ALLEN & OVERY

CLIMATE POLICY INITIATIVE

How big is the Net Zero financing gap?

September 2023

Contents

Executive summary

The transition to a low-carbon, resilient, and just economy is the greatest investment opportunity of our lifetime. Institutions that are well prepared to embark on Net Zero pathways will be able to take full advantage of decarbonization-focused policy shifts and avoid being stuck with stranded assets.

Until now, however, no comprehensive estimate existed of the scale of that opportunity, (or, to put it another way, the size of the financing gap between committed spending and the investment needed to deliver Net Zero by 2050 across sectors and geographies).

Allen & Overy and Climate Policy Initiative have conducted this study to quantify the finance needed to achieve the Net Zero transition, shed light on the current funds available, and outline the roles different stakeholders can play in closing the gap.

Better climate finance data can enable investors and policymakers to identify the areas of greatest need and to align their efforts around the most promising opportunities, ensuring that financial and policy resources are being deployed to their greatest effect.

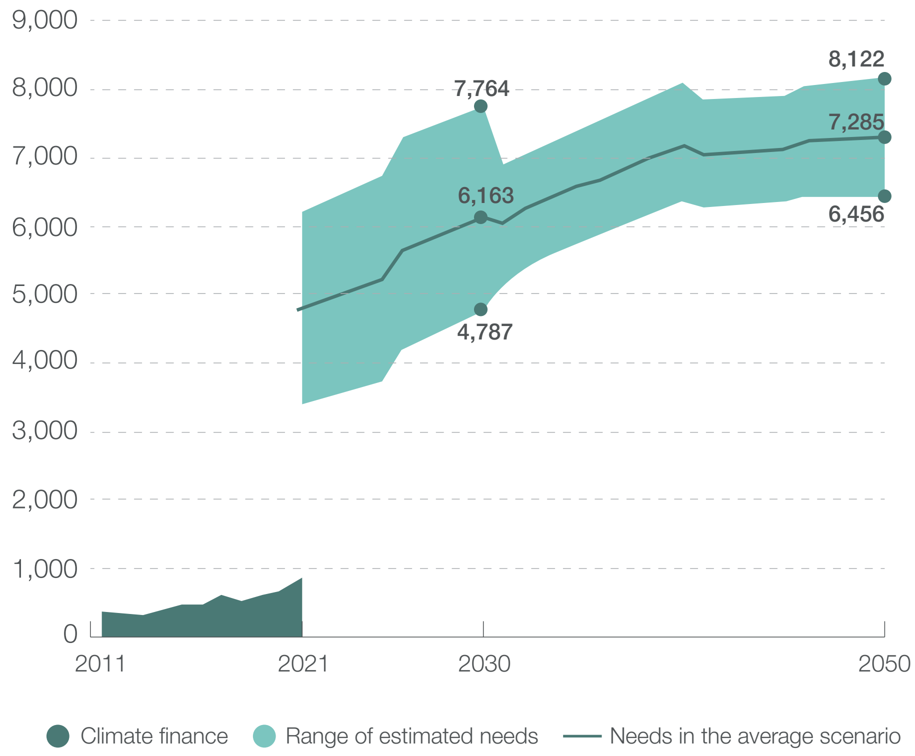
By making this data publicly available we hope to focus minds on the scale of the challenges and opportunities that lie ahead, while informing debate about how to accelerate financial flows to decarbonize the global economy and improve climate resilience.

Our study reveals the scale of climate finance required to deliver Net Zero

Climate finance flows have grown consistently over the past decade, but they still lag far behind what is needed to meet the goals of the Paris Agreement. Our study estimates that USD6.2 trillion of climate finance is required annually between now and 2030, and USD7.3tn by 2050, to deliver Net Zero – a total of almost USD200tn.

However, tracked global climate finance is only expected to pass USD1tn for the first time in 2022.

Figure ES.1: Global tracked climate finance and estimated annual climate finance needs through 2050 (USD million)



Source: Climate Policy Initiative

While the sums involved in decarbonization are substantial, the benefits are even larger. Some studies suggest that concerted climate action and investment could add net USD43tn to the global economy – equivalent to a rise of up to 4.4% in global GDP by 2070 – relative to business as usual.

Transport and energy require the greatest investment

The sectors with the greatest climate finance needs are transport (requiring 50% of the total estimated finance needs, or at least USD3.2tn annually through 2050) and energy systems (requiring 32%, or at least USD2.1tn annually through 2050). Huge increases in climate investment are also required to deliver building energy efficiency (to reach USD731 billion annually through 2050); decarbonize industrial processes (USD320.2bn); and develop clean energy storage solutions (USD251.3bn) and carbon capture, utilization, and storage (USD145.3bn).

Finance for climate adaptation and resilience is far below the estimated USD254bn needed on average per year through 2050. Further adaptation finance may also be needed given that the rate of global warming is accelerating faster than many scientists expected.

Action is required from both the public and private sectors

To rise to these challenges, both public and private actors will need to increase their ambition, efficacy, and coordination. Public climate finance has grown faster than private climate finance over the past decade, but this may change; multilateral development banks (MDBs) have publicly committed to increase their annual climate finance by just 32% annually through 2030, and only six of the 27 largest national and bilateral development finance institutions have set climate investment targets.

Given the scarcity of public capital, effective deployment of funding, policies, and frameworks will be crucial to mobilize private investment at the scale required. This is more urgent in regions where public money makes up a larger share of total climate finance; for example, public funding comprised 86% of total climate finance in Africa over the past decade, but just 4% in North America.

To scale private finance globally, public finance should be deployed to lower the cost of capital for private investors who, due to the respective risks, require a rate of return that is three to ten times higher in developing economies than in the EU or the U.S.

Private climate finance expected to grow in future

Research indicates larger future growth in private climate finance than public finance, given the amount of private capital in the global financial system and the fact that public finance will continue to remain scarce. For example, the 30 largest global banks have committed USD870bn annually to finance climate solutions, although asset owners and managers have been slower to set public climate investment targets.

Venture capital (VC) investment in businesses providing climate solutions reached USD70.1bn in 2022, 89% higher than the previous year, with climate-focused VC investors holding USD37bn in unallocated capital as of late 2022. Climate solutions businesses have been able to raise equity and debt capital relatively easily, though these companies' equity raising in 2022 was 40% lower than in 2021, in line with general reduced availability of capital in the second half of 2022.

Funding for mining of critical minerals – and manufacturing capacity – needs to rise

Investments in supply chain and manufacturing facilities for climate solutions rose to USD79bn in 2022, 44% higher than in 2021. However, this figure needs to increase by a further 58% to stay on a Net Zero pathway. Similarly, investment in the mining and processing of critical minerals must triple by 2050 to USD331.5bn annually to achieve this goal.

Neither public nor private finance can bridge the investment gap alone; collaboration and more effective use of financial resources will be vital to achieving Net Zero. Multiple gears need to move together to deliver the broader energy transition, with government policy and public money creating the environment for private investment to flow.

In addition, the scale and complexity of the financing needed to decarbonize the global economy will only grow if adequate funds are not deployed now.

Unfortunately, current climate regulation and policy is insufficient to meet the 1.5°C target set by the Paris Agreement.[1] Many governments do not have the necessary capacity or political backing to take the actions necessary, causing the financing gap to grow and preventing more rapid expansion of private investment.

There has been progress in recent years, but solutions with great potential impact, such as setting an explicit price for carbon commensurate with its impact on the climate, remain out of reach.[2] Developing comprehensive, negotiated solutions is hampered by politics and narrow national interests, making it harder to address multigenerational global common issues.

Against this backdrop, our research identifies a range of steps that can help close the Net Zero financing gap.

- Stakeholder alignment on policies to accelerate private investment that transcend short-term economic and political cycles and are designed to avoid investment in stranded assets. Public financial institutions should channel their funding to mobilize private finance and achieve higher impact, including by providing political risk support, guarantees to reduce foreign exchange risk, and liquidity to increase funding for less commercially viable sectors and regions.
- Policy and financial support to boost critical decarbonization technologies that are not currently commercially viable and for regions that receive less private investment.
- Emissions policies that smooth the path to Net Zero, accounting for the ongoing demand and negative externalities of demand for fossil fuels.
- Support for a just transition for communities reliant on fossil fuels or that will be impacted by a transition to low-carbon solutions, including through measures such as Just Energy Transition Partnerships.

In order to tackle any challenge, it is vital to first understand its scope. We hope that this research will provide a critical missing piece of the decarbonization puzzle.

Research methodology

Our research tracks climate finance to projects in the real economy that have mitigation or adaptation benefits, such as solar infrastructure and electric vehicles (EVs), or those that improve communities' resilience to climate change.[3]

It uses data sourced through CPI's Global Landscape of Climate Finance from several third-party providers, including BloombergNEF (BNEF), IJ Global, the Organization for Economic Cooperation and Development (OECD) and the International Energy Agency (IEA), as well as proprietary surveys of the activity of more than 50 development finance institutions (DFIs), including the major MDBs.

We have included all climate finance flows that are disclosed and can be reliably tracked without double counting. However, our analysis remains limited by a lack of disclosure of climate finance data in some areas, such as where figures are only available through to 2020. Data for 2021 and 2022 will be included in the next iteration. In the interim, we have used external estimates to fill these gaps where possible. More information on data gaps is provided in Annex 1.

Figures on annual climate investment needs are sourced from third-party estimates and analysis (including BNEF, the International Renewable Energy Agency (IRENA) and the IEA). Details on these needs estimates are provided in Annex 1.

Glossary of terms

Climate finance:

primary capital flows to low-carbon and climate-resilient infrastructure that serves (either directly or indirectly) to reduce greenhouse gas (GHG) emissions or to adapt to the effects of climate change.

Net Zero:

the point at which man-made GHG emissions are balanced globally with CO2 removals over a specific period.

Paris Agreement:

a legally binding treaty on climate change adopted at COP 21 in Paris in 2015, with a goal of holding "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursuing efforts to "limit the temperature increase to 1.5°C above pre-industrial levels."[4]

Sector:

our analysis covers investments into various sectors and technologies. "Sectors" covers energy systems; industry, waste, water and wastewater; buildings and infrastructure; [5] transport; agriculture, forestry and other land uses; and fisheries.

Technology:

a subset of a sector, for example wind energy (a subset of energy systems) or EV chargers (a subset of transport).

Part 1.
The current landscape of climate finance

Key findings

- Climate finance has grown consistently over the last decade, but still falls far below what is needed to meet the goals of the Paris Agreement.
- Estimates for 2022 suggest that global climate finance surpassed USD1tn for the first time. However, our research reveals USD6.2tn is needed annually by 2030 – and USD7.3tn by 2050 – to deliver Net Zero. These needs may increase in future if investment does not reach required levels in the next few years.
- While the cost of decarbonization is huge, the potential benefits are even greater. Some estimates suggest that climate action could create almost USD1tn of additional economic output per year by 2070 compared to business as usual.
- Recent policies such as the U.S. Inflation Reduction Act and Japan's Green Transformation Act offer hope of a step change in climate finance.

Increased investment across sectors and regions is critical to achieving the goals of the Paris Agreement. Significantly raising climate finance flows in the near term will help to avoid the costs of future harm and also realize long-term growth opportunities.[6]

By contrast, any delay in climate action will cause finance needs to rise. As of 2022, the available "carbon budget"[7] (the total volume of emissions possible to keep average global temperature rises within 1.5°C) was 380 gigatons.[8] Annual emissions hit 58 billion tons (more than 15% of the total) in the same year.

Each year of inaction exhausts our carbon budget more quickly. This takes us further from our climate mitigation goals and increases physical and financial risks, creating the need for more dramatic investment in the future, potentially including the deployment of more expensive carbon removal technologies and other technologies that are still maturing. The more we overshoot our carbon limits, the worse the physical, financial, and social harm will be. Potential consequences include greater likelihood of breaching climate "tipping points,"[9] greater sea-level rises, more extreme weather events, and more severe heatwaves.[10] These worsening climate impacts will increase poverty, lower crop yields, and raise the risk of injury and death, especially for vulnerable communities. In 2022, for example, India was hit by unprecedented heatwaves while flooding devastated vast swathes of Pakistan[11].

While the cost of decarbonizing the global economy over the next 30 years is substantial, the potential economic benefits in terms of asset appreciation and productivity growth are even bigger. One study estimates that concerted climate action and investment could add net USD43tn to the global economy – equivalent to a rise of up to 3.8% in global GDP by 2070. This would equate to additional economic output of almost USD1tn per year.[12],[13] Meanwhile, the negative economic consequences of climate change are being felt now. Annually, over USD300bn of infrastructure damage can be attributed to climate change,[14] not to mention the health costs associated with fossil fuel-induced pollution[15].

In addition, carbon-intensive investments through the middle of this decade are increasingly likely to become stranded as the carbon budget is exhausted,[16] or will require large-scale investment in carbon capture, utilization and storage (CCUS) in the future, adding to the social cost of energy infrastructure. Some studies suggest that the effects of climate policy could result in upstream oil and gas assets with the potential to generate USD1tn in future profits becoming stranded. [17] We anticipate that regulations aimed at curbing carbon-intensive investments will continue to exhibit a time lag, with governments not providing clear pricing signals (either positive for low-carbon or punitive for high-carbon). Subsequently, swift re-alignments with legislative changes may trigger major disruption.

