Closing the Investment Gap to Achieve Paris Agreement Goals

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Executive summary

Achieving global net zero emission (NZE) ambitions in line with the goals of the Paris Agreement necessitates an annual investment of trillions of US$ into various clean energy and climate change mitigation technologies. Considering the massive scale of investment needs, raising the required funds continues to be a major challenge, especially in developing countries, where access to finance remains low.

In this contribution to the Global Stocktake, we assess investment gaps across countries, defined as the difference between current investment flows and the annual investment required to achieve a Paris Agreement-aligned scenario. Our assessment of this investment is based on a Global Change Analysis Model (GCAM) developed by Ou et al. (2021), which focuses on the power sector. While this rather narrow focus does not capture the full transition picture, it provides data appropriate for a cross-country analysis. This is because the power sector has been the focus of decarbonization efforts in many countries. The gaps would be substantially larger if investment needs in other sectors, as well as associated adaptation, capacity building and policy implementation costs, were to be taken into account.

Our assessment of the investment gaps reveals that current investment is substantially below the required levels. Second, and perhaps more importantly, investment gaps are particularly striking for non-Annex I (developing) countries. Over the current decade, annual investments in the power sector in developing countries directed toward clean energy and hydrocarbons with carbon management technologies will need to increase exponentially (from four to over 12 times existing levels). This highlights the urgency of delivering on the current climate finance target under the Convention. It also draws attention to the need for a significantly higher level of ambition regarding the new collective quantified goal on climate finance under the Paris Agreement.

Our analysis of the financial development differences between the developed and developing world reveals similar gaps. Countries with low financial development, defined as scoring low on the IMF's financial development index, also tend to experience larger investment gaps.

This is to say, many developing countries with relatively less developed financial institutions and markets seem also to be less able to attract private capital for decarbonization projects.

In addition to these financial development challenges, many developing countries have not yet established their local Environmental, Social and Governance (ESG) frameworks. The ESG approach, however, is becoming a global trend that increasingly guides decisions related to financing for sustainable energy transitions. The analysis highlights the low current annual share of total ESG investments held by non-Annex I countries, with most of these funds concentrated in European and North American countries. In the worst case, ESG frameworks could constitute a further barrier to accessing financing for developing countries in the future.

Because of these bottlenecks, accelerated action and cooperation are required on many fronts to improve financing conditions for sustainable energy transitions, especially in developing countries. First, most existing ESG guidelines are not fully inclusive or reflective of the wide variety of national and regional circumstances worldwide. This can result in a non-inclusive view for ESG investors and hence, impede cost-effective scaling up of efforts. For instance, industry structures in many developing countries are currently more carbon-intensive than many developed countries. This creates practical difficulties for rapid electrification. In such cases, carbon management technologies (e.g., carbon capture, utilization and storage) and clean hydrogen fuels (e.g., blue hydrogen and ammonia) should be more explicitly recognized in ESG frameworks. This can also support transitions more broadly, in hard-to-abate sectors worldwide. Second, global cooperation on climate finance should be expanded along multiple dimensions, including via increased climate finance provisions by developed countries and knowledge sharing among countries. More active contributions from international institutions are also needed, including capacity building, policy support tools and funds.

1 Introduction

This study has been developed by the King Abdullah Petroleum Studies and Research Center (KAPSARC) as an input to the first Global Stocktake (GST) under the Paris Agreement on climate change, which is taking place from 2021 through 2023. The GST is a critical element of the Paris Agreement's ambition mechanism, as it assesses collective progress toward achieving the purpose and long-term goals of the Agreement. Its outcome informs parties in updating and enhancing their actions, support and international cooperation for climate action, including their nationally determined contributions (UNFCCC 2015).

Assessing progress, needs and gaps in means of implementation, particularly finance flows, is a crucial element of the GST. Among the questions suggested by the Subsidiary Bodies' Chairs for the Technical Assessment component of the first GST (UNFCCC 2022) are the following[1]:

[1] The questions have been shortened by the authors to reflect the scope of this submission.

- What is the collective progress in the current implementation of making finance flows consistent with a pathway toward low greenhouse gas (GHG) emissions and climate-resilient development?
- To achieve this alignment and scale up the provision and mobilization of finance from various sources and at various levels:
  - What further action is required?
  - What are the barriers and challenges, and how can they be overcome at regional and international levels?

This study aims to answer the above questions by using the power sector as a proxy and quantifying investment gaps specifically in this sector, which accounts for 31.8% of global GHG emissions (Climate Watch, 2022).[2] While it is equally important to focus on other sectors, our narrower focus is due to the availability of high-quality modeling studies and worldwide data for this sector. We first generate estimates for cumulative transition investment needs in the power sector in a Paris Agreement-compatible scenario by using the Global Change Analysis Model (GCAM) under a set of scenarios reflecting current climate targets, including nationally determined contributions (NDCs) and net-zero emission (NZE) targets. We then compare the investment needs to current investment levels to establish the investment gap for countries. The study also analyzes the relation between the investment gaps and countries' current levels of financial development (as a proxy for access to traditional finance) and access to Environmental, Social and Governance (ESG) finance (a proxy for access to sustainable finance). Finally, it concludes with recommendations on how to scale up financial resources and re-align their distribution with urgent needs.

Over the next several decades, transitions to NZE energy systems worldwide will require a major and accelerated shift in investment allocation and levels. While investment in mature, cost-effective and scalable technologies will continue to expand, other technologies necessary to meet the goals of the Paris Agreement are still in early development stages, requiring sizable funding to move them to market. Investments must be scaled up to sustain and accelerate the deployment of renewable and other clean energy technologies while simultaneously enabling a major ramping-up of carbon capture, utilization and storage (CCUS) technologies and clean hydrogen.

