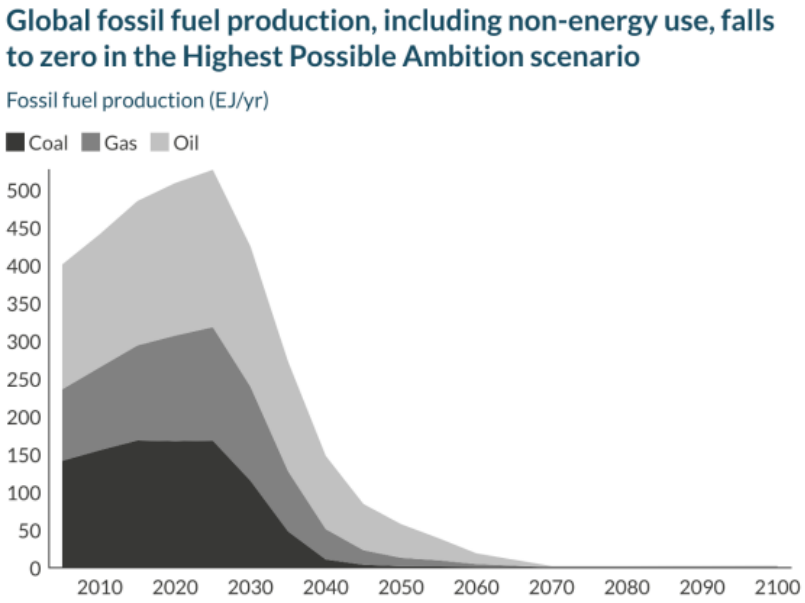
[6] https://climateanalytics.org/publications/rescuing-1-5c



Four key levers underlie the HPA:

- **Widespread electrification powered by renewables:** Renewable electrification is the mainstay of the energy transition, as it significantly outperforms all other options on cost, scalability and energy efficiency. The HPA scenario sees global electricity generation nearly quadruple by 2050, with wind and solar supplying over 90% of electricity demand.
- **A much faster phaseout of fossil fuels:** Production and consumption of all fossil fuels peak immediately and fall rapidly, with coal effectively phased out by the 2040s, gas in the 2050s and oil in the 2060s. Advanced economies take the lead in phasing out fossil fuels, achieving a fossil-free economy by mid-century. The result is a fossil free global economy by 2070
- **Substantial reduction of methane:** In the HPA scenario, methane emissions fall around 20% by 2030 and 32% by 2035 (relative to 2020), driven particularly by emissions reductions from fossil fuel extraction
- **Finally, deployment of carbon dioxide removal (CDR)** at commercial scale from 2030 onwards to bring warming to below 1.5°C, while avoiding overreliance on temporary removals from afforestation and reforestation.

Electrification and renewables are the cornerstones of a fossil fuel phaseout. Under the HPA, the production and use of coal, oil, and gas each peak immediately in 2025 and fall rapidly towards zero as illustrated in the figure below:



Coal production falls fastest, with total production down by almost a third in 2030 relative to 2025 levels. This is driven particularly by the power sector, with around 60% of the reduction in coal over 2025–2030 coming from closing coal-fired power stations. This continues through the 2030s but is complemented by increasing action to phase out coal use in industry, particularly in steel, as electric arc furnaces and hydrogen direct reduction furnaces replace the traditional blast furnace route. Coal production and use is essentially phased out in the 2040s as illustrated in the figure and table below.

Phasing out coal alone is not enough, and is complemented by deep reductions in oil and gas production (see table below). Combined production of oil and gas falls 13% by 2030, over 60% by 2040 and over 80% by 2050. Gas production is effectively phased out in the 2050s and early 2060s, while oil is effectively phased out in the late 2060s. Total fossil fuel production is cut by around a fifth in 2030 and almost three-quarters by 2040. This means that total fossil fuel production falls 4% a year from now until 2030 in the HPA scenario. The result is a fossil free economy by 2070. Importantly, this includes non-energy use (e.g., petrochemicals or plastics).

Table 3: Reductions in fossil fuel production in the Highest Possible Ambition scenario relative to 2 levels

	2030	2040	2050	2060	2070
Coal	-32%	-93%	-99%	-99%	-100%
Oil[9]	-11%	-53%	-79%	-93%	-99%
Gas	-17%	-73%	-92%	-98%	-100%
Oil and Gas	-13%	-62%	-84%	-95%	-100%
Total fossil fuel production	-19%	-72%	-89%	-96%	-100%

We note that not all countries will achieve net zero at the same time, with some countries (especially those with the largest transition capacities) achieving net zero ahead of the global average, and others behind the average. Advanced economies take the lead in this transition, achieving a fully fossil-free economy by 2050. There is a small tail of fossil fuels remaining in emerging and developing markets, but this is fully eliminated by 2070.

