MEDRC

Water | Environment | Peace

Issue 20

Climate Finance for Net Zero *2030-2050*

Climate Finance for Net Zero

"It is not just about inventing new solutions but about transforming our relationship with the planet. We must shift from a paradigm of exploitation to one of stewardship. This requires profoundly rethinking how we produce, consume, and live within the limits of our planet." - Johan Rockström

Shared Goals:

Climate targets of +1.5°C are slipping out of reach. The pathway to Net Zero requires an economic transformation, alongside continued growth and development. Climate finance will be key to achieving each of these goals.

Introduction

Good news & bad news

The year 2024 has been another historic year for the climate and for climate finance. New agreements have been reached, pledges have tripled in size, and major polluters may this year reach their peak emissions, years ahead of schedule.

Meanwhile, the World Meteorological Organization (WMO) issued yet another *Red Alert* due to the sheer pace of climate change being observed, with January to September of 2024 being the hottest months on record, with a global mean surface temperature of +1.54° Celsius above the pre-industrial average (1850-1900). In effect, the 1.5°C barrier has already been broken, due in part to a seasonal El Niño effect. However, to have truly failed the goal of the Paris Agreement's temperature targets, this measure would need to be exceeded for a decade or longer. No one or more individual years count, but the overall trend. This trend, however, is going in the wrong direction.

This release of this report coincided with the 29th Conference of the Parties of the UNFCCC, COP29 in Baku, Azerbaijan. The latest COP was mired in some controversy, with boycotts from Papua New Guinea to France, some global political grandstanding, leading to open questions like, *"Was COP29 in Azerbaijan a Failure?"*, as well as an 11th-hour agreement for a new $300 billion USD climate finance deal. The frustration with COP and its painfully slow progress is warranted.

There is good news as well, renewables are being installed at historic rates, outpacing all estimates again, while costs continue to fall year over year. Solar is becoming so cheap that panel producers face financial challenges, with 98% of panels coming from China. More panels were installed there in 1 year, than in the history of the United States. So much renewable capacity is coming online, the choking points are the queues for grid connections, or the ships for offshore wind installations. These are good challenges for the climate on the Net Zero pathway.

The financial cost of this global socio-economic transformation into a decarbonized Net Zero economy is a matter of intense debate from both advocates and skeptics. Estimates range from $3 trillion USD per year to $12 trillion USD per year or *more*, due to the inherent challenges of modeling so many factors so far out. Alongside this Net Zero cost, is the bill for climate equity and justice, decided to be $300 billion a year going forward, according to COP29.

Another cost is that of loss and damage, which increases in its potential year after year with a delayed transition. A new fund set up just for this purpose will be hosted by the World Bank, but no one is admitting liability. While some countries race ahead to transform their own economies and shore up energy security, others are being left behind, particularly with respect to adaptation requirements.

As 2024 ends, the two hottest years and hottest months of recorded history have been 2023 and 2024, with the top 10 years all in the last decade. Signs that even the IPCC's projections of warming pace may be too conservative. Climate tipping points lay ahead. The costs of action and inaction must be weighed and balanced between those able to pay.

This issue will explore the field of Climate Finance since our previous issue in 2019 to now in 2024, and the global progress towards Net Zero with a look ahead to 2030-2050.

Practical Summary

- The Paris temperature targets are already being exceeded, while emissions have slowed and advanced economies have peaked, thanks to large increases in renewable energy. Continued pace is necessary, alongside rapid rollout of CDR technology at scale.
- The greatest share of progress has been dominated by China's exponential growth in renewable energy capacity, but structural challenges remain, with risks of backsliding progress and continued emissions growth despite these efforts.
- Climate finance flows to developing countries have finally reached their promised levels, and new higher targets are welcome. The pace of this rollout must also increase, with a greater focus on addressing climate justice as well as solidarity among all countries.
- Additional spending of ~$3 trillion USD a year is likely necessary to achieve Net Zero, while also rapidly phasing out coal and fossil fuel subsidies, with mandates for carbon capture tied to new fossil fuel investments from 2030-2050.
- The cost of reaching Net Zero by 2050 is directly linked to the 1.5°C and 2.0°C temperature targets, with higher near terms costs. Climate tipping points approach critical levels from 1.5°C to 3.0°C, which would further accelerate warming increasing the costs of loss and damage.
- In MENA and the GCC, states are lagging behind in their Net Zero targets and strategies, despite increased risks and higher potential climate impacts, while also having a greater ability to respond in the richer gulf states. Less prepared states need increased support, funding, and innovative approaches that swap debt for climate.

State of the Climate & Need for Net Zero

Five years have passed since our briefing on Climate Finance in November 2019, with another five until we reach the global climate benchmark of 2030, whereby global emissions should have nearly halved from their 2010 levels. Today, they have likely not yet peaked.

These climate benchmarks are mile markers on the road to Net Zero, set for the purpose of limiting the accumulation of CO_2e in the atmosphere that contributes to average temperature rises, with targets of +1.5°C and +2.0°C. For more background on these targets and their history please see our previous briefing series on *Transboundary Carbon*.

Paris Temperature Targets—
In 2019, the average atmospheric CO_2 concentration measured at Mauna Loa Observatory in Hawaii, USA, was approximately 411 parts per million (ppm), per the National Oceanic and Atmospheric Administration (NOAA). The 400ppm marker was first crossed in 2013 as a daily average, and as an annual average in 2015, and is a level that has not been seen on earth in at least 800,000 years according to ice core data.

In December 2024, atmospheric CO_2 concentrations are 426ppm, continuing to rise at around 2.5ppm per year. The pre-industrial era baseline was just 280ppm, showing a rapid change in the past 250 years due to human activity.

These concentrations directly translate to temperature changes, which the Paris climate agreement is centered around. In 2019, the average global temperature anomaly (difference today from baseline) was +0.95°C from 13.9°C, the second warmest on record at that time. All of the top-10 warmest years on record have now occurred since 2014, with 2023 holding the current record of +1.18°C for the full calendar year. September 2023 reached an anomaly value of +1.44°C for the largest positive monthly global temperature anomaly on record, per the NOAA. In 2024 as the year draws to a close, the second hottest November on record (surpassed only by Nov. 2023) at +1.34°C gives a 99% likelihood that 2024 will break the 2023 record with a ~+1.28°C anomaly for the year.

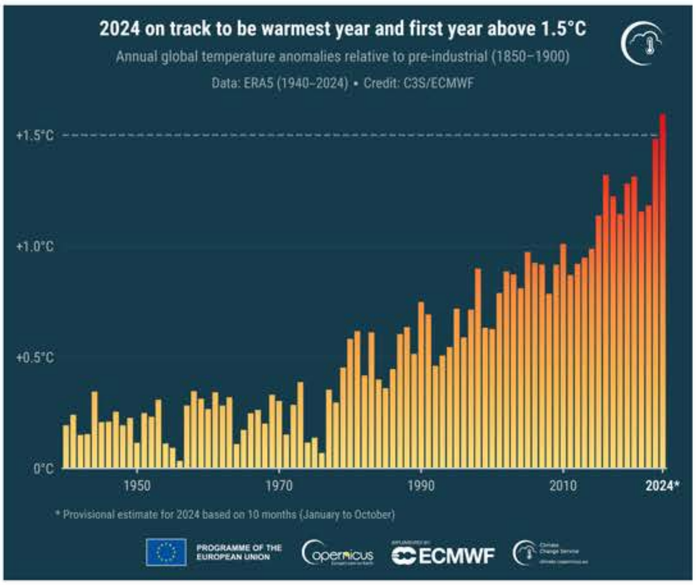
Another measurement source, the EU's Copernicus Climate Change Service (C3S), recorded 2023 to be +1.4828°C, and estimate that 2024 will be +1.5957°C.

