



G20
INDONESIA
2022

ENERGY
TRANSITIONS
MINISTER'S
MEETING

2 SEPTEMBER 2022



**STOCKTAKE ON ACCESS, TECHNOLOGY,
AND FINANCE**

*Accelerating Energy Transitions Towards
Net Zero Emissions or Carbon Neutrality*

Stocktake on Access, Technology, and Finance

*Accelerating Energy Transitions Towards Net Zero
Emissions or Carbon Neutrality*

2022

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Introduction

At their Rome Summit in 2021, G20 Leaders reaffirmed their commitment to the Paris Agreement goal of holding the global average temperature increase well below 2°C and pursuing efforts to limit it to 1.5°C above pre-industrial levels. G20 countries committed to net zero emissions or carbon neutrality by mid-century as part of their announced 2030 pledges at the COP26 Glasgow Summit. To implement these goals, G20 Leaders called for accelerating actions across mitigation, adaptation and finance in this decade.

Towards 2030, G20 countries will develop national pathways that align the mid-century long-term ambition with short- and medium-term goals. On the road to net zero emissions or carbon neutrality by or around mid-century, the energy sector will have to play a critical role, as it accounts for almost 80% of global GHG emissions. Similarly, the G20 has to play its role as a leading international cooperation forum for aligning efforts on finance, technology and sustainable development for all.

The Indonesia G20 Presidency has made the acceleration of clean energy transitions to net zero emissions or carbon neutrality as a leader-level priority and confirmed three pillars of action - boosting energy accessibility, scaling up clean energy technology deployment and clean energy financing and investment. Through these three pillars the G20 should promote sustainable and clean energy transitions.

This commitment by the G20 towards accelerating clean energy transitions has never been as relevant as today. Energy security and clean energy transitions are integral parts of a sustainable future and the Bali Compact highlights the critical principle of resilient energy supply and market stability.

In 2022, the G20 has to address collectively the economic, social and energy security implications from the triple global crisis: the global humanitarian crisis, economic slowdown and accompanying supply chain disruptions stemming from the COVID-19 pandemic, and the global climate and energy crisis, which directly affects global oil, gas, electricity and coal markets and brings about rising cost of living and a risk of growing inequality of energy access. Concerns around energy security and market stability have not been this urgent since the oil crisis of the 1970s. In response, energy systems have to become more resilient, more energy secure, and reliant on stable supply, prioritizing renewable resources wherever possible. This will affect every corner of the world. For example, increasing the resilience of small island developing states and archipelagic regions means creating opportunity for renewable energy, thus decreasing the dependence on fossil fuels.

The objectives of the Agenda for Sustainable Development (SDGs) and the Paris Agreement, adopted by all G20 countries, are increasingly converging and becoming mutually supportive. In terms of SDG7, this has evolved into a recognition that the global clean energy transitions will need to address energy access as well as energy efficiency targets, in addition to scaling up renewable energy, and adapt to regional and national needs.

For developing economies, this is being articulated in terms of a just, inclusive and equitable energy transitions that recognizes the access deficit, economic development needs, and local supply chain needs. The inclusion of women, youth and the empowerment of local communities is a vital factor for making energy transitions a success for everyone. The Global Commission for People-Centered Clean Energy Transitions believes that all clean energy transitions should be truly people-centered and inclusive, and that this is essential to the success of energy system transformation at the pace and scale required to deliver global ambition for climate change mitigation (IEA, 2021a).

Clean energy technology deployment is a key enabler for implementing global climate goals and for accelerating clean energy transitions by 2030 towards net zero emissions or carbon neutrality by mid-century. Under their Nationally Determined Contributions (NDCs), developing economies aim to raise climate ambitions, conditional upon access to finance and technology. While each country's circumstances and priorities may vary, clean energy technologies will be a fundamental driver of progress towards 2030 and 2050 targets. Post-pandemic economic recovery plans in many economies focused heavily on renewables and energy efficiency but also industrial transformation and technology innovation, making the outlook stronger but global fiscal stability may limit the scope of such recovery spending.

Getting the world on track to meet net zero emissions or carbon neutrality by mid-century requires more than three-fold increase in clean energy investments reaching USD 4.6 trillion by 2030, according to the IEA Net Zero by 2050 A Roadmap for the Global Energy Sector report. A coordinated G20 approach across finance, infrastructure, energy and climate tracks to coordinate action over investment in clean energy transitions would also help leverage positive spill-overs, making the transitions easier for all.

Financing an accelerated clean energy transitions is one of the core priorities of the Bali Compact and Roadmap. Importantly, at COP26, countries reaffirmed their pledge of providing USD 100 billion annually from developed to developing countries. A new collective quantified goal (NCQG) on climate finance is to be agreed by 2024, starting from a floor of USD 100 billion per year. This funding will be critical for enabling access to clean energy and its technology deployment.

Radically transforming the energy system will require a substantial scaling-up of investment between now and 2030. In the energy sector, depending on the ownership structure, investment will be privately or publicly financed. On average, about 30% of additional investment globally is expected to come from public sources, with additional public investment needs to reach net zero emissions or carbon neutrality estimated at a cumulative 2% of GDP (with a range between 0.5 and 4.5 percent) for the decade between 2021 to 2030. The remaining 70% of the additional investment would come from private sources. Mobilizing private finance will require putting in place adequate financing, institutional, and regulatory frameworks with appropriate fiscal policies. A range of innovative financing instruments and vehicles are also needed to mobilise private capital from domestic and international sources and the role of new partnership models to help meet the G20's finance priority.

The G20 remains strongly committed to implementing and accelerating clean energy transitions to address these multiple crises. G20 countries will work jointly and individually towards meaningful and effective actions contained in the commitment under the Bali Energy Transitions Roadmap towards net zero or carbon neutrality, proposed by the G20 Presidency of Indonesia. If carried out consistently over the next years, G20 countries have the potential to be a driving force to reduce the gap collectively between existing emission reduction plans and what is required to reduce emissions towards 1.5°C. Energy transitions will be vital to make significant progress to deliver near term climate mitigation action.

This G20 leader-level ambition and the three key priorities will need to be consistently implemented across several Presidencies in the Energy Transitions Working Group and link to the relevant discussions and work programmes in the G20 finance and climate tracks.

The annual stocktake of progress, prepared jointly by the SEforAll, IEA and OECD will allow the G20 as a whole to track progress on energy accessibility, clean energy technology, and scaling-up clean energy finance and investment, with a view to identify emerging priorities and key opportunities for international collaboration in the G20. This stocktake provides an overview of recent trends in the clean energy sector with regard to access, technology and finance, highlighting the latest data and indicators to track progress and opportunities for enhanced international collaboration for the G20 to build new partnerships. The stocktake can facilitate an annual progress update under each Presidency, while capturing the priorities highlighted by future Presidencies.