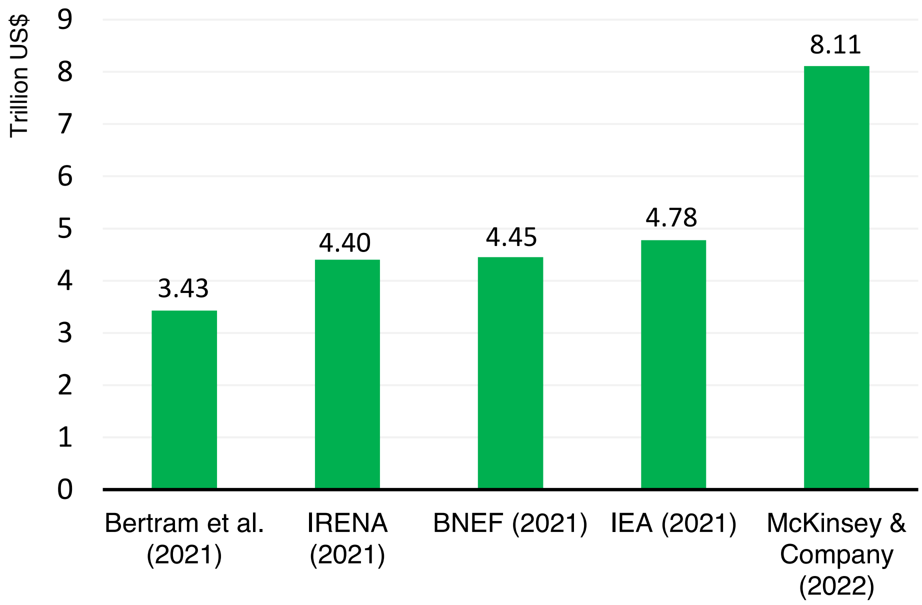
Recent estimates from different institutions show that the total cumulative investment required to reach NZE globally by 2050 ranges between US$103 trillion and US$243 trillion, which translates into annual investment needs between US$3.4 trillion to US$8.1 trillion (Figure 1). Although the estimates vary significantly depending on the source, the underlying investment levels present two features worth highlighting. First, the average required investment is around 2.5 times that observed in recent years (around US$2 trillion). The challenge of addressing this investment gap and bringing in necessary funds at scale requires globally coordinated action. The imperative to ensure sufficient funding for the transition has spurred several international institutional initiatives to effectively direct capital flows toward low-carbon assets and technologies, notably to developing countries. In November 2021, the

[2] The figure includes electricity generation and heat.

Glasgow Financial Alliance for Net Zero (GFANZ) assembled 450 major financial institutions from 45 countries, controlling over US$130 trillion in assets, committed to coordinating and accelerating investment in a net-zero economy (GFANZ 2021).

Second, the projected inter-temporal distribution for investments over the coming decades is not smooth. Most NZE scenarios project that annual investments will rapidly increase over the next several years and then peak by the mid-2030s before gradually declining toward 2050.[3] Meeting the steep increase in capital investment over the current decade is critical to achieving NZE, highlighting the need for an accelerated ramp-up in capital allocation over the coming years.

Figure 1. Average annual global investments in selected net-zero scenarios, 2021-2050.



Source: Authors' calculations based on Bertram et al. (2021), BNEF (2021), Gielen et al. (2021) labelled as IRENA in the figure, IEA (2021a) and McKinsey & Company (2022).

Note: The reported investment figure for Bertram et al. (2021) is the average investment from five models, assuming a linear interpolation up to 2050. Total investments across models range between US$2.2 trillion and US$ 4.6 trillion in the year 2030 and between US$3.0 trillion and US$5.8 trillion in the year 2050. The reported investment figure for BloombergNEF (2021) is the average investment across scenarios, ranging between US$3.1 trillion and US$5.8 trillion. The investment value for McKinsey & Company (2022) is based on the reported cumulative investment of US$275 trillion, excluding forestry.

Proportionally, around 3%-6.6% of the world's gross domestic product (GDP) needs to be dedicated to financing the NZE transition, based on the above-cited estimates.[4] As global investments account for around a quarter of annually generated GDP, between 13% and 26% of the investment effort would serve to fund the NZE transition.[5] While the patterns of already

[3] Many scenarios focus on specific sectors and technologies and therefore exclude sectors and/or technologies that will also require significant investment. Also, individual countries will reach net-zero emissions via different pathways and with different timelines.

[4] Lowest and highest shares from reported sources in Figure 1.

[5] According to the World Bank, gross fixed capital formation accounted for 25.9% of the world's GDP in 2020.

pledged future investment show mobilization of large financial flows, the cost of NZE policies seems more moderate. Indeed, the actual capital cost of reaching NZE lies in the incremental investment to decarbonize the energy system to align with the NZE target rather than its total investment needs. Overall, the effort required is sizeable, and it remains difficult to achieve. The current policies comprised in national pledges contain substantial investment, showing only a moderate increase under NZE. This can be attained at an additional cost ranging between 10% and 33% of the overall investment between the baseline and NZE scenarios (Gielen et al. 2021; McKinsey & Company, 2022). However, as highlighted previously, the capital spending gap compared to current investment levels remains substantial. Financing energy system decarbonization requires a significant push in the deployment of clean energy and carbon management technologies to a degree several times that observed in recent years. The required investment scale-up for 2030 for breakthrough technologies, that is, CCUS, hydrogen and bioenergy, is tenfold higher than the current investment amount (World Economic Forum 2021). Current investment in these technologies has remained at the only US$2 to US$3 billion over the last two years (Figure A1 of the Appendix). Investment in abatement other measures with significant mitigation potential still falls short of requirements. For instance, investment in energy efficiency would require an increase of two to seven times the current level to close the sector's capital gap (IPCC 2022).

At the regional level, most NZE scenarios reveal significant disparities, with developing countries exhibiting higher exposure to transition risks given their reliance on carbon-intensive sectors and lack of scalable access to finance. Proportionally, developing countries would require an investment of over 5%-10% of GDP instead of the much lower rates for developed nations, at 2%-4% (IPCC 2022). Moreover, the necessary global investment acceleration over the mid-term, that is, up to 2030, could aggravate disparities across regions. The scale of the funding effort remains unbalanced across economies. Developed countries need a relatively manageable yearly increase of two to five times current investment levels. In contrast, while absolute investment levels remain moderate in developing countries, the required increase is massive. Investment in developing countries, on average, must increase by four to eight times current flows, with more sizable needs in Africa (i.e., 7-16 times current flows) and the Middle East (i.e., 12-23 times current flows) (IPCC 2022).

