Clean Energy Investment for Development in Africa

Status and opportunities

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Abstract

This report on financing clean energy investments in Africa was requested by the Italian presidency of the Group of Seven (G7) to support the presidency's new Energy for Growth in Africa initiative. This initiative builds upon existing G7 efforts to promote energy and climate investment in Africa and seeks to develop bankable clean energy projects, attract public and private capital, encourage concessional finance, and overcome investment barriers across Africa. This report aims to inform the G7 initiative by providing an overview of the energy-related investments needed to achieve all African energy and climate-related goals, including universal energy access and its nationally determined contributions, by 2030. It then explores how clean energy projects can best be financed, focusing on three key investment pillars: household access to modern energy; the electricity sector; and emerging industries. Finally, it identifies the main types of initiatives needed to develop human and institutional skills and capabilities across Africa, without which the financing of clean energy will remain a challenge in many countries. With energy vital to Africa's long-term prosperity and the need for investment in clean energy technologies in Africa never being more urgent, this report comes at a critical time and lays the foundations for coordinated financing efforts between governments of African countries and developed nations, international financial institutions, and development organisations.

Acknowledgements, contributors and credits

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Executive summary

Increasing energy investment is at the heart of enabling African prosperity

Africa's aspirations for greater economic and social development depend on access to affordable, reliable, modern and sustainable energy. Despite immense energy resources, Africa remains energy poor. Today, around 600 million Africans still lack access to electricity and more than 1 billion still cook their meals over open fires and traditional stoves using wood, charcoal, kerosene, coal and animal waste. The consequences are dire in terms of health, education, climate, and economic and social development, with many of these impacts disproportionally affecting women and children. A lack of reliable and affordable energy restrains Africa's farmers from higher productivity; hinders industry, where energy prices and affordability remain key determinants in competitiveness; and limits the ability of countries to attract and cultivate new sectors of their economies.

Enhancing Africa's energy systems can address these issues, but mobilising more investment remains challenging. Today, Africa accounts for around 20% of the world's population but attracts less than 3% of spending on energy. Energy investment on the continent has been falling since its peak in 2014 and is down by 34%. Increasing investment in domestic energy systems faces hurdles, notably a shortage of bankable projects and the high cost of capital, which can be two to three times higher for renewable projects in Africa than in advanced economies. Overlapping crises have also raised the bar for attracting new capital to Africa. Currently, 21 African countries are in or are at high risk of being in debt distress, weighing heavily on public balance sheets and those of state-owned enterprises (SOEs). At the same time, higher interest rates have increased the expectations on returns in commercial markets. For clean energy projects in emerging market and developing economies, this has resulted in an increase in expected returns greater than those in advanced economies.

Meeting growing energy demand from African countries requires a more than doubling of annual energy investment by 2030, of which three-quarters is in clean energy. The IEA's Sustainable Africa Scenario lays out a pathway in which Africa achieves all its energy-related goals in full and on time, including its pledges on climate and access to electricity and clean cooking, and aligns with the goals of the African Union's Agenda 2063: The Africa We Want. In this scenario, energy investment in Africa grows to almost USD 240 billion annually by 2030. This report – commissioned by Italy's G7 Presidency in support of its new initiative: Energy for Growth in Africa – lays out key areas for investment that are

consistent with the objectives set by countries in Africa and supports the realisation of the Dubai Consensus's objectives of tripling renewable capacity and doubling energy efficiency by 2030. The report also highlights financing mechanisms best suited to ensure these investments materialise in a timely manner.

Investments in energy access and the power sector remain the top priority for new energy infrastructure

Extending access to electricity and clean cooking remains the most important lever for growth and development, and is central to a just energy transition. From 2023 to 2030, around USD 22 billion per year is required to connect all African homes and businesses to electricity, while USD 4 billion per year is needed to provide them with clean cooking solutions. In total, the needed annual investments in access for Africa equate to less than 1% of current energy investment worldwide. There are also affordability challenges to consider; only half of households without electricity access today would be able to afford basic energy services without additional financial support, and even fewer would be able to afford modern cooking solutions. A number of private companies based in Africa, many of which are small and medium-sized enterprises, are offering innovative solutions beyond traditional public-sector-led approaches but scaling them requires more financing and specialised incentives to reach rural areas. Recent multilateral efforts are attracting greater political attention to energy access and bringing in new concessional and commercial funding, including the USD 2.2 billion in new financing mobilised at the Summit for Clean Cooking in Africa.

Around half of the energy investment required in Africa to 2030 is needed in electricity, where policies play a key role in attracting more investment. Total electricity sector investment increases from just under USD 30 billion in 2022 to more than USD 120 billion in 2030 in the Sustainable Africa Scenario, with around 50% going towards renewable generation alone. Africa is home to some of the most cost-competitive renewable resources in the world, with 60% of the best solar resources globally, and many countries are home to high-potential resources for hydropower, geothermal, and wind. Utility-scale renewable power projects, often based on power purchase agreements, have found a foothold in markets with access to commercial finance in Africa, where around 80% of clean power projects by volume have reached investment decisions in the last five years. However, less developed markets, where three-quarters of African people live today, face greater perceived investment risks, especially where utilities are not seen as a credible off-taker. Authorising the use of concessional agreements or other regulatory carve-outs for private investors can help attract new capital to debt-distressed utilities, as can tariff reform, though such approaches need to guard against the real risks of offering terms that are ultimately costly to consumers and governments.

New industries, including those related to clean energy technologies, can support Africa's growing energy sector

Developing industry goes hand-in-hand with the expansion of Africa's energy system. By 2030, Africa is projected to build more floor area than exists in Japan and Korea today. Accordingly, demand for steel and cement is set to grow considerably from today's levels, alongside rising demand for irrigation pumps, cold chains, data centres and mining. Productive uses – which include industry, agriculture, freight, and public and commercial buildings – make up nearly half of the growth in electricity demand in Africa over the last ten years. These are often large and reliable customers that can financially encourage the development of new energy infrastructure. Based on today's prices, these uses cover two-thirds of Africa's electricity expenditure, despite only representing just over half of Africa's electricity demand. If structured well, development financing support for African industries can play a dual role: creating reliable off-takers for new energy projects, while also providing the right incentives to install the efficient equipment that will underpin the energy systems of the future. This is increasingly important for new steel plants, with some countries currently electing to use coal-based technologies instead of hydrogen-ready, natural gas-based technologies which are cost-competitive for countries with easy access to natural gas.

Critical minerals and the manufacturing of clean energy technologies present practical opportunities to cultivate a growing industrial base. Revenues from the production of copper and key battery metals in Africa are already estimated to be more than USD 20 billion annually. The current pipeline implies a 65% increase in market value is possible by 2030, with significant potential for further growth given that investment in mineral exploration is on the rise again. New manufacturing plants for clean energy technologies and solutions to improve energy access are being developed across the continent as well, including some backed by the development finance institutions of G7 members. Additionally, low-emissions hydrogen production from announced electrolyser projects in Africa could reach 2 Mt by 2030 if all projects come to fruition. Investments in these fast-growing sectors can help diversify global supply chains and reduce import burdens for Africa. If well-designed, these projects could also be powered by energy investments that serve Africa's wider domestic energy needs, and ensure their development creates jobs, supports local communities, and meets important health, safety, and labour criteria.

Boosting energy investment relies on private sector participation, which concessional finance can help unlock

Private sector spending needs to grow 2.5 times between 2022 and 2030 to meet Africa's energy investment needs. In the Sustainable Africa Scenario, USD 190 billion of private capital is required by 2030, growing from around

USD 75 billion today. Concessional capital from international sources will play a key role in mobilising this increase, with an estimated USD 30 billion per year for clean energy projects required to mobilise commercial funding over the 2023-2030 period.

Blended finance, a proven tool, can attract commercial financing that is up to seven times the level of concessional funding from donors. Blended finance – whereby donors, development finance institutions (DFIs) and philanthropies use their funds to improve the risk-return profile of projects and attract private capital to a project – will be crucial to achieving the level of investment needed in the Sustainable Africa Scenario. The number of deals using blended finance in Africa has grown since 2014, with the volume doubling from 2019 levels to reach more than USD 3 billion in 2021. Other instruments have also demonstrated their ability to improve the risk-return profile of energy investments, including green, social, sustainable and sustainability-linked (GSSS) bonds; carbon credits and voluntary carbon markets; syndication platforms and pooled investment vehicles, and instruments to address currency risk.

Connecting concessional finance with the right projects remains a barrier but can be addressed

Ongoing initiatives within the G7 can be reinforced with targeted technical assistance and improved coordination. G7 countries have reiterated their commitment to mobilise more energy and climate investment in Africa in the Climate, Energy and Environment Ministers' Meeting Communiqué, including reinforcing capacity building efforts. Over the past 10 years, advanced economies have provided, on average, USD 2.4 billion of development assistance to Africa's energy sector annually. Our tracking shows that G7 members have programmes operating in nearly every country in sub-Saharan Africa with the aim of delivering greater energy and climate-oriented investments. These include Global Gateway, Just Energy Transition Partnerships, and the Partnership for Global Infrastructure and Investment. Many of these initiatives face similar challenges, notably developing a pipeline of bankable projects and guiding them through the higher-risk development and construction phases. A survey of ongoing activities, however, highlights several effective approaches that can help to address these gaps – notably capacity building with African governments and small and medium-sized enterprises (SMEs), and developing new financing vehicles that absorb early-stage development risk. Scaling these efforts will be key to unlocking more finance for Africa's energy sector, and to ensuring these investments realise the full suite of economic, development, energy security, health and climate benefits.

Introduction

Energy is vital to Africa's long-term prosperity. It can unlock sustainable economic growth, improve human well-being, and enable healthier and more productive lives. The recent energy crisis, following on the heels of the Covid-19 pandemic and ensuing global economic disruption, has hit many African countries hard. Access to modern energy services remains a pressing concern, primarily in sub-Saharan countries, where half the population still lacks electricity, and four out of five people do not have access to clean and healthy cooking methods. Soaring energy prices and the financial difficulties of electricity utilities have recently reversed the progress that had been made in expanding energy access. There has never been a more urgent need for a concerted push for investment in clean energy technologies to ensure universal access to modern energy, drive economic and social development, and eradicate the poverty that persists across much of Africa.

This investment will not happen on a sufficiently large scale without strong interventions by the governments of African countries and the assistance of developed nations, international financial institutions and development organisations. Financing Africa's energy development is a massive undertaking and must overcome several hurdles – notably the high cost of capital faced by investors in energy projects and a lack of bankable projects. Evidence of this can be seen in Africa's ability to attract financing to its energy sector: while Africa accounts for around 20% of the world's population, it attracts less than 3% of its spending on energy, and energy investment in the continent has been falling in recent years. Mobilising international funding, notably concessional finance, will be crucial.

This report aims to provide an overview of the energy-related investments that are needed to meet the targets set out by African countries in their nationally determined contributions (NDCs) under the Paris Agreement, their net zero goals, the United Nations Sustainable Development Goal 7 (SDG 7) on access to affordable and clean energy, and the 2023 Nairobi Declaration on climate change. The report also analyses how clean energy projects would need to be financed and the supporting policies and measures required to make that happen, focusing on three key investment pillars: household access to modern energy; the electricity sector; and emerging industries, including manufacturing of clean energy technologies, hydrogen and related fuels, and critical minerals. Finally, the report identifies the main types of initiatives needed to build human and institutional skills and capabilities in Africa, without which the financing of clean energy will remain constrained in many countries.

This report on financing clean energy investments in Africa was requested by the Italian Presidency of the Group of Seven (G7). African development is a major focus of Italy's G7 agenda, exemplified by the Italy-Africa Summit held in January 2024, which was attended by high-level representatives from 46 African countries, major international organisations – including the IEA – international financial and development institutions, multilateral development banks, and leaders of the European Union.

The Italian G7 Presidency's new initiative, Energy for Growth in Africa, aims to build upon existing G7 efforts to promote sustainable energy in Africa by leveraging programmes from advanced economies, such as the Mattei Plan, to direct development and climate funding towards financing vehicles that could attract further private capital. Announced at the Climate, Energy and Environment Ministers' Meeting on 29-30 April 2024 and launched at the G7 Summit on 13-15 June 2024, with the IEA as a knowledge partner and the United Nations Development Programme (UNDP) as the implementation partner, this initiative seeks to develop bankable clean energy projects, attract public and private capital, encourage concessional finance, and overcome investment barriers across Africa.

This report aims to inform the G7 initiative by providing an overview of the energy-related investments needed in the IEA's Sustainable Africa Scenario (SAS). The SAS is a pathway developed by the IEA that envisions the continent achieving all its energy and climate-related goals, including universal energy access and its NDCs, by 2030.

Chapter 1. The outlook

The Sustainable Africa Scenario

Energy and investment trends

The Sustainable Africa Scenario (SAS), first set out in the IEA's Africa Energy Outlook 2022, describes a realistic pathway for the continent to achieve the energy-related goals set out in Sustainable Development Goal 7, including universal access to modern energy by 2030, as well as fulfilling all announced climate pledges, including conditional NDCs, in full and on time.[1] This requires a steep increase in investment, a shift away from export-oriented projects towards clean energy projects predicated on local demand, and enabling a greater role for decentralised systems. This hinges on tapping into a range of new capital sources and financing approaches.

Providing modern energy services to the 600 million Africans still lacking electricity and the more than 1 billion without access to clean cooking remains the priority of the SAS. Economic growth across the region also drives higher demand for modern energy from industry, transport and agriculture in this scenario. Modern primary energy supply rises to 2030, an increase that is propelled mainly by renewables accounting for more than four-fifths of the total, though oil use also rises sharply, primarily due to strong growth in transport demand.

In the SAS, electricity use grows across all end-use sectors, with households contributing more than half of the growth. In total, demand surges by more than 60% between 2022 and 2030 to 1 160 TWh, driven largely by more than a doubling of household use of air conditioners, fans and refrigerators. The share of electricity in total final energy consumption jumps from 10% to 20%. Renewable energy generation, mainly from solar PV, accounts for most generating capacity additions as declining costs drive rapid global uptake. By 2030, solar and wind together provide 27% of the continent's power generation, compared with barely 5% in 2022.

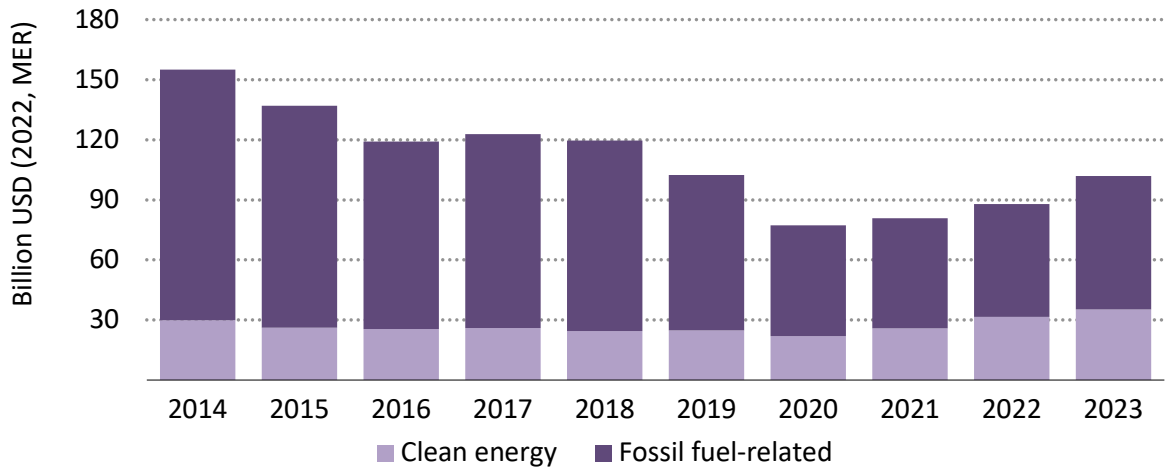
Energy trends to 2030 are very different across Africa. Although modern renewables grow fastest everywhere, oil and gas continue to dominate energy

[1] In the rest of the world, it is assumed that all announced global commitments to reach net zero emissions are fully implemented, as per the Announced Policies Scenario. See the latest edition of the IEA's World Energy Outlook (WEO) for further details.

supply in North Africa and coal in South Africa, while renewables become the dominant fuel category in sub-Saharan Africa.