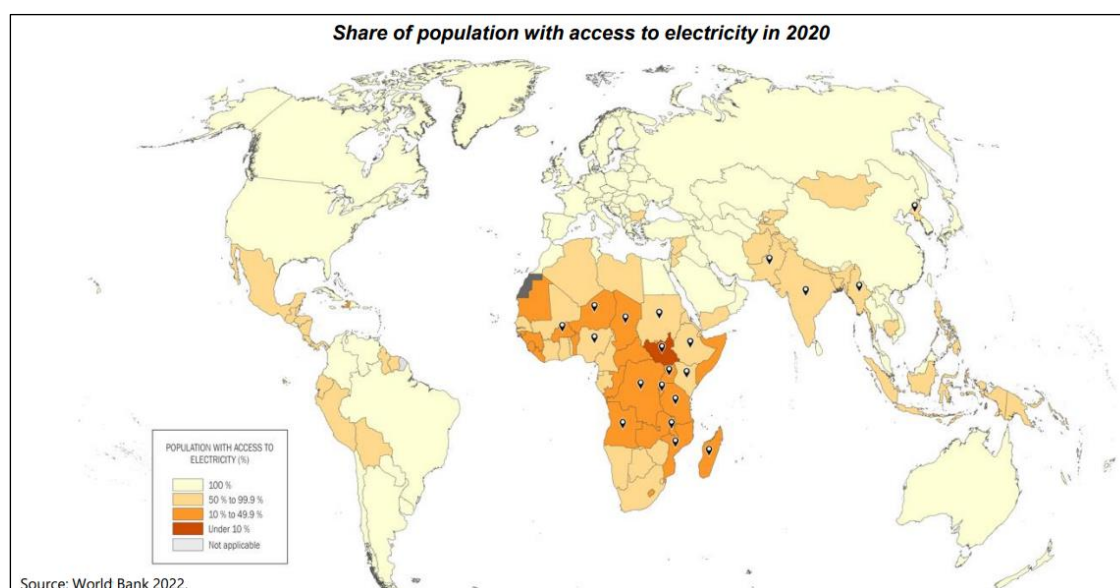
I. Stocktake of Priority #1: Energy Accessibility

I.1 Context

At today's rate of progress, the world will not achieve the SDG 7 goal by 2030. The most prominent gap remains in Sub-Saharan Africa where access rates to electricity continue to be below 50% in many countries (see Figure 1). The largest unserved populations can be found in Sub-Saharan Africa in Nigeria (92 million people), the Democratic Republic of Congo (72 million), and Ethiopia (56 million).

Recent progress on SDG7 indicator 7.1.1 (access to electricity) has been mixed, as is the outlook between now and 2030. The global electricity access rate rose markedly between 2010 and 2020, from 83% to 91%. During this period, the number of unserved people fell from 1.2 billion in 2010 to 733 million in 2020 (IEA et al, 2022a). Meeting the 2030 target requires increasing the number of new connections to 100 million a year. At current rates of progress, the world will reach only 92% electrification by 2030. In addition, the development dividend of increased access to electricity--the ultimate goal of SDGs, will only take off well beyond basic access (Energy for Growth Hub, 2021).

Figure 1. Share of population with access to electricity in 2020



In terms of SDG7 indicator 7.1.2 (access to clean cooking fuels and technologies), the number of people gaining access to clean cooking around the world increased significantly between 2010 and 2020. In addition, more than 67 countries have already included household energy or clean cooking related goals in their Nationally Determined Contributions (NDCs) in the lead-up to COP26 (Clean Cooking Alliance, 2021).

However, as in previous years, population growth outpaced these improvements, particularly in Sub-Saharan Africa. As a result, the total number of people lacking access to clean cooking

has stagnated for decades. In 2000–10, this number was close to 3 billion people. It dropped to 2.4 billion people (2.1–2.7) in 2020.¹ In contrast to improvements in other parts of the world, the access deficit in Sub-Saharan Africa has nearly doubled since 1990 and rose by more than 50% since 2000, reaching a total of 923 million (898–946) people in 2020.

Because the elimination of the clean cooking deficit is inherently complex due to multiple factors, a multisectoral, coordinated effort is needed to achieve the target of universal access to clean cooking by 2030. Without an increased effort, it is estimated that 2.1 billion people will still lack access to clean cooking in 2030. The prioritization of this challenge during the Saudi Arabia G20 Presidency highlighted the criticality of this energy deficit.

1.2. Trends in universal access to energy

Five key trends will influence the progress of this G20 priority on energy accessibility:

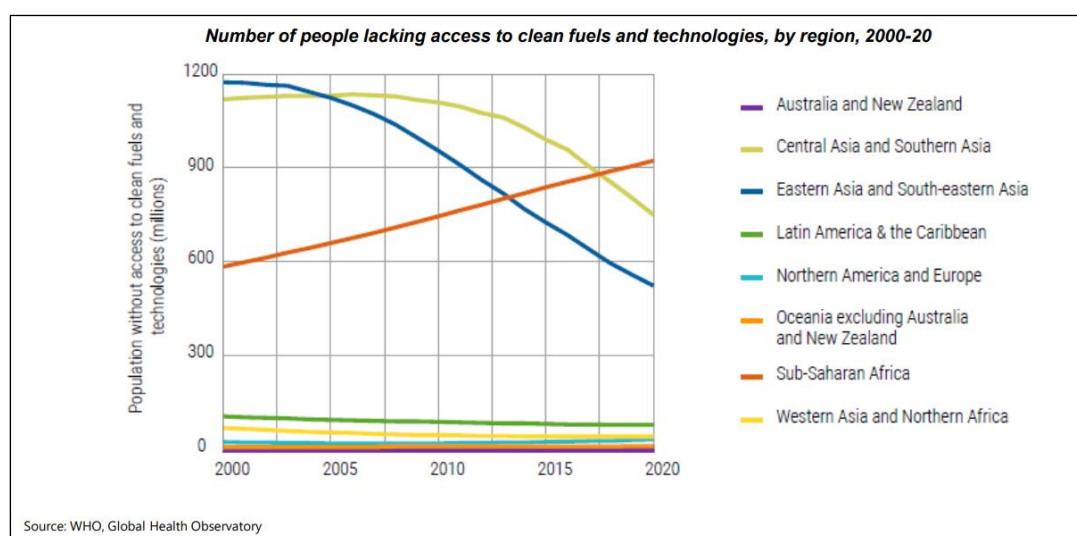
- 1) *Africa's energy access challenge.* While other regions have made progress in both electrification and clean cooking, Africa represents 77% of the global electrification deficit with a majority of the 20 countries with the highest access deficit coming from Africa. Closing the access gap by 2030 will depend on the progress made in Africa.
- 2) *A missed opportunity amongst small island countries.* Small island states are highly reliant on imported fossil fuels, especially oil to service their electricity and transport systems. A transition to almost 100% renewable electricity before 2030 is technically and economically feasible, opening further opportunities for low-cost electric clean cooking and the electrification of the transport sector, but is dependent on finance.
- 3) *Low prioritization of clean cooking.* Despite best intentions, clean cooking still lacks the political prioritization that is needed to address this multi-faceted and multi-sector challenge. While several regions are moving in the right direction, the trend in Africa needs to be reversed (see Figure 2).
- 4) *Financing flows for energy access.* Financing for energy access is not flowing to the countries that need it the most (see Figure 8). Overall financing flows from all sources are at a three-year low (see Priority #3 of this stocktake).
- 5) *Energy affordability and energy poverty*². In addition to the pace of electrification slowing in recent years, the pandemic's impact on household incomes made basic energy

