CLIMATE POLICY INITIATIVE

IRENA
International Renewable Energy Agency

GLOBAL LANDSCAPE OF

# RENEWABLE ENERGY FINANCE

# 2023

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## About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security, and low-carbon economic growth and prosperity.

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# ABBREVIATIONS

| | |
|---|---|
| **BNEF** | Bloomberg New Energy Finance |
| **°C** | degree Celsius |
| **C&I** | commercial and industrial |
| **CAGR** | compound annual growth rate |
| **CFD** | contract for difference |
| **COVID-19** | Coronavirus disease |
| **CPI** | Climate Policy Initiative |
| **CSP** | concentrated solar power |
| **DFI** | development finance institution |
| **EU** | European Union |
| **FI** | financial institution |
| **FIP** | feed-in premium |
| **FIT** | feed-in tariff |
| **FMO** | Dutch Entrepreneurial Development Bank |
| **GSSS BOND** | green, social, sustainable and sustainability-linked bond |
| **GW** | gigawatt |
| **KFW** | German Development Bank |
| **IEA** | International Energy Agency |
| **IRENA** | International Renewable Energy Agency |
| **LDC** | least-developed country |
| **OECD** | Organisation for Economic Co-operation and Development |
| **PAYG** | pay-as-you-go |
| **PPA** | power purchase agreement |
| **PV** | photovoltaic |
| **SDG** | Sustainable Development Goal |
| **SHS** | solar home system |
| **SOE** | state-owned enterprise |
| **SOFI** | state-owned financial institution |
| **USD** | United States dollars |
| **USDFC** | US International Development Finance Corporation |
| **ESMAP** | Energy Sector Management Assistance Program |
| **RISE** | Regulatory Indicators for Sustainable Energy |
| **FEI** | Facility for Energy Inclusion |

# FOREWORD

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International Renewable Energy Agency

Global investment in technologies related to the energy transition, including for energy efficiency, reached USD 1.3 trillion in 2022 - a new record-high. Nonetheless, annual investments need to at least quadruple to remain on track to achieve the 1.5°C Scenario laid out in IRENA's *World energy transitions outlook 2022*.

Ongoing global crises present both a challenge and an opportunity for the accelerated deployment of renewable energy. The tighter fiscal space and uncertain macroeconomic outlook are negatively impacting flows of investment towards renewables, while the present energy crisis is forcing countries to urgently deploy alternative sources of energy that are sustainable, reliable and affordable. Meanwhile, 733 million people had no access to electricity and nearly 2.4 billion people relied on traditional fuels and technologies for cooking at the end of 2020.

While global investment in renewable energy, specifically, reached a record high in 2022 - at USD 0.5 trillion - it represented less than 40% of the average investment needed each year between 2021 and 2030 according to IRENA's 1.5°C Scenario. Investments are also not flowing at the pace or scale needed to achieve the improvements in livelihoods and welfare called for under the 2030 Agenda for Sustainable Development. For example, investments in off-grid renewable energy solutions in 2021 - at USD 0.5 billion - fell far short of the USD 2.3 billion needed annually in the sector between 2021 and 2030 to accelerate progress towards universal energy access.

Moreover, investments have become further concentrated in specific technologies and uses, and in a small number of countries/regions. In 2020, solar photovoltaic alone attracted 43% of the total investment in renewables, followed by onshore and offshore wind (at 35% and 12%, respectively). To best support the energy transition, more funds need to flow to less mature technologies and to sectors beyond power (*e.g.* heating and cooling, transport, energy efficiency and system integration).

More importantly, about 70% of the world's population, mostly residing in developing and emerging countries, received only 15% of global investments in 2020. Sub-Saharan Africa, for example, received less than 1.5% of the amount invested globally between 2000 and 2020. The disparity in renewable energy financing received by developed versus developing countries has increased significantly over the past six years. For example, the renewable energy investment per capita in Europe and North America (excluding Mexico) was about 22 times higher than that in Sub-Saharan Africa in 2015. In 2021, investment per capita in Europe was 127 times that in Sub-Saharan Africa, and in North America it was 179 times more.

For the energy transition to have a positive impact, governments and development partners need to play a more active role in ensuring a more equitable flow of finance that recognises the different endowments and starting conditions of countries. This report underscores the need to direct public funds to regions and countries that have considerable untapped potential but find it difficult to attract investment. These funds should be directed to support energy transition infrastructure development, and enabling policy frameworks to drive investment and address persistent socio-economic gaps.

Achieving an energy transition in line with the 1.5°C Scenario requires the redirection of USD 0.7 trillion per year from fossil fuels to energy-transition-related technologies; but following a brief decline in 2020 due to COVID-19, fossil fuel investments are on the rise. In addition, the fossil fuel industry continues to receive considerable support through subsidies. Subsidies doubled in 2021 across 51 countries, with consumption subsidies expected to have risen even further in 2022 due to contemporaneous price pressures. The phasing out of investments in fossil fuel assets should be coupled with the elimination of subsidies to level the playing field with renewables. However, the reduction of subsidies needs to be accompanied by a robust safety net to ensure adequate standards of living for vulnerable populations.

This report emphasises how lending to developing countries seeking to deploy renewables must be reformed. The analysis highlights the limitations of using public funds mainly for de-risking investments and emphasises the need for a much stronger role for public financing. Recognising the limited public funds available in the developing world, the need for stronger international collaboration to achieve a substantial increase in financial flows from the Global North to the Global South is highlighted. The report also discusses the different sources, intermediaries and policy instruments that can channel public financing into the energy sector and the broader economy to support a just and inclusive transition.

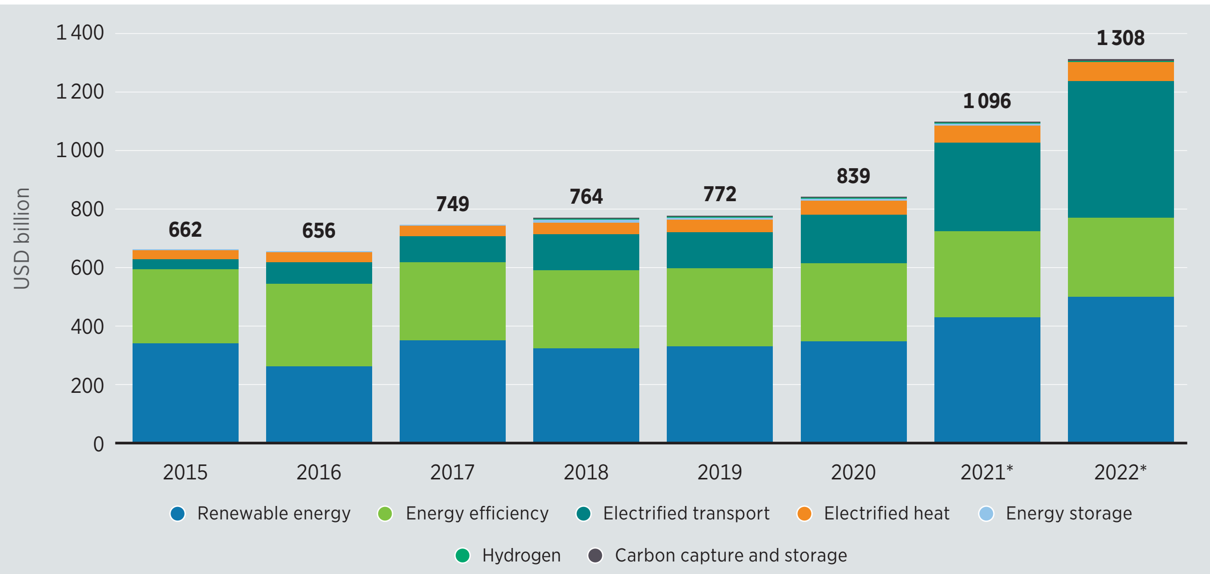
# EXECUTIVE SUMMARY

**Global investments in energy transition technologies reached USD 1.3 trillion in 2022, a record high. Yet, the current pace of investment is not sufficient to put the world on track towards meeting climate or socio-economic development goals.**

In 2022, global investments in energy transition technologies – renewable energy, energy efficiency, electrified transport and heat, energy storage, hydrogen and carbon capture and storage (CCS) – reached USD 1.3 trillion despite the prevailing macroeconomic, geopolitical and supply chain challenges. Global investments were up 19% from 2021 levels, and 50% from 2019, before the COVID-19 pandemic (Figure S.1). This trend demonstrates a growing recognition of the climate crisis and energy security risks associated with over-reliance on fossil fuels.

Yet, the current pace of investment is not sufficient; annual investments need to at least quadruple. Keeping the world on track to achieving the energy transition in line with the 1.5°C Scenario laid out in IRENA's *World energy transitions outlook 2022* will require annual investments of USD 5.7 trillion on average between 2021 and 2030, and USD trillion 3.7 between 2031 and 2050 (IRENA, 2022a).

**Figure S.1** Annual global investment in renewable energy, energy efficiency and transition-related technologies, 2015-2022




**Notes:** Renewable energy investments for 2021 and 2022 represent preliminary estimates based on data from Bloomberg New Energy Finance (BNEF). As BNEF does not include large hydropower investments, these were estimated at USD 7 billion per year, the annual average investment in 2019 and 2020. Energy efficiency data are from IEA (2022a). These values are in constant 2019 dollars, while all other values are at current prices and exchange rates. Due to the lack of more granular data, the units could not be harmonised across the databases. For this reason, these numbers are presented together for indicative purposes only and should not be used to make comparisons between data sources. Data for other energy transition technologies come from BNEF (2023a).
**Based on:** IEA (2022a) and BNEF (2023a).

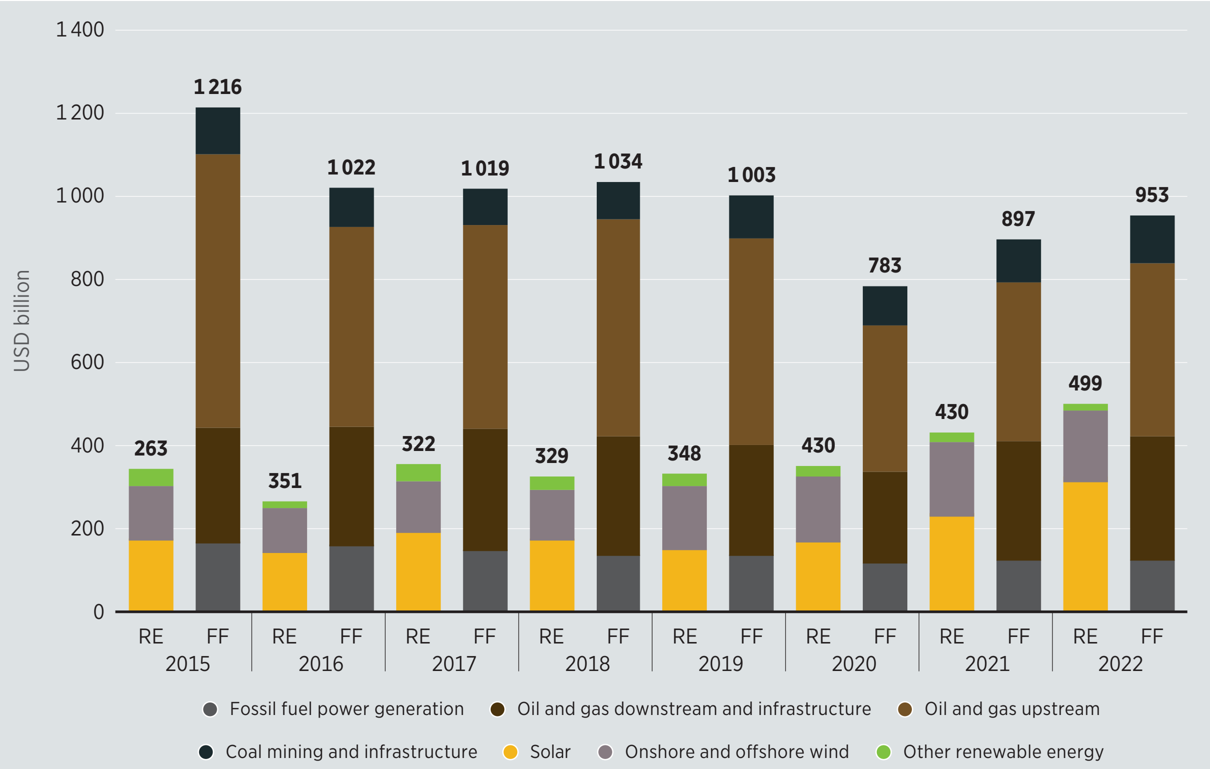
**Achieving an energy transition in line with the 1.5°C Scenario requires the redirection of USD 0.7 trillion per year from fossil fuels to energy-transition-related technologies; but fossil fuel investments are still on the rise.**

Fossil fuel investments had declined in 2020 (down 22% from the USD 1 trillion invested in 2019) mainly due to the impacts of the COVID-19 pandemic on global energy markets (IEA, 2022c). Nevertheless, 2021 saw fossil fuel investments bounce back up 15% to USD 897 billion (Figure S.2), and preliminary data for 2022 suggest they might have almost returned to their pre-pandemic levels (+6%), reaching USD 953 billion (IEA, 2022c).

Investment in energy is still going into funding new oil and gas fields instead of renewables and it is estimated that USD 570 billion will be spent on new oil and gas development and exploration every year until 2030 (IISD, 2022).

Investors and banks have already committed to financing fossil fuel development over and above the limit needed to meet the 1.5°C target. Over the six years following the Paris Climate Agreement, some large multi-national banks maintained and even increased their investments in fossil fuels at an average of about USD 750 billion dollars per year (Environmental Finance, 2022a). The world's 60 largest commercial banks invested around USD 4.6 trillion in fossil fuels between 2015 and 2021, more than one-quarter of which came from US banks (Environmental Finance, 2022a).

**Figure S.2** Annual investment in renewable energy vs. fossil fuels, 2015-2022

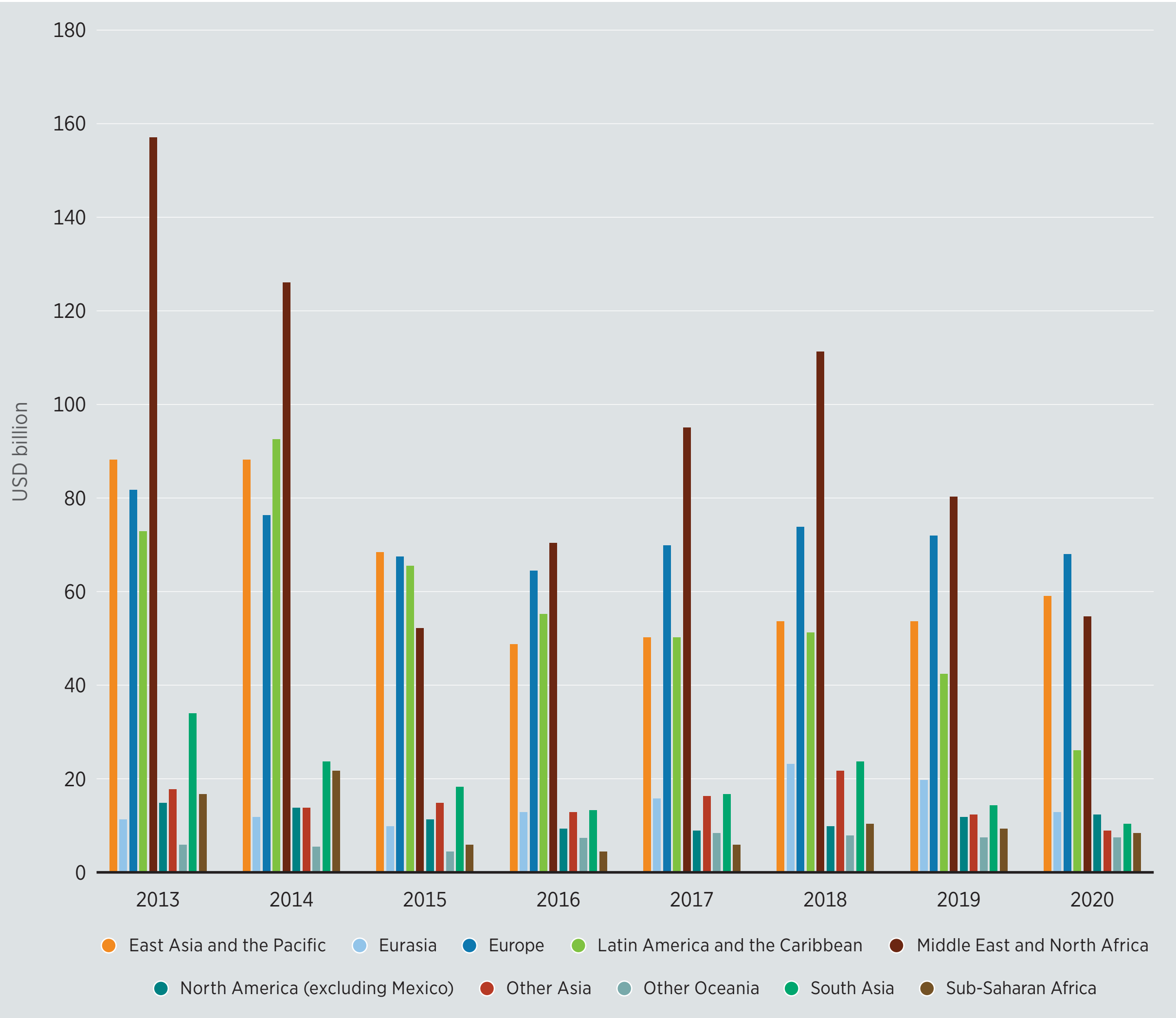



**Note:** FF = fossil fuel; RE = renewable energy.
**Based on:** CPI (2022a) and IEA (2022b).

Fossil fuel companies based in emerging markets and developing economies have continued to attract substantial volumes of financing. Between 2016 and 2022, their outstanding debt rose by 400% for coal and 225% for oil and gas, despite the need to align investments with the goals outlined in the Paris Agreement (IMF, 2022a). In Africa, capital expenditures for oil and gas exploration rose from USD 3.4 billion in 2020 to USD 5.1 billion in 2022. African companies accounted for less than one-third of this sum.

In addition to direct investments in assets, the fossil fuel industry continues to receive considerable support through subsidies. Between 2013 and 2020, USD 2.9 trillion was spent globally on fossil fuel subsidies (Fossil Fuels Subsidy Tracker, 2022). In 2020, Europe was the region providing the most subsidies, having overtaken the Middle East and North Africa (MENA) (Figure S.3). On a per capita basis, fossil fuel subsidies in Europe totalled USD 113 per person, more than triple those in MENA (USD 36 per person). However, fossil fuel subsidies in MENA make up 1.56% of the gross domestic product (GDP) while in Europe, they constitute only 0.3% of GDP.

**Figure S.3** Annual fossil fuel subsidies by region, 2013-2020



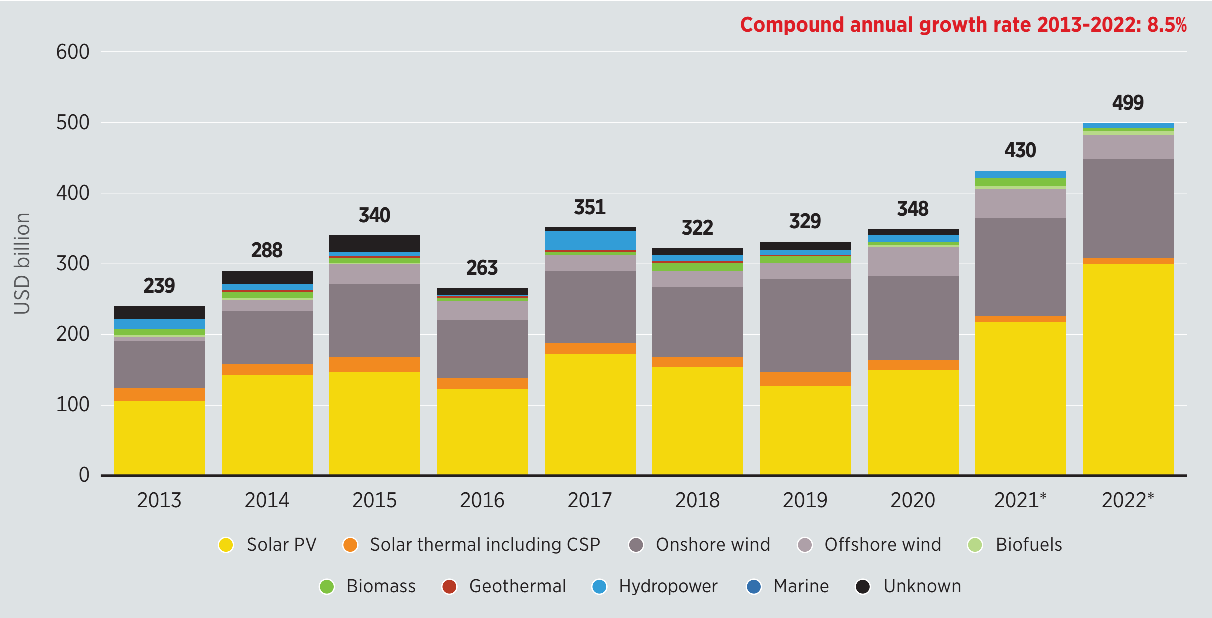

**Source:** Fossil Fuels Subsidy Tracker (2022).

Subsidies doubled in 2021 across 51 countries, from USD 362 billion in 2020 to USD 697 billion, with consumption subsidies expected to have risen even further in 2022 due to contemporaneous price pressures (OECD and IEA, 2022). The phasing out of investments in fossil fuel assets should be coupled with the elimination of subsidies to ensure that the full costs of fossil fuels are reflected in their price and to level the playing field with renewables and other energy-transition-related technologies. However, the phaseout of subsidies needs to be accompanied by a proper safety net to ensure adequate standards of living for vulnerable populations (IRENA, 2022a).

**Investments in renewable energy continue to grow, but not at the pace needed to achieve climate, energy access and energy security objectives along with other socio-economic development goals by 2030.**

Despite multiple economic, social and geopolitical challenges, annual investments in renewable energy continued a positive trend that began after 2018 (see Figure S.4). Preliminary data suggest that in 2021, investments reached USD 430 billion (24% up from 2020) and in 2022 they further increased by 16% reaching almost USD 0.5 trillion (BNEF, 2023b).[1] Yet, investment in 2022 was 40% of the average investment needed each year between 2021 and 2030 (about USD 1.3 trillion in renewable power and the direct use of renewables) according to IRENA's 1.5°C Scenario.

**Figure S.4** Annual financial commitments in renewable energy, by technology, 2013-2022




**Note:** CAGR = compound annual growth rate; CSP = concentrated solar power; PV = photovoltaic.

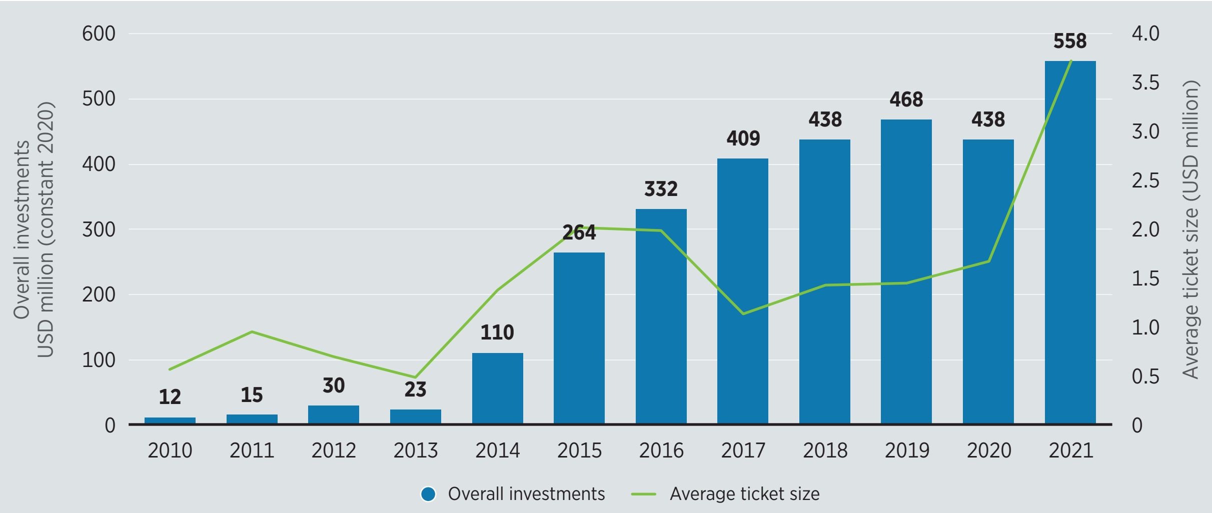
**Source:** CPI (2022a). Investments for 2021 and 2022 are preliminary estimates based on data from BNEF (2023b). As BNEF data has limited coverage of large hydropower investments, these were assumed to be USD 7 billion per year, equivalent to the annual average investment for the preceding two years.

[1] *These figures represent "primary" financial transactions in both large- and small-scale projects that directly contribute to deployment of renewable energy, and therefore exclude secondary transactions, e.g. refinancing of existing debts or public trading in financial markets. Note that this is different from investments discussed in Chapter 3 for the off-grid renewable energy sector which relates to corporate-level transactions (both primary and secondary) and is therefore different from investments discussed in Chapter 2 (although some overlap is possible). For more details, please see the methodology document (Appendix). As previously noted, 2021 and 2022 investment numbers in Chapters 1 and 2 are preliminary estimates based on BNEF (2023b).*

Investments are also not flowing at the pace or scale needed to achieve the improvements in livelihoods and welfare envisioned in the 2030 Agenda for Sustainable Development. Despite progress in energy access, approximately 733 million people had no access to electricity and nearly 2.4 billion people relied on traditional fuels and technologies for cooking at the end of 2020 (IEA, IRENA, et. al., 2022). Between 2010 and 2021, the off-grid renewables sector attracted more than USD 3 billion (Wood Mackenzie, 2022a). Investments in off-grid solutions reached USD 558 million in 2021, a 27% increase from 2020 (Figure S.5). But this amount is far short of the USD 2.3 billion needed annually in the sector between 2021 and 2030 to accelerate progress towards universal energy access (ESMAP *et al.* 2022a).[2]

Although on the rise, off-grid investments are concentrated among seven large incumbent companies that have already reached scale and are looking to further solidify their market position through their ability to attract capital. The average transaction size climbed from USD 1.1 million in 2017 to 1.7 million by 2020, before more than doubling to USD 3.7 million in 2021 (Figure S.5). While a trend of growing ticket size is a sign of sector growth and maturity, it may also indicate existing challenges for enterprises looking for smaller investments.

**Figure S.5** Annual investment in off-grid renewable energy and average transaction size, 2010-2021




**Based on:** Wood Mackenzie (2022a).

**Investments have become further concentrated in specific technologies and uses. To best support the energy transition, more funds need to flow to less mature technologies and to sectors beyond power.**

While annual renewable energy investments have been growing over time, these have been concentrated in the power sector. Between 2013 and 2020, power generation assets attracted, on average, 90% of renewable investments each year, and up to 97% in 2021 and 2022.

*[2] This will be needed on both the supply side for off-grid renewable energy companies and demand side (mainly in the form of public funding) to enhance affordability for consumers.*

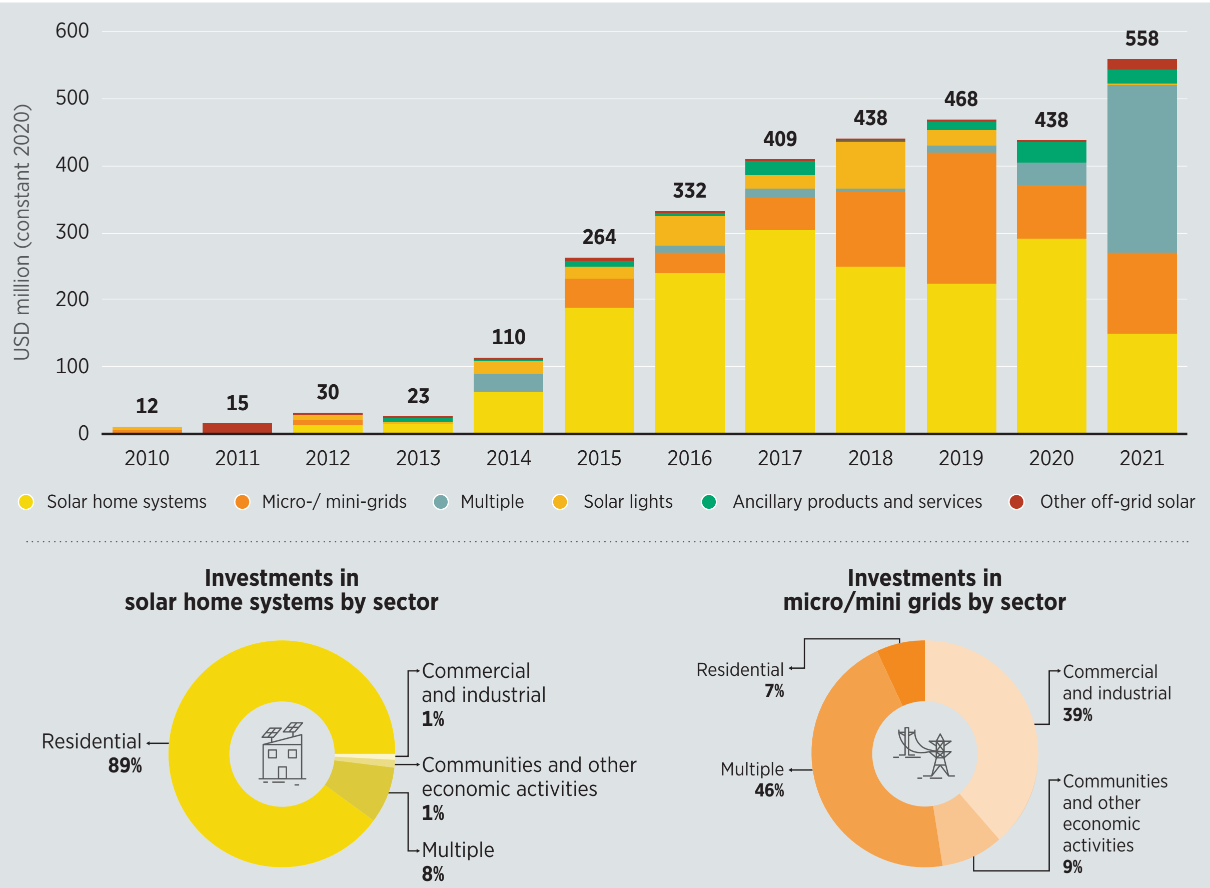
Solar and wind technologies consistently attract the largest share of investment by a wide margin. In 2020, solar photovoltaic (PV) alone attracted 43% of the total, followed by onshore and offshore wind (at 35% and 12%, respectively).

Investments in end uses, *i.e.* direct applications, which include heat generation (*e.g.* solar water heaters, geothermal heat pumps, biomass boilers) and transport (*e.g.* biofuels) are lagging; they will need to increase from USD 17 billion in 2020 to an average USD 284 billion each year between now and 2030 and USD 115 billion through 2050 to achieve the energy transition (IRENA, 2022a).

In the off-grid space, solar PV products also dominate, attracting 92% of overall investments in 2010-2021, owing chiefly to their modular and distributed characteristics, and their adaptability to a wide variety of applications. Solar home systems (SHSs) are the most funded technology (Figure S.6).

Even though the majority of off-grid investments went to residential applications between 2010 and 2021, the share going to commercial and industrial (C&I) applications has been expanding over time (from 8% in 2015 to 32% in 2021) as consumer needs grow beyond basic household access to more energy-intensive uses in local industry and agriculture. Powering C&I applications can promote local economies by creating jobs and spurring economic growth, while also enhancing food security and resilience against the impacts of climate variability on agri-food chains (IRENA, 2016b).

**Figure S.6** Annual investment in off-grid renewable energy, by off-grid product, and energy use, 2010-2021



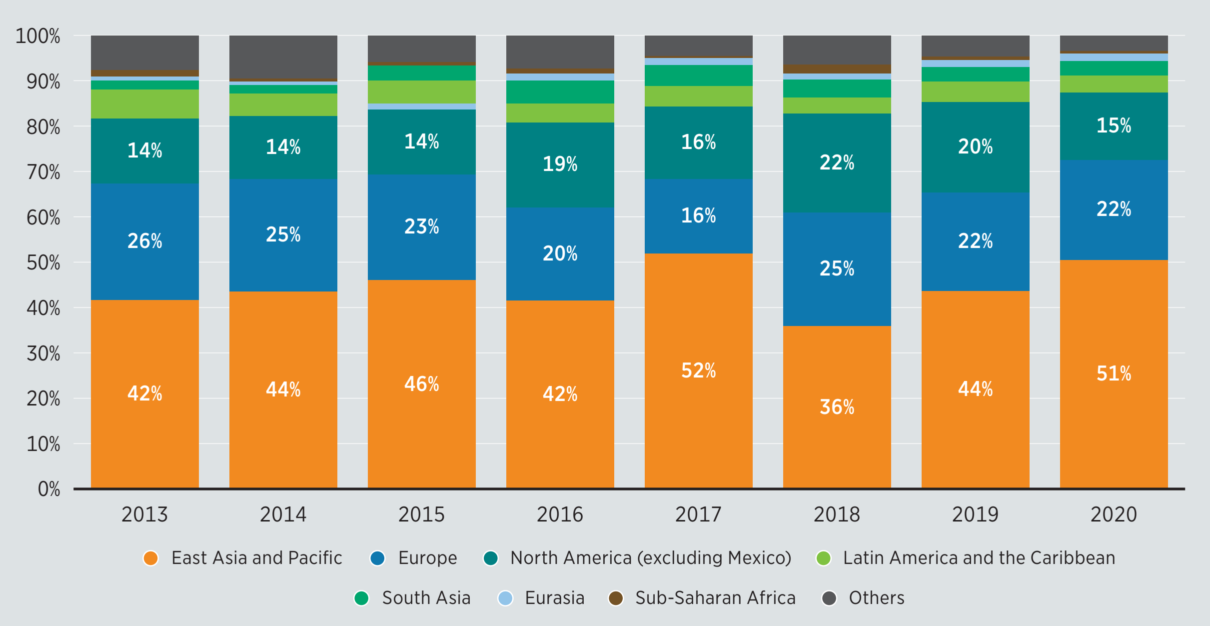

**Based on:** Wood Mackenzie (2022a).

**Investments are increasingly focused in a number of regions and countries. They need to be more universal for a more inclusive energy transition.**

Although renewable energy investments are on the rise globally, they continue to be focused in a number of countries and regions. The East Asia and Pacific region continues to attract the majority of investment – two-thirds of the global total in 2022 (Figure S.7) – primarily led by China. A suite of policies including tax exemptions have driven investments in solar and wind in China, putting the country on track to meeting the targets set out in the 14th Five-Year Plan (Carbon Brief, 2021). Viet Nam saw investment in solar PV grow by an average of 219% per year between 2013 and 2020, driven mainly by feed-in tariffs (Lorimer, 2021). North America excluding Mexico attracted the second-largest share of investment in 2022, mainly driven by the production tax credit in the United States, followed by Europe, where net-zero commitments and extensive policies to phase out fossil fuels are driving growth in renewables.

In the United States, the 2022 Inflation Reduction Act – encompassing new tax credits, USD 30 billion in grants and loans for clean energy generation and storage, and USD 60 billion in support of manufacturing of low-carbon components – is expected to attract USD 114 billion investment by 2031. In Europe, the European Commission presented a *Green Deal Industrial Plan for the Net-Zero Age*, which would provide investment aid and tax breaks towards technological development, manufacturing, production and installation of net-zero products in green sectors including renewables and hydrogen (Bloomberg, 2023; European Commission, 2023). The plan looks to mobilise EUR 225 billion in loans from its existing Recovery and Resilience Facility, and an additional EUR 20 billion in grants (European Commission, 2023).

**Figure S.7** Investment in renewable energy by region of destination, 2013-2022




**Note:** "North America (excluding Mexico)" includes Bermuda, Canada and the United States. "Others" include the Middle East and North Africa, Other Oceania, Transregional, Other Asia and Unknown. For more details on the geographic classification used in the analysis, please see methodology document (Appendix).

**Source:** CPI (2022a).

**Regions home to about 120 developing and emerging markets** continue to receive comparatively low investment. Across these regions, the bulk of renewable energy investments is captured by a handful of countries: Brazil, Chile and India. In other words, more than 70% of the world's population, mostly residing in developing and emerging countries, received only 15% of global investments in renewables in 2022. Further, the share of renewable energy investments going to these regions has been progressively declining year on year (*e.g.* from 27% in 2017 to 15% in 2020). In absolute terms, annual investments have been declining precipitously since 2018 at an average rate of 36%. Countries defined as "least developed" by the Intergovernmental Panel on Climate Change attracted only 0.84% of renewable energy investments on average between 2013 and 2020.