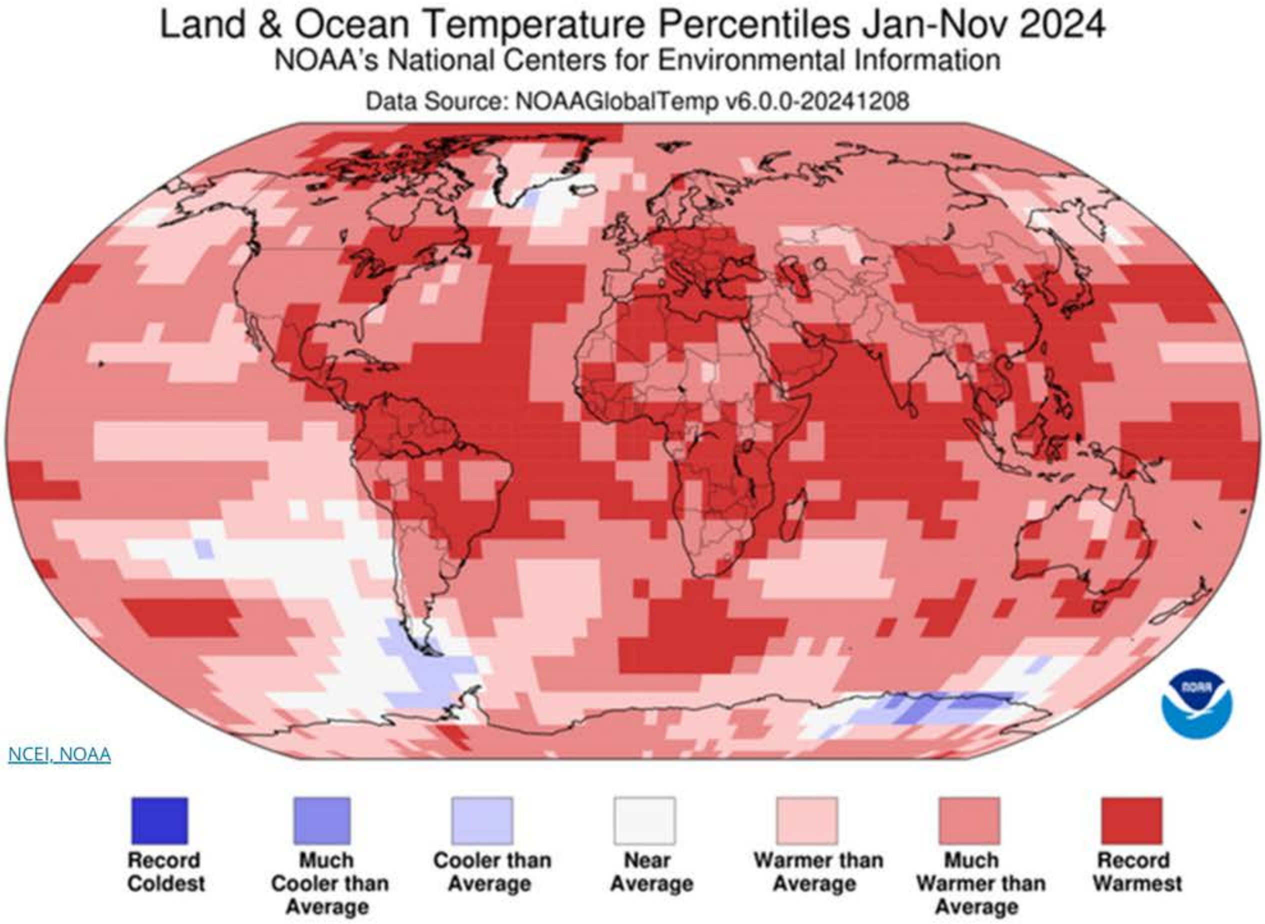
Global temperature averages and targets can be very unintuitive to grapple with as averages and durations vary. While oceans may have warmed +0.9°C, the land may have warmed +2°C at the same time. One region can show +1°C, another +2.5°C, while one month's average can be higher and another's lower, the comparison might be to 1850-1900, or 1991-2020. So what does it really mean to cross the +1.5°C 'barrier'?

Ultimately, the climate is not the daily weather, though often used as a political tool to downplay climate risks or as a reason to defer action. What matters is the trend, and the global average anomaly is just one measurement tool to keep in context the fluctuations regionally and through seasons—signal versus noise.

El Niño and La Niña periods (warm & cool respectively) also cause natural variabilities that need to be considered. For 2023 and 2024, from September to April, the planet was in an El Niño period, or a warm phase of the El Niño Southern Oscillation (ENSO), forming from June 2023 and dissipating in May 2024. Currently, the earth is in an ENSO 'neutral' period again and in a La Niña 'watch'. This is considered to be late by the NOAA and is likely to be a weak event.

In short, the +1.5°C barrier has been 'crossed' briefly already (and +2°C on land, +2.5°C in the arctic), but the annual global average has not quite yet, but will soon, regardless of any actions today. This is due to the delayed onset of atmospheric CO_2e accumulation and why a daily average and monthly average precedes an annual average. If all emissions stopped today, we would still see continued warming as carbon cycles through the planet. Which is why emissions must peak as soon as possible, and then lower back to 'Net Zero'.





NCEI, NOAA

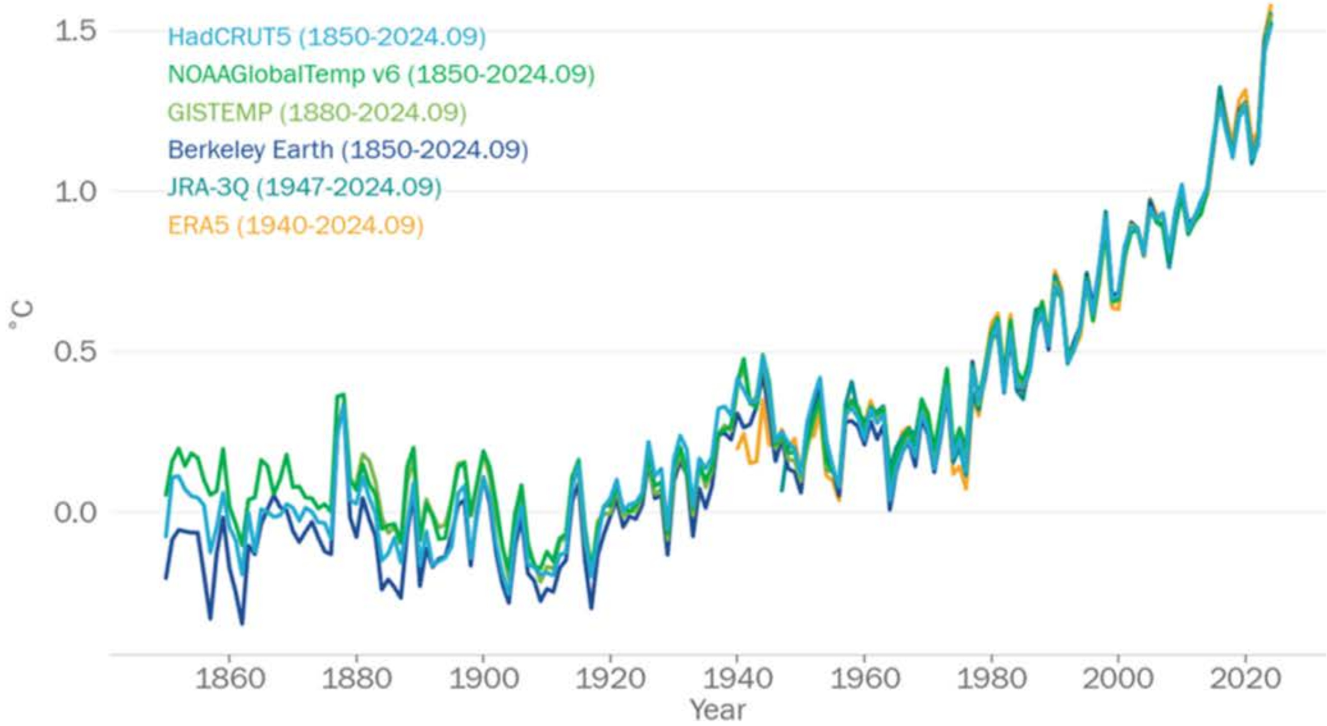


Figure 1: Annual global mean temperature anomalies (relative to 1850–1900) from 1850 to 2024 from six datasets. The 2024 average is based on data from January-September.

Climate Tipping Points—
So why do these temperature targets and timing benchmarks matter? There are seven major climate systems that are at risk of breaking down as temperatures rise, known as climate 'tipping points':

1. Mass death of coral reefs— *+1.5-2°C*
2. Abrupt thawing of permafrost— *+2-2.5°C*
3. Collapse of Greenland ice— *+2-3°C*
4. Breakup of West Antarctic ice— *+2-3°C*
5. Sudden shift of West African monsoon— *+3-3.5°C*
6. Loss of Amazon rainforest— *+5-6°C*
7. Shutdown of Atlantic Current— *+6-8°C*

Each of these risks deserve their own briefing on their impacts and the potential to be irreversible. As we can see, each are predicted along a sliding scale, with increasing likelihood with further warming, and may act as their own accelerant like thawing of permafrost.

Preventing these tipping points requires limiting warming and to stop adding emissions to the atmosphere that use up the global carbon budget. To limit the anomaly below 1.5°C is considered aspirational, and is already highly unlikely at the current pace of transition. From ~40Gt to Net Zero would need to happen before 2030, let alone 2050. While 2.0°C is still within reach, the potential of accelerated warming would upend all climate models currently underpinning global policy decisions.

Peak Emissions—
The top 10 countries for emissions today are China, the United States, the European Union (27), India, Russia, Japan, Iran, Saudi Arabia, and Indonesia. While some of these states emissions have peaked and are continuing to decline, others have not yet peaked, and do not actually plan to in the near future either.

The latest annual data for 2023 shows global energy-related emissions continued to increase, by 1.1% to 37.4 billion tons, with ***65%*** of this increase coming from more coal usage, and a drop in hydropower due to droughts. So while emissions did not peak in 2023-24, it is possible that major emitters like China are well ahead of schedule. Furthermore, the decoupling of GDP growth from emissions growth in advanced economies continues, with the U.S. down nearly ***20%*** from a 2007 high, and collectively advanced economy emissions are now lower than they were in 1973, continuing on a structural decline. Weak industrial performance data is a headwind however, that could indicate this trend slowing if activity had been higher.