It is better that we make sensible choices now rather than invest in assets that quickly become unusable. For example, a large investment in nuclear power post-2030 could strand high-carbon power plants and renewables. The reluctance of governments to lead their electorates and address the difficult decisions that lie ahead – and, it must be said, the inability of some voters to accept that tackling climate change will come at a cost – means insufficient thought is being put into system design.

The current socioeconomic and geopolitical context has made the case for investing in low-carbon infrastructure more compelling, although not yet sufficiently compelling to overcome cost parity issues or the legal and regulatory barriers that are preventing a faster transition. At a fundamental level, energy must be secure, sustainable, and economical. Renewable energy ticks many of these boxes and it is more freely available globally than fossil fuels, offering most countries greater potential to enhance energy access and energy security, though some (including Germany and Japan) will still need to import renewable power.

Power from new renewable infrastructure – specifically wind and solar – is also cheaper than power from new fossil fuel plants in most parts of the world. Studies show that as installed capacity rises, the price of renewable electricity falls, thanks to economies of scale and technological advances (similar price reductions are not a feature of high-carbon generation). Building renewable infrastructure requires materials such as concrete and copper, which carry an environmental cost. But overall renewables are much cleaner and cheaper than oil and gas, with the cost differential an opportunity for developing economies to accelerate growth while increasing energy access.

Realizing these benefits will require trillions of dollars of investment (further detail in Part 2). In addition, countries may need to address legal and regulatory barriers that are currently preventing a faster transition.

For individual businesses, the transition to a Net Zero future presents opportunities to secure market share in growing industries, and to take advantage of policy tailwinds and the evolving regulatory environment.

Despite these benefits, investment in renewable energy is unevenly distributed across the world, and 90% of the growth in clean energy investment in recent years has occurred in advanced economies and China.[18] Developing nations can learn from this activity and leapfrog some of the issues that other countries have faced, but they require more financial and technical support to do so.

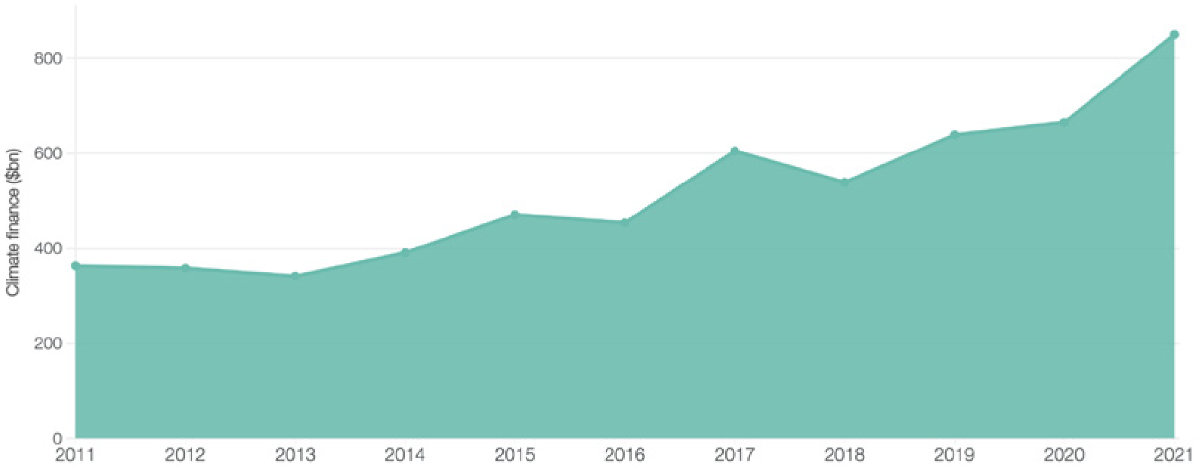
Transition opportunities are not being realized fast enough: the rate of climate finance growth is weak, and remains far below that needed to deliver on Net Zero goals. Our research shows that investment in climate-positive solutions and adaptation and resilience has grown at an average rate of 7% annually over the past decade. While this may appear encouraging, it is from a low base and does not reach the necessary growth rate.

We estimate that climate finance rose to USD850bn in 2021, a 28% increase on 2020 (Figure 1). Initial external estimates suggest that climate finance for the energy transition broke the USD1tn barrier for the first time in 2022, which would represent a 29% uptick year-on-year.[19]

The rate of Net Zero investment is accelerating, but not quickly enough. Our research shows that global climate finance flows may need to increase by 625% by 2030 to meet the goals of the Paris Agreement (estimated needs range from USD4.8tn per year to USD7.8tn).[20] By comparison, global defense spending reached a new high of USD2.2tn[21] in 2022, while consumers worldwide are predicted to spend almost USD2tn on tobacco and alcohol in 2023.[22]

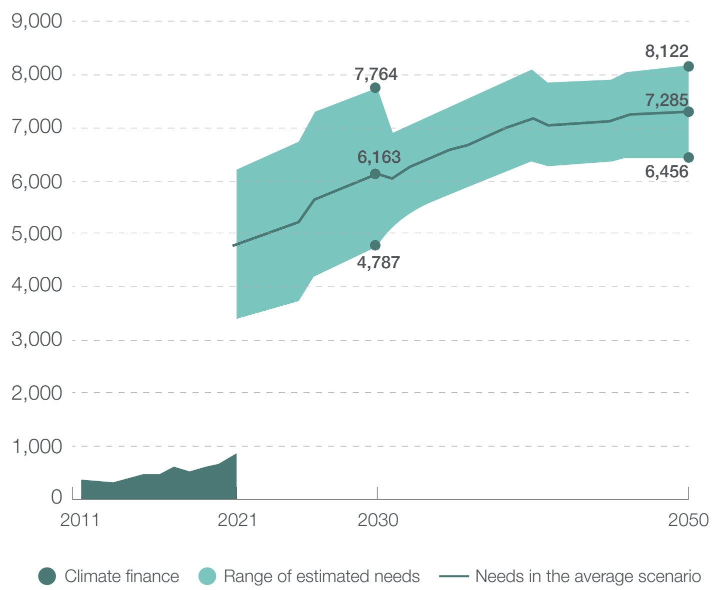
In addition to expanding the amount of finance, spending also has to be channeled to solutions that will most effectively reduce emissions. This can include an initial focus on renewables, energy efficiency, batteries, and electrification, followed by new technologies related to nuclear power, CCUS, and low-carbon industrial processes at scale over the subsequent decade. Work must be done to scale this development before the 2020s are out.

Figure 1: Global climate finance flows (2011 to 2021, USDbn)



Source: Global Landscape of Climate Finance: A Decade of Data (CPI, 2022)

Figure 2: Global tracked climate finance and estimated annual climate finance needs through 2050 (USD million)



Source: Climate Policy Initiative

There are further challenges on the horizon. First, many countries, including the world's most populous, China and India,[23],[24] continue to build new coal-fired power plants, although India is considering ending construction after its current wave of new projects come on line. Across developing economies, governments face the challenge of balancing the investment required to decarbonize their economies against the spending needed to improve healthcare, education, and infrastructure, all while keeping their debt load sustainable.

Then there is the rapid increase in demand for – and limited supply of – critical energy transition minerals, including lithium, polysilicon, copper, and nickel (required in everything from wind turbines to batteries). Prices for some of these materials soared by as much as 700% year-on-year in 2022, although prices have moderated in 2023.[25] Further, a rapid and sustained increase in interest rates in 2023 has also raised the cost of capital for new projects.

Pessimism among scientists over whether 1.5°C limit remains within reach

Finally, while leading economies, including the U.S. and China, remain committed to achieving Net Zero by 2050 in order to stay on a 1.5°C climate pathway, there is growing pessimism among scientists over whether keeping within this limit remains within reach.[26]

Research from the World Meteorological Association suggests the 1.5°C threshold could be breached as early as 2027,[27] although temperatures would need to remain above this level for a sustained period before we would consider the Paris Agreement to have failed. Despite doubts over the feasibility of current targets, the imperative to reduce emissions remains.

This is because the pace and magnitude of harm escalate significantly with every incremental increase in global temperature. The urgency generated by staying committed to the 1.5°C target remains our best chance of driving the necessary policy interventions and massive scaling of investments needed to tackle climate change.

Recent climate policy developments offer hope

There have been some dramatic climate policy developments over the past year, including the passage of the U.S. Inflation Reduction Act, which provides a USD370bn boost for low-carbon investment in the U.S. via a series of grants, loans, and tax incentives.

Jurisdictions including Japan and the European Union have similar policies, and the EU's Carbon Border Adjustment Mechanism is due to take effect in 2026, which will strengthen the carbon price across the world's second-largest market. Developments such as these may encourage copycat policies and could accelerate the deployment of existing technologies and foster breakthroughs in solutions such as green hydrogen that will have benefits across the world.

These policies are already resulting in deployment of mature technologies such as wind and solar, and novel projects such as Norway's North Lights CCUS project, "the world's first cross-border, open-source CO2 transport and storage infrastructure network,"[28] which is set to launch in 2024. Whether these policies will be sufficient to decarbonize the global economy by 2050 remains to be seen.

As discussed in Part 3, bridging the Net Zero financing gap will involve a greater role for non-government public institutions. This will include MDBs and the entire ecosystem of public banks increasing financing flows towards mitigation and adaptation, aligning export credit agency funding with the goals of the Paris Agreement, and developing more sources of blended financing.

These are critically needed now to prevent greater environmental damage and financial losses in future. Cutting-edge solutions are being developed to free up MDB funding and create pools of blended capital, but it is early days.

Part 2.
The need for sector- and region-wide climate strategies

Key findings

- Climate finance to date has been dominated by renewables (52% of the total) and low-carbon transport (23%).
- These proportions will need to flip to deliver Net Zero, given that transport has the greatest investment need (at 50% of total required finance or at least USD3.2tn annually), compared to USD163bn in 2019/2020), followed by energy systems (at least 32%, or at least USD2.1tn annually, compared to USD363bn in 2019/2020). Within this, annual investment in EVs will need to rise by 14x, investment in solar PV by 2.2x, and investment in wind power by 3.3x through 2050.
- While energy and transport are the most important sectors for delivering Net Zero, huge investment increases are also needed for building efficiency (to reach USD731bn through 2050); efficient and low-carbon industrial processes (USD320.2bn); clean hydrogen, pumped hydro, and energy storage (USD251.3bn); and CCUS (USD145.3bn).
- Finance for adaptation and resilience is also far below the amount of at least USD254bn required on average per year through 2050. This figure is highly dependent on the rate of warming, which is accelerating faster than expected.
- Investment needs to be scaled across regions, with none currently receiving the necessary quantum of climate finance to meet climate goals.

The volume of investment in climate mitigation varies dramatically across solutions. To date, most policies mandating or incentivizing the adoption of climate technologies have channeled the majority of climate finance to renewable energy and low-carbon transport. As shown in Figure 3, investments in renewables in 2020 represented 52% of overall climate finance, followed by low-carbon transport at 23%.

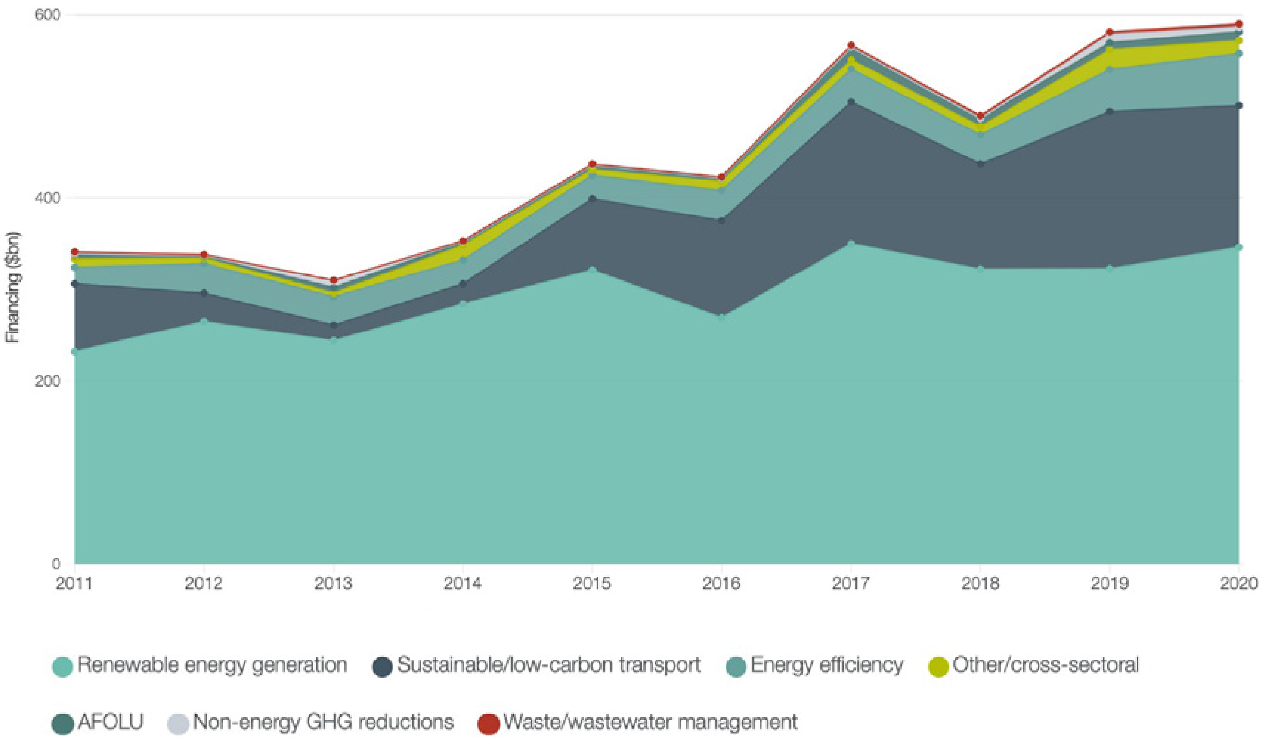
Well-developed, stable regulations in the renewables sector (eg tax credits, feed-in tariffs and contracts for difference) have driven a rapid decrease in the levelized cost of electricity[29] from 2010 to 2021 across clean technologies.[30], [31] This, coupled with the factors outlined in Part 1, has significantly accelerated clean energy investment to the point where it is expected to outstrip spending on high-carbon alternatives for the first time in 2023.[32] In some markets, clean energy projects have a lower cost of debt capital than fossil fuel developments, although this varies depending on existing grid conditions, government policies, and availability of and access to fossil fuels and renewable resources.[33]

Policy support for low-carbon transport delivers results

A wave of policy support for low-carbon transport has brought similar investment growth, especially for passenger EVs, which now represent all of the net growth in global car sales (as of 2022).[34] However, investment in decarbonizing other sectors such as buildings, industry, and agriculture remains relatively low, despite these sectors accounting for more than half of global emissions.[35] This is largely because the decarbonization process itself is relatively more difficult and/or expensive than the status quo in many of these industries, and in some cases because the technologies required are still in development.