**Looking at investments on a per capita basis further reveals the disparity in investments**. In East Asia and Pacific, investment per capita increased by 19% between 2015 and 2021 from USD 88 /person in 2015 to USD 105 /person in 2021. The bulk of the increase took place in China, and in fact, the region excluding China experienced a decrease of 20%. In South Asia, investments per capita declined by 26% between 2015 and 2021; however, the true extent of the decline is masked by India which saw investment per capita grow by 34% in the same period. Excluding India, investment per capita declined by 76% from USD 20 /person in 2015 to USD 5 /person in 2021. The most striking – and rapidly growing – disparity is between Sub-Saharan Africa and both North America (excluding Mexico) and Europe. In 2015, renewable energy investment per capita in North America (excluding Mexico) or Europe was just about 22 times higher than that of Sub-Saharan Africa. In 2021, investment per capita in Europe was 127 times that in Sub-Saharan Africa (which in 2021 fell to just USD 1 /person from USD 7 /person in 2015), and North America was 179 times more.

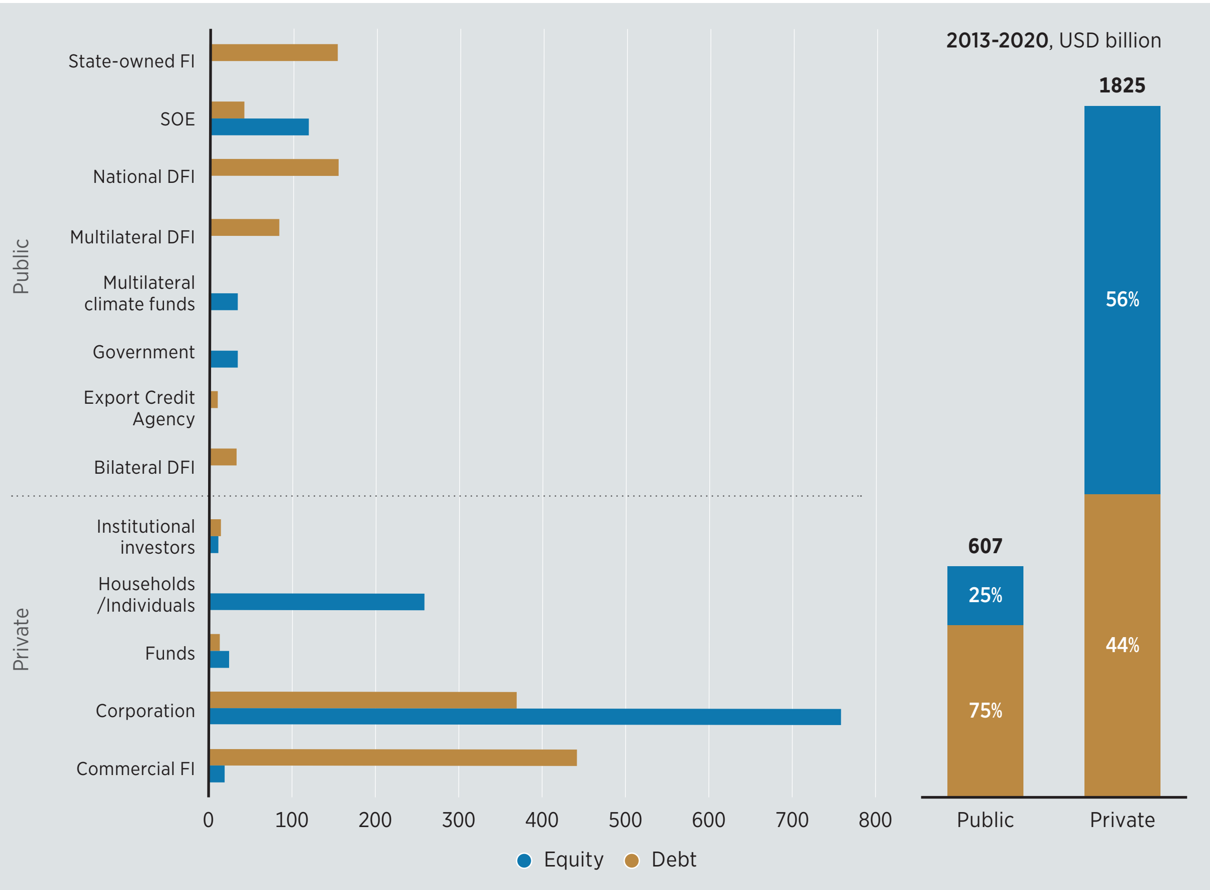
**Sub-Saharan Africa remains the primary destination for investment in off-grid renewables.** The region attracted USD 2.2 billion in 2010-2021 – more than 70% of global off-grid investments. Electrification rates are among the lowest in the world, with 568 million people lacking access to electricity in 2020 (IEA, IRENA *et al.* 2022). Within Sub-Saharan Africa, East Africa – home to three of the top five recipient countries of off-grid investment (Kenya, the United Republic of Tanzania and Rwanda) - attracted 43% of the total. Investment in these destinations benefited from the existing mobile money ecosystem, which was leveraged by the pay-as-you-go (PAYG) business model. Approximately 78% of the total commitments in off-grid renewables in 2010-2021 (or USD 2.4 billion) involved the funding of companies or projects using PAYG, with East Africa accounting for USD 917 million.

During the COVID-19 pandemic, off-grid renewable energy investments in Southeast Asia declined by 98%, leaving key off-grid markets even more vulnerable. Although the majority of countries in the region have achieved high or near-universal rates of electricity access, parts of the populations in countries such as Myanmar and Cambodia (26% and 15%, respectively in 2020) still lack access to electricity (World Bank, 2022). Whereas the region attracted USD 137 million in off-grid renewable energy investments over 2018-2019 (led primarily by Myanmar), during 2020-2021, investments plummeted to USD 3 million, likely due to the impacts of the COVID-19 pandemic and political developments (ESMAP *et al.* 2022b).

**Investments have been primarily made by private actors. Private capital flows to the technologies and countries with the least risks – real or perceived.**

The private sector provides the lion's share of global investments in renewable energy, committing around 75% of the total in the period 2013-2020 (Figure S.8). The share of public versus private investments varies by context and technology. Typically, lower shares of public finance are devoted to renewable energy technologies that are commercially viable and highly competitive, which makes them attractive for private investors. For example, in 2020, 83% of commitments in solar PV came from private finance. Meanwhile, geothermal and hydropower rely mostly on public finance; only 32% and 3% of investments in these technologies, respectively, came from private investors in 2020.

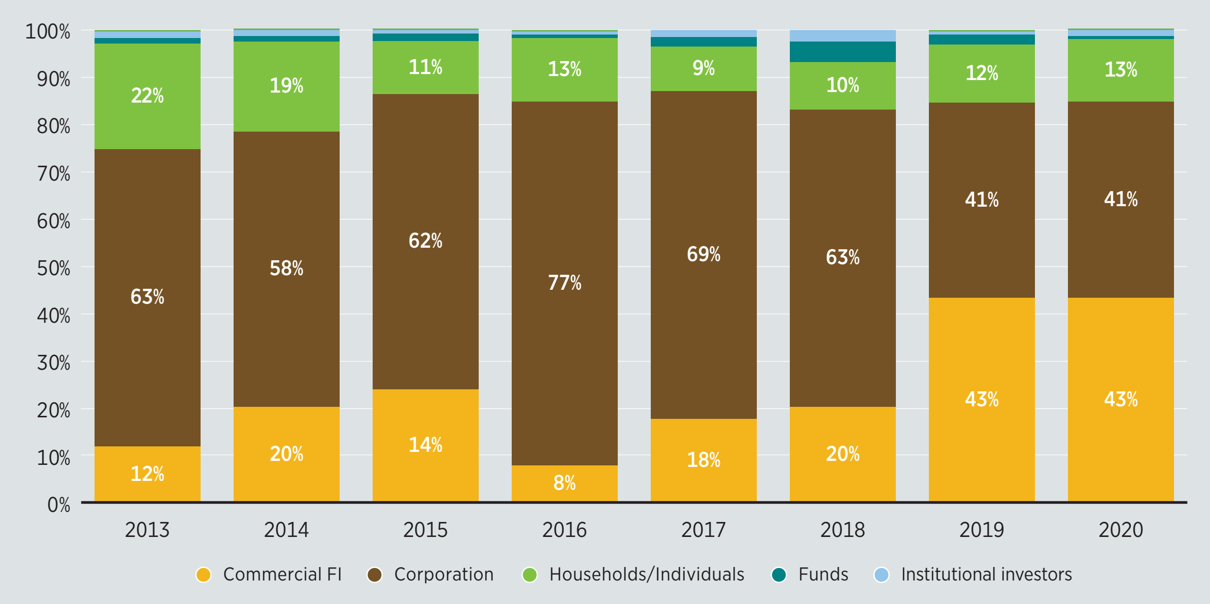
**Figure S.8** Debt and equity investment by type of investor, 2013-2020




**Note:** DFI = development finance institution; FI = finance institution; SOE = state-owned enterprise.
**Source:** CPI (2022a).

Globally, commercial financial institutions and corporations are the main private finance providers, accounting together for almost 85% of private finance for renewables in 2020 (Figure S.9). Up until 2018, private investments came predominantly from corporations (on average, 65% during 2013-2018), but in 2019 and 2020 the share of corporations went down to 41% per year, and a larger share of investments was filled by commercial financial institutions (43%).

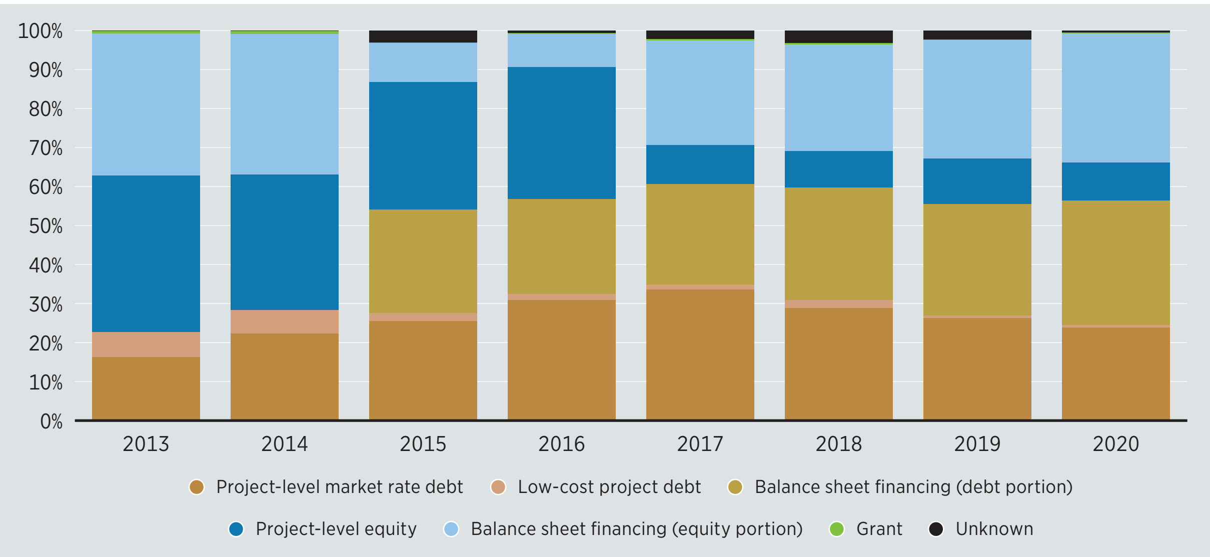
**Figure S.9** Private investment in renewable energy by investor, 2013-2020




**Note:** FI = finance institution.
**Source:** CPI (2022a).

This aligns with the falling share of equity financing globally, from 77% in 2013 to 43% by 2020 (Figure S.10) as corporations together with households/individuals provided 83% of equity financing during 2013-2020 (Figure S.8). During this time, the share of debt financing increased from 23% in 2013 to 56% in 2020 (Figure S.10). This is likely linked to the maturation and consolidation of major renewable technologies such as solar PV and onshore wind that are able to attract high levels of debt, as lenders are able to envision regular and predictable cash flows over the long term, facilitated by power purchase agreements (PPAs) in many countries.

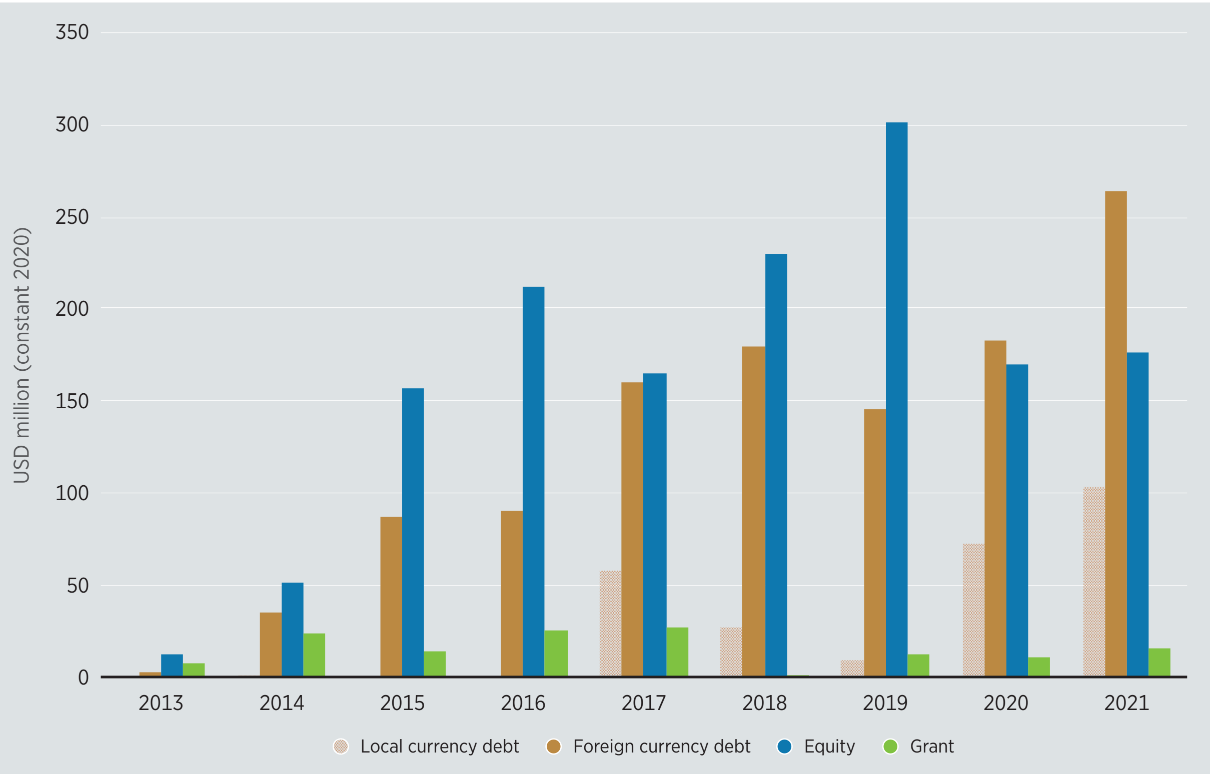
**Figure S.10** Investment in renewable energy, by financial instrument, 2013-2020




**Source:** CPI (2022a).

In the off-grid space, debt and equity investments contributed about 47% and 48% of the overall financing, respectively between 2010 and 2021, with an additional 5% contributed by grants. By technology, debt financing constituted the majority of the investments in solar home systems and solar lights (54% of the total and rising over time) while equity financing dominated the micro-/mini-grid space. Prior to the COVID-19 pandemic, the majority of off-grid financing came from equity investments owing to the domination by private equity, venture capital and infrastructure funds and the lack of debt access for the sector. Ever since, the share of private equity has seen a relative decline (Figure S.11), in part due to the uncertainties posed by the pandemic, and the limited track record of exits and capital recycling in the sector. The contribution of debt has increased sharply over the past two years, particularly as debt-preferring DFIs bolstered their support during the pandemic (Figure S.15) and major off-grid companies were able to capitalise on their strong market position to secure (large-size) predominantly debt-based deals from both public and private investors (ESMAP *et al.* 2022b). Another remarkable trend is the increase in local currency debt, driven mainly by markets in Kenya and Nigeria.

**Figure S.11** Annual investment in off-grid renewable energy, by financing instrument and local versus foreign currency debt, 2013-2021




**Based on:** Wood Mackenzie (2022a).

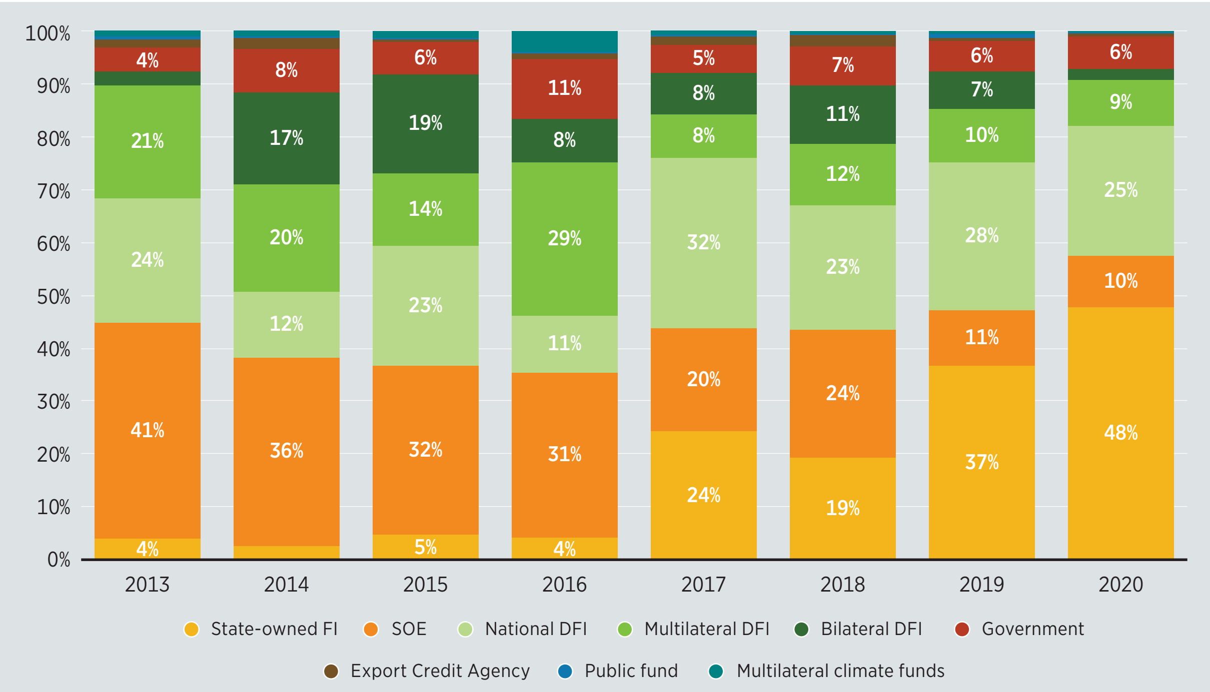
Going forward, widespread mobilisation of low-cost debt will be critical for deployment of capital-intensive renewable energy projects, while equity financing will also remain key, particularly to kick-start relatively less mature technologies, and finance projects in relatively high-risk or credit-constrained contexts.

**The majority of public investments are made domestically with relatively little international collaboration. The international flow of public money to renewable energy has been in decline since 2018.**

Public funds are limited, so governments have been focusing what is available on de-risking projects and improving their risk-return profiles to attract private capital.

Globally, the public sector provided less than one-third of renewable energy investment in 2020. State-owned financial institutions, national DFIs and state-owned enterprises were the main sources that year, providing more than 80% of public finance (Figure S.12). Multilateral DFIs provided 9% of public finance – in line with their past annual commitments – and accounted for about half of international flows coming from the public sector. Commitments from bilateral DFIs in 2020 fell 70% compared to 2019, largely due to a 96% decline in international commitments by the German Development Bank (KfW). This means that multilateral and bilateral DFIs provided less than 3% of total renewable energy investments in 2020.

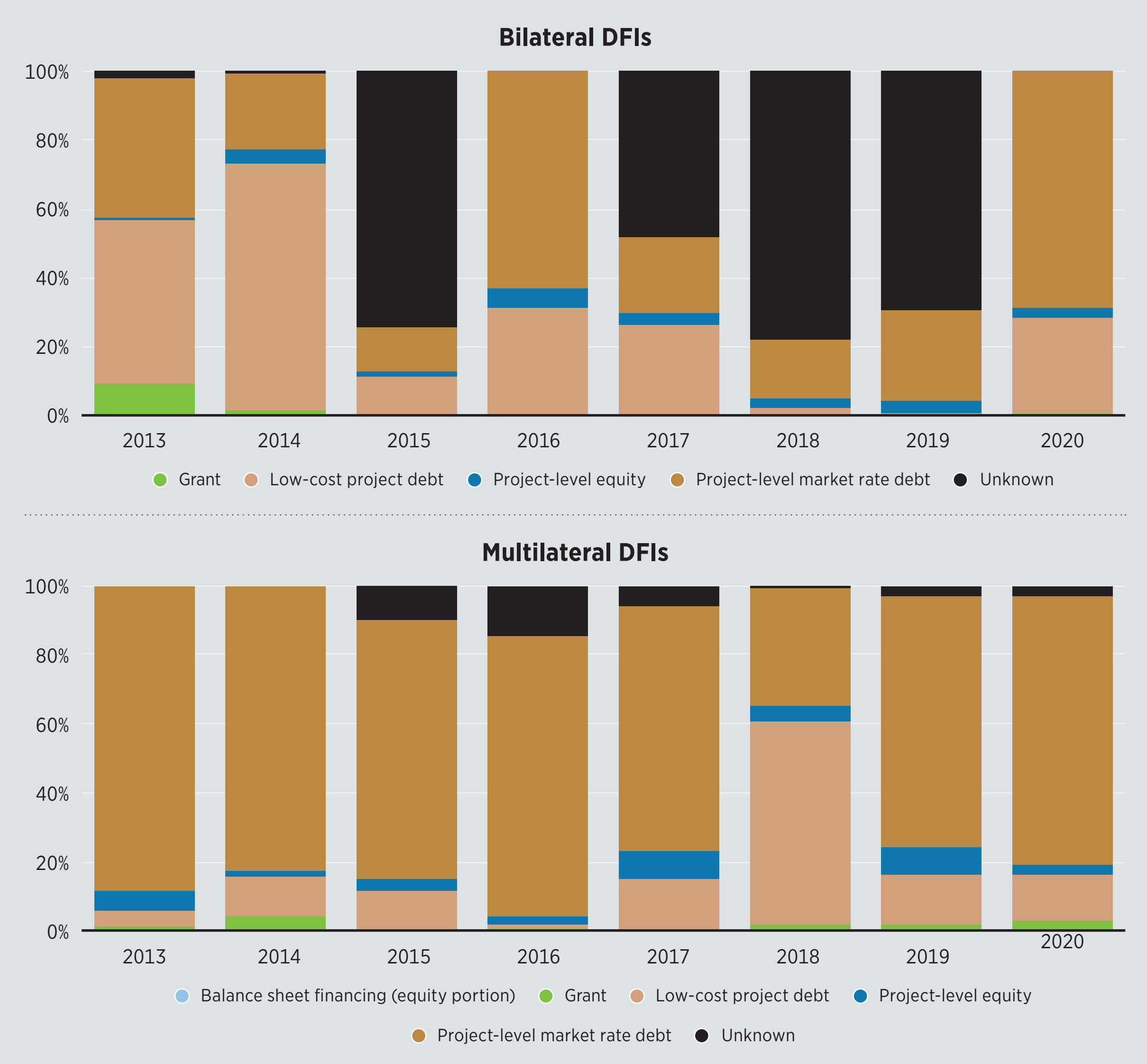
**Figure S.12** Public investment in renewable energy by investor type, 2013-2020




**Note:** DFI = development finance institution; FI = finance institution; SOE = state-owned enterprise.
**Source:** CPI (2022a).

In addition, financing from DFIs was provided mainly in the form of debt financing at market rates (requiring repayment with interest rates charged at market value). Grants and concessional loans amounted to just 1% of total renewable energy finance, equivalent to USD 5 billion. Since the interest rates are the same, the only difference that DFI financing provides is to making finance available, albeit at the same high costs for users. Figure S.13 illustrates the portion of DFI funding provided in the form of grants and low-cost debt.

**Figure S.13** Portion of DFI funding in the form of grants and low-cost debt

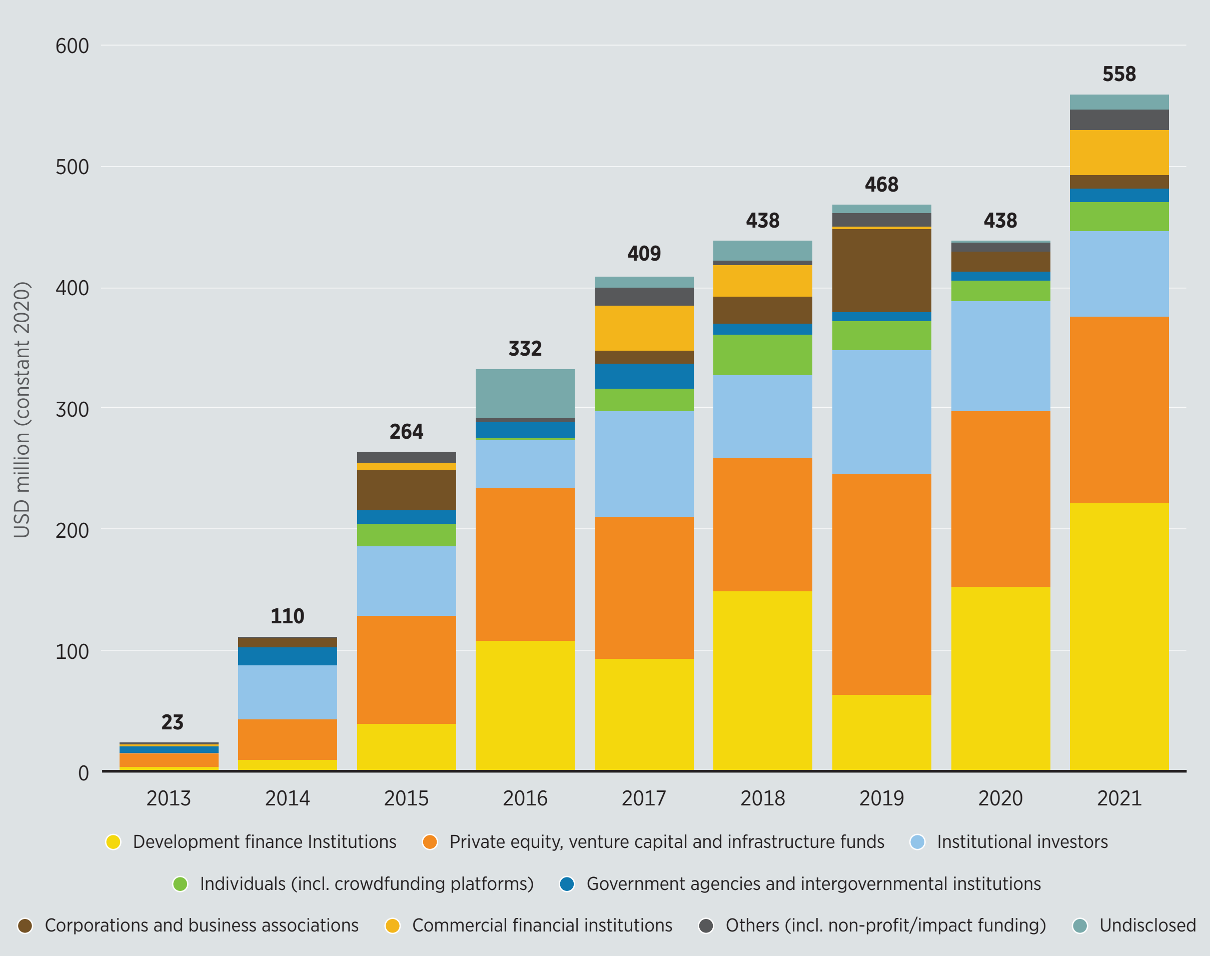



**Note:** DFI = development finance institution.
**Source:** CPI (2022a).

In the off-grid space, the role of the public sector, in particular DFIs, is much more important. DFIs were the largest public capital providers (accounting for 79% of the public investments in off-grid solutions and 27% of the total investments in off-grid solutions in 2010-2021). Notably, DFIs' contributions after the pandemic constitute half of their overall contributions since 2010 (Figure S.14).

Public finance flows to the Global South are essential to achieving the 1.5°C Scenario and its socio-economic benefits (together with progressive fiscal measures and other government programmes such as distributional policy, as outlined in IRENA [2022a]). In fact, almost 80% of the off-grid investments between 2010 and 2021 involved North–South flows. However, the international flow of public finance going to renewable energy in the broader context has been in decline since 2018 (IEA *et al.* 2022). Preliminary data show that the downtrend continued through 2021.

**Figure S.14** Annual commitments to off-grid renewable energy by type of investor, 2015-2021




**Note:** Definitions of all investor type included in this analysis are provided in the accompanying methodology document (Appendix).
**Based on:** Wood Mackenzie (2022a).

**To achieve a just and inclusive energy transition, public financing – including through international collaboration – has a critical role to play across a broad spectrum of policies.**

Among risk mitigation instruments, sovereign guarantees have been preferred for lenders looking to obtain a "one-size-fits-all" solution for credit risks. But such guarantees are treated as contingent liabilities and may hamper a country's ability to take on additional debt for critical infrastructure development and other investments (IRENA, 2020a). Moreover, sovereign debts are already stressed to their breaking point in many emerging economies grappling with high inflation and currency fluctuations or devaluations in the wake of the COVID-19 pandemic. In this macroeconomic environment, many countries cannot access affordable capital in international financial markets or provide sovereign guarantees to mitigate risk.

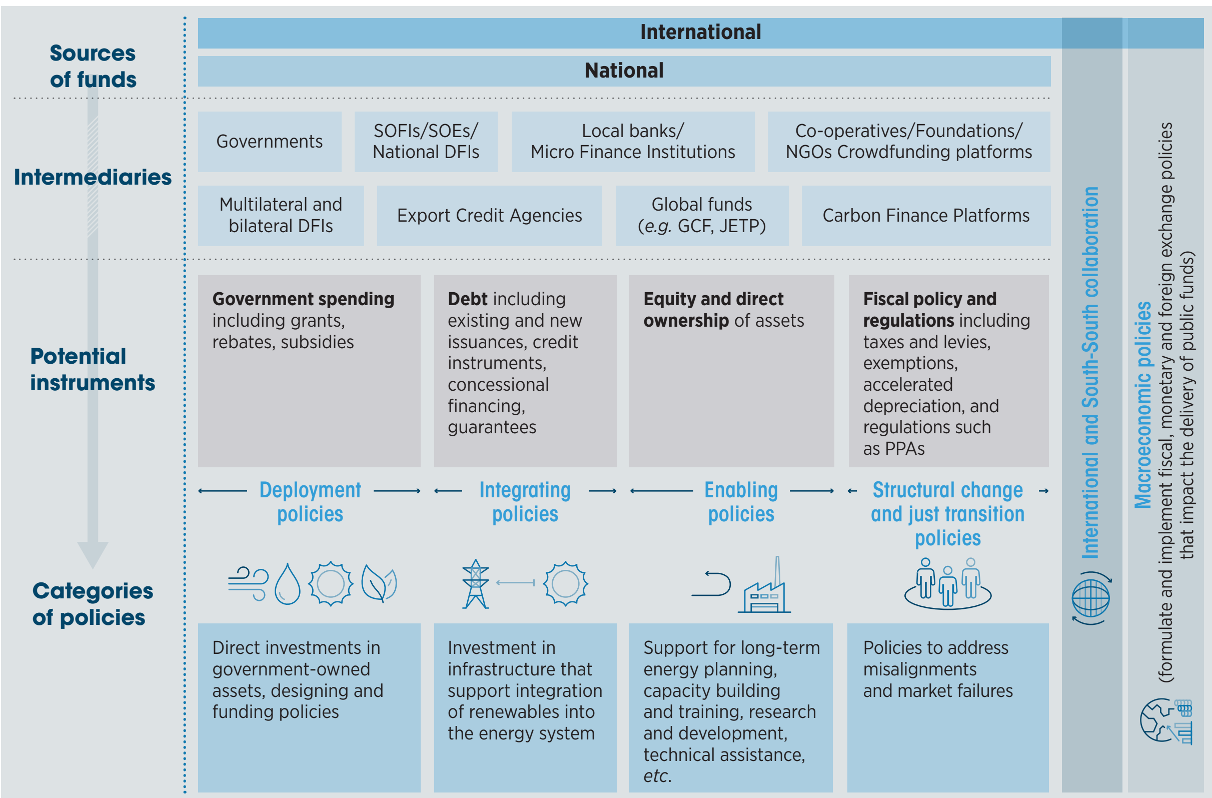
Given the urgent need to step up the pace and geographic spread of the energy transition, and to capture its full potential in achieving socio-economic development goals, more innovative instruments are needed that help under-invested countries reap the long-term benefits of the energy transition without putting their fiscally constrained economies at a further disadvantage.

Public funding must flow into the renewable energy sector (covering all segments of the value chain), the wider energy sector and the economy as a whole, for a just and equitable energy transition. Public funds can be mobilised and provided using a variety of instruments. Figure S.15 shows the types of instruments that can be used to channel public finance, the sources of public funds (domestic or international through collaboration) and the intermediaries that can help channel them (*e.g.* governments, national DFIs, local banks, multilateral and bilateral DFIs, export credit agencies, global funds including the Just Energy Transition Partnership [JETP] and UN-linked funds such as the Green Climate Fund).

These instruments can be existing or newly designed and may include (1) government spending such as grants, rebates and subsidies; (2) debt including existing and new issuances, credit instruments, concessional financing and guarantees; (3) equity and direct ownership of assets (such as transmission lines or land to build projects) and (4) fiscal policy and regulations including taxes and levies, exemptions, accelerated depreciation, deferrals and regulations such as PPAs (especially when the tariffs paid to producers – in addition to the cost of running the system – are lower than what is collected by consumers and the difference is paid through a government subsidy).

As shown in Figure S.15, public finance flows via instruments in various policy categories of IRENA's broad policy framework. Examples include the following:

**Figure S.15** The flow of public finance for a just and inclusive energy transition




**Note:** DFI = development finance institution; GCF = Green Climate Fund; JETP = Just Energy Transition Partnership; NGO = non-governmental organisation; PPA = power purchase agreement; SOFI = state-owned financial institution; SOE = state-owned enterprise.

1. Under **deployment policies**, public funds can flow as direct investments in government-owned energy-transition-related assets, public-private partnerships, or in designing and funding policies that can attract or support private investment (*e.g.* capital subsidies, grants and tariff-based mechanisms such as auctions, feed-in tariffs and feed-in premiums).

2. Under **integrating policies**, public investments can go into infrastructure and assets that support the integration of renewables into the energy system (*e.g.* regional and national transmission lines, pumped hydroelectric energy storage facilities).

3. Under **enabling policies**, public money can support long-term energy planning, capacity building and training, research and development, the development of local industry and value chains, as well as technical assistance offered via multilateral development banks (MDBs) and inter-governmental organisations such as IRENA.

4. Under **structural change and just transition policies**, public funds can go into the redesign of power markets to make them more conducive for large shares of variable renewable energy, towards compensation for the phasing-out of fossil fuels, as well as policies to ensure that the energy transition promotes gender equality and social inclusion, among many other priorities.

5. The **global policy framework** defines international and South-South collaboration, which is key to structuring and ensuring the international flows from the Global North to the Global South.

6. In addition, although not directly related to any specific sector, there are **macroeconomic policies** (fiscal, monetary and currency exchange policies) that affect the delivery of public funds towards the energy transition.

Some elements presented in the framework (Figure S.15) might overlap. For example, tax incentives are at the same time fiscal or macroeconomic policies while acting as deployment policies, and funding grid infrastructure can be viewed as an enabling or an integrating policy. While funding capacity building is part of an enabling policy, these funds also facilitate structural change, being part of social development programmes, and education, social protection and compensation policies, *etc.* Thus, there are complex inter-linkages and feedback loops between the different policies and instruments. By understanding the broad structural workings underlying the renewable energy "economy", public policy and financing can be strategically used to advance the energy transition.

**Governments from developed and developing countries will play a central role in providing an enabling environment for both public and private investments.**

A more comprehensive way of defining risk (including risk sharing) is needed. A narrow investor-centric focus on the risk of investment in energy assets not paying off needs to be broadened to include environmental, planetary and social risks. These include the risk of leaving a large part of the population out of the energy transition and locked in underdevelopment, and the risk of the Sustainable Development Goals remaining far from being met. This is how investment risks must be viewed from the perspective of governments and the international community. And with the very limited public funds available in the developing world, the international community must step up.

## The availability of capital for public investments in renewable energy will need to be increased, and lending to developing nations transformed.

Today's environment calls for a fundamental shift in how lending is made to developing nations, especially those affected by economic and climate crises, and particularly how countries in the Global North support countries in the Global South to cope with and adapt to crises related to climate change, the cost of living and debt. The situation in developing countries is being made more difficult amid tightening monetary policies and a strengthening US dollar. One in five countries is experiencing fiscal and financial stress, which left unaddressed would deepen hardship, increase debt defaults, widen inequality and delay the energy transition.

At the 27$^{th}$ United Nations Climate Change Conference (COP27) a decision was reached to establish a loss and damage fund, particularly for those nations most vulnerable to climate events. Details regarding the amounts involved, and how the facility will be set up and operationalised are yet to be negotiated. The fund is expected to address adverse effects of climate impacts such as droughts, floods, rising seas and other disasters that impair the deployment of renewable energy.