¹ Parenthetical figures appear reflect 95% uncertainty intervals, as defined in the methodology section at the end of the access to clean cooking chapter in IEA et al (2022).

² Italy G20 Presidency Documents (2021) provides a G20 definition of energy poverty: "Energy poverty occurs when households or territorial units cannot fulfill all of their domestic energy needs (lighting, cooking, heating, cooling, information-communication) as a result of lack of access to energy services, an inability to afford them, or their poor quality or unreliability in order to, at minimum, safeguard their health and provide for opportunities to enhance their well-being. Energy poverty affects, to a greater or lesser extent, every country (both developing and mature economies) and requires addressing constantly changing risks while targeting support to populations most vulnerable

services unaffordable for around 90 million people in Asia and Africa who had previously enjoyed access. Affordability of energy services in other parts of the world have presented similar challenges making the G20 focus on energy poverty under last year's Italian G20 Presidency incredibly timely. The challenge of energy poverty (both in terms of access and affordability) will continue to be an important trend that many countries will need to confront. This is further underlined by the SDG's target 7.1 which explicitly focuses on *modern energy services*.

Figure 2. Number of people lacking access to clean fuels and technologies by region, 2000-20



I.3. Emerging priorities

Half-way through the SDGs, there are several key issues that have emerged for SDG7. These emerging issues should be considered in the Bali Energy Transitions Roadmap that will shape political priorities over the next several years. These emerging issues include:

- **Adopting a 'modern energy minimum'.** For energy access to unlock the sustainable development opportunities that were intended, the global community needs to look beyond basic access. A modern energy minimum of 1,000 kWh per capita per year is a minimum standard that all development efforts should target. This will require new metrics, monitoring protocols, and improved technologies to ensure that communities and nations are maximizing their developmental benefit of energy access.
- **Prioritizing 'mutual support' between electrification and clean cooking.** There are an estimated 1.7 billion people who currently have access to electricity, but not to clean

to these risks. For developing economies energy poverty should also take into consideration energy services needed by public services and productive uses.”

cooking. Technologies and appliances that can adapt to local preferences and store energy to overcome blackouts now exist. Addressing this population cohort as new initiatives get underway would help to make major progress in the clean cooking access deficit.

- ***Transitioning archipelagic and small island states to near 100% renewable energy for electricity.*** The technologies exist and need to be matched with opportunities for public and private investment in order to build greater resilience and energy security.

I.4. Enhancing international collaboration and partnerships

In line with the emerging priorities, there are several key international collaborations and partnerships that can be considered. The **Global Energy Alliance for People and Planet (GEAPP)** was recently launched at COP26 to address the energy access and energy transitions challenge in developing countries. While led by philanthropies, GEAPP aims to leverage USD 10 billion of public and private investment in countries that demonstrate ambitious visions for addressing their energy access and energy transitions challenges. Similarly, this year's COP27 in Africa represents another good opportunity for G20 to demonstrate its support to **Egypt's COP27 Presidency** and intention on focusing on Africa's just and equitable energy transitions challenge. Finally, the **Archipelagic and Island States Forum (AIS Forum)** provides an important platform for reaching out to 47 countries that manage similar challenges in terms of energy security and transition to renewables. The AIS Forum, together with the energy work program of the Pacific Community (SPC), can provide needed leadership to ensure that island economies are not left behind in terms of a more inclusive energy transitions.

II. Stocktake of Priority #2: Technology

II.1. Context

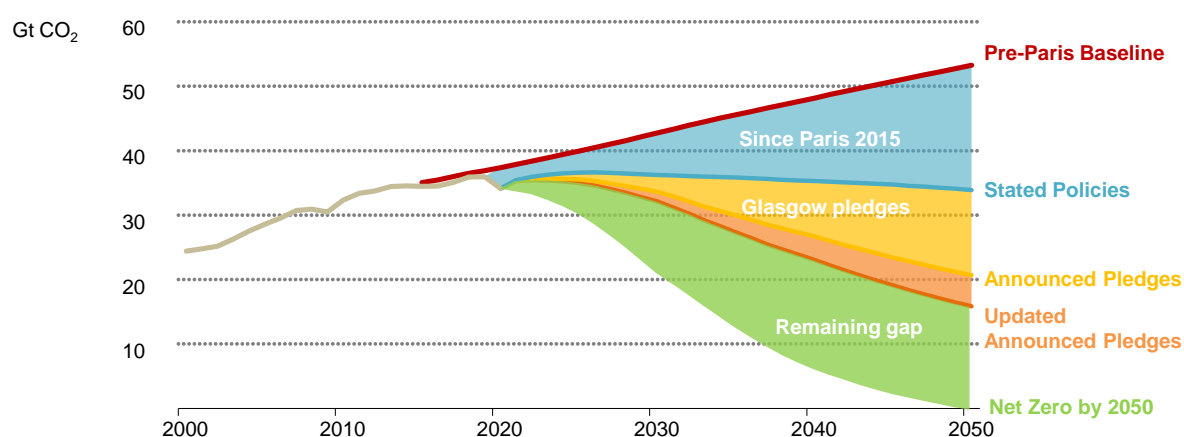
The next decade will be critical. The technologies needed to achieve the necessary emissions reduction by 2030 already exist, and the policies that can drive their deployment have already been proven. Increased support for these technologies can help ensure that climate ambitions are met.