Decarbonization—
To finally reach peak emissions and bend the emissions curve the global economy needs to decarbonize. Climate financing is key to making this vast economic transition and address social changes.

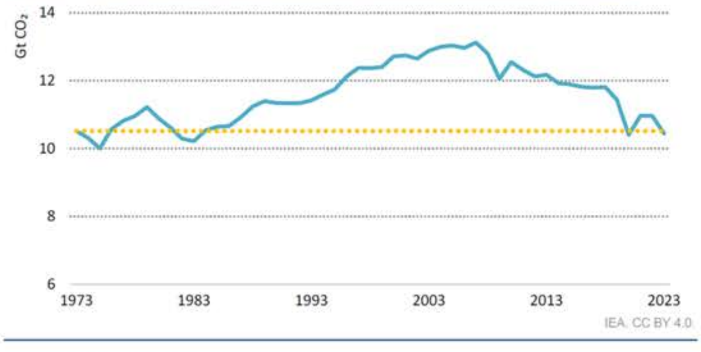
In the race to transition economies towards Net Zero the vast majority of emissions come from the use of fossil fuels for electricity, transport, and heat, at over 70%. Investments in renewable energy capacity from 2010-2019 were led by China ($758bn USD), the U.S. ($356bn), Japan ($202bn), Germany ($179bn) and the UK ($122bn). Since 2019, China has continued to surge and lead the way, while the U.S. has made significant increases in investment along with the EU. At the same time, the growing demand for electricity has led China as well as Germany to build new or bring back coal-fired power plants to meet this rising demand.

The decoupling of economic growth and GDP from emissions is critical for developing and middle income countries, particularly those with very large populations that deserve increasing qualities of life.

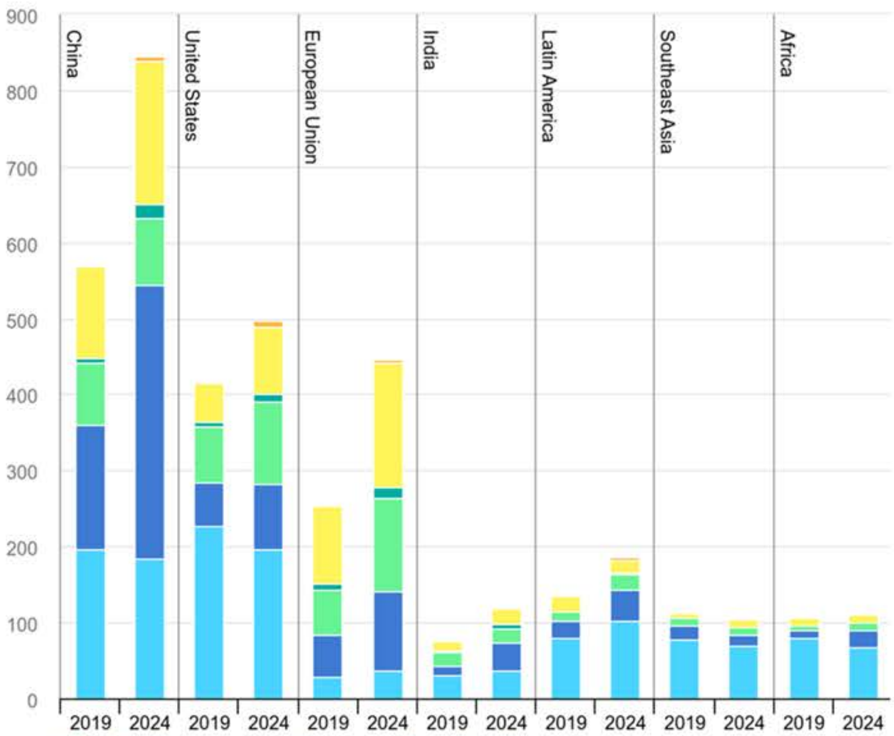
A key to achieving decarbonization is having clear mandates and a strategic direction, particularly with respect to physical infrastructure investments and asset phase outs. An 'orderly transition' pathway that sees assets being replaced in due course with a decarbonized option will likely fall short if more polluting options are still available and cheaper in the nearer term. Policy needs to be at least a 'nudge' in this direction, to set clear business and investment expectations. This can include rapid coal phase outs, electric or fuel-cell vehicle requirements, and updated standards like the use of green ammonia in fertilizers.

The other side of 'Net Zero' that will be critical is the rapid rollout and scaling of CDR technology, from 1 Gt to up to 10 Gt per year as soon as possible.

Figure 7: **CO_2 emissions from combustion in advanced economies, 1973-2023**



IEA – CO_2 Emissions in 2023



IEA – [Annual investment in clean energy by selected country and region, 2019 and 2024]

Renewables—

China has stormed to the front of the renewables world, dominating the supply chain and adding more capacity each year. This was not done overnight, but took a strategic approach in building up a domestic solar market, subsidizing producers to make them more competitive and weather through financial losses—much to the frustration of the EU and US. The draw for China's renewables push is not just climate related however, but tied to its energy security and lowering reliance on imported fossil fuels.

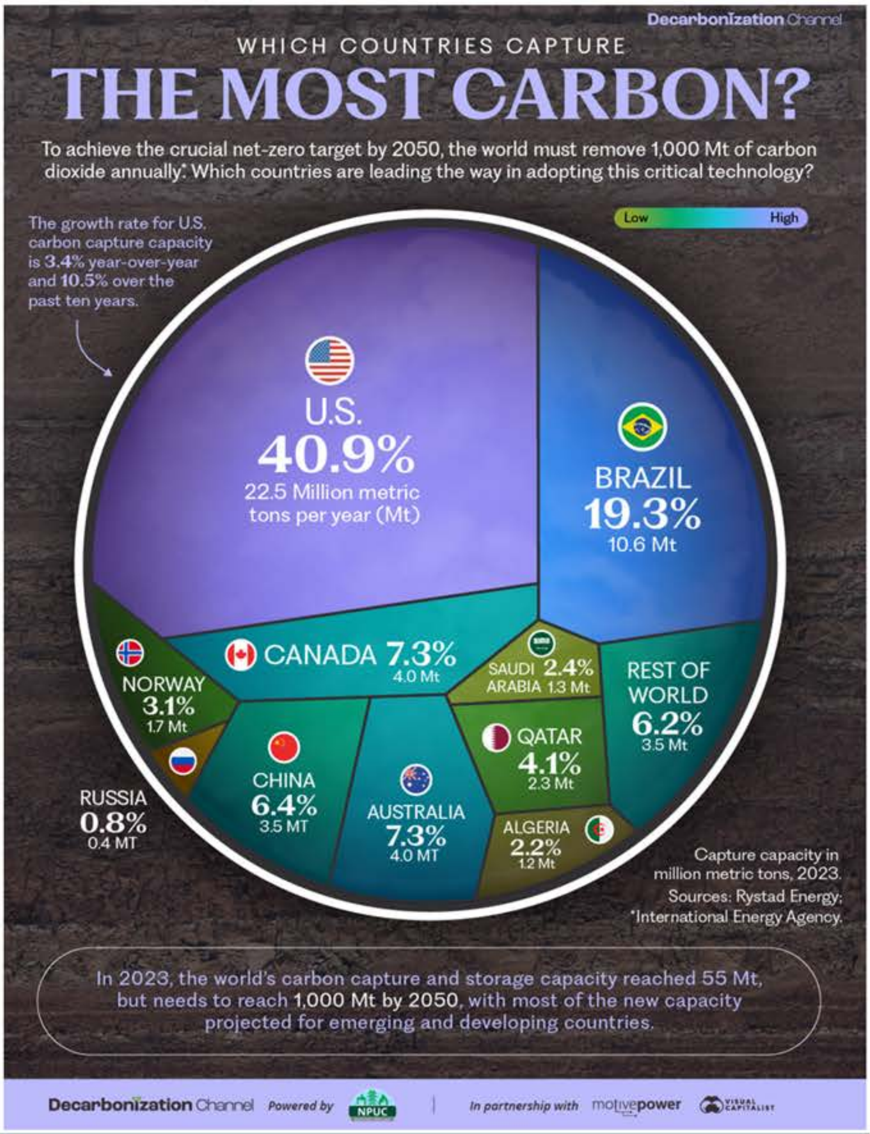
Globally the world now invests 2x what it does in fossil fuels annually, but still, nearly $1 trillion USD a year is put towards new fossil fuel infrastructure, and more to fuel subsidies. A 3x increase in renewables is needed to stay on a Net Zero pathway, while oil and gas become more niche fuel sources.

Carbon Removal—

In addition to cutting emissions and increasing efficiency throughout supply chains globally, getting to Net Zero will require a large-scale increase in novel carbon removal solutions, or CDR. Hydrocarbons will still be necessary in a Net Zero world, just as plastics and chemicals will be.