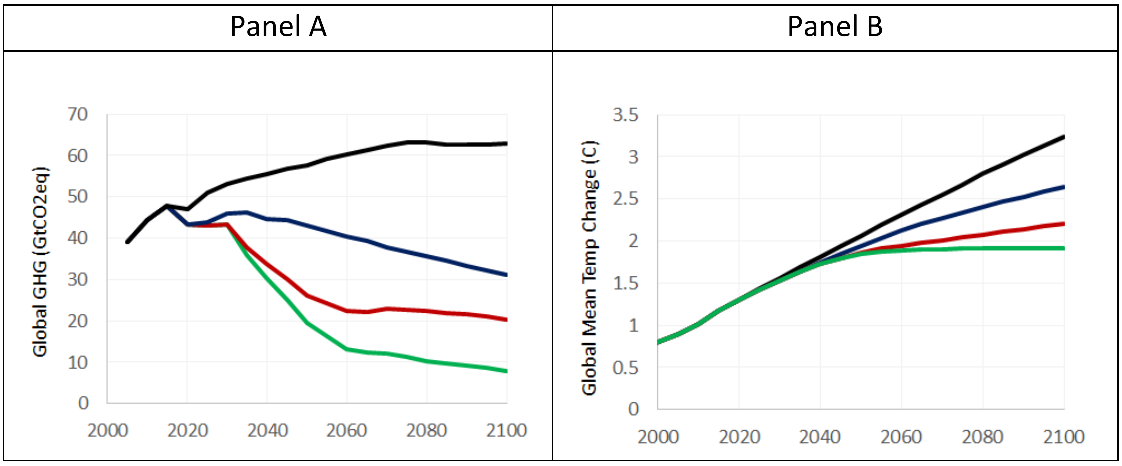
As we move forward with implementing policies to reach the Paris Agreement goals, the lack of funds and proper financing mechanisms for developing regions could threaten their transition. A delayed transition in developing countries could in turn jeopardize the achievement of a smooth, balanced and fair global shift. The gap between regions could widen as investment needs in emerging economies become substantial, underscoring the need for action. Up to 2030, according to some estimates, emerging economies would require US$1 trillion per year to achieve NZE by mid-century, over ten times the pledged funding from developed markets to support emerging economies' transition (Blackrock 2021). The persisting financial challenge is to provide clean and affordable energy to regions that currently have little to no access to energy yet are highly populated, such as Sub-Saharan Africa and Southeast Asia. However, these regions still lack tailored regulations, capacity and institutional frameworks to attract the necessary investments, notably private capital. This highlights the complexity of closing the transition gap in funding.

2 Modeling NZE pathways: A GCAM approach

GCAM is a globally integrated assessment model (IAM) (Calvin et al. 2019) widely used in major integrated climate-energy-economic assessments (Calvin et al. 2017; Clarke et al. 2014; Thomson et al. 2011). It is a dynamic-recursive market-equilibrium model calibrated to a historical base year (2015), which stimulates the evolution of socioeconomics, energy, agriculture and land, water, and climate systems and their interactions over time to 2100. The model encompasses a technology-detailed energy model with representations of supplies and demands,a land and agricultural submodule that provides projections of commodity supplies and prices as well as land use and cover changes, a water module that tracks demand in six major sectors and represents supplies from renewable and non-renewable resources, and a reduced-complexity climate model that can translate GHG emissions into temperature estimates. While the model tracks the co-evolution of all these systems in a consistent fashion, we focus our investment analysis on the capital stock turnover in the power sector. GCAM assumes that generating technologies have a prescribed lifetime, and investments in new plants are added by vintage (i.e., the period in which the investment is made) at a pace allowing sufficient generating capacity to meet demand. Each power plant operates until it reaches the end of its lifetime or is retired from production if its operating costs surpass electricity market price. The new technology investments compete for a share of energy markets based on cost differences among competing options (Santos da Silva et al. 2021; Zhao et al. 2021). Thus, the model can estimate the new installations and capital investments driven by future changes in the power sector under any devised scenario.

In this study, we build on GCAM emission scenarios developed by Ou et al. (2021). More specifically, we focus on four scenarios that reflect alternative pathways of climate policy regimes and their associated global GHG emissions, in gigatons of carbon dioxide (Figure 2: Panel A). The scenarios also reflect the resulting global mean temperature change, in degrees Celsius (°C), above pre-industrial levels (Figure 2: Panel B). The reference scenario (black line) reflects a no climate policies world (i.e., a counterfactual scenario rather than a forecast or most likely scenario). The current climate policies scenario (blue line) is a world where countries maintain their decarbonization efforts beyond 2030 at the same decarbonization rate implied in their current policies between 2015 and 2030. The updated NDCs scenario (red line) reflects a world where the updated NDCs to 2030 and NZE pledges are accounted for, and for regions without NZE pledges, a 2% annual rate of improved performance in CO2 emissions per unit of GDP is assumed. The scenario for updated NDCs with increased ambition (green line) is similar to the previous one with the addition of increasing ambition in the second half of the century to be in line with a 2 °C world and the Paris Agreement. The discussion here focuses on the Paris Agreement-compatible scenario results (green line). The extended results for all the scenarios are displayed in Table A1 of the Appendix.

Figure 2: Model scenarios and results (in global GHG and global mean temperature change)

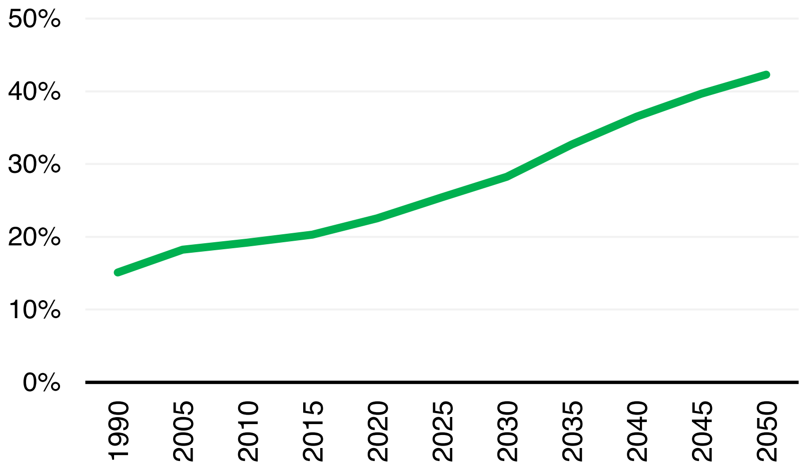


Source: Authors' construction from Ou et al. (2021)

A significant portion of the effort to reach NZE relies on the power sector as a decarbonization lever. According to the International Energy Agency (IEA 2021a), the deployment of renewable energy, mostly solar and wind, combined with the electrification of end-uses, notably in the transport and industry sectors, could represent 41% of the carbon abatement needed by 2050. Other technologies provide critical, cost-effective support in meeting the carbon reduction over the next few decades. For instance, CCUS in fuel supply, power generation and industry could mitigate exposure to stranded assets while decreasing about 14% of carbon emissions by 2050 (IEA 2021b).