Tapping pools of public funds for both developed and developing countries without burdening the fiscal space remains a key priority. Governments should adopt a "doing more with what is available" approach through enhanced collaboration among DFIs and MDBs, and by exploring the following mechanisms:

**Capital release from balance sheets of DFIs.** Balance sheets of investors and financial institutions disclose rights and obligations connected to the owning and lending of assets. It is possible for DFIs to use those elements to raise additional funds through posting existing assets as collateral (provided their value is free and clear of any encumbrances), and partially repackaging receivables from guaranteed loan repayments (*e.g.* loans that are guaranteed by insurers) into new financial structured products in the market. The DFIs could offer a (high rated) new debt product (*e.g.* a collateralised debt obligation)[3] guaranteed and managed by a bank such as an MDB to qualified investors (*e.g.* pension funds, insurers, institutional investors, *etc.*) and traded on international exchanges. However, such a product should be used with rigorous due diligence.

[3] *Collateralised debt obligations are asset-backed securities that bundle together a diversified portfolio of instruments (e.g. loans, bonds). Cash flows from underlying assets are used to repay investors.*

**Product innovation among MDBs.** Multilaterals benefit from the convening power granted by shareholders in both developed and developing countries, to craft, implement and operate innovative frameworks to mobilise capital and mitigate risks. In particular, liquidity facilities can be scaled up to assist renewable energy investors in fulfilling their business obligations by ensuring an uninterrupted flow of payments from off-takers – without posing a burden on the fiscal space of developing countries (local-currency-denominated PPAs can also benefit from this facility). These liquidity facilities can evolve to incorporate the role of guarantor supported by MDBs and DFIs in compliance with guidelines issued by multilaterals and agreed by shareholders. The highly capitalised guarantor becomes a supranational facility to mitigate credit and foreign exchange risks for renewable energy investors and lenders. MDBs, under the approval of host governments, can allocate funds and credit lines to the facility up to prudent limits determined by ministries of finance and central banks.

**Broadening capitalisation routes for MDBs.** Capital calling from shareholders has been the common approach adopted by multilaterals to expand technical assistance and lending programmes. The new capital increases MDBs' fund availability and enables them to place bonds in the global capital market, thereby raising additional capital. Bonds are placed as AAA-rated obligations guaranteed by MDBs – de facto, such institutions have an enviable track record recognised by countries and market participants in managing risks – that can be placed in the market, if appropriate financing vehicles are used and target markets are identified. MDBs should now consider risk-tiered debt obligation placements with a different investment grade (BBB+ and above, *e.g.* multi-rated green bonds), implying different level of returns to bondholders. The initiative broadens access to the investor base – from institutional investors and sovereign wealth funds to corporate/qualified investors – increasing the amount of capital that could become available and deployed in renewable energy investments.

## Meanwhile, public finance and policy should continue to be used to crowd in private capital. Policies and instruments beyond those used to mitigate risks are needed.

Public finance should continue to be used strategically to crowd in additional private capital. Risk mitigation instruments (*e.g.* guarantees, currency hedging instruments and liquidity reserve facilities) will still play a major role, but public finance and policy must go beyond risk mitigation. Examples include funding capacity building, support for pilot projects and innovative financing instruments such as blended finance initiatives, *etc*. In addition, policy makers may consider the following:

**Incentivise an investment swap from fossil fuels to renewable energy by banks and national oil companies**. Incentivising investors to divert funds towards the energy transition can be done through measures such as phasing out of fossil fuel subsidies and adapting fiscal systems to account for the environmental, social and health impacts of a fossil-fuel-based energy system. However, the phaseout of subsidies should be accompanied by a proper safety net to ensure adequate standards of living for vulnerable populations (IRENA, 2022a).

A supplemental way of incentivising this shift is through highlighting and recognising the leadership role of those institutions that are paving the road through early investments in the energy transition. More than 30 significant financial institutions including banks, insurers, asset owners and asset managers have committed to stop financing fossil fuels. Governments and civil societies can take action to reward their leadership and encourage other institutions to take similar steps. After that, public pressure, along with policy and regulation, can further influence financial decision-making in favour of renewable energy and other energy transition technologies (Environmental Finance, 2022a).

**Mobilise institutional investment and promote greater use of green bonds for renewables.** With about USD 87 trillion of assets under management, institutional investors have a key role to play in reaching the investment levels required for the ongoing global energy transition. Greater participation of institutional capital will require a combination of effective policies and regulations, capital market solutions that address the needs of this investor class (*e.g.* green bonds), as well as a variety of internal changes and capacity building on the part of institutional investors (IRENA, 2020d).

Green bonds can help attract institutional investors and channel considerable additional private capital in the renewable energy sector, helping to fill the significant outstanding investment gap. Green bonds have experienced significant growth over the past decade (about 103% a year in 2011-2021), increasing from about USD 800 million of issuances in 2007 to about USD 545 billion of issuances in 2021 – an all-time annual high despite pandemic-induced economic challenges. The cumulative value of green bond issuances broke the USD 1 trillion threshold at the end of 2020 and stood at about USD 1.64 trillion as of the end of 2021 (Environmental Finance, 2022b). Some recommended actions for policy makers and public finance providers to further increase green bond issuances include the adoption of green bond standards in line with international climate objectives, the provision of technical assistance and economic incentives for green bond market development and the creation of bankable project pipelines (IRENA, 2020e).

**Implement regulatory sandboxes for broadening access to capital and credit instruments.** Regulatory sandboxes designed to serve broader social and environmental goals can help unlock more investments. By enacting regulatory sandboxes for start-ups and investors for both grid and off-grid initiatives, new solutions may emerge towards enabling access to pools of capital/credit instruments. Such initiatives can benefit from MDBs' support (Barbalho *et al.* 2022) in connection with other available funding agencies at local, regional and global levels. Furthermore, companies can be invited to participate in the sandbox with a view to pilot innovative concepts that facilitate risk mitigation, including foreign exchange risks in electricity exchanges.

**Facilitate local currency lending and denominate PPAs (at least partially) in local currencies.** Local currency PPAs are helpful to address the risks of currency devaluations which may otherwise cripple power off-takers' ability to make payments to power producers in hard currency (such as the USD) at times when the domestic currency plummets. Relatively established markets in the off-grid space, for instance, such as Kenya and Nigeria are seeing more local currency debt financing.

During 2020-2021, about 28% of debt in the two countries was denominated in local currencies (primarily the Kenyan shilling, followed by the Nigerian naira), compared with just 11% during the pre-pandemic years. Going forward, low-cost local currency financing will be preferred for the next phase of the off-grid renewable energy sector's development. A complementary mechanism to address foreign currency risks is to facilitate local currency lending for projects with development capital channelled through intermediaries including national banks or non-banking financial institutions. Several countries, including Bangladesh, Brazil and Jordan, have piloted such approaches to catalyse investment into the renewable energy sector.

**Enhance the participation of corporate actors.** Although companies that produce renewable energy are already providing substantial investment in the sector, non-energy-producing corporations have a preeminent role to play in the energy transition by driving demand for renewable energy. By setting up the right enabling framework, policy makers can encourage active corporate sourcing and unlock additional capital in the sector. Recommended actions include, for example, establishing a transparent system for the certification and tracking of renewable energy attribute certificates, enabling third-party sales between companies and independent power producers, and creating incentives for utilities to provide green procurement options for companies (IRENA, 2018b).

**Incentivise the participation of philanthropies**. According to Oxfam's report titled *Survival of the Richest: How We Must Tax the Super-Rich Now to Fight Inequality*, the richest 1% own almost half of the world's wealth while the poorest half of the world own just 0.75% (Oxfam, 2023). To tap into the existing wealth, governments should look at incentivising philanthropies to mobilise additional funds into support for renewable energy that can help fight poverty, inequality, climate change and humanitarian crises. Philanthropies are playing an increasingly important role in bridging funding gaps, especially in the energy access context, where funds have gone into market development (*e.g.* technology innovation funds) and delivering financing for end users and enterprises through various instruments, such as results-based grants and equity. Individuals (high-net-worth individuals, families or households) invested an average of USD 20 million per year in off-grid renewables during 2015-2021, primarily through dedicated crowdfunding platforms (IRENA, 2022f). In 2021, individuals, bequests, foundations and corporations gave an estimated USD 485 billion to charities in the United States alone. These were distributed towards education, human services, foundations, public-society benefit organisations, health, international affairs, and environmental and other social services (Giving USA 2022). The energy transition being tied to all these objectives, tapping into these funds can help fill gaps left by governments, and support the livelihoods and well-being of relatively poor populations without relying on fossil fuels (Dennis, 2022).

# OVERVIEW

Renewables are at the heart of the global energy transition, a transition that promises to put the world on a climate-safe pathway while ensuring universal access to sustainable, reliable and affordable energy. The urgent need for accelerated renewable energy investments is further underscored by the widening effects of climate change around the world, growing food shortages and the looming energy crisis. An energy sector based on renewables can offer improved energy security and independence, price stability and reductions in greenhouse gas emissions, all of which are required to achieve climate and sustainable development goals. To that end, significant capital must be shifted from fossil fuels to renewables at a faster pace. Investments in renewables must more than triple from their current level.

This is the third edition of the biannual *Global landscape of renewable energy finance* report, jointly produced by the International Renewable Energy Agency (IRENA) and the Climate Policy Initiative (CPI). Since the last edition of the report, the world has experienced a multitude of crises including COVID-19, the conflict in Ukraine and associated supply chain disruptions, more frequent and destructive climate-induced disasters, and global inflation. The current crises present both a challenge and an opportunity for accelerated deployment of renewable energy.

On the one hand, they provide the political momentum for hurrying the deployment of energy transition technologies. Indeed, the crisis in Ukraine has forced a global reckoning with the fact that 80% of the world's population live in countries that are net energy importers, a situation that carries profound implications for energy security and affordability.

On the other hand, tighter fiscal circumstances and higher costs of capital are dimming the prospects for renewable energy, which is particularly capital intensive. The current uncertain macroeconomic outlook, with inflation at levels not seen in many countries for over 40 years and the possibility of sovereign defaults, could threaten renewable energy development, especially in low-income countries.

Like the first two editions, this report analyses investment trends and financing gaps, the goal being to inform policy making for the deployment of renewable energy at the scale needed to achieve the energy transition. This third edition looks at key investment trends between 2013 and 2020 and provides preliminary insights and figures for 2021 and 2022.[1] The report is structured as follows:

- Chapter 1 presents an overview of the investment needed for IRENA's 1.5°C Scenario. Investments made to date are compared with those made in fossil fuel technologies.

- Chapter 2 presents the landscape of global renewable energy finance, providing insights into key trends by technology and sector, region, source of finance (public and private) and financial instrument.

- Chapter 3 provides an in-depth analysis of off-grid renewable energy finance in developing and emerging economies, analysing trends by technology, country, type of investor and financial instrument.[2]

- Chapter 4 presents recommendations for policy makers and financial institutions to accelerate renewable investments globally across technologies and sectors.

[1] *The analysis of renewable energy investments in 2021 and 2022 in Chapters 1 and 2 are based on data from BNEF (2023b). Investment figures for previous years (2013-2020) come from the CPI Global Landscape of Climate Finance database, which gathers and cleans data from several sources, including Bloomberg New Energy Finance (BNEF). These figures represent "primary" financial transactions going into both large- and small-scale projects that directly contribute to deployment of renewable energy. They therefore exclude secondary transactions, e.g. refinancing of existing debts or public trading in financial markets. For more details, please see the methodology document (Appendix).*

[2] *The data in Chapter 3 cover 2010-2021 and come from Wood Mackenzie (2022a). They relate to corporate-level transactions (both primary and secondary) and therefore differ from the investments discussed in Chapters 1 and 2, although some overlap is possible. These figures are important as they provide an indication of how this rapidly emerging sector is evolving, given its importance to achieving universal energy access.*

# RENEWABLE ENERGY INVESTMENT IN CONTEXT

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01

## 1.1 Investment needs for the energy transition

Keeping the world on track to achieving the energy transition in line with the 1.5°C Scenario laid out in IRENA's *World energy transitions outlook 2022* will require a cumulative investment totalling around USD 131 trillion between 2021 and 2050. In the short term, the report estimated that investments would need to reach USD 5.7 trillion per year between 2021 and 2030, including the redirection of USD 0.7 trillion per year from fossil fuels to energy transition–related technologies. Between 2031 and 2050, around USD trillion 3.7 would be needed on average per year. Table 1.1 shows the breakdown of annual investment needs in the short term (2021-2030) and long term (2031-2050) by technological avenue.

**Table 1.1** Annual investment needs by technological avenue in the short and long terms

| | Investment needs for IRENA's 1.5°C Scenario (billion/year) | |
|---|---|---|
| **Technological avenue** | **2021-2030** | **2031-2050** |
| Renewable power generation capacity | 1 045 | 897 |
| Direct use of renewables, including district heat | 284 | 115 |
| Power grids and energy flexibility | 648 | 775 |
| Energy efficiency (including circular economy) | 2 285 | 1 106 |
| Electrification in end-use sectors | 240 | 229 |
| · Charging infrastructure for electric vehicles | 86 | 153 |
| · Heat pumps | 154 | 77 |
| Hydrogen and its derivatives | 133 | 176 |
| CCS and BECCS | 41 | 77 |
| Other (including fossil fuel, nuclear, innovation) | 1 010 | 321 |
| **Total** | **5 686** | **3 696** |

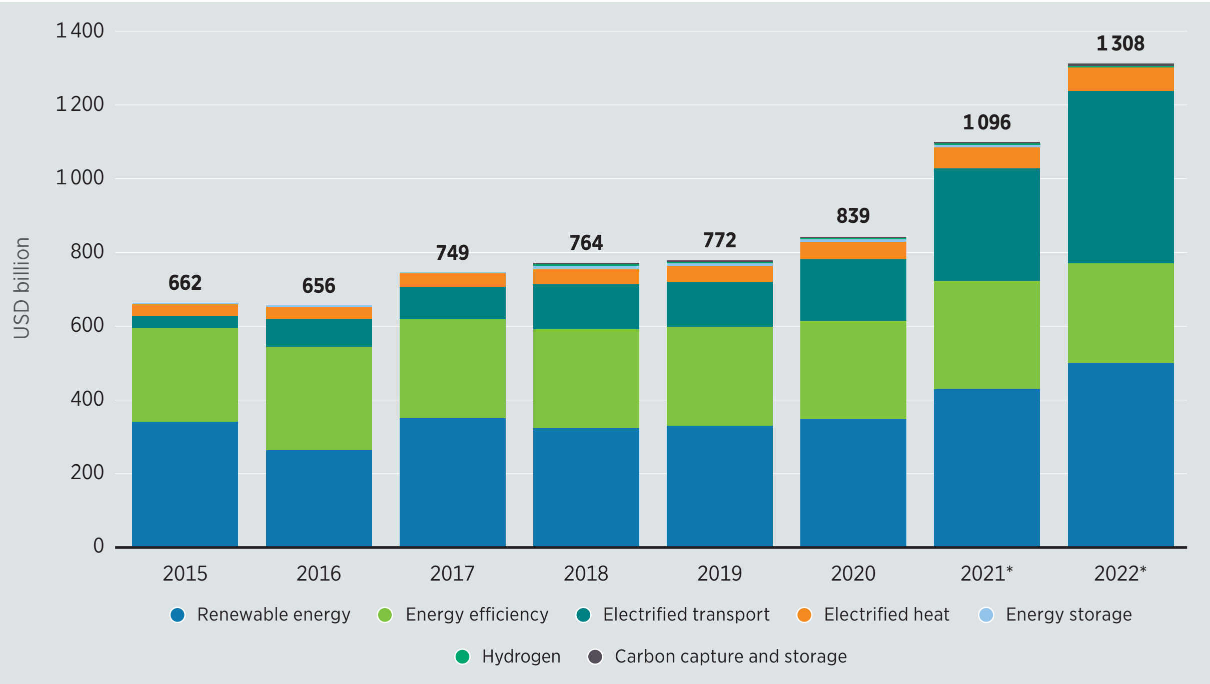
**Note:** CCS = carbon capture and storage; BECCS = bioenergy coupled with carbon capture and storage.
**Source:** IRENA (2022a).

## 1.2 Global transition-related investment to date

In 2022, global investments in energy transition technologies reached USD 1.3 trillion, a record high, up 19% from 2021 investment levels, and 50% from before the pandemic in 2019 (Figure 1.1). These include investments in renewable energy and energy efficiency, electrified transport and heat, energy storage, hydrogen and carbon capture and storage.

While renewable energy and energy efficiency remained the largest sectors – with a combined value of USD 772 billion in 2022 – their share in total energy transition investments has progressively declined as other technologies have begun to attract larger amounts of investments. This is the case for electrified transport technologies (including electric vehicles and associated charging infrastructure),[3] which reached USD 466 billion in 2022, a 54% increase compared to 2021. Investments in electrified heat[4] have grown rather modestly over the last few years, reaching USD 64 billion in 2022, while hydrogen[5] investments more than tripled from 2021, attracting USD 1.1 billion in 2022 (Box 1.1).

**Figure 1.1** Annual global investment in renewable energy, energy efficiency and transition-related technologies, 2015-2022




**Notes:** Renewable energy investments for 2021 and 2022 represent preliminary estimates based on data from BNEF. As BNEF has limited coverage of large hydropower investments, these were assumed to be USD 7 billion per year, equivalent to the annual average investment in 2019 and 2020. Energy efficiency data are from IEA (2022a). These values are in constant 2019 dollars, while all other values are in current prices and exchange rates. Due to the lack of more granular data, the units could not be harmonised across the databases. For this reason, these numbers are presented together for indicative purposes only and should not be used to make comparisons between data sources. Data for other energy transition technologies come from BNEF (2023a).

**Based on:** CPI (2022a), IEA (2022a) and BNEF (2023a).

[3] *Electrified transport investments include sales of electric cars, commercial vehicles and buses, as well as home and public charging investments (BNEF, 2023a).*

[4] *Electrified heat investments include residential heat pump investments (BNEF, 2023a).*

[5] *Hydrogen investments include hydrogen electrolyser projects, fuel cell vehicles and hydrogen refuelling infrastructure (BNEF, 2023a).*

The increase in transition-related investments in 2022 was driven chiefly by national policies introduced for objectives related to climate, energy security, access and socio-economic development, but some of the increase can be attributed to higher costs. After years of declines, the costs of solar panels and wind turbines rose temporarily by 10% to 20% between 2020 and 2022 (IEA, 2022b). The increases were due mainly to supply chain issues and higher costs for labour, financing, shipping and construction materials such as steel and cement.

**Box 1.1 Hydrogen investments**

Although hydrogen has been identified as a key technology for the energy transition, it has so far attracted only a fraction of energy transition–related investments: USD 1.1 billion in 2022, 0.08% of the total (BNEF, 2023a).

Hydrogen's role in decarbonisation lies in hard-to-abate sectors, where electrification is deemed technologically infeasible, impractical or not cost effective. Among these are heavy industrial processes, such as steel, aluminium and cement production, as well as energy-intensive modes of transport such as aviation, shipping and heavy-duty trucks. Hydrogen will also prove useful as a fuel in continental countries with remote cities, for storing energy and for providing grid flexibility.

Green hydrogen is expected to become significantly cheaper than alternative methods. It could reach production costs as low as USD 1/kilogramme by 2050, compared to a lower bound of close to USD 3/kilogramme in 2021 (IRENA, 2019). Although prospects for cost reduction are good, the cost-effective long-distance transport of large volumes of hydrogen remains a challenge being addressed by major technology developers.

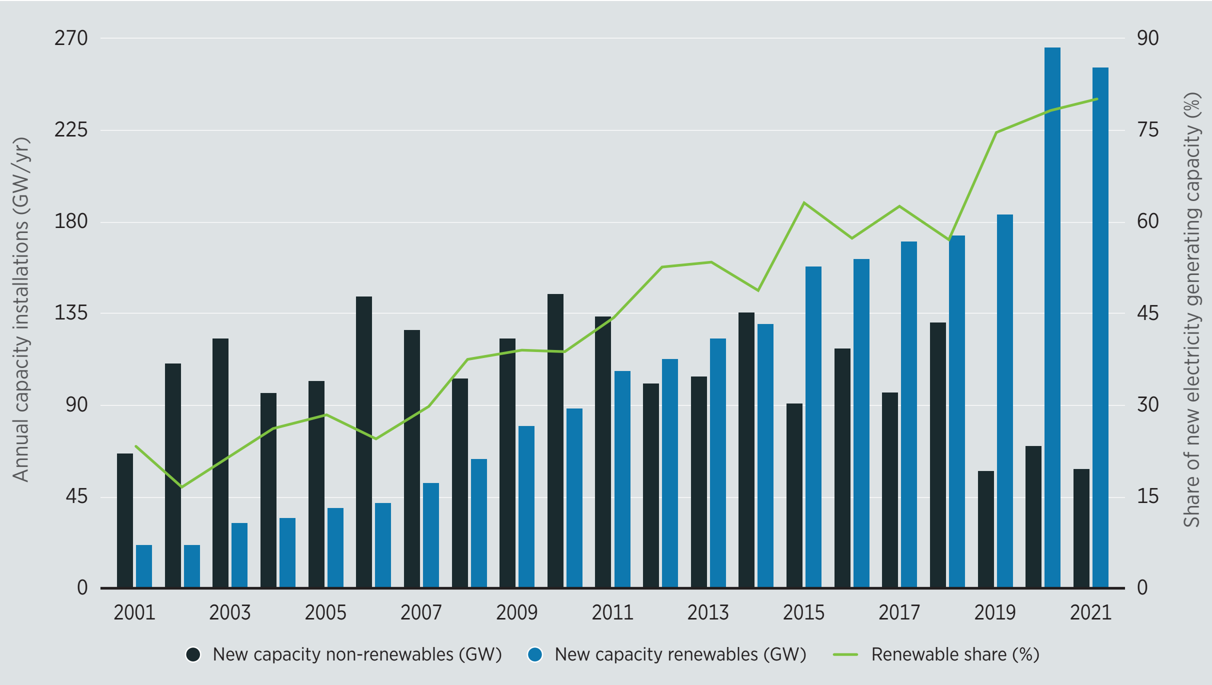
Hydrogen technologies are gaining momentum across the world. Investment has been led by the Americas (particularly the United States), which made up 44% of overall investments in 2022, followed by Asia and the Pacific (mainly China) accounting for 33% of the USD 1.1 billion global total. Despite receiving relatively lower investments, China commissioned 2.5 times more electrolyser capacity than the Americas, but electrolysers sold in China are more than 70% cheaper than elsewhere. Europe and the Middle East made up the remainder of investments; many projects in the region struggled to reach financial close due to uncertainties over hydrogen standards and subsidies (BNEF, 2023c). As of October 2022, more than 60 countries had developed or were preparing hydrogen strategies, up from just one country (Japan) in 2017. It is expected that 115 gigawatts of electrolyser capacity will be added by 2030, 73% of it in Europe (IRENA, 2022b).

While current investment is significantly less than for mature renewable energy technologies such as wind and solar, hydrogen technology has seen strong inflows of early-stage capital as well as high levels of national funding in recent years. A substantial portion is in the form of venture capital. In 2021, hydrogen start-ups in Europe received more investment than their US counterparts (IEA, 2021a). Meanwhile, the Inflation Reduction Act in the United States, as well as similarly robust public policy in Europe, led to governments committing USD 126 billion to developing the hydrogen ecosystem in the first half of 2022.

## 1.3 Renewable energy vs. fossil fuel investments up to 2021

Looking at new power generation capacity only, investments in new renewable power assets were consistently higher than those in new fossil fuel–powered electricity plants in the period between 2015 and 2021. On average, USD 339 billion per year was committed globally for renewable power generation, compared to USD 135 billion, on average, for fossil fuel power generation (IEA, 2022b). These investments correspond with capacity addition trends: renewables capacity grew by 130% between 2011 and 2021, compared to only 24% growth in non-renewables (Figure 1.2), with solar photovoltaic (PV) showcasing the fastest capacity growth, mostly due to technological advancement, high learning rates, policy support and innovative financing models (IRENA, 2022a).

**Figure 1.2** Share of new electricity capacity, 2001-2021



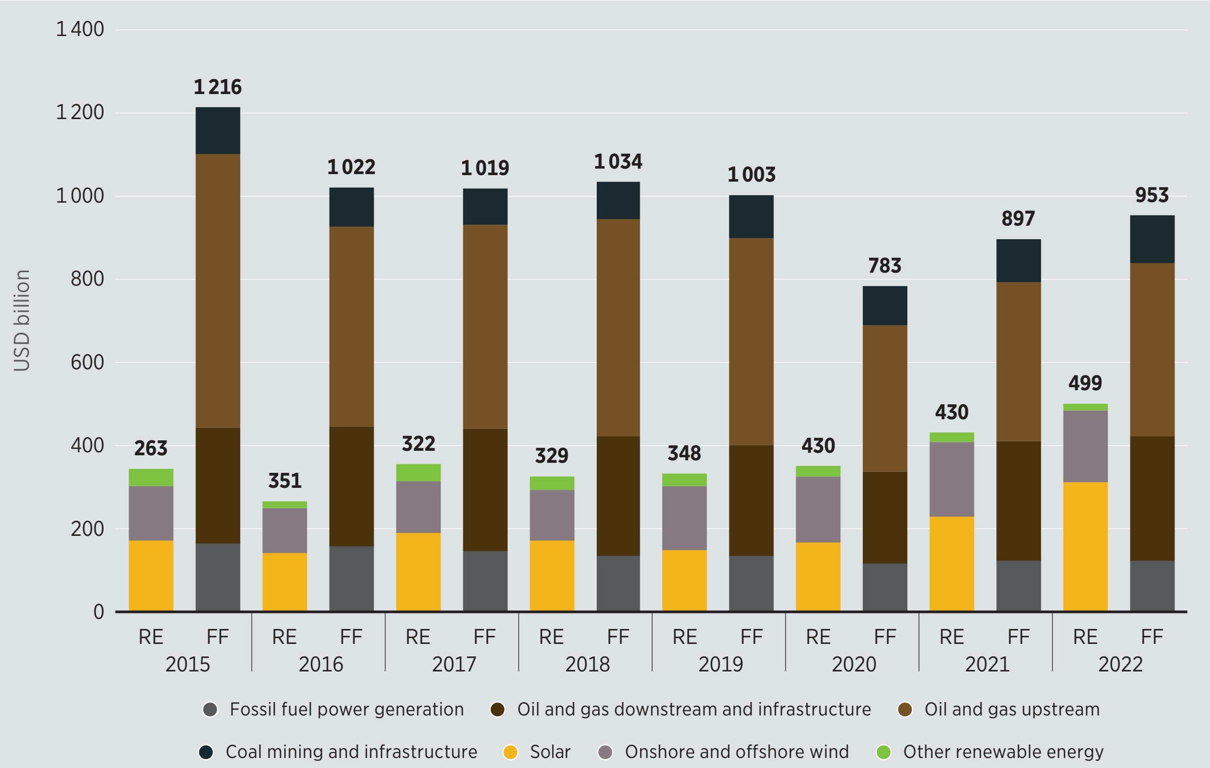

**Note:** GW/yr = gigawatts per year.
**Source:** IRENA (2022a).

Beyond new power generation capacity, however, investments in renewable energy are dwarfed by those in fossil fuels. Considering upstream, downstream and infrastructure investments,[6] fossil fuel capital investments – with an average USD 991 billion invested annually between 2015 and 2022 – were almost three times higher than renewable energy investments – estimated at an average USD 360 billion annually (Figure 1.3).

[6] *Upstream investments refer to those in exploration and production of oil and gas, while downstream and infrastructure investments usually refer to those in refining, manufacturing, and distribution assets of oil, gas and their products.*

Fossil fuel investments declined in 2020 (down 22% from the USD 1 trillion invested in 2019), mainly due to the impacts of the COVID-19 pandemic on global energy markets (IEA, 2022c). Nevertheless, 2021 saw them bounce back up to USD 897 billion, and preliminary data for 2022 suggest they might have almost returned to their pre-pandemic levels (+6%), reaching USD 953 billion (IEA, 2022c). This recovery is partly driven by rising costs across the entire energy sector globally, particularly in relation to reserves replacement, and partly by the conflict in Ukraine, which, together with high oil and gas prices, is incentivising fossil fuel exploration in emerging markets and developing economies, at least in the short run (see Section 1.4).

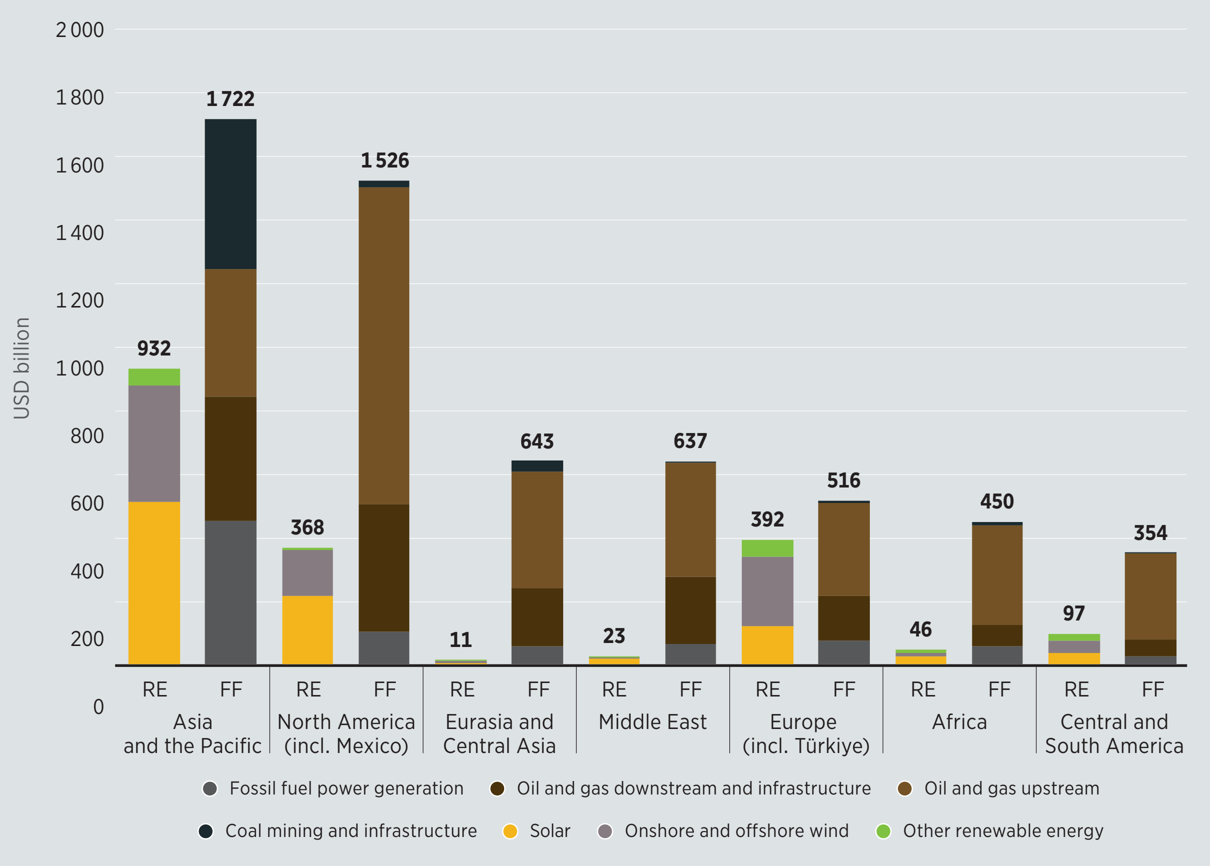
**Figure 1.3** Annual investment in renewable energy vs. fossil fuels, 2015-2022




**Note:** FF = fossil fuel; RE = renewable energy.
**Based on:** CPI (2022a) and IEA (2022b).

**Regionally, fossil fuel investments (including upstream, downstream and infrastructure investments) were highest in Asia and the Pacific followed by North America.** Asia and the Pacific saw high fossil fuel investments across all aspects of the sector – power generation, upstream and downstream oil and gas infrastructure, and coal mining and associated infrastructure – totalling over USD 1.7 trillion between 2015 and 2020 (Figure 1.4). North America followed at USD 1.5 trillion invested over the same period, much of which was directed towards upstream oil and gas. However, it was Eurasia and Central Asia that showed the biggest gulf, proportionately, between renewable energy and fossil fuel investments, with the latter 58 times higher than the former. The Middle East followed, with fossil fuel investment 28 times higher than renewable energy investment. The African continent also exhibited a wide gap between renewable energy investment and fossil fuels (the latter 10 times higher).

**Figure 1.4** Annual investments in renewable energy vs. fossil fuel by region, 2015-2020




**Note:** FF = fossil fuel; RE = renewable energy.
**Based on:** CPI (2022a) and IEA (2022b).

**Fossil fuel investments must be urgently phased out, with capital redirected to energy transition-related assets if the world is to meet the goals outlined in the Paris Agreement.** Investment in energy is still going into funding new oil and gas fields instead of renewables. Investors and banks have already committed to financing fossil fuel development over and above the limit needed to stay within 1.5°C. Over the six years since the Paris Climate Agreement, some large multi-national banks maintained and even increased their investments in fossil fuels at an average of about USD 750 billion dollars a year (Environmental Finance, 2022a). The world's 60 largest commercial banks invested around USD 4.6 trillion in fossil fuels between 2015 and 2021, more than a quarter of which came from US banks (Environmental Finance, 2022a).

Fossil fuel companies based in emerging markets and developing economies have continued to attract substantial volumes of financing. Between 2016 and 2022, their outstanding debt rose by 400% for coal and 225% for oil and gas, despite the need to align investments with the goals outlined in the Paris Agreement (IMF, 2022a). In Africa, substantial investments have been made in 48 countries over the past few years, both in exploration and in exploitation of recently discovered reserves, with the majority of projects being export oriented and undertaken by foreign companies. A study by Ganswindt *et al.* (2022) shows that total capital expenditures for oil and gas exploration in Africa rose from USD 3.4 billion in 2020 to USD 5.1 billion in 2022. African companies accounted for less than one-third of this sum (Table 1.2).

**Table 1.2** African countries with the highest capital expenditure on oil and gas exploration, 2020-2022

| Country | Capital spending for exploration (USD million) | Companies that spent USD 100 million or more on exploration |
|---|---|---|
| Algeria | 3 256 | Sonatrach |
| Egypt | 1 744 | Eni, BP, APA Corporation, Edison E&P |
| Nigeria | 1 331 | Shell, ExxonMobil, Sunlink, TotalEnergies |
| Namibia | 1 124 | Qatar Energy, Shell, TotalEnergies, Namcor, Maurel & Prom |
| Angola | 977 | TotalEnergies, Sonangol, Eni |
| Mozambique | 498 | ExxonMobil |

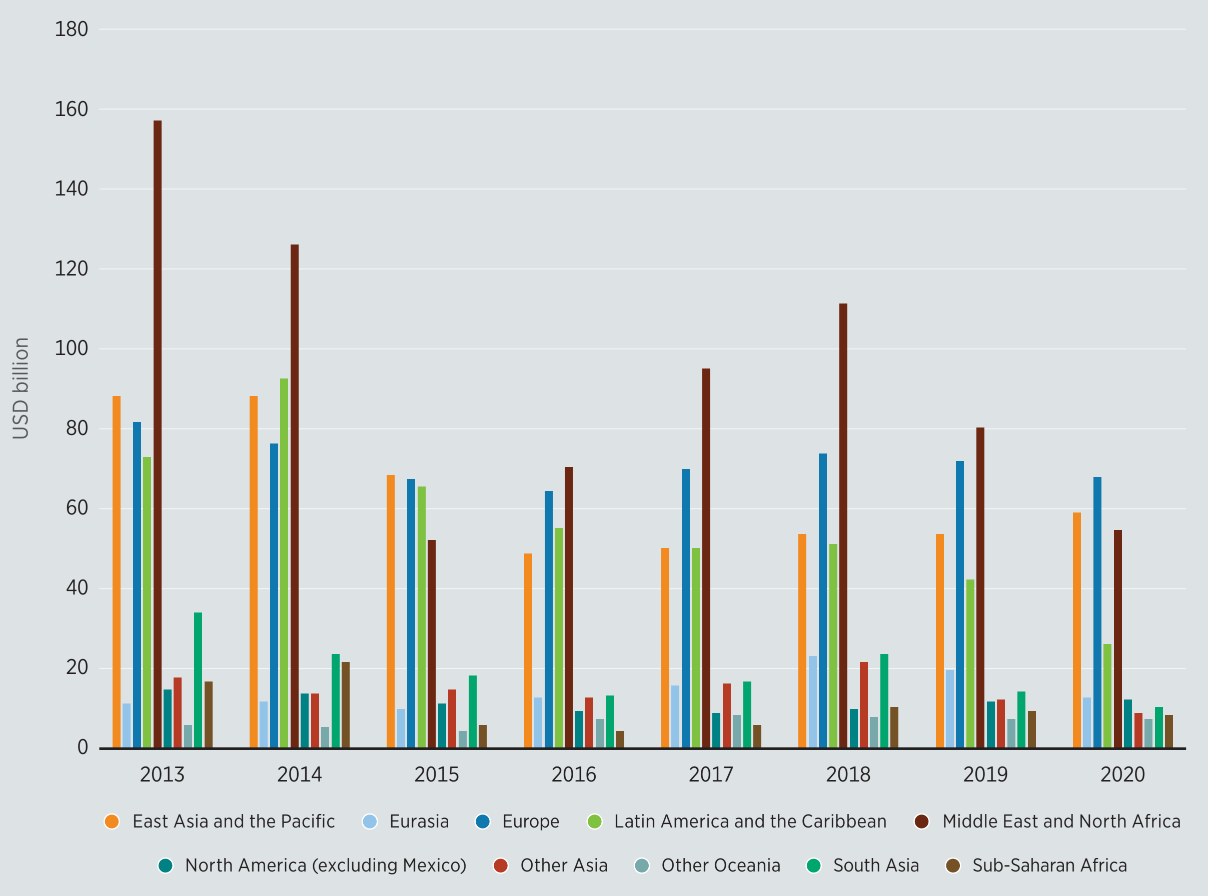
**Source:** Ganswindt *et al.* (2022).