In 2023, global carbon capture and storage capacity reach 55 megatons (Mt), but is still well behind pace to reach the *1,000* megatons (1Gt) per year needed by 2030-50. More likely, several Gt's of novel CDR will be necessary, in addition to the conventional and nature-based solutions that remove ~2Gt today.

Compared with the top emitting countries, the top carbon capturing countries are the U.S. (40.9%) at 22.5 Mt, followed by Brazil (19.3%), Canada (7.3%), Australia (7.2%), China (6.4%), as well as oil states like Qatar (4.1%), Norway (3.1%), and Saudi Arabia (2.4%). The rest of the world combined accounts for 6.2% with 3.5 Mt. Globally, CCUS grew at a rate of 6.6%, behind the pace necessary to reach Net Zero and the Paris temperature targets, while in China it's capacity tripled year-over-year from 1.1 Mt to 3.5 Mt.



Motive Power - [Decarbonization Channel]

State of Climate Finance

To assess the state of climate finance today and how it has progressed since 2019, we must review what counts as 'climate finance' according to the technical definition applied, which can be more narrow or more broad, depending on the goal in mind.

The IEA naturally defines it primarily in the context of investments towards clean energy transitions for the Net Zero pathway, both public and private cashflows towards renewable energy projects, increased energy efficiency, as well as low-carbon technologies (not necessarily *zero* carbon), and can be either mitigation or adaptation measures like batteries and grid resilience. The UNEP definition broadens this to include financial resources mobilized to support mitigation or adaptation to climate change, which may be renewable energy, or a forest restoration or conservation. Neatly stated by them, "Climate finance refers to all financial flows addressing the causes and consequences of climate change."

The OECD and UNFCCC outlook focuses on the transfer of funds from developed countries to developing countries, with the OECD tracking progress towards the COP pledges of $100bn in climate finance from developed to developing countries per year. National projects spent in-country are not relevant to this consideration but do matter towards reaching Net Zero. In 2023 alone, China spent $890bn USD on clean-energy investment domestically, which became the largest driver of its economic growth for the year. This investment is what makes the country the global leader in renewable energy today, but it should not be considered as climate finance. In fact, the second largest economy is still considered as a developing country by many metrics, including in GDP per capita. Still, China is making its own pledge of $100bn USD in 'green' climate assistance for developing countries, as part of its Belt & Road initiative, but this should also not be considered climate finance under the UNFCCC.

These definitions can be broadly viewed as similar but have key distinctions around a focus on energy (as the primary driver of climate change), or equity (to address the unbalanced impacts and responsibilities for climate change), or on market-creation by crowding-in private finance to catalyze and maximize investment flows. Which definition applies determines how we can measure progress towards policy goals, such as the $100bn a year promise of climate finance for developing countries.

This promise was materially reached in 2022, and was just tripled to be set at $300bn per year of financial flows from rich countries to poor countries to address climate change. There is still a question of whether these funds should focus on adaptation to climate impacts and building resilience, or on economic transformations towards a Net Zero pathway.

To clarify, there is broad climate finance—any funds from any sources directed to deal with the causes and impacts of climate change—and there is the COP 'climate justice' finance, the global development aid finance from developed to developing countries to mitigate their emissions and adapt to climate change. Climate Finance for Net Zero therefore is the financial, economic and social costs of transitioning and transforming to a Net Zero economy by 2050, in line with achieving the Paris temperature targets.

The global transition to Net Zero is a fundamental reorganization of the world economy from a carbon-intensive system to a decarbonized one. The state and trend of the climate is clear, and climate science shows the need for Net Zero to halt further warming, and the timescales involved before negative feedback loops start to take over. The scale of this transition and its timing are critical to preventing these climate tipping points. However, there is much debate about what it will actually cost, how to properly value this change, and how quickly the transition will happen.

Estimates of the cost for a Net Zero transition have ranged from an additional $1 trillion USD per year, to up to $12 trillion, or more. The wide discrepancies indicate the sensitivity of so many variables around unit costs, economic growth assumptions, and the pace of technological innovation. In practice, there are also the trade-offs of alternative choices, and that many investments pay for themselves over time. One estimate of loss & damage over 20 years from 2000-2019 is estimated to be *at least* $2.8tr, with 63% of this coming from the loss of human life. Meanwhile, the pledge for climate finance to developing countries has increased from $100 to $300bn, having just been met in 2022, two years late. Per CPI, the estimated losses by 2100 caused by warming beyond 1.5°C are ***5x*** greater than the cost of achieving it in the first place.

Next we will look at the updated climate finance figures since 2019, what the cost estimates for Net Zero say about modeling global socio-economic change, and how these realities are playing out in practice. First, a note on climate justice and finance.

Climate & Justice—

For developing countries 'climate justice' sits at the heart of the global response to climate change, demanding that the burdens of climate action be shared, in consideration of equity. Central to this is the recognition that developed nations, as the primary contributors to historical greenhouse gas emissions, ought to have a moral and historical responsibility to support still developing countries, which are also disproportionately affected by climate change. Such vulnerable nations, often having contributing the least to the problem, face the most severe consequences, with the fewest means to respond.

Funding from developed to developing countries has been a cornerstone of global climate negotiations for decades. In 2009, the Copenhagen Summit saw wealthy nations pledge $100bn USD annually *by* 2020 to support climate action in the developing world. Yet, the reality of these commitments has been disappointing. Some funds are counted through private investments and concessional loans rather than only direct grants, raising questions of fairness. For some small island states, this funding shortfall is not just a failure of diplomacy but a matter of survival.

The challenge extends beyond the raw numbers. Accessing climate finance often involves navigating complex bureaucratic processes, creating barriers for countries with more limited technical capacity. Even when funds are secured, their allocation can be inequitable, with some middle-income nations receiving substantial resources while poorer, more vulnerable countries are left behind. Furthermore, a significant imbalance exists in how these funds are used. The majority are directed toward mitigation projects, such as renewable energy initiatives, which may be attractive to private investors due to higher costs of capital. Meanwhile, adaptation projects—critical for helping communities withstand climate impacts—remain underfunded despite their urgency.

A particularly contentious issue in climate finance is the concept of loss & damage, and specifically liability. This refers to compensation for irreversible harm caused by climate change, such as the destruction of homes, the loss of cultural heritage, or the disappearance of ecosystems. At COP27, progress was made with the establishment of a Loss & Damage Fund, seen as a major win for developing countries. However, fundamental questions about how the fund will operate—who will pay into it, how much, and who will benefit—remain unresolved. Developed nations are hesitant to establish systems that could imply liability, while vulnerable nations are increasingly vocal about the need for financial redress. Part of this argument centers around knowingly doing harm, when the world became fossil dependent before the full risks to the climate were known. Undoing that dependency now cannot happen overnight, and many developing nations want the right to use cheaper and dirtier fuels now, in spite of knowing the climate impacts. So what is the equitable solution that takes into account historic responsibility, with an understanding of moving forward.

The use of loans in climate finance introduces another layer of complexity. For many developing countries, loans could exacerbate debt burdens that undermine their development goals. True climate justice then demands innovative and fair solutions, such as grant-based funding or debt-for-climate swaps, to ensure that climate action supports rather than hinders long-term sustainability.

Governance and accountability further complicate the picture. Transparent and inclusive systems are essential to ensure that climate funds are effectively managed and reach those who need them most. Without strong governance in place, the risk of mismanagement and inequity looms large, and funds will be wasted, not contributing to either development or climate action.

At its core, climate justice is about fairness, responsibility, and solidarity going forward. Ensuring that financial flows from developed to developing nations meet the scale of the climate crisis is not only a moral imperative but also a practical necessity. As we will see in practice, a few countries have received a majority of climate finance funds, while others very much in need have missed out. Bridging gaps in funding, addressing inequities in access, and strengthening international cooperation are critical steps towards a just transition to Net Zero.

In December 2024 the International Court of Justice concluded hearings on the legal responsibilities of states with respect to climate change. The case was brought by the Pacific island nation of Vanuatu, and seeks to establish an advisory opinion linking human rights and climate change through states actions and omissions, with legal obligations and responsibilities, as well as legal consequences. The United States, China, and Saudi Arabia argued against the case in court, in that current UN agreements are sufficient.

Climate Finance Flows—

In 2019, the OECD's tracking of developed to developing country climate finance stood at $80.4bn, driven by growth to $34.7bn from the multilateral public funds. In 2020, more incremental growth saw a total of $83.3bn for the year, followed by $89.6bn in 2021. Finally, in 2022, a total of $115.9bn was mobilized for developing countries, thereby hitting the target set back in 2009. However, each of these years' totals also featured between $13-14bn of private finance that was 'mobilized', or crowded-in. This is an important factor in financing the global transition, as public funds alone will not suffice. Yet without the inclusion of 'mobilized private finance', the 2022 total would then stand at $94bn, still including $2.4bn in export credits. So has this goal actually been reached?