Total energy investment in Africa was already declining prior to the Covid-19 pandemic (Figure 1.1). Historically, fossil fuel supply – primarily oil and gas production – has dominated energy investment in Africa, and a sharp fall in upstream investment explains most of the fall in overall capital spending since 2015. Investment fell even lower in 2020, and while it has been increasing slightly year-on-year since then, in 2022 the almost USD 90 billion invested in energy was equal to around 3.5% of Africa's GDP, well below percentages seen in the decade prior.

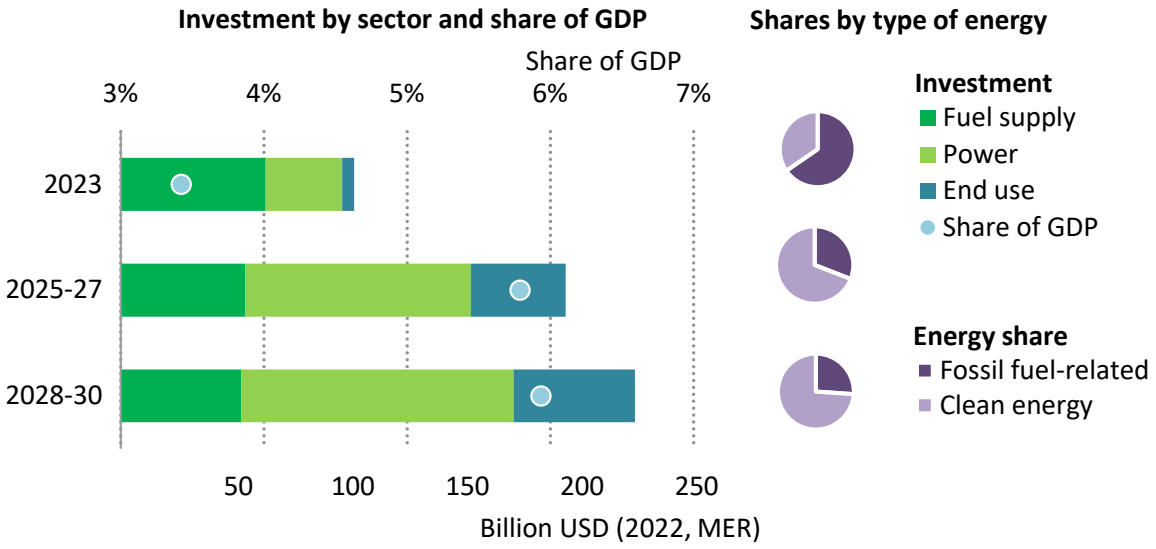
Figure 1.1 Energy investment in Africa by type, 2014-2023



Overall energy investments in Africa were on a downward trend in the 2015-2020 period, although they have begun most recently to pick up

In the SAS, energy investment in Africa picks up in the period to 2030, driven by a surge in clean energy spending (Figure 1.2). Clean energy investment rises to reach nearly three-quarters of energy investment by the end of this decade. Still, around 30% of total spending goes to fossil fuel supply over the 2022-2030 period. Total annual investments in renewables and power grids see a substantial climb, jumping from almost USD 39 billion in 2023 to an average of USD 172 billion in 2028-2030.

Figure 1.2 Average annual energy investment in Africa by sector and share by type of energy and investor in the Sustainable Africa Scenario



Annual capital spending on energy grows more than double, reaching an average of USD 225 billion in 2028-2030, with three-quarters of the investment in clean energy

Renewable generation and power grids together account for close to 70% of the clean energy investment needed over 2023-30 in the SAS and over 80% of all new power generation capacity added over 2023-30. Solar remains the largest growing source, as Africa is home to 60% of the best solar resources globally, yet only 1% of installed solar PV capacity today. By 2030, solar PV – already the cheapest source of power in many parts of the continent – outcompetes all other generating technologies continent-wide. These capacity additions call for large investments in grid infrastructure, both to expand network capacity and to upgrade grids to provide adequate flexibility and support the integration of renewables, including through the installation of digital technologies (see Chapter 3). Regional interconnections need to be strengthened and their operations better integrated to effectively manage the impact of intermittency of renewable power generation on the stability and reliability of national power systems. Dispatchable power providers such as hydropower, natural gas, battery and pumped-hydro storage are also needed to provide flexibility.

Investment to reach the goal of universal access to modern energy averages USD 26 billion per year over 2022-30 in the SAS, accounting for around 15% of total African energy investment. Of this investment, USD 22 billion per year goes to electricity access, while around USD 4 billion is channelled to provide individuals with clean cooking devices. Mobilising this level of investment is contingent on a major policy push for access projects, involving the establishment of national targets and action plans that clearly lay out the role of different energy access solutions and providers, coupled with new financing solutions to support

the effective use of public funds and attract private capital where possible (see Chapter 2). Investment is also needed to drive the switch to electric two- and three-wheelers, as well as green public transport such as electric buses and urban rail systems, and the use of renewables in buildings and industry for heating and cooling.

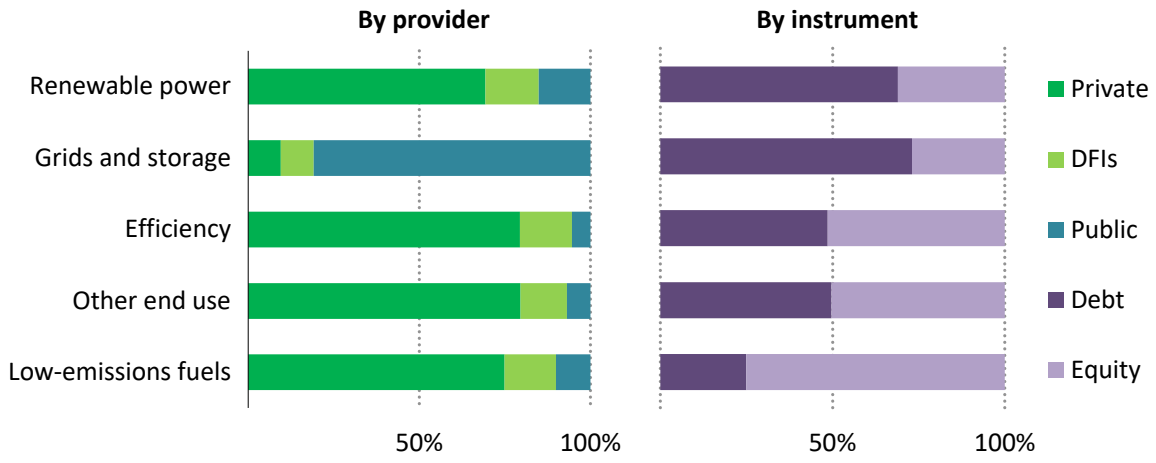
Sources of finance

In the SAS, private investment increases 2.5 times between 2022 and 2030 in absolute terms, buoyed by policy reforms and the use of concessional capital from development finance institutions (DFIs) to de-risk projects. Concessional financing takes many forms but typically involves several broad instruments including grants that do not need to be repaid, loans with very favourable interest rates or guarantees whereby a third party agrees to cover losses in case repayments cannot be made. DFIs[2] play the dual role of investing their own capital, both in projects via debt and equity and in early-stage development financing, while also using their concessional funds to mobilise private capital (Figure 1.3). Finance for energy projects in Africa from DFIs in advanced economies has largely been stable at around USD 11 billion annually, while Chinese DFI activity boomed in the middle of last decade at USD 14 billion but has fallen back substantially in recent years (Box 1.1). In total, an average of around USD 30 billion per year of concessional finance is required in the SAS between now and 2030 to help attract the USD 190 billion of private capital for energy projects in 2030 needed in that same scenario.

Today, DFI finance plays a particularly prominent role in renewable power generation, including that related to electricity and clean cooking access projects, and emerging technologies (such as low-emissions hydrogen). State-owned enterprises (SOEs) retain a key role in grids and storage, although achieving the necessary level of investment relies on improving their financial health, which has deteriorated in many cases in recent years, most likely requiring grants and other forms of concessional support from DFIs and donors.

[2] Multilateral development banks (MDBs), other international and regional financial institutions, national development banks and export credit agencies.

Figure 1.3 Sources of finance for clean energy investments in Africa by sector, provider and instrument in the Sustainable Africa Scenario, 2030



The private sector plays the main role in all energy investment categories except grids by 2030, with equity remaining important for new technologies and end-use sectors

Note: SAS = Sustainable Africa Scenario; DFI = development finance institution.

Source: IEA (2023), Financing Clean Energy in Africa.

Scaling up investment in energy hinges on mobilising capital providers and financing instruments to match the capital structure of energy companies and assets. As with most project finance investments, debt plays a large role in most clean energy developments. Commercial debt in Africa can be expensive and in short supply since debt markets are small outside South Africa, while public debt has become increasingly unsustainable in many economies. Currently, 21 African countries are in or are at high risk of being in debt distress, weighing heavily on public balance sheets and those of SOEs. At the same time, higher interest rates have increased the expectations of returns in commercial markets. For clean energy projects in emerging market and developing economies this has resulted in an increase in expected returns greater than those in advanced economies.

However, alternative financing approaches exist, each utilising different debt-to-equity ratios according to the stage of the project. While the role of debt increases in the SAS, equity remains essential where risks are higher, such as in new markets and for novel technologies. Equity capital is limited in most African countries, with many of the equity funds which currently finance energy projects funded by DFIs. Other sources of equity include corporate balance sheets and – for start-ups and small and medium-sized enterprises – private equity and venture capital firms.

Box 1.1. Chinese investment in Africa's energy sector

The involvement of the People's Republic of China (hereafter "China") in African economies took off in the early 2000s, and the country became the continent's largest trading partner in 2009. China is now the fourth-largest investor in Africa and accounts for about one-fifth of all lending, much of which goes to energy and infrastructure projects. China committed to USD 150 billion in loans to Africa between 2000 and 2018, roughly a quarter of which were in the energy sector. However, lending to African power projects fell from its peak of almost USD 14 billion in 2016 to USD 2 billion in 2019 as China's policy banks focused more on domestic projects.

Financing from China has primarily been in the form of large low-cost loans from development banks and energy- or construction-oriented SOEs. The level of lending has led to concerns around the sustainability of debt, particularly as Chinese loans are generally exempt from the restructuring arrangement of the Paris Club – a group of officials from major creditor countries whose role is to develop co-ordinated solutions to address payment difficulties in debtor countries. Several African countries have been forced to renegotiate repayment terms, notably in the case of loans to railways in Kenya and Ethiopia. Default risks on the continent are rising due to the combination of increased debt since the Covid-19 pandemic and inflationary pressures.

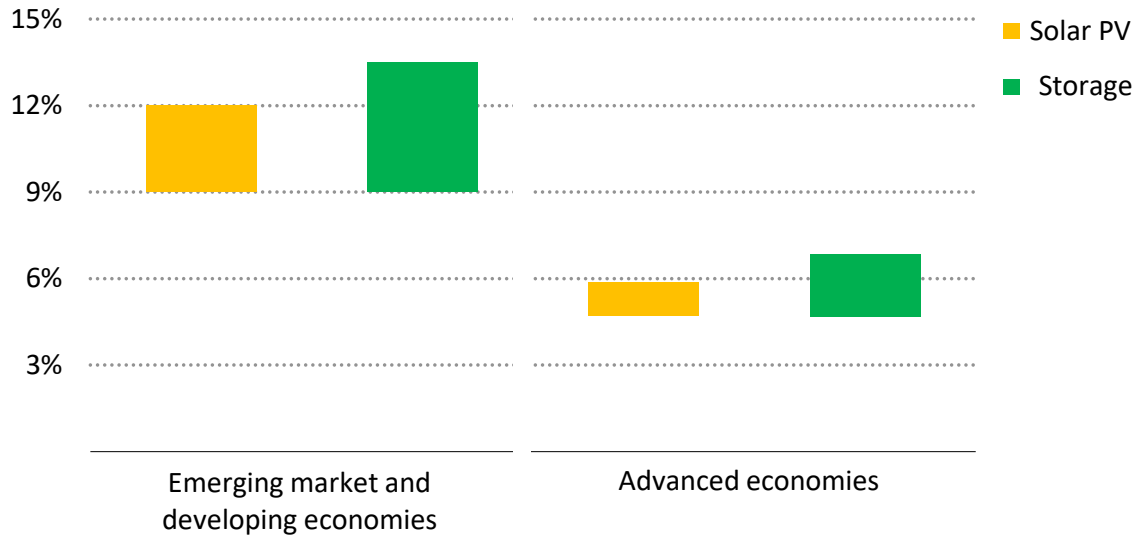
Changing dynamics point to a shift in China's dealings with Africa. At the Forum on China Africa Cooperation in November 2021, China's president announced a one-third reduction in public financing to Africa and emphasised the growing role of Chinese private investment, although no specific targets have been announced. Together with China's move away from funding coal plants abroad, this is likely to result in more emphasis on renewable energy projects by Chinese developers.

Source: IEA (2022), Africa Energy Outlook 2022

Hurdles to ramping up clean energy investment

Improving access to affordable finance is key to achieving the huge increase in investment in clean energy projects required to put Africa on a sustainable development path. At present, there are several hurdles to financing such projects, reflected in the high cost of capital relative to other parts of the world; the weighted average cost of capital for renewable generation projects in Africa is currently at least two to three times higher than in the advanced economies and China (see Figure 1.4). This is due to the greater risks, real or perceived, of investing in Africa.

Figure 1.4 Cost of capital ranges for solar PV and storage projects taking final investment decision in 2022



The cost of capital for solar PV and storage projects in EMDE is at least twice the value in advanced economies, despite relatively larger interest rate hikes in advanced economies

Notes: Values are expressed in nominal, post-tax and local currency. WACCs for solar PV projects represent responses for a 100-megawatt (MW) project and for utility-scale batteries a 40 MW project. Values represent average medians across countries. Advanced economies represent values in the United States and Europe.

Source: IEA (2024), World Energy Investment 2024; IEA (2024), Cost of Capital Observatory.

Higher costs of capital act as a brake on private sector involvement as they make projects either unaffordable or unviable for the investor. They can also leave countries trapped in a loop of higher risks, higher costs, energy deficits and deepened reliance on fossil fuels, which typically require less upfront investment. A high cost of capital has a particularly large impact on capital-intensive investments such as renewable power projects, including off-grid solutions. As a result, it raises overall power generation costs, which are either passed on to customers or absorbed by governments as subsidies.

The cost of capital largely reflects two sets of risks: those associated with the country (the base rate) and those associated with the sector, project or company (the premium). These risks vary considerably across the continent; some countries have investment-grade credit ratings and/or a well-developed energy sector, while others are plagued by social and political conflict or instability and low economic growth, and thus struggle to attract investment. Costs also vary by capital provider and currency, depending on whether the provider is taking on currency risk, their familiarity with the local market and the base rate in their country of origin, as well as according to the company or project that is seeking to raise capital. Larger international companies are able to tap into concessional finance from DFIs and donors or cheaper capital in international markets more

easily. Meanwhile, local companies more reliant on domestic capital markets can struggle to access both early-stage financing to make projects bankable and sufficient affordable capital to develop projects.