Looking ahead, it has been estimated that USD 570 billion will be spent annually on new oil and gas development and exploration through 2030 (IISD, 2022), despite the pledges made to halt such investments. The Glasgow Financial Alliance for Net Zero (GFANZ), for example, a coalition of financial institutions formed at the 26th United Nations Climate Change Conference (COP26) and representing USD 150 trillion in assets, announced one year after its launch that it has scrapped membership criteria that demanded net-zero plans and eliminated an independent vetting mechanism called Race to Zero (Environmental Finance, 2022a).

**In addition to direct investments in fossil fuel assets, the industry continues to receive considerable support through subsidies.** Between 2013 and 2020, USD 2.9 trillion was spent globally on fossil fuel subsidies (Fossil Fuels Subsidy Tracker, 2022). In 2020, Europe was the region providing the most subsidies, having overtaken the Middle East and North Africa (MENA) (Figure 1.5). On a per capita basis, fossil fuel subsidies in Europe totalled USD 113/person, more than triple those in MENA (USD 36/person). However, fossil fuel subsidies in MENA make up 1.56% of the Gross Domestic Product (GDP) while in Europe, they constitute only 0.3% of GDP.

Subsidies doubled in 2021 across 51 countries, from USD 362 billion in 2020 to USD 697 billion, with consumption subsidies expected to have risen even further in 2022 due to contemporaneous price pressures (OECD and IEA, 2022). These subsidies create significant market distortions wherein the negative environmental, health and social impacts of burning fossil fuels are not properly priced, thus affecting the competitiveness of cleaner alternatives. The phasing out of investments in fossil fuel assets should be coupled with the elimination of subsidies to ensure that the full costs of fossil fuels are reflected in their price and to level the playing field with renewables and other energy transition–related technologies. However, the phaseout of subsidies should be accompanied by a proper safety net to ensure adequate standards of living for vulnerable populations (IRENA, 2022a).

**Figure 1.5** Annual fossil fuels subsidies by region, 2013-2020




**Source:** Fossil Fuels Subsidy Tracker (2022).

## 1.4 Impacts of recent macroeconomic and geopolitical events

**The global pandemic and the crisis in Ukraine have severely disrupted energy markets, on both the supply and demand sides.** The price increases witnessed over the past year – 60% for oil and 400% for natural gas in Europe (CER, 2022) – first arose as post-pandemic demand surged around the world; they grew as Western sanctions cut imports from Russia. Although the prices for natural gas had returned to pre-pandemic levels by January 2023, the Ukraine crisis has forced a global reckoning that 80% of the world's population lives in countries that are net energy importers (IRENA, 2022a), a fact that has profound implications for energy security and affordability.

**The European Union's REPowerEU strategy, which aimed to cut Russian gas imports by two-thirds in 2022, has had cascading effects worldwide.** In Africa, key oil and gas producers, notably Algeria, Mozambique and Nigeria, have been given a new opportunity to cement their place in the global energy supply landscape, while in Asia, where liquefied natural gas (LNG) prices rose in response to higher European demand, some countries are turning back to coal or oil to meet power generation needs. Japan and the Republic of Korea returned to nuclear energy to ease supply concerns before the winter (ING, 2022).

**The current global energy crisis serves as an opportunity to speed up the renewable energy transition; however, supply chain costs and regulatory hurdles are obstacles to deployment, mainly in developed markets.** France, Germany and the United Kingdom, among other countries inside and outside Europe, have set more aggressive renewable energy targets. France and Germany have committed to addressing red tape and the lengthy permitting process for offshore wind, while the United Kingdom is set to triple the pace of developing wind and solar projects (Ashurt, 2022). While steep fossil fuel prices make renewable energy comparatively more cost competitive, a big challenge will be supply chains, with the costs of solar and wind turbine components affected by spiralling inflation. The risk persists that prices for energy transition components will rise and limit demand growth if supply does not keep pace. In this context, actions to support circularity (*e.g.* mandating recycling of retired equipment; funding for research and development to reduce materials' intensity or enable substitution) can help reduce these risks (Wood Mackenzie, 2022b). Indeed, solar panel supply chains have been marked by continued disruptions from COVID-19 lockdowns in China and by the sudden constraints on steel production in Ukraine and aluminium from Russia (Ashurt, 2022). At the same time, policies in Europe still focus on further compressing prices, threatening the sustainability of the industry (IISD, 2022). But on a more positive note, expansionary fiscal stimulus packages (through industrial policy measures) by governments – for example, the Inflation Reduction Act in the United States, which provides tax incentives for wind, solar and other renewables – could help spur a new wave of public and private investment in renewables, especially as other jurisdictions look to enact similar packages of support for clean energy (see Section 2.3.1). However, countries outside the developed world may lack the fiscal space for such measures, which is why IRENA has been proposing a transfer of funds from the Global North to the Global South based on equity considerations (IRENA, 2022a).

**Tighter monetary policy – pushing up interest rates and therefore the cost of capital – is hitting clean energy hard (Rockefeller Foundation, 2022), especially in developing markets.** The current uncertain macroeconomic outlook, with inflation at levels not seen in many countries for over 40 years (ECB, 2022), could threaten renewable energy development globally. Public funding for the energy transition, especially in low-income countries, is enduring more challenges in a deteriorating economic context as governments divert attention and funds towards adjustment policies to deal with inflation, misalignment of supply chains, food shortages and slow growth (Chapter 4).

The global energy crisis has served as a reminder to policy makers of the potential that renewable energy offers for solving the interlinked issues of energy security, energy sustainability, energy affordability and energy access, particularly for the Global South. Renewables also create a much broader industry/economy for shareholders, investors, lenders, producers, technology providers and users. The following chapter focuses on investments in renewables.

# THE LANDSCAPE OF RENEWABLE ENERGY FINANCE FROM 2013 TO 2022

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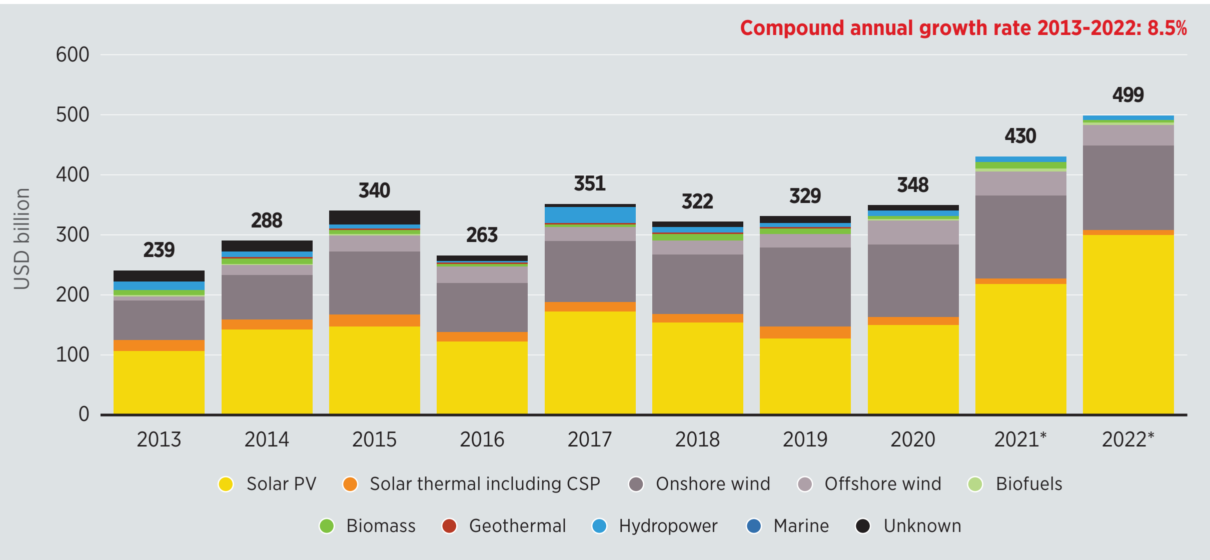
# 02

Despite multiple economic, social and geopolitical challenges, annual investments in renewable energy continued a positive trend that began after 2018 (see Figure 2.1). In 2020, renewable energy investments reached USD 348 billion, representing a 5.6% increase from 2019. The Sankey diagram in Figure 2.2 provides an overview of the global landscape of renewable energy finance, depicting flows along their investment life cycle in 2019 and 2020. Preliminary data suggest that investments further accelerated in 2021 and 2022. In 2021, investments reached USD 430 billion (24% up from 2020) and in 2022 they further increased by 16% reaching USD 499 billion (BNEF, 2023b).[1]

**Figure 2.1** Annual financial commitments in renewable energy, by technology, 2013-2022




**Note:** CAGR = compound annual growth rate; CSP = concentrated solar power; PV = photovoltaic.
**Source:** CPI (2022a). Investments for 2021 and 2022 are preliminary estimates based on data from BNEF (2023b). As BNEF data has limited coverage of large hydropower investments, these were assumed to be USD 7 billion per year, equivalent to the annual average investment for the preceding two years.

[1] *These figures represent "primary" financial transactions in both large- and small-scale projects that directly contribute to deployment of renewable energy, and therefore exclude secondary transactions, e.g. refinancing of existing debts or public trading in financial markets. Note that this is different from investments discussed in Chapter 3 for the off-grid renewable energy sector which relates to corporate-level transactions (both primary and secondary) and is therefore different from investments discussed in Chapter 2 (although some overlap is possible). For more details, please see the methodology document (Appendix). As previously noted, 2021 and 2022 investment numbers in Chapters 1 and 2 are preliminary estimates based on BNEF (2023b).*

The increase in renewable energy investments has been driven by 1) policy makers' growing awareness of the importance of renewable energy in fighting climate change, strengthening energy security and reducing dependence on volatile energy sources; and 2) investors' appetite for alternatives to balance out the volatility and risks of investments in fossil fuels. The years 2020 and 2021 also coincided with deadlines in some jurisdictions for achieving renewable energy targets and applying for support mechanisms, notable examples being the feed-in tariffs (FiTs) in China and Viet Nam (Do *et al.* 2021; Jaghory, 2022), both of which demonstrate the power of policy incentives in the deployment of renewable energy.

While annual investments have continued to grow – at a compound annual growth rate of 8.5% over 2013-2022 – renewable energy costs declined dramatically during that period, meaning that a dollar invested today translates into higher capacity installed than it did in the past. For instance, between 2013 and 2021 the global weighted average of total installed costs for solar PV, onshore wind and offshore wind came down by 69%, 33% and 45%, respectively (IRENA, 2022c). Without these cost reductions, far higher investments would be needed to bring the same level of capacity online.

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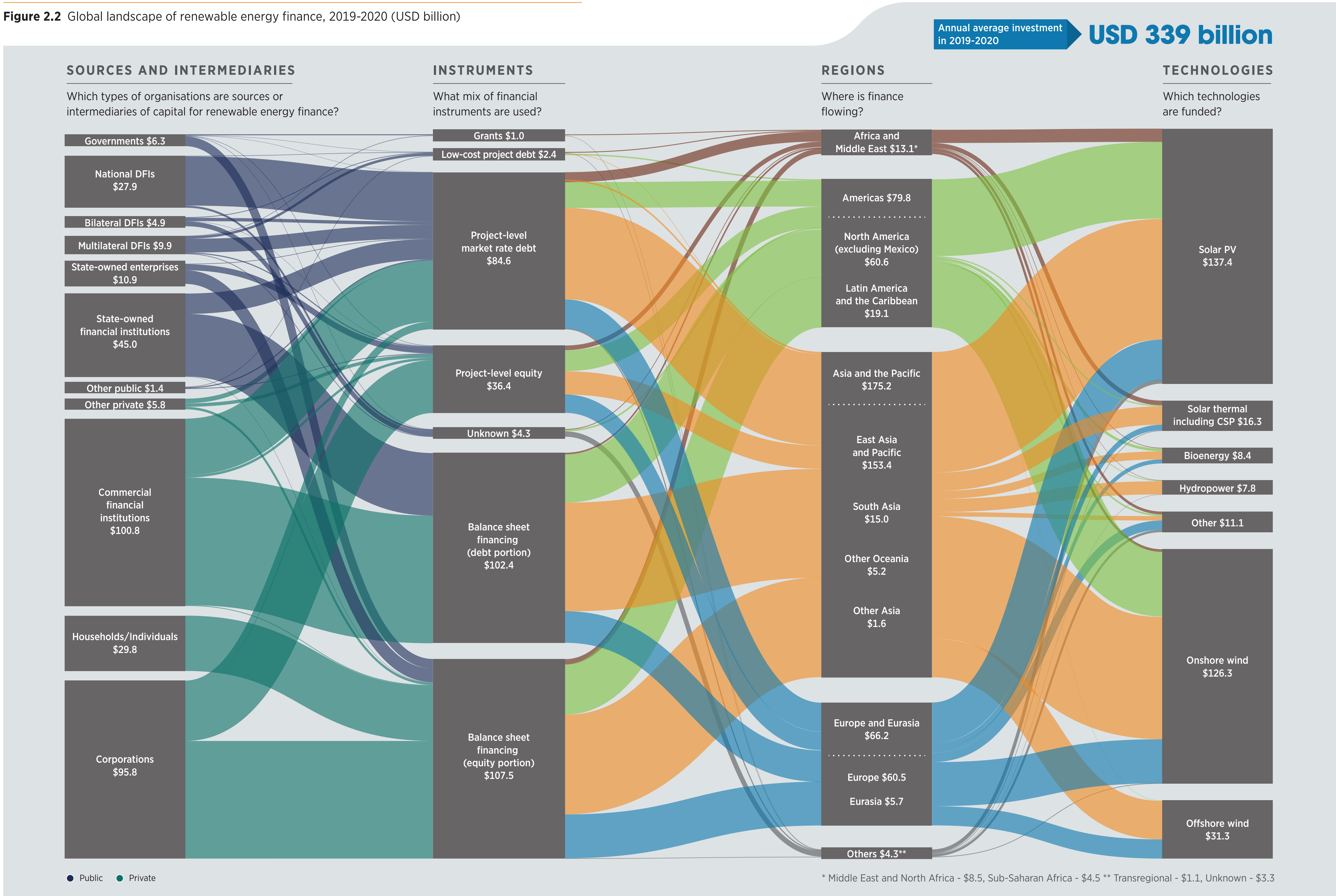
**Figure 2.2** Global landscape of renewable energy finance, 2019-2020 (USD billion)

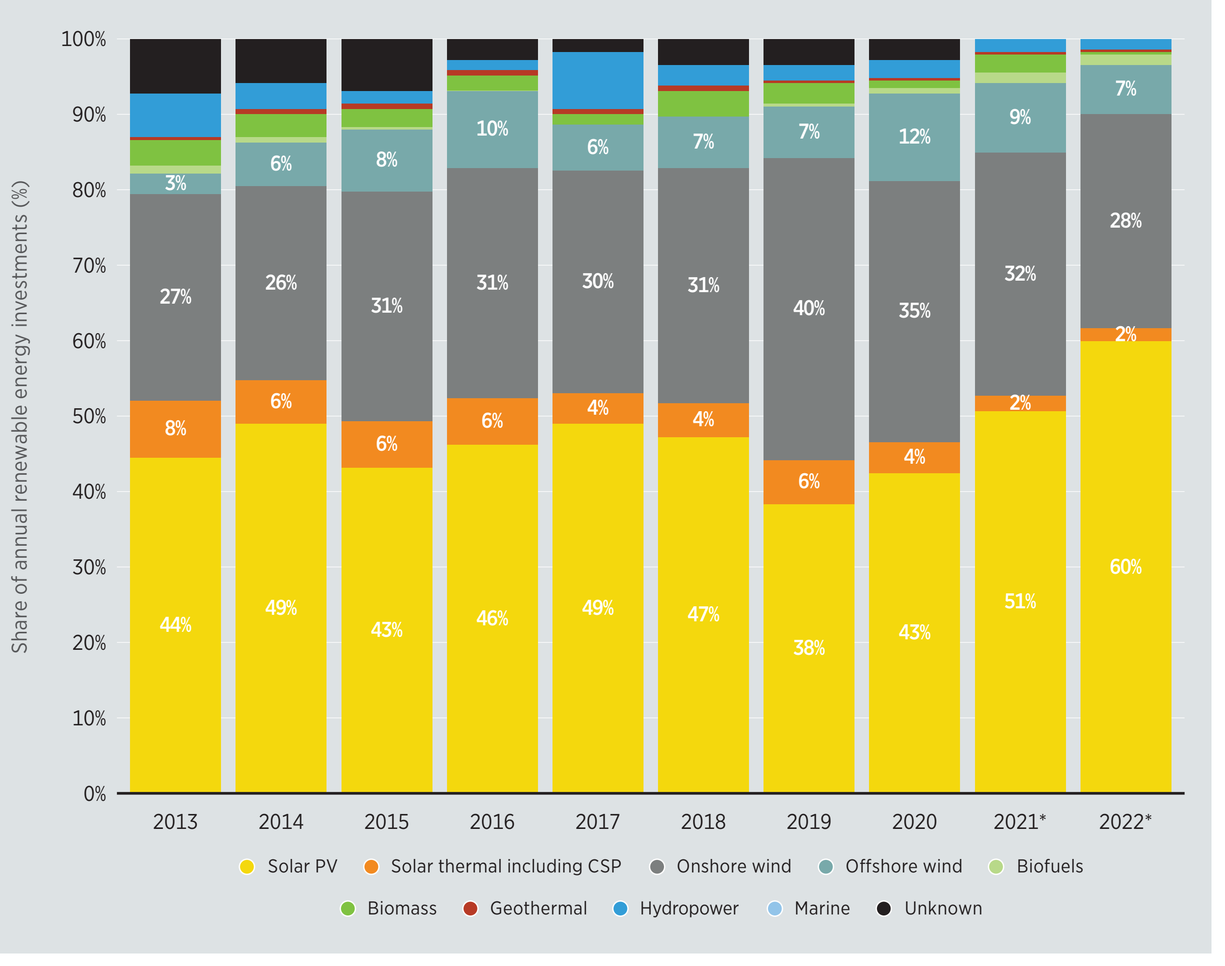



**Note:** CSP = concentrated solar power; DFI = development finance institution; PV = photovoltaic, $ = USD.

## 2.1 Investments by technology

**Between 2013 and 2022, solar and wind technologies consistently attracted the largest share of investment in renewables by a wide margin**, as shown in Figure 2.3. In 2020, solar PV alone attracted 43% of the total, followed by onshore wind (at 35%) and offshore wind (at a record 12%).[2] Solar thermal attracted just 4% of total investments. The attractiveness of solar and wind over other renewable energy technologies can be traced back to their increasing maturity, efficiency advances and continued declines in technology costs (with the exception of the temporary increases experienced in 2021 and 2022), in part due to the greater policy support these technologies have received compared to the other technologies. In addition, the shorter lead times of these technologies and the modular and distributed nature of solar PV make them the most suitable technologies to deliver specific objectives.

**Figure 2.3** Share of annual renewable energy investments, by technology, 2013-2022




**Note:** Note: CSP = concentrated solar power; PV = photovoltaic.

**Source:** CPI (2022a). Investments for 2021 and 2022 represent preliminary estimates based on data from BNEF (2023b). As BNEF data has limited coverage of large hydropower investments, these were assumed to be USD 7 billion per year, equivalent to the annual average investment over 2019-2020.

[2] *The analysis of renewable energy investments in this chapter is mainly based on data from the CPI Global Landscape of Climate Finance database covering investments made up to 2020. Investments for 2021 and 2022 are presented as preliminary data from Bloomberg New Energy Finance (BNEF).*

### 2.1.1 Solar technologies

Investment in solar technologies reached a combined total of USD 162 billion in 2020, an 11% increase from 2019, but still slightly lower than average investments in the preceding two years of 2017-2018. However, solar investments shot up in the past two years (based on preliminary data from BNEF) reaching USD 226 billion in 2021 (an almost 40% increase from 2020) and USD 308 billion in 2022 (a further 36% increase from 2021), as shown in Figure 2.4.

Increased maturity and declining costs helped attract investments in solar technologies, particularly in solar PV deployment, which accounts for around 90% of total solar investments between 2013 and 2020, with the remaining going to solar thermal (including concentrated solar power [CSP]) (Figure 2.4). By end use, the majority of solar investments went to power generation during that period, with a small fraction (9%) targeting heat generation technologies, namely solar water heaters.

China and the United States consistently attract the majority of annual solar investments, with their combined share making up about 50% of all solar investments since 2013. Reductions and delays in solar investments have occurred in some major countries, including Japan and India (down 54% and 29% between 2019 and 2020, respectively), partly due to policy changes and the impacts of the COVID-19 pandemic in these two countries. However, these reductions were offset by investment growth in China and the United States (36% and 13%, respectively, between 2019 and 2020), as well as in Viet Nam, where solar investments grew ninefold from 2019, driven by a FiT programme (Box 2.2).

In terms of installed capacity in the power sector, during 2013-2021, 714 gigawatts (GW) of solar PV and CSP were added globally, with capacity additions increasing by an average 19% each year (Figure 2.4).[3] For heating, most of the solar thermal installations (excluding CSP) were made prior to 2013 (almost 400 gigawatts thermal [$GW_{th}$] out of the total 522 $GW_{th}$ installed by 2021 had come online before 2013), as solar water heaters, especially small-scale systems, reached maturity earlier than other solar technologies. In 2021, large-scale solar heating systems for district heating and for residential, commercial and public buildings (>350 kilowatt thermal [$kW_{th}$]) were added, mainly in China, Europe, Türkiye and Mexico. Meanwhile, interest in solar thermal systems for industrial processes has grown steadily around the globe (Weiss and Spörk-Dür, 2022).

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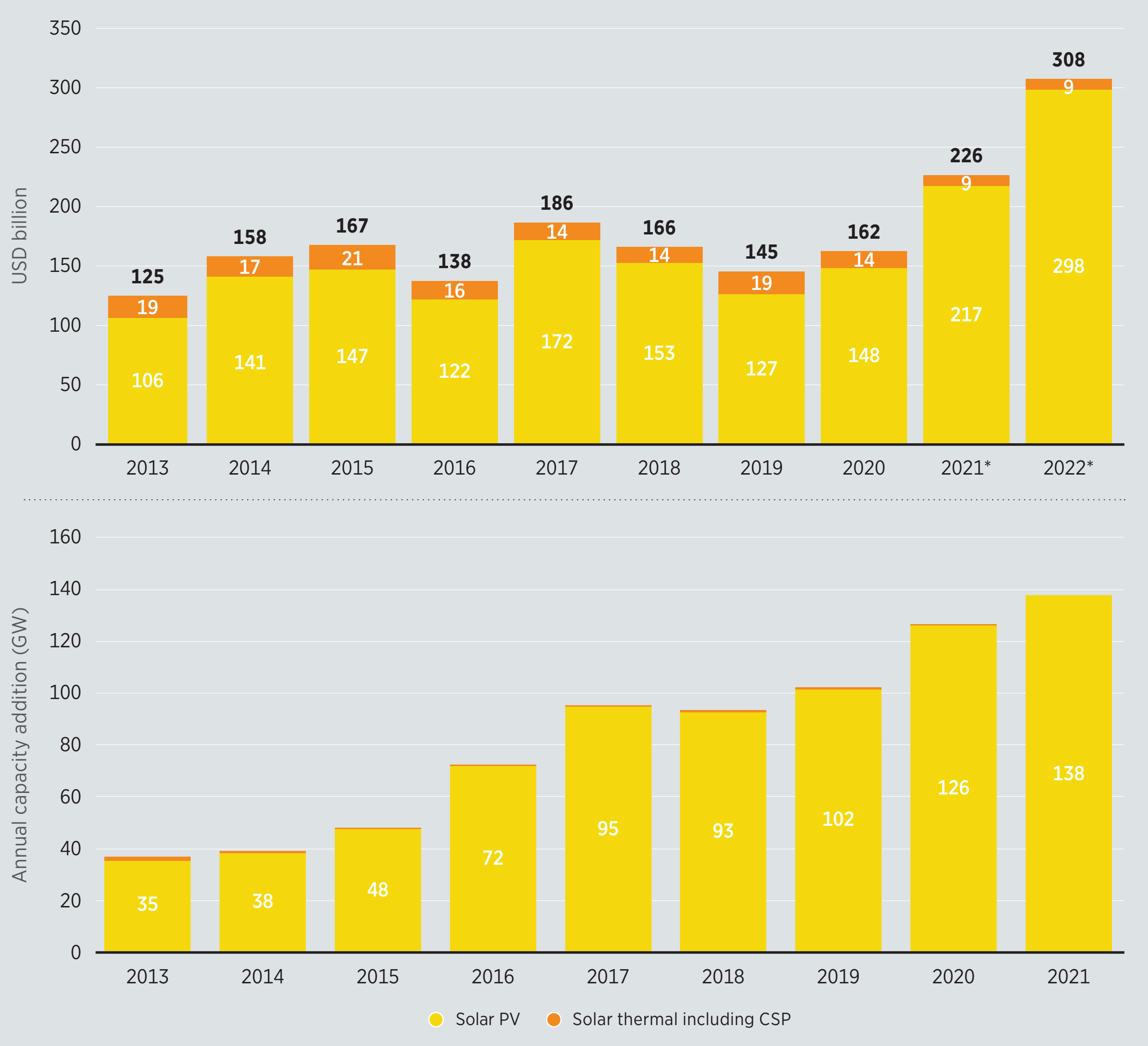
[3] *Data on installed capacity for 2022 were not available at the time of writing.*

**Figure 2.4** Annual investments vs. capacity additions for solar energy technologies, 2013-2022




**Note:** A decrease in investments in a given year may not translate into a decrease in the capacity installed in that same year; in 2016, for example, investments went down yet capacity added went up. This is in part due to cost decreases and in part due to the time lag between the financing and completion of a project. The lag is estimated to be about 0.5 years for solar PV, and 2 years for solar thermal, although some projects can take longer to be commissioned. CSP = concentrated solar power; GW = gigawatt; PV = photovoltaic.

**Source:** CPI (2022a) and IRENA (2022c). Investments for 2021 and 2022 represent preliminary estimates based on data from BNEF (2023b).

### 2.1.2 Wind technologies

Investment in onshore and offshore wind reached a combined total of USD 161 billion in 2020, a 4% increase from 2019, and preliminary data from BNEF show that investments reached USD 176 billion per year on average between 2021 and 2022, a 9% increase from 2020, as shown in Figure 2.5.

**Figure 2.5** Annual investments vs. capacity additions for wind energy technologies, 2013-2022


**Note:** A decrease in investments in a given year may not translate into a decrease in the capacity installed in that same year; in 2017, for example, investments went up yet capacity added went down. This is in part due to cost decreases and in part due to the time lag between the financing and completion of a project. The lag is estimated to be about 0.9 years for onshore wind and 2 years for offshore wind, although some projects can take longer to be commissioned. GW = gigawatt.

**Source:** CPI (2022a) and IRENA (2022d). Investments for 2021 and 2022 represent preliminary estimates based on data from BNEF (2023b).

During 2013-2022, onshore wind accounted for 80% of total investment in wind technologies. In 2019, onshore wind investment saw a 32% increase from 2018 to reach a record high of USD 133 billion before declining 9% in 2020 to USD 120 billion and rising again to USD 140 billion in 2021 and 2022, according to preliminary data.

Meanwhile, offshore wind investment reached USD 40 billion in 2020, nearly doubling the 2019 amount, while preliminary data show 2021-2022 investments to be USD 37 billion, a 7.5% decrease from 2020 but still 68% higher than 2019.

Policies in China drove the recent increase in wind investments, as project developers accelerated installation to meet the deadlines for the FiTs for onshore wind ending in August 2021 and for offshore wind at the end of 2021 (Fitch Ratings, 2021; Jaghory, 2022). For offshore wind, while China accounted for 48% of total investment in 2020, major increases were also recorded in Europe, mainly in the Netherlands and the United Kingdom. Technological improvements such as larger turbines, specialised logistics and manufacturing, and standardisation have helped drive down costs and enabled more installations in deeper water farther from shore (IRENA, 2022c).

In terms of capacity, during 2013-2021, 557 GW of onshore and offshore wind were added globally, with capacity additions increasing by an average of 19% each year. In 2021, while onshore wind capacity additions declined by 31%, new offshore capacity more than tripled (Figure 2.5).[4] Lower onshore capacity additions in 2021 were due to a decline in installations in the two largest markets for onshore wind – China and the United States. In China, the drop was mainly a consequence of record-high installations in 2020 (+50 GW), as the deadline to qualify for the onshore wind FiT was set at the end of the year. In the United States, supply chain problems led to some projects being delayed or postponed in the second half of 2021 (GWEC, 2022).

### 2.1.3 Other renewable energy technologies

Over the 2013-2022 period, while investments in solar and wind increased, combined investments in other renewable energy technologies declined, as shown in Figure 2.6. These technologies include hydropower (including pumped hydropower), biomass, biofuels, geothermal and marine energy.[5] Between 2017 and 2022, the total investment in these technologies declined by 57.5%, from USD 40 billion to USD 16 billion. Moreover, their share in total annual investments dropped from 11% in 2017 to 3% in 2022 (preliminary data).

As these technologies have different characteristics, there are different reasons that have contributed to the lack of investment growth.

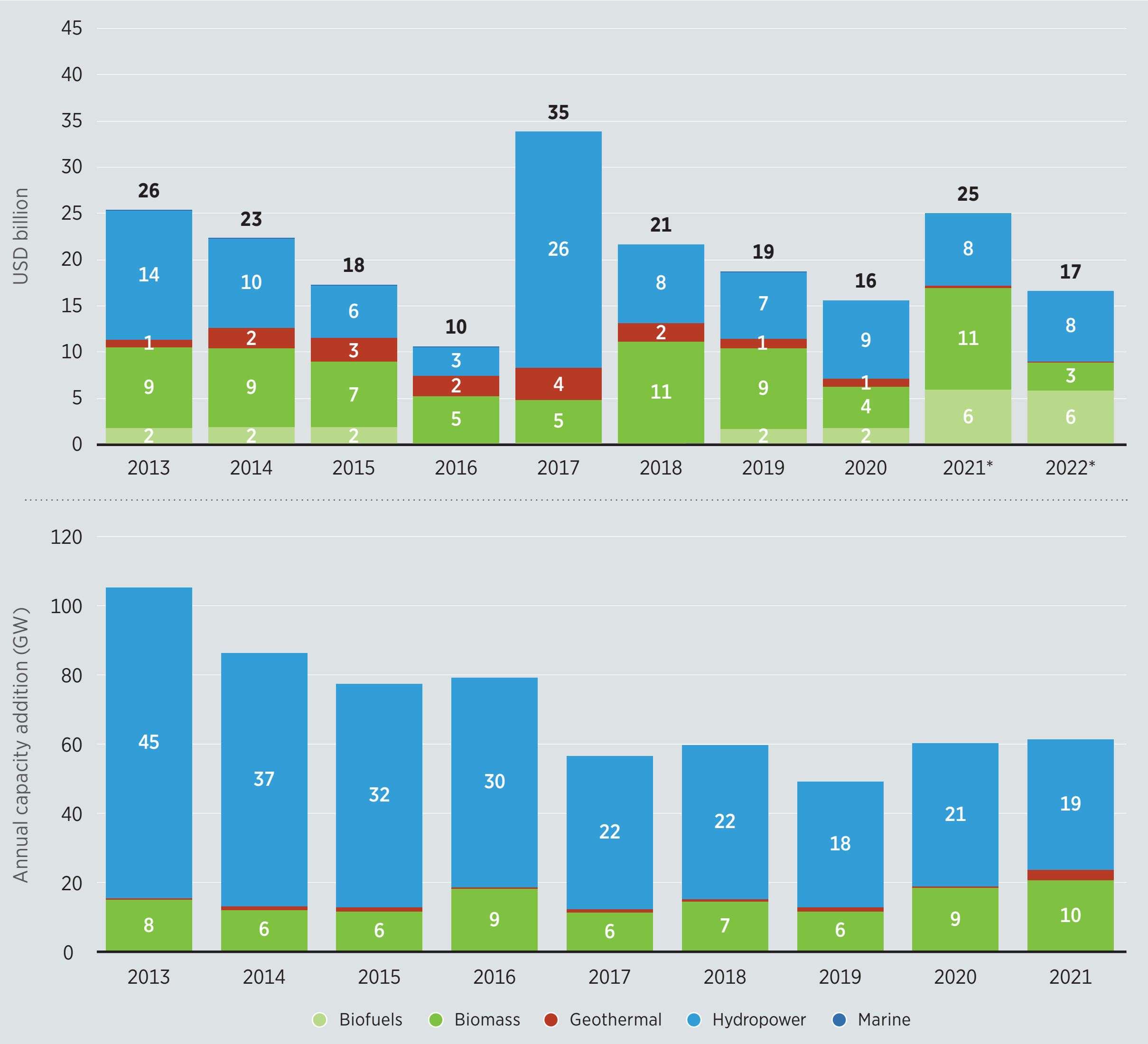
For **hydropower**, particularly large-scale plants (with capacity greater than 10 megawatts), many of the locations available for construction are already utilised, especially in countries that rely heavily on hydropower, with potential new areas usually located in less accessible locations, making construction significantly more expensive. In addition, the construction of new large hydropower plants may encounter opposition from local populations and environmental groups. Comprehensive mitigation measures may be needed to manage possible negative social and environmental impacts (IRENA, 2023).

The future use of modern **biomass** for electricity and heat generation depends heavily on the availability of low-cost feedstock. For **biofuels**, investments depend on policy incentives such as blending targets, which have changed over the years, influenced by market fundamentals (feedstock and oil prices, distribution costs, customers' disposable incomes and preferences).

[4] *Data on installed capacity for 2022 were not available at the time of writing.*

[5] *Tracked investments include only investments in energy production facilities (e.g. they exclude investments needed to secure and transport feedstock or construction equipment). For more details, please see the methodology document (Appendix).*

**Figure 2.6** Annual investments vs. capacity additions for renewable energy technologies other than solar and wind, 2013-2021




**Note:** A decrease in investments in a given year may not translate into a decrease in the capacity installed in that same year; in 2017, for example, investments went up, yet capacity added went down. This is in part due to cost decreases and in part to the time lag between the financing and completion of a project. The typical lag is 1.7 years for bioenergy, 2 years for geothermal, 2.3 years for small hydropower and 2 years for marine. GW = gigawatt.

**Source:** CPI (2022a) and IRENA (2022d). Investments for 2021 and 2022 represent preliminary estimates based on data from BNEF (2023b). As BNEF data has limited coverage of large hydropower investments, these were assumed to be USD 7 billion per year, equivalent to the annual average investment in 2019 and 2020.

While preliminary data suggest a tripling of investment for biofuel and biomass in 2021, a substantial portion was likely driven by the significant rise in feedstock cost in the major producing countries (IEA, 2021b). Policies driving investment in bioenergy should be designed to ensure its sustainable use (IRENA, 2022e).

**Marine** energy is still considered too expensive, owing to its limited economies of scale (most projects being limited to demonstration scale) and technical difficulties (IRENA, 2020b). For **geothermal**, the high cost of surface exploration and drilling has been the main obstacle to funding (IRENA, 2017).

Hydropower and biomass have consistently received the largest share of investments after solar and wind technologies, although investment amounts have fluctuated over time. While there was an increase in hydropower annual investment in 2017 due to a major commitment from the China Development Bank (Chen X. *et al.* 2020), annual investment in hydropower has levelled off since then, ranging between USD 7 and USD 9 billion. In terms of capacity additions, about 201 GW of total hydropower capacity was added between 2013 and 2021, the third highest among renewable energies.