By that horizon, our GCAM-based, modeled electricity share in the final energy demand is double its current level, representing 42% of the final energy consumption in the Paris Agreement-compatible scenario (Figure 3).

Figure 3. Electricity as a share of the final energy consumption under the Paris Agreement-compatible scenario.



Source: Authors based on GCAM simulations.

Over the next few decades, most decarbonization investments will occur at the power system level. Electrifying end-uses and upgrading infrastructure to accommodate intermittent sources and energy storage requires capital flows higher than current levels. Up to 2030, the power sector should mobilize two to five times current investments (IPCC 2022). The accelerated shift toward low-carbon technologies for power generation highlights an ongoing trend driven by renewable energy. The current power mix remains a significant source of emissions in most countries worldwide. However, renewable energy deployment, in particular, has been increasing rapidly. In 2015, it overtook non-renewable capacity additions as solar and wind came on par with conventional generation sources in many markets worldwide (Gielen et al. 2021). Financing for carbon management technologies such as CCUS in the sector has remained at low levels. Up to 2050, most NZE scenarios associate energy systems' deep decarbonization with massive power sector investments. On the global scale, yearly investments in power generation and its underlying infrastructure, including grid flexibility, often exceed US$2 trillion. This represents between a quarter and two-thirds of the mobilized funds under the NZE scenarios.

3 Identifying investment gaps

Building on the earlier discussion, investment needs for sustainable energy transitions are immense. Achieving targeted levels can be a difficult task for many regions, considering the heterogeneity across regions in terms of various key enabling factors, particularly access to the appropriate financial resources. Therefore, based on the GCAM model, we first identify the required level of investment aligned with the Paris Agreement. We then compare required investment levels with countries' current investment levels to diagnose the investment gaps. As explained above, to achieve this, we employ the GCAM model and the scenarios developed by Ou et al. (2021). The GCAM model allows us to compute the required level of annual investment flows compatible with the Paris Agreement at the country and regional levels. The scenario analysis covers the implementation of the NDCs and NZE targets announced as of September 2021, in line with Ou et al. (2021). We focus on the power sector in our investment gap assessment because power sector decarbonization efforts are commonly practiced in many countries. This provides useful data for cross-country comparison. While this approach does not provide the full picture of the transition investment gaps (i.e., not accounting for other sectors, such as transportation, or other costs, such as adaptation or policy costs), it is still a useful case study to present existing gaps across countries. The discussion here focuses on the Paris Agreement-compatible scenario results. The extended results for all the scenarios are displayed in Table A1 of the Appendix.

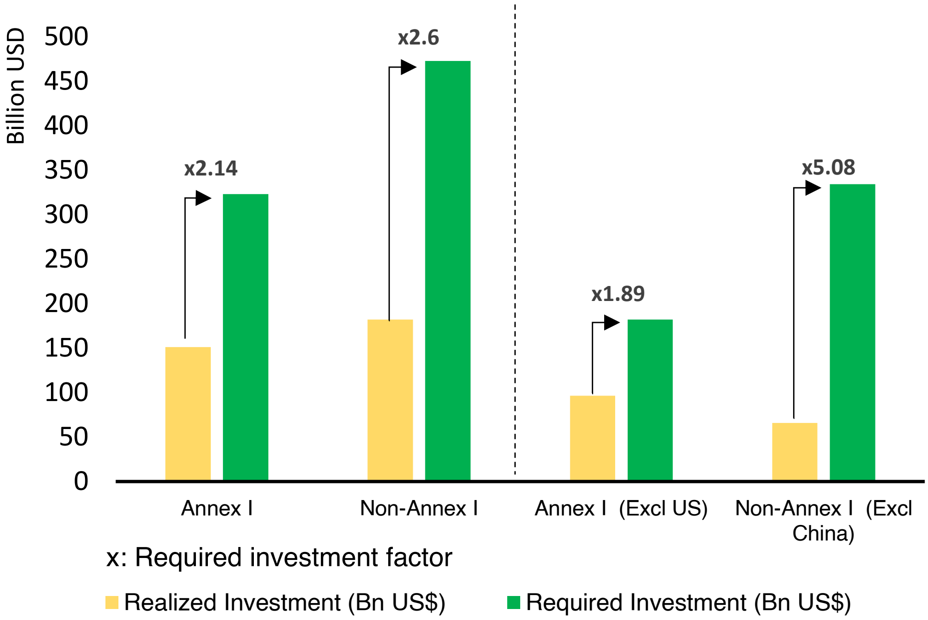
The model estimates that roughly 1-1.6 trillion US$ in sustainable energy transition investment is needed annually for the power sector alone. The vast majority of this investment will be in clean energy, particularly renewable energy, as well as fossil fuels with carbon management technologies, such as the CCUS. Among the renewable technologies, wind and solar are the two key technologies receiving the most attention globally.

To identify investment gaps, we compare required investment levels (i.e., based on the GCAM model) and realized annual investment flows, based on power sector investment data from BloombergNEF. It is worth noting that our investment definition only covers physical infrastructure costs (e.g., power generation infrastructure). To construct country groups, we use the United Nations Framework Convention on Climate Change (UNFCCC) Annex classification. Figure 4 shows the result for the investment gaps across the two country groups, Annex I and non-Annex I.[6,7] More specifically, in the figure, the realized investment bars display the average annual investment flows in the last three years available, 2019-2021. The required investment levels, derived from the GCAM model, show the average annual investment flows required over the current decade (i.e., 2021-2030). Hence, the investment gap is defined as the difference between the two numbers. The gaps are displayed in Figure 4, which also shows the needed increase in the annual realized investment flows.