Certain investment risks originate from outside the energy sector, but there are financial tools, policy measures and technical assistance that can help mitigate project-specific risks and help ensure more projects reach financial close. The main energy sector-specific factors driving higher costs of capital for clean energy projects according to a survey of investors are regulatory risk (e.g. changing regulations, government renegotiations of contract terms), off-taker risk (e.g. no credible buyer, utility financial distress), land acquisition risks, and transmission risks (e.g. delays in interconnection or not being able to reliable deliver energy to the grid due to network issues). Addressing these risks will be key to the focus of the new G7 initiative, Energy for Growth in Africa.

Chapter 2. Access to energy

Key targets and investment needs

Ensuring that everyone has access to modern energy services remains the primary developmental goal for Africa. According to IEA data, around 600 million Africans lack access to electricity and more than 1 billion Africans – roughly two-thirds of the population – still cook their meals over open fires and traditional stoves, using wood, charcoal, kerosene, coal and animal waste. Most of these people are in sub-Saharan Africa, concentrated in just five countries: Democratic Republic of the Congo, Ethiopia, Nigeria, Tanzania and Uganda.

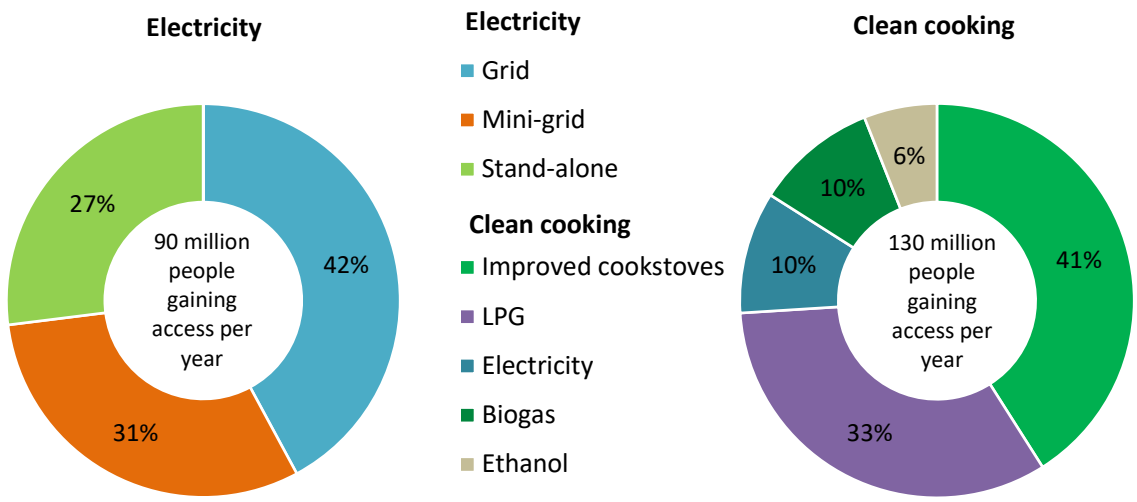
The consequences of such "energy poverty" are dire. A lack of electricity undermines public health, education and communication and holds back economic and social development. Poor air quality due to cooking indoors using traditional fuels is the second-leading cause of premature deaths across the continent. Women suffer the most, both directly from the pollution and from forgoing opportunities to pursue schooling, employment and revenue-generating economic activities as they spend five hours a day on average gathering fuel and tending to cooking fires. A lack of clean cooking also contributes to deforestation, environmental degradation and climate change.

Africa was already well off track to reach the Sustainable Development Goal 7 (SDG 7) target, set in 2015, of universal access to modern energy by 2030 at the beginning of 2020 and the Covid-19 pandemic. The recent energy crisis has set back progress even more, despite a modest tick upward during 2023. Current government policies fall far short of what is required to meet that goal, and without additional measures, 550 million people will still be without access to electricity and around 1 billion still without access to clean cooking even in 2030. Political momentum is growing to resolve these issues, notably for clean cooking, with renewed focus within the G7, G20, and Conference of the Parties (COP), and USD 2.2 billion of new financial commitments announced at the Summit on Clean Cooking in Africa, convened in Paris on 14 May 2024. Still more is required to get Africa on track to achieve universal access to modern energy services by 2030 – a central pillar of the Sustainable Africa Scenario (SAS).

For every African to have access to electricity by 2030 (SDG 7.1), almost 70 million people, or 5% of the current total population, including 60 million from rural areas, would need to gain access each year on average from 2023. In rural areas, where more than 80% of Africans without electricity access live today, progress needs to be even faster. Rural customers predominantly gain access

through stand-alone and mini-grid systems, which can provide first access quickly and represent roughly two-thirds of new connections by 2030 in the SAS (Figure 2.1).

Figure 2.1 Africans gaining access to modern energy by type and technology in the Sustainable Africa Scenario, 2023-2030



Universal access to electricity is achieved largely through off-grid solutions, while access to clean cooking comes mainly through improved cookstoves and LPG

Note: LPG = liquefied petroleum gas.

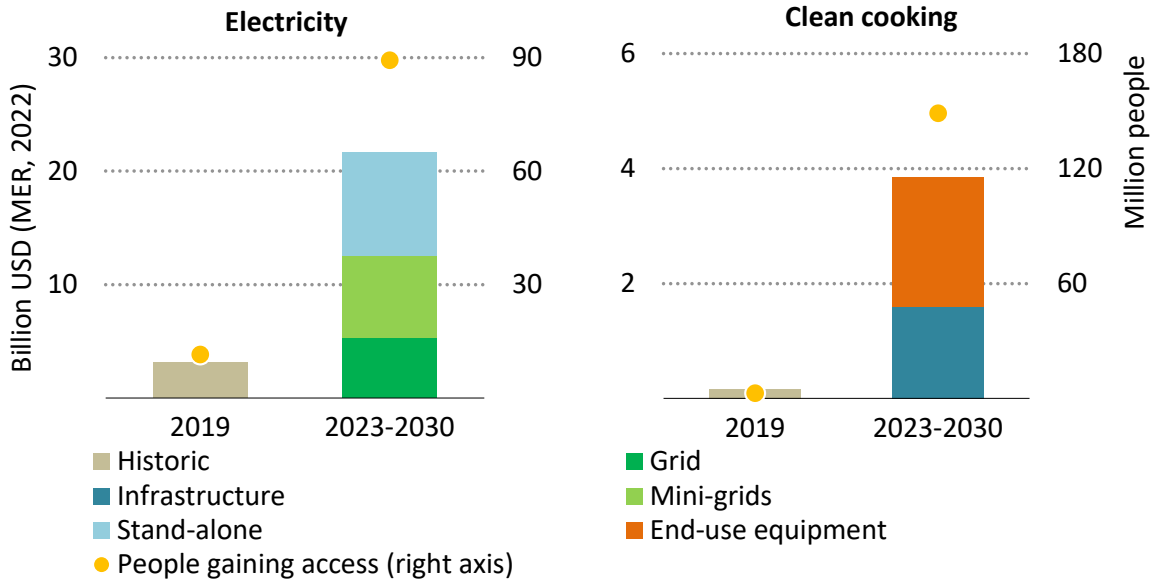
Source: IEA (2022), Africa Energy Outlook 2022.

Achieving universal access to clean cooking fuels and technologies by 2030 (SDG 7.2) in Africa requires an abrupt reversal of current trends; the population without access has been climbing continuously. In the SAS, 130 million Africans (including 80 million in rural areas) gain access to clean cooking each year between 2023 and 2030 – roughly 10% of Africa's current population each year. Around 40% of the people gaining first-time access to clean cooking by 2030 do so with the use of solid biomass in improved biomass cookstoves, which is generally the cheapest and most practical means of providing clean cooking in rural areas. One-third of the people gain access via LPG, 10% via electricity, 10% via biogas from biodigesters and 6% via ethanol. In urban areas, LPG represents a practical, quickly deployable clean cooking solution; however, more African households adopt electric cooking after 2030 as electricity becomes more reliable and connections are strengthened.

On average, around USD 22 billion per year in investment is required to connect Africans to electricity sources and USD 4 billion per year to provide them with clean cooking devices over 2023-30 in the SAS. These are modest sums – less than 1% of current energy investment globally – and would bring enormous

benefits, such as better health, improved conditions for women and children, and general economic development. However, mobilising this investment represents a massive undertaking for the poorest African countries in view of the limited public funds and local private capital at their disposal. Current investment falls far short of these levels: in 2019, it amounted to just 10% of the average needs for 2023-2030 in the case of electricity and 3% for clean cooking (Figure 2.2). In the case of electricity access, the bulk of investment to 2030 is needed for decentralised mini-grids and stand-alone systems, mostly solar photovoltaic (PV) based. For clean cooking, end-use equipment requires the most finance, with infrastructure in fuel supply, delivery and supply chains needing about 40% of the annual investment.

Figure 2.2 Annual investment in and people gaining access to electricity and clean cooking in Africa in the Sustainable Africa Scenario, 2019 and 2023-2030



To achieve universal access, investment in electricity access infrastructure needs to increase sevenfold and investment in clean cooking over twenty-fold

Note: Historical data for investment in access to electricity comprise not only first access projects, but also investment aimed at improving the level of access for households already with access.

Sources: IEA (2023), A Vision for Clean Cooking Access for All; IEA analysis based on SE4All and Climate Policy Initiative (2021), Energizing Finance: Understanding the Landscape.

Financing vehicles and instruments

There is a range of financing vehicles and instruments available for energy access projects, but in general, a high share of it would need to be concessional to address the affordability gap that many African households face. While accompanying infrastructure for grids and fuel distribution rely on a wider set of

financing approaches and tools, they can also benefit from any measures that improve end-user payment reliability (Table 2.1).

Table 2.1 Common financing instruments by type of energy access project and project stage

Project type	Development	Operation
Grids	Grants Concessional equity and debt Corporate cash flow Viability gap funding	Corporate bonds (if credit rating allows)
Mini-grids	Grants Concessional equity and debt Commercial debt Viability gap funding Private equity (PE)/venture capital (VC)	Commercial debt Results-based finance Aggregation/securitisation Corporate (growth) equity and, where possible, public listing
Stand-alone solar	Technical assistance and grants Concessional equity and debt Corporate equity (PE/VC)	Concessional or commercial debt Results-based finance Aggregation/securitisation Corporate (growth) equity and, where possible, public listing Carbon markets
Clean cooking	Technical assistance and grants Concessional equity and debt Corporate equity (PE/VC)	Carbon markets Results-based finance Aggregation/securitisation

Notes: Equity can be concessional if it is provided in a subordinated or first-loss capacity, or if it has lower return expectations or a longer time period to exit. Aggregation and securitisation refer to the pooling of assets and selling the cash flows to investors to raise capital, generally via an asset-backed security or a bond. Viability gap funding refers to the practice of providing grants or concessional short-term loans to projects that are economically beneficial but not financially viable. Results-based financing refers to approaches where payments are made, usually by governments, donors or development finance institutions (DFIs) to the private sector, on the achievement of predefined results.

Source: IEA (2023), Financing Clean Energy in Africa.

The primary hurdle to attracting finance for expanding energy access is affordability, especially in rural areas. As a result, government affordability support and concessional financing are essential if all households are to gain access by 2030. It is estimated that due to affordability constraints, only around half of the new electricity access connections providing the most basic energy services[3] in the SAS are likely to be commercially viable without incentives such as reduced connection charges, lower tariffs and subsidised electrical appliances. The situation is similar for clean cooking access projects where the upfront cost of stoves and the cost of fuels, such as electricity, LPG and charcoal, undermine adoption. For example, LPG is one of the key solutions to closing the access gap,

[3] The basic bundle includes more than one light point providing task lighting, phone charging and a radio. For further information on these definitions see Guidebook for Improved Electricity Access Statistics.

yet only one-fifth of the population without access could afford to switch to LPG at current tariffs if they were given access to affordable credit to purchase the LPG stove and cylinder. Excluding current affordability support, only 5% of those without access today could afford LPG cooking.

Making electricity affordable requires a combination of well-targeted government incentives covering grid and off-grid solutions (potentially involving cross-subsidisation), de-risking instruments such as grants, existence of productive uses as anchor loads and tariff reforms. Traditionally, many African countries have subsidised domestic energy by setting prices at below-market levels, but this has often led to electricity utilities and other energy companies – usually state-owned enterprises (SOEs) – failing to recover their costs, resulting in rising debt, falling investment and an inability to expand new connections fast enough. Making clean cooking affordable on the other hand typically requires the upfront costs of acquiring the equipment to be subsidised. Solutions based on "PayGo" models, where families pay as they use gas, or models based on smaller gas cylinders that reduce the cost of each refill, have proven successful in some markets, including Kenya and South Africa, but usually need to go together with subsidised prices.

Adequately funded national access programmes, involving transparent subsidy mechanisms, are an important prerequisite. Currently, only 41% of the people without access to electricity in Africa and 55% of those without access to clean cooking are in countries with programmes that provide affordability assistance to consumers for access. Developing integrated energy strategies is a fundamental building block to attract supporting investment by providing greater certainty to investors.

Governments also have a major role to play in funding access projects. Grid extensions are generally the responsibility of SOEs, so are indirectly publicly funded. This is expected to remain the case in the medium term: roughly four-fifths of grid investments are carried out by public utilities in 2030 in the SAS (see Chapter 3). Private sector financing is set to take on a larger role, though this is likely to be limited to countries that have relatively well-developed power systems and a stable regulatory environment. It also requires governments to make private involvement legally viable by authorising the use of concessional agreements or other regulatory carve-outs for private sector investment and ownership, and as a matter of best practice should be accompanied by auctions and competitive tenders.

Some successful grid extension programmes have combined central government and local community financing, ensuring local engagement. For example, in 2020, Ghana introduced the Self-Help Electrification Scheme, which allowed communities to be connected to the grid earlier if they could provide poles for low-voltage lines and guarantee that at least 30% of the households in the community

were ready to start using the electricity provided. Some countries, such as Côte d'Ivoire, have implemented the option of on-bill repayment of connection costs, reducing the upfront burden and permitting many households to connect to the grid legally.

Mini-grid projects also typically depend on public sector assistance to support the relatively high upfront costs and to ensure a tariff structure that is both cost-reflective and sensitive to what end users can afford. When it comes to stand-alone systems providing electricity, their inherent small scale often poses a barrier to finance. Traditional channels of energy financing are not well adapted to support these smaller, higher-risk projects, or to finance small and medium-sized enterprises and local start-ups. These companies often struggle to access DFI capital or other international sources of finance and, therefore, rely more on local commercial banks. As a result, many of them operate as retail businesses, which can attract more private capital but need to focus on the most profitable projects. There will need to be an increase in patient equity and affordable local currency debt, as well as an emphasis on early-stage financing, to support the development of bankable projects. An alternative approach would be an energy-as-a-service model via public-private partnership, whereby the government leverages DFI capital to buy the solar home systems from a private developer, and the households pay affordable tariffs for the use of energy (and providing for equipment maintenance) under a long-term contract.

In view of the constraints on public spending and the difficulties facing SOEs, especially electricity utilities, international concessional capital from DFIs and private donors will need to continue to play a critical role in de-risking access projects and leveraging private sector finance, especially for projects aimed at the poorest households in the most remote regions that would otherwise struggle to attract investment. Concessional financing needs to be focused on projects where their presence can crowd in commercial financing. In the case of clean cooking projects, the share of private capital in international financial flows to Africa has been growing in recent years, in part thanks to the leveraging effect of concessional capital from DFIs and growing funds from carbon markets.

Given the limited availability of concessional finance and the large amounts of capital needed to expand access projects, it is vital that concessional funds from DFIs and philanthropies are used in such a way as to mobilise the maximum amount of private capital by improving the risk-return profile of projects and lowering the cost of capital. A number of so-called blended finance instruments can be used to stimulate private investment in access projects, including guarantees or other risk-sharing and liquidity support to mitigate risks, or providing grants to support project preparation and project structuring (see Chapter 5).