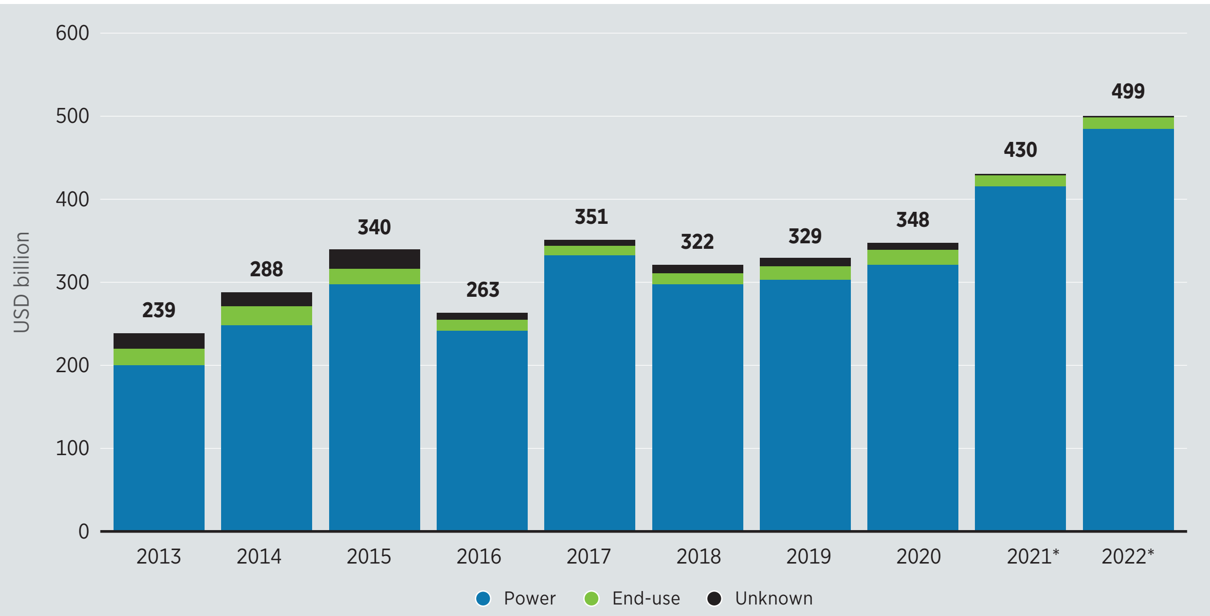
## 2.2 Investments by application (power vs. end uses)

**Investments in renewable energy for end uses need to be urgently scaled up, in parallel with efforts towards renewable energy power generation and end-use electrification.** While annual renewable energy investments have been growing over time, these have been concentrated in the power sector. Between 2013 and 2020, power generation assets attracted, on average, 90% of renewable investments each year, and up to 97% in 2021 and 2022.

Investments in end uses, *i.e.* direct applications, which include heat generation (*e.g.* solar water heaters, geothermal heat pumps, biomass boilers) and transport (*e.g.* biofuels) are lagging. Over time this gap has increased, as shown in Figure 2.7. In 2020, renewable energy for end-use applications received less than 5% of the total (or USD 17 billion), down from 8.5% in 2013 (or USD 20 billion).

It should be noted, however, that a large share of investments in end-use applications is made at the household or firm level (*e.g.* biomass boilers, geothermal heat pumps), and data on such investments can be limited, affecting the overall investment figures provided throughout this report (see Box 2.1).

**Figure 2.7** Annual renewable energy investment by application, 2013-2022




**Source:** CPI (2022a). Investments for 2021 and 2022 represent preliminary estimates based on data from BNEF (2023b). Investment in large hydropower technology in 2021 was estimated as an average of 2019-2020 investments. The category "Unknown" includes investments that could not be attributed to either the power sector or end use.

**Box 2.1 Scope of CPI data: Power generation vs. end-use applications**

The analysis of global renewable energy finance flows is based on data drawn from the Climate Policy Initiative's Global Landscape of Climate Finance database, which captures primary investment in electricity production and end-use applications made in the technologies listed below.

| | Electricity production | End-use applications |
|---|---|---|
| **Bioenergy** | Biomass-, biogas- or biofuel-fired power plants (including waste-fired power plants); combined heat and power plants (power portion) | Biofuel production for transportation (*i.e.* gasoline/petrol, diesel, natural gas substitutes); combined heat and power plants (heat portion)<br>Does not include biomass boilers |
| **Solar photovoltaic (PV)** | Utility scale and rooftop solar PV | Not applicable |
| **Solar thermal (including CSP)** | Concentrated solar power | Solar water heaters |
| **Geothermal** | Conventional geothermal power plant; combined heat and power plants (power portion) | Combined heat and power plants (heat portion)<br>Does not include geothermal heat pumps |
| **Hydropower** | Small- and large-scale hydropower plants | Not applicable |
| **Offshore wind** | Offshore wind power plants | Not applicable |
| **Onshore wind** | Onshore wind power plants | Not applicable |
| **Marine** | Power plants based on ocean technologies, *e.g.* wave, tidal, ocean currents, salt gradient | Not applicable |

The database does not include investments in private research and development or investments in manufacturing for the production of renewable energy technologies (*e.g.* new types of wind turbines).

For more details, see the methodology document (Appendix).

This leaves a substantial portion of the global energy system heavily reliant on fossil fuels, as in 2019 the share of renewables in the total final energy consumption was only 11.2% for heating and cooling, and 3.2% for transport (REN21, 2022).

Even though power accounts for half of the total energy consumption by 2050 according to IRENA's 1.5°C Scenario, and there have been measures to encourage electrification for end uses such as electric vehicles and heat pumps in some countries (chiefly members of the OECD), support for more widespread adoption of direct uses of renewables will be needed to accelerate the decarbonisation of the entire energy system (IRENA, 2022a).

Based on IRENA's 1.5°C Scenario, direct applications for end uses will be crucial to replace fossil fuels in the industrial, residential and transport sectors. Investments in renewables for end uses need to increase significantly, from USD 17 billion in 2020 to USD 284 billion per year by 2030 and USD 115 billion per year between 2031 and 2050 (Table 1.1). To achieve this, deployment policies such as targets, mandates, financial incentives, and enabling policies such as awareness promotion, and funding for research and development and pilot projects, among others, will be needed.

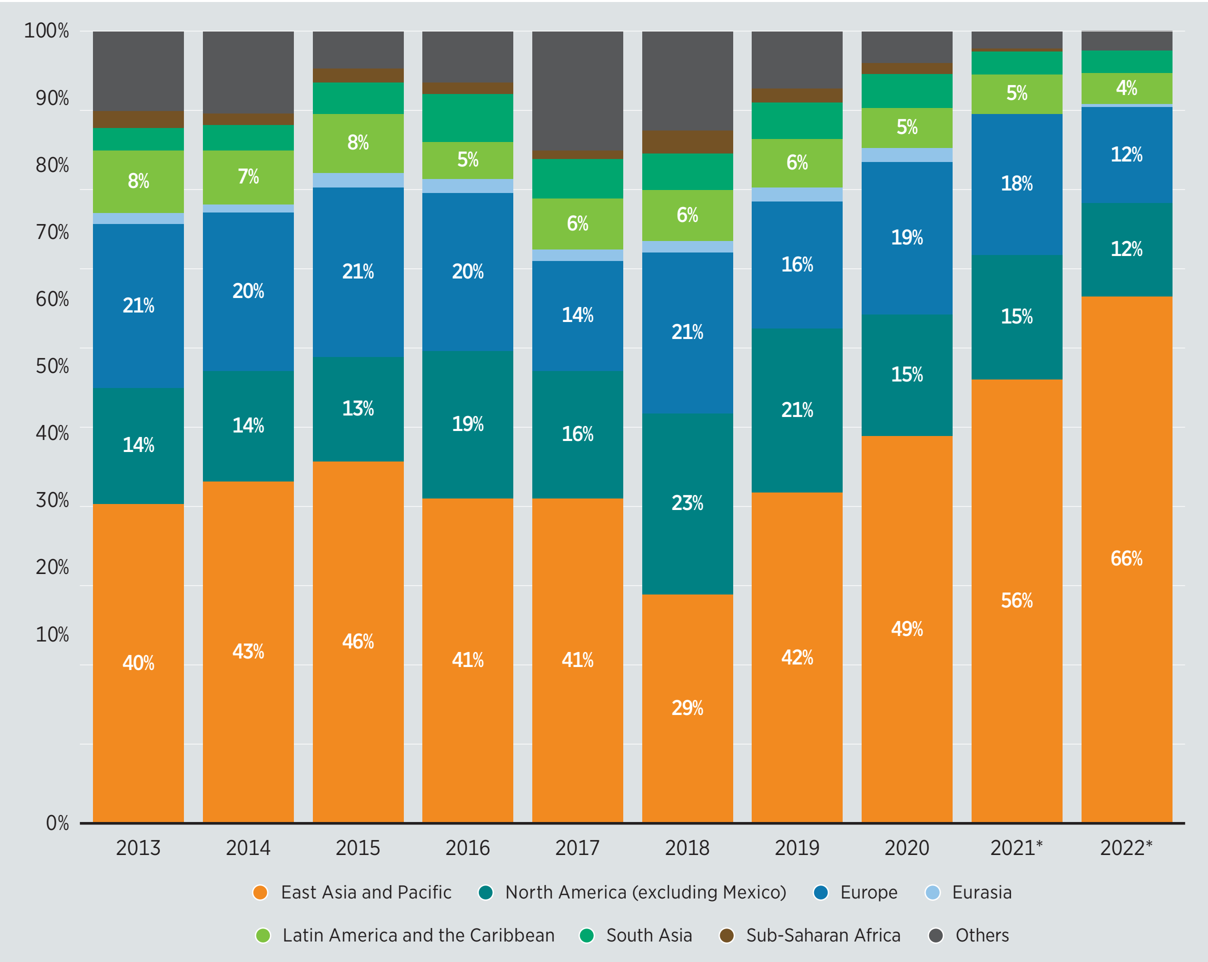
## 2.3 Investments by region

### 2.3.1 Investment by region of destination

**The East Asia and Pacific** region continues to attract the majority of global renewable energy investment. Countries of the region received USD 137 billion in 2019 and USD 170 billion in 2020 (or 42% and 49% of global renewable energy financing for those years) (Figure 2.8). Preliminary data for 2021 and 2022 indicate that the share of investments going to the East Asia and Pacific region surpassed 50% in 2021, rising to two-thirds of the global total in 2022, led by China.

**China** attracted the lion's share of investment in the region (84% in 2019 and 79% in 2020). Between 2013 and 2020, China alone attracted 23-39% of global renewable investments each year, most of them raised domestically. China's story is one of immense government ambition to contain peak emissions by 2030 and achieve carbon neutrality by 2060 (Energy Post, 2022).

**Figure 2.8** Investment in renewable energy by region of destination, 2013-2022




**Note:** "North America (excluding Mexico)" includes Bermuda, Canada and the United States. "Others" include the Middle East and North Africa, Other Oceania, Transregional, Other Asia and Unknown. For more details on the geographic classification used in the analysis, please see methodology document (Appendix).

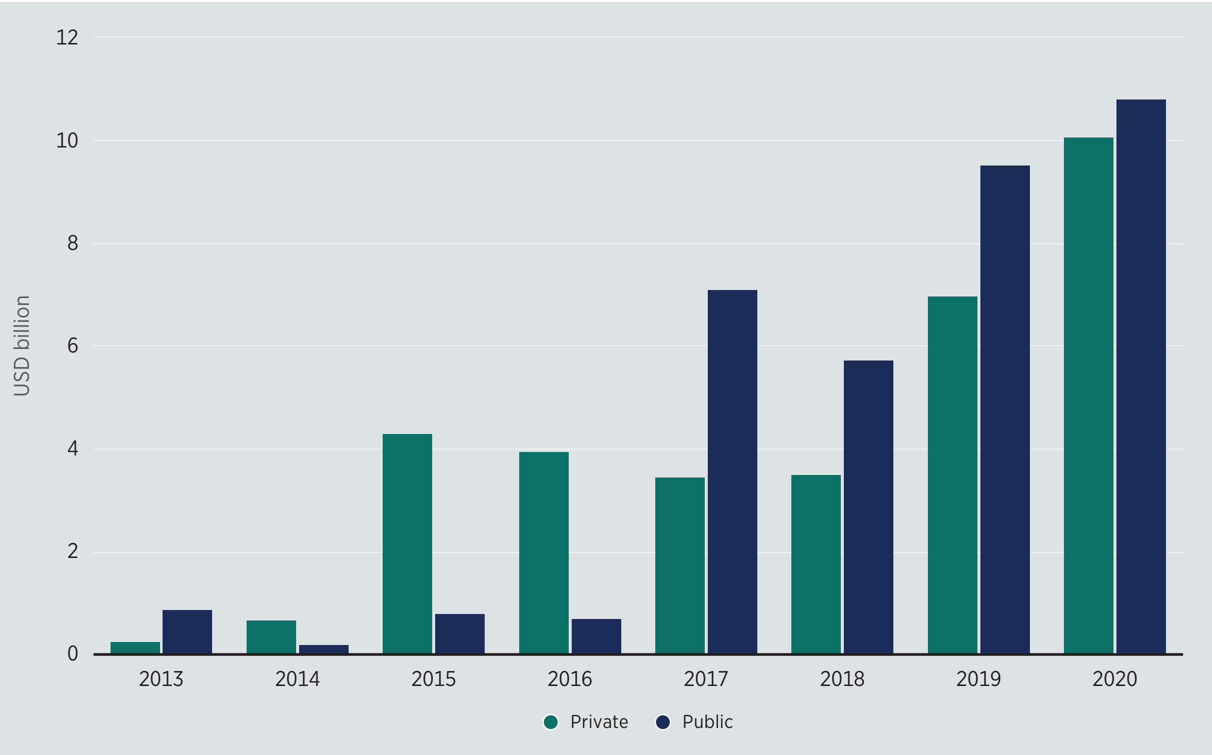
**Source:** CPI (2022a). Investments for 2021 and 2022 represent preliminary estimates based on data from BNEF (2023b).

Concerns about climate change, energy security and air pollution have led the country to invest historic sums in renewable energy deployment and development (Chiu, 2017); USD 792 billion was invested in renewable energy projects in 2013-2020, as investments grew 17% a year on average. Nearly 99% of this was funded domestically. Also, considerable public investment has gone into creating an enabling environment for deployment at this scale, and the pace of this investment has accelerated sharply in recent years. In 2022, China invested more than USD 274 billion (an amount greater than all global investments made in 2013), up from USD 176 billion and USD 115 billion in 2021 and 2020, respectively.

Consistent strong investments in wind and solar put China on track to meet its target of having 1 200 GW of installed capacity in these technologies by 2030 (Carbon Brief, 2021), as set out in the 14th Five-Year Plan announced in 2022. A suite of policies, including value added tax exemptions on renewable energy generation, income tax exemptions for renewable energy developers and guaranteed purchase of renewable energy by utilities have been instrumental in this growth.

China's targeted policies have had substantial effects on investment. The 2014 announcement of a FiT for offshore wind was followed by a fivefold increase in investment in this sector in 2015 (Figure 2.9) (BNEF, 2022a). Annual investment grew by 20 times in the few years between 2014 and 2019. Likewise, onshore wind investment in China surged in 2019 and 2020 as developers rushed to install projects before the expiration of a national FiT at the end of 2020 (REN21, 2022).

**Figure 2.9** Public and private investments in offshore wind, China, 2013-2020




**Source:** CPI (2022a).

Investment in renewable energy has grown significantly in **Viet Nam**, which overtook Japan to become the region's second-largest destination of capital in 2020, largely due to expiring FiT applications (Lorimer, 2021). Domestic private investment in solar PV is an important part of the regional story. From 2013 to 2020, investment grew by an average of 219% per year, rising from only USD 47 million to nearly USD 18.7 billion. Private domestic investment in solar PV accounted for 58% of total financing over this period. Spurred by lower interest rates, favourable policy and strong growth in power-hungry industries, solar PV projects in Viet Nam added 19 GW of capacity in 2019-2020 (Climatescope, 2022a). However, after the FiT expired, investments declined quickly – from about USD 18.7 billion in 2020 to about USD 9.7 billion in 2021, to less than USD 4.7 billion in 2022. Box 2.2 examines the growth of investments in Viet Nam in greater detail, and compares this trend with that of neighbouring Thailand.

**North America** (excluding Mexico) saw the second-highest investment in renewables, attracting USD 68 billion in 2019 and USD 53 billion in 2020 (equivalent to 21% and 15% of the global total, respectively). Much of this was focused on the United States, and the share of funding going to the region has gradually declined in recent years due to a drop in domestic US investments (BNEF, 2022c). According to preliminary data, investments in the region increased to almost USD 58 billion in 2021 and then decreased to USD 53 billion in 2022 (BNEF, 2023b). The imminent closing of the Production Tax Credit in the United States may have been one cause for the fall in investments – mostly onshore wind - from 2019 to 2020.

The 2022 Inflation Reduction Act in the United States intended to spur a new wave of domestic investment. New tax credits and USD 30 billion in targeted grants and loans for clean energy generation and storage were earmarked for the renewable energy sector. This is 11 times higher than the total USD 2.6 billion in direct government financing seen from 2013 to 2020. The earmarked USD 60 billion in support of manufacturing of low-carbon components, including solar panels and wind turbines, seeks to further crowd in private investment (US Congress, 2022). Investments in the US renewable energy sector are expected to reach USD 114 billion by 2031, driven by the momentum of the Inflation Reduction Act (PV Magazine, 2023).

**Europe** attracted USD 54 billion in 2019 and USD 67 billion in 2020 (17% and 19% of the global total, respectively). Preliminary data suggest investments exceeded USD 69 billion in 2021, but dropped to USD 53 billion in 2022 (BNEF, 2023b).

In 2020, investments in the region grew by a record 26% compared to 2019, driven primarily by an almost fourfold increase in investments in the United Kingdom and an almost threefold increase in the Netherlands, compared to 2019. This increase was driven by an almost fourfold increase in offshore wind investments – from USD 4 billion in 2019 to USD 17 billion in 2020 – while investments in solar PV and onshore wind remained stable.

Offshore wind investment in Europe continues to be led by the United Kingdom, the Netherlands and Germany. In the United Kingdom, the Renewables Obligation on companies to source an increasing share of their energy needs from renewables, and its successor, the Contract for Difference mechanism, have decreased investor risk, lowered the cost of capital and prompted a surge in private investment (McNally, 2022).

## Box 2.2 Renewable energy trends in Viet Nam and Thailand

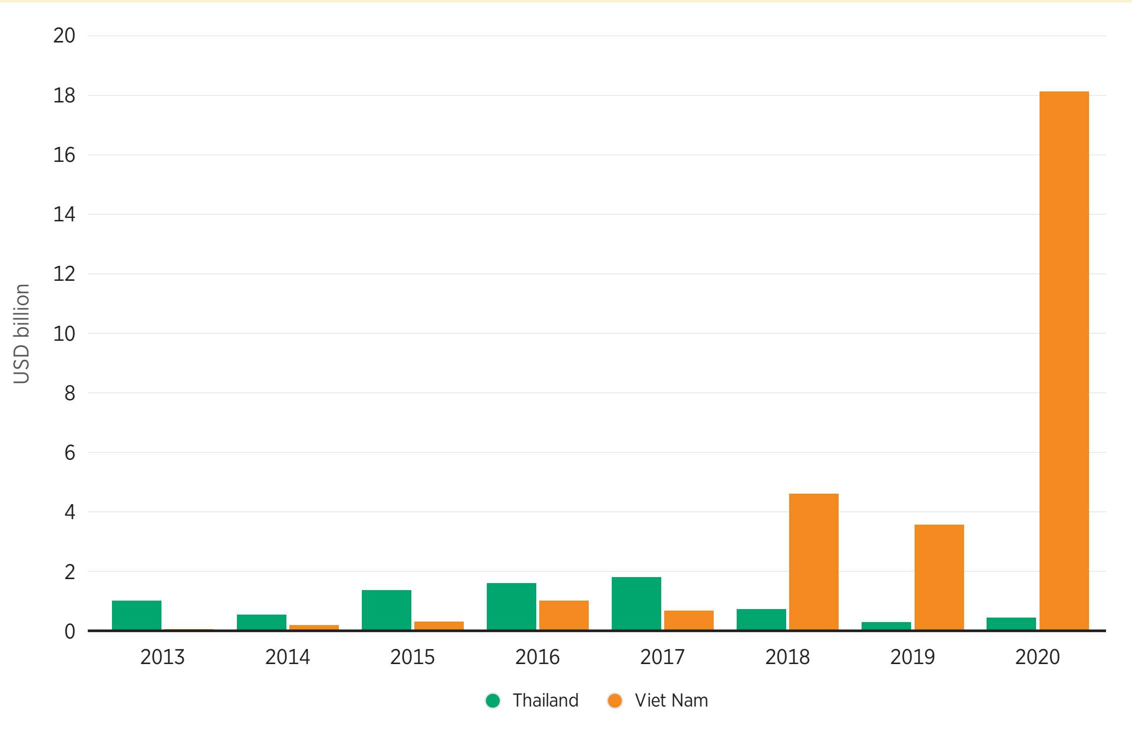
Viet Nam's rapid industrialisation has prompted a surge in energy demand. Much of this industrial growth has been fuelled by foreign direct investment, as companies look to diversify their supply chains away from China. Rooftop solar installations in industrial parks have grown to meet these companies' requirements for renewable energy (and more climate-friendly products). The country has incentivised the growth of renewable energy generation via feed-in tariffs (FiTs) in the solar industry. Tariffs for onshore and offshore wind were made more generous in 2018 after poor initial uptake (BNEF, 2022b). Coal is still the primary source of electricity production in the country, though slow development of new plants led the government to pivot to solar (and later wind) along with gas to meet its rising energy needs (Government of Viet Nam, 2016).

In contrast, investment in neighbouring Thailand has been anaemic (Figure 2.10). This can be partly explained by differences in the two countries' stages of economic growth, and energy mixes, among other factors. While endowed with similar natural resources, economic growth in the 1990s helped Thailand set up a well-functioning and robust power supply. A subsequent decline in economic growth rates slowed energy demand significantly, and Thailand's demand now lags that of its rapidly industrialising neighbour. In 2020, due to restrictions associated with COVID-19, Thailand's installed capacity exceeded demand by 40%.

Government ambitions are the other side of the story. Thailand's Power Development Plan aims for a 10 GW expansion in solar PV capacity by 2037, whereas Viet Nam has targeted an additional 18 GW of solar PV capacity by 2030 and another 18 GW from wind power (BNEF, 2022b). With renewable energy growth in Thailand remaining tepid for the foreseeable future, private energy giants such as Super Energy Corp have been increasingly turning to foreign markets, including Viet Nam, to fuel growth.

Both countries have used generous FiTs to help grow the supply of renewable energy. However, Viet Nam's high energy demand and ambitious renewable energy targets have made FiTs a more effective policy tool. Viet Nam serves as a positive model for other countries experiencing similar growth.

**Figure 2.10** Renewable energy investments in Viet Nam and Thailand, 2013-2020




**Source:** CPI (2022a).

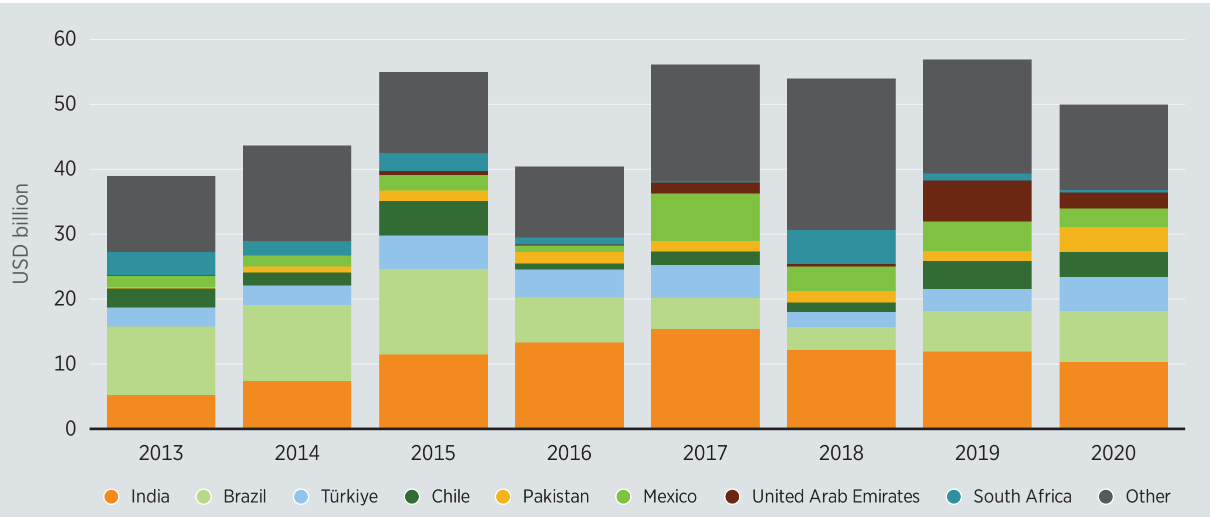
The Netherlands' feed-in premiums scheme and energy tax exemption for renewable energy generators have also prompted rapid growth in the industry, which led the continent in offshore wind investment in 2020 (Climatescope, 2022b). Germany has also chosen to pursue a FiT and national and state grants to accelerate growth in renewable energy generation (BNEF, 2022d).

Across the continent, net-zero commitments and extensive policies to phase out fossil fuels are driving growth in renewable energy. The Green New Deal commits members of the European Union (EU) to reducing net emissions by at least 55% by 2030 compared to 1990 (European Commission, 2022). Building on this, the European Commission presented a Green Deal Industrial Plan for the Net-Zero Age in February 2023, which would provide investment aid and tax breaks towards technological development, manufacturing, production and installation of net-zero products in green sectors including renewables and hydrogen (Bloomberg, 2023; European Commission, 2023). The plan looks to mobilise EUR 225 billion in loans from its existing Recovery and Resilience Facility, and an additional EUR 20 billion in grants (European Commission, 2023). The plan came soon after the announcement of the 2022 Inflation Reduction Act in the United States, as Europe looks to stay competitive in the net-zero age.

A forthcoming Net-Zero Industry Act seeks to streamline permitting processes, with the view to speed development and reduce costs. After a rocky start, the European Emission Trading scheme provides the largest and one of the most functional cap-and-trade systems of any economic bloc.

**Regions home to about 120 developing and emerging markets** continue to receive comparatively low investments, attracting a combined investment of USD 59 billion and USD 51 billion in 2019 and 2020, respectively. Among these, Latin America and the Caribbean attracted 6.1% (2019) and 4.9% (2020) of global investments, followed by South Asia, the Middle East and North Africa, Eurasia and Sub-Saharan Africa. Across these regions, the bulk of renewable energy investments is captured by only a handful of countries: Brazil, Chile and India (Figure 2.11).

**Figure 2.11** Renewable energy investments in developing and emerging markets, by top countries, 2013-2020




**Source:** CPI (2022a).

In other words, more than 70% of the world's population, mostly residing in developing and emerging countries, received only 15% of global investments in renewables in 2020. Further, the share of renewable energy investments going to these countries has been progressively declining year on year (*e.g.* from 27% in 2017 to 15% in 2020). In absolute terms, annual investments have been declining precipitously since 2018 at an average rate of 36%. Countries defined as "least developed" by the Intergovernmental Panel on Climate Change attracted only 0.84% of renewable energy investments on average between 2013 and 2020.

**Looking at investments on a per capita basis further reveals the disparity in investments.** In East Asia and Pacific, investment per capita increased by 19% between 2015 and 2021 from USD 88/person in 2015 to USD 105/person in 2021. The bulk of the increase took place in China, and in fact, the region excluding China experienced a decrease of 20% (Table 2.1). This decrease is mainly led by Japan, with a 49% decline over the same period. Excluding these two outliers, the region experienced a 4% increase.

In South Asia, investments per capita declined by 26% between 2015 and 2021, however the true extent of the decline is masked by India which saw investment per capita grow by 34% in the same period. Excluding India, investment per capita declined by 76% from USD 20/person in 2015 to USD 5/person in 2021.

**Table** 2.1 Investment per capita by region and population growth, 2015-2021

| Region | Investment per capita (USD/population) | | | Population growth |
|---|---|---|---|---|
| | 2015 | 2021 | Percentage change (%) | Percentage change (%) |
| **East Asia and Pacific** | **88** | **105** | **19%** | **3%** |
| (excl. China and Japan) | 61 | 64 | **4%** | **6%** |
| (excl. China) | 94 | 75 | **-20%** | **5%** |
| China | 85 | 124 | **46%** | **2%** |
| Japan | 276 | 140 | **-49%** | **-1%** |
| **South Asia** | **9** | **7** | **-26%** | **7%** |
| *South Asia (excl. India)* | *20* | *5* | **-76%** | **9%** |
| *India* | *6* | *8* | **34%** | **6%** |
| **North America (excluding Mexico)** | **161** | **179** | **11%** | **4%** |
| **Europe** | **154** | **127** | **-17%** | **1%** |
| **Eurasia** | **28** | **3** | **-90%** | **2%** |
| **Latin America and Caribbean** | **53** | **31** | **-41%** | **5%** |
| **Sub-Saharan Africa** | **7** | **1** | **-91%** | **17%** |
| **Others** *(incl. Eurasia, Other Asia, MENA, and Oceania)* | **26** | **11** | **-55%** | **8%** |

**Percentage change in investment per capita (%)** > 10% 0% < 10% < 0%

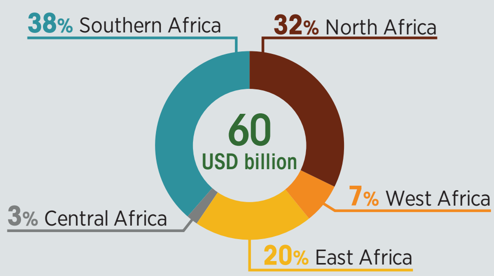
**Based on:** Investment data from Wood Mackenzie (2022) and population data from World Bank (n.d.)

The most striking growing disparity is between North America (excluding Mexico) and Europe, and Sub-Saharan Africa. In 2015, renewable energy investment per capita in North America (excluding Mexico) and Europe was just about 22 times higher than that of Sub-Saharan Africa. In 2021, investment per capita in Europe was 127 times that in Sub-Saharan Africa (which in 2021 fell to just USD 1/person from USD 7/person in 2015), and North America was 179 times more (Table 2.1).

IRENA analysed the finance landscape of Africa in its publication, *Renewable energy market analysis: Africa and its regions* (IRENA, 2022f). The report showed that of the USD 2.8 trillion invested in renewable energy globally between 2000 and 2020, only 2% – equivalent to USD 60 billion, excluding large hydropower – went to Africa, despite the continent's enormous potential and needs (Figure 2.12). Moreover, the report showed that 75% of the investments made between 2010 and 2020 went to just four countries: South Africa, Morocco, Egypt and Kenya. These countries offer relatively favourable risk-return profiles owing to their policy and institutional environment, regulations, access to finance and market characteristics (*e.g.* size, prospects and stability).

**Figure 2.12** Cumulative renewable energy investment in Africa and globally, 2000-2020

| USD billion, current 2020 | 2000-2009 | 2010-2020 | Cumulative 2000-2020 |
| --- | --- | --- | --- |
| **Global** | 587 USD billion | 2 254 USD billion | 2 841 USD billion |
| **Africa** | 4.8 USD billion; 0.8% of global investment | 55 USD billion; 2.4% of global investment | 60 USD billion; 2% of global investment |
| North Africa | USD 1.9 billion | USD 17.5 billion | |
| West Africa | USD 0.5 billion | USD 3.9 billion | |
| East Africa | USD 2.0 billion | USD 9.7 billion | |
| Central Africa | USD 0.1 billion | USD 1.3 billion | |
| Southern Africa | USD 0.3 billion | USD 22.4 billion | |




**Source:** IRENA (2022f).

Looking at African regions, **North Africa** was the second-largest recipient of renewable energy investments on the continent during 2000-2020, after **Southern Africa** (Figure 2.12). Morocco and Egypt received the majority of funding (47% and 45%, respectively), primarily for solar PV (57%) and onshore wind (22%). The North African region benefits from greater private sector participation than is seen elsewhere on the continent. In 2020, private actors provided 65% of all renewable energy finance in North Africa, up from only 11% in 2013.

The share of global renewable energy investments going to **Sub-Saharan Africa** remains small. The region received less than USD 41 billion cumulatively during 2000-2020 – that is, less than 1.5% of the amount invested globally during that period. Investments in the region dropped considerably in 2021, to one-quarter of what they were in 2020 (from USD 4 billion to less than USD 1 billion), despite the fact that the world emerged from the pandemic supposedly recognising the critical role energy plays in enabling health care, sanitation, telecommunications and resilient livelihoods. However, in reality, the inequality in the spread of investments between the Global North and the Global South only increased.

In **Southern Africa**, South Africa was the primary destination of this financing, having received USD 17 billion during this period, or 40% of total investment in the region. Much of this came in the form of private domestic investment in solar PV and wind projects, totalling USD 3.9 billion and USD 4.2 billion over the period, respectively. The pre-eminence of South Africa in the region can be explained by its relatively mature renewable energy market – perceived as relatively less risky by investors – and a burgeoning commitment to decarbonising the national energy system. The Renewable Energy Independent Power Producer Procurement Program, introduced in 2011, as well as South Africa's Integrated Resource plan and Integrated Energy Plan explicitly target a more diverse energy mix, and have provided confidence for private sector investors beyond that offered by other large economies in Sub-Saharan Africa (Climatescope, 2022c). Looking ahead, South Africa is among the first countries to benefit from the Just Energy Transition Partnership (JETP) funding (see Box 4.1).

In **East Africa**, Kenya dominates, receiving 49% of overall investments in the region, with private sources of capital playing an increasingly larger role in recent years. FiTs (though faced with a backlog of applications), along with growing demand as the country aims for 100% electricity access, have contributed to this increase. In other East African markets, renewable energy investments continue to be low and financed primarily through public sources, which accounted for 57% of investments in the region during 2013-2020, the majority coming from bilateral and multilateral development finance institutions (DFIs) (51%).

The situation is similar in **West Africa,** where 61% of renewable energy investments during 2013-2020 came from public sources, about half of them backed by bilateral and multilateral DFIs. Half of all renewable energy investments in the region went to just two countries – Nigeria (29%) and Senegal (21%). In terms of technologies, investments were mainly in solar PV (55%) and onshore wind (13%) projects.

**Central Africa** received the lowest levels of investment of any region on the continent, despite the dire need to expand energy access. About 56% of financing comes from public sources, though some markets are able to attract a significant proportion of investment from private sources, namely Angola (57%) and Chad (79%).

The need for increased investment in renewable energy in Sub-Saharan Africa becomes even clearer as much of the region struggles to reach universal access to electricity. Providing electricity to the 600 million Africans that lack it is crucial to the continent's development. However, the USD 9 billion in renewable energy investments that the continent attracted on average in 2019/20 remains far short of the estimated USD 133 billion needed annually (CPI, 2022b).

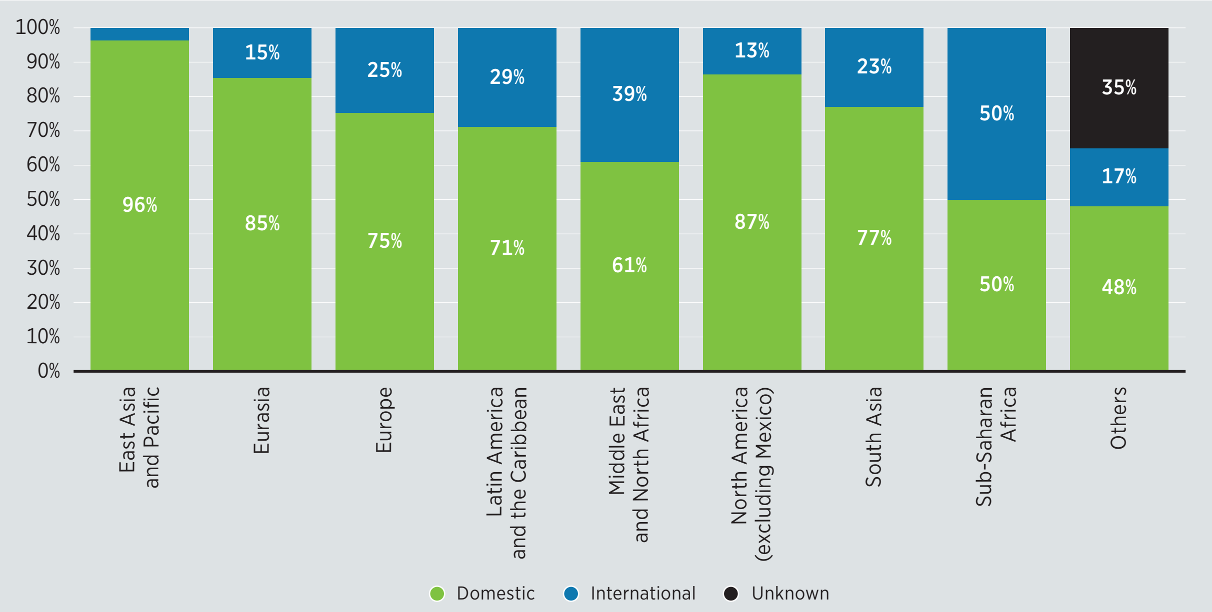
### 2.3.2 Investment by region of origin

During 2013-2020, the majority of renewable energy investments (83%) were made domestically, *i.e.* funded through in-country sources. The share of domestic investments was higher in regions with mature renewable energy markets such as East Asia and Pacific (96%), North America (excluding Mexico) (87%) and Europe (85%) (Figure 2.13).

By contrast, only 61% of investment flowing to the Middle East and North Africa and 50% to Sub-Saharan Africa originated from domestic sources, highlighting the dependency of these markets on international capital.

The COVID-19 pandemic, aggravated by the recent economic and energy crises, has had especially damaging effects on emerging and developing economies in terms of impacts on consumers' income, companies' balance sheets and public finances. This makes it likely that these markets will continue to rely on international public and private funding in the coming years.