[6] We also construct the same figure based on the developed and developing country classifications used in the United Nations (2020) report. The figure reveals almost identical investment gaps across the developed and developing countries, as can be seen in Figure A2 of the Appendix. Only four countries, Belarus, Russia, Turkey and Ukraine, are listed as developing countries by the United Nations (2020) report but are listed under Annex I by the UNFCCC. We, therefore, use the two groupings interchangeably in the report.

[7] In Figure 4, we present the investment gaps based on the Paris Agreement-compatible scenario. The same gaps are presented in Table A1 of the Appendix for all the other scenarios.

Figure 4: Sustainable energy investment gaps by country groups.

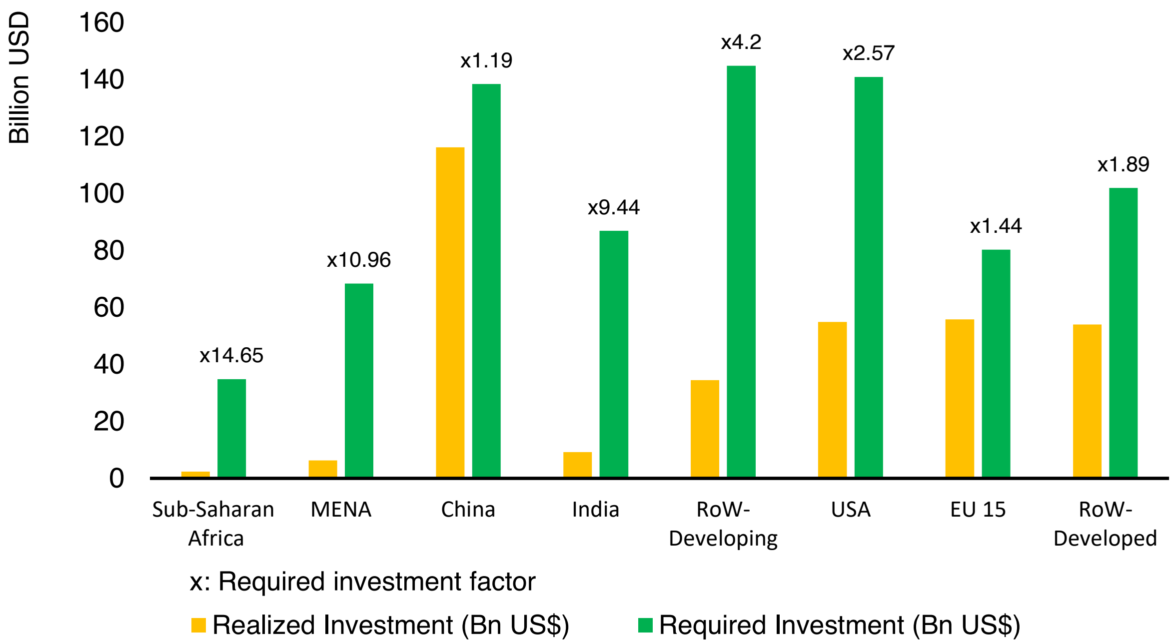


Source: Authors' calculation from the Bloomberg, World Bank and Ou et al. (2021).
Note: Realized investment is the average sustainable energy transition investment flows into the power sector between 2019 and 2021, from Bloomberg. The required investment is the average investment flow needed to achieve the Paris Agreement-compatible scenario in the model. "x" is the additional investment needed to achieve the required level. Annex classification is based on the UNFCCC. Sustainable energy transition investment numbers in the figure include hydro, geothermal, bioenergy, solar, wind and nuclear investments. CCUS investments are not included due to data shortages.

According to Figure 4, investment realization levels for Annex I economies are higher, relative to their required investment levels, than in the non-Annex I group. Put differently, while developed countries will need 2.1 times more investment in the Paris-aligned scenario, this number is much higher for the developing nations, around 2.6. Among developed countries, the United States reveals a lower performance (e.g., lower investment performance relative to required levels) than the group average, with 2.6 times more investment needed, while this number for China is roughly half that at 1.2 times (Figure 5). Among the developing countries, China displays considerable success, with high levels of transition investment in the power sector. Therefore, excluding these two countries from their respective groups doubles the investment gap between the two groups. More specifically, the gap decreases to 1.8 times current levels for developed countries and increases to 4.8 times for developing countries.

In Figure 5, we present a breakdown of the sustainable energy transition gap in the power sector, highlighting some major economies and regions. In line with the earlier discussion, regions with mostly non-Annex I countries display larger gaps compared to the regions with primarily Annex I countries. More specifically, Sub-Saharan Africa records the highest investment gap, where the realized investment needs to increase to about 15 times the current level. The Middle East and North Africa (MENA) region displays the second-largest gap among the selected groups, followed by India. Among developing countries, China stands out as the leading country with a relatively small gap. The average realized annual investment flows in China were around US$116 billion against the annual requirement of US$138.4 billion.

Figure 5: Sustainable energy transition gaps by region.



Source: Authors' calculation from the Bloomberg, World Bank and Ou et al. (2021).
Note: Realized investment is the average sustainable energy transition investment flows into the power sector between 2019 and 2021, from Bloomberg. The required investment is the average investment flow needed to achieve the Paris Agreement-compatible scenario in the model. "x" is the additional investment needed to achieve the required level. "RoW Developing" is the rest of the developing countries, and "RoW-Developed" is the remaining developed countries. “Sub-Saharan Africa” contains all of the continent except the north, which is covered in “MENA.” “EU15” contains Austria, Belgium, Germany, Denmark, Spain, Finland, France, the United Kingdom, Gibraltar, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Sweden. Clean investment numbers in the figure include hydro, geothermal, bioenergy, solar, wind and nuclear investments. CCUS investments are not included due to data shortages.

The Annex I countries in Figure 5 show moderate gaps. The EU15[8] will only need an additional 44% increase in their current investment levels to align with the Paris Agreement’s goals. This figure is roughly 89% for the rest of the group, excluding the US and the EU15. As mentioned above, the US has a low investment performance as its transition investment needs in the power sector reach US$145 billion annually until 2030. However, its current average annual investment levels are far from this, at about US$55 billion.