Chapter 3. The electricity sector

Key targets and investment needs

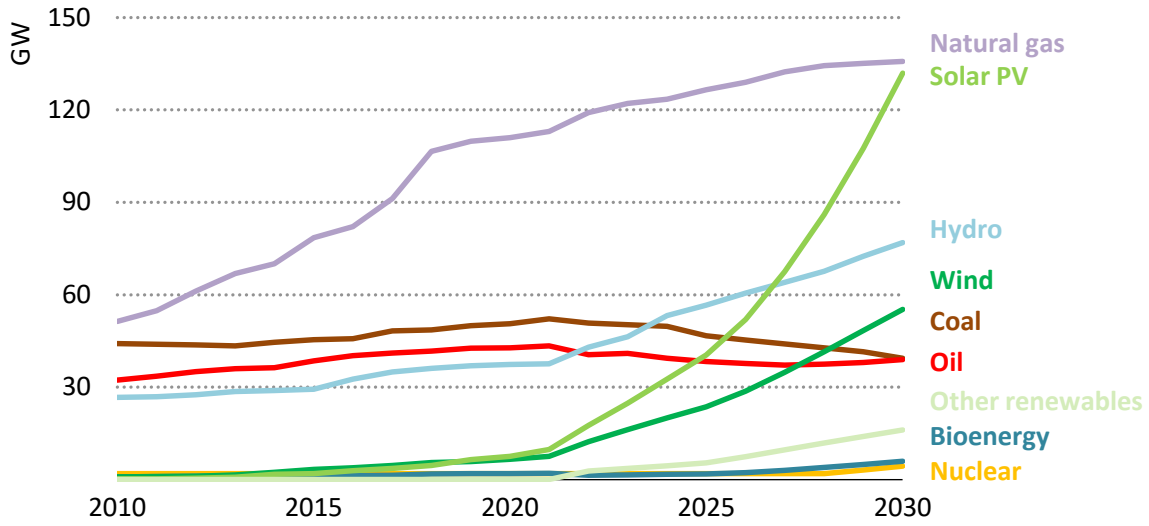
The electricity sector lies at the heart of the energy transition and is central to achieving universal access to modern energy services. In many African countries today, the sector is suffering from years of under-investment and poor operational and financial performance, including large network losses, low collection rates, widespread under-recovery of costs and unmet demand. Major reforms and new sources of finance will be needed to bring about a step increase in investment in generating capacity, transmission and distribution.

Ensuring universal access to reliable electricity for all households, schools, hospitals, companies and businesses, together with an underlying shift towards the electrification of energy end uses, means electricity becomes the fastest-growing component of final demand in Africa in the Sustainable Africa Scenario (SAS). Electricity demand surges by around 60% this decade from a little over 700 TWh in 2022 to more than 1 160 TWh in 2030, driven by both households gaining access and greater use of electricity in industry and other productive uses.

The majority of this increase in demand is met by increased generation from renewables – primarily hydropower (160 TWh to 312 TWh in 2022-30), solar PV (16 TWh to 215 TWh) and wind (25 TWh to 156 TWh). This shift towards renewables is driven by falling costs and policies promoting low-emissions energy, capitalising on Africa's abundant resources. By 2030, solar PV and wind combined contribute 38% to total power generation – eight times more than in 2022.

Installed power generation capacity in Africa doubles in the SAS, from 278 GW in 2022 to 510 GW in 2030, with a profound shift in the type of power plants built across the continent. Renewables account for 80% of the generating capacity additions. Solar PV leads the way, with 120 GW of capacity added between 2022 and 2030 – over 40% of the total increase in capacity. It overtakes hydropower before 2030 and approaches natural gas as the largest source of power generation capacity (Figure 3.1). Wind power capacity also expands rapidly, especially in North and East Africa, where resources are located close to demand centres. Hydropower also remains a cornerstone, with several large-scale projects currently under development to provide affordable and dispatchable electricity. Natural gas-fired capacity continues to grow, but more slowly than in recent years. The relative stability of the oil-fired plant fleet hides different regional dynamics, with an increase in capacity related to expanded access in sub-Saharan Africa offset by a decline in North Africa.

Figure 3.1 Installed power generation capacity in Africa by source in the Sustainable Africa Scenario, 2010-2030



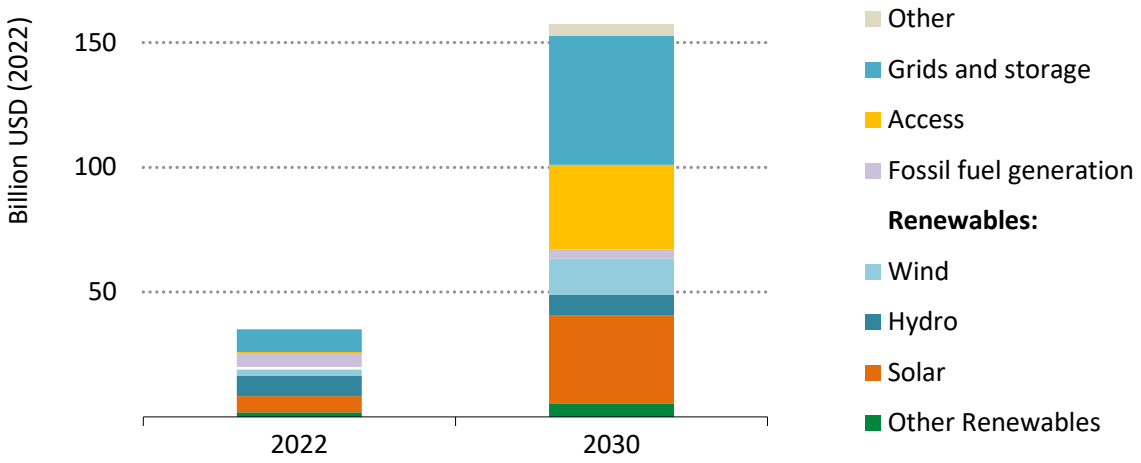
Solar PV, hydropower and wind capacity surpass that of coal and oil this decade, while the dominant position of natural gas is overturned in the 2030s

Source: IEA (2022), Africa Energy Outlook 2022.

The rapid growth in the share of intermittent renewables has implications for the operation of power systems, which must be managed in conjunction with efforts to shore up electricity reliability. A range of assets and measures are developed to improve reliability and improve system flexibility in the SAS from now to 2030, including hydropower facilities (including pumped storage), gas-fired power plants, geothermal plants and energy storage. Improvements in grid operation in terms of scheduling and dispatch are also needed to make the most of these dispatchable resources. Battery storage deployment remains modest to 2030, but accelerates quickly thereafter, mainly to provide short-duration flexibility and provide stable power supply in both on-grid and off-grid applications.

Electricity sector investment accounts for around half of all energy investment by 2030 in the SAS (Figure 3.2). Total electricity sector investment rises from an estimated USD 30 billion in 2022 to USD 120 billion in 2030, with renewables accounting for over half of this amount. Solar PV accounts for the bulk of this investment.

Figure 3.2 Electricity sector investment by sector in Africa in the Sustainable Africa Scenario, 2022-2030



Reaching the continent's Sustainable Development Goals, including energy access and climate targets, will require nearly a fivefold increase in electricity sector investment by 2030. This increase is driven mainly by clean energy and infrastructure

Note: STEPS = Stated Policies Scenario; SAS = Sustainable Africa Scenario. Grid investment excludes that related to extending electricity access.

Supporting these capacity additions requires large-scale investments in grid infrastructure, not just to expand networks to meet the needs of newly connected customers and rising demand from existing ones, but also to upgrade them to provide adequate flexibility, support the integration of digital technologies to improve real-time awareness of the situation on the grid and improve the ability for dispatchers to operate the grid. The achievement of universal access to electricity by 2030 is a significant driver of electricity sector investment, accounting for 13% of the total over 2023-2030, compared with barely 4% in 2019-2022. Maintenance and modernisation of existing infrastructure represents almost a quarter of total capital spending on grids to 2030, helping to reduce network losses in 2030 by 30% compared with 2022. The financial difficulties experienced by many utilities over several years have hampered investment in new transmission and distribution assets as well as the maintenance of existing ones, resulting in a deterioration in operational performance, including increasing network losses. Most utilities report losses of at least 10%, with an average of 15% across the continent in 2020 – more than double the global average of 7%.

Financing vehicles and instruments

The way electricity sector investment in Africa is financed must evolve to support the near-tripling of investment by 2030 and a shift towards renewables and networks in the SAS. The types of financing instruments typically used for power and network projects vary markedly according to the type of projects, the technology involved, the maturity of the market and the project stage (Table 3.1).

For instance, solar PV and wind projects can benefit from technical assistance in early development stages and concessional equity and debt during their development, but once they are operational with a proven performance, they can be refinanced on commercial capital. Arrangements for private investments are also an important factor. Several models to facilitate private sector participation in the power sector are in operation across the continent, including long-term concessions; build, own, operate and transfer (BOOT) projects; merchant plants, long-term power purchase agreements facilitated by auctions, and transmission lines; and dedicated lines for independent power projects.

Table 3.1 Common financing instruments for power generation and networks by technology and project stage

Technology	Development	Construction	Operation
Solar PV/wind – nascent market	Technical assistance grants; seed grants Concessional equity Corporate cash flow	Concessional debt Viability gap funding Corporate equity (private equity [PE]/venture capital [VC])	Commercial debt Aggregation; securitisation
Solar PV/wind – developed market	Corporate cash flow Equity	Project finance Commercial debt Corporate equity (PE/VC)	Commercial debt Refinance via corporate bond (if credit rating allows; on local markets ideally)
Geothermal and hydro	Technical assistance grants in new markets, such as resource potential assessment Equity	Funding from state-owned enterprises (SOEs) Project finance Concessional debt Corporate equity (PE/VC)	Commercial debt Refinance via corporate bond
Transmission and distribution	Grants Corporate cash flow Concessional equity	Grants Viability gap funding Concessional debt and equity	Corporate bond (if credit rating allows; on local markets ideally)

Notes: Equity can be concessional if it is provided in a subordinated or first-loss capacity, or if it has lower return expectations or a longer time period to exit. Viability gap funding can take several forms but refers to the practice of providing grants or concessional short-term loans to projects that are economically significant but not financially viable. Aggregation and securitisation refer to the pooling of assets and selling the cash flows to investors to raise capital, generally via an asset-backed security or a bond. Viability gap funding refers to the practice of providing grants or concessional short-term loans to projects that are economically beneficial but not financially viable.

Source: IEA (2023), Financing Clean Energy in Africa.

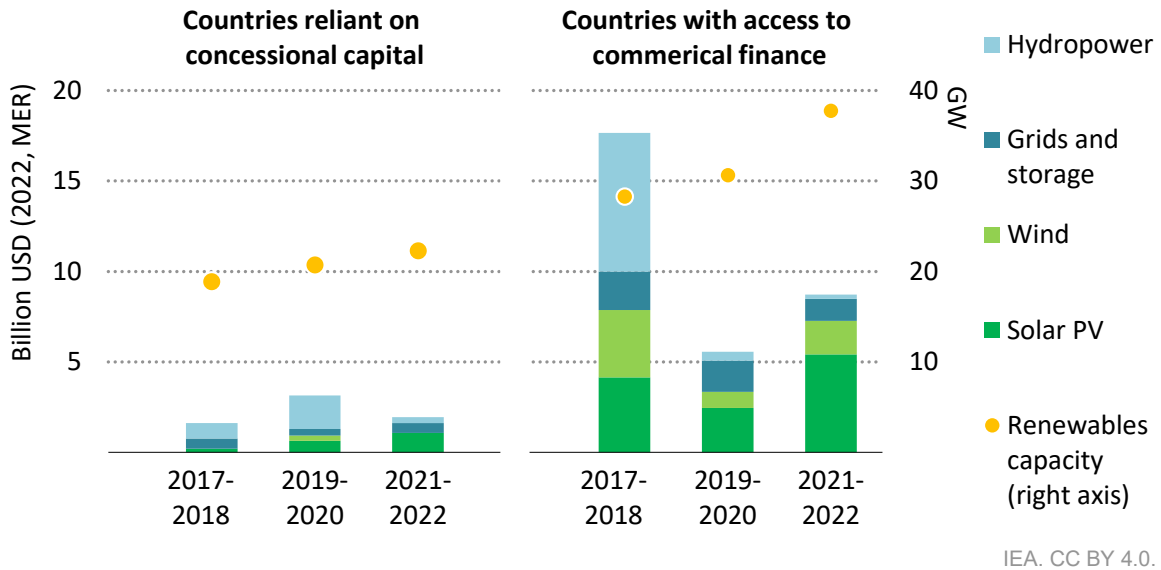
Utility-scale renewable power projects

Utility-scale renewable power projects, especially in less mature markets, are often hard to finance due to higher risks in the development and construction phases. This means that higher levels of equity financing, as well as public spending and/or concessional support from development finance institutions (DFIs), are needed. Geothermal and hydropower projects, which have more specific geological and hydrological requirements for their successful development, have an additional risk phase during the exploration and scoping

that is greater than that required for wind and solar. Hydropower projects also require long due diligence, permitting and environmental licensing procedures. This can present a major hurdle, particularly for large projects such as the proposed Grand Inga Dam project in the Democratic Republic of the Congo, which has been stalled for years due to its large scale (40 GW) and the associated need for both transmission works and cross-border agreements, as well as ongoing discussions regarding its potential environmental impact.

Many African countries still rely on concessional support for the development of their large renewable projects. As a result of the limited availability of concessional finance, investment in such projects has so far been concentrated in countries with access to commercial capital due to their broader access to finance (Figure 3.3). There is a need to increase the amount of funding to lower-income countries, accompanied by support to strengthen the regulatory environment and build institutional and technical capacity within these countries. There are signs of progress here; for example, lower-income countries are seeing a shift from licensed schemes to competitive bidding, which accounted for 20% of renewables projects in 2017-2018, rising to 90% in 2019-2021. Programmes such as the African Development Bank (AfDB) Desert to Power Initiative, which began working with five countries in the Sahel and is now entering a second phase in East Africa, demonstrate the value of a co-ordinated approach that includes working with governments on national sector roadmaps, as well as supporting individual projects through viability gap funding.

Figure 3.3 Clean power project financing by ability to access commercial capital in Africa, 2017-2022



Renewable power investments are concentrated in larger economies with greater access to commercial capital, with poorer countries forced to rely on limited concessional capital finance

Note: MER = market exchange rate; PV = photovoltaics.

Sources: IEA analysis based on IJ Global and WB PPI.

In more developed African countries, especially those with strong renewables-related regulations and existing projects, a major barrier to their widespread adoption is concern over non-payment of offtake agreements (electricity supply contracts). Aside from cultivating a reliable, paying customer base to buy this energy, other measures can help overcome this risk. These include measures that ensure utilities are not over-contracted for energy that will not get used, such as the creation of realistic integrated resource plans with clear capacity targets by technology type. It can also be improved through contract structures that assume some of the offtake risk, which includes introducing independent power producer frameworks and power purchase agreements (PPAs) which have contracts that have the governments or international development financiers absorb some of the repayment risk. Still, regulators must also ensure that risks are shared in a balanced way between sellers and purchasers of electricity to avoid putting too much risk on utility off-takers and government backstops, many of whom are already in financial difficulty. Greater transparency around financial terms, including any de-risking or credit enhancements provided by DFIs, can help in this regard.