Investment in all of these sectors, both nascent and mature, will need to grow dramatically, from USD850bn in 2021 to an average of USD6.2tn annually in 2030 and USD7.3tn by 2050. To put these numbers in context, investments in low-carbon infrastructure and fossil fuel infrastructure were roughly equal in 2022. In 2023, investment in clean energy technologies is expected to reach USD1.7tn compared to just over USD1tn for coal, oil and gas. Low-carbon spending will need to rise to four times that for high-carbon spending by 2030, and ten times by 2050.[36]

Figure 3: Climate mitigation finance by solutions (2011 to 2020, USDbn)[37]



Source: Global Landscape of Climate Finance: A Decade of Data (CPI, 2022)

Financing needs and gaps vary dramatically by sector and technology.[38] To better understand these differences, we gathered technology- and sector-level estimates from a range of sources and compared them with our own analysis of tracked financing (Table 1). Based on this research, transport will become the top investment need through 2050, requiring at least USD3.2tn annually, followed by energy systems with at least USD2.1tn.

The technologies with the highest projected investment needs are those that are receiving the most investment today: solar power, wind power, and battery EVs. That said, the financing gap differs between these technologies. For example, annual investment in solar power needs to increase by 2.2 times to USD298.5bn on average through 2050, while annual wind power (onshore and offshore) investment needs to increase by 3.3xto USD508.8bn over the same period. Comparatively, investment in battery EVs needs to increase by almost 14x, from USD78.2bn per year in 2019/20[39] to USD1.1tn annually through 2050.

These investment needs also vary by country; for example, EV penetration is much higher in China, which bet on batteries early, than Japan, which clung on to the internal combustion engine and hybrid vehicles for too long and where there are few charging stations as a result. Japan is now betting on growth in the hydrogen fuel cell market to decarbonize passenger transportation, as well as other areas of its economy.

Table 1: Climate finance flows and needs by sectors and technologies (USDbn)

Segment	Technology	2019/2020 Investment ($bn/yr)	Implementation cost of Paris-aligned scenarios through 2050 ($bn/yr)			Progress against avg. scenario(%)
		Tracked	Lower bound	Average Scenario	Upper bound	Tracked(%)
Energy Systems	Electricity Transmission & Distribution	4.8	487.4	650.4	785.3	3%
	Wind (Onshore & Offshore)	154.9	356.8	508.8	660.8	30%
	Solar PV	136.5	273.2	298.5	323.8	46%
	Integration Solutions (Hydrogen, Pumped Hydro, Storage)	0.0	147.3	251.3	408.3	0%
	Carbon Capture, Utilization, and Storage	0.0	65.0	145.3	251.7	0%
	Concentrated solar power	2.2	63.4	63.4	63.4	3%
	Biofuel & Biogas	1.3	35.1	62.4	93.1	2%
	Nuclear	30.7	55.4	55.4	55.4	55%
	Biomass	6.8	5.2	39.7	74.3	17%
	Marine	0.0	38.9	38.9	38.9	0%
	Geothermal	1.0	37.1	37.1	37.1	3%
	Hydropower	1.8	16.7	35.1	53.4	5%
Buildings & Infrastructure	Energy efficient buildings (incl heat pumps)	14.2	441.3	731.0	1,020.8	2%
	Renewables direct uses and district heat	14.5	61.8	96.1	130.3	15%
Industry, Waste & wastewater	Efficient and Low-carbon Processes	10.2	242.0	320.2	398.4	3%
	Methane (Solid waste and Wastewater)	0.0	44. 3	44.3	44.3	0%
Transport	Battery Electric Vehicles	78.2	1,071.0	1,105.9	1,140.7	7%
	Rail & Urban transport	13.4	770.0	770.0	770.0	2%
	Energy Efficiency	0.0	264.9	278.8	292.7	0%
	Electric vehicle chargers	4.3	88.0	103.8	119.5	4%

Key: Progress tracked against average scenario(%)		
0-20%	20-40%	40-60%

Sources: BNEF,[40] IEA [41, 42]

Note: The lower and upper bounds of estimated needs reflect the varying assumptions on cost curves and rates of adoption for different technologies. It is important to note that these cost estimates are indicative and could vary depending on slower or quicker adoption rates of technologies, unexpected technological advancements, or non-ideal deployment decisions, and need more dynamic assessment.

Investment in other areas will need to consistently double or triple in scale. For example, we have seen average annual investment in nuclear infrastructure – which is critical to the International Energy Agency's Net Zero pathway as it provides a stable source of low-carbon energy – reach USD26.4bn per year between 2015 and 2022.[43]

An average of more than USD57bn annually will need to be invested in nuclear through 2050.[44] However, unlike climate finance more generally, nuclear investment has been variable, ranging from USD3bn to USD39bn per year over the past decade due to a variety of factors, including escalating project costs, competition from alternative low-carbon technologies such as wind and solar, and the dampening effect of the 2011 Fukushima earthquake.

Nuclear investment expected to rise

Investment in nuclear energy is expected to grow, with new projects in China, the U.S., France, the UK, Poland, the Czech Republic, Saudi Arabia and Japan, among others. But to hit the levels required, financing may also need to come from more varied sources – 77% of nuclear investment since 2015 has been provided by public institutions, and 69% has come from state-owned entities.

The highest projected financing gap is in technologies that are not yet as commercially mature as those mentioned above. For example, annual investments in hydrogen and CCUS projects need to hit an average of USD287.7bn and USD125.6bn, respectively. To put this challenge another way, BNEF has calculated that there was global capacity to capture 43 million tons of CO2 in 2022, yet this needs to reach between one and two billion tons by 2030.

Increased investment will need to be deployed across sectors, including in harder-to-abate areas such as industry (including steel and cement) and parts of transport (including heavy-duty trucking) that are not on track to deliver.

Investment in developing sectors will require clear policy signals

In order to achieve this scale, these developing industries will require clear market and regulatory signals in the short term. These may include financial support to reduce investment risk such as through grants, concessional government lending, government procurement, or advanced market commitments. These newer technologies may also require policy and regulatory changes to enable development at scale, including in permitting, offtake agreements, and supporting supply chains.

As an example, nature-based solutions and low-carbon agriculture will require countries to adapt their regulatory and policy frameworks to deploy at the necessary scale. These programs may not fit neatly into a country's environmental and permitting regime, and there may not be a clear financial incentive to adopt technologies like precision fertilizers and methane-reducing livestock feed. The cost to stop emitting or store carbon in nature and on farms needs to be less than the cost of emitting it, and currently, in most places, the latter is free. In low-carbon agriculture, adopting a precision technology to more efficiently use fertilizer (to reduce N2O emissions) could ultimately lower costs, but requires training and upfront capital.

There is an additional challenge for technologies such as CCUS in that for a storage project to be viable the developer first needs to have invested in carbon capture, and vice versa.

This is why the private sector has found it difficult to make CCUS work without government support. A lot of early stage work is being done around the world to develop CCUS infrastructure, but this is not expected to come to fruition at scale for a decade or more.

IRA and Japan's Green Transformation Act offer hope

There is hope that policies such as the U.S. Inflation Reduction Act and Japan's Green Transformation Act could enable emerging technologies to be developed at scale, including green hydrogen, CCUS, low-carbon agriculture, and steel and cement manufacturing. Nevertheless, the extent to which these policies can deliver within a short timeframe is yet to be determined.

It is also important to stress that these investment targets are based on scenarios, not projections. They assume an optimized pathway to Net Zero based on known technologies and assumed costs, and are designed to show decision makers what implementation of a set of coordinated measures could deliver.

Technological developments will have big impact on eventual costs of achieving Net Zero

The actual costs of achieving Net Zero will vary depending on how quickly different technologies are adopted, the pace of technological improvements and breakthroughs, and the efficacy of deployment decisions. Additional unknown non-climate factors may play a role too and are impossible to model.

For example, climate change is expected to be a source of increased conflict in the future, which in turn will have an impact on the climate – both in terms of increased emissions[45] and because wars consume capital that might otherwise have been deployed towards mitigation and adaptation.[46] These models also do not include the costs of climate-adjacent needs, such as finance for nature and biodiversity, which will both be affected by, and potentially impact, climate change.

A decade ago, we were not even modeling scenarios that limited global temperature rises to 1.5°C, and did not factor in the cost declines of wind and solar generation or battery technologies.[47] It is therefore almost guaranteed that the scenarios considered here will, on the upside, miss breakthroughs for new or existing technologies that could reduce the cost of the energy transition and, on the downside, miss shocks that will knock progress off course.

Governments may not choose optimal decarbonization pathways

At the same time, adoption rates do not always follow expectations due to economic, social, technological, and policy restrictions, among other things. As a hypothetical example, if a country decided not to build renewable infrastructure even though it would generate cheaper electricity than high-carbon alternatives, its transition to Net Zero would be slower and more expensive than our modeling anticipates.

Countries may make decisions that are not optimal from a decarbonization perspective to ensure greater reliability of supply, bolster local economies, or provide jobs for communities that currently rely on fossil fuels. See Annex 1 for more information on what drives variation in our financing needs assessment.

Adaptation and resilience finance lags significantly. In addition to the finance required to reduce emissions, capital is also urgently needed to help communities adapt to the impacts of climate change. In 2019/20, adaptation finance comprised just USD49bn of the USD653bn of global climate finance delivered that year. This relatively low percentage is due in part to challenges in tracking private adaptation finance with adaptation projects highly context-dependent and limited impact metrics to confirm project benefits.[48]

Volume of adaptation finance required is highly dependent on rates of warming

Based on our gap estimates, the average adaptation scenario will require USD286bn of annual climate finance through 2050. However, this figure is highly dependent on the rate of warming and how destructive the impact of associated temperature rises will be, meaning our adaptation finance estimates range of USD197bn to USD374bn per year may change in the future.

To reach this level will require a significant scaling up of private investment in climate adaptation and resilience: 98% of current adaptation financing comes from public sources, primarily multilateral and national DFIs (84% of which is through market-rate or low-cost project debt) and governments (84% of which is through grants).

At COP 26 in 2021, world leaders called for a doubling of adaptation finance by 2025 (based on 2019 levels). They also committed to working towards achieving a better balance between mitigation and adaptation finance relative to the current split, where adaptation finance is only 7.5% of total climate finance.[49] With developing economies more exposed to the direct impacts of climate change, achieving this goal will be crucial to ensuring those who are least responsible for emissions do not bear the brunt of their effects.

The finance required could be redirected from fossil fuel-based investment. In 2022, USD1.1tn was spent on fossil fuel supply globally, an amount equal to tracked investment in low-carbon infrastructure.[50] On top of this, a further USD1tn was spent on subsidizing fossil fuels, more than double the amount spent in 2021 (this was largely due to efforts in Europe and other advanced economies to shield consumers from high natural gas prices).[51]

To achieve the goals of the Paris Agreement, we estimate that all new power generation needs to be low-carbon, and indeed the IEA's latest Net Zero scenario is based on "no investment in new fossil fuel supply projects and no further final investment decisions for new unabated coal plants." This scenario assumes that, by 2035, there will be no sales of new internal combustion engine passenger cars, and there will be Net Zero emissions from the global electricity sector by 2040.[52]

However, this must be tempered by reality, and does not mean that there will be no near-term investment in fossil fuel infrastructure, such as LNG terminals. For example, recent estimates from the IEA reveal that while investment in clean energy infrastructure is on course to hit USD1.7tn in 2023, there will still be around USD1tn spent on coal, gas and oil.