**Figure 2.13** Cumulative domestic and international investment in renewable energy, by region of destination, 2013-2020

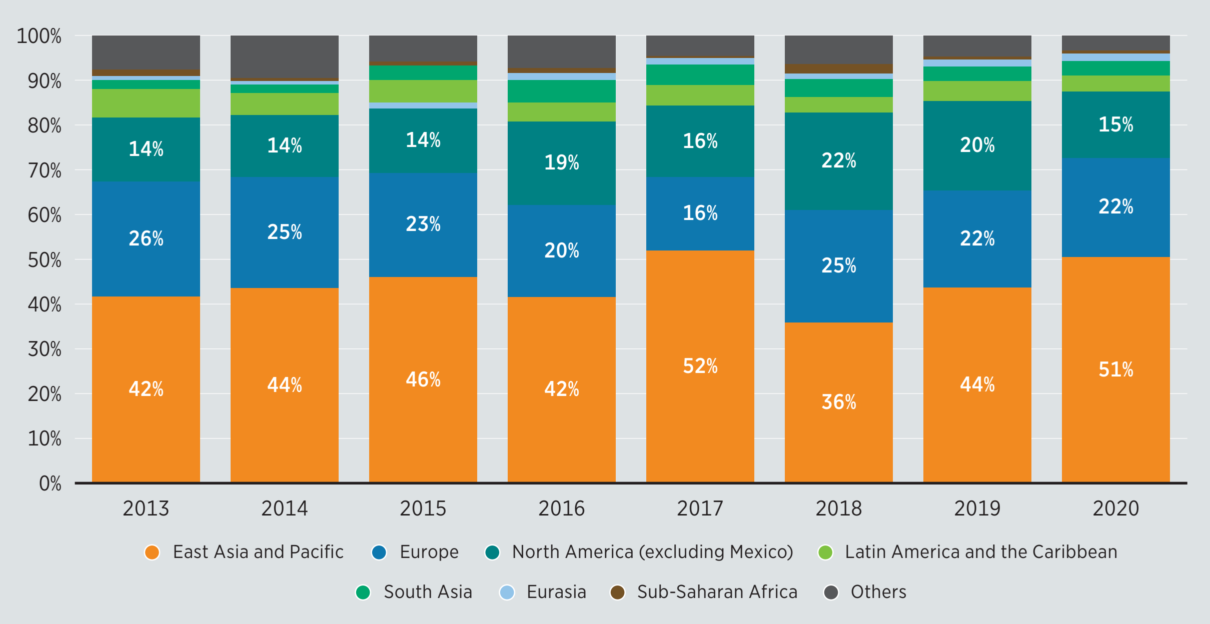



**Note:** "North America (excluding Mexico)" includes Bermuda, Canada and the United States. "Others" include Unknown, Other Oceania, Transregional and Other Asia. For more details on the geographic classification used in the analysis, please refer to the methodology document (Appendix).

**Source:** CPI (2022a).

Given the prevalence of domestic investments, the distribution of renewable energy investment by source region matches the distribution by target region (Figure 2.14). The East Asia and Pacific region invested most heavily, accounting for 44% and 51% of total investments in 2019 and 2020, respectively. China alone provided 82% (2019) and 79% (2022) of this. Next were investors based in Europe (providing 22% of investments in 2019 and 2020) and in North America (excluding Mexico) (20% in 2019, 15% in 2020).

**Figure 2.14** Investment in renewable energy by region of origin, 2013-2020

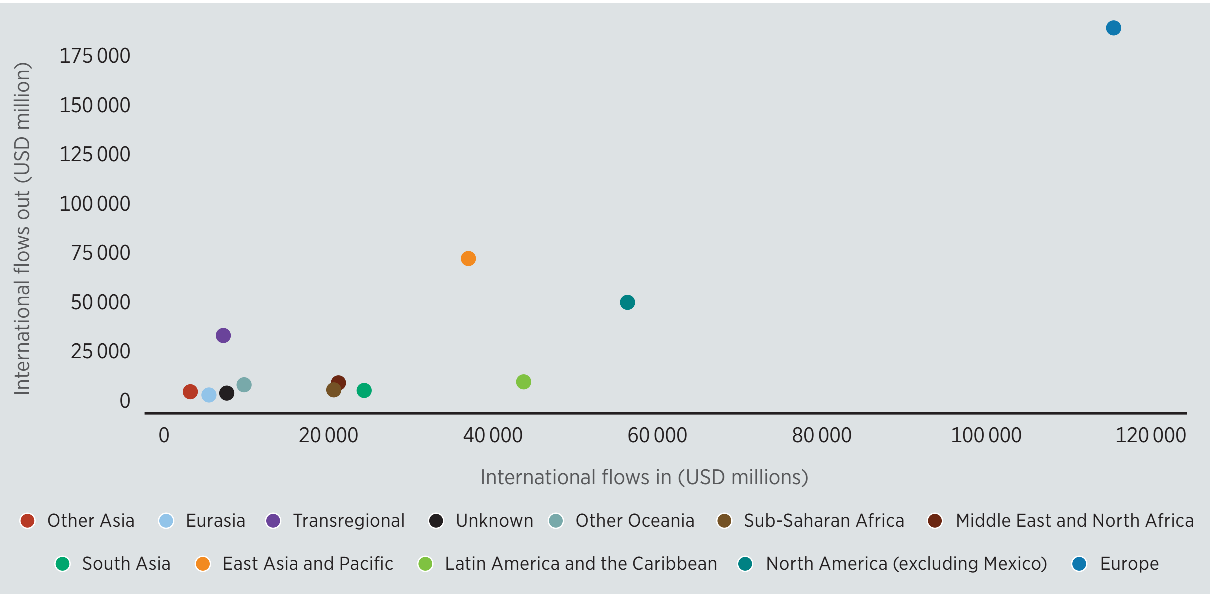



**Note:** "North America (excluding Mexico)" includes Bermuda, Canada and the United States. "Others" include Unknown, the Middle East and North Africa, Other Oceania, Transregional and Other Asia. For more details on the geographic classification used in the analysis, please refer to the methodology document (Appendix).

**Source:** CPI (2022a).

**When looking at international flows of finance, the largest amount of financing flows between countries within Europe.** As can be seen in Figure 2.15, there is a robust cross-border market on the continent. Europe also invests heavily in other regions, namely North America (excluding Mexico) and Latin America and the Caribbean.

**Figure 2.15** Regional providers and receivers of international renewable energy investments, 2013-2020




**Source:** CPI (2022a).

## 2.4 Investments by financial instrument

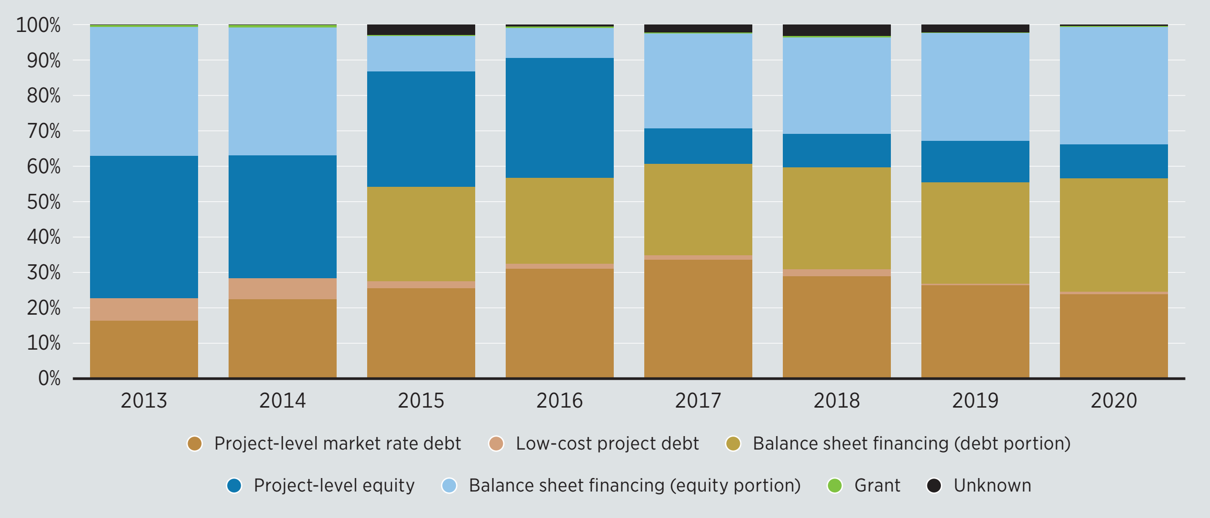
This analysis considers three types of financial instruments: project-level financing (debt and equity), balance sheet financing (debt and equity) and grants.[6]

The **share of equity financing** fell from 77% in 2013 to 43% by 2020, globally. Therein, balance sheet financing (equity portion) accounted for 55% of equity investment, on average, while project-level equity averaged 45% over the period (see Figure 2.16). Conversely, the **share of debt financing** increased – from 23% in 2013 to 56% in 2020. This is likely linked to the maturation and consolidation of major renewable technologies such as solar PV and onshore wind that are able to attract high levels of debt, as lenders are able to envision regular and predictable cash flows over the long term, facilitated by power purchase agreements (PPAs) and other policy support (*e.g.* FiTs) in many countries. Going forward, widespread mobilisation of low-cost debt will be critical for deployment of capital-intensive renewable energy projects, while equity financing will also remain key, particularly to kickstart relatively less mature technologies, and finance projects in relatively high-risk or credit-constrained contexts.

In terms of financing structures, **project financing** has been declining since 2013, while **balance sheet financing** has shown growth in recent years. The share of project equity fell from 40% in 2013 to 10% in 2020 while the debt and equity portions of balance sheet financing constituted 30% and 31%, respectively, of total commitments by 2020. Project finance transfers risks from the lender to the project developer and insurance structures through non-recourse financing, based on the projected cash flow of the project over a specific period. Balance sheet finance, on the other hand, involves using retained earnings from business activities to finance assets on a company's balance sheet, an indication of the extent to which a company self-finances its assets. As the renewable energy sector has matured, and project developers have grown their portfolios, balance sheet financing has become a viable structure when the cost of non-recourse finance becomes more expensive, and risks are well understood and mitigated. It also allows the company to transfer gains to equity shareholders.

[6] *Project-level financing: debt or equity investment relying on a project's cash flow for repayment. Balance sheet financing: direct debt or equity investment in a recipient entity by a company or financial institution. Grants: transfers made in cash, goods or services for which no repayment is required.*

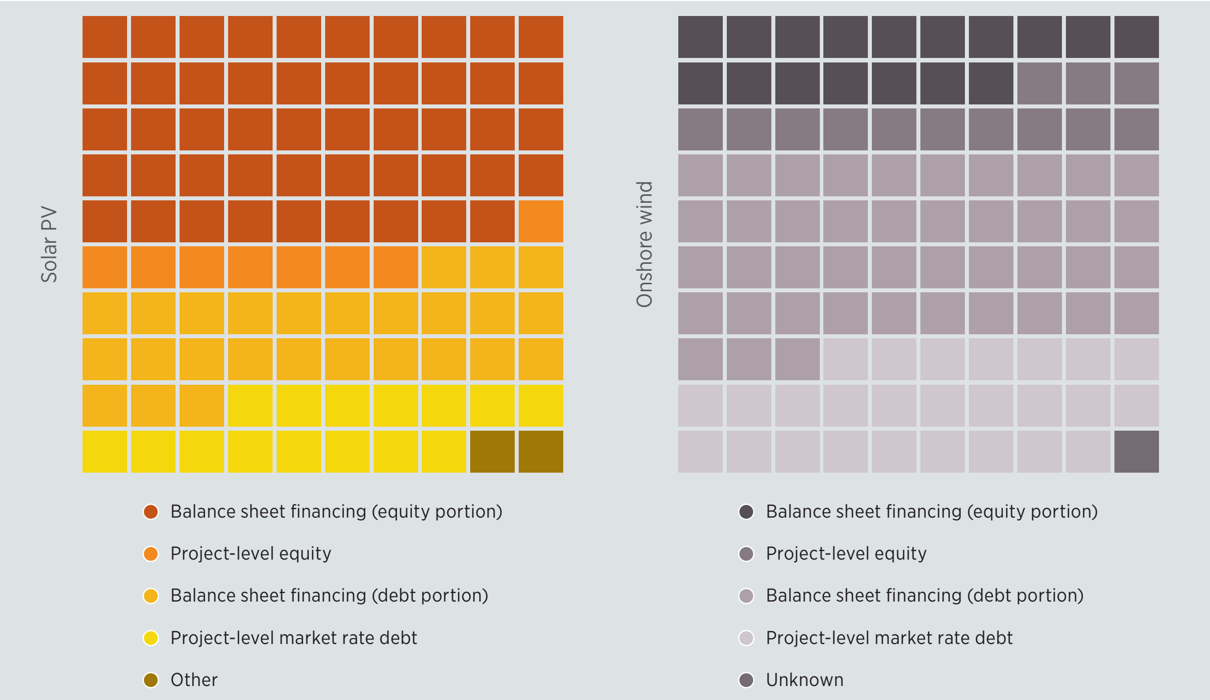
**Figure 2.16** Investment in renewable energy, by financial instrument, 2013-2020




**Source:** CPI (2022a).

In 2019/2020,[7] over half of solar PV investment (57%) was channelled via equity while investment in onshore wind was still dominated by debt (69%) (see Figure 2.17). The lower share of equity in onshore wind relative to solar PV could relate to the larger role played by state-owned financial institutions in developing wind projects – such institutions generally prefer debt lending.

**Figure 2.17** Solar PV and onshore wind investments by instrument, 2019/2020 average




**Note:** 1 square = 1%; PV = photovoltaic. "Other" includes unknown + the negligible amounts of grant/low-cost project debt.
**Source:** CPI (2022a).

[7] *There was no significant change between 2019 and 2020 in the distribution of financial instruments by technology; therefore, the average over the two years has been used.*

The share of **concessional finance (grants and low-cost project debt[8])** remained small, accounting for only 1% of total renewable energy finance in 2020. Scarce concessional finance – most often provided by governments and multilateral, bilateral or national DFIs – is not making its way to less mature markets, which means the energy transition is not able to advance in many developing countries (Chapter 4).

Governments provided the majority of grant-based finance (55%), with DFIs together contributing 93% of total low-cost project debt committed for renewable energy between 2013 and 2020. Of the concessional finance that could be tracked to specific countries, 68% was directed to low- and lower-middle-income countries.[9] Within that pool of grants and low-cost debt, 30% flowed to the least-developed countries.[10] It is now widely acknowledged that blended finance – the strategic use of concessional finance to mobilise additional private capital – is a key tool for easing investor concerns and supporting long-term market growth, especially for more niche, less commercial renewable energy technologies (Mutambatsere and de Vautibault, 2022). Indeed, DFIs (particularly multilateral development banks) have an important role to play in de-risking renewable energy projects for new markets or technologies. This topic is discussed in Chapter 4.

Among regions, Latin America and the Caribbean had the largest share of concessional finance (37%); other developing regions had a more even spread. The share of low-cost project debt was also largest in Latin America and the Caribbean (43% of total low-cost debt), while Sub-Saharan Africa received the most grant financing (29% of total grants between 2013 and 2020). These regional trends are explained by the relative dominance of DFIs providing low-cost debt in Latin America, and a mix of DFIs and governments providing grants in Sub-Saharan Africa. Grant finance is essential for building a pipeline of bankable projects, helping projects reach a level of maturity that might attract investors, launching pilot projects, as well as helping to fund non-profit-driven activities such as geothermal exploration drilling or the decommissioning of fossil fuel plants (IRENA, 2016a).

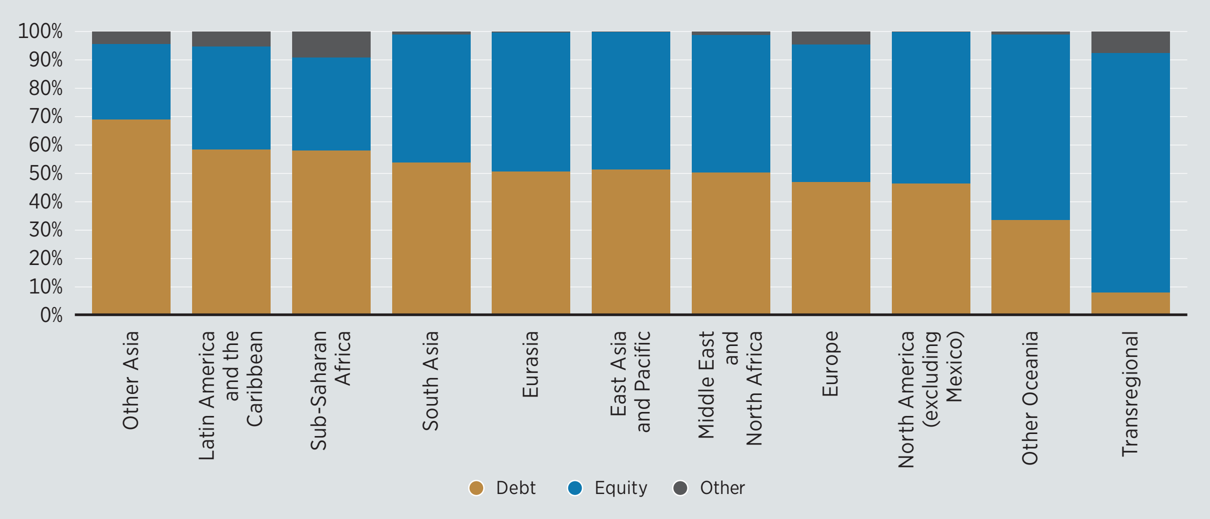
Looking at all financial instruments (concessional and non-concessional) by region, public spending (particularly multilateral development finance – see Section 2.5.2) dominated in most developing markets, hence their higher shares of debt lending. A group of countries in Central Asia – Kazakhstan, Kyrgyzstan and Tajikistan (classified as Other Asia in this report) – had the largest portion of debt lending over the period 2013-2020 (69%), followed by Latin America and the Caribbean and Sub-Saharan Africa (each at 58%) (Figure 2.18). In Europe and North America, on the other hand, private finance dominated (see Section 2.5), with high investment from commercial financial institutions and corporations, resulting in the emergence of equity finance in these regions. Projects tagged as Transregional were heavily dominated by equity investments (85%). Oceania also had a higher proportion of equity investments than other regions (65%), due to the relatively larger role of households and individuals in financing renewable energy.

*[8] Low-cost project debt refers to debt with interest rates lower than the market rate, and longer loan tenor to provide project developers with more time for repayment. Whether debt is considered low-cost or market-priced is determined by data providers in this analysis.*

*[9] As per the World Bank's (2021) country income classification.*

*[10] As per the United Nation's list of least-developed countries.*

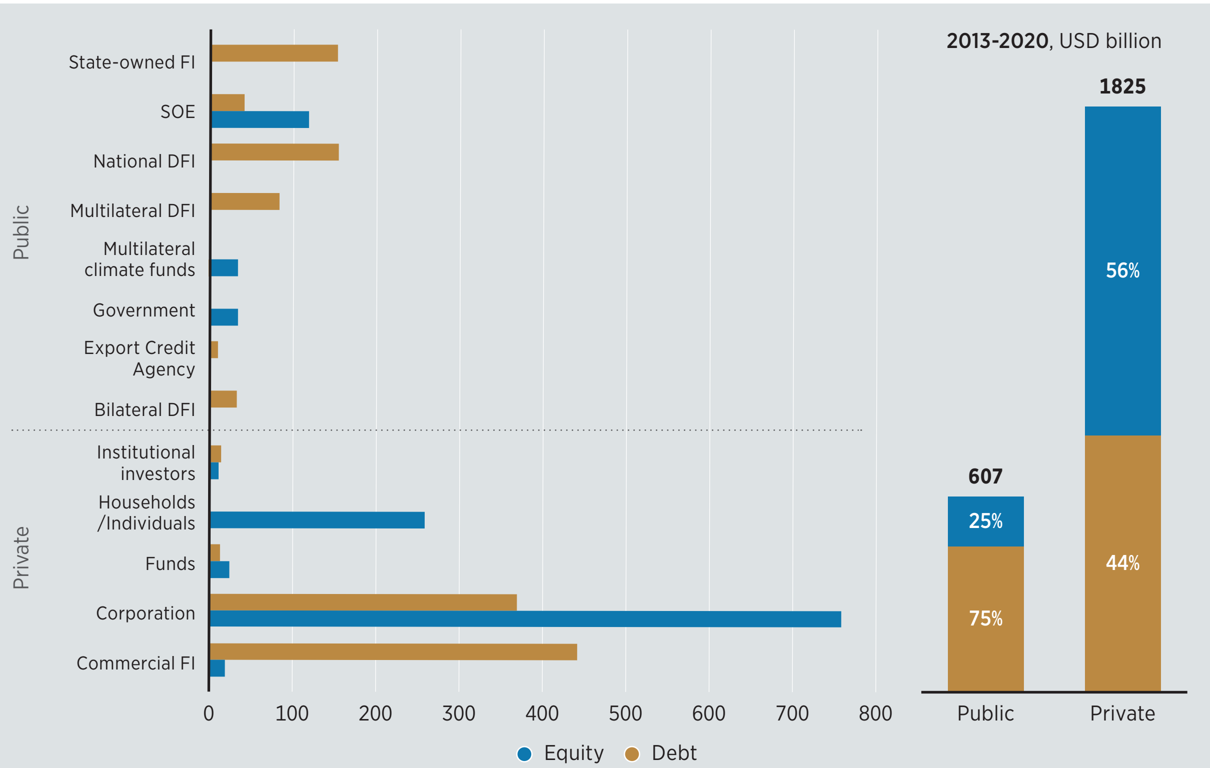
**Figure 2.18** Renewable energy investment by region and type of investment (debt vs. equity), 2013-2020




**Source:** CPI (2022a).

**Private actors provided the vast majority (87%) of equity financing; the public-private split for debt was more balanced** (see Figure 2.19). Corporations and households/individuals provided a substantial portion of equity financing (together, 83% during 2013-2020) while most debt lending was provided by commercial financial institutions, state-owned financial institutions and multilateral/national DFIs (together providing 63% of debt). Section 2.5 considers investments by source of finance.

**Figure 2.19** Debt and equity investment by type of investor, 2013-2020




**Note:** DFI = development finance institution; FI = finance institution; SOE = state-owned enterprise.
**Source:** CPI (2022a).

Innovative, context-specific instruments and financing structures are needed to scale up and accelerate investment in renewable energy and address investment barriers, especially in regions and technologies still perceived as risky. These are discussed in Chapter 4.

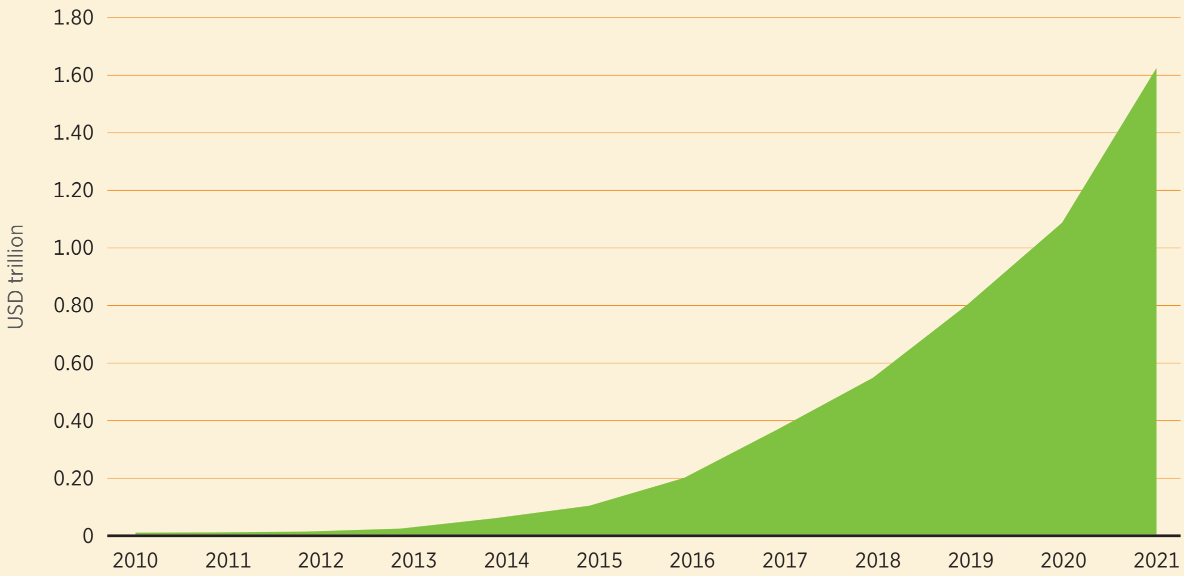
The market for fixed-income securities is also expanding and holds great potential for channelling considerable capital into energy transition–related technologies, including renewable energy. These types of instruments, including green, social, sustainable and sustainability-linked bonds, are discussed in detail in the deep dive Section on sustainable fixed income market.

## Deep dive: Sustainable fixed-income market

The fixed-income market has enormous potential to redirect global capital towards addressing climate-related challenges. Estimated to hold about USD 123 trillion of assets as of the end of 2020, with annual long-term issuances of about USD 27 trillion (SIFMA, 2021), fixed-income securities can go a long way towards meeting the capital requirements of the global energy transition.

Already a widely known instrument in the financial industry, **green bonds** have experienced significant growth over the past decade (about 103% a year in 2011-2021), increasing from about USD 800 million of issuances in 2007 to about USD 545 billion of issuances in 2021 – an all-time annual high despite pandemic-induced economic challenges. The cumulative value of green bond issuances broke the USD 1 trillion threshold at the end of 2020 and stood at about USD 1.64 trillion as of the end of 2021 (Environmental Finance, 2022b) (Figure 2.20).

**Figure 2.20** Green bonds' cumulative issuances, 2007-2021




**Source:** Environmental Finance (2022b).

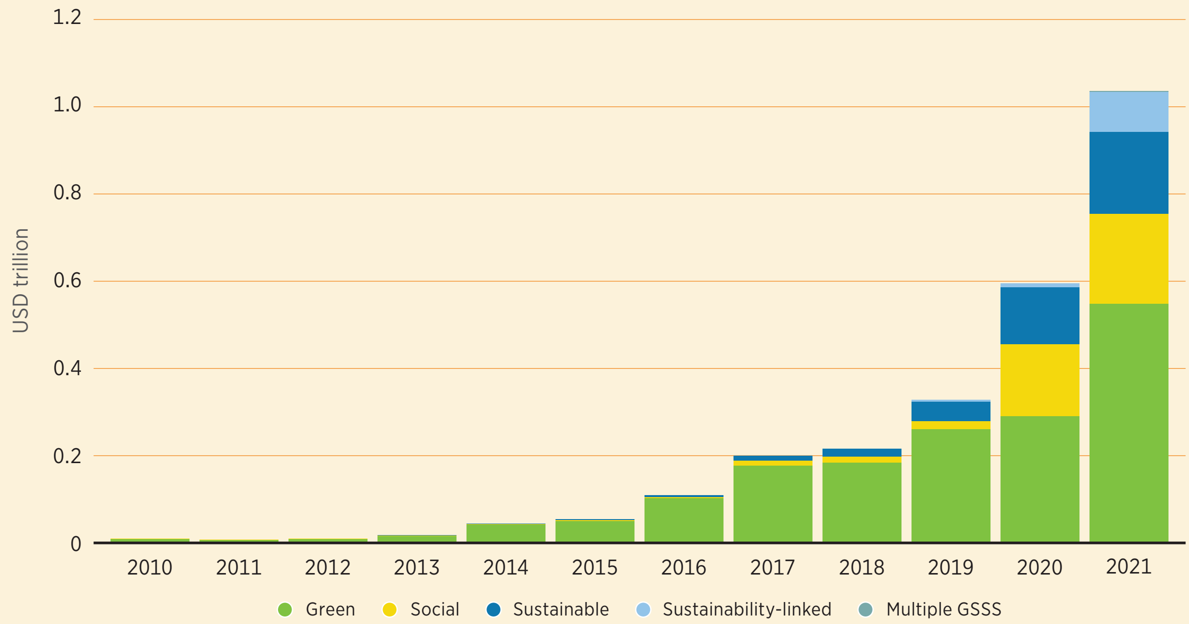
In addition to the growth in the amount of capital raised, the green bond market has greatly diversified in terms of types of issuers, markets' geographic reach, as well as the number of use-of-proceeds categories. Early on, green bonds were almost entirely supported by development banks, such as the European Investment Bank and the International Financial Corporation, which remain important in regions new to green bonds. But the instrument quickly evolved. Corporates now dominate issuances (accounting for 37% of cumulative issuances in 2007-2021), followed by financial institutions (22%), agencies (17%), sovereigns (10%), development banks (8%) and municipal issuers (7%). In terms of its geographic reach, the growth in Asia-Pacific has been particularly strong; the region now ranks second in terms of overall cumulative issuances (23% in 2007-2021) – ahead of North America (22%), but behind Europe (45%).

Renewable energy continues to dominate the use-of-proceeds categories for green bonds. About 62% of all green bond issuances (in USD, 2007-2021) include renewable energy, while about 15% of green bonds are earmarked solely for renewable energy, followed by green buildings (11%) and clean transport (5%) (Environmental Finance, 2022b).

In addition to green bonds, other forms of sustainable fixed-income offerings are becoming increasingly common in the financial market. **Green, social, sustainable and sustainability-linked bonds (GSSS bonds)** reached a cumulative value of about USD 2.6 trillion as of the end of 2021. **Green bonds** account for the largest share of the market (63% of cumulative issuances), followed by social bonds (17%), sustainable bonds (16%) and sustainability-linked bonds (4%). In terms of annual issuances, green bonds recorded USD 545 billion in 2021, followed by USD 207 billion worth of issuances for social bonds, USD 190 billion for sustainable bonds, USD 92 billion for sustainability-linked bonds and another USD 2 billion for bonds that span multiple GSSS categories (Figure 2.21). This represented an annual record for the GSSS market, which grew by 74% from 2020 to 2021 (Environmental Finance, 2022b).

Even in emerging and developing markets the growth has been surprisingly positive. While they still lag behind the annual and cumulative issuances of developed economies of Europe, Asia-Pacific (mostly China) and the Americas, issuances of GSSS bonds in emerging and developing economies reached USD 159 billion, nearly triple the 2020 volume (Amundi and IFC, 2022).

**Figure 2.21** GSSS bonds' annual issuances, 2007-2021




**Note:** "Multiple GSSS" refers to bonds deemed to belong to multiple GSSS categories at the same time (*i.e.* green and social bond, social and sustainability-linked bond, *etc.*)
**Source:** Environmental Finance (2022b).

**Social bonds** are intended to finance activities that support positive social outcomes, such as affordable housing and access to essential services, including basic infrastructure and food security. Sometimes aligned with the Social Bond Principles of the International Capital Markets Association (ICMA), social bonds are often aimed at disadvantaged segments of the population – those living below the poverty line, minorities, displaced persons and people with disabilities, among others. Over 2 900 social bonds had been issued by the end of 2021, with an estimated value of about USD 427 billion, predominantly by development and multilateral banks, such as the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, New Development Bank and International Finance Corporation (Environmental Finance, 2022b). Among countries, France in particular has been active in this segment with large issuances from banks, such as Société Générale and Crédit Agricole, for example, as well as its government agencies, such as Unédic, the French unemployment agency, and Caisse d'Amortissement de la Dette Sociale (CADES) that issues social bonds to help finance the French social security system (NatWest, 2022).

In the past few years, COVID-related bonds have focused on those most negatively affected by the pandemic. A notable example is the European Commission's issuance of social bonds under the Support to mitigate Unemployment Risks in an Emergency (SURE) programme, intended to support short-term employment schemes in EU member states. From October 2020 until May 2021, the Commission issued EUR 89.64 billion of social bonds in seven issuances, making this the world's largest social bond scheme, with plans for further issuances up to the total limit of EUR 100 billion (EU, 2022).

**Sustainability bonds** typically finance activities that support both social and green outcomes and are aligned with ICMA's Sustainability Bond Guidelines. Over 2 700 sustainability bonds were issued by the end of 2021, with an estimated value of about USD 405 billion (Environmental Finance, 2022b). The most common issuers are development banks, in particular the International Bank for Reconstruction and Development (the lending arm of the World Bank Group), the European Investment Bank and the Asian Infrastructure Investment Bank (Environmental Finance, 2022b). Among countries, the United States is particularly active in this segment, mostly through government agencies, such as the New York State Housing Finance Agency, which has issued sustainability bonds to raise capital for the development of affordable housing in the state.

**Sustainability-linked bonds** link the bond's coupon (annual or semi-annual fixed payment to the bond holder) to the issuer's achievement of selected sustainability goals. For example, the issuer may set a target to lower its greenhouse gas emissions, its water use or its waste, by a certain percentage as of a specific deadline, and in the event the target is not achieved the coupon payment is increased by a pre-specified amount. Italian energy producer Enel issued the first sustainability-linked bond in 2019 (raising USD 1.5 billion from institutional investors), which had a condition that Enel would meet a target of having 55% of its installed electricity capacity supplied by renewables by 2021; if the target went unmet, the coupon was to increase by 25 basis points (or 0.25%) (Enel, 2019). Almost entirely issued by corporations and as a relatively new addition to the GSSS market, sustainability-linked bonds have just crossed the USD 100 billion threshold in terms of cumulative notional spread over 190 issuances as of the end of 2021 (Environmental Finance, 2022b).

In addition to long-term fixed-income market instruments like GSSS bonds and loans, **short-term debt** instruments present another capital pool that can help finance the energy transition. Valued at about USD 55 trillion globally, short-term debt can be used for pre-financing or the operating expenditures of companies and includes instruments such as credit facilities, short-term bank loans, export finance and letters of credit, among others (CBI, 2022).

Growing the GSSS market further requires co-ordinated actions and supportive policies to accelerate the momentum of green finance. These include:

- Sustained government support and incentivisation of sustainable finance initiatives, such as clear and long-term climate-aligned programmes and budgets, provision of financial help to cover higher transaction costs incurred by the issuers of green instruments and lower capital requirements for green debt/loans, as well as having government bodies themselves actively issue green debt instruments of various forms.

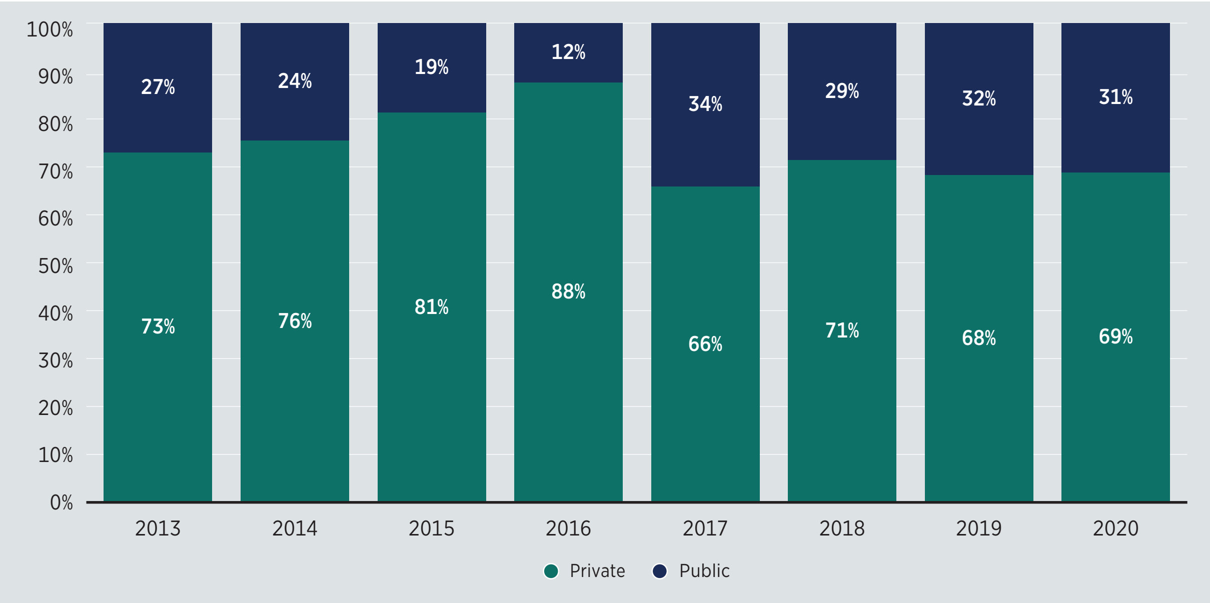
- Continuous active involvement by development banks in kick-starting GSSS bonds in markets where their issuances are still lagging, via demonstration issuances, co-issuances and provision of seed capital, as well as provision of financial and technical assistance to new GSSS issuers. For development banks to de-risk projects using risk mitigation instruments continues to be crucially important to help build a pipeline of bankable green assets.

- Greater efforts among industry participants to adopt rigorous and best practices in the issuance of GSSS instruments, including third-party verification and certification, proper ring-fencing of the capital raised, and reporting on capital u se and environmental/social benefits.

## 2.5 Investments by source

In 2020, the private sector continued to provide the lion's share of investments in renewable energy, committing USD 240 billion (or 69% of the global total), a 7% increase compared to 2019. Public-sector finance provided USD 108 billion in the same year (31% of the total), 2% less than in 2017-2019 (Figure 2.22).