Once countries already have a developed market for renewables projects, the pipeline of new projects can rely increasingly on commercial debt with partial assistance from the public sector, even in the development and construction phases. This opens the country up to a larger pool of capital providers while also freeing up DFI or donor capital to invest in more nascent markets. It also creates opportunities to refinance projects, allowing concessional finance providers to exit the investment and be replaced by private investors. For example, the 380 MW Benban Solar Park project in Egypt was originally funded with equity from the private sector and debt solely from multilateral development banks (MDBs). In April 2022, Scatec and its partners refinanced the non-recourse project debt through the issuance of a 19-year, USD 335 million green project bond. This transaction – the first of its kind in Africa – reduced the project's financial costs over its lifetime while freeing up MDB capital to reinvest elsewhere.

Distributed renewable power for businesses

African grids are prone to frequent power outages. As a result, many end users, ranging from small and medium-sized enterprises (SMEs) and smallholder farmers through to large commercial and industrial firms, are forced to operate diesel generators as a backup. In recent years, as the cost of solar PV modules has fallen and diesel prices have risen, the market for distributed solar PV supplied to businesses has grown.

Projects to supply distributed solar power are generally financed on the consumer's own balance sheet or via off-balance sheet arrangements, such as third-party ownership supported by corporate PPAs. In the latter case, the end

user is often a creditworthy business, but such third-party arrangements are also suited to cash-constrained companies, including SMEs. Most distributed solar and battery systems sold under these arrangements have, to date, been concentrated in Egypt, Nigeria and South Africa. However, projects with similar arrangements are planned or are underway in at least 12 other countries across the continent. National policies, particularly around third-party ownership, interactions with utility distribution and billing systems, and tax exemptions for importing solar equipment, will play an important role in supporting the further growth of the distributed solar PV market in these applications, to reduce risks to subsequent grid investments undermining the project economics of these systems.

Grids and storage

Public utilities will need to be responsible for much of the investment in upgrading electricity systems across the African continent, accounting for 80% of grid investment in 2030 in the SAS. This is a daunting prospect given their perilous financial state today. Poor payment collection rates, illegal connections, cost increases (including the cost of capital), operational problems and supply chain constraints are reducing cash flows and driving up debt in many countries, especially in sub-Saharan Africa. Private sector financing will therefore need to take on a larger role, although this is likely to be limited to countries that have relatively well-developed power systems, a stable regulatory environment and the legal frameworks in place to allow for private sector participation in their power sector. In addition to providing new sources of finance, private operators generally outperform their public counterparts across a range of technical and commercial indicators. Nonetheless, it is important that moves to open up transmission and distribution are accompanied by strong regulation, in part to ensure that private operators invest in less-profitable areas such as the electrification of rural areas.

In many countries, boosting private investment requires authorising their participation, whether through the use of concession agreements or other regulatory carve-outs for private sector investment and ownership, which should be accompanied by auctions and competitive tenders to ensure these processes are managed fairly and efficiently. Although private participation in generation in Africa has been increasing gradually in recent years, with over half of African countries now allowing it, private operators of both transmission and distribution assets are present in only three countries – Côte d'Ivoire, Gabon, and Zambia. Several other countries are exploring ways to open networks to private investors, but public concessional finance is likely to be necessary to de-risk projects, particularly in the early stages. For example, Gridworks, an investment platform owned by the DFI British International Investment, is working with the Ugandan government on a pilot for private investment in transmission, while the Kenyan

government signed an agreement with India's POWERGRID in 2022 to create Africa's first independent power transmission project.

Digitalisation, including outage management systems and smart metering, accounts for a small share of total grid investment in the SAS but makes a disproportionately large contribution to reducing network losses, particularly non-technical (mainly due to poor collection rates and theft). These losses were estimated to cost African utilities in total around USD 15 billion in 2020 alone. Several countries have already begun piloting these measures, notably smart metering (Benin, Kenya), smart substations (Senegal, Democratic Republic of the Congo), fibre optic communication added to transmission lines (Ethiopia, Kenya) and the use of thermal-based tools with drones to support routine inspection of hotspots on the grid (Ghana, Kenya). Much of this investment is likely to occur via public utilities, but it can also be supported by the private sector, where their participation in electricity networks is permitted. Robust planning to signal to the market that there is a strong pipeline of potential projects is necessary to attract private investors.

Chapter 4. Emerging industries

Key targets and investment needs

As in the rest of the world, an emerging set of industries based on various energy technologies will need to play an increasingly important role in Africa over the coming decades as the energy transition advances. They include the mining and processing of critical minerals; the production of low-emissions steel and cement; the production of hydrogen and hydrogen-based fuels; and the manufacturing of clean technologies such as vehicle batteries, solar PV panels, wind turbines, heat pumps, fuel cells and electrolysers. For now, Africa has a significant presence only in the mining of critical minerals, notably cobalt, platinum group metals (PGMs), manganese and copper. However, some parts of Africa have effectively parlayed their low-emissions power mix, growing workforce, and competitive costs into attracting new investment in related industries, such as in Egypt, Kenya and Morocco. Within the broader context of Africa's growing industries, including in steel, cement, textiles, paper and agriculture, industrial energy demand growth can be seen as an opportunity – anchoring new energy infrastructure on these clients as reliable, paying sources of demand. Productive uses – the grouping to describe energy use linked to economic activity – made up nearly half of the growth in electricity demand in Africa over the last ten years, and pay two-thirds of Africa's electricity bills, despite only making up just over half of Africa's electricity demand. This section explores opportunities to develop these new industries with an eye for how their development supports African and global energy objectives.

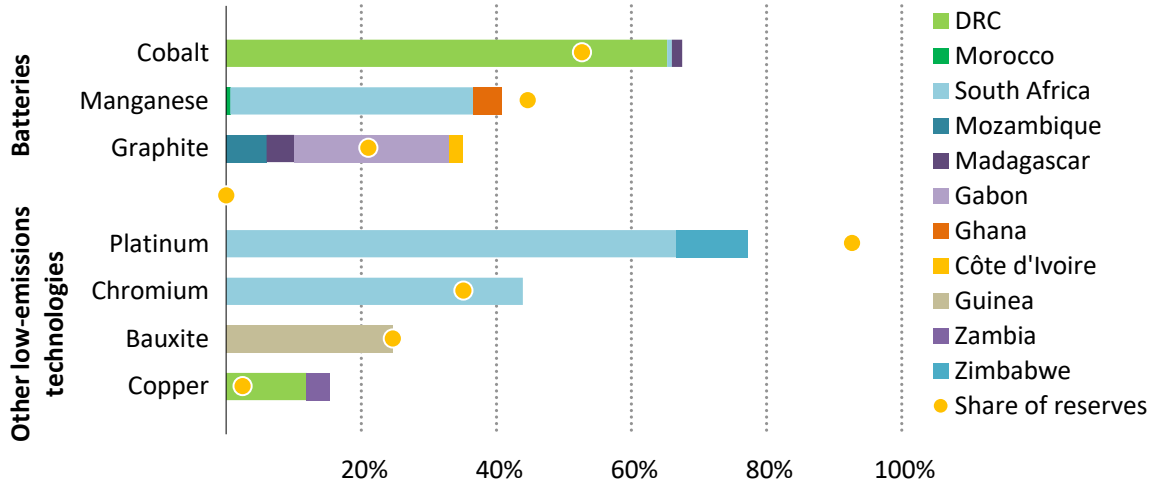
Critical minerals

Expanding the extraction of critical minerals to meet rapidly growing global demand represents an enormous economic opportunity for Africa. Production of mineral resources is already a vital source of income for Africa, representing around 8% of government revenues in resource-rich African countries. In 23 African countries, minerals represent over 30% of total product exports. The mining sector has also been one of the main recipients of foreign direct investment in the region.

Several African countries are endowed with large mineral resources, many of which are critical to various clean energy technologies. For some minerals such as cobalt, PGMs and manganese, the region is already a major supplier to the global market (Figure 4.1), as reiterated also in the IEA's latest report Global Critical Minerals Outlook 2024. The Democratic Republic of the Congo accounts for about 70% of global cobalt production, though only a small amount is

processed in the country (the bulk of it is exported to China for processing). It is also Africa's leading producer of copper and among the top five producers worldwide, and could be among the top three in 2030. South Africa dominates global supplies of PGMs and is also a leading producer of chromium and manganese. There are also substantial untapped resources of other minerals such as lithium and nickel. Africa's lithium mining is expanding, led by Zimbabwe, with planned projects in Ethiopia, Mali, Namibia, the DRC, and Ghana, potentially boosting production to 53-70 kt by 2030, despite possible delays from price volatility. The continent also holds a sizeable share in the production of other mineral resources such as bauxite and graphite (such as in Uganda).

Figure 4.1 Share of African global production of selected minerals, 2023



IEA. CC BY 4.0.

Africa is already a major producer of key critical minerals today, holding in some cases more than half of known global reserves

Notes: DRC = Democratic Republic of the Congo. Anticipated supply includes existing production and that from projects that are currently planned or under construction.

Source: IEA (2022), Africa Energy Outlook 2022.

The extraction of critical and other minerals needed for clean energy technologies across the continent is expected to grow strongly in the coming years, especially cobalt, led by the Democratic Republic of the Congo and Zambia. Revenues from copper and key battery metals production in Africa are already estimated at over USD 20 billion annually, and the current pipeline would imply a 65% increase in market value by 2030.

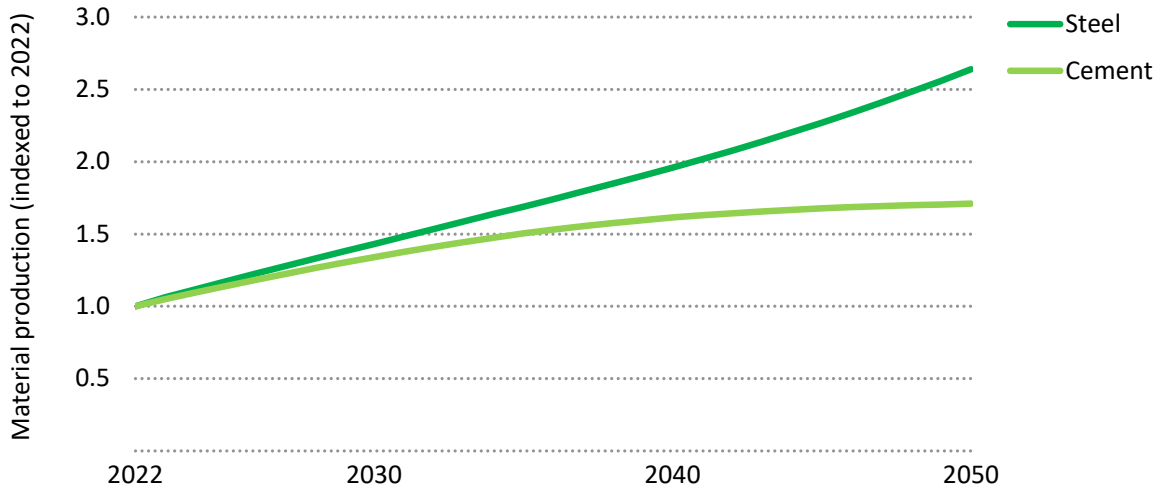
There is enormous potential for expanding output as global demand for those minerals soars in parallel with that for clean energy technologies, which will be outlined in the IEA's upcoming Critical Minerals Security Mechanisms Research Study. This expansion will require large-scale investments in mines as well as a range of supporting infrastructure such as ports, roads, railways and power supply.

Improving the quality of geological surveys to gain a better understanding of the resource potential, robust governance, transparent regulatory frameworks and adequate incentives will also be needed to stimulate investment. All of this necessitates the strengthening of the capacity of local authorities to design, monitor and regulate resource developments and processing, as well as transparent mineral wealth management systems to translate mining revenues into widespread economic prosperity and use them to support the diversification of the economy. The environmental and social effects of exploiting mineral resources also need to be managed carefully, both to protect local communities and to gain public acceptance for future projects.

Steel and cement

While almost 20% of the global population resides in Africa, in 2022 the continent accounted for just over 5% of global cement production and 1% of global steel production, almost a third of which is from scrap-based electric arc furnace. In the Sustainable Africa Scenario (SAS), economic development drives up building and infrastructure needs greatly on the continent, with Africa set to build more floor area by 2030 than currently exists in Japan and Korea. This drives up the demand for steel and cement on the continent considerably, with steel production growing by over 40% and cement production increasing by almost 35% by 2030 (Figure 4.2) to meet the rising demand. Increasing the production of these products in Africa could bring a suite of benefits for African countries, such as reducing import dependency for steel, increasing the security of supply and creating employment opportunities.

Figure 4.2 Steel and cement production in Africa in the Sustainable Africa Scenario, 2022-2050

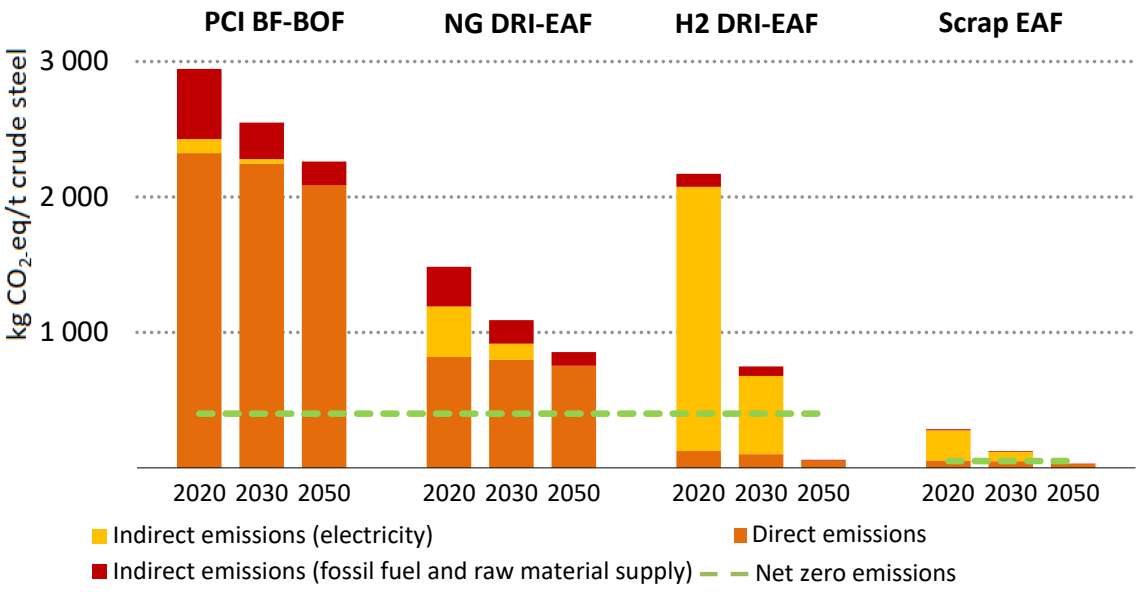


Driven by economic development, steel and cement production increase rapidly to meet rising demand for infrastructure

The production of steel and cement is currently dominated by emissions-intensive processes which rely on fossil fuels. While there is limited production of low-emissions steel and cement in Africa, there are a few plans to invest in these sectors in the foreseeable future, such as in Mauritania and South Africa for steel and Ghana for cement. While decarbonising steel and cement production is important to avoid locking in emissions-intensive assets for decades, meeting the rising production demand for steel and cement via low-emissions technologies in the near term is challenging, as these technologies have higher upfront costs and are not yet demonstrated at scale. For example, in 2030 steel production pathways based on low-emissions hydrogen are expected to be considerably more costly than those of natural gas.