Spending on upstream oil and gas is expected to increase by 7% in 2023, taking it back to levels last seen before the COVID-19 pandemic, indicating that there will not necessarily be a smooth transition away from fossil fuels in terms of either consumption or costs.[53]

Renewables have limitations as a source of on-demand power

While massive strides have been made in recent years to build out renewable energy capacity, renewables cannot deliver power on demand. They also take time to plan, permit, and build. In the meantime, fossil gas remains the predominant commercially viable energy storage method, with green hydrogen and batteries not yet capable of taking its place (although battery storage installations are expected

to double in 2023 compared to 2022, and triple again by 2030).[54] Although it has a lower financial cost today, fossil gas has substantial carbon and methane emissions impacts.[55]

Periods of rising fossil fuel prices and supply chain disruption typically lead to increased fossil fuel exploration and extraction, potentially exacerbating a boom-bust cycle that is bad for consumers and long-term investors seeking stability. It would be better for governments, energy suppliers, and consumers to accelerate the scope and timing of fossil fuel transition planning. Just Energy Transition Partnerships, discussed in more detail in Part 3, are a step in the right direction and offer valuable lessons for how a country- or sector-focused program can engage stakeholders and enable a transition more quickly and cohesively than an ad-hoc project-by-project approach.[56]

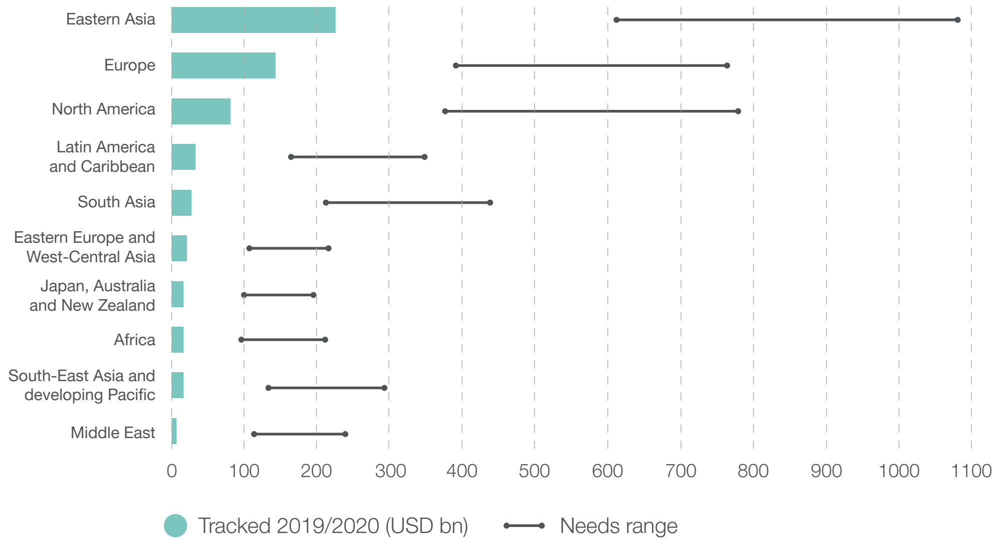
Our limited carbon budget means that strong policy interventions are required to rapidly accelerate low-carbon investments and integration of solutions like renewable energy into existing energy networks. However, policies in many parts of the world are still making fossil fuel generation cheaper through subsidies, and efforts to impose carbon pricing are patchy at best.

The specific interventions required will be different in a low-energy-price versus a high-energy-price scenario, but long-term thinking is critical to deliver a smooth transition. At present, we face a disorderly transition pathway given lagging government action and a lack of global agreement, among other things.

Investment needs to be scaled up across regions, as nowhere in the world is close to delivering the capital required to achieve Net Zero. Climate finance continues to be concentrated in a few regions, with 75% of the total global spend invested in East Asia and the Pacific, Europe, and North America in 2019/20 (Figure 4).

While no region is spending the required quantum of climate finance, the relative gap is particularly large for those with a higher concentration of developing economies, such as Latin America and the Caribbean, South Asia, Africa, and the Middle East. As discussed in Part 1, developing countries have to invest to develop their economies at the same time as adapting to and mitigating the impacts of climate change. This dynamic has sparked debate around the responsibilities of developed countries to help finance a "just" transition in the global South. Western nations built their economies on fossil fuels, yet the impacts of climate change are being felt disproportionately in poorer regions of the world.

Figure 4: Mitigation finance flows and needs by region



Source: Global Landscape of Climate Finance: A Decade of Data (CPI, 2022)

Part 3.
Public finance and policies must play a catalytic role

Key findings

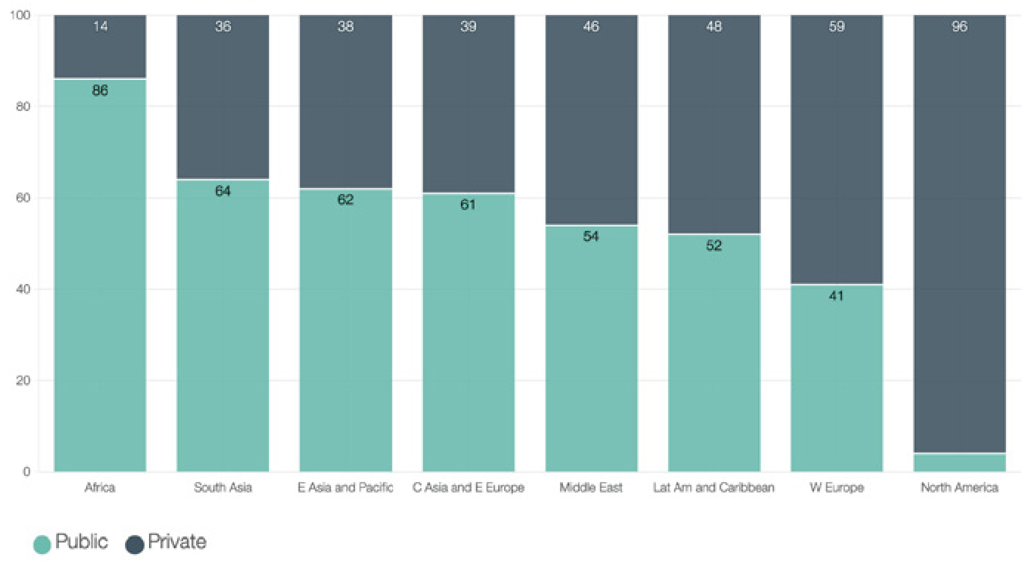
- To meet the goals of the Paris Agreement, public actors need to increase the scale and effectiveness of their financing activities and policies.
- Public climate finance has grown faster than private climate finance over the past decade, but MDBs have committed to increase climate finance by just 32% annually through 2030, and only six of the 27 largest national and bilateral DFIs have set climate investment targets.
- Against this backdrop, public financial institutions will need to identify ways to use existing capital more effectively to mobilize private investment.
- Enacted policies indicate likely growth in government climate finance and supportive policy regimes, including USD369bn in the U.S. Inflation Reduction Act, EUR210bn in the REPower EU plan, and USD150bn in Japan's Green Transformation Act, in addition to USD44bn in Just Energy Transition Partnerships in South Africa, Indonesia, and Vietnam.

Public finance will continue to play a critical role in the climate finance ecosystem. Through 2020, public finance (including financing from governments, DFIs, and state-owned institutions) grew at 9.1% per year compared to 2011, more than double the growth in private finance (4.3%).

However, the share of public finance as a proportion of total climate finance varies dramatically across regions (Figure 5), providing 86% of the total in Africa over the past decade but just 4% in North America.[57]

Given the enormous volume of investment needed to deliver Net Zero (see Part 2), it is evident that traditional public funding cannot bridge the financing gap alone. Effective deployment of public capital, policies, and frameworks will be crucial if we are to mobilize private investment at the scale required.

Figure 5: Climate finance by region and public-private sources (average for 2019 to 2020)[58]



Source: Global Landscape of Climate Finance: A Decade of Data (CPI, 2022)

Concessional finance, or below market rate lending through low-cost loans, grants, or equity, is critical to investment in less mature, high-risk sectors, geographies, and technologies. In 2020, 56% of total public financing was channeled to the relatively mature transport and energy systems sectors – including for the purpose of replacing energy from coal-fired power plants – with agriculture, forestry, and other land use (AFOLU), waste and water, buildings and infrastructure, and industry together accounting for less than 20%.

Opportunity to use grants and concessional finance to reduce risk for private investors

Redirecting grants and concessional finance away from mature technologies and sectors and towards commercially less viable areas (eg early stage R&D projects in edge technologies, grants for pilot projects, and funding for emerging technologies such as green hydrogen or innovative climate smart approaches in agriculture) can help develop technologies and reduce risk for private investors.

Public financial institutions should further target regions and economies where a higher cost of capital is inhibiting private investment. For example, research indicates that debt investors may require a 5x to 10x higher rate of return to account for the risk of investing in a developing economy compared to the same project in the EU or U.S., and equity investors require a 3x to 7x higher rate of return.[59]

Despite this, almost 50% of international public financing was delivered through project-level market-rate debt in 2019/20 (see Table A.2 in Annex 3). In lower-income countries, this approach is likely to exacerbate their already high debt vulnerability.

Some governments and DFIs are already helping to reduce the cost of capital in developing economies by scaling risk mitigation instruments such as grants, overseas development aid, insurance, guarantees, loans, first-loss protections, foreign exchange hedges and collateral support mechanisms.

International public financial institutions are stepping up, but their approach requires a strategic, creative and transformational rethink. In 2019/20, DFIs – multilateral, bilateral and national – provided around 70% of public climate finance.

The amount of climate finance available from DFIs is expected to increase, but it will still be nowhere near what is needed to deliver Net Zero.

For example, nine MDBs are committing to investing approximately USD108bn annually in climate solutions through 2030 (Table 2). However, developed economies' failure to fulfill their promise to deliver USD100bn of annual climate financing to poorer nations has been a source of friction at previous COPs, with the figure hitting USD82bn in 2021.[60], [61] If international public finance is to deliver the impact required, the focus will need to shift to increasing the effectiveness of the way this public money is deployed, as well as to the quantity of the financing itself.[62]

Table 2: Recent climate finance commitments by MDBs

MDB	Announced commitment
African Development Bank[63]	Allocate 40% of project approvals to climate finance by 2021, with equal proportions for adaptation and mitigation. Secure increased access for low-income African countries with a target of USD25bn by 2025.
Asian Development Bank[64]	Deliver USD100bn in climate financing to its developing member countries from 2019 to 2030.
Asian Infrastructure Investment Bank[65]	Ensure 50% of overall approved financing by 2025 is directed to climate finance (estimate cumulative approvals of USD50bn by 2030).
European Bank for Reconstruction and Development[66]	Increase green financing to more than 50% of annual business volume by 2025.
European Investment Bank[67]	Increase the share of climate action and environmental sustainability financing to more than 50% of annual lending by 2025 and beyond. Support EUR1tn (USD1.1tn) of investment in climate action and environmental sustainability through 2030.
Inter-American Development Bank Group[68]	Increase financing of climate-change-related projects in Latin America and the Caribbean to 30% of its total financing.
Islamic Development Bank[69]	Provide 35% of overall annual lending to climate finance by 2025.
New Development Bank[70]	Provide 40% of direct total financing to climate projects, including energy transition.
World Bank Group[71] **(WBG)**	Achieve an average of 35% of climate finance for the WBG from 2021 to 2025.

National and bilateral DFIs have made fewer forward-facing commitments, although these institutions continue to increase their climate investment each year. In 2015, the International Development Finance Club (which comprises 27 DFIs with over USD4tn in assets) committed to deliver USD1tn of green finance by 2025, and met this goal in 2020.[72] However, an analysis of major national and bilateral DFIs reveals that only six of the 27 largest institutions have set future-facing climate targets.[73]

To scale DFI financing, the decades-old paradigms of the global development finance architecture need to be reassessed. For example, according to S&P Global, MDBs, by better leveraging their balance sheets through the use of structured finance tools such as securitization, could lend a further USD1tn without reducing their AAA-rated credit profile.[74]

MDBs could incentivize staff to prioritize climate impacts above risk reduction

This is already a major focus of the MDBs, with one bank developing a mechanism that provides credit support coverage of its sovereign debt portfolio, giving it headroom to expand its lending (work assisted by Allen & Overy).

Additionally, MDBs could modify their investment allocation processes to incentivize staff to prioritize climate and development impacts above risk reduction, standardize processes across MDBs, reform the callable capital structure to fully utilize it, ensure consistent replenishment, and identify opportunities to raise money on the open market.[75]

Outside of MDBs, reforms to the wider finance architecture offer to improve liquidity in the poorest countries by leveraging and re-channeling unused special drawing rights (SDRs)[76] (an asset created by the International Monetary Fund to provide liquidity to countries). The African Development Bank, for example, has published a plan whereby recycled SDRs would be used as hybrid capital to leverage its lending.[77]

Bridgetown Initiative could prove transformational

The Bridgetown Initiative proposes expanding existing SDR-based funds such as the Poverty Reduction and Growth Trust and the Resilience and Sustainability Trust (launched in October 2020), and setting up a new "Global Climate Mitigation Trust" holding USD500bn of unused or new SDRs.[78] This could be transformational in catalyzing climate action that would deliver economic growth. Such initiatives propose investing directly in mitigation projects, taking costs off government balance sheets and reducing sovereign debt and the risk of default.