The world is off track, but recent energy technology project pipelines are growing and deployment has gathered pace on some technologies, getting the world closer to recent pledges at COP26, if implemented, the world would see a temperature increase of 1.80C.

In this decade, it is critical the G20 makes sure that the clean energy technologies that underpin this ambition are on track. However, reflecting the announced ambitions and pledges

to the COP26 in Glasgow, as shown in the IEA's Announced Pledges Scenario (APS), there is a huge remaining gap still towards a 1.50C trajectory and additional action can be identified for advanced and developing economies.

Figure 3. Energy technology deployment can close the gap by 2030 on the road to 2050



Source: IEA (2021b), [COP26 climate pledges could help limit global warming to 1.8 °C, but implementing them will be the key – Analysis - IEA](#)

The IEA's Net Zero Emissions (NZE) by 2050 Scenario (IEA, 2021c) is a pathway for the global energy sector to achieve net zero CO₂ emissions by 2050, while also achieving universal energy access by 2030 and major improvements in air quality. With around 400 milestones across all sectors, the NZE roadmap gives a sense of pace and scale needed for technology deployment. These include:

- **Energy efficiency:** Annual energy intensity decreases by over 4% through 2030, with further annual decreases of almost 3% up through 2050. This translates into a necessary 50% increase in energy efficiency (GDP/energy use) of the global economy by 2030.
- **Buildings:** By 2030, all new buildings are zero-carbon ready, paving the way for more than 85% of buildings to be zero-carbon ready by 2050.
- **Electricity:** Over 1000 GW of wind and solar is added each year by 2030. Net zero emissions are achieved in advanced economies by 2035 and globally by 2040. By 2050, nearly 70% of global electricity generation comes from solar PV and wind.
- **Hydrogen:** Low-emissions hydrogen production accelerates to 150 Mt in 2030, with a big increase in electrolyser capacity to 850 GW by 2030. This scales to 435 Mt of low-emissions production and 3,000 GW of electrolyser capacity by 2045.
- **Carbon capture, utilisation and storage (CCUS):** Around 1.7 billion tonnes (Gt) of CO₂ are captured per year by 2030, scaling to around 7.6 Gt CO₂ annually by 2050.

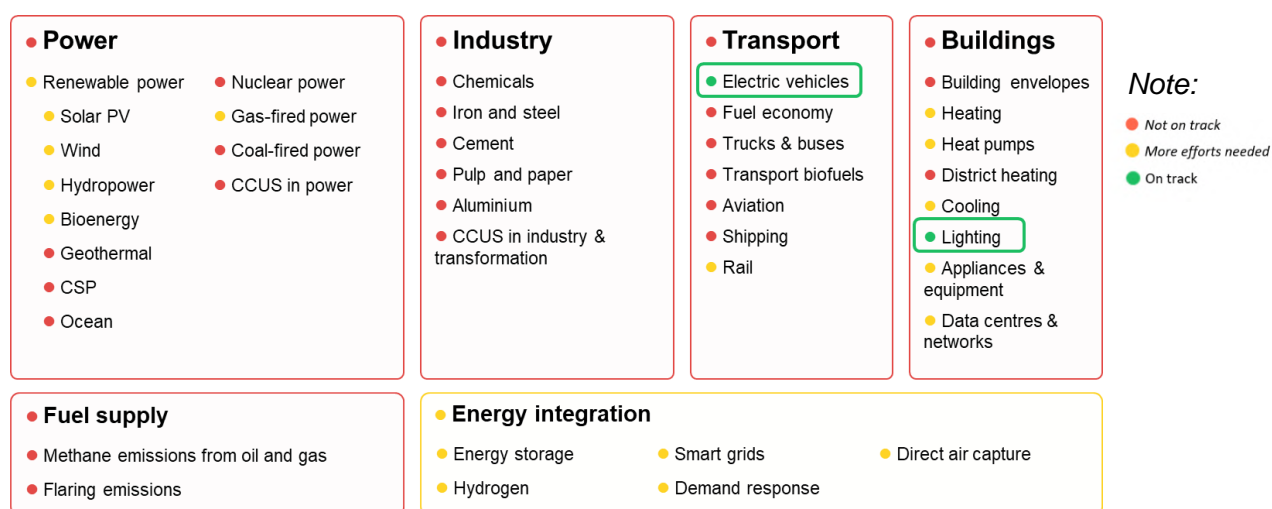
- **Investment in clean energy technology:** By 2030, public resources for clean energy RDD need to triple by 2030 with at least USD 90 billion required by 2026 for a portfolio of clean energy demonstration projects and a tripling of clean power investment by 2025.

II.2. Global trends in energy technology deployment

Progress by sector and technology

By technology, out of 46 technologies only two technologies were on track in 2021, that was electric vehicles and lighting, as the IEA Tracking Clean Energy Progress in 2021 illustrated.

Figure 4. Tracking Clean Energy Progress (2021)



Source: IEA (2021d), *Tracking Clean Energy Progress*, [Tracking Clean Energy Progress – Topics - IEA](#)

Decarbonising the power sector is a fundamental step to reduce emissions, especially in an increasingly electrified world. However, key power generation technologies are not on track (such as nuclear, geothermal, CCUS in power, concentrating solar power and ocean energy).

Energy integration technologies will become increasingly important, especially as shares of variable renewables rise. More efforts are needed to scale technologies like hydrogen, energy storage and direct air capture, as well as investments in smart grids and demand response.

All three energy end-use sectors – industry, buildings and transport – are not on track. In industry, much stronger progress is needed on material and energy efficiency, the uptake of renewable fuels, and development and deployment of low-carbon processes. Unprecedented efficiency improvements are required in buildings, addressing growing demand from cooling, heating and powered devices. The transport sector will need to undergo a major transformation, including vastly improving efficiency and shifts from oil to electricity and other low-emissions fuels. A rapid step-change in industry action is needed.

Latest trends for critical carriers for accelerating clean energy transitions

- **Low emissions power:**
 - In 2021, 245 GW of wind and solar PV were added globally, complemented by another 50 GW of other renewables and 5.6 GW of nuclear capacity.
 - Total low-emissions capacity additions were 6% higher than in 2020 and 73% higher than 2015.
- **Energy intensity:**
 - In 2021, the energy intensity of the global economy improved by 1.9%, up from 0.5% in 2020.
 - This is similar to the annual average over the last decade 2010 to 2020 (2%).
- **Clean transport electrification and fuels:**
 - Electric vehicle sales accounted for 9% of the global car market in 2021.
 - This is four times higher than their market share in 2019.
- **Low emissions fuels:**
 - Global investment in liquid biofuels more than doubled in 2021, reaching just over USD 8 billion. Two-thirds of this growth was in biodiesel, spurred by rising investment in renewable diesel, although ethanol investment also nearly doubled.
 - Just under 270 MW of electrolyser capacity that can produce hydrogen from water came online in 2021, more than in any previous year. Around 70 MW of electrolyser capacity came online in 2020.
 - Over 150 CCUS projects were announced in 2021, compared to around 30 in 2020.