As new production expands in Africa, there are opportunities, however, to ensure the latest steel and cement production developed is as efficient and future-proof as possible. For steel production, for instance, the emissions intensity of natural gas-based direct reduced iron-electric arc furnace (DRI-EAF) routes is less than half that of coal-based routes, such as blast furnace-basic oxygen furnace (BF-BOF) and coal-based DRI-EAF (Figure 4.3). Additionally, gas-based DRI processes can be more easily shifted to low-emissions hydrogen without substantial retrofits. Such an approach has been adopted by countries such as Uganda, which through its recently drafted Energy Transition Plan is planning to focus all new steel-producing plants on using natural gas instead of coal by the end of this decade. While serving domestic markets and reducing import dependency should be the priority, for countries with good iron ore and low-emissions hydrogen resources, there could be opportunities to export higher-value products like low-emissions steel to foster economic growth. In Namibia, for example, German developers are exploring a novel technology to produce low-emissions iron (the precursor of steel) using renewable energy, while in Mauritania, ArcelorMittal is evaluating the potential to develop a DRI production plant that would take advantage of Mauritania's potential for renewable electricity generation and low-emissions hydrogen production. Foreign offtake can also help enhance the creditworthiness of the project and help lower the cost of capital for such projects.

Figure 4.3 Global average direct and indirect emissions intensities in crude steel production via key decarbonisation pathways



In 2030, the emissions intensity of natural gas-based DRI production routes is more than half of that of coal-based routes. By 2050, hydrogen-based DRI process create opportunities for net zero emissions crude steel production

Notes: PCI BF-BOF = blast furnace-basic oxygen furnace with pulverised coal injection; DRI-EAF = direct reduced iron-electric arc furnace; H2 = hydrogen-based; NG = natural gas-based; Scrap EAF = scrap-based electric arc furnace. All process routes use zero scrap, apart from the Scrap EAF route, which uses 100% scrap.

Source: IEA (2022), Achieving Net Zero Heavy Industry Sectors in G7 Members.

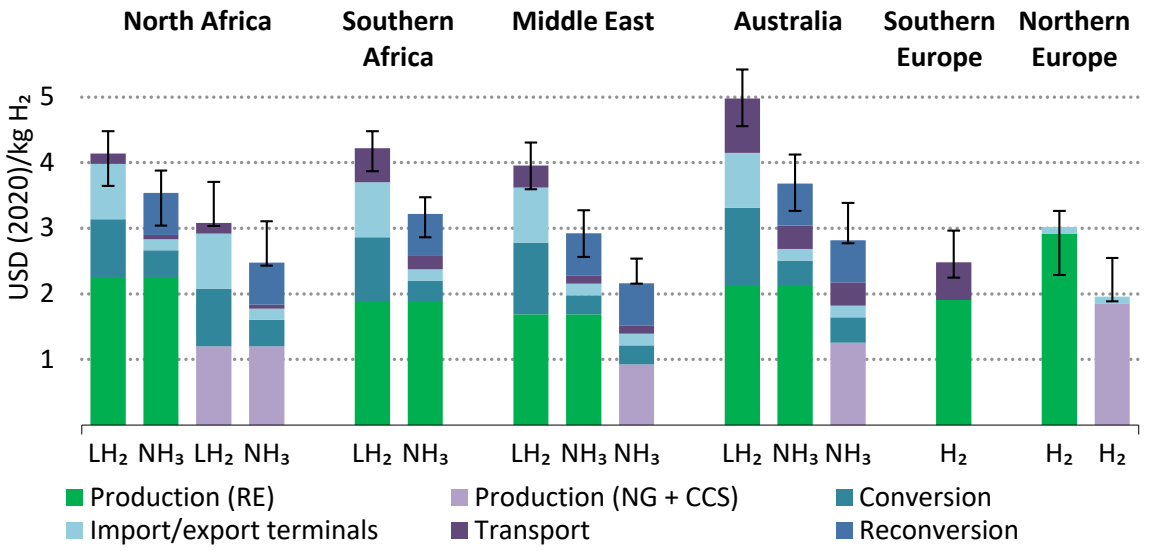
For cement production, combustion emissions account for around 30-40% of total emissions, while process emissions – the more difficult to abate – account for the remainder. Today, much of Africa's cement production uses biomass residues along with coal and oil products to manage seasonal availability of biomass. Developing more stable biomass stocks, and firing with gas, for instance, can be cheaper and reduce emissions. Reducing the clinker content through substitution with alternative materials, such as calcined clay, can also reduce process emissions. To fully decarbonise cement production, carbon capture, utilisation and storage (CCUS) technologies are needed to capture CO_2 process emissions. While CCUS technologies are currently not economically feasible for facilities in Africa, the technology could create opportunities for carbon credit purchases to finance projects, particularly given that power systems in Africa have historically had a significant amount of underutilised capacity and a high share of renewables.

Low-emissions hydrogen

It is a similar picture regarding the production of low-emissions hydrogen and hydrogen-based fuels such as ammonia, which are globally at a very nascent

stage of development. Today's most common applications for low-emissions hydrogen include fertiliser production and oil refining, as well as use of ammonia-based fuels in shipping and ammonia-blending with coal in electricity generation. In principle, Africa is well-placed to develop a hydrogen industry given its large potential wind and solar resources (Figure 4.4), and low-emissions hydrogen production from announced electrolyser projects in Africa could reach 2 Mt by 2030 if all projects come to fruition. However, this would require massive investment in production and export facilities, as well as in renewables-based electricity production, power grids, seawater desalination and CO2 transport and storage. However, some models, such as the project being developed in Namibia, are exploring how a firm hydrogen offtake agreement could lower risk and financing costs for accompanying renewable energy investments and could allow for overbuilding these projects to supply power to the broader grid.

Figure 4.4 Delivered costs of low-emissions hydrogen from selected producer regions delivered to Northern Europe, 2030



Africa has potential to export low-emissions hydrogen, especially as ammonia, produced from renewable electricity to demand centres in Europe at competitive prices

Notes: H_2 = hydrogen; LH_2 = liquefied hydrogen; NH_3 = ammonia; RE = renewable energy; NG = natural gas; CCS = carbon capture and storage.

Source: IEA (2023), Financing Clean Energy in Africa.

Clean technologies manufacturing

As of today, Africa is a very minor player in the manufacturing of clean energy technologies, which is dominated by China and, to a lesser extent, North America and Europe. African countries rely heavily on imports for some key clean technology, such as solar home systems – an essential technology for achieving universal access to electricity (see Chapter 2). To help make them affordable, they

are typically exempt from duties and value-added tax, but this measure undermines efforts to nurture domestic production. Most African companies involved in producing solar home systems focus on the assembly of batteries and PV panels, which are no longer produced on the continent. A few companies pioneered production of solar panels as early as 2011 in Kenya and 2012 in South Africa but have since turned away from manufacturing to focus on distributing panels in partnership with Southeast Asian manufacturers. However, there are plans to build new production facilities, such as in Burkina Faso. In 2022, the Democratic Republic of the Congo and Zambia set up a common governance structure – the DRC-Zambia Battery Council – to create a business environment conducive to the development of a battery value chain based on their indigenous critical mineral resources.

Clean cooking equipment and fuels also face similar challenges. Often exempted from tariffs to help manage affordability, increasingly domestic efforts are focusing on developing local manufacturing of stoves and developing strong local supply chains, as is the case with Burn Manufacturing, which is expanding its stove manufacturing facilities to other countries in Africa.

Expanding manufacturing centres to meet domestic demand would require major investments in energy, transport and digital infrastructure. Dedicated industrial parks with reliable and affordable supplies of energy and other services can be a way to attract anchor industries. The reliability of electricity supply is particularly important to attract industry, increase productivity, reduce costs and cut emissions; many African manufacturers currently rely on inefficient diesel or gasoline generators to provide backup power.

Productive activities

Other productive activities, including light industry, commercial businesses and agriculture, are set to demand more energy, and can also be the target of modernisation efforts that could switch processes to electricity. Industry in total currently accounts for two-thirds of energy demand for productive uses, with services (commercial and public buildings, and desalination) contributing a quarter and agriculture less than one-tenth. Total energy consumption for productive uses across Africa rises by a quarter over 2023-2030 in the SAS, with the use of almost all major fuels increasing in all three productive sectors.

This growth can be directed increasingly towards electricity, with the right measures in place to keep electricity rates affordable, improve reliability and address the upfront investment hurdles for many of the small and medium-sized enterprises that would be making these investments. Key productive uses where the right policies could drive greater electrification include switching irrigation pumps from diesel to pumps powered by solar and batteries; expanding cold

chains to allow for safe, hygienic transportation of agricultural products to urban centres; data centres; and industries such as paper and textiles. Support would be needed from financing institutions to address the high upfront costs of these modernisation efforts, even if the most efficient, modern and sustainable options are lower-cost over their lifetime. Many productive uses demonstrate a higher ability to pay for electricity and can improve the economics of the overall power sector.

Many industries will also continue to rely on biomass, notably brickmaking, paper and pulp, food processing, and textiles, given the ample supply of biomass waste. Local authorities can assist in ensuring a continuous supply of biomass and waste to industrial plants, but also developing reliable supply chains for other modern fuels needed when by-products are unavailable. This can help reduce pressure to use other unsustainably harvested biomass, including wood and charcoal. Ethiopia, Morocco and Rwanda have implemented policies that support industrial growth using more sustainable technologies.

Financing vehicles and mechanisms

Stimulating investment in emerging energy industries in Africa, as well as stimulating the growth of clean tech demand, calls for both broad economic reforms to create a more attractive business environment for private investors and a change in the way projects are financed, in particular through the greater use of concessional finance and new financial instruments such as climate finance. The main constraint to financing now is not the supply of private finance, but rather the absence of bankable projects, in turn caused by the absence of a robust policy and regulatory framework, policy predictability and a strong political commitment to an announced energy transition pathway. Deep-seated economic policy reforms must, therefore, be the first step in the process of attempting to secure investment in these industries.

Economic development in Africa is gradually driving up the pool of available domestic capital, but most domestic financial markets remain underdeveloped and ill-equipped to channel this capital into emerging clean energy projects, while foreign investors are in many cases discouraged by excessive country and project risk. Mobilising private capital to support investments in emerging industries will, therefore, often rely on bilaterally negotiated agreements with international partners, of which government partners could bring concessional and climate finance to bear, especially in the near term for clean technology and access-related manufacturing investments, critical mineral processing, and projects that can demonstrate clear emissions reductions (Table 4.1). This calls for the expansion of existing financing instruments and the introduction of new ones, as well as innovations in establishing efficient platforms and partnerships. By contrast, mining projects are likely to continue to depend on equity finance at the

exploration and development/construction phase and on corporate cash flow for operations. Securing foreign demand for large low-emissions hydrogen projects will be necessary initially to provide the stable revenue stream needed to mobilise investors at the necessary scale.

As with investments in the electricity sector and related to extending energy access, concessional finance will undoubtedly need to play a major role in getting projects in non-mining emerging energy sectors off the ground given the limited scope for debt financing. As these public and philanthropic funds are limited, they need to be used strategically to leverage high multiples of private funding and to support high-impact development projects where risks are too high to attract sufficient capital from the private sector.

Table 4.1 Common financing instruments for emerging energy industries by project stage

Industry	Development	Construction	Operation
Critical minerals	Equity of mining juniors and corporate cash flow	Mining juniors acquired by majors and projects developed using corporate cash flow; equity from downstream offtake agreement	Corporate cash flow
Low-emissions hydrogen	Government grants, Concessional debt from multilateral development banks	Concessional and commercial debt, equity, grants, green/sustainable bonds	Corporate cash flow Revenue from government subsidies
Steel and cement	Corporate balance sheet	Concessional debt	Corporate cash flow
Clean tech manufacturing	Concessional equity Private equity/venture capital	Concessional debt	Corporate cash flow

Notes: Mining juniors, often funded by speculative stock market investors, are small project development companies intervening in early development phases such as exploration and prefeasibility/feasibility studies, which are characterised by lower capital requirements and a higher level of risk, due to inherent geological incertitude, commodity price fluctuations and long lead times.

Chapter 5. Mobilising investment

Creating a conducive investment ecosystem

Many clean energy projects in Africa today – especially in sub-Saharan countries – rely on concessional funding, with development finance institutions (DFIs) among the largest energy investors on the continent. Yet the total investment this funding is mobilising is far from sufficient to meet the needs of the energy transition to put Africa onto a truly sustainable development path. There is an urgent need to step up this funding and tap into the range of sources of financing available for such projects on a much larger scale, in particular from private lenders. Enhanced commitments by donors and DFIs are an essential condition to scaling up clean energy investment, particularly in energy access projects, but they must be accompanied by improvements to their existing delivery channels, changes to their business models to take a more active role in riskier early-stage project development, and a greater focus on how to mobilise more private investment. This is all the more pressing in the case of fragile and conflict-prone countries, where other sources of capital are severely lacking.

In parallel, host countries themselves have a role to improve the overall investment climate, lower the cost of private capital and encourage the development of local capital markets in order to attract more private capital. In the longer term, there will be a growing need to secure financing from institutional investors for clean energy projects in the electricity sector and emerging energy industries via tools such as sustainable debt issuances. Private equity and venture capital will also need to play an important role in funding start-ups, including companies that are tackling energy access gaps or providing innovative solutions to develop local clean energy-related industries. And local banks and institutional investors will need to contribute more to clean energy projects as the transition advances. All this hinges on building the human and institutional skills and capabilities in government, the energy sector and the local financial community.

A set of high-level cross-cutting developmental objectives that governments (of both donor and host countries), DFIs and other providers of concessional capital should take into consideration in financing clean energy projects in Africa are outlined below. The aim should be to encourage equitable African-driven investments that create lasting and inclusive social and economic developmental benefits. The types of technical and institutional capacity-building initiatives specific to the energy sector that are needed to assist African countries in securing those investments are identified, and examples of successful programmes are provided.

Better leveraging public funds to attract private capital

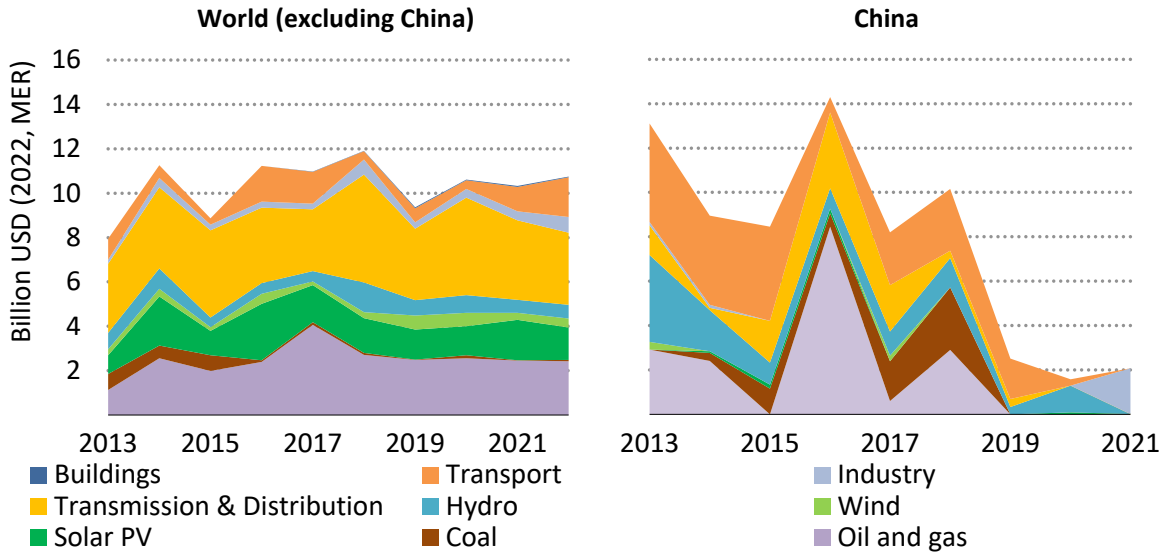
Concessional and blended finance

Concessional finance will be critical to many types of clean energy investment, notably those related to energy access, the electricity sector and nascent energy industries. DFIs and philanthropies need to use it in ways that help to mobilise the maximum amount of private capital by de-risking investment through co-investment or blended finance. This finance involves the use of concessional development capital to mobilise private capital by improving the risk-return profile of projects and lowering the cost of capital, using guarantees or other risk-sharing and liquidity support to mitigate risks, or providing grants to support project preparation and project structuring.