Aligning fiscal policies and government spending to national decarbonization priorities is critical. As mentioned in Part 1, some modeling indicates that global temperatures could exceed the 1.5°C threshold as early as 2027. A 2022 analysis by the UN Principles on Responsible Development of more than 80 current climate policy and technology developments predicts that – despite the fact that government investment in climate solutions is set to grow – global temperatures are still likely to rise by 1.8°C on average by 2050.[79]

The study includes 20 announcements from Q4 2022 that marginally accelerate a pathway to scenarios compatible with 1.5°C, others that increase the probability of a temperature rise of 1.8°C, and two that indicate potential deceleration to a pathway above 1.8°C.[80]

Several countries in Global South propose more ambitious NDCs

The positive developments include more ambitious Nationally Determined Contributions (from Mexico, Vietnam and Turkey), increased policy ambition in relation to tackling methane emissions from oil and gas operations (from Australia, Canada, the EU, and U.S.), recommitments to forestry protection (Brazil), increased policies and commitment to nature-based solutions (EU), 2050 non-binding Net Zero target for aviation (by the UN International Civil Aviation Organization) and Just Energy Transition Partnerships (discussed in more detail below).

As pointed out above, several countries are also likely to increase their climate spending. For example, the 2022 Inflation Reduction Act (IRA) in the U.S. includes an annual

USD37bn for climate solutions over the next ten years (although analysts from Credit Suisse and Goldman Sachs believe this amount could be twice or three times as large after taking into account increased demand for tax credits and hundreds of billions of dollars of increased lending capacity, among other things).[81]

In the EU, the Russia-Ukraine war has led to the development of the REPower EU plan, which is estimated to cost EUR210bn from 2022 to 2027. The plan calls for increased energy efficiency, accelerated rollout of renewable energy and heat pumps, and reduced fossil fuel usage in industry and transportation.[82] The EU is also considering investment to respond to the industrial policy investments from China and the U.S., while Japan has also announced a USD150bn funding package for energy transition projects which aims to catalyze USD1tn of investment over the next 10 years.[83]

The impact of these policies on the Net Zero transition globally remains to be seen. Will there be level growth in clean energy investment across the world, or will the pull of the IRA prove stronger than the incentives offered by Japan, for example?

But the fact that many national governments are recommitting to climate action in the face of competing budget priorities and political constraints in reallocating existing public financing has led some to view these policies as once-in-a-decade opportunities. The rapid response from developed economies to the energy crisis in 2022 to 2023 – and to COVID-19 before that – shows that funding can be made available when needed, with European governments' allocation of USD775bn (between September 2021 and January 2023) to respond to rising energy costs being a case in point.[84] As the economist and academic Lord Stern stated in 2022, delivering Net Zero will require the "biggest economic transformation in peacetime."[85]

Collaboration between public and private institutions will be critical to deliver Net Zero

Catalyzing collaboration between public and private finance will be instrumental to achieving targeted climate and broader global developmental goals. There is intense international debate over whether linking climate investment to the broader UN Sustainable Development Goals could provide a solution to the multiple, interlinked crises we face, given that all can be achieved in part or substantially through climate investment and a just transition.

A good example are the Just Energy Transition Partnerships. These are frameworks that have so far been adopted in South Africa,[86] Indonesia,[87] and Vietnam[88] that will channel around USD44bn from consortia of wealthy countries and private companies to decarbonization over the next three to five years.

They work by funding the decommissioning of coal-fired power plants that still have many years of operational life left, in exchange for expanded or improved electrical grid infrastructure and jobs for affected communities, to ensure they are not left behind. Addressing and preventing these impacts would require large volumes of public and private finance, and on their own these investments would be too risky or unprofitable for private investors to pursue.

Part 4.
Private finance is positioned to meet the opportunity and fill the needs gap

Key findings

- Corporations and commercial financial institutions together provide approximately 78% of private climate finance, more than 90% of which goes to renewables and low-carbon transport.
- Publicly announced commitments from these organizations point to future growth in climate finance, including a commitment from the 30 largest banks to finance USD870bn annually in climate solutions.
- Asset owners and asset managers have been slower to commit, with only 27% of asset owners and 2% of asset managers publicly announcing Net Zero and climate financing targets.
- VC investment in climate solutions companies reached USD70.1bn in 2022, 89% higher year-on-year, with climate-focused VC investors holding USD37bn in dry powder as of late 2022.
- However, it remains to be seen whether this growth will continue, as higher interest rates push investors to focus on near-term returns.
- Climate solutions companies have raised equity and debt capital relatively easily, though companies' equity raising in 2022 was 40% lower than in 2021 (reflecting the general downward trend in financing).
- Similarly, in 2022 green bond issuances were 6.8% lower than in 2021. Investments in supply chain and manufacturing facilities for climate solutions increased to USD79bn in 2022, 44% higher than 2021, although annual investment needs to increase by a further 58% to stay on a Net Zero pathway.

There is a tremendous opportunity for private investors and companies to reallocate capital and take advantage of the transition to a low-carbon, resilient and just economy. In contrast, institutions that are not properly prepared for Net Zero may be stuck with stranded assets or unable to take full advantage of decarbonization-focused policy shifts.

This section analyzes current spending trends alongside future commitments to climate investment by private organizations. Specifically, we review the potential for investment by sector and by actor (based on announced commitments to future climate action), as well as analyzing broader investment trends, some of which point to potentially increased future private climate finance.

There is substantial capital being deployed that could be reallocated to climate-positive solutions. Global financial GDP is estimated at USD101tn.[89] While not all of that is suitable for Net Zero investment, trillions of dollars are currently being spent on sectors that will be low-carbon in the future. For example, approximately USD3.5tn is spent every year on vehicles,[90] compared to the USD280bn spent on EVs in 2021.[91]

Subsidies for fossil fuels continue to rise

Fossil fuel subsidies hit USD1tn in 2022, a substantial rise year-on-year,[92] while in the real estate sector, only USD260bn of the USD5.8tn invested in new buildings in 2021 was spent in accordance with green certificates.[93] As far as adaptation and resilience is concerned, for every USD1 spent on climate-resilient infrastructure, USD87 was spent on non-climate-resilient infrastructure.[94]

Climate finance from private institutions is currently provided primarily by corporations, commercial financial institutions and households/individuals, rather than directly from funds and institutional investors. Financing from corporations primarily goes to energy (74% in 2019/20) and low-carbon transport (18%).[95] Commercial financial institutions are even more focused on energy, with 82% of their climate financing directed to such projects and the rest focused on low-carbon transport (17%). While funds and institutional investors are relatively small contributors to annual climate finance flows themselves (0.6%, or USD4bn), they play a critical role in providing capital to the corporations and commercial financial institutions that fund real economy projects (19% each, or USD125bn and USD122bn respectively).

Role of private finance in Net Zero transition will depend on risk-return preferences

Private actors will play different roles in the energy transition, depending on their risk-return preferences and which technologies and markets they prioritize. For example, analysis from the IEA reveals that on a Net Zero pathway through to 2025, corporations will primarily use their balance sheets and the capital markets to finance investments in renewable energy. Commercial financial institutions will primarily make direct investments in transport, decarbonizing real estate, and supporting investment in developing economies. Meanwhile, funds and institutional investors will largely provide capital to corporations, as well as investing directly in infrastructure.[96]

Climate targets set by private financial institutions point to increased future investment in climate solutions, although further commitments are needed to fill the Net Zero financing gap. In recent years, we have seen a rapid increase in the number of private institutions that have publicly committed to achieving Net Zero emissions.

In April 2021, the COP 26 presidency and former Bank of England Governor Mark Carney launched the Glasgow Financial Alliance for Net Zero (GFANZ), a sector-wide coalition of existing and new Net Zero finance initiatives.[97] To be a member of GFANZ, financial institutions must commit to Net Zero carbon emissions (Scopes 1, 2, and 3 emissions, including emissions linked to their financing activities) by at least 2050 and set interim targets to meet this goal, as well as taking other actions based on the Race to Zero campaign's criteria such as transparent reporting and restrictions on the use of offsets to meet climate targets.[98] In essence, GFANZ was established to ensure financial institutions work to decarbonize the trillions of dollars of assets they hold.

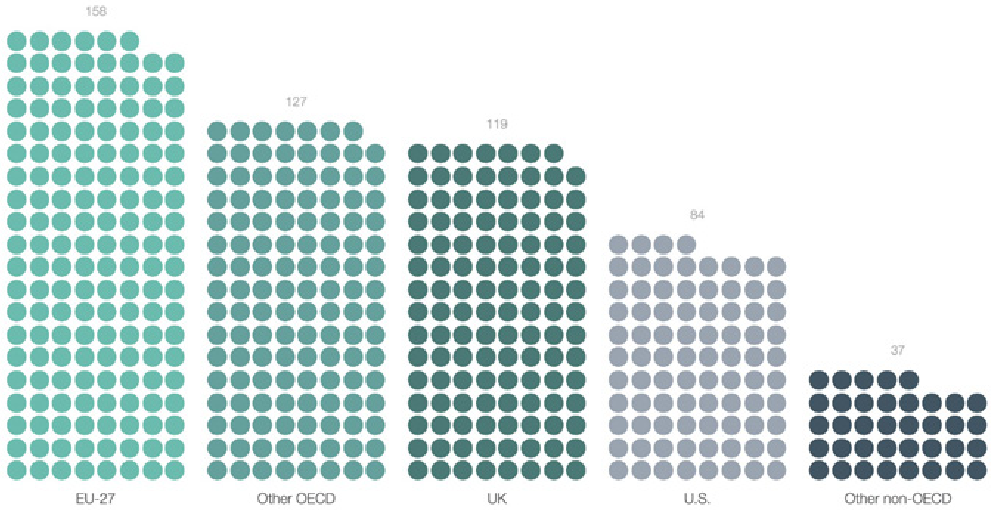
As of November 2022, GFANZ comprised 550 financial institutions, representing USD150tn of total assets.[99] This scale is a recent development – in 2020, prior to the establishment of GFANZ and many of the Net Zero finance initiatives, institutions representing just USD12.4tn of assets were committed to Net Zero by 2050.[100]

Private financial institutions are starting to add specifics to their Net Zero commitments, providing a medium-term indication of how much capital we can expect to be deployed with climate solutions in mind.

For this study, we reviewed publicly announced targets for future investment in, or the financing of, climate solutions. These targets are not necessarily comparable with the climate finance flows described in Part 1, which track investments in specific projects. These targets may include a broader set of investments – for example, secondary markets transactions (the public trading of securities on the financial markets), or underwriting public equity offerings.

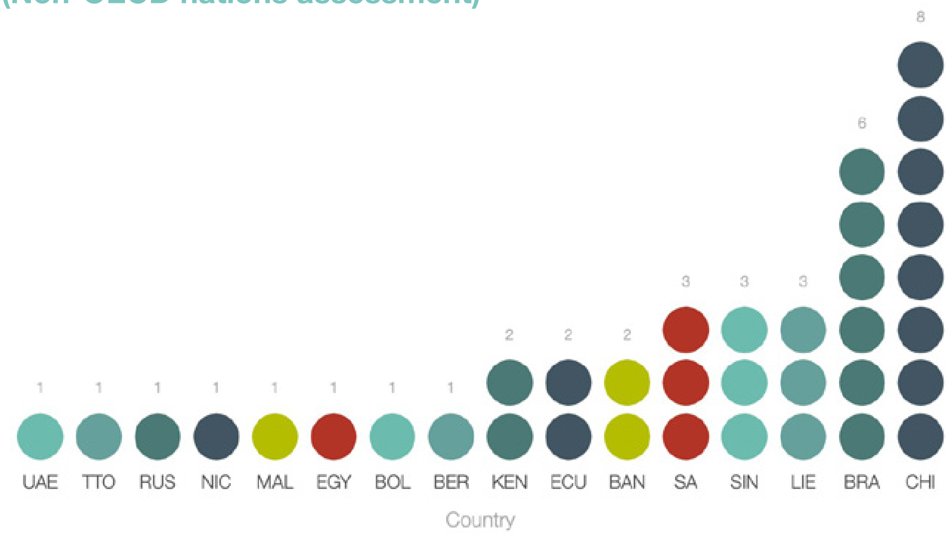
Actor type	Financial institutions committed to Net Zero	Estimated % of industry assets committed to Net Zero
Total	547	32%
Asset manager	266	42%
Commercial bank	128	39%
Asset owner	74	6.7%
Insurer	54	16%

Number of institutions committed to Net Zero (Global, 2022 assessment)



Source: GFANZ

Number of institutions committed to Net Zero (Non-OECD nations assessment)



Source: GFANZ

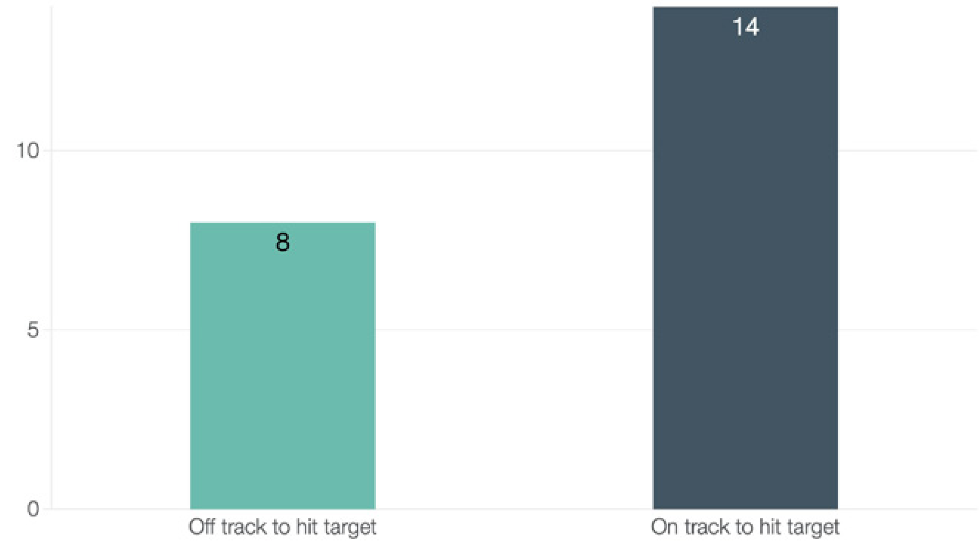
Commercial banks increase financing commitments for climate solutions

For commercial banks, we calculate that as of January 2023, the 30 largest banks in the world had cumulatively committed to financing at least USD870bn of climate solutions annually by 2030,[101] up from USD600bn in 2021.[102] This is due in part to more institutions setting targets, but also comes from institutions raising their level of ambition. Some banks are conducting stock takes of the CO2 emissions from the projects they finance and are looking to reduce these over time. This effectively places limits on the fossil fuel projects they can fund, and some are also refusing to support certain types of infrastructure such as thermal coal mines, coal-fired power plants and upstream oil and gas facilities. This also makes more funds available to deploy towards green projects, pushing down pricing.