II.3. Emerging priorities

Achieving critical technology and sector breakthroughs to 2030 offers a number of key emerging priorities for clean energy transitions. At COP26 in Glasgow, five breakthrough sectors were identified, **power, road transport, hydrogen, agriculture and steel.**

For the **power sector**, there is no shortage of technology options but **G20 needs to accelerate** investment in energy efficiency, a wide portfolio of renewables, as well as hydrogen and other low carbon fuels, such as ammonia.

In the **road sector**, the rate of energy efficiency, electrification and the penetration of low-emissions fuels need to accelerate dramatically. The shift in behaviour, the switch of the vehicle fleet and the deployment of technology and service infrastructure will determine the speed of decarbonisation.

For industry, up to 2030, G20 countries need to demonstrate low-emissions technologies, notably in heavy industry and other hard to abate sectors, notably in steel.

In partnership with IRENA and the UN High Level Action Champions, the IEA leads the **State of Sectoral Transitions report** which will provide every year an annual report to track progress by sector against a 1.5 °C trajectory (IEA, 2022b upcoming). The first report will be presented in September 2022. This will help G20 countries to track and identify common milestones, the state of international collaboration between countries, companies and civil society. The report provides recommendations for key focus areas over the next 1-2 years.

Promoting energy efficiency

Energy efficiency takes the core priority in early action, as demonstrated in the IEA net zero roadmap by 2050. Efficiency measures could help the global economy be one third more efficient by 2030. And that despite the fact the global economy grows by 40% by 2030, driven by higher populations and income levels, but uses 7% less primary energy. Around 80% of the additional energy efficiency gains over the next decade result in overall net cost savings to consumers, helping to lower energy bills and to cushion the effects of price volatility.

In the current geopolitical context, behavioural aspects and voluntary action are very important. Implementing programmes for energy efficiency in low-intensity industries offer great value for efficiency processes and result in greater competitiveness of industries, notably SMEs.

Boosting a broad clean energy technology portfolio

In the period beyond 2030, diverse low-emissions technologies that currently are at the demonstration or prototype stage need to be developed and deployed, in particular dispatchable generation technologies that can add capacity and flexibility to power systems. Examples include various forms of storage and demand-side response technologies, which are projected to provide the bulk of electricity flexibility options by 2050.

Carbon Capture, Utilisation and Storage (CCUS) and advanced nuclear technologies such as small modular reactors are also important options for the clean energy transitions. All effective technologies must be mobilised to achieve climate goals in a cost optimal and secure way. This requires that governments strategically direct and quickly increase spending on research and development. Developing, demonstrating and deploying clean energy technologies will boost the availability of innovative technologies as a hedge against technological uncertainty.

Accelerating emissions reductions in hard-to-abate sectors

Near zero emissions by 2050 requires decarbonising all energy producing and consuming sectors, including industry. In industry, the decarbonisation pathway will be most challenging. Two sectors that can enable global breakthroughs, are steel and cement.

China and India are the largest producers of steel & cement and the G20 can play a major role in tackling industry emissions. For deep emission reductions in industry, we need a massive technology shift, towards near zero emission technologies, primarily CCUS and hydrogen.

A massive push is needed to scale CCUS and hydrogen to levels required in the NZE. One critical area is the planning and building out of supporting infrastructure, such as CO₂ transport and storage, hydrogen transportation infrastructure, and electricity production and distribution.

A toolbox for advancing steel sector decarbonisation includes industry transitions planning, carbon pricing, market creation mechanisms, international finance, level-playing field mechanisms. We hope the toolbox will be useful to government around the world, as they look to accelerate progress on the industry transitions (IEA, 2022c).

II.4. Enhancing international collaboration and partnerships

Since the creation of the energy working group of the G20 in 2015, the group has increasingly advanced discussions on the role of technology as part of energy transitions. In 2019, Japan placed a strong focus on hydrogen in the G20 and Saudi Arabia on hard-to-abate sectors, CCUS, hydrogen as well as recycling. G20 Presidencies have created synergies with global energy technology partnerships, notably the initiatives by the Clean Energy Ministerial and Mission Innovation, supported by the IEA technology collaboration partnerships and advancing the Glasgow Breakthrough Agenda. Building on the Breakthroughs Agenda, the CEM and MI platforms can enable G20 partnerships that help advance and close technology gaps as identified in this stocktake.

Initiated by the UK and shared by 42 world leaders, **the Breakthrough Agenda** is an unprecedented global clean technology plan to help keep 1.5°C within reach of all parties. The main key is the successful implementation of technology transfer from developed countries to developing countries.

G20 countries can build on the Breakthrough Agenda with a view to work on five key areas in the coming years:

1. **Coordination** – establishing a clear ‘centre of gravity’ for each major emitting sector, making use of existing initiatives / structures where possible.
2. **Assistance** – strengthening the technical and finance offer by bringing together donor and recipient countries, philanthropies and delivery partners in globally coordinated fora for the delivery of scaled-up assistance programmes in each major emitting sector.
3. **Trade** – agreeing net-zero aligned trade arrangements that can enable a faster transitions across sectors and regions. This could include, high-level dialogues in each sector (where relevant) to develop a common approach to reaching a level-playing field.
4. **Demonstration** – increase spending on technology demonstration projects to at least \$90bn by 2026. Early deployment projects should be supported by matchmaking forums in all regions, and by commitments and process to ensure deep and sustained sharing of learning from these countries between countries.
5. **Infrastructure** – accelerate the build-out of key international infrastructure to enable the transitions across multiple sectors, through strengthened collaboration. This includes agreeing top priority projects that can support near-term growth in renewable and low carbon hydrogen, clean power and CO2 transport and storage, for example.

Clean Energy Ministerial (CEM) is an international collaboration platform that brings together a powerful community of the world’s largest and leading countries, companies, and experts to form action coalitions that accelerate clean energy transitions. With almost all G20 members also members of the CEM, it serves as a valuable forum in which to take practical actions to implement the political leadership of the G20. The CEM’s flexible work programme currently consists of more than twenty active workstreams, which span across all sectors of the clean energy economy.