For 2023, the 'climate justice' finance totals are not yet available from the OECD and double counting is possible, but it has likely reached a new record. For their part the MDBs claimed a 25% growth of funding to $125bn according to Reuters, but $74.7bn of this went to low and medium-income countries, with $50bn to high income. In addition, increases from the European Union at €28.6bn, and the United States from just $1.5bn to $9.5bn in 2023, likely achieved a new record high, again above the $100bn mark for developing countries in 2023. For 2024, a new agreement at COP29 sets out to triple this number to $300bn in support, per year, for developing countries.

Climate Finance Gap—

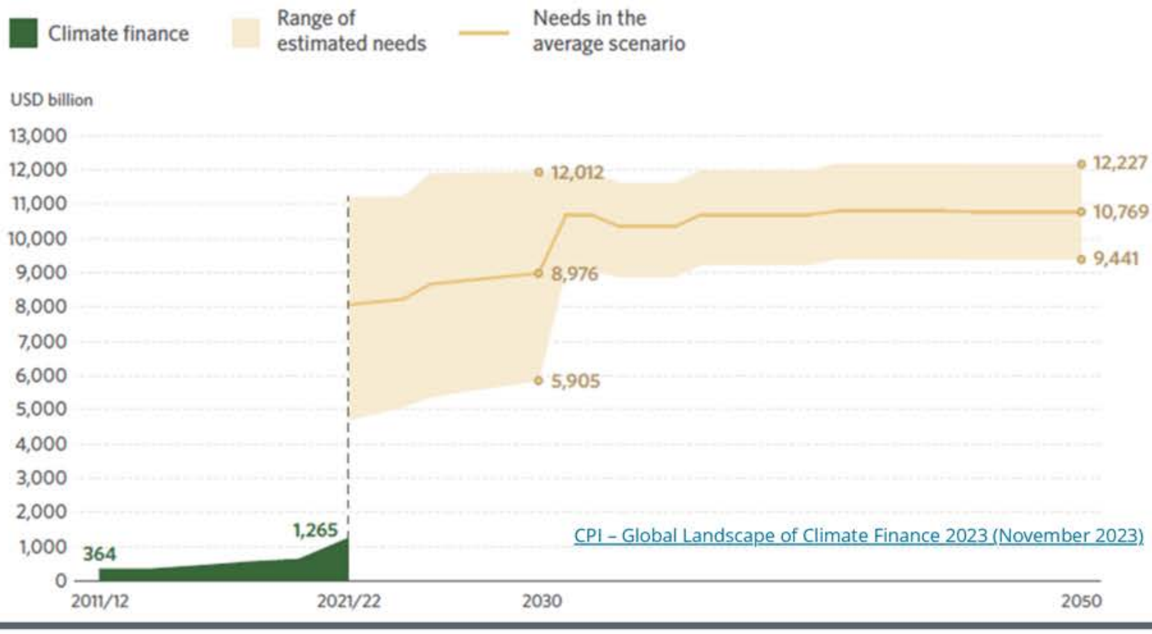
Aside from the developed to developing flows, there are major discrepancies between mitigation and adaptation projects. While carbon mitigation projects addressing the causes of warming directly are critical, more than ***17x*** the flows go towards mitigation than to adaptation, with $68bn vs. $1,171bn in 2021-2022 per CPI. Where again, the countries most in need of adaptation finance contributed the least to emissions.

In the generalized definition of climate finance, any funds used to address the causes or consequences of climate change, currently the world spends around $2tr USD on clean energy, leaving a gap of $2.4tr on mitigation by 2030, with another $300bn on adaptation, according to Moody's and the IEA. Meanwhile, another $1tr is still spent on fossil fuel energy infrastructure, plus subsidies for consumers.

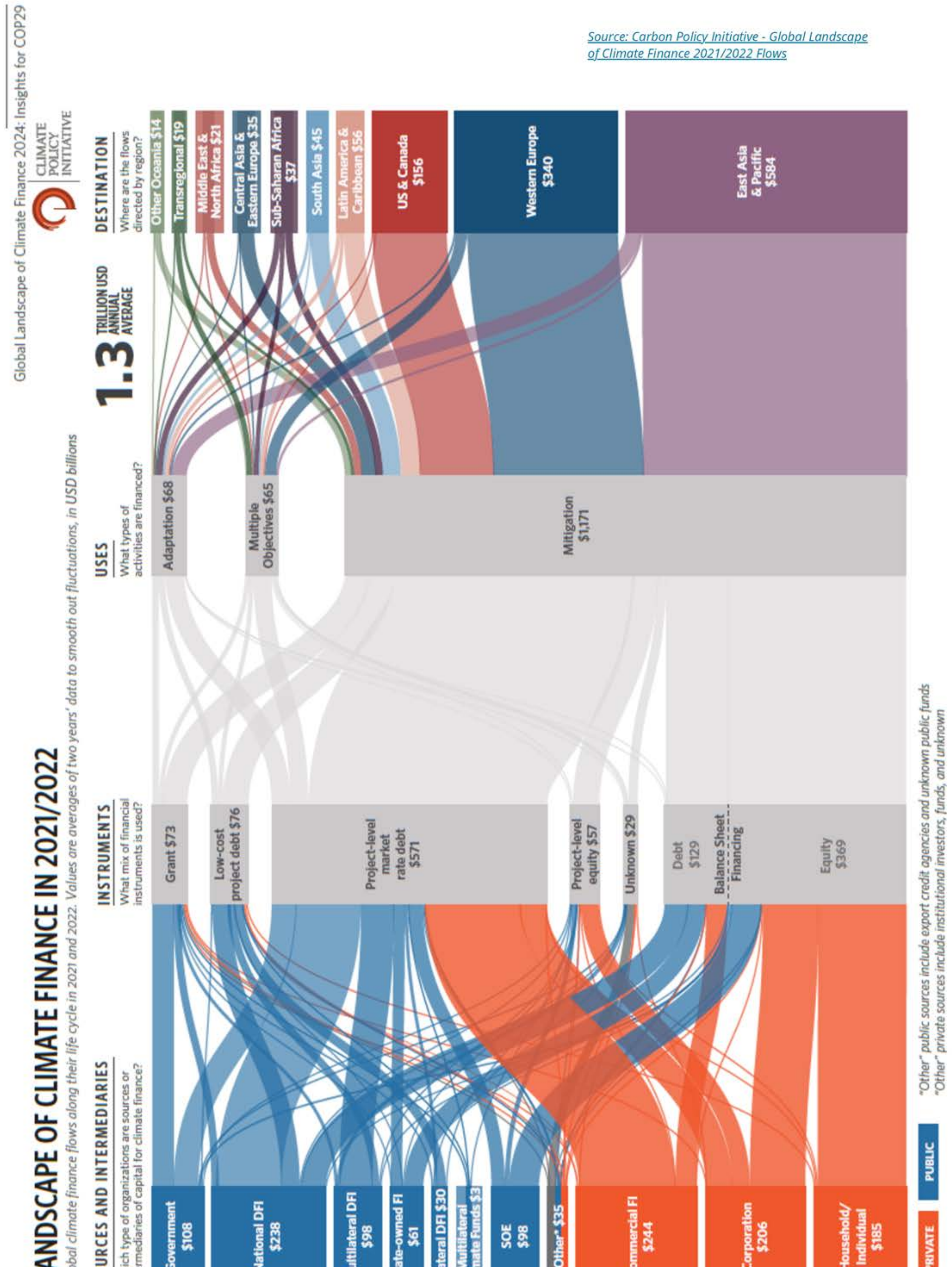
Ultimately the 'Climate Finance Gap' as it is often referred to is the Net Zero Financing Gap, and the climate justice finance for developing nations should be kept wholly separate, with an increased focus on adaptation projects, pure grants, or a cancellation of debt for climate mitigation projects.

The amount of funds it will take to reach Net Zero, as well as to stay under the 1.5°C & 2.0°C temperature targets, has made for wildly different estimates and been the subject of much academic debate, which can lead to more disappointing summits about the best way forward.

Figure ES3: Global tracked climate finance and average estimated annual needs through 2050[3]



CPI – Global Landscape of Climate Finance 2023 (November 2023)



[Source: Carbon Policy Initiative - Global Landscape of Climate Finance 2021/2022 Flows]

Climate Finance for Net Zero in Practice

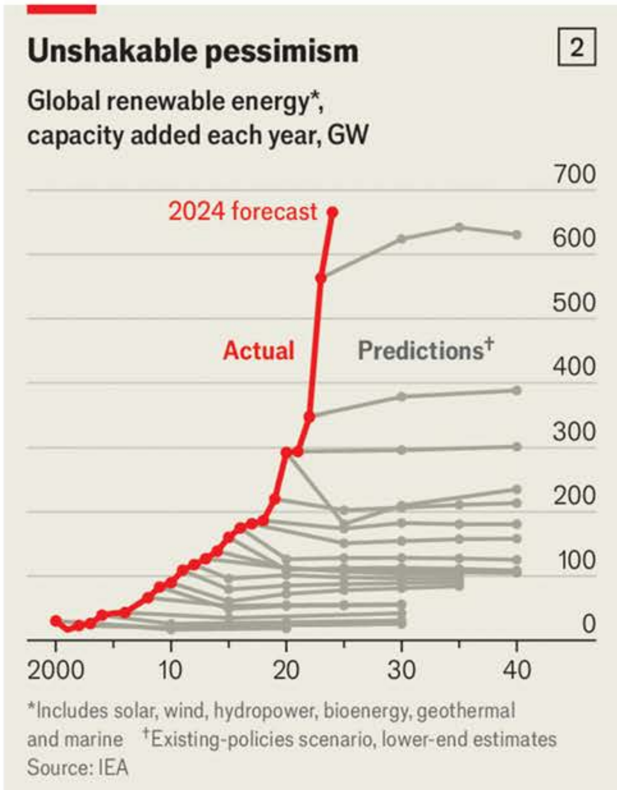
Net Zero Finance Gap—
So, what's the damage? What will it cost to achieve Net Zero? More importantly, at what time scale? Modeling the climate 80 years into the future is a difficult task, yet likely a more predictable and rules-based scenario than the modeling of collective human behavior and technology markets over the next 5 years or 25 years.