In 2017 for example, JP Morgan Chase committed to facilitate USD25bn in clean financing per year by 2025.[103] In 2020, this target was increased to USD50bn, and in 2021 it was raised again to USD100bn annually through 2030.[104] This trend – which is largely visible through the rest of the sector – gives corporations and other private actors confidence that banks are building the internal capacity to facilitate their projects.

While these commitments are substantial in terms of bridging the Net Zero financing gap, there is evidence that they could be increased further in the future. Of the 22 commercial banks we tracked that had set targets, 14 were on course to meet them before 2030 if they continued the pace they achieved in 2021.

Figure 6: Commercial banks' prospects of meeting their 2030 climate finance targets



Source: Climate Policy Initiative

Asset managers and asset owners are also starting to set Net Zero investment and financing targets, though these are less widespread and have fewer specifics. For example, of the 74 institutions in the Net Zero Asset Owners Alliance, only 28 have set investment targets (compared to the 44 that have set an interim emissions reduction target).[105] Of these, only 20 have set specific targets with quantitative goals.

Alliance members invested USD253bn in climate solutions in 2022,[106] so a lack of targets does not necessarily mean a lack of investment. However, the existing targets lack specificity, making it harder to assess how much capital they are set to deploy to climate solutions in the future.

Asset managers in the Net Zero Asset Managers initiative also offer relatively few specifics around their future investment targets. As of May 2022, just 43 of the 301 signatories had set targets for their percentage of assets under management to be aligned with Net Zero targets; only five had set specific, quantifiable investment targets. However, as with asset owners, the lack of quantifiable targets does not mean that asset managers will not increase their investment in climate solutions.

These Net Zero alliances and their member institutions will be under increasing pressure from civil society organizations, policymakers, and clients to demonstrate that their commitments are having a measurable impact on the real economy. As financial institutions develop and internalize strategies to reduce emissions, we anticipate more detailed and quantifiable targets will be set, including in relation to investments.

Figure 7: Institutions with interim and investment targets in Net Zero alliances

Source: Climate Policy Initiative

Tracking the integrity of commitments is important, since commitments alone will not drive change. While institutions have Net Zero goals and interim investment targets, it does not mean that they will direct all of their capital towards low-carbon infrastructure.

First, many institutions are focused on other sectors or strategies that need more liquid investments. Second, they may pursue their emission reduction goals by focusing their capital allocation on companies with low carbon footprints rather than those developing low-carbon infrastructure. Third, an analysis of interim 2025 or 2030 targets shows that many institutions are only committing to align a portion of their total assets to Net Zero, and only a fraction have plans that have been verified by an external party such as the Science-Based Targets initiative.[107]

Outside of tracking current financing flows and needs, this current difference between commitments and action is why the integrity of those commitments is so important.[108] While pledges indicate there is interest from private institutions that represent trillions in capital, this is only slowly turning into investment in real economy mitigation or adaptation projects.[109]

VC funding for Net Zero has risen sharply

Other spending metrics indicate a potential future increase in climate finance flows.

In addition to the analysis of expected future spending by actor type above, we reviewed spending trends across the low-carbon economy. These include VC investments in companies working on climate solutions, corporate finance (eg raising equity and debt capital), and spending on clean energy manufacturing such as for solar panels, wind turbines, and batteries.

All of these will be crucial for developing a robust ecosystem in which investments in real economy Net Zero projects can occur.

Venture capital (VC): While VC funding is not a perfect indicator of future climate finance flows on the ground, such investment in climate solutions companies has increased substantially in recent years. VC funding for climate tech companies was USD70.1bn in 2022, 89% higher than in 2021, and 10.5 times larger than in 2016.[110]

While fundraising figures from Q1 2023 indicate this total figure may decrease by 50% in 2023[111] due to macroeconomic factors such as rising interest rates, inflation, and slower economic growth, capital has already been raised for future investments. Estimates indicate that as of late 2022, VC firms focused on climate change held USD37bn in unallocated cash reserves, ie dry powder.[112] Alongside this dedicated capital, VCs as a whole held USD585.5bn in dry powder as of September 2022, portions of which may be invested in climate solutions companies.[113]

Multi-billion-dollar climate-focused private equity funds also launched in 2022[114] with estimates suggesting USD17.6bn was raised for energy transition-specific funds in the period from January to September. This included funds focused on renewable energy, hydrogen, biofuels, and carbon capture.[115]

Not all of this capital will result in climate finance flows as described in Part 1, with only a portion resulting in changes to the real economy. For example, not all VC-funded climate solutions companies will succeed and implement their products. Even among those that do, some of the initial funding will be used to hire staff, conduct research and development, and develop the business. However, these investments are potentially indicative of increased real economy flows in the future, as more climate solutions come to market.

Corporate finance: In order to channel money to climate-positive solutions in future, companies will need the ability to raise additional capital via equity or debt. For climate solutions companies seeking to raise non-VC finance through equity offerings, 2022 was a less lucrative year than 2021 with IPOs, secondary offerings and mergers with special purpose acquisition companies (SPACs) decreasing by more than 40%.[116]

This fall was especially stark for de-SPAC transactions. In 2021, climate solutions companies were involved in SPAC deals worth a combined USD35.1bn, compared to just USD8.7bn in 2022, with the transport sector accounting for 67% of the difference.[117]

Equity capital financing flows to energy storage, renewables and electric vehicles

The companies raising the most equity capital in 2022 align with the sectors and technologies with the largest finance needs as described in Section 2, led by energy storage, utility-scale renewables development, and EVs and batteries.

Equity raising can also be an indicator of future investment – for example, while we have not tracked investments in CCUS projects, companies focused on this sector raised USD1.1bn in 2022.

For companies seeking to raise debt, green and other sustainable bonds – which are “use of proceeds”-focused instruments – are a growing source of capital, as are sustainability-linked bonds which incentivize a specific ESG-friendly performance by the issuer. In order for a bond or loan to be labelled as ESG, sustainable or green, there are certain industry (and/or regulatory) standards that need to be met. According to the Climate Bonds Initiative, annual green bond issuances in 2021 hit USD522.7bn, a 75% increase on 2020.[118]

Initial estimates indicate that USD487.1bn worth of green bonds were issued in 2022, a year-on-year drop of 6.8%. Corporations issued 55% of all green bonds, with non-financial corporates issuing 27.8% and financial corporates issuing 27.2%. The proceeds were primarily used to finance energy (35% of the total), buildings (29%), and transport (16%) projects. These three sectors have been the largest destinations for use of green bond proceeds since tracking began in 2014.

Clean energy manufacturing: Spending on supply chains and manufacturing for climate solutions (such as parts and materials for solar panels) is another investment trend that is likely to spur implementation of emissions-reducing technology in the future.

Recent estimates indicate that USD79bn was invested in clean energy manufacturing in 2022, a 44% increase on 2021 and a fourfold rise compared to 2018.[119] Of this figure, 58% and 30% of the investment went to battery storage and solar manufacturing facilities, respectively.

While the percentages have varied year-to-year, those two technologies have dominated investment in new manufacturing capacity over the past five years. More than 90% of investment in battery storage and solar manufacturing facilities in 2022 occurred in China, although that trend may shift due to the policies described in Section 3, including the Inflation Reduction Act in the U.S.

Spending on climate solutions supply chains and manufacturing capacity set to grow further

There has been a significant uptick in spending on climate solutions supply chains and manufacturing in recent years, and further growth is anticipated. To reach Net Zero, BNEF estimates that clean energy factory investment needs to increase by 58% to USD125bn annually from 2027 to 2030.[120] The IEA estimates that the market for manufacturing of clean energy solutions (including solar, wind turbines and components, electrolyzers and more) will more than triple from its current size to reach USD650bn by 2030.[121]

Net Zero set to triple demand for key minerals

In addition to clean energy manufacturing, mining and processing of critical minerals will play a key role in enabling the growth of climate solutions including clean energy, EVs, and battery storage. The market value of these minerals is estimated to triple by 2050 in a Net Zero scenario, rising to USD331.5bn annually compared to USD117.5bn in 2022.[122] The minerals with the largest annual value in the Net Zero scenario will be copper (USD123bn), aluminum (USD75bn), and lithium (USD62bn), followed by steel, nickel, cobalt, and rare earths. As with the financial needs assessment in Part 2, estimates of critical minerals needed to meet Net Zero are likely to change based on technological efficiency improvements or substitutions to reduce costs and reliance on specific minerals.[123]

Given the investment required to scale sectors and technologies described in Section 2 and the limitations of public finance to fully fill that gap, private investors will play a crucial role in driving funding to climate solutions to meet the goals of the Paris Agreement.

With the support of public finance and policy, businesses and private investors may be able to take advantage of the multi-trillion-dollar opportunity, although further information from companies is required to identify how likely current commitments are to meet this needs gap.

Part 5.
Conclusion and potential solutions

An average of USD6.4tn of investment per year in low-carbon infrastructure is required through to 2050 if we are to achieve the goals of the Paris Agreement, which will rise in future years if we continue to undershoot this figure.

A multi-trillion-dollar gap remains between current climate finance flows and estimates of the sums needed to achieve Net Zero, and certain sectors will need policy and direct public support to achieve sufficient scale.

Technologies already at commercial scale – including onshore and offshore wind, solar, and EVs – may need policy interventions to overcome barriers such as permitting timelines, slow grid upgrades and the provision of additional transmission lines.

Policy support and government funding will be needed for key technologies

Alongside this, solutions such as floating offshore wind, next-generation nuclear infrastructure, CCUS, and technologies to abate emissions from air travel and heavy industry will need a wide range of public policy and direct government support to achieve sufficient scale.

Public policy is starting to address the need in some areas (see Part 3). However, the global response to date is insufficient and implementation is too slow. Potential structural changes such as carbon taxes and emissions trading schemes – which reflect the environmental damage caused by GHGs – are needed now, yet research from the IMF reveals that only 46 jurisdictions have either a carbon tax or ETS in place. While there are more in the pipeline, major economies including India, Russia, Australia and most U.S. states do not appear on the list.[124]

Macro shocks have capacity to blow progress off course

As we have seen over the past two years, war, inflation, supply chain disruptions and materials shortages act to delay the decarbonization process and make it more expensive. If, for instance, wind turbine manufacturers struggle to make money because of rising input costs, supply disruptions and permitting delays, ambition will be curtailed.[125]

These challenges raise the importance of maintaining a long-term perspective for both public and private actors, while recognizing that immediate action is needed.

With this in mind – and considering the opportunities and constraints discussed in this report – the potential solutions to close the financing gap are complex and multifaceted.

Firstly, stakeholders need to align. As discussed in Part 2 there are many potential pathways to Net Zero and it is not yet clear how much investment will be needed in different technologies to meet the Paris goals. However, most involve at least a 700% increase in climate finance by 2030 and further rapid scaling of technologies including solar, wind, and batteries.

The sheer size of the challenge means that Net Zero cannot be reached without the majority of businesses, investors, governments and development finance agencies working together. Policy must create the conditions to accelerate private investment in Net Zero through a combination of price support measures, targeted financial incentives, streamlined permitting regimes and international mechanisms to penalize high-carbon activities, among others.