Many G20 countries co-lead or participate in CEM workstreams, which range across a wide spectrum of clean energy topics, ranging from power systems to energy efficiency, transportation to industry, clean fuels to CCUS, and various other enabling topics.

On clean fuels for instance, CEM has initiatives on bioenergy (the Biofutures Platform Initiatives) and hydrogen (the CEM Hydrogen Initiative (H2I)). Led by several G20 governments, with participation of many others, the CEM H2I not produces analytical work for long term H2 scenarios, but offers to be a platform facilitating partnerships with other fora undertaking work in this area such as the Hydrogen Council, International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), IEA’s Advanced Fuel Cells and Hydrogen Technology Collaboration Programmes, Mission Innovation, World Economic Forum, etc. As these initiatives are delivering action on the ground, the Global Ports Hydrogen Coalition, a part of the Hydrogen initiative (H2I) dedicated to support the scale-up of clean hydrogen in the

global economy, brings together over 60 ports from around the world to engage in supporting H2 deployment.

The Super-Efficient Equipment and Appliance Deployment (SEAD), again another long-standing CEM initiative, is the key international platform for exchange for practitioners of energy efficiency for products. The initiative is led by the UK, EU, India and Sweden and coordinated by the IEA. It currently has 21 members with a strong economic and geographical diversity. In addition to being a CEM initiative, SEAD is associated with the Energy Efficiency Hub, hosted by the IEA. The Energy Efficiency Hub encourages and fosters exchange and collaboration on key energy efficiency policies across its members from the IEA and G20 countries.

Likewise, CEM's initiatives on Carbon Capture Utilisation and Storage (CCUS), Electric Vehicles (EVI), Industrial Deep-Decarbonisation (IDDI), Smart Grids (ISGAN) and power systems transformation (21CPP) have all been very popular fora for collaboration among many G20 members.

Building upon the three percent club, **Mission Efficiency** was launched at the Sustainable Energy for All Forum in Kigali, Rwanda in 2022. Mission Efficiency is a collective of commitments and actions from a coalition of governments, organizations and initiatives coming together to accelerate the energy transitions towards energy efficient economies worldwide. The end-use sectors covered by Mission Efficiency collectively represent nearly all of global electricity consumption. The efforts being undertaken by Mission Efficiency, a coalition of partners who aim to elevate, support and invest in energy efficiency globally through public and private financiers, provides a promising framework for making needed progress on energy efficiency.

Mission Innovation (MI) promotes investment in research, development and demonstration to make clean energy affordable, attractive and accessible for all. A global initiative of 22 countries and the European Commission (on behalf of the European Union), among them many G20 countries MI promotes public-private innovation alliances – Missions – to bring down costs and boost scale of clean energy solutions. Major missions include: Green Powered Future, Zero Emission Shipping, Clean Hydrogen, Carbon Dioxide Removal, Urban Transitions, Net Zero Industries, Integrated Biorefineries.

III. Stocktake of Priority #3: Finance and Investment

III.1. Context

Getting the world on track to meet net zero emissions or carbon neutrality by mid-century requires a more than three-fold increase in clean energy investments reaching USD 4.6 trillion by 2030. All regions will need to see a massive scale up in investments with the largest

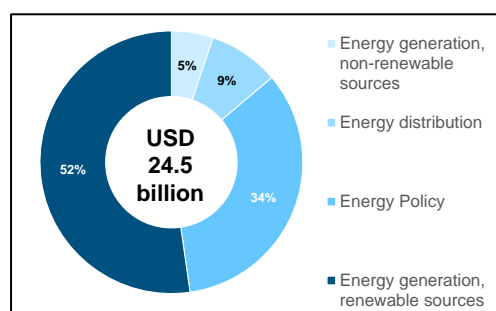
increases needed in emerging and developing countries where a 4-fold increase from current levels, reaching more than USD 1 trillion by the end of 2020s. Investment in the power sector alone needs to grow at a rate of more than 25% annually, compared to a 3% average growth rate seen over the past few years (IEA, 2022d) - a significant challenge given fiscal constraints in these countries. At the same time, this challenge represents an opportunity for foreign investors to expand their green portfolios into these fast-developing economies, while increasing domestic participation of citizens and local businesses to contribute and reap benefits from a just energy transitions.

III.2. Clean energy finance and investment trends

Achieving the 100 billion climate finance goal requires continued efforts to scale up public finance that mobilises private capital

In 2020, climate finance provided and mobilised by developed countries for developing countries totalled USD 83.3 billion, a 4% increase from the previous year, but more than USD 16 billion short of the 100 billion annual pledge (OECD, 2022a). In 2016-2019, over one-third of total climate finance provided and mobilised targeted the energy sector (Figure 5). During the same period more than half of the total climate finance provided and mobilized in the energy sector was targeted for renewable power. 32% (USD 7.6 billion) of all energy sector finance was mobilized from the private sector, mainly for renewables. Between 2016 and 2020, lower middle- and upper middle- income countries accounted for more than three quarters of the total energy financing where Africa and Asia collectively represented 68% of this total (OECD, 2022a). Achieving the USD 100 billion goal requires continued efforts to scale up public finance and improve its effectiveness in mobilizing private capital, particularly in least developed countries.

Figure 5. Breakdown of the climate finance to the energy sector, 2016-2019 annual average

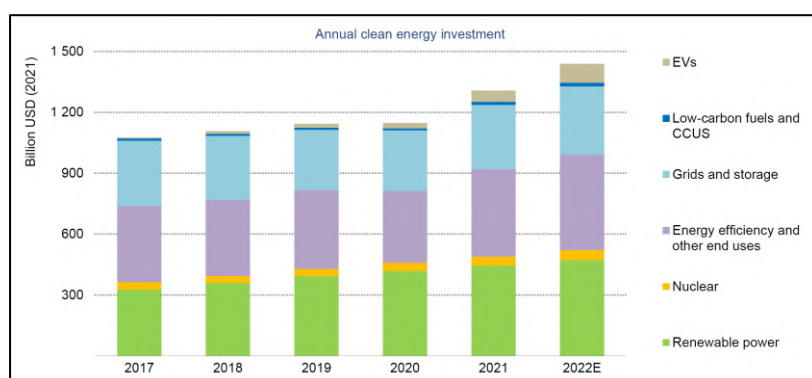


Source: OECD (2021)

Clean energy investments are estimated to reach USD 1.4 trillion by the end of 2022

World energy investments are set to rise over 8% in 2022 to reach a total of USD 1.4 trillion, well above pre-COVID levels. Within this total, annual clean energy investments are estimated to rise for a second year in a row, however at a level below that needed to put the world on a net-zero path by mid-century. China with the highest level worldwide, together with the European Union and the United States are estimated to represent 60% of global clean energy investments in 2022. Renewable power, grids and energy storage investments represent the lion's share with more than half of all clean energy investments globally (Figure 6). Energy efficiency investments follow renewables, thanks to government incentives and the surge in energy prices. Besides the need for rapid scale up in clean energy investments, there will be a need for a massive shift away from fossil fuels to achieve the Paris Agreement goals (IEA, 2022d).