How much will the global economy grow, or particular countries with high populations and more limited renewable energy potential? What will the cost of a solar panel be in 10 years time? Will a solar project's assets last for 15 years, as estimated, or last less under actual working conditions? For these variety of reasons, the Net Zero climate finance gap has been estimated to be anywhere from an additional $1tr USD/year of new spending, along with shifting current spending from high-carbon to low-carbon ventures, to as much as $12tr a year. Two major points drive these varied estimations—which temperature target is trying to be met, 1.5°C or 2.0°C, and how quickly.

In November 2024, The Economist reviewed many of the underlying assumptions related to the global energy transition, and why it should be cheaper than we project. Key among them is the relative continuous pessimism about the roll-out of renewable energy year after year. Most predictions have generally been flat, assuming a certain saturation of markets and bottlenecks in roll-out that have actually been mostly overcome, and at an accelerating rate. As a result, the cost of solar panels have dropped rapidly, and the amount new global energy capacity added each year has been more exponential rather than logarithmic.

As the marginal costs of renewable energy and decarbonized solutions continues to fall, the long-term operating cost and efficiencies of renewables should make them inherently more attractive and help lead to their wider adoption as the most economic choice.

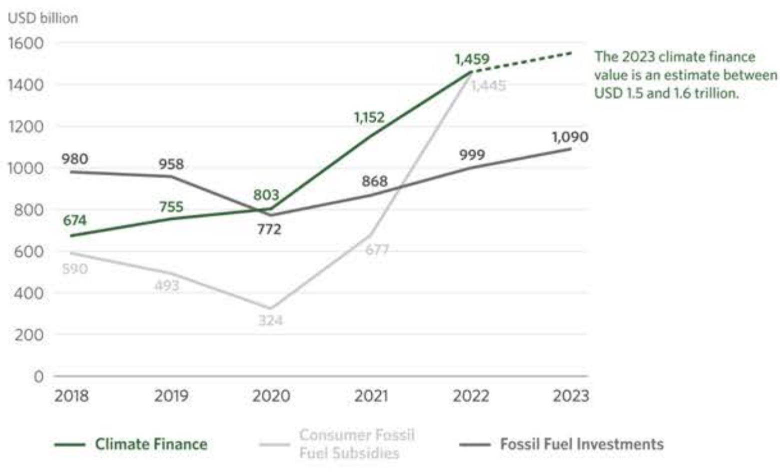
Getting to this point however will require continued investment and clear implementation strategies to remove remaining barriers. If done, we should expect the transition to follow an S-curve of rapid adoption. Emissions can and will fall, but the question of sufficient pace towards Net Zero remains, and legitimate concerns of climate tipping points being triggered earlier than first anticipated.



The Economist - *The energy transition will be much cheaper than you think*

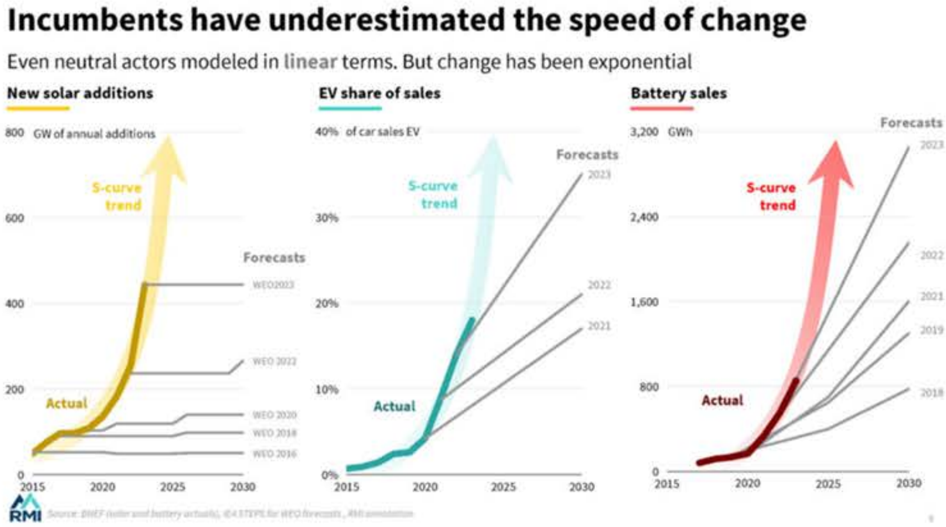
This chart from CPI's latest edition of the Global Landscape of Climate Finance shows a troubling trend that still continues. While climate finance flows continue to grow, from $800bn in 2020 to $1.5 and $1.6tn in 2022 & 2023, fossil fuel investments are also rising, albeit at a slower rate, while consumer fossil fuel subsidies, which directly lower the relative cost of fossil fuels against renewables (to say nothing of externalities), have more than *quadrupled*. Shifting away from fossil fuels must also mean shifting away from subsidizing the cost of them, and putting these funds towards renewables. To move from covering up negative externalities to promoting positive externalities.

Figure 2.1: Evolution of climate investment



Source: Climate Policy Initiative

CPI - Global Landscape of Climate Finance 2024



China picks up pace—

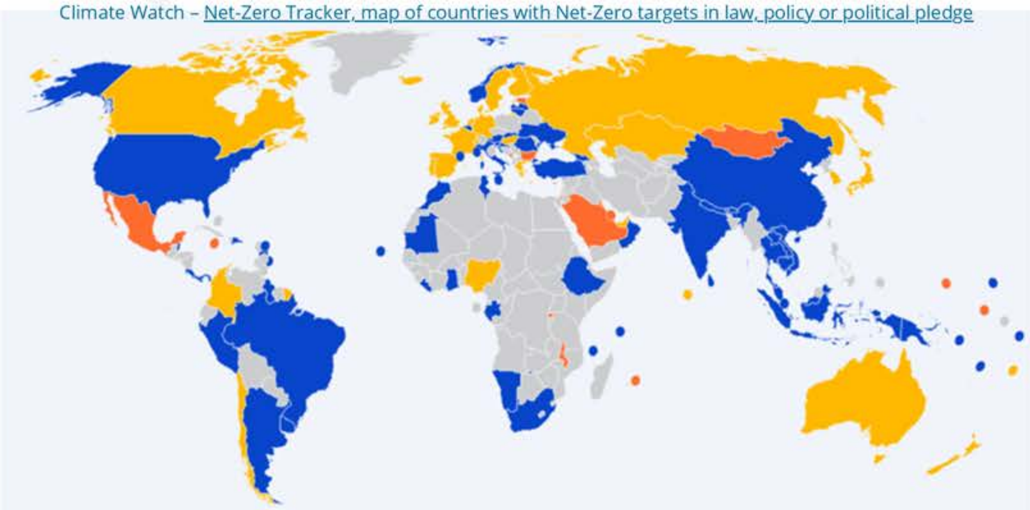
A decade ago, China's energy mix was dominated by over 66% fossil fuels, primarily coal, but today is now 50% renewable energy thanks to large investments in wind, solar, and high-voltage DC transmission lines. China is now building two-thirds of the world's wind and solar projects, and will have 1,200 GWs of installed wind and solar capacity by the end of 2024, or 6 years ahead of schedule. In effect, China is moving from the largest polluter and the biggest 'problem' in global climate action to the global leader.

Today, the U.S. energy mix is at 23% renewables, up from 20% in 2021. At that time, China's share was 28%, while the EU stood at 38%.

According to the Global Wind Report 2024, China also set a new record for new wind power installations with 75 GWs of added capacity, accounting for 65% of global new capacity in 2023, and the vast majority of APAC's 71% share. By contract, the Middle East and Africa combined made up just 1%.

Unfortunately, many of the countries most vulnerable to climate change impacts also have no official Net Zero plan, domestic laws, or even high-level political pledges. For these states, development of their economies overall is still the main concern, and their historic cumulative emissions begs the question why they should be forced to pay for this transition.