Policy must incentivize long-term private investment

Every effort must be made to ensure policy catalyzes private capital flows in a way that transcends short-term political cycles. Laws and regulations must be calibrated to encourage clean energy investment without exposing companies, their boards and management to excessive risk, such as uncertain subsidies, permitting processes or liability regimes (as is the case with CCUS). In return, if governments have enabled it, businesses must commit to Net Zero publicly. By creating business strategies with these pathways in mind, companies can avoid investing in stranded assets and take advantage of future policy shifts.

Greater alignment among stakeholders can unlock private capital across the developed and developing world. While Net Zero initiatives are picking up, the goals can only be achieved if the majority of economic actors commit and deliver.

As an example, less than 16% of asset owners and insurers were committed to Net Zero as of mid-2022.[126] At the same time, 89% of Net Zero targets came from OECD countries, and substantial amounts of capital in non-OECD countries are not yet committed to Net Zero.

In Asia (excluding Japan and Australia), institutions committed to Net Zero only manage 4.3% of total AuM, although this trend may start to shift with the establishment of GFANZ regional networks in Asia-Pacific and Africa.[127] States themselves can play their part – those with sovereign wealth must craft long-term strategies to channel investment towards climate-positive solutions, and those with export credit agencies and other development financing institutions could align their missions with the Paris goals.

Second, policy and financial support will need to be directed towards critical decarbonization technologies that are not currently at commercial viability, including carbon capture, nuclear, green hydrogen, and industrial sectors such as steel and cement. To deliver Net Zero these technologies and sectors will need to go from near-zero investment in actual projects in 2020 to hundreds of billions of dollars a year through 2050.

Progress has been made in recent years with USD6.4bn (including corporate and government R&D and VC funding) invested in CCUS in 2022. Policies supporting CCUS deployment have been introduced in the U.S. and Japan, bolstering existing CCUS schemes in countries including Norway and Australia.

However, in an environment where private investment in cutting-edge technologies is limited by the reality that there are less risky opportunities available, public finance will need to be deployed to ensure viability across every stage of development, from R&D to pilot facilities, first-of-a-kind commercial scale projects, public procurement and ongoing subsidies.[128]

Third, alignment between stakeholders will require enhanced engagement and a reframing of public debate. Achieving Net Zero may require behavioral change and an acceptance that compromise will be necessary on the path to the greater common good. Policy will need to be tailored for different markets, regions and sectors, requiring policymakers to work in tandem with the private sector for an on-the-ground perspective of the investment incentives required and the barriers to scaling technologies. As the last year has shown, there is still robust demand for coal, natural gas, and oil in a world with limited security of supply. Dramatic falls in the price of high-carbon energy may reduce political will to phase out fossil fuel production, while price rises make carbon pricing measures more politically challenging. Policymakers should therefore prioritize how to manage this inherent volatility.

Finally, a just transition is essential. To encourage international collaboration, every effort must be made to protect communities that currently rely on fossil fuels or that will be impacted by low-carbon solutions, and to support developing economies through the transition. This will include the scaling up of the type of funding delivered through Just Energy Transition Partnerships to retire and decommission fossil fuel infrastructure and provide financial support and jobs for existing workers.

MDBs and DFIs will need to fuel up or receive additional capital to support these programs, and to channel their funding in ways that mobilizes private finance. They can do so by using concessional capital more effectively to provide political risk support or liquidity to increase funding for less commercial sectors and regions, and by lowering the cost of capital to enable greater investment from local public and private sources.

As discussed in Part 3, this is not currently happening – 56% of public finance is concentrated in transport and energy systems, and almost 50% is delivered through project-level market-rate debt. To support the Net Zero transition in this way will require MDBs and DFIs to increase their risk appetite, and provide capacity-building and technical assistance for local financial institutions that do not have the resources to develop expertise in climate-aligned industries. Implementing the above solutions and enabling the Net Zero transition requires capacity building at every level among public and private institutions.

Annex 1:
Methodology

For this report we used a definition of climate finance aligned with the United Nations Framework Convention on Climate Change (UNFCCC) Standing Committee on Finance, which states: “Climate finance aims at reducing emissions and enhancing sinks of GHGs and aims at reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negative climate change impacts.” [129]

Our climate finance mapping exercise is limited to primary capital flows directed toward low-carbon and climate-resilient development interventions with direct or indirect GHG mitigation or adaptation benefits. Our taxonomy of climate finance is based on international best practices, including from MDBs, the Climate Bonds Initiative, the UN Intergovernmental Panel on Climate Change (IPCC), and the EU sustainable finance taxonomy.

Climate finance data collection [130]

We use project-level data where available, and cross-check our figures for consistency in relation to actors, geographies, instruments, and sectors. Desk research complements this cleaning process where the datasets are incomplete. We observe the following general principles when collecting and reporting the data:

1. Avoid double counting

We track only those transactions that represent new money targeting climate-specific outcomes. For example, both private R&D for new technologies and investment in manufacturing for low-emissions and climate-resilient development are excluded. This is because at the technology deployment stage, such costs are capitalized and factored into the investment amounts of new projects that implement these technologies, increasing the risk of double counting if the initial investment was to be tracked separately.

Similarly, revenue support mechanisms such as feed-in tariffs reimburse the initial investment costs, so including them would constitute double counting. Thus, we do not track policy-induced revenue support mechanisms or other public subsidies whose primary function is to pay back initial investment costs.

Where there is overlap between datasets, we select only the highest quality entry in terms of reliability and comprehensiveness for each transaction.

2. Track primary investment

We capture total primary financial transactions and investment costs or, where tracked, components of activities that directly contribute to adaptation and/or mitigation, plus public framework and capacity development expenditures (eg development of national climate strategies). Secondary market transactions (eg re-selling of stakes or public trading on financial markets) are not tracked because they do not represent new investment targeting climate-specific outcomes, but rather money being exchanged for existing assets.

3. Exclude carbon emissions lock-in

Investments and expenditures in our dataset do not capture investments that have a high risk of locking in significant future GHG emissions. Based on this principle, fossil fuel-based lower-carbon and energy-efficient generation transactions, such as financing for efficiency retrofits of coal-fired power plants, are excluded.

4. Maximize granularity

Wherever possible, we use project-level data to check and select flows. Project-level information is more likely to provide verifiable details on project characteristics, instruments, destinations of financing and financing structures. Where project-level data is not available or insufficiently complete, aggregated data is used.

5. Include tangible financial commitments

We study financial commitments made during the period being tracked. Depending on the context (eg a public commitment by a government, versus a private financing contract agreed between corporate actors), commitments may refer to firm obligations by means of board decisions on investment programs, closure of financing contracts or similar actions.

Although the focus on commitments rather than disbursements may affect the sequencing of flows over time – given that committed amounts are often disbursed over a number of years – disbursement information would provide a more accurate picture of the actual volume of financial resources devoted to addressing climate change in a given year. However, consistent data on disbursements is often lacking across various actors.

6. Err toward conservativeness

Where we have insufficient details, we take a conservative approach and prefer to under-report rather than over-report climate finance. A case in point is energy efficiency investment from the private sector. Due to methodological differences regarding how energy efficiency components, often part of a larger project, are estimated in external sources using top down approaches (IEA, 2021), these investments are not included in this report.

This focus on conservativeness, and a general lack of publicly available data, results in data gaps. These include flows from domestic government budgets, from private companies in certain sectors such as land use and industry, and in sectors such as energy efficiency where metrics and definitions are non-standardized and disclosure and transparency on finance flows are limited.

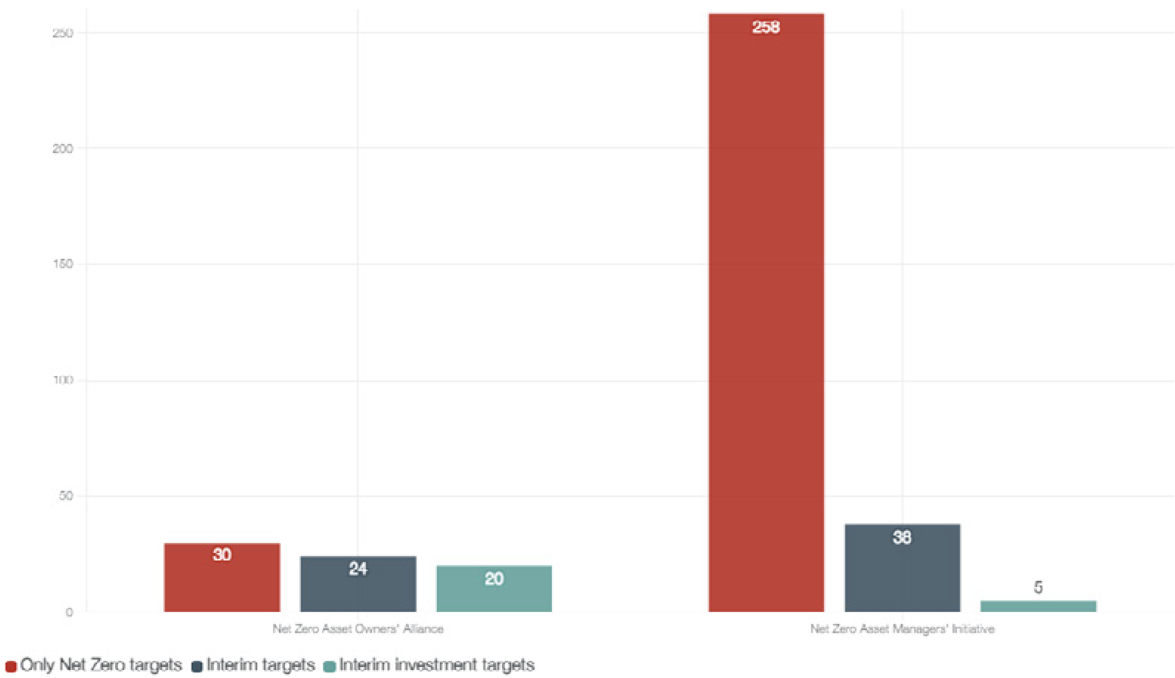
Climate finance needs assessment

We built our assessment of climate finance needs based on the best publicly available resources that are comparable to current climate finance flows. These figures are based on projected emissions pathways to achieve Net Zero by 2050 with their upper and lower bounds reflecting the variance over time in technological development, adoption rates and cost (the figures are also subject to change in the future in response to external shocks such as pandemics, war, and inflation, among other things). We do not apply additional assumptions to third-party scenarios.

These reports provide annual investment needs for different sectors and technologies based on projected technology costs, technology developments and breakthroughs, and land availability, and the need for relatively more expensive solutions such as nuclear, floating offshore wind, and carbon removal for certain countries and sectors.

For reports that are updated regularly, we have only used the most recent publication. As more literature and knowledge build up, and depending on the course of economic development (eg high inflation environment) and climate investment decisions made in the future, our climate needs assessment may change.

Institutional targets among Net Zero Alliances (No. of members with interim targets vs investment targets)



Source: Climate Policy Initiative

Table A.1: Literature review on climate finance needs assessment

Reference	Scope/coverage
Bloomberg New Energy Finance (BNEF), 2022. New Energy Outlook 2022.	Renewable power, Power Transmission & Distribution, CCUS, Integration solutions (Hydrogen, Pumped Hydro, Storage)
Bloomberg New Energy Finance (BNEF), 2022. Electric Vehicle Outlook 2022.	Battery EVs
International Energy Agency (IEA), 2020. Global EV Outlook 2020.	Battery EVs
International Energy Agency (IEA), 2019. The Future of Rail.	Rail transport
International Energy Agency (IEA), 2021. Net Zero by 2050 A Roadmap for the Global Energy Sector.	Renewable power, Power T&D, Biofuels, CCUS, Integration solutions, Transport, Industry, Buildings, Distributed Renewables
International Energy Agency (IEA), 2020. Outlook for biogas and biomethane.	Biofuels
International Renewable Energy Agency (IRENA), 2022. World Energy Transition Outlook. Abu Dhabi.	Renewable power, Power T&D, Biofuels, CCUS, Integration solutions, Transport, Industry, Buildings, Distributed Renewables
United Nations Environment Program (UNEP), World Economic Forum (WEF), and The Economics of Land Degradation (ELD), 2021. State of Finance for Nature.	Re/Afforestation, Silvopasture, Mangrove and Peatland restoration
United Nations Environment Program (UNEP), 2018. "The Adaptation Gap Report 2018." Nairobi.	Adaptation
Harmsen, J. H. M., D. P. van Vuuren, D. R. Nayak, A. F. Hof, L. Höglund-Isaksson, P. L. Lucas, J. B. Nielsen, P. Smith, and E. Stehfest. 2019. Long-term marginal abatement cost curves of non-CO2 greenhouse gases.	Methane abatement
Kreibiehl, Silvie; König, Michael; Moon, Jongwoo (2022): Data for Figure TS.25 – Technical Summary of the Working Group III Contribution to the IPCC Sixth Assessment Report. MetadataWorks, 04 April 2022. DOI: 10.48490/dw6j-ef56	Regional split of climate investment needs

Why is there such variation in our financing needs assessments?

The objective of assessing climate finance needs is to understand how much it would theoretically cost to limit global warming to a level compatible with the Paris Agreement. Because there are so many factors involved in projecting the response to climate change, every model takes a different approach on how to estimate Net Zero pathways.