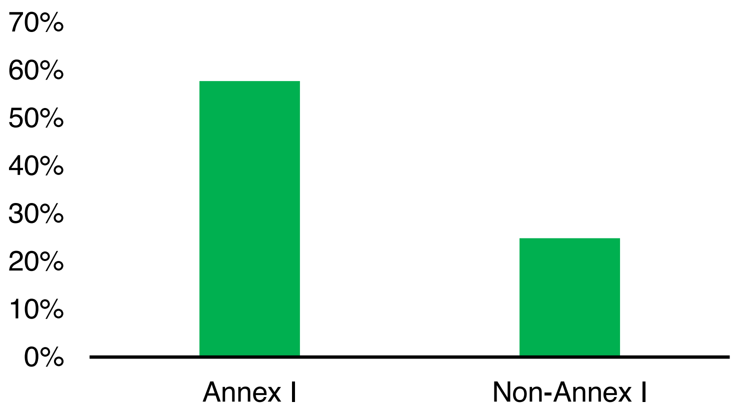
[8] The EU15 contains Austria, Belgium, Germany, Denmark, Spain, Finland, France, the United Kingdom, Gibraltar, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Sweden.

4 The role of finance in addressing investment gaps

The discussion above reveals an important finding: almost all countries face significant investment gaps. These are particularly acute in developing countries. The relevant academic literature discusses several factors that can potentially contribute to these gaps, such as challenges relating to policies and technological development (e.g., Bourcet 2020). However, raising the necessary finance for the required investment appears to be the most daunting challenge, especially for developing countries (e.g., Anton and Afloarei Nucu 2020; Best 2017; Lin and Omoju 2017).

While, in principle, finance can come from various sources, both public and private, mobilizing private financial resources is crucial to meeting the unprecedented size of the investment requirements. This, however, is conditional on the development of domestic financial institutions. That is to say, without achieving a certain level of financial development—measured by the International Monetary Fund (IMF)'s financial development index that combines financial access, market efficiency and financial depth—mobilizing foreign and domestic private finance will be challenging. Financial development is, therefore, an important factor affecting countries' current and future investment levels. To better shed light on this argument, we present current financial development levels for Annex I and non-Annex I countries in Figure 6. Financial development is measured by the Financial Development Index, developed by Svirydzenka (2016) of the IMF. This index accounts for the multiple dimensions of financial development at the country level, including financial access, depth, and efficiency.

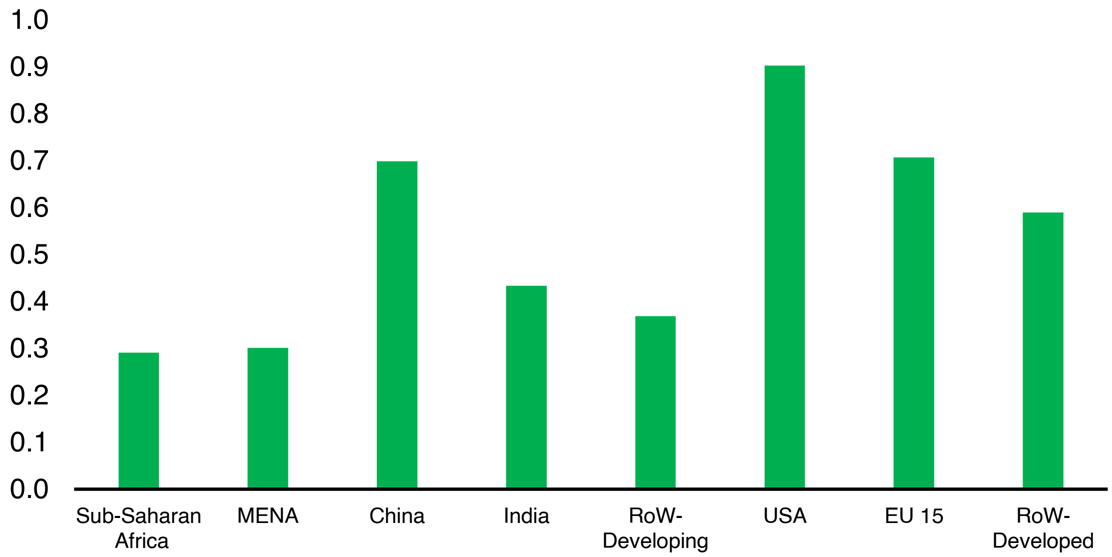
Figure 6: Average financial development by country group.



Source: Authors' calculation from IMF Financial Development Index.
Note: The Annex classification is based on UNFCCC.

As displayed in Figure 6, the average Financial Development Index score among developing nations (25%) is less than half of the average score for developed nations (58%). This implies that many non-Annex I countries lack the necessary financial development to mobilize the private financial resources to undertake the necessary investment needed for their sustainable energy transitions. This is better visualized in Figure 7, which displays financial development by selected major economies and regions. Notably, while the largest investment gaps were noted in the Sub-Saharan Africa and MENA regions, these regions also indicate the lowest financial development levels. In line with the findings of the academic literature, there appears to be a direct mapping between countries' clean investment levels and their financial development levels.

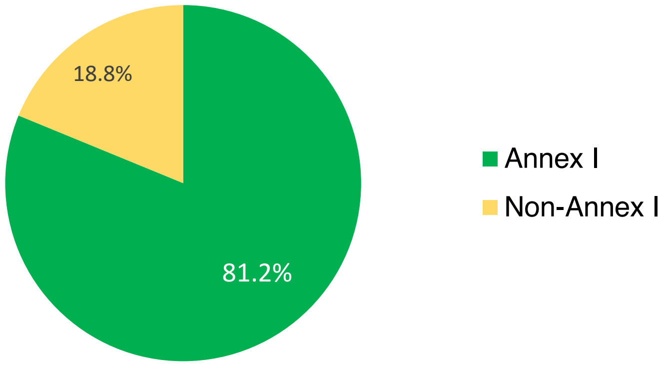
Figure 7: Average financial development by region.



Source: Authors' calculation from IMF Financial Development Index.
Note: "RoW Developing" is the rest of the developing countries, and "RoW-Developed" is the remaining developed countries. "Sub-Saharan Africa" contains all of the continents except the north, which is covered in "MENA." "EU15" contains Austria, Belgium, Germany, Denmark, Spain, Finland, France, the United Kingdom, Gibraltar, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Sweden.