Climate Watch – Net-Zero Tracker, map of countries with Net-Zero targets in law, policy or political pledge



Model problems—

Discrepancies in forecasts of the cost of Net Zero have oddly united both climate advocates and climate 'sceptics', as they both agree it will be hugely expensive. For one side, it's all the more reason to move now, and save expenses later, while for the other, it's an expensive task that's hard to quantify, best to wait and see. And perhaps both are wrong.

Assumptions of global economic growth contained in such models can be simplistic, as linear economic growth has in fact been rapid and then slowing with maturation, which in turn produces declining population growth. Both factors would mean less emissions needing to be mitigated. Further, predicting the cost of technological uptake and subsequent price drops is tricky, as political interests and policies can interfere, while others fall rapidly with Moore's law. Finally, global investment in energy must happen regardless of its carbon intensity. Much of these costs are in fact shifts from one type of industry to another.

The final issue pointed out with such models, is that the speed of transition and emissions cuts are often overly quick, which will likely not match reality anyway, and increases the near term costs before leveling off, raising the 'sticker price' of Net Zero. This may be true, but the realities of month to month and year to year measurements are showing that the pace of transition is exactly the sticking point that global climate diplomacy is not sufficiently dealing with.

It may be a rather dangerous point being made, that since past projections of warming a decade ago were as high as +5°C, while now the outlook is +3°C, and thus trending down, as if on its own. But it is precisely because of progress and greater efforts being made as opposed to the business-as-usual at that time. It should be an indication to continue progress, rather than an excuse to slow down or scale back because models adjust over time.

The crux of the argument made is that 1.5°C is already out the window, so we may as well just aim for 2.0°C and base predictions and cost models on this alone. It may be correct that the transition to Net Zero will be cheaper than we expect, in terms of the technologies employed as they mature and reach scale. This does not account for the economic and social disruptions however, which will have their own costs, or to say anything about climate tipping points accelerating warming rates, ultimately rending current models wholly insufficient to track pace.

"when trying to decide what to do, it is of little help to demonstrate that achieving the impossible is impossibly expensive." - The Economist

"The IEA's modelling finds that reaching net zero by 2050 will require $5trn a year of investment in clean energy by 2030. That is more than twice the $2trn a year it reckons is currently going into clean energy and two-thirds more than its estimate of total current investment in energy. A similar scenario from BNEF involves $5.4trn a year this decade. McKinsey Global Institute, a research outfit, puts the annual cost of net zero by 2050 at $9.2trn; Wood Mackenzie at just under $3trn. UNEP estimates that a range of $7trn to $12trn per year will be needed by 2035 to limit warming to 1.5°C."

"Nonetheless, the outlook for the climate is improving. In 2015 the "Emissions Gap Report" the UN Environment Programme (UNEP) produces before every climate summit projected that, on the basis of policies then in force around the world, global average temperatures would be almost 5°C higher than in pre-industrial times by the end of the century. This year's report puts that number at just over 3°C. Other forecasters are even more optimistic: the IEA reckons current policies will yield around 2.4°C of warming. Bloomberg New Energy Finance (BNEF), a research outfit, thinks existing policies and the falling prices of green technologies will lead to 2.6°C of warming by 2050. Wood Mackenzie, a consultancy, is forecasting 2.5°C by 2100 as its base case.

None of these projections, however, imagine that the world will keep warming below 2°C, as the Paris agreement stipulates, let alone below 1.5°C, the supplementary target that signatories said they would try to meet. There is a wide range of views about how much investment is needed to meet these goals. Naturally, though, staying below 1.5°C is costlier than staying below 2°C. It is the cost of the 1.5°C target that typically gets the most attention."

Net Zero in the GCC—
For many of the GCC—Gulf Cooperation Council—countries, achieving Net Zero is particularly important and challenging, as they will be on the front lines of dealing with climate change impacts, and have been among the largest emitters per capita as oil and gas producing nations. Their economies will need to change drastically with many potential disruption risks, and increasing heat and droughts will challenge livelihoods and livability. Adaptation projects are perhaps equally important to mitigation projects, while their economies need to diversify away from fossil fuel industries. They are also generally high-income and high human development index (HDI) states, albeit with varying degrees of development.

Various 'Vision' strategies are seeking to both drastically transform the state's economy, building entire new cities and industries, while also achieving Net Zero emissions at the same time. Target dates for achieving these goals have been set for 2050 or 2060 for Net Zero, with economic diversification about a decade prior. Past experiences have already shown that mega-projects with mega-ambitions often have to be scaled back down to reality when costs overrun, and the economic fundamentals don't materialize.

Five GCC states have committed to Net Zero targets—Bahrain and Kuwait in a pledge or declaration, and Oman, Saudi Arabia, and the UAE in a policy document. Bahrain pledges to reduce emissions by 30% by 2035 and reach Net Zero by 2060. Oman's Vision 2040 seeks to first transform to a diversified economy by 2040, with 30% renewables by 2030 and achieving Net Zero by 2050 thereafter. Saudi Arabia has its Vision 2030 including the infamous NEOM series of mega-projects, and a later Net Zero commitment for 2060. Qatar has made medium-term commitments towards increasing renewable energy production and investments but does not have an official set date for its Net Zero target, though beyond 2050 is most likely.

The GCC states are among the most suited to respond and adapt to climate change, having among the highest cumulative per capita emissions, the highest per capita emissions today, among the highest GDP per capita and HDI scores, as well as among the lowest cost burdens to transition to solar and other renewables. They are responsible, capable, well-positioned, and stand to gain among the most from limiting climate change impacts. Will these visions become a mirage in practice?

Exhibit 6: Two examples of GCC countries pursuing green growth & reinventing ecosystems

Illustrative & non-exhaustive

	Oman	Saudi Arabia
Net Zero target year	**2050**	**2060**
Green growth opportunity (examples)	**Renewables & Green hydrogen (H_2), for domestic use & export**	**Carbon capture and storage (CCS)**
Competitive advantage	High solar radiation and wind speeds (est. renewable potential: 7,000 TWh/year), vast land, favorable location for global trade	Large & concentrated industrial clusters, vast geological CO_2 storage opportunities (e.g., oil & gas fields, aquifers)
Targets	**Renewables:** 20% by 2030, 35%+ by 2040 (Oman Vision 2040); **Green hydrogen:** 1-1.25 mn tons by 2030, 7.5-8.5 mn tons by 2050 (i.e. 2x today's LNG exports in energy-equivalent terms)	Jubail CCS hub will capture up to 9 mn tons of CO_2 per year from 2027 (Aramco: 6 mn tons per year; other industrial emitters: 3 mn tons). 2035 target: 44 mn tons captured
Ecosystem development	Created a **national champion** (Hydrom) to master plan the sector, developing **shared infrastructure assets** (H_2 pipeline, electricity grid, water supply, storage), advanced plans for domestic **green steel** cluster (fueled by green H_2)	Industrial emitters share **CO_2 transport & storage infrastructure**, reducing risks and cost while leveraging economies of scale
Estimated impact	**Costs:** Cum. capex by 2030 of >$33bn (>$20bn for renewables, >$13bn for electrolysis and ammonia conversion, see IEA) **Benefits:** +50% GDP by 2050 vs 2021 from hydrogen (2/3) and renewables (1/3); 20-30% increase in jobs (see National Strategy)	Build up of capacity of 44mn tons of CO_2 per annum will likely create tens of thousands of direct jobs, with even higher indirect job impact. CCS helps **extend 'license to operate' for high-emission industries** (e.g., chemicals, cement, metals).
Deals/Partners to date	**Hydrom runs open auctions** to award land to H_2 developers: 5 projects in Round 1, i.e. $30bn capex, 18 GW renewables, 750 ktpa H_2. Round 2 ongoing. **Potential offtakes** for >15% of 2030 export volumes so far (IEA, June 2023)	Partnering with SLB and Linde to build one of the **world's largest CCS hubs in the Jubail industrial zone**

Note: These are select examples. Other GCC countries are also exploring green H_2 and CCS (among others); some already have advanced targets as well as partnerships. Source: IEA 2023 (Renewable Hydrogen from Oman), Oman's National Strategy for an Orderly Transition to Net Zero (November 2022), Saudi Aramco, Hydrom, CCS Institute (2020) The value of CCS.

BCG - Net Zero Meets Green Growth in GCC countries

To ensure it does not, a top-down approach and careful monitoring are being pursued, particularly in Oman where a larger share of the native population will be driving this green growth transformation.

Green Hydrogen is a popular strategy for many of these economies, such as Oman and the UAE, which are hoping to use its oil and gas industry base and a blue hydrogen transition towards a future hydrogen ecosystem run on renewable energy. However, while there is huge potential for solar and wind renewables in Oman, they are yet to be built, and today just ***0.6%*** of the electricity grid share is made up of renewables.