DFIs have played a crucial role in financing energy projects in Africa from 2013 to 2022. Overall, global (excluding the People's Republic of China [hereafter "China"]) DFI financing is more diversified and steadily increasing support for renewable energy, whereas China's financing is characterised by large, targeted investments in specific years (Figure 5.1). The level of global DFI financing in energy has been relatively static over the last decade, spread across various sectors with 30% of it in transmission and distribution in 2022 and with solar PV almost doubling. In contrast, Chinese DFI financing exhibits significant volatility, with sharp peaks followed by rapid declines, driven by central government policy on lending abroad. China's investments have focused heavily on fossil fuel projects, although going forward the government has announced its intention to focus on greener investments, including in sectors such as transmission and distribution and transport.

Overall, while DFIs, including in China, have committed to reducing their financing to fossil fuels – particularly coal and oil – the data do not yet show a significant increase in clean energy spending. This is in contrast to the overall trend in energy investment, which has seen total spending increase from over USD 2 billion in 2013 to nearly USD 3 billion in 2023, driven by a near-tripling of clean energy investment.

Figure 5.1. Development finance institution spending in energy by source and sector in Africa, 2013-2022



While global development financing in energy for Africa has increased with a focus on renewable energy and transmission, China's spending shows significant volatility with large investments in specific years and a declining trend

Note: MER = market exchange rate.

Source: IEA analysis based on OECD (2023), Development finance assistance.

Today, G7 countries together provide roughly USD 80 billion in financing to Africa from their bilateral development finance institutions, of which around 6% goes to energy. Much of this capital today focuses on technical assistance, supporting an enabling environment for better energy and climate investments. In some regions, these efforts are bearing fruit, and in these leading markets a shift towards concessional finance used to mobilise additional investments, such as low-cost debt, equity and guarantees, could be instrumental to achieving the doubling of energy investment needed on the continent. An examination of ongoing G7 initiatives in the energy and climate sectors (Table 5.1) shows that a significant portion of official development assistance (ODA) is directed towards relatively developed economies such as Egypt, Nigeria and South Africa, which are among the four countries with the highest GDP in Africa. Other overseas development aid efforts are also ongoing and could also be leveraged with a wider view of energy's role in development, such as in the context of a lack of clean cooking access which carries grave impacts on health, gender equality and the environment.

Table 5.1 Official development assistance received and number of initiative participations for selected African countries, 2022

ODA USD Million	LDCs	Non-LDCs
500-600		Egypt (3), Nigeria (3)
300-400		South Africa (4)
200-300	Mozambique (3), Tanzania (3), Niger (2)	Kenya (5)
100-200	Senegal (7), Benin (4), Ethiopia (4), Burkina Faso (3), Guinea (3), Zambia (3)	Morocco (3), Côte d'Ivoire (5)
<100	Democratic Republic of the Congo (3), Rwanda (3), Togo (3), Uganda (3), Djibouti (2), Guinea-Bissau (2), Liberia (2), Malawi (2), Mali (2), Mauritania (2), Sierra Leone (2), Somalia (2), Sudan (2), The Gambia (2), Chad (1), Madagascar (1)	Ghana (5), Tunisia (3), Cameroon (2), Namibia (2), Cabo Verde (2), Zimbabwe (1), Algeria (2), Congo (2), Angola (2)

Notes: LDCs = Least Developed Countries. The number of G7 initiatives having active or past projects on energy in these countries is included in parentheses. G7 initiatives included in this count are: the Clean Energy for Development: A Call for Action initiative, G20 Compact with Africa, Global Gateway, Just Energy Transition Partnerships, "Mattei Plan" for development in African continent states, Partnership for Global Infrastructure and Investment, and Power Africa. LDC = Least Developed Countries.

Source: IEA analysis based on OECD (2023), Development finance assistance.

A number of different blended finance instruments can be used (Table 5.2). In structuring blended finance projects, the choice of instrument is determined largely by the rationale for using concessional funds, reflecting the project-specific investment risks or market barriers. This helps ensure that the minimum amount of concessional funding needed to attract the required amount of private capital is used.

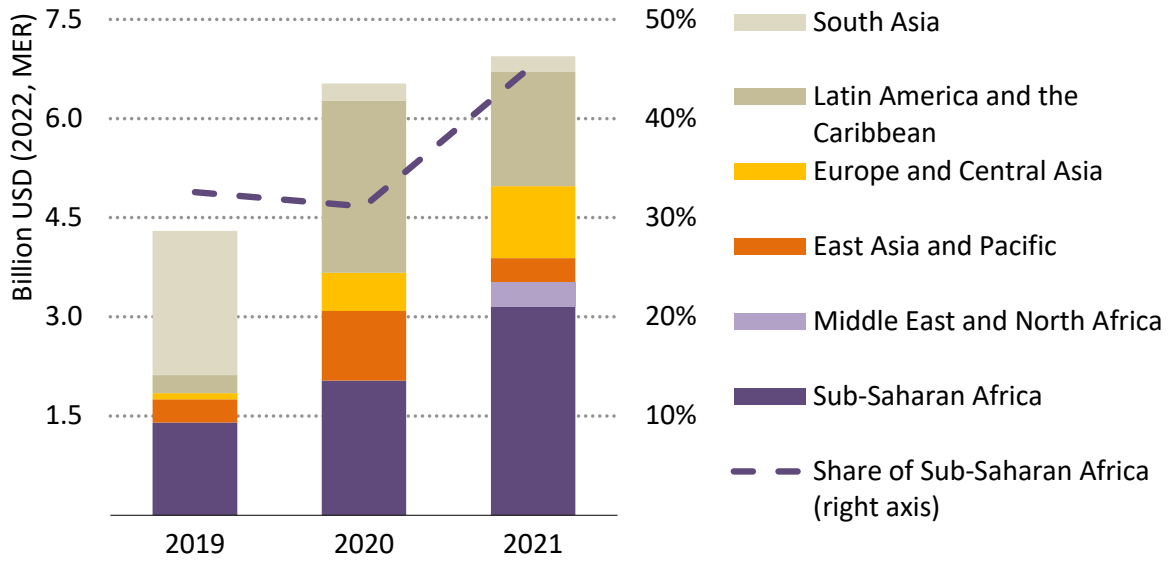
Table 5.2 Blended finance instruments

Instrument	Characteristics
Concessional loan	Concessional senior loan, priced below market, or subordinated loan in liquidation and/or in payments to all senior lenders, also priced concessionally.
Guarantee	First loss cover, up to an agreed maximum amount. Can be protected as a (funded or unfunded) guarantee on a single loan, or as a pooled first-loss guarantee on a portfolio of loans. Liquidity support guarantee can be provided on a revolving standby letter of credit that can be drawn by the project company if the off-taker fails to honour its payment obligation.
Concessional equity	Lower-priced equity with a lower internal rate of return to offer affordable equity funding, or subordinated equity with cash waterfall (distribution of all proceeds including exit and dividends according to a waterfall).
Investment grant	Performance-based incentive (PBI): rebates to provide incentives and disincentives to achieve desired outcomes or results (e.g. tie at least a portion of payments to achievement and aim to reward innovation and successful implementation). Viability gap funding: capital grant provided up to certain percentage of total investment costs for projects that are not commercially viable yet due to long gestation period.

Instrument	Characteristics
Bond investment	Similar to a loan, can be traded privately or publicly, offshore or onshore. Can be used with PBIs.
Local currency support	Concessional funds to provide fully or partially subsidised currency hedge, or concessional loan with a subsidised spread (or with a swap-cost buy-down) to absorb the high cost of currency hedge.

The long-term objective of blended finance is to achieve commercial sustainability with concessional support reducing over time. Experience has shown that blended finance can leverage or crowd in commercial financing of up to seven times the amount of concessional funds from donors. Yet despite the clear potential of blended finance, it does not always attract much private capital in practice; expert interviews highlighted that blended finance is most often used by DFIs and multilateral development banks (MDBs) to de-risk their own capital. The requirements for investment returns at these institutions result in most of their concessional support going to projects where they are the dominant financier, instead of targeting the concessional capital to de-risk projects. Blended finance has been growing strongly in sub-Saharan Africa in recent years, reaching over USD 3 billion and accounting for 45% of all transactions worldwide in 2021 (Figure 5.2).

Figure 5.2. Blended finance by region across developing economies in Africa



The use of blended finance instruments has been steadily increasing, with sub-Saharan Africa now accounting for over 40% of transactions listed

Note: Some projects at a global level are excluded here. MER = Market exchange rate

Source: IEA (2023), Financing Clean Energy in Africa.

A leading example of the use of blended finance for emerging energy industries in Africa is the funding of research and development and feasibility studies for Namibia's Green Hydrogen Strategy, which targets production of 10 Mt to 12 Mt per year of hydrogen equivalent by 2050. In May 2023, Namibia signed a feasibility and implementation agreement with Hyphen, a German company, to develop a 2 Mt/year low-emissions ammonia project involving investment of roughly USD 10 billion – equal to close to 80% of the country's GDP in 2022. The country also mobilised concessional funding of EUR 540 million (USD 579 million) from the European Investment Bank and Invest International, a Dutch firm, to finance its industrial clean energy ecosystem and to fund a potential equity share in the project. Mauritania and Egypt have also signed agreements with private developers for major hydrogen projects and memoranda of understanding with potential off-takers, while South Africa announced in June 2023 its intention to launch a new hydrogen blended finance fund (SA-H2) to accelerate the development of low-emissions hydrogen with support from Denmark.

In designing blended finance deals, ensuring the right proportion of concessional funding that is used is critical; it needs to be high enough to attract private capital while still ensuring the most efficient use of concessional capital. Part of the challenge is the limited availability of data on how these deals have been structured, which reduces the replicability of deals. Broadly, though, more than half of the blended finance transactions for all climate-related projects include concessional loans, whereas only about 20% utilise guarantees and risk insurance and another 20% use technical assistance grants. A shift towards guarantees and insurance would help to leverage higher amounts of private capital and require less concessional funds as the provision of a guarantee would require holding just 25-30% of the amount in reserve, therefore allowing more projects to be supported.

Innovative financial instruments

Several other financial instruments will be needed, in addition to or in combination with concessional and blended finance, as well as new platforms and partnerships to mobilise private capital at scale in emerging industries in Africa. These include green, social, sustainable and sustainability-linked (GSSS) bonds; carbon credits and voluntary carbon markets; and co-investment, syndication platforms and pooled investment vehicles. These instruments are primarily aimed at attracting foreign private capital but could later draw on domestic banks and capital markets, especially where revenue streams are typically denominated in local currency. This would require developing domestic bond, equity and derivatives markets (e.g. currency swaps).

GSSS bonds have the potential to attract more private climate financing into African energy projects, including in emerging industries. Africa has so far

managed to attract very little GSSS finance: in 2022, a total of USD 1.9 billion of GSSS bonds were issued in Africa. Since 2014, issuers from just nine different sub-Saharan African countries have entered the GSSS bond market. This is partially explained by the fact that many African countries do not have a well-functioning capital market and only 13 sub-Saharan African countries have international market access. Developing a GSSS bond market could facilitate the diversification of the financial sector.

Sovereign green bonds hold the potential for stimulating green corporate bonds and domestic currency financing from both local and international sources. Several emerging economy governments have used green bonds to raise local currency financing for infrastructure projects, and even without an investment-grade rating, they have benefited from a "greenium".4 Green bonds are likely to be most applicable to countries that have reasonable debt sustainability and have a growing domestic capital market. The Nigerian government launched the Green Bond Market Development Programme in 2017, resulting in two sovereign issuances in 2017 and 2019 – the first of their kind in Africa – with a combined value of around USD 70 million, and four corporate issuances totalling USD 72 million. Both bonds achieved a greenium and were used to support projects in renewable energy, primarily rooftop solar and rural electrification, and afforestation. However, questions have been raised about the implementation of projects and reporting has not been made available on the environmental impact of the bond proceeds. Ensuring best practices on reporting would increase confidence in the market, particularly among international investors.

Alongside more traditional green bonds, there has also been a rise in sustainability and sustainability-linked bonds. They can be particularly useful for sovereign bonds since fungibility rules can prohibit the issuance of "use of proceeds" bonds (where, in the case of liquidation, the lenders have recourse to the issuer's other assets). In 2021, Benin became the first country in Africa to issue a sustainability bond – a EUR 500 million bond with a 12.5-year tenor that was reportedly three times oversubscribed and attracted a greenium of 20 basis points.

Carbon credit markets have the potential to channel more private capital into clean energy investment in Africa, but stronger application of methodology standards and monitoring, reporting and verification processes is needed for them to grow from today's low base. Credits used to comply with greenhouse gas emissions mitigation targets in other countries could be a valuable revenue stream for African countries. Project developers can generate and sell credits either under the international crediting mechanisms of the United Nations Framework Convention on Climate Change (UNFCCC) (including the Clean Development Mechanism

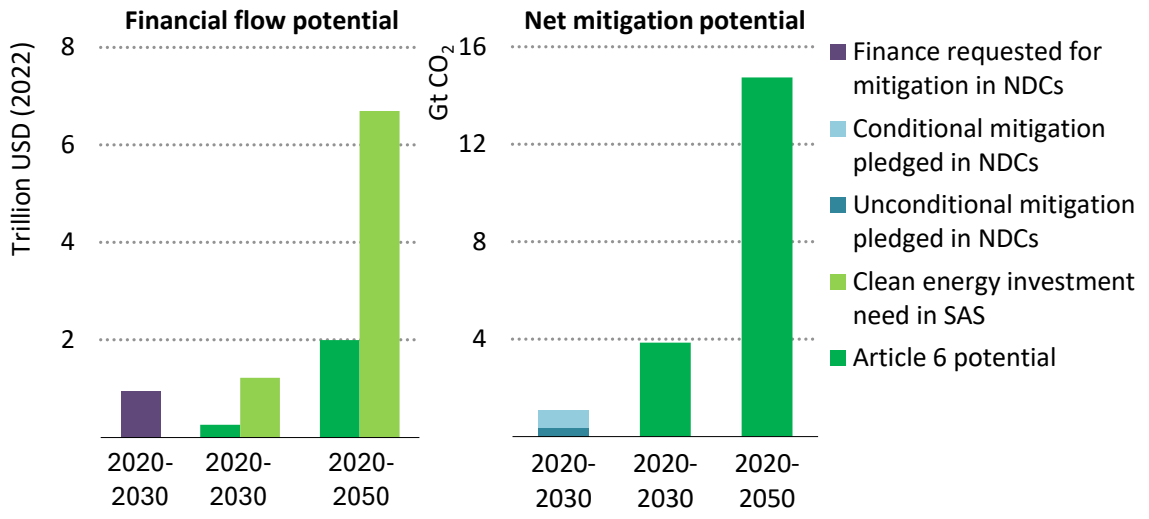
[4] The amount by which the yield on the green bond is lower than that on a conventional bond, i.e. the premium the investor is prepared to pay for the perceived benefits of investing in that green instrument.

[CDM] under the Kyoto Protocol and through the Article 6.4 mechanism under the Paris Agreement), or via voluntary carbon markets – independent crediting programmes, self-regulated and managed by non-governmental entities (such as Verra or Gold Standard).