**Figure 2.22** Public and private investment in renewable energy, 2013-2020

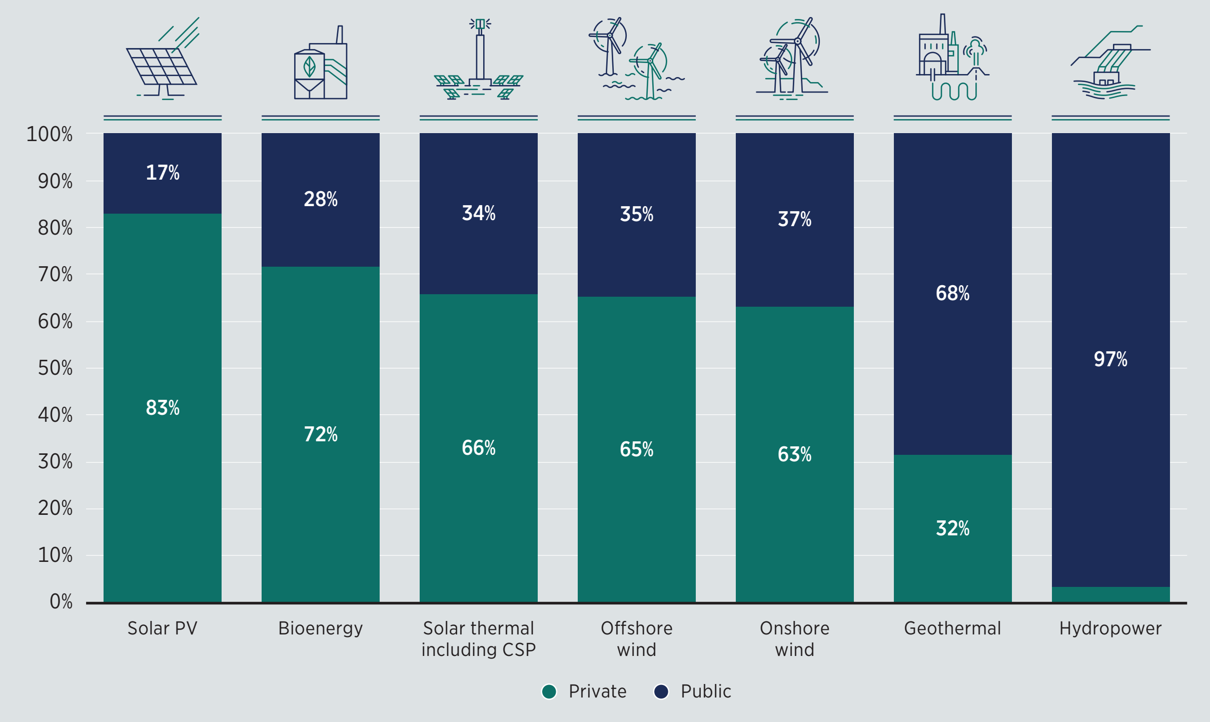



**Source:** CPI (2022a).

The global share of public versus private investments varies by technology. Typically, lower shares of public finance are devoted to renewable energy technologies that are commercially viable and highly competitive, which makes them more attractive for private investors. Thanks to supportive policies, in 2020, solar PV was able to attract private finance amounting to 83% of total commitments (Figure 2.23). A relatively high share (72%) of private participation was also found in bioenergy (*i.e.* biomass and biofuels). Although more than 60% of onshore and offshore wind is financed by private investors, public finance continues to play a large role in promoting these technologies. One possible explanation for this trend is the concentration of wind investment in China, most of it from state-owned financial institutions and state-owned enterprises (Section 2.5.2).

At the other end of the spectrum, geothermal and hydropower receive the largest shares of public finance; only 32% and 3% of investments, respectively, came from private investors in 2020. A larger need for public finance in hydropower is linked to large upfront investments (over a billion dollars), high construction risks, the need for long-tenor loans (as projects can take over a decade to complete), complex and lengthy permitting procedures, and high costs and social and environmental risks, all of which can significantly hamper the ability of private sector investments to finance large hydropower projects (IRENA, 2023).

**Figure 2.23** Share of public/private investments by renewable energy technology, 2020



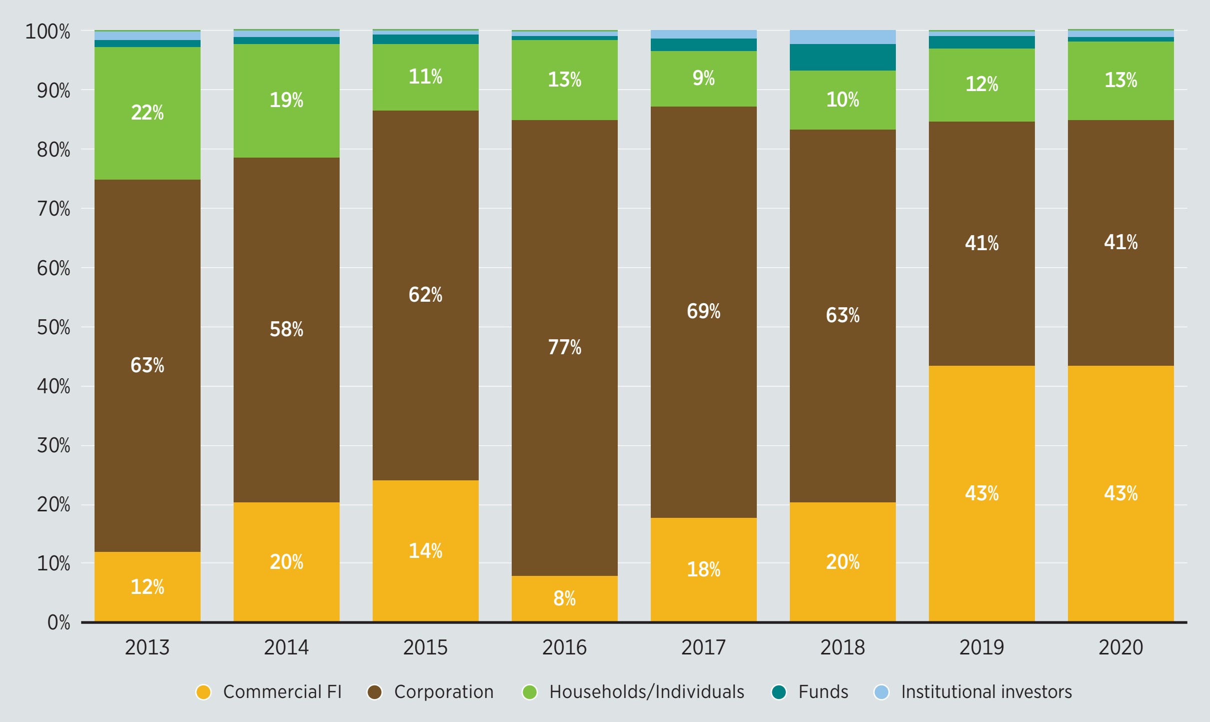

**Note:** No investments in marine technologies in 2020 were captured in the data. CSP = concentrated solar power; PV = photovoltaic.
**Source:** CPI (2022a).

### 2.5.1 Private investments

In 2020, **commercial financial institutions and corporations** continued to be the main private sector providers, together accounting for 85% of total private finance for renewables. In absolute amounts, commercial financial institutions committed USD 104 billion (6% more than in 2019), while corporations invested USD 99 billion (up 7%). Up until 2018, private investments came predominantly from corporations (on average, 65% during 2013-2018), but in 2019 and 2020 corporations' share decreased to 41% per year, while a higher share of investments was filled by commercial financial institutions (43%) (Figure 2.24). This was mainly due to a rise in these institutions' commitments to onshore wind and solar PV in the United States and onshore wind in China, coupled with a drop in commitments made by corporations in solar PV in China.

**Households and individuals** accounted for 13% of private renewable energy investments, providing USD 32 billion per year in 2020 (up from USD 26 billion in 2019). Investments by households and individuals were concentrated on solar PV (85% in 2020) with the rest being invested primarily in solar water heaters (15%). Households in many countries are increasingly favouring rooftop solar PV systems, driven by the falling costs of solar PV, and high and/or rising residential electricity prices (Taylor, 2022). In Australia, for instance, more than 30% of all homes had installed a rooftop solar PV system with 3 million systems installed countrywide by early 2022 (Government of Australia, 2022). The country now has the highest solar PV capacity per capita, globally (IRENA, 2022d; World Bank, n.d.).

**Figure 2.24** Private investment in renewable energy by investor, 2013-2020




**Note:** FI = finance institution.
**Source:** CPI (2022a).

**Households and individuals** also play an important role in financing direct applications of renewable energy. In 2020, they provided close to one-third of total renewable energy financing for end uses, with the remaining two-thirds being provided by governments and corporations.

The role of **institutional investors**[11] in providing direct financing for new renewable energy assets remained limited. In 2020, they accounted, on average, for only 1% of private investments in renewables, providing USD 2.5 billion. This represented a 26% increase compared to 2019 (USD 2 billion), but a 41% drop over the average USD 4.3 billion invested in 2017-2018.

When investing in renewables, institutional investors generally show a preference for more established technologies such as solar PV and onshore wind – which, together, accounted for 74% and 84% of their investments in 2019 and 2020, respectively. Over half of the investments made in the two years 2019-2020 was concentrated in the United States (USD 1.3 billion), followed by China (USD 495 million) and Sweden (USD 334 million). Box 2.3 provides a deep dive analysis into the role of institutional investors and funds in driving private finance into the renewable energy sector.

[11] *Institutional investors here include pension funds, insurance companies, endowments and foundations, sovereign wealth funds, asset managers and investment companies; this differs from the definition used in Box 2.4.*

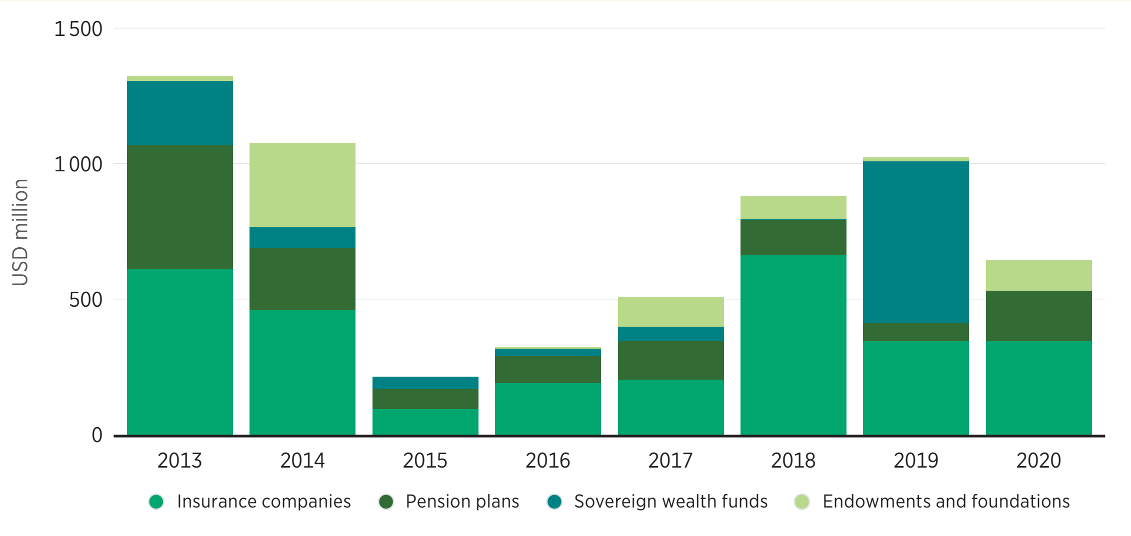
## Box 2.3 The role of institutional investors

The success of the energy transition depends on the renewable energy sector's ability to attract capital flows in unprecedented amounts. Institutional investors[a] in particular can play a pivotal role in this regard.

While already vast, the asset base of institutional investors continues to grow, thanks largely to the growth of stock markets over the past few years. IRENA's (2020) analysis of over 5 800 investors belonging to a "core" group, composed of pension funds, insurance companies, sovereign wealth funds, and endowments and foundations, estimated their assets at about USD 87 trillion (2018-2019 average) (IRENA, 2020c). This number has since grown by about USD 20 trillion to reach **USD 107 trillion**. Pension plans are estimated to have grown their assets from USD 44 trillion in 2018-2019 (annual average) to about USD 56.5 trillion in 2021 (Thinking Ahead Institute, 2019, 2022). Insurance assets grew from USD 33 trillion in 2018-2019 to about USD 40 trillion in 2020 (Statista, 2022; Thinking Ahead Institute, 2019). Similarly, the 100 largest sovereign wealth funds grew from USD 8 trillion in 2018-2019 to about USD 10 trillion as of mid-2022 (SWFI, 2022). Endowments and foundations hold another USD 1.2 trillion of assets (SWFI, 2022).

In terms of their direct financing of renewable energy projects, however, activities of the "core" group of institutional investors remained relatively subdued. While annual investment in renewable energy projects has hit one record high after another over the past few years, reaching USD 347 billion in 2020 and an estimated USD 417 billion in 2021, direct institutional investments into renewable energy projects hovered at about USD 1 billion per year in the 2013-2020 period – less than 1% of the total investment (see Figure 2.25).

**Figure 2.25** Annual financial commitment in renewable energy projects made by institutional investors, 2013-2020




**Source:** CPI (2022a).

Analysis of institutional investors' behaviour in relation to renewables-based projects reveals a continued preference for "tried and tested" modes of operation. Most institutional investments flow into the developed markets of North America (an average 31% of all institutional investments in renewable projects over 2013-2020), Europe (27%), and East Asia and Pacific (14%), where the real or perceived risks are lower. Such investors continue to seek large transaction sizes to lower their overall transaction costs. These are most often delivered via wind projects (average of 34% for onshore wind and 9% for offshore wind over 2013-2020), followed by solar PV (28%). In terms of investment instruments deployed by institutional investors for direct asset financing, project-level debt is their preferred mode (43% of institutional investments over 2013-2020), followed by project-level equity (33%).

Institutional investors continue to be far more active in the refinancing and acquisition stages of existing renewable energy assets, achieved via instruments like listed common stock shares, bonds (including green and other GSSS [green, social, sustainable and sustainability-linked] bonds, discussed in Box 2.3) or fund shares, to name a few. While refinancing does not provide investment for a new asset, it is still important for the renewables markets as it helps original financiers "recycle" their capital into new renewable projects and may also reduce their overall financing costs. Institutional investors have increased their activities in this later funding stage, accounting for nearly one-quarter of energy project acquisitions and financing in 2019, compared to less than one-fifth in 2010. For renewable energy in particular, this translates to about USD 12 billion invested in 2019 (IEA, 2020). Examples include refinancing of the 588 megawatts (MW) Beatrice offshore wind farm in the United Kingdom and the acquisition of the 402 MW Veja Mate offshore wind farm in Germany (IEA, 2020).

The case for institutional investors to increase their focus on renewable energy investments remains strong and increasingly urgent. Many institutional investors have committed to aligning their assets with global climate targets via a growing number of global alliances, such as the Glasgow Financial Alliance for Net Zero (GFANZ), for example. Renewables continue to hold other important benefits for such investors. In the context of a global economic slowdown, the importance of asset diversification becomes more pronounced, as do concerns about reducing volatility and uncertainty related to fossil fuel prices. Also, the need to preserve long-term value for asset holders through sustainable investments and to address growing public scrutiny of actions to mitigate climate change will only become more pressing over time.

Ramping up institutional investments in renewables continues to depend on lowering barriers to entry to this segment and on co-ordinated action among involved stakeholders. Priorities include:

- Policy makers' continued and transparent support of the integration of renewable energy in overall development and sustainability targets.
- Improved provision of risk mitigation solutions for regions that continue to be seen as high risk. Public capital providers, such as development finance institutions, can play an important role in this regard.
- Adoption of co-financing and blended finance structures that allow for the sharing of know-how and that can also reduce the cost of financing in new markets.
- Continuous creation of bankable green asset pipelines and truly green market instruments that can channel institutional capital towards renewable assets (*e.g.* listed equities, indices, funds and fixed income instruments) containing more green (sustainable or ESG [environmental, social and governance]) assets.
- Development of internal expertise for direct investment in projects or indirect investment through green instruments, considering the overall impact of climate change on portfolios.

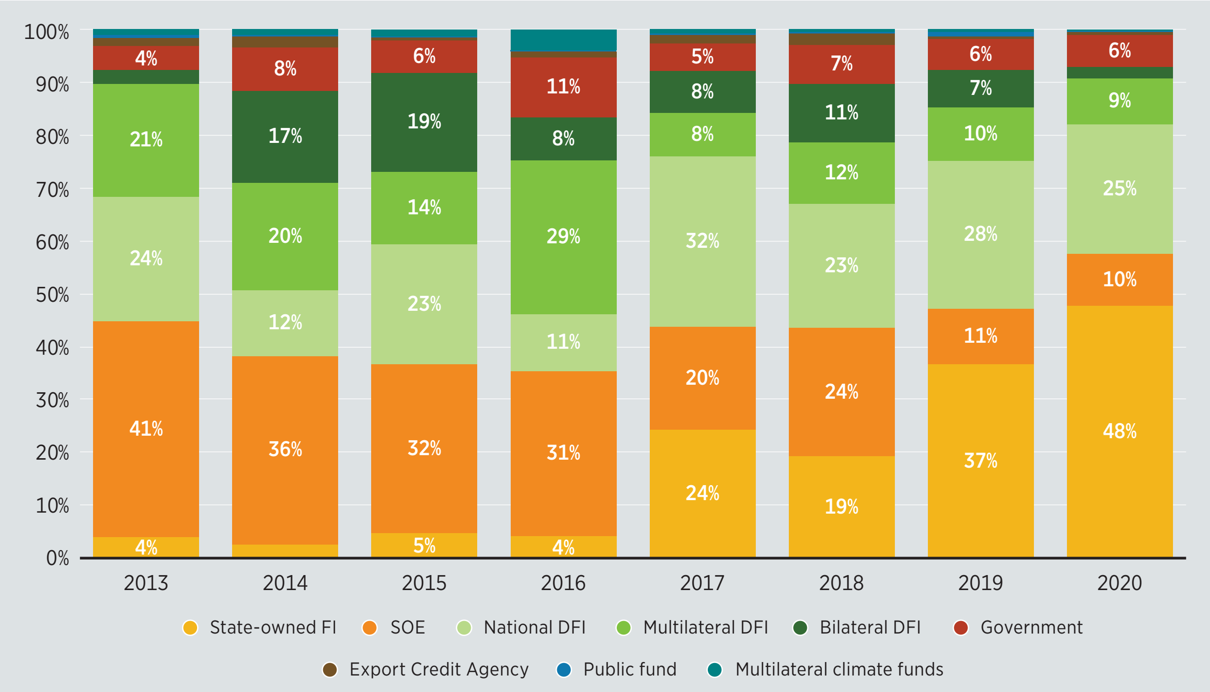
[a] The analysis in this box looks at a "core" group of institutional investors composed of pension funds, insurance companies, sovereign wealth funds, and endowments and foundations. It excludes asset managers and insurance companies.

### 2.5.2 Public investments

To date, only a handful of public financial institutions have committed to aligning their investments with the Paris Agreement. A recent report (CPI, 2022c) analysed the 70 largest public financial institutions representing 95% of the total assets held by public financial institutions (equivalent to USD 20.4 trillion). The report found that only 20 such institutions have set net-zero targets. National and subnational development banks, in particular, lag behind their peers in terms of setting climate finance targets.

In 2020, **public investments** in renewable energy assets totalled USD 108 billion (31% of all investments), up 4% from 2019 (Figure 2.26). Given that the majority of renewable energy investments are made domestically (Section 2.3), and in the absence of any meaningful international collaboration despite pledges such as the USD 100 billion a year made in international forums, it is not surprising that state-owned financial institutions (SOFIs), national DFIs and state-owned enterprises (SOEs) were the main sources of public finance for renewables.

**Figure 2.26** Public investment in renewable energy by investor type, 2013-2020




**Note:** DFI = development finance institution; FI = finance institution; SOE = state-owned enterprise.
**Source:** CPI (2022a).

Funding from **governments** remained stable at USD 6.5 billion in 2020, or 6% of total public finance for renewables. Over half of this (55%) was invested domestically in China for solar water heaters. While governments are not among the main providers of capital for new renewable energy assets, much of their spending goes to fund renewable energy support schemes such as grants and subsidies. This is in addition to the regulated payments – or public PPAs – that are used as the main procurement method in some cases, and that are needed to address inadequate organisational structures (marginal pricing) – both of which are topics beyond the scope of this analysis.[12] Looking at the lifetime public expenditure for PPAs, FiTs, feed-in premiums (FiPs), contract for difference (CfD) schemes, *etc.* would give a more holistic view of governments' role in supporting the deployment of renewables, especially when the tariffs paid to producers – in addition to the cost of running the system - are lower than what is collected by consumers and the difference is paid through a government subsidy (see Section 4.4).

[12] *For more details about the coverage of the database, please see the Methodology document (Appendix).*

In 2020, **state-owned financial institutions (SOFIs)** provided, on average, USD 52 billion (or 48% of total public finance), increasing their commitments by 35% compared to 2019. About 83% of investments from these institutions in 2020 was directed towards projects in China, primarily for onshore wind (42%), solar PV (22%) and offshore wind (19%).

**Commitments from state-owned enterprises (SOEs)** recorded a steep decline in 2019 and 2020, reaching USD 11 billion per year (10% of total public financing), down by 53% compared to the average USD 23 billion invested annually in 2017-2018. Similar to SOFIs, SOEs provided capital almost exclusively for onshore wind (40%, mainly invested in China), offshore wind (30%, mainly in the Netherlands) and solar PV (29%, mainly in China).

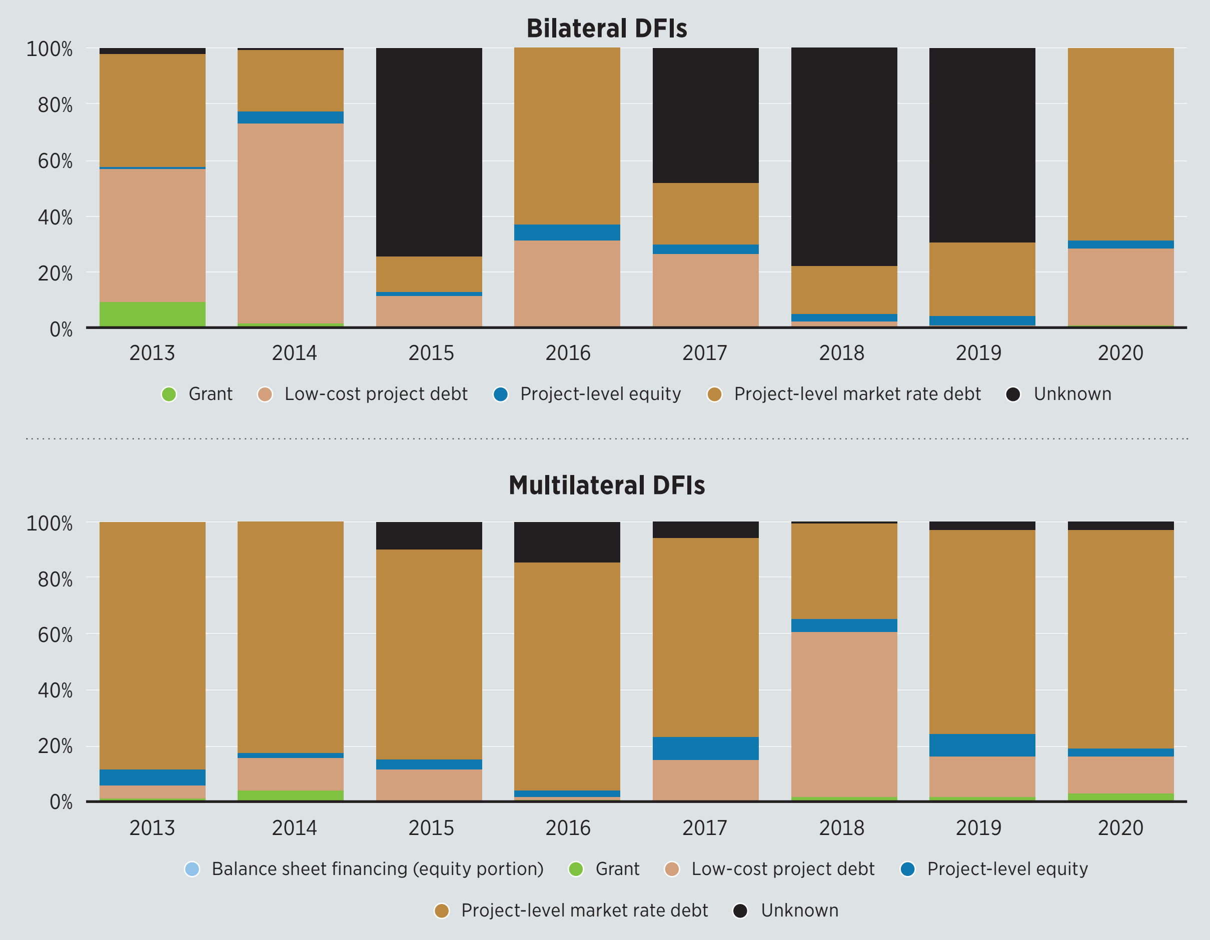
**National DFIs** were the second-largest source of public investment in 2020, providing 25% of the total (or USD 27 billion). Their investments focused on onshore wind projects (49%), hydropower (26%) and solar PV (16%). China Development Bank, alone, accounted for over 90% of the total in 2020, investing primarily in China. National DFIs were the single-largest provider of finance for hydropower projects, accounting for 65% of cumulative investments in this technology during 2013-2020, and 81% of annual investments in 2020. This trend was largely driven by the China Development Bank, which committed USD 5.2 billion and USD 6.9 billion for hydropower projects in 2019 and 2020, respectively, 90% of which were located in China.

**Multilateral DFIs** provided USD 9.4 billion in 2020 (or 9% of total public finance) – in line with their past annual commitments, which fluctuated between USD 8.7 billion and USD 10.7 billion during 2015-2019. These institutions were a key provider of international finance, accounting for about half of international flows coming from the public sector.

Commitments from **bilateral DFIs** in 2020 fell 70% compared to 2019, moving from USD 7.5 billion to USD 2.3 billion. This decline is largely attributable to a 96% decline in international commitments by the German Development Bank (KfW). This drop is remarkable, especially given the need for a steep increase in international collaboration to achieve a just transition (see Chapter 4). Instead, the world is facing a decline even of debt financing (which requires repayment and involves interest rates on top of that).

Governments and international donors play major roles in enabling investments in renewables, especially in developing countries, where real or perceived risks contribute to the high cost of financing or prevent projects from seeing the light of day. In fact, multilateral and bilateral DFIs together accounted for only USD 11.7 billion in 2020. Since grants and concessional loans amounted to 1% of the total renewable energy finance equivalent to USD 5 billion (Section 2.4), this means that even if all concessional financing were to be provided by DFIs, less than half of these funds had positive impacts on the beneficiaries, whereas for more than half, interest rates were as high as the rest of the market. Since the interest rates are the same, the only difference that public financing provides is making finance available, but at the same high costs for users. Figure 2.27 illustrates the portion of DFI funding provided in the form of grants and low-cost debt.

**Figure 2.27** Portion of DFI funding in the form of grants and low-cost debt




**Note:** DFI = development finance institution.
**Source:** CPI (2022a).

The strategic use of public finance remains key for delivering projects that are essential for socio-economic development in contexts where private investors do not venture. Such use of public finance also helps create an enabling environment for private investors in areas where they are active, by developing infrastructure and addressing the risks and barriers that deter private capital. In addition, public funding is needed to implement policies – capacity-building, education, retraining and industrial – that would ensure a just and inclusive energy transition (see Chapter 4).

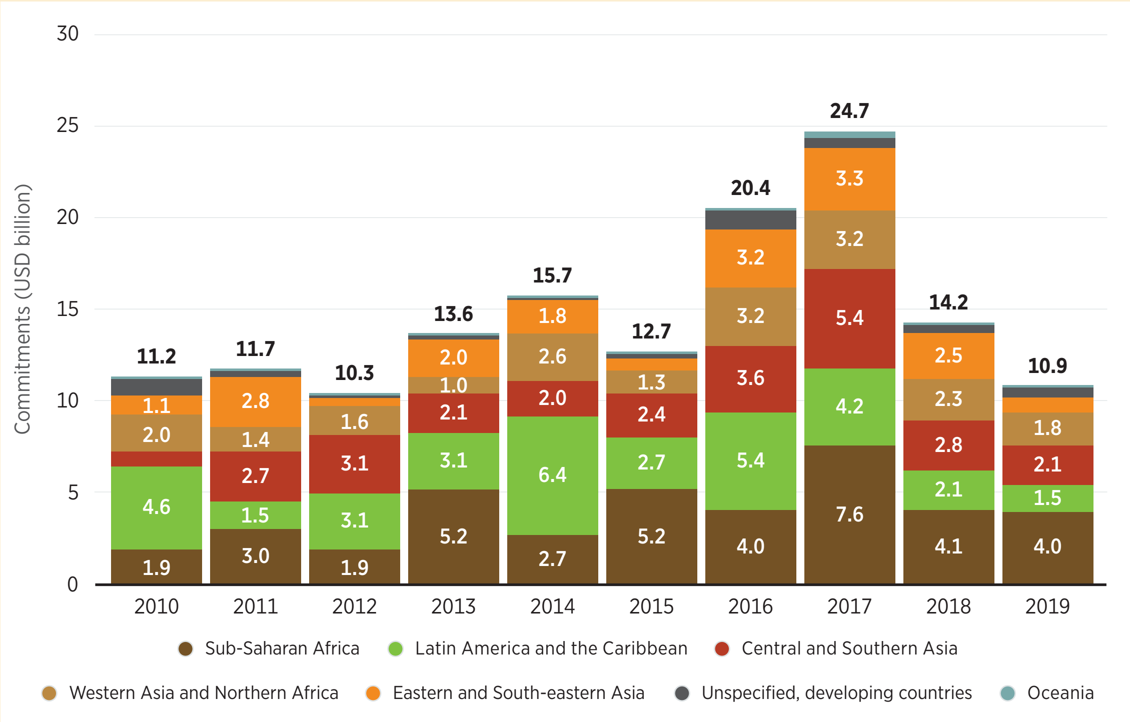
International flows of public finance to the Global South are essential to the 1.5°C Scenario and related socio-economic goals (along with progressive fiscal measures and other government programmes such as distributional policy) (IRENA, 2022a). However, international flows of public finance have been in decline since 2018. Box 2.4 provides a deep dive into international public finance flows to developing countries in support of renewable energy, as tracked by IRENA and the OECD.[13]

[13] *IRENA and the OECD have been appointed to track annual progress towards SDG indicator 7.a.1 on "measuring international financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems". Data for 2020 will be presented in the upcoming report Tracking SDG7: The Energy Progress Report 2023.*

## Box 2.4 International public finance flows to developing countries in support of renewable energy

International public financial flows to developing countries in support of clean energy decreased in 2019 for the second year in a row, falling to USD 10.9 billion. This level of support was 23% less than the USD 14.2 billion provided in 2018, 25% less than the 2010-2019 average, and less than half of the peak of USD 24.7 billion in 2017. Except for large fluctuations in 2016 for solar energy and 2017 for hydropower, flows have remained within the range of USD 10-16 billion per year since 2010 (Figure 2.28). A five-year moving average trend shows that average annual commitments decreased for the first time since 2008 by 5.5%, from USD 17.5 billion in 2014-2018 to USD 16.6 billion in 2015-2019. The level of financing remains below what is needed to reach Sustainable Development Goal (SDG) 7, in particular for the least-developed countries (LDCs), landlocked developing countries and small-island developing states.

**Figure 2.28** Annual international public financial commitments to developing countries in support of renewable energy production, and research and development, by region, 2000-2019




**Notes:** Multiple/other renewables include commitments whose descriptions are unclear in the financial databases; commitments that target more than one technology with no details specifying the financial breakdown for each; bioenergy commitments, which are almost negligible; multi-purpose financial instruments such as green bonds and investment funds; and commitments targeting a broad range of technologies. Examples of the latter include renewable energy and electrification programmes, technical assistance activities, energy efficiency programmes and other infrastructure supporting renewable energy.

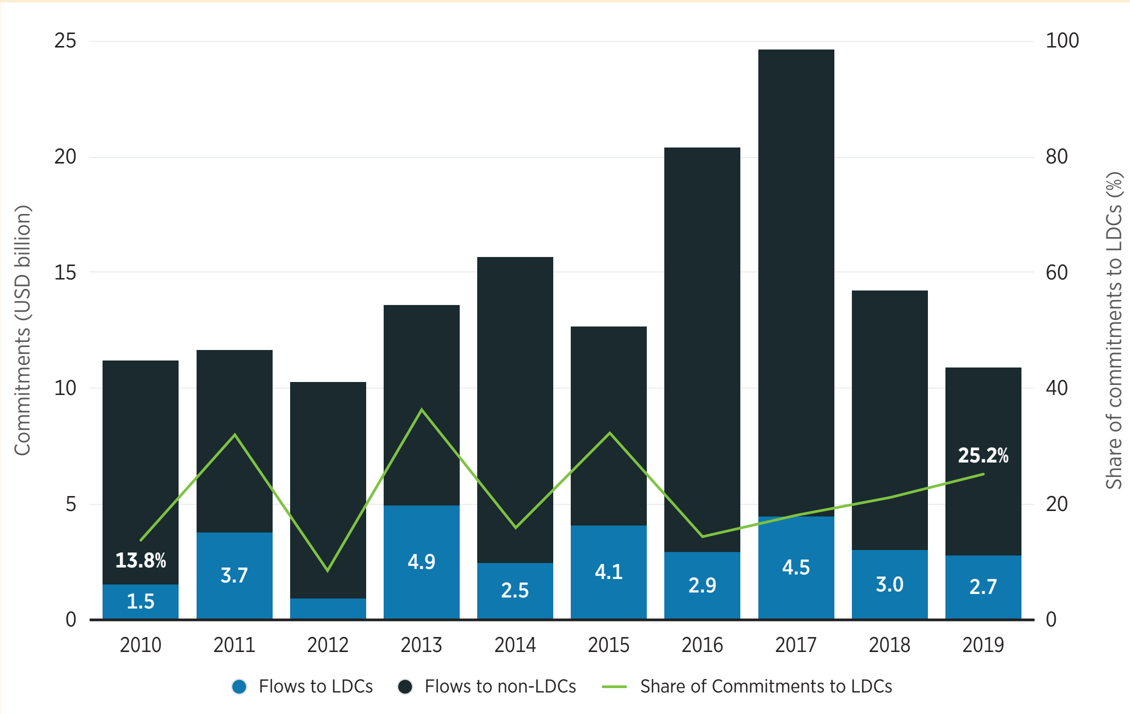
**Source:** IEA *et al.* (2022).

Geographically, most regions saw a decrease in international public flows in 2019. Flows increased only in Oceania, where they rose by 72% (USD 55.1 million). Decreases were less significant in Sub-Saharan Africa, where they fell 1.7% to USD 4.0 billion. Flows to Western Asia and Northern Africa decreased by 22% to USD 1.8 billion. The bulk of decreases were concentrated in Eastern and Southeastern Asia, where they fell 66%; Latin America and the Caribbean, where they dropped by 29.8%; and Central and Southern Asia, where they declined by 24.5%.

In 2019, 24 countries received 80% of all commitments. Nigeria, Guinea and India were the top recipients, attracting one-quarter of total commitments. Guinea was also a top recipient in 2018, thanks to a USD 1.1 billion commitment to the Souapiti Hydro Project.

It is also important to highlight the difference in flows directed to emerging markets in developing countries and those furthest behind, as categorised by the United Nations. In 2021, the same countries belonged to the groups of LDCs, landlocked developing countries and small-island developing states, but commitments directed to these countries varied widely by group (Figure 2.29). The LDCs received 25.2% of commitments in 2019, an increase from 21% in 2018, continuing an upward trend since 2016 but masking a 9% decrease from USD 3.0 billion to USD 2.7 billion in absolute amounts. Among the 46 LDCs, São Tomé and Príncipe, Eritrea and Kiribati were the only ones that did not receive any flows in 2019. Chad and Timor-Leste did receive funding in 2019, after receiving no commitments in 2018.