Figure 6. Annual global investments in clean energy technologies, 2017-2022

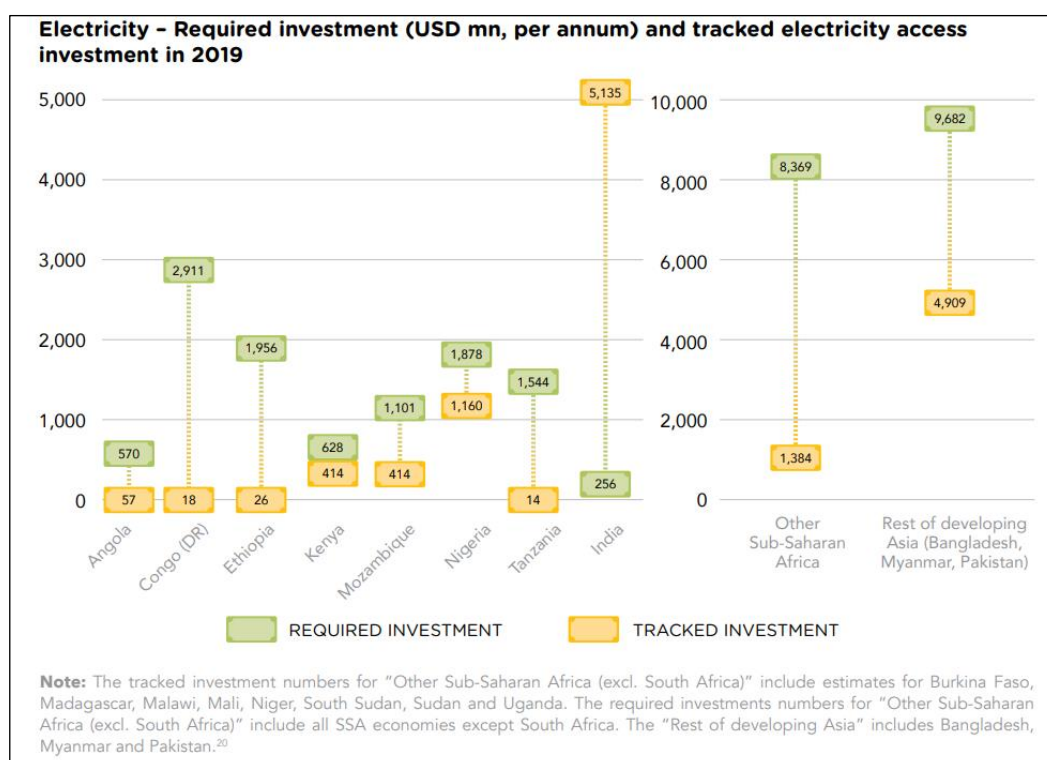


Source: IEA (2022d)

Efforts towards increasing electricity access and accelerating a low-carbon energy transitions should be strategically paired with clean cooking investments to leverage finance and policies

To achieve the universal access target and maintain development aligned with the net-zero pathway, USD 42 billion in clean energy investments for electrification and clean cooking solutions are needed (IEA, 2021c). Tracked investments of USD 13.6 billion in 2019 are about 41% of what is required, indicating a significant gap that needs to be closed (SEforAll, 2021).ⁱ

Figure 7. Required investment and tracked electricity access investment (2019)



Source: SEforALL (2021)

Financing flows for access to electricity and clean cooking continue well below what is needed. The latest data on financing flows (from all sources: public, private, international, domestic) for access to electricity indicates a three-year low of USD 31.9 billion (2019) to the 20 countries that represent 80% of the electrification access deficit. Even more critical, the financing flows from all sources for clean cooking only reached USD 133.5 million for the 20 countries that represent approximately 80% of the access deficit (SEforALL and CPPI, 2021).

Meaningful progress on phasing down fossil fuel subsidies would help to level the playing field in favour of clean energy

Total fossil fuel subsidies to consumers and producers across G20 economies rose to USD 190 billion in 2021 from USD 147 billion in 2020 as energy prices rose with the rebound of the global economy. Support for producers reached levels not previously seen in OECD tracking efforts, at USD 64 billion in 2021 – up almost by 50% year-on-year, and 17% above 2019 levels (OECD, 2022b). Those producer subsidies have partly offset low energy prices during the COVID-19 slump, as well as losses from domestic consumer price controls as global energy prices surged in early 2021.

A total of USD 246 billion equivalent response measures were put in place for households and firms across 42 countries between October 2021 and December 2022. This included USD 169

billion direct support for fossil fuels consumption (OECD, 2022c). There is an ongoing challenge faced by governments in targeting support measures to households and businesses most in need, and in maintaining consistent incentives to reduce fossil-based energy and encourage the transitions to carbon neutrality.

In 2021, global public spending on energy research and development (R&D) rose to USD 38 billion, nearly 90% of which was allocated to low-carbon energy R&D

The 5% increase in public spending in 2021 was slightly lower than the 7% annual average between 2017 and 2020 (IEA, 2022d). Spending on hydrogen and fuel cells have been systematically increasing since 2015 as the only two technologies showing constant growth. Corporate energy R&D spending by listed companiesⁱⁱ returned to growth in 2021, with a major increase in China and renewables compensating for tightened budgets elsewhere and among fossil fuel companies. At the same time energy-intensive industry sectors spent more on R&D whereas aviation sector declined.