A further challenge with financing the global net-zero transition is that traditional financial instruments do not incorporate many of the risks and opportunities associated with sustainable energy transitions, as they focus on short-term financial return maximization. Different from the traditional investment approach, sustainable finance puts more emphasis on long-term returns with a focus on environmental, social and governance issues in financing decisions. Accordingly, it promises lower financing costs and greater investment and asset allocation toward projects compatible with Paris Agreement goals. Particularly, the E pillar of ESG finance has captured the most attention in recent years from various institutional investors, such as pension funds, hedge funds and sovereign wealth funds (SWFs), worldwide. Scaling up ESG finance is anticipated to become increasingly more important for raising funds for the investment needs of sustainable energy transitions (OECD 2021). Despite its crucial role, many developing countries have yet to attract significant ESG flows, which are highly concentrated in developed economies (Figure 8).

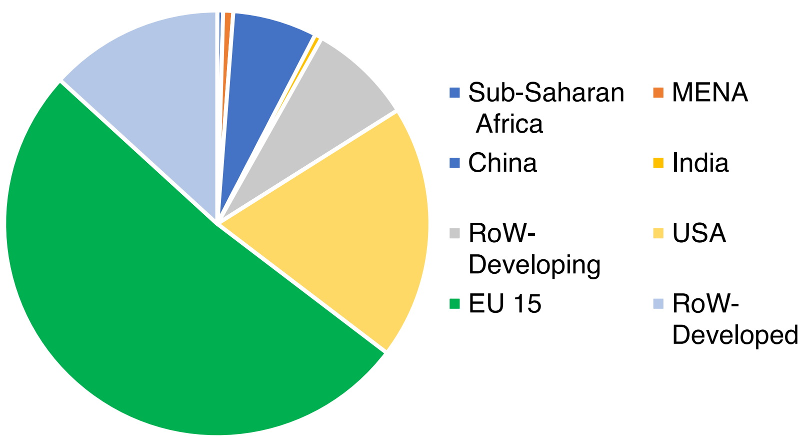
Figure 8: Share of ESG funds by country group.



Source: Authors' calculation from BloombergNEF.
Note: Annex classification is based on the UNFCCC. The figure displays the group shares of average ESG flows in the last three available years (2019, 2020 and 2021) in the data source. The instruments included in the calculations of average ESG flows are green, social and sustainability-linked bonds and loans.

Figure 9 presents the share of ESG flows by selected economies and regions. Despite relatively higher investment performance and financial development, China receives only 6% of the global flows. India and other developing countries in Sub-Saharan Africa and MENA obtain only negligible shares of these flows. In contrast, the EU15 receives about half, and the US alone attracts 19%. Considering the fact that ESG is expected to play an increasingly more visible role in the finance of sustainable energy transitions, the current allocation of flows displays a concerning picture. Many developing nations already experience difficulties in raising the investment funds required to realize their NZE ambitions. The transformation of financial markets toward ESG may impede their financial access in the near future.

Figure 9: Share of ESG funds by region.



Source: Authors' calculation from BloombergNEF.

Note: The figure displays the group or country shares of average ESG flows in the last three available years (2019, 2020 and 2021) in the data source. The instruments included in the calculations of average ESG flows are green, social and sustainability-linked bonds and loans "RoW Developing" is the rest of the developing countries, and "RoW-Developed" is the remaining developed countries. "Sub-Saharan Africa" contains all of the continent except the north, which is covered in "MENA." "EU15" contains Austria, Belgium, Germany, Denmark, Spain, Finland, France, the United Kingdom, Gibraltar, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Sweden.

5 Policy recommendations

As a contribution to the first Global Stocktake within the framework of the Paris Agreement, this study aimed to assess the investment gaps that must be closed to achieve the temperature goals of the Paris Agreement. First, we reviewed estimates of global energy-related investment requirements derived from different scenarios, for example, the IEA and International Renewable Energy Agency. Second, we identified investment gaps (i.e., the difference between the required and actual annual investment levels), building on a modeling study by Ou et al. (2021). The gap analysis focused on the power sector because this sector is commonly the first target of decarbonization efforts. Consequently, the data necessary for a cross-country comparison were readily available. More and better data on other sectors are urgently needed to enable similar exercises and more accurate economy-wide estimates.

Our investment gap analysis revealed that significant gaps persist on the road to achieving the Paris Agreement goals in almost all countries. A more profound shift in investment scale and focus is essential, particularly for developing countries, where many climate change effects are projected to be felt most severely. While different factors can contribute to these results (e.g., policies, technology access), finance-related enablers appear to be key. Our results showed that the geographic distribution of financial development levels inversely maps vis-a-vis investment gap distribution: higher investment gaps are indicated for financially less developed countries. Greater costs of raising funds and access to finance are increasing the investment gap in developing countries. Indeed, given the weakness of financial markets and the relatively high domestic risks in developing countries, private investors require high-risk premiums on the funding that they provide, rendering the transition more costly for these countries. Consequently, low-carbon transition investment penetration in developing countries continues to be below potential, in competition with other priorities. Profound transformation and structural changes are needed to distribute capital more equitably among countries. Policy initiatives targeting the reduction of capital cost levels for low-carbon investments can significantly support the transition in many developing countries, where the need for capital is greatest.

More importantly, our study highlighted that the distribution of ESG finance is extremely unequal, with ESG finance being broadly defined as capital flows to low-carbon initiatives with direct GHG mitigation benefits, which is an important part of the energy transition finance puzzle. Developing countries generally receive a very small portion of ESG financing.

According to the data reviewed, about 83% of recent ESG flows have gone to developed economies.

Furthermore, considering the increasing importance of ESG finance as a source of transition investment in the coming years, many developing countries may face further difficulties in accessing the necessary finance. To address this challenge, globally harmonized ESG standards, as currently pursued by the international community under the International Sustainability Standards Board, should clarify existing ambiguities around green taxonomies. They should also recognize structural differences and diverse circumstances across countries and regions as well as the challenges that most developing countries face in attracting and scaling up funding for their energy transition investment projects. Some of these circumstances include higher dependency on hard-to-abate sectors, challenges with energy access or equality and lower technological and institutional capacities. In that regard, besides renewable energy, carbon management technologies (e.g., carbon capture and utilization methods), decarbonization efforts (e.g., switching to lower carbon fuels) and emerging technologies (e.g., clean hydrogen) should be explicitly and appropriately addressed by globally established ESG standards so as to recognize and realize their potential in the global NZE transition.