Article 6 voluntary co-operation provides new opportunities for African countries to engage in carbon markets. They can exchange Internationally Transferred Mitigation Outcomes (ITMOs) with other countries (under Article 6.2) or issue credits in the Article 6.4 mechanism. Voluntary co-operation under Article 6.2 has already started, though agreement on specific operational details was not reached at the 28th Conference of the Parties (COP28) in December 2023. At least 42 African countries have expressed their interest in or intention of participating in the Article 6 mechanisms in their latest nationally determined contribution (NDC) submissions, with the majority seeing themselves as a seller of credits. Financial flows under Article 6 could reach up to USD 245 billion, or over one-fifth of total clean energy investment needs, by 2030 and close to USD 2 trillion, or one-third, by 2050 (Figure 5.3). While these investment flows would apply across all sectors, they could nonetheless be an important investment source for emerging energy industries in Africa.

Additional revenues from credits issued in voluntary carbon markets, purchased by non-state actors, can also play a role in fostering clean energy solutions in Africa, although these have largely been for nature-based solutions to date. Still, carbon credits are a meaningful source of revenue for clean cooking developers. At the Summit for Clean Cooking in Africa, over 50 organisations decided to establish a Carbon Credit Task Force committed to creating demand for high-integrity carbon credits from clean cooking activities, and endorsed the update of methodologies that address the concerns of carbon credit integrity, with many organisations signalling their intention to back the Clean Cooking Alliance-led Clean Cooking and Climate Consortium (4C) initiative.

Figure 5.3. Article 6 financial flows and CO2 emissions reduction potential in Africa in the Sustainable Africa Scenario



Article 6 financial flows could reach over 20% of investment in clean energy in Africa in 2020-30 and roughly 30% in 2020-2050

Note: The estimation of Article 6 financial and mitigation potential is from the research project "Modelling the Economic Benefits of Article 6" by the International Emissions Trading Association (IETA) and the Center for Global Sustainability at the University of Maryland. Levels reported represent upper bands of the scenarios included in the model. The model simulates demand and supply of credits through Article 6 co-operation by countries, and presents some limitations, such as the assumption that all revenues from Article 6 co-operation are reinvested in increased mitigation ambition.

Source: IEA analysis based on data from Yu et al. (2021), The Potential Role of Article 6 Compatible Carbon Markets in Reaching Net-Zero.

Other financing platforms and mechanisms could help drive investment in emerging energy industries in Africa in the long term. Project aggregation platforms and securitisation vehicles can help overcome the asymmetry between the relatively small size of most such projects in Africa and the relatively large minimum investment size that major institutional investors require. Aggregation and securitisation, whereby assets are pooled into a special purpose vehicle to create a tradable asset-backed security, can be an effective means of raising debt from capital markets in local currency. These platforms can pool and de-risk large numbers of smaller projects and thereby create standardised investment-grade multi-asset portfolios, reducing transaction costs, diversifying risk and attracting interest from institutional investors. DFIs have a long track record of syndicating investment opportunities in emerging economies, including support for clean energy projects. Co-investment models have been central to this, enabling private investors to broaden the types of risk they are willing to consider by leveraging DFI expertise and financial resources.

Integrating cross-cutting developmental objectives

Africa's social and economic development is heavily intertwined with its energy development. Universal access to modern energy service, more reliable electricity and less volatile energy pricing would all contribute to improving the welfare of Africans and accelerating economic development across the continent. Seizing this opportunity calls for an economic transformation that goes beyond energy supply, covering an expansion of key industries, including fertiliser, steel and cement, as well as the manufacture and assembly of appliances, low-emissions vehicles and other clean energy technologies. That would generate wealth, create jobs and reduce Africa's burden of imports generally. This economic diversification is an integral part of the SAS.

Achieving that economic transformation requires large amounts of investment in all parts of the energy system, alongside investment in building infrastructure within and between African markets, including transport links and telecommunication networks, as well as energy networks. All those investments should be African-driven, inclusive and aligned with social and economic developmental goals, chief among which are boosting local employment, involving local actors and enterprises and supporting local value chains. Another important consideration in this regard is the need to ensure that the provision of energy services is as efficient as possible, thereby contributing to development by both lowering their cost to end users and reducing climate and broader environmental impacts.

Creating jobs and local value chains

Employment is a primary developmental consideration in Africa. There is enormous pressure to create productive and well-paid jobs in all African countries in the face of rising population and widespread underemployment and poverty. The continent has the youngest population in the world, with around 15 million people joining the labour force each year. The unemployment rate across Africa has been broadly stable at around 7% since 2020, slightly above the global average, but rates are much higher in certain countries, including South Africa, where it is over 32%. Unemployment increased everywhere as a result of the Covid-19 pandemic. Most African countries are characterised by underemployment, widespread informal employment and limited social system protection. Over 80% of employed Africans work in the informal sector, where wages are low and jobs less secure. Around 45% of them work in agriculture, earning on average just one dollar per day, while 13% work in manufacturing and 38% in services.

Building a clean energy system in Africa offers major opportunities to stimulate the creation of decent jobs that require wide-ranging skills. According to official data, around 2 million Africans were employed in the energy sector in 2019, accounting for just 0.5% of the total labour force, but total energy-related employment may be as high as 11 million when informal jobs, such as firewood and charcoal production, are included.

Employment in Africa's energy sector will undoubtedly grow rapidly in the coming years and decades as the demand for energy services rises and power capacity expands. In the SAS, almost 4 million energy-related jobs in total are created across the continent over 2023-2030, largely as a result of providing universal access to modern energy to households in sub-Saharan Africa and the rapid deployment of clean energy technologies. But this is contingent on governments developing the human resources, as well as physical infrastructure, required for the local assembly of clean energy technologies. Shortages of skilled labour for large-scale renewable capacity installations could emerge in the coming years. With increased digitalisation and automation, it is crucial that governments and companies boost education and training to ensure that more workers can participate in the clean energy sector.

The development of value chains and associated jobs goes beyond the energy sector itself, as it would stimulate economic activity across the economy, especially in the communities where energy production and access to households and local businesses are established. The number of jobs created this way is potentially far greater than those in the energy sector itself. The expansion of reliable and affordable electricity supplies, in particular, is a key driver of economic activity, higher incomes and employment. For example, access to electricity would allow households to power small appliances such as sewing machines or refrigerators, which can support entrepreneurial opportunities – especially for women. Expanding the electricity supply to non-residential uses such as agriculture would also create jobs. Larger-scale infrastructure developments that electrify the entire agricultural value chain can bring additional benefits for agricultural employment and productivity.

Making transitions just and inclusive

Putting people and inclusivity at the centre of all clean energy transitions is key to the successful implementation of energy and climate policies. Host governments and international partners must ensure that their clean energy transition strategies are people-centred and truly fair and take account of the needs and rights of all members of society. Africa's energy transition will bring profound shifts in the sector's employment, including massive new opportunities for job creation in clean energy but declining job opportunities in existing sectors, including the fossil fuel industry and the supply of traditional fuels.

It is vital that this transition involve the creation of decent work opportunities, support for workers who lose their jobs, effective social dialogue among all affected groups and respect for fundamental labour principles and rights. An important first step is comprehensive stakeholder engagement with the goal of reaching a broad consensus around the transition. The long-term aim should be to make the new energy workforce more inclusive and gender-balanced and ensure equal opportunity for all. In most cases, this will require the development of new programmes of education, certification and vocational training along with targeted upskilling or reskilling programmes for the existing workforce. South Africa is already taking this approach (Box 5.1).

Box 5.1. Support for coal workers in South Africa

Retraining programmes targeting coal workers for jobs in renewables, ecotourism and agribusiness are at the heart of South Africa's Just Transition Strategy. Under a partnership agreement, the governments of France, Germany, the United Kingdom and the United States, and the European Union, are making available USD 8.5 billion in the form of grants and highly concessional loans to support the closure of Eskom's coal plants and just energy transition initiatives, including developing green hydrogen and boosting electric vehicles. Mpumalanga, where 90% of the country's coal production and 70% of its coal-fired power generation are concentrated, will be the region most affected by the phase-down of coal in South Africa. The region already suffers from high unemployment, so generating new jobs is the focus of transition management discussions. Even in regions where coal phase-out is not immediately looming, it is critical to begin planning early as implementation and training workers for alternate employment can take years.

Source: Center for Strategic and International Studies (2021), Understanding Just Transitions in Coal-Dependent Communities

Prioritising energy efficiency

Energy efficiency is a critical consideration in development planning. Africa is set to experience an unprecedented increase in energy demand over the coming decades, driven primarily by rapidly growing economies and populations. Steering investment towards the most efficient sources of energy supply and end-use technologies in the buildings, transport and productive uses sectors would have a massive impact on both the overall need for energy and the costs of providing energy services, as well as investment needs. In the SAS, energy efficiency-related capital spending rises sevenfold to around USD 43 billion in the second half of the current decade, driven by surging demand for housing combined with stronger building codes and minimum energy performance standards (MEPS),

purchases of more efficient and electrified vehicles, appliances and cooling systems, and electrification and efficiency improvements in industrial processes.

Policy action to reduce investment risk and the use of public capital to leverage private sources and harness new financing structures will be needed to make this happen, accompanied by robust enforcement of MEPS and measures to prevent imports of inefficient second-hand vehicles and appliances, including screening and testing, and link investment and purchase incentives to efficiency.

Energy efficiency finance is still a nascent market in most African economies and is yet to be prioritised for concessional and commercial capital. The complex and relatively small-scale nature of energy efficiency projects – combined with low awareness about their potential, risks and business models – requires a more systemic approach. Projects often need de-risking, standardisation and aggregation mechanisms to mitigate transaction and financing costs that reflect higher risk perception among local financial institutions. Initially, this is likely to require grants and equity capital as markets and business models develop. The role of DFIs in providing catalytic capital for energy efficiency, including the creation of energy service companies (which supply energy efficiency improvements on a third-party basis and are compensated based on the energy savings achieved) will be key.

Required capacity-building initiatives

Capacity building is a vital component of efforts to kick-start Africa's transition to a clean and sustainable energy system. That transition is currently severely constrained by a lack of well-trained professionals and officials, and a broader lack of awareness among local populations about clean energy solutions. Capacity building needs to cover high-level professionals in the public and private sectors, civil society, and academic and research institutions. It is for the African people themselves to shape their transitions, create the institutions and frameworks needed to guide it, and build and operate the physical infrastructures. This cannot happen where there are no resources, most importantly workers, equipped with the requisite skills and knowledge to perform those tasks.

This calls for a sustained collective effort to build the human and institutional skills and capabilities needed to develop policy and regulatory frameworks, prepare projects, secure the financing needed to get them off the ground, and operate, manage and maintain those assets once they are built. For example, many mini-grid projects in rural areas have failed in the past due to a shortage of local skilled personnel to maintain the equipment, deterring investors from financing new projects. Reinforcing or creating rural electrification and clean cooking agencies by providing training and funding positions within these agencies, which are often understaffed, could remedy this. In addition, funding the establishment of field

offices in rural provinces can improve the standing of programmes among the local population, which may be mistrustful of centralised efforts.

Institutional capacity remains a major hurdle in Africa, reflected in the lack of detailed government strategies and roadmaps in the countries where progress is least advanced. This often results in costly short-term solutions and disappointing outcomes. For example, even if all the finance that we project will be needed to meet the goal of universal access by 2030 is forthcoming, finding the projects and facilities by which to disburse those funds will be difficult, especially given the limited number of projects that are currently ready to be financed. The increase in the activities of local green banks and micro-finance institutions across the continent will undoubtedly help support off-grid and clean cooking enterprises, but large government programmes administered by utilities and dedicated government agencies will also need to play an important role to reduce the perceived risks by creating an investment climate that is conducive to attracting private capital.

The need to build capacity is particularly crucial in the electricity sector in view of its central role in the clean energy transition and its large share of overall investment needs. In government, there is a particular need for officials in energy and finance ministries to develop skills in electricity policy formulation, implementation and monitoring, based on an understanding of investors' requirements for participating in new renewable and off-grid projects and the measures needed to de-risk private financing. Regulatory commissioners also need specific training in tariff-setting, licensing, regulatory decision-making procedures and implementing regulations. Regulatory bodies also need their technical staff to be equipped to set targets, standards and monitoring measures to evaluate equipment quality such as batteries and meters.[5]

The technical and financial weaknesses in electricity utilities also need to be addressed, through providing training in organisational management as well as technical capacities to oversee least-cost integrated electrification plans, carrying out integrated power system planning across all segments, managing contractual arrangements and drawing up efficient procurement procedures. Distribution companies need training in implementing off-grid solutions and coordinating them with conventional distribution activities based on international best practices.

A variety of tools are available to enhance human and institutional capacity. Structured in-depth training sessions, seminars, workshops and on-the-job tutoring for national energy planning practitioners, both in-country and online, can be an effective approach to develop the skills needed to implement an enabling

[5] The AfDB's Electricity Regulatory Index (ERI) assesses the quality of electricity regulatory frameworks of African countries on an annual basis, including the degree of independence and regulatory outcomes, and proposes areas to improve among those countries evaluated.

policy and regulatory framework, collate and analyse field data, draw up national and regional plans and programmes, access international funds, and prepare access projects in partnership with electricity utilities and local enterprises, banks, and academic and research institutions. Partnerships between academic bodies in advanced economies and those in African countries have also proven effective in raising awareness of the solutions to raising energy access and developing analytical and planning capabilities.

Several international bodies, including the IEA, other governmental organisations, development agencies, DFIs and MDBs, as well as private foundations and industry associations, already run programmes or provide assistance to countries in Africa and other parts of the developing world in building capacity in the field of access to clean energy. A number of universities, research centres, and foundations in Africa and Europe are also developing capacity building programmes on sustainable energy development. For example, the Mediterranean Renewable Energy Centre (MEDREC) in Tunisia is seeking to expand capacity building in sub-Saharan Africa, while the South African Renewable Energy Technology Centre trains solar technicians, mostly women, through local universities and is collaborating with other universities across Africa. Various development institutes, including the Florence School of Regulation, the Fondazione Eni Enrico Mattei and RES4Africa in Italy, GIZ, Get Invest, and the European Union Technical Assistance Facility for Sustainable Energy for All (SEforALL) also offer capacity-building programmes throughout Africa.

Annexes

Annex A – Abbreviations and acronyms

BF	blast furnace
BOF	basic oxygen furnace
BOOT	build, own, operate and transfer
CCS	carbon capture and storage
CCUS	carbon capture, utilisation and storage
CDM	Clean Development Mechanism
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent
COP	Conference of the Parties
DFI	development finance institution
DRC	Democratic Republic of the Congo
DRI	direct reduced iron
EAF	electric arc furnace
EMDE	emerging market and developing economies
G7	Group of Seven
G20	Group of 20
GDP	gross domestic product
GSSS	green, social, sustainable and sustainability-linked
IEA	International Energy Agency
IETA	International Emissions Trading Association
ITMOs	Internationally Transferred Mitigation Outcomes
LDCs	Least Developed Countries
LH_2	liquified hydrogen
LPG	liquefied petroleum gas
MDB	multilateral development bank
MEDREC	Mediterranean Renewable Energy Centre
MEPS	minimum energy performance standard
MER	market exchange rate
NDC	Nationally Determined Contributions
NG	natural gas
NH_3	ammonia
ODA	official development assistance
OECD	Organisation for Economic Co-operation and Development
PayGo	Pay-As-You-Go
PCI	pulverised coal injection
PE	private equity
PGM	platinum group metals
PPAs	power purchase agreements

PV	photovoltaic
RE	renewable energy
SAS	Sustainable Africa Scenario
SDG	Sustainable Development Goals
SMEs	small and medium-sized enterprises
SOEs	state-owned enterprises
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollar
WACC	weighted average cost of capital
VC	venture capital

Annex B – Units of measure

Emissions	kt CO_2-eq	thousand tonnes of carbon-dioxide equivalent
Energy	TWh	terawatt-hour
Mass	Mt	million tonnes (1 tonne x 10^6)
	Mt/year	million tonnes per year
Power	MW	megawatt (1 watt x 10^6)
	GW	gigawatt (1 watt x 10^9)

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