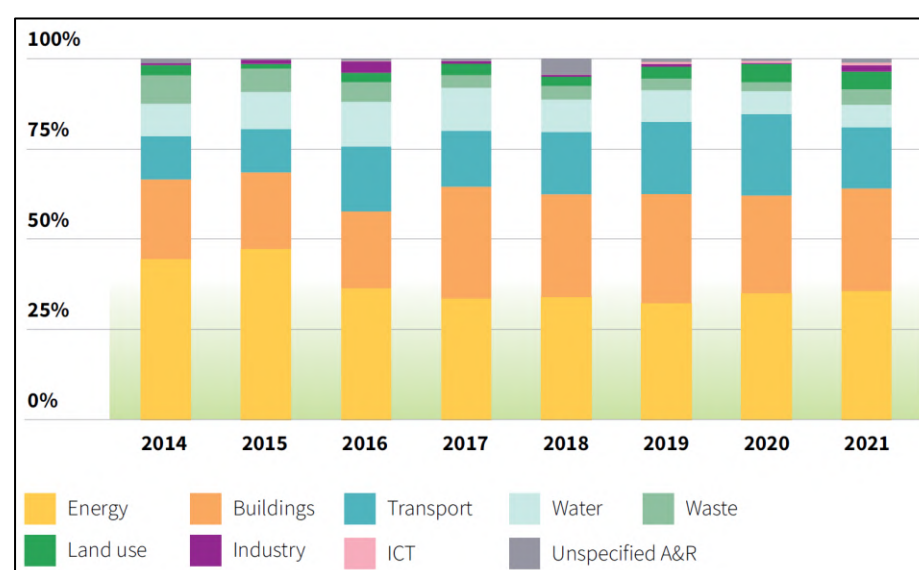
Renewables are attracting investments from institutional investors, while a few still remain highly exposed to fossil fuel assets

Renewable energy has an important share of assets under management by large pension funds and collectively with transmission accounts for about one third of the infrastructure equity holdings according to the latest survey of large pension funds undertaken by the OECD (OECD, 2021a). A large range is observed depending on fund size, the country's energy transitions progress and the economy's dependence on fossil fuels.ⁱⁱⁱ With respect to the funds' total investments, green investments represented on average 8% of the total, with a range from <1% to as high as 58%. Green equity investments accounted for nearly three-quarters of all green investments and highlights the potential for green debt, including green, social and sustainability bonds, to play a larger financing role in the future.

Green, social and sustainability bond market represents a growing source of finance

Green, social and sustainability as well as the sustainability-linked and transition bond market surpassed the USD 1 trillion mark in 2021 with about half of this total represented by green bonds. Energy, buildings, and transport were the three largest sectors where proceeds were used, collectively contributing 81% to the 2021 total (Figure 8).

Figure 8. Breakdown of the use of green proceeds by sector, 2014-2021



Source: CBI (2022)

III.3. Emerging priorities

Blended finance for clean energy

Overcoming the clean energy finance gap in emerging and developing economies will require more targeted efforts to mobilise both domestic and international sources of private capital using innovative financing solutions. Blended finance, the use of development finance and philanthropic funds to crowd in commercial finance, can be an effective way to catalyse private capital, but is not a panacea and needs to form part of a wider package of support measures and reforms. A robust understanding of the market failures, barriers and risks to clean energy investments at the national level is a prerequisite to designing effective financing solutions. The OECD's forthcoming blended finance guidelines for the clean energy sector provide a detailed overview of blended finance solutions for different clean energy sub-sectors that can be used to de-risk projects or provide additional support needed to mobilise private capital, with a summary of the main solutions provided in the table below. This will complement the G20 Blended Finance Principles underdevelopment.

Table 1. G20 Blended Finance guidelines and principles

Blended finance solutions		Description
Aggregation	and	Pooling of smaller projects to rateable and investable financial products
securitisation		
Grants		For early-stage investment, project preparation and structuring

Revenue guarantee	To help establish viability in new markets or less mature technologies
Energy savings insurance	To increase market confidence in energy efficiency project performance
Partial risk guarantee or 1st loss facility	As a credit enhancement to improve investor confidence, lower financing costs and address supply chain risks
Equity capital fund for EE	Address collateral requirements and capital constraints of ESCOs
On-lending schemes and revolving funds	Build awareness and capacity of domestic financial institutions on viability for energy efficiency and newer clean energy solutions to the market
Tenor extensions	Increase access to long term debt to better match project life times
Political risk insurance	Protection against breach of contract or other changes in political or policy context affecting projects
Performance insurance	Improve investor confidence in project viability and projected returns
Current risk hedging or forex guarantees	Forex risks created by lending in hard currency or importation of equipment in foreign currency
Viability gap fund	To increase project returns for first projects to meet return expectations

Source: OECD (2022 forthcoming)

Financing the energy transitions will require a comprehensive, system wide approach

Collaboration and coordination with the wider financial ecosystem will be an important driver to unlocking finance at scale. Efforts to green financial systems led by the G20 Finance track and outlined in the G20 Sustainable Finance Roadmap and the forthcoming Sustainable Finance Report should be considered and where appropriate integrated into the Bali Compact and Bali Energy Transitions Roadmap. In addition, enhanced engagement with related Working Groups such as Climate Sustainability, Development and Infrastructure would strengthen financing efforts for a just transitions.

The private sector can take on a crucial role in the energy development process to accelerate the transitions, by investing in necessary infrastructure, research and development, as well as in innovative solutions that foster the adoption of energy efficiency, renewable energy and other low carbon energy solutions. However, challenging risk-return profiles that impede access to finance can pose significant obstacles and early engagement with the private sector

can enable the development of innovative financing solutions that address perceived and real risks that can help to lower financing costs and improve project returns. It can also help to create the right domestic enabling frameworks that private investors require as a precondition to invest. G20 clean energy investor dialogues can provide a platform to facilitate closer engagement with the private sector.

III.4. Enhancing international collaboration and partnerships

Enhancing international collaboration will be critical to support countries in meeting the global net zero or carbon neutrality goal. Achieving the finance priority of the G20 energy transitions will require new partnership models to be developed that encompass not only countries, but the private sector as well.

The Just Energy Transition Partnership (JETP) for South Africa, announced at COP 26 and the USD 8.5 billion financial commitments made by countries to support the transitions is a model that is being replicated in other countries. At the same time, financial sector led initiatives such as the [Glasgow Financial Alliance for Net Zero \(GFANZ\)](#), together with philanthropic organisations, are collaborating with governments to create country platforms that can support the creation of bankable project pipelines at scale. These different partnerships and platforms will need to work closely together to create the necessary conditions to accelerate investments and unlock finance for energy transitions.

ⁱ This includes country specific data from Angola, Congo (DR), Ethiopia, Kenya, Mozambique, Nigeria, Tanzania and India as well as aggregate data for all sub-Saharan Africa countries except for South Africa and aggregate data from developing Asia based on Bangladesh, Myanmar and Pakistan.

ⁱⁱ This includes reported R&D expenditure by companies active in sectors that are dependent on energy technologies, including energy efficiency technologies where possible.

ⁱⁱⁱ This survey is the eighth since the data collection exercise was first established in 2011. Its scope covers 100 public and private pension funds from 40 countries that responded to the survey, which in total managed USD 10.3 trillion in assets in 2020.

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