In order to build out both massive *excess* gigawatts of renewable electricity, to be able to produce millions of tons of green H_2 (forecasted to be 8 million tons by 2050), while also electrifying other parts of the economy and decarbonize its expanding electrical grid for Net Zero, the country must invert its development history, and at a rapid pace. Producing 1 million tons of hydrogen requires ~6-9 GWs of electrolysis capacity and around ~10-16 GWs of renewable energy capacity, meaning a 60-fold increase to 40-60 GWs just to meet regional green hydrogen targets. Such a transition is possible for these nations, but requires clear strategic commitment and planning that is currently underway.

The green hydrogen economy will also be linked to 'green steel', as well as green ammonia and fertilizer industries, while being situated in a strategic shipping location. The orderly transition envisioned moves from the oil & gas sectors to hydrogen—from grey to blue to green—determined by the pace of its renewables roll out. For the rest of the economy, clear laws and policy direction will be key to changing consumer habits and channeling business investment.

In other parts of MENA, the climate finance for Net Zero market has been dominated by just two countries, with Egypt and Morocco at $1.2bn received, while no other has even $100 million. As shown on the previous map, much of MENA have not set any Net Zero targets and are playing catch-up, particularly as domestic challenges and economic growth are more pressing priorities than 2050 climate targets.

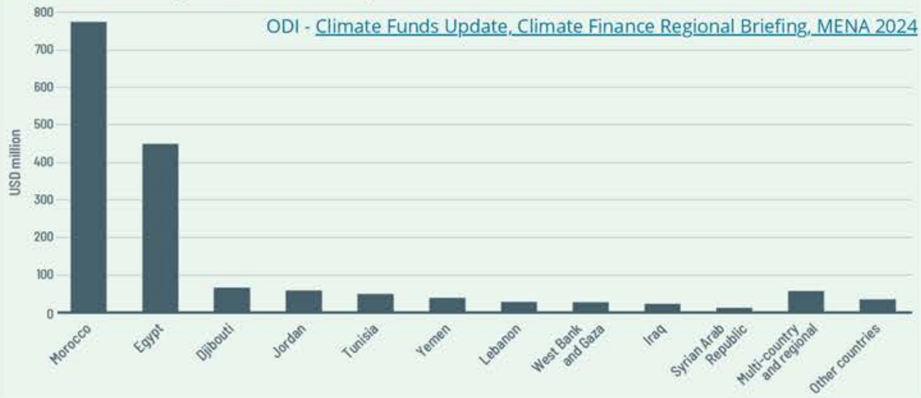
Recipient countries in the Middle East and North Africa

Table 1: Climate funds supporting the MENA region (2003–2023, USD millions)

Fund	Amount approved	Projects approved
Clean Technology Fund (CTF)	824.2	10
Green Climate Fund (GCF-IRM, GCF-1)	335.7	8
Global Environment Facility (GEF-4, 5, 6, 7, 8)	163.3	62
Adaptation Fund (AF)	101.2	17
Least Developed Countries Fund (LDCF)	44.1	9
Special Climate Change Fund (SCCF)	37.3	7
Global Energy Efficiency and Renewable Energy Fund (GEEREF)	16.6	1
Adaptation for Smallholder Agriculture Programme (ASAP)	14.6	4
Forest Investment Program (FIP)	12.0	1
Global Climate Change Alliance (GCCA)	11.6	2
Partnership for Market Readiness (PMR)	10.2	6
Millennium Development Goals Achievement Fund[3] (MDG-F)	7.6	2
Pilot Program for Climate Resilience (PPCR)	3.1	3
Scaling up Renewable Energy Program in Low Income Countries (SREP)	0.9	2

Figure 2: Amount approved for MENA recipient countries (2003-2023)

ODI - Climate Funds Update, Climate Finance Regional Briefing, MENA 2024



Glossary of Key Terms

Source: Convergence—State of Blended Finance, Climate Edition 2024

BLENDED FINANCE

The use of catalytic capital from public or philanthropic sources to increase private sector investment in developing countries to realize the Sustainable Development Goals (SDGs). Blended finance is a structuring approach, not an investment approach.

MITIGATION BLENDED FINANCE

The use of blended finance structures to deliver private sector investment to climate mitigation transactions in developing countries.

ADAPTATION BLENDED FINANCE

The use of blended finance structures to deliver private sector investment to climate adaptation transactions in developing countries.

CLIMATE BLENDED FINANCE

The use of blended finance structures to deliver private sector investment to transactions that explicitly aim to combat and/or respond to the effects of climate change in developing countries.

CLIMATE MITIGATION FINANCE

Climate mitigation finance channels investment toward interventions aimed at reducing the current level of GHG emissions produced by human activity to prevent the future consequences of climate change. It also includes investment in efforts to remove GHGs from the atmosphere, such as carbon sequestration.

CLIMATE ADAPTATION FINANCE

Climate adaptation involves channeling investment to efforts focused on adjusting to the already apparent and expected effects of climate change. These effects include, but are not limited to, rising ocean levels, increased ocean temperatures, more frequent and intense extreme weather events (hurricanes, droughts, monsoons), and irregular seasonality. Climate adaptation interventions are often linked to the concept of increased "resiliency" in human, biological, ecological, and geological systems. This includes resilient food systems, livelihoods, and natural systems, like biodiversity.

CATALYTIC CAPITAL/FUNDING

Financial instruments allocated to transactions with the intent to mobilize private sector investment. The definition of catalytic capital can vary widely. In this report, catalytic capital refers to financial instruments priced below market (concessional), with the intent to mitigate investment risks and/or enhance expected returns for private sector investors, deployed through one of Convergence's four blending archetypes:

-concessional debt/equity,

-concessionally priced guarantees/insurance,

-project preparation or design-stage grant funding,

-technical assistance grant funding.

CONCESSIONAL CAPITAL

Funds provided on below-market terms within the capital structure of a transaction to reduce the overall cost of capital for the borrower and/or provide additional downside protection to senior investors (e.g., in a first-loss position). Concessional capital can be provided through various instruments, including debt, equity, grants, and mezzanine capital.

NATURAL CAPITAL

The planet's stock of water, air, land, and renewable (e.g., wind, solar energy, forests) and non-renewable resources (e.g., mineral deposits). Natural capital refers to resources that provide ecosystem services supporting human activity.

CONSERVATION FINANCE

Investments that support the management of natural systems, including land, water, air, and natural resources. Conservation finance is distinct from climate adaptation finance, as it may also target climate mitigation outcomes and focuses exclusively on natural capital. Climate adaptation finance targets human systems impacted by climate change.

NATURE-BASED SOLUTIONS

Efforts to protect, manage, and/or restore ecosystems to address societal challenges like food insecurity, climate vulnerability, and public health. These solutions recognize that healthy ecosystems are critical for both natural systems and sustainable economic development.

JUST TRANSITION

Climate mitigation and adaptation efforts in emerging markets and developing economies that take other development goals into consideration to ensure equitable transitions to greener economies.

Sources for Further Learning

Net Zero Tracker – https://zerotracker.net/

Climate Funds Update (ODI) – https://climatefundsupdate.org/

NOAA National Centers for Environmental Information – https://www.ncei.noaa.gov/products/land-based-station/us-climate-normals

Copernicus Climate Change Service (C3S) – https://climate.copernicus.eu/

Key Reports

[1] State of Blended Finance 2024 – Convergence (April 2024) https://www.convergence.finance/resource/state-of-blended-finance-2024/view

[2] State of Blended Finance 2024, Climate Edition – Convergence (October 2024) https://www.convergence.finance/resource/state-of-blended-finance-2024-climate-edition/view

[3] State of Carbon Dioxide Removal, 2nd edition – State of CDR (2024) https://www.stateofcdr.org/

[4] Global Landscape of Climate Finance 2024 – Carbon Policy Initiative (CPI) (October 2024) https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2024/

[5] State and Trends in Climate Adaptation Finance 2023 – Carbon Policy Initiative (CPI) (December 2023) https://www.climatepolicyinitiative.org/publication/state-and-trends-in-climate-adaptation-finance-2023/

[6] Emissions Gap Report 2024: No more hot air… please! – UN Environment Programme (October 2024) https://www.unep.org/resources/emissions-gap-report-2024

[7] State of Finance for Nature 2023 – UN Environment Programme (December 2023) https://www.unep.org/resources/state-finance-nature-2023

[8] CO2 Emissions in 2023 – International Energy Agency (IEA) (March 2024) https://www.iea.org/reports/co2-emissions-in-2023

[9] World Energy Outlook 2024 – International Energy Agency (IEA) (October 2024) https://www.iea.org/reports/world-energy-outlook-2024

[10] Renewables 2024 – International Energy Agency (IEA) (October 2024) https://www.iea.org/reports/renewables-2024

[11] Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach, 2023 Update – International Energy Agency (September 2023) https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach

Acknowledgements

MEDRC's Transboundary Environments Practitioner Briefing series has been developed for industry practitioners and government officials at the request of MEDRC's member countries, with sponsorship provided by the Netherlands. The briefings are meant to be informative and practical, providing an overview of the subject matter material, while remaining accessible to various backgrounds and disciplines. The briefings serve to develop shared knowledge and serve as a basis for further discussions between partners. If you would like to learn more about these subjects, please see the section 'Sources for Further Learning'.

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