The climate benefits of implementing the Global Stocktake provisions

Unfortunately, the current level of ambition enshrined in NDCs is insufficient to deliver on the Paris Agreement. At the first Global Stocktake (GST1) Parties agreed to contribute to the global goal of tripling renewable energy capacity, doubling the average rate of energy efficiency improvements by 2030 and accelerating the transition away from fossil fuels and energy systems in this critical decade[7].

Implementing these GST measures would substantially reduce the projected warming for the 21st century significantly (about 0.9˚C from 2.6˚C to 1.7˚C).[8] This reduced warming would also slow or halt the acceleration in the sea level rise rate and lower the projected sea level rise by 12-17cm by 2100 compared to current policies[9]. Tripling renewables, doubling energy efficiency and cutting methane by 2030 and beyond would cut the warming rate by a third in ten years, and halve it by 2040.

The establishment of the Global Implementation Accelerator at COP30 presents as a major opportunity to mobilise and coordinate global action to phase out fossil fuels thereby reducing the risk of many meters sea level rise beyond 2100. The global implementation accelerator could become a major opportunity to close the emissions camp and to consolidate and advance the progress on implementing the first Global Stocktake energy package and other measures.

The benefits and feasibility of phasing out fossil fuels

The phasing out of fossil fuels is technically, economically and financially possible. This becomes even more clear as one considers the full range of benefits derived from a fossil fuel free economy:[10]

- **Competitiveness and cost leadership:** The frontier of options to phase out fossil fuels is expanding due to the rapidly declining costs of renewables and electrolysers, increases in battery storage, durability and efficiency, emerging other energy storage technologies and accelerating innovation in reducing process- related emissions

[7] https://unfccc.int/topics/global-stocktake/about-the-global-stocktake/outcome-of-the-first-global-stocktake
[8] https://climateanalytics.org/publications/three-key-near-term-actions-could-bend-the-warming-curve-bringing-projected-warming-below-2-c (2025)
[9] https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool.
[10] https://ca1-clm.edcdn.com/publications/Real-zero-an-opportunity-not-a-cost.pdf?v=1762427267

across so called “hard-to-abate” sectors. At the same time, carbon capture and storage (CCS) is not delivering promised capture rates, while costs remain high and efficiency low. Countries and firms moving early to transition to real zero systems will benefit from lower operating costs and first-mover access to low-carbon demand pools.

- **Economic resilience:** Taking fossil fuels out of the production process (both energy and non-energy) reduces exposure to fuel-price volatility and regulatory interventions (e.g., carbon pricing). It can also stabilise operating expenditures, and limit stranded asset risks inherent to strategies dependent on offsets or CCS. In the case of steel, taking fossil fuels out of the mix also enhances supply security by increasing reliance on domestically available energy and circular-material inputs rather than imported combustibles and virgin feedstocks.
- **Broader social benefits:** Phasing out fossil fuels would bring a wide range of benefits: preventing millions of deaths from fossil fuel air pollution; alleviate associated health and socio-economic injustices; reduce negative impacts on biodiversity from fossil fuel extraction; and ultimately prevent further escalation of the climate emergency. A fossil free future is not only achievable, but desirable, in order to create a healthier, fairer and safer future for all

In the particular case of costs, evaluations from both IRENA and the IEA[11] consistently show that renewable electricity technologies—particularly solar PV and onshore wind—are now the lowest-cost options for new power generation globally. Cost reductions over the past decade have shifted the economic balance away from fossil-fuel generation, with most new renewable projects producing electricity at significantly lower costs than new coal or natural-gas plants.

For example, utility-scale solar photovoltaic and onshore wind in particular have reached very competitive cost levels, with solar PV electricity estimated to be approximately 41 % cheaper and onshore wind around 53 % cheaper than new fossil-fuel generation. These technologies have therefore become among the most economically attractive options for expanding electricity supply in many countries.

The feasibility of phasing out fossil fuels at the sector level is also illustrated by our work on the topic or real zero[12] pathways –i.e., pathways that lead to the complete elimination of fossil fuels-:

- A **fossil-free power sector** could be achieved by around 2040, with multiple IAM frameworks indicating that this transition is feasible during the 2040s. Because electricity is a key driver of decarbonization in many other sectors, the rapid transformation of the power sector is essential for enabling a fossil-free energy system overall. Wind and solar power are expected to form the backbone of such a system, with large-scale energy storage becoming essential at generally the last 10-20% of eliminating fossil fuels.