In parallel to the global efforts, local governments, especially in developing countries, should engage more with the global community to expand their ESG finance infrastructures. This includes developing local ESG standards dealing with debt (e.g., green or sustainability bonds and loans) and equity (e.g., green stocks) markets and ensuring their alignment with the global ESG architecture. Capacity building and knowledge transfers constitute essential steps in this development. More active participation from international institutions, such as the World Bank and IMF, can support the process. They can bring practical solutions to help meet the capacity-building and knowledge transfer needs of developing countries.

Fulfilling the so far failed promise of delivering US$100 billion per year in climate finance for developing countries and significantly increasing ambition on the new collective goal on climate finance, currently under negotiation, are crucial starting points for delivering on the energy transition investment required by the developing world. Moreover, public climate finance flows can also substantially catalyze the scaling up of ESG funds in developing countries. While the size of these funds is relatively small, especially compared to the massive investment requirements, they can mobilize other private funds to flow into developing countries. Multilateral international investment institutions (e.g., the World Bank's Multilateral Investment Guarantee Agency) can also spur the process by assessing country-specific risks and providing hedging mechanisms for private investors. Further dynamic involvement of these institutions could potentially leverage the environmental character of multinational corporations and stimulate low-carbon activities.

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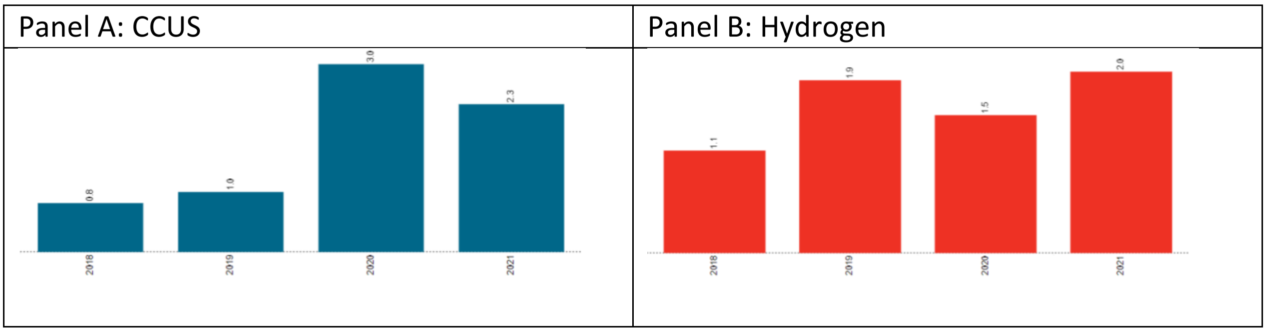
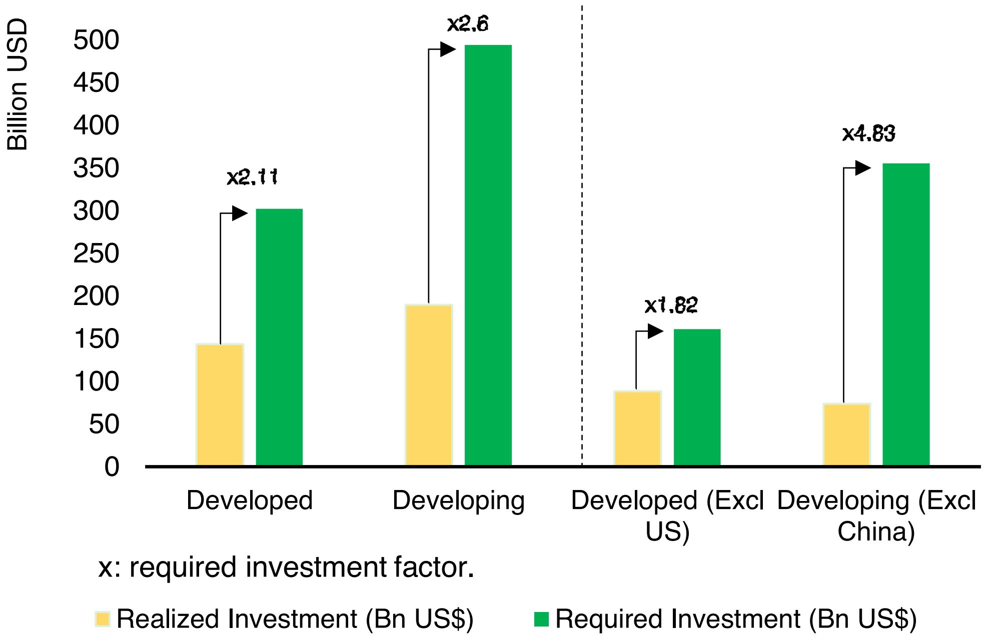
Appendix

Figure A1. Global emerging technology investments.



Source: Authors' calculation from Bloomberg Transition Investment.

Figure A2. Sustainable energy transition investment gaps, power sector.



Source: Authors' calculation from Bloomberg, United Nations (2020) and Ou et al. (2021).

Note: Realized investment is the average sustainable energy transition investment flows into the power sector between 2019 and 2021, from Bloomberg. The required investment is the average investment flow needed to achieve the NZE-compatible scenario in the model. "x" is the additional investment needed to achieve the required level. Development classification is based on the United Nations (2020) report. Sustainable energy transition investment numbers in the figure include hydro, geothermal, bioenergy, solar, wind and nuclear investments. CCUS investments are not included due to data unavailability.

Table A1: Investment gaps for other scenarios

Country Groups	Updated NDCs scenario with increased ambition scenario (Paris Agreement Compatible)	Updated NDCs scenario	Current climate policies scenario	Reference scenario
Annex I	2.135	2.137	1.338	1.055
Non-Annex I	2.599	2.600	2.503	2.267
Developed	2.107	2.109	1.273	1.015
Developing	2.602	2.604	2.505	2.247

Source: Authors' calculation from Bloomberg, United Nations (2020) and Ou et al. (2021).
Note: The investment gap is defined as the additional "realized investment" needed to achieve the "required investment level." Realized investment is the average flows of sustainable energy transition investment into the power sector between 2019 and 2021, from Bloomberg. The required investment is the average investment flow needed to achieve the Paris Agreement-compatible scenario in the model. Annex classification is based on the UNFCCC. Development classification is based on the United Nations (2020) report.