Most scenarios concentrate on three emissions reduction pillars:

– behavioral and practice changes;

– efficiency and productivity gains; and

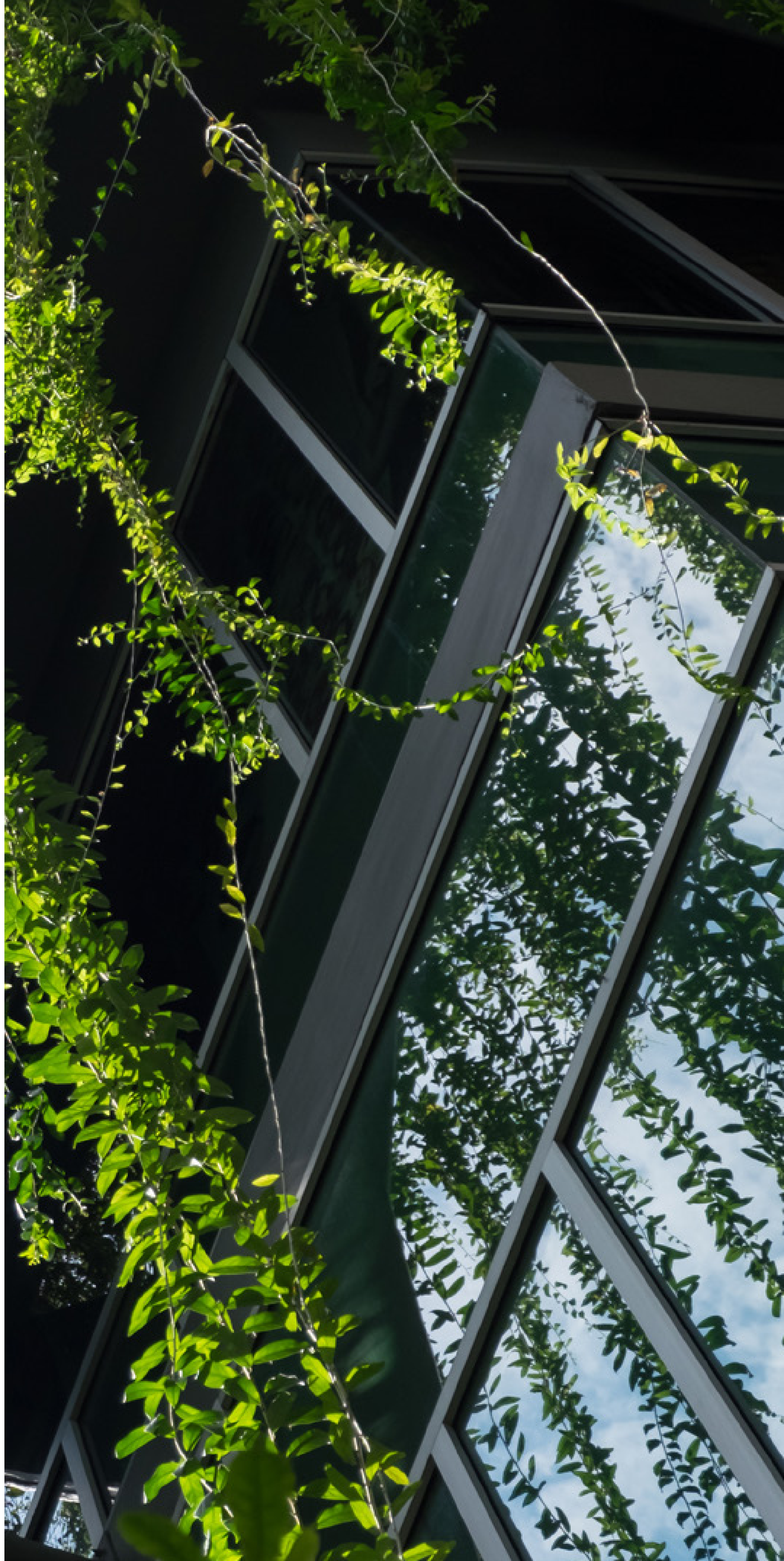
– low-carbon energy generation.

Depending on the weight attributed to each pillar, scenarios can have very different costs of implementation. For example, scenarios that rely on “technological bets” on less mature and more costly low-carbon technologies such as CCUS or green hydrogen can come with significantly greater implementation costs.

Some scenarios assume more significant cost declines in key technologies such as wind and solar while others exclude technologies such as nuclear and CCUS entirely, which causes cost estimates to increase.

To counter these difficulties, the models we use are consistent in their projection of which technologies will require the most investment in a modeled transition to a Net Zero economy – namely battery EVs, solar power, wind power, energy efficiency, and electricity transmission and distribution. By averaging the models’ projections and incorporating sector-specific scenarios, we are able to capture the full range of differences.

Together these diverse visions, and their underlying methodological assumptions, can result in differences of trillions of dollars. However, all scenarios share a simple yet crucial concept: the longer we wait to take action, the higher the costs will be.



Annex 2:
Geographies and countries

This study adopts the regional breakdown from the 2022 Landscape of Climate Finance in Africa.[131]

Region	Country or territory
Central Asia & Eastern Europe	**OECD**: Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Turkey. **Non-OECD**: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Kazakhstan, Kosovo,[132] Kyrgyz Republic, North Macedonia, Montenegro, Republic of Moldova, Romania, Russian Federation, Serbia, Tajikistan, Turkey, Turkmenistan, Ukraine, Uzbekistan
East Asia & Pacific	**Non-OECD**: American Samoa, Brunei, Cambodia, China, Cook Islands, Democratic People's Republic of Korea, Fiji, Indonesia, Kiribati, Lao PDR, Malaysia, Marshall Islands, Micronesia (Federated States of), Mongolia, Myanmar, Nauru, Niue, Palau, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Solomon Islands, Thailand, Timor-Leste, Tonga, Tuvalu, Vanuatu, Vietnam
Latin America & Caribbean	**OECD**: Chile, Colombia, Costa Rica, Mexico **Non-OECD**: Anguilla, Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia (Plurinational State of), Bonaire, Brazil, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, St. Barthélemy, Sint Eustatius and Saba, St. Kitts and Nevis, St. Lucia, St. Vincent and Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela (Bolivarian Republic of), West Indies
Middle East	**Non-OECD**: Bahrain, Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, State of Palestine, Syrian Arab Republic, United Arab Emirates, Yemen
Other Oceania	**OECD**: Australia **Non-OECD**: New Zealand, Tokelau
Africa	**Non-OECD**: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Comoros, Republic of Congo, Democratic Republic of the Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, São Tomé and Principe, Saint Helena, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, United Republic of Tanzania, Tunisia, Togo, Uganda, Zambia, Zimbabwe
South Asia	**Non-OECD**: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka
US & Canada	**OECD: Canada**, United States of America
Western Europe	**OECD**: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland, United Kingdom. Annex I Parties: Andorra, Liechtenstein, Malta, Monaco **Non-OECD**: San Marino, Vatican City

Annex 3:
Data tables

Table A.2: Public climate finance by actors and instrument (average for 2019 to 2020, USDbn)

Actor type	Balance sheet financing (debt portion)	Balance sheet financing (equity portion)	Grant	Low-cost project debt	Project-level equity	Project-level market-rate debt	Unknown	Grand total
National DFI	0	0	1	29	0	115	0	145
Multilateral DFI	0	0	3	13	2	44	6	68
State-owned FI	34	0	0	0	0	11	0	45
Government	2	5	20	0	4	0	1	32
Bilateral DFI	0	0	1	16	0	6	0	24
SOE	0	7	0	0	5	0	0	13
Multilateral Climate Funds	0	0	2	1	0	0	0	4
Public Fund	0	0	1	0	1	0	0	2
Export Credit Agency (ECA)	0	0	0	1	0	0	0	1
Unknown	0	0	0	0	0	0	0	0
Grand Total	**36**	**13**	**29**	**60**	**12**	**178**	**7**	**335**

Source: Global Landscape of Climate Finance: A Decade of Data (CPI, 2022)

Table A.3: Private climate finance by actors and instrument (average for 2019 to 2020, USDbn)

Actor type	Balance sheet financing (debt portion)	Balance sheet financing (equity portion)	Grant	Low-cost project debt	Project-level equity	Project-level market-rate debt	Unknown	Grand total
Corporation	3	85	0	0	33	4	0	125
Commercial FI	69	0	0	0	1	51	0	122
Households/ Individuals	0	55	0	0	0	0	0	55
Unknown	4	2	0	0	0	0	1	7
Funds	0	1	0	0	3	1	0	5
Institutional Investors	0	1	1	0	1	1	0	4
Grand Total	**76**	**143**	**1**	**0**	**39**	**58**	**1**	**318**

Source: Global Landscape of Climate Finance: A Decade of Data (CPI, 2022)

Appendix

1. https://climateactiontracker.org/countries/
2. https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2022/03/16/Economic-and-Environmental-Benefits-from-International-Cooperation-on-Climate-Policies-511562
3. As discussed in Annex 1, the study analyzes new investments targeting climate-specific outcomes, thereby focusing on primary financial transactions and investment costs and excluding secondary market transactions (ie the re-selling of stakes in projects or the public trading of securities on financial markets).
4. https://unfccc.int/process-and-meetings/the-paris-agreement
5. Infrastructure in this context includes, for example, energy efficiency for new construction and retrofits, solar thermal water heaters and heating, ventilation, and air-conditioning systems, as well as infrastructure for resiliency such as stormwater drainage.
6. https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/11/IHLEG-Finance-for-Climate-Action-1.pdf, p. 31
7. The phrase "carbon budget" refers to how much total GHGs can be emitted before reaching global net-zero emissions.
8. https://essd.copernicus.org/articles/14/4811/2022/
9. Tipping points are "conditions beyond which changes in a part of the climate system become self-perpetuating" or positive feedback loops lead to dramatically increased warming. See https://www.science.org/doi/10.1126/science.abn7950
10. https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_SPM.pdf
11. https://www.ipcc.ch/sr15/chapter/chapter-3/
12. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/gx-global-turning-point-report.pdf
13. https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_.pdf.pdf
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19. BNEF Energy Transition Investment Trends
20. Comparing estimated climate finance flows of USD850bn in 2021 to average estimated needs of USD6.1tn in 2030.
21. https://www.sipri.org/news/2023/world-military-expenditure-reaches-new-record-high-european-spending-surges-0
22. https://www.statista.com/forecasts/1164018/alcohol-and-tobacco-consumer-spending-forecast-in-the-world
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24. https://www.reuters.com/business/energy/india-amends-power-policy-draft-halt-new-coal-fired-capacity-sources-2023-05-04/
25. https://www.spglobal.com/commodityinsights/en/market-insights/blogs/metals/051122-battery-metals-lithium-cobalt-nickel-prices; https://www.iea.org/commentaries/critical-minerals-threaten-a-decades-long-trend-of-cost-declines-for-clean-energy-technologies
26. See for example: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7064
27. https://www.theguardian.com/environment/2023/may/17/global-heating-climate-crisis-record-temperatures-wmo-research
28.
29. The levelized cost of electricity refers to the average cost of electricity from a piece of generation infrastructure over its lifetime.
30. 88% decline for solar photovoltaic projects, 68% for onshore wind, and 60% for offshore wind.
31. Renewable Power Generation Costs in 2021, IRENA, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jul/IRENA_Power_Generation_Costs_2021.pdf?rev=34c22a4b244d434da0accde7de7c73d8, p.17.
32. https://www.iea.org/news/clean-energy-investment-is-extending-its-lead-over-fossil-fuels-boosted-by-energy-security-strengths
33. https://www.bloomberg.com/news/articles/2021-11-09/cost-of-capital-widens-for-fossil-fuel-producers-green-insight
34. https://www.iea.org/news/global-electric-car-sales-have-continued-their-strong-growth-in-2022-after-breaking-records-last-year; https://www.iea.org/reports/electric-vehicles
35. https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
36. https://about.bnef.com/blog/investment-requirements-of-a-low-carbon-world-energy-supply-investment-ratios
37. Note that this figure does not include the estimated increase in climate finance flows in 2021 to USD850bn, which CPI estimates is driven in large part by an increase in investment in low-carbon transport.
38. Technologies are a subset of sectors. Sectors in this analysis include energy systems; industry, waste, water and wastewater; buildings and infrastructure; transport; and agriculture, forestry and other land uses, and fisheries. Sample technologies within these categories include solar photovoltaic and wind energy in energy systems, EVs and rail and public transport in transport, and heat pumps and energy efficiency in buildings and infrastructure.
39. Given the different financial year-ends of public and private investors, we used annual averages of 2019 and 2020 throughout to smooth out data fluctuations.
40. BNEF Energy Transition Trends Report.
41. International Renewable Energy Agency 2022 World Energy Transition Outlook.
42. [CPI to add other references for final version.]
43. We assume that investment occurred in the year during which construction on a nuclear power plant unit began.
44. https://about.bnef.com/new-energy-outlook/
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47. https://iea.blob.core.windows.net/assets/ebe15dfb-30c8-42cf-8733-672b3500aed7/WEO2012_free.pdf; https://www.carbonbrief.org/exceptional-new-normal-iea-raises-growth-forecast-for-wind-and-solar-by-another-25/
48. https://www.climatepolicyinitiative.org/expanding-the-horizon-of-climate-adaptation-finance/
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