[11] https://www.irena.org/Publications/2025/Jun/Renewable-Power-Generation-Costs-in-2024 and https://www.iea.org/reports/renewables-2025/renewable-electricity

[12] https://climateanalytics.org/publications/real-zero-is-within-reach

- F**ossil-free trucking** could be achievable as early as 2040 in leading regions, particularly Europe, with global fossil-free trucking achievable by 2050. Electrification is the dominant lever for achieving a fossil-free trucking sector due to the clear economic and technical advantages of electric vehicles over alternative zero-emissions technologies in the majority of use cases.
- A **fossil-free steel sector** could occur by 2050 or earlier. Achieving this transition would require rapid deployment of zero-carbon technologies in primary steel production, with green hydrogen used as a reducing agent emerging as the leading option. Alongside expanded secondary steel production, green hydrogen and renewable electricity will be key drivers of a fossil-free steel sector.
- **International shipping** could reach a fossil-free state by 2050, with both IAMs and sector-specific studies identifying this as technically feasible. Ammonia emerges as a particularly promising zero-carbon fuel, although other options—including direct electrification for short-distance routes and biomethanol—could also play important roles.

Cooperation at the center of phasing out fossil fuels

The question therefore remains: if phasing out fossil fuels is feasible and, above all, essential to avoid the worst impacts of Climate Change, why do nations still struggle to move forward? International forums such as United Nations Framework Convention on Climate Change (UNFCCC), along with efforts by the conference presidency to catalyze action, must strengthen international cooperation to address the key barriers preventing a fossil-fuel-free future from becoming a reality. The most significant of these barriers include the following:

- **Dependency and reliability.** Many countries rely on fossil fuels not only for their economic importance but also to ensure stable energy supply. Fossil fuels contribute significantly to GDP, government revenues, exports, and foreign exchange, and in some cases help service public debt. Rapid phase-outs could therefore strain budgets and external balances. At the same time, energy systems require constant supply, while renewables like solar and wind are variable. Unless sufficient storage, backup capacity, and grid infrastructure are developed, fossil fuels will remain essential, reinforcing structural dependence and slowing the transition.
- **Financial constraints.** The transition is also limited by financial barriers linked to existing infrastructure and investment conditions. Long-lived fossil-fuel assets create risks of stranded assets if retired early, discouraging rapid change. Meanwhile, shifting to renewables requires substantial upfront investment, including in supporting infrastructure and storage. The pace of this transition depends on the cost of capital, which is often higher in developing countries and further increased by policy and market uncertainty. Unclear or inconsistent policies raise investor risk, leading to higher required returns and slower clean energy investment.
- **Political resistance and lobbying.** Fossil-fuel industries often have significant political influence due to their economic importance and employment impact. Companies may lobby governments to delay or weaken climate policies that restrict fossil-fuel production or consumption. At the same time, politicians may resist rapid transitions

due to concerns about job losses, higher energy prices, or electoral consequences. This political resistance can slow the implementation of policies aimed at phasing out fossil fuels.

Coordinated action, shared commitments, and collaboration across countries in an expansion of a fossil-free energy trading system depending on cross-border electricity and green hydrogen, ammonia and industrial commodities, are crucial to overcome these barriers. In advancing discussions for a roadmap to phase fossil fuels, cooperation could seek to accelerate the existing expansion of renewable energy sources and seek the full electrification of end use sectors by:

- Developing credible national pathways for a just, orderly, and equitable phase-out of fossil fuels, with clear benchmarks, sequencing, and evidence on technology, costs, and feasibility.
- Strengthening the evidence base on the development benefits of transition, including energy security, health, jobs, fiscal resilience, and long-term competitiveness.
- Reducing the cost of capital and mobilizing investment through coordinated policy reform, concessional finance, guarantees, and other de-risking tools.
- Addressing fiscal, macroeconomic, and debt-related dependence on fossil fuels, while supporting diversification and managing stranded-asset risks.
- Building public support through transparency, social dialogue, and coordinated efforts to counter misinformation and undue fossil-fuel lobbying influence.
- Reforming fossil-fuel subsidies and aligning international public finance away from unabated fossil fuels and toward clean energy and social protection.
- Supporting just transition measures for affected workers, communities, and fossil-fuel-dependent regions and economies.
- Expanding cooperation on enabling infrastructure, technology, regional grids, storage, and clean-energy supply chains.
- Improving transparency, common metrics, and accountability for phase-out planning and implementation.

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