**Figure 2.29** Annual commitments to LDCs and non-LDCs in support of renewables, 2010-2019

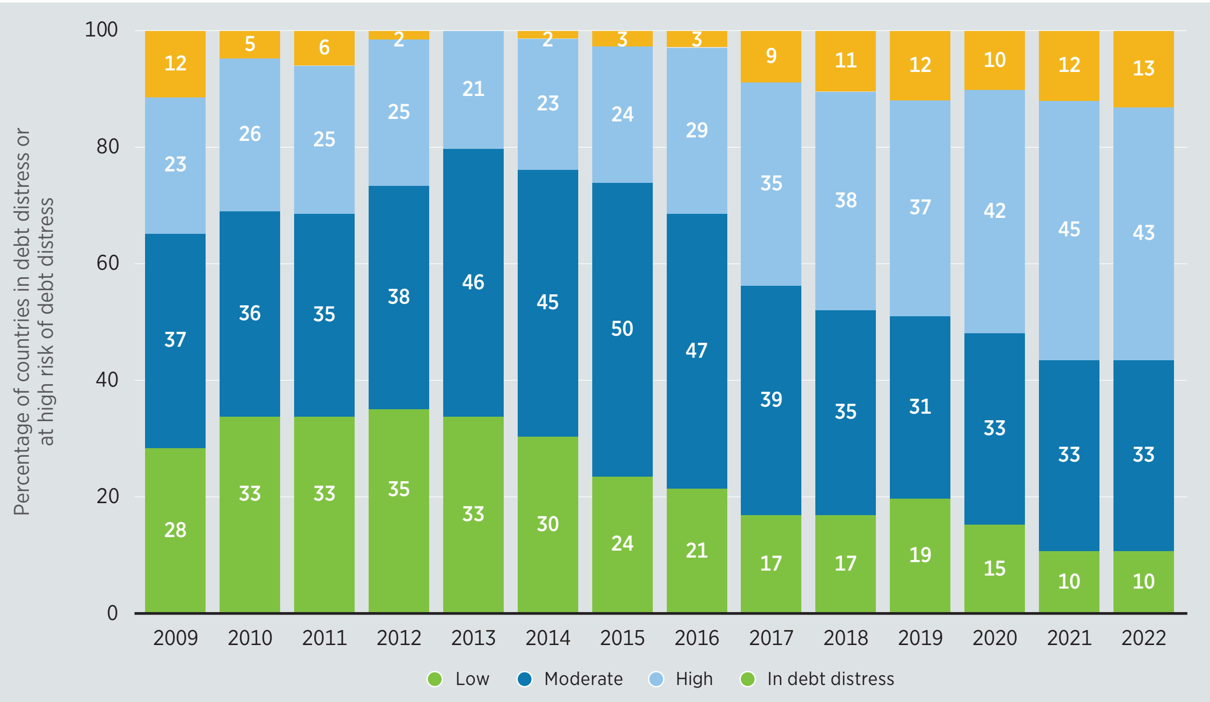



**Note:** LDCs = least-developed countries.
**Source:** IEA *et al.* (2022).

Public funding for renewable energy has endured many challenges in recent years in a deteriorating global economic context. Figure 2.30 shows the growing proportion of countries in debt distress, or at high risk of debt distress in recent years. A combination of high public debt, inflation and slow growth is affecting both developed countries and emerging economies. Policy responses to those challenges will impact countries and the global financial markets' ability to address the ever-growing climate financing needs. As such, this new paradigm requires revisiting the role of public funds, including international flows, to achieve a just and inclusive energy transition.

Given the urgent need to step up the pace and geographic spread of the energy transition, and to capture its full potential in achieving socio-economic development goals, more flows of international funds are needed that help underinvested countries reap the benefits of the energy transition without putting their fiscally constrained economies at a further disadvantage (see Sections 4.5 and 4.6).

**Figure 2.30** Proportion of countries in debt distress, or at high risk of debt distress (as of 31 March 2022)




**Source:** IMF (2022b).

# THE LANDSCAPE OF OFF-GRID RENEWABLE ENERGY INVESTMENT IN DEVELOPING COUNTRIES

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# 03

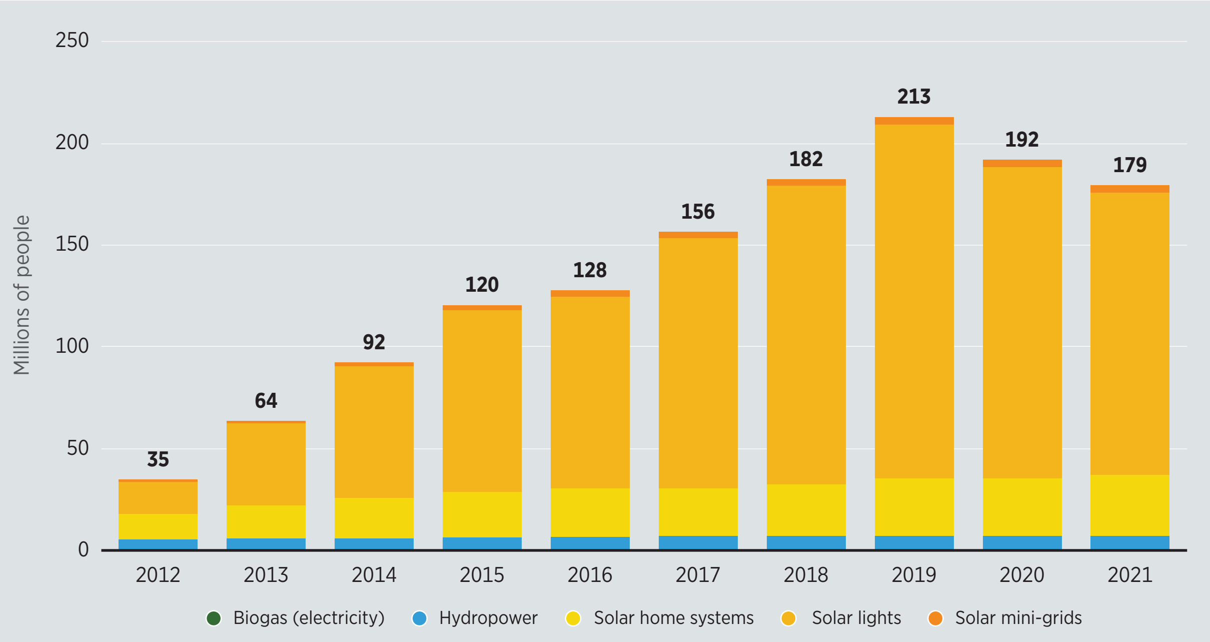
Modern energy access is a key pillar of a just and inclusive energy transition given its central role in meeting the Sustainable Development Goal 7 on ensuring access to affordable, reliable, sustainable and modern energy for all (SDG 7) and contributing towards all other SDGs. However, despite progress in energy access, approximately 733 million people had no access to electricity and nearly 2.4 billion people relied on traditional fuels and technologies for cooking at the end of 2020.

Moreover, the world is not on track to achieve universal energy access by 2030. Nearly 670 million are expected to be without electricity and 2.1 billion without access to clean cooking under current and planned policies (IEA, IRENA, et. al., 2022). Scaling up investments and policy support in the off-grid renewables sector will be crucial to closing the access deficit.

Off-grid renewable energy technologies – both stand-alone systems and mini-grids – can be a cost-effective solution to accelerate electricity access for households and businesses especially in contexts with inadequate power and grid infrastructure. From 2012 to 2019, the population served by off-grid renewables increased from 35 million to 213 million, as seen in Figure 3.1, generating a range of socio-economic and environmental benefits (IRENA, 2022g). In 2020-2021, the number of people served by off-grid solutions reported a decrease primarily driven by improving grid access rates in South Asia (particularly India and Bangladesh) and reduced replacement rates for solar light and solar home systems (SHSs) due to COVID-19. Conversely, the adoption of off-grid solutions in Africa continued to increase during this period along with investments in the sector.

This chapter provides an in-depth analysis of off-grid renewable energy investments in developing and emerging economies, analysing trends across technologies, countries, types of investors and financial instruments. It is important to note that the data in this chapter refer mainly to commitments made to enterprises operating in the off-grid renewable energy sector delivering electricity access solutions. Investments going into training, capacity building, planning exercises, grants for end users, *etc.* are covered to a very limited extent, although they make a substantial and important portion of the energy access financing landscape (see Box 3.4).

**Figure 3.1** Population served by off-grid renewable power in developing and emerging economies, 2012-2021




**Note:** Data on the number of people with access to these forms of electricity supply are gathered based on sales of solar technologies, project reports and other publicly available sources.
**Source:** IRENA (2022g).

## 3.1 Overview of the off-grid financing landscape

Between 2010 and 2021, the off-grid renewables sector attracted more than USD 3 billion (Wood Mackenzie, 2022a).[1] Although off-grid renewable energy investments still represent a small portion of the overall energy access financing landscape, they are a crucial, and cost-effective, piece in the access puzzle. They have the potential to bring new electricity access to almost 580 million people by 2030 (UN, 2021). In recent years (2013-2019), they consistently made up less than 1% of the overall USD 212 billion committed to the electricity sector in the 20 countries with the greatest access deficit[2] (SEforAll, 2021), yet have enabled access for over 200 million people in developing countries globally.

Despite the COVID-19 pandemic and its economic fallout, annual investments in off-grid renewable energy reached a record high of USD 558 million in 2021, as shown in Figure 3.2 (Wood Mackenzie, 2022a). Recent growth has been driven by investments in Sub-Saharan Africa, particularly in East Africa, and more recently in West Africa. However, current investment levels fall far short of the USD 2.3 billion required annually in the sector between 2021 and 2030 (ESMAP *et al.* 2022a).[3]

[1] *These data mainly cover corporate flows. Other flows such as those going into training, capacity building, planning exercises, grants for end users, etc. are covered to a very limited extent, although they compose a substantial portion of the energy access financing landscape.*

[2] *Together, these countries host more than 80 percent of people without electricity access globally (SEforAll, 2021). At the time of this analysis, these countries consisted of: Angola, Bangladesh, Burkina Faso, Chad, the Democratic Republic of Congo, Ethiopia, India, Kenya, the Republic of Korea, Madagascar, Malawi, Mozambique, Myanmar, Niger, Nigeria, Pakistan, South Sudan, Sudan, Uganda and the United Republic of Tanzania (SEforAll, 2021).*

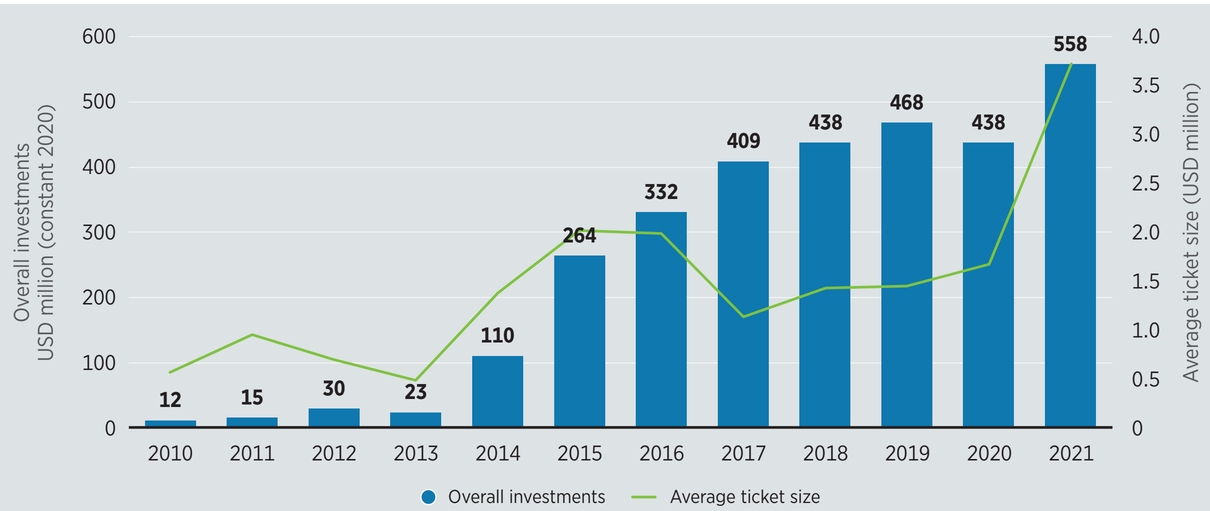
[3] *About four-fifths of this investment is needed to fund company operations, while the remaining is needed to close the affordability gap, e.g. through end-user subsidies (ESMAP et al. 2022a).*

Off-grid renewable energy investments in Africa showed strong resilience to the disruptions caused by the COVID-19 pandemic, which exposed companies to a range of financial and operational risks. Supply chain disruptions had an inflationary impact on consumer prices via a sector-wide increase in manufacturing and distribution costs, particularly for SHSs. At the same time, pandemic-related economic impacts depressed household incomes (ESMAP *et al.* 2022b). Many customers defaulted on their bills, leaving companies to find new ways to secure cash flows while a significant portion of their capital was locked in receivables (IRENA, 2022f). Despite these challenges, Africa showed strong signs of recovery to record-high levels of investments in 2021, while investments in other regions have yet to bounce back to pre-pandemic levels.

Globally, off-grid renewable investments are increasingly skewed towards seven large incumbent companies that have already reached scale and are looking to further solidify their market position through their ability to attract capital. This demonstrates that the sector is maturing and unlocking financing that can support scale. But the growth in early-stage enterprise financing has halted since 2020, with equity financing particularly difficult to attract (ESMAP *et al.* 2022b).

A diverse set of investors has entered the investment landscape over the past several years, including private equity, impact investors, institutional investors (mainly foundations) and development finance institutions (DFIs). Yet the overwhelming majority of investments continue to originate from only a few major players. For instance, since 2017, investments have increased but are now spread out over fewer transactions. The average transaction size gradually climbed from USD 1.1 million to 1.7 million by 2020, before more than doubling to USD 3.7 million in 2021 (Figure 3.2). While a trend of growing ticket size is a sign of sector growth and maturity, it may also indicate existing challenges for enterprises looking for smaller investments.

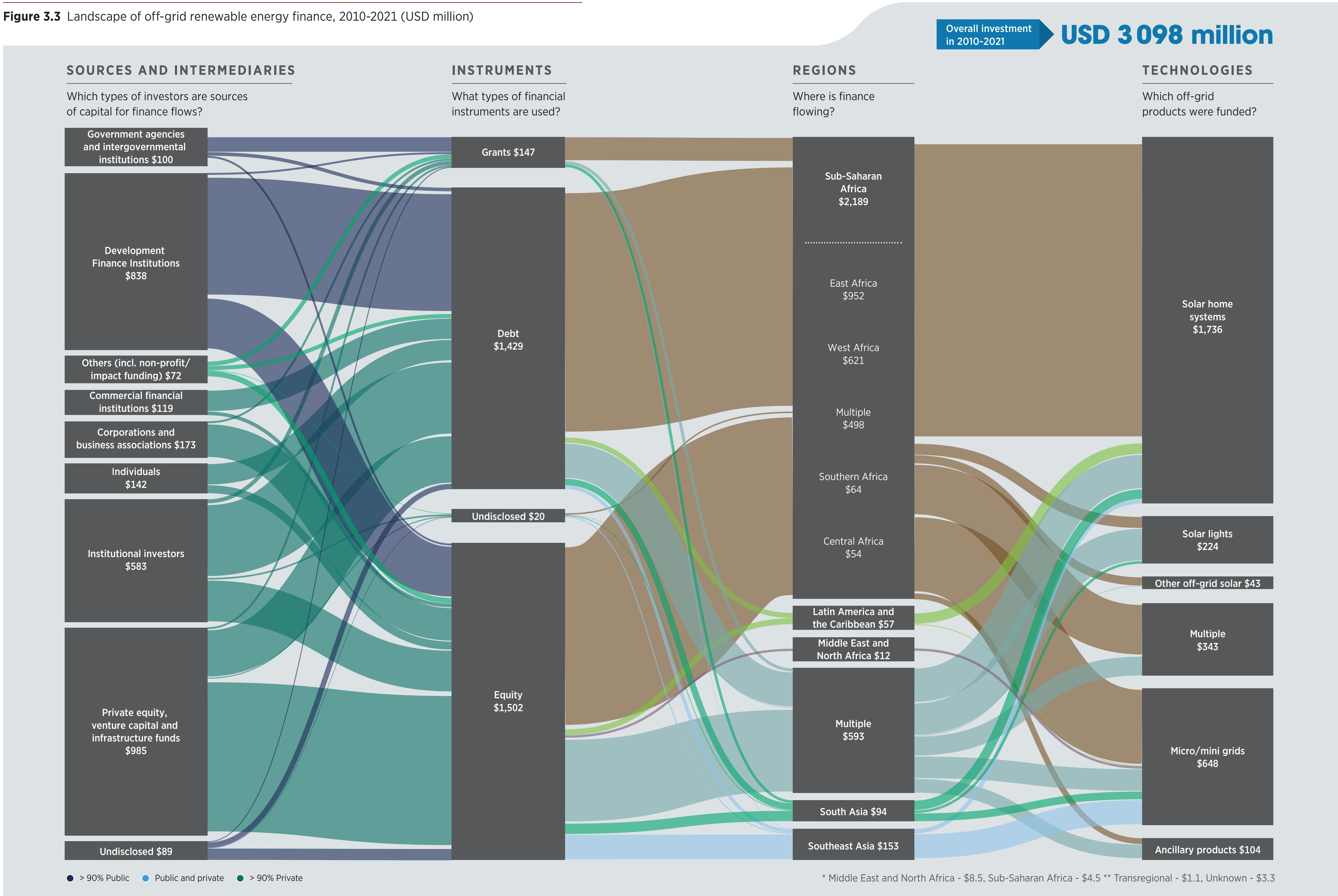
**Figure 3.2** Annual investment in off-grid renewable energy and average transaction size, 2010-2021




**Based on:** Wood Mackenzie (2022a).

Figure 3.3 outlines the investment landscape for off-grid renewable energy during 2010-2021, following the life cycle of investments from sources to instruments employed, regions and technologies targeted.

**Figure 3.3** Landscape of off-grid renewable energy finance, 2010-2021 (USD million)




**Note:** All '$' figures refer to USD **Based on:** Wood Mackenzie (2022a).

## 3.2 Off-grid renewable energy investments by energy use and product

### 3.2.1 Investments by energy use

Between 2010 and 2021 the majority of investments went to residential applications, although the share going to commercial and industrial (C&I) applications has been expanding over time. To date, residential applications attracted 54% of cumulative investment or USD 1.7 billion of overall investments during 2010-2021, followed by C&I applications which took another 14% (USD 444 million) during the same period (Figure 3.4). Sub-Saharan Africa attracted more than 80% of the investments in both categories as this is where the largest access deficit lies, and where the demand for off-grid services is the greatest for both residential and commercial uses.

The share of investments going only to **C&I applications** expanded from 8% in 2015 to 32% in 2021 (Figure 3.4), given the growing needs of off-grid populations from basic household access through solar lights and solar lanterns to more energy-intensive uses in local industry, mining and agriculture. Powering C&I applications can promote local economies by creating jobs and spurring economic growth, while also enhancing food security and resilience against the impacts of climate variability on agri-food chains (IRENA, 2016b).

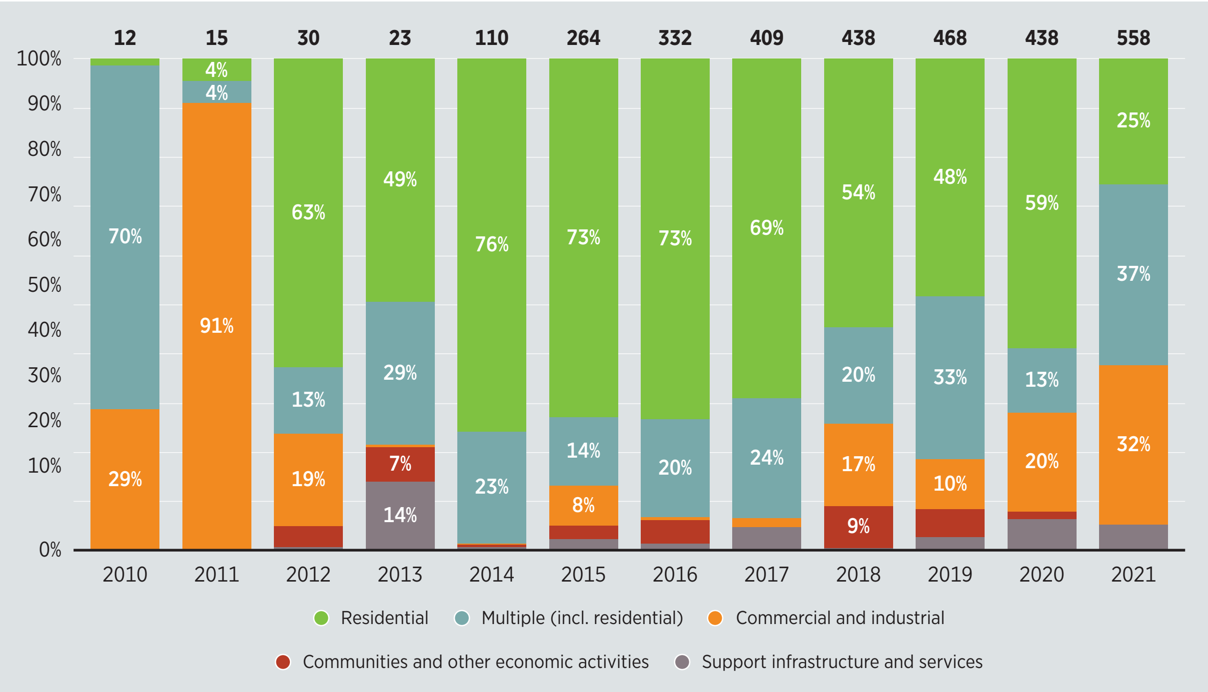
The share of investments for **residential purposes** declined substantially from 59% in 2020 to 25% in 2021. At the same time, multi-purpose investments (*i.e.* investments supporting a mix of residential, C&I or community-based and other related economic activities) increased threefold, mainly focused on a few large off-grid companies that are looking to further scale-up while diversifying their operations further upstream to reach new market segments (*e.g.* C&I customers and powering local clinics and schools) or geographies. This expansion of services partly explains the declining share of investments going only in the residential sector in 2021. For example, Zola Electric expanded its customer base to more than 300 000 homes and businesses across Africa. In 2021, the company raised another USD 90 million to finance product development and expansion into new markets across Africa (Kene-Okafor, 2021).

**Off-grid technologies that power communities and their economic activities** (*e.g.* streetlights and power for schools and hospitals) accounted for 3% of cumulative commitments towards off-grid renewables in 2010-2021. As with the residential sector, community-focused investments are increasingly being absorbed by investments for multiple purposes.

Finally, **support infrastructure and services** have grown in recent years, attracting 3.5% of total investment. This is a broadly defined category that includes investments in all ancillary products and services – including storage systems, smart meters, voltage converters, software services and data platforms – as well as research and development (R&D). It also includes investments in financial products or innovations designed to serve the off-grid renewable energy sector.

Previous innovations in support infrastructure and services such as Internet of Things (IoT) enabled technologies (*e.g.* smart meters), blockchain and pay-as-you-go (PAYG) business models have helped further reduce costs, improve reliability and expand the range of electricity services provided. In 2021, this included a USD 30 million investment in an innovative artificial intelligence (AI)–enabled energy financing platform called Nithio FI. The platform collects essential information, including consumer repayment data, to standardise credit risk assessments, inform due diligence and enhance portfolio and impact monitoring (UNDP, 2022). It mobilises off-grid solar financing at scale through its financial intermediary, Nithio FI B.V., to households, micro businesses and smallholder farmers (PR Newswire, 2021).

**Figure 3.4** Annual investment in off-grid renewable energy, by energy use, 2010-2021




**Based on:** Wood Mackenzie (2022a).

## 3.2.2 Investments by energy products and service

Solar photovoltaic (PV) products continued to dominate the off-grid space, attracting 92% of overall investments in 2010-2021. Owing to their modular and distributed characteristics, solar PV technologies can be adapted to a wide variety of off-grid applications (IRENA, 2018a). Bioenergy and mini/micro hydropower together make up USD 60 million of commitments made to date (totalling more than USD 3 billion – so less than 2%), distributed among countries across East Africa (mainly Rwanda for bioenergy), South Asia and Southeast Asia.[4]

[4] *This includes hybrid solar and bioenergy which attracted around 44%.*

**SHSs** attracted USD 1.74 billion between 2010 and 2021 and are the most funded technology (as seen in Figure 3.5). Their ability to provide reliable access that goes beyond lighting to power appliances such as fans, televisions, refrigerators and others, makes them important for households. Almost 90% of investment in SHSs has gone to residential uses (Figure 3.5). The remaining has gone to C&I applications and less-energy-intensive community uses, which involve energy access for schools, local clinics and information centres.

The widespread deployment of SHSs is enabled by the success of the PAYG (lease-based) financing model that helps low-income consumers avoid the upfront costs and risks of investing in solar home systems and appliances (see Box 3.1). This in turn has enabled off-grid renewable energy companies to further scale up their services to a larger pool of customers looking to secure reliable and affordable electricity while monetising PAYG-based sales to address their own funding needs. Meanwhile, investments in micro/mini-grids (mainly for commercial and residential applications) have also been supported through favourable regulatory frameworks and policy support.

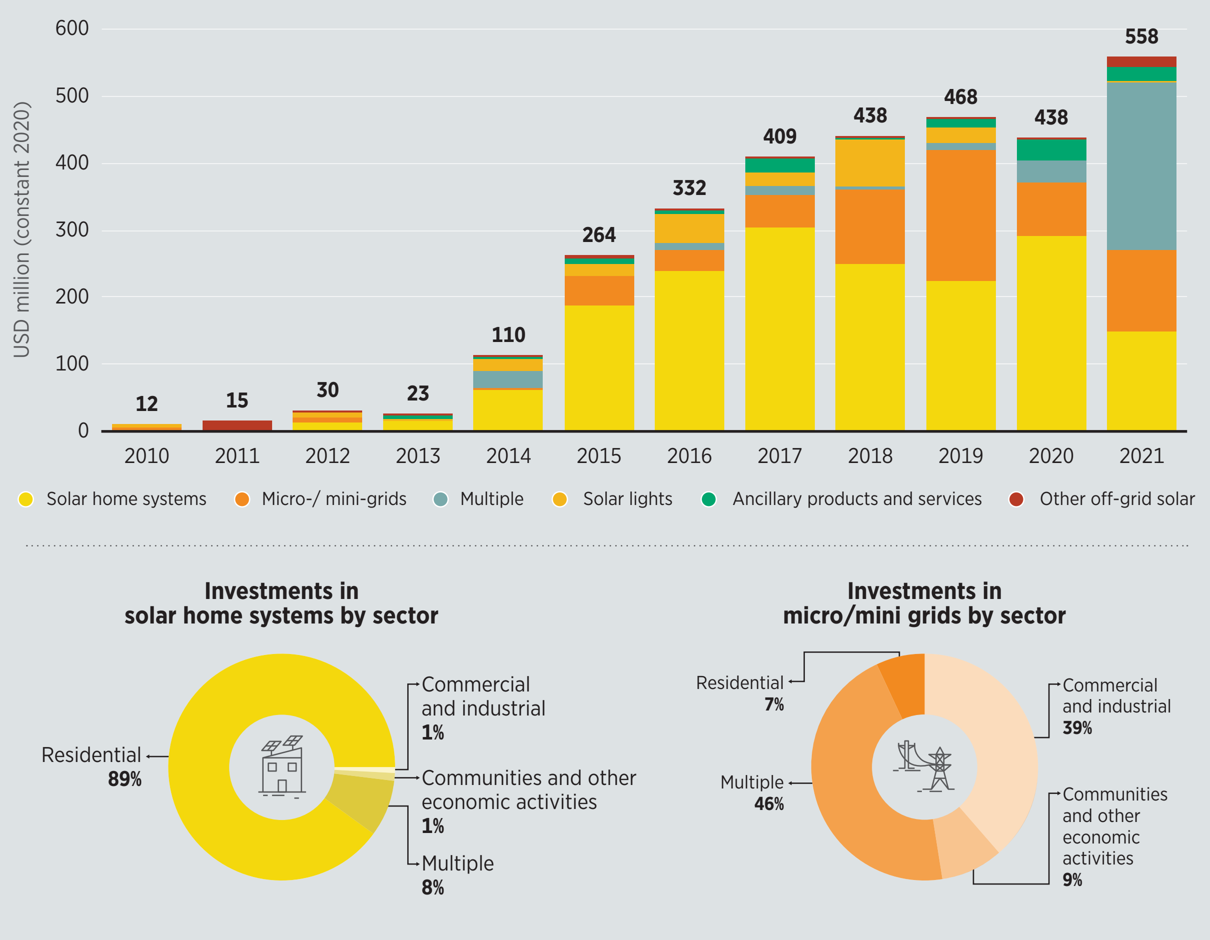
**Micro- and mini-grids** garnered USD 648 million in investments between 2010 and 2021 (Figure 3.5). According to the World Bank's Multi-Tier Framework for measuring energy access,[5] micro- and mini-grids can simultaneously supply many homes and buildings with an adequate level of energy access (up to Tier 5). Because these products are relatively capital intensive, their commercial viability requires additional demand from C&I and community-based applications on top of less energy intensive residential uses. This explains why a large share of these investments are going to either stand-alone C&I applications (39% of the total) or multiple applications which include C&I customers (46% of the total).[6]

**Other off-grid solar products** accounted for USD 43 million in commitments between 2010 and 2021. More than two-thirds went to C&I applications *e.g.* to solar water pumps for irrigation purposes. Solar refrigerators – used by small businesses such as barber shops and restaurants – and solar water heaters (*e.g.* for use in hotels in Kenya) contributed to a few small deals in recent years (Solar Thermal World, 2017). Investments going to off-grid solar products for wider community-based uses accounted for 8% of overall investments between 2010-2021. This primarily consisted of solar streetlights and solar kiosks, targeting communities without electricity access.

*[5] Instead of the binary definition of access that is widely employed today, the Multi-Tier Framework redefines energy access to encompass a complex spectrum of availability, capacity, reliability, quality, affordability, formality and health and safety. The framework ranks access to electricity from Tier 0 to Tier 5 across these dimensions (ESMAP, n.d.)*

*[6] Multiple refers to a combination of residential, C&I and community-based economic activities.*

**Figure 3.5** Annual investment in off-grid renewable energy, by off-grid product, and energy use, 2010-2021




**Based on:** Wood Mackenzie (2022a).

## 3.3 Off-grid renewable energy investments by region

### 3.3.1 Investments by region of destination

Sub-Saharan Africa remains the primary destination for investment in off-grid renewable investments. The region attracted at least USD 2.2 billion (equivalent to 71%) of the overall investments in 2010-2021. Electrification rates in these countries are among the lowest in the world, with 568 million people in the region lacking access to electricity in 2020 (IEA, IRENA *et al.* 2022).

Within Sub-Saharan Africa, **East Africa** attracted 43% of the total cumulative investment, receiving USD 952 million. East Africa was home to three of the top five recipient countries, namely, **Kenya**, the **United Republic of Tanzania** and **Rwanda**. Investment in these destinations benefited from the existing mobile money ecosystem, which was leveraged by the PAYG business model (see Box 3.1). Approximately 78% of the total cumulative commitments in off-grid renewables in 2010-2021 (or USD 2.4 billion) involved the funding of companies or projects using PAYG, with East Africa accounting for USD 917 million.

**Box 3.1 PAYG model to attract financing in the off-grid solar sector**

A typical pay-as-you-go (PAYG) structure allows users to purchase a solar home system (SHS) with an initial down payment, followed by periodic payments ranging from six months to eight years. Payments are collected via mobile payment platforms, while smart meters and data analytics facilitate operation, monitoring and other after-sales services (IRENA, 2022f).

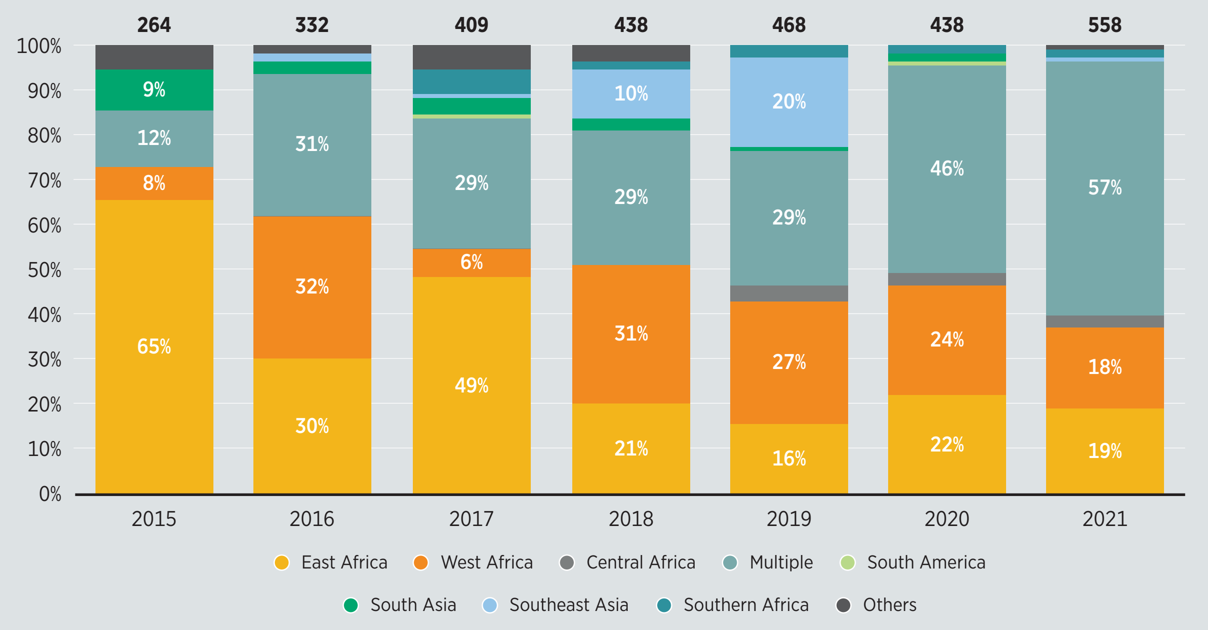
This allows consumers to shift the upfront costs of purchasing an off-grid energy system while avoiding risks such as system failure. At the same time, companies can generate predictable cash flows based on existing PAYG contracts. The PAYG model has helped address some of the affordability gaps in the sector, while enabling companies to service a large consumer base and attract financing.

A recent example of this is Brighter Life Kenya 1 Limited, which is the first large-scale demonstration of receivables-purchase financing in local currency in the sector (USDFC, n.d.). The USD 127 million off–balance sheet financing vehicle is designed to acquire PAYG SHS accounts receivables from d.light, an off-grid solar products provider operating across 70 countries and catering to more than 100 million people. Through d.light, the facility is expected to finance the provision of improved energy access to 1.9 million people in Kenya, create USD 88 million of additional income for the Kenyan economy and save 600 000 tonnes of greenhouse gas emissions. Public financing remains key in enabling such ventures as part of the facility was financed by a USD 20 million senior debt commitment from the US International Development Finance Corporation, with Norfund providing an additional USD 15 million (Norfund, 2021).

In recent years, **West Africa** has begun closing the financing gap with East Africa (Figure 3.6). During 2018-2021, West Africa saw more investment than East Africa. With PAYG sales starting to surpass cash-based sales, the region is witnessing a growing ecosystem of local retailers and international companies (ESMAP *et al.* 2022b). **Nigeria** is driving this growth as the largest single recipient country both in Sub-Saharan Africa and globally, attracting USD 287 million during 2010-2021. Aside from a large untapped market and rising diesel prices, this is linked to the implementation of the Nigeria Electrification Program by the Rural Electrification Agency with funding from the World Bank and the African Development Bank (ESMAP *et al.* 2022b) and a regulatory framework for mini-grids (see Box 3.2). Moreover, **Burkina Faso** and **Mali** (two conflict-affected states) have seen positive signs in their off-grid solar sector as governments and development partners are frequently supporting market development through subsidies and result-based financing mechanisms (ESMAP *et al.* 2022b).

**Central and Southern Africa** together attracted a total of USD 93 million during 2018-2021, as investments picked up over this period. Given the relative nascency of these two markets, public policy and development finance support remains crucial in driving investments. For example, **Mozambique's** 50% off-grid electrification target (by 2030) has helped attract USD 13 million since 2017. Targeted grants and result-based financing initiatives such as the BRILHO programme (financed by the United Kingdom and Swedish Aid) have helped create an enabling regulatory environment, de-risk investments, helping to provide access to more than 306 000 people and 5 000 small businesses through the deployment of SHSs, green mini-grids and improved cooking solutions (SNV, 2021).

**Figure 3.6** Shares of annual investment in off-grid renewables by subregion of destination, 2015-2021




**Based on:** Wood Mackenzie (2022a).

During the COVID-19 pandemic, off-grid renewable energy investments in **Southeast Asia** declined by 98%, leaving key off-grid markets even more vulnerable. Although the majority of countries in this region have achieved high or near-universal rates of electricity access, parts of the populations in countries such as **Myanmar** and **Cambodia** (26% and 15%, respectively in 2020) still lack access to electricity (World Bank, 2022). Whereas the region attracted USD 137 million in off-grid renewable energy investments over 2018-2019 (led primarily by Myanmar), during 2020-2021, investments plummeted to USD 3 million, likely due to the negative impacts of the COVID-19 pandemic and political developments (ESMAP *et al.* 2022b).

**South Asia** attracted USD 26 million in investments during 2018-2021, with **India** attracting more than 80% of all investments in the region. Of late, more investments are being mobilised for productive use of energy. Under its PM-KUSUM scheme (launched in 2019), the Indian government has incentivised the purchase and installation of over 152 000 solar water pumps as of October 2022. Oorja, an Indian pay-per-use service based solar-powered irrigation, milling and cooling company, has attracted significant investments in recent years, including a USD 1 million seed funding round in 2021, with equity investment from Schneider Electric Energy Access Asia and grant funding from Water & Energy for Food Grand Challenge (WE4F). Oorja's services are used by 15 000 farmers with potential for adoption by 130 million households in India alone.

During 2018-2021, **Latin America and the Caribbean**[7], and the **Middle East** together attracted only USD 21 **million,** equivalent to less than 1.5% of cumulative commitments over that period. These regions have respectively achieved electricity access rates of more than 90% (World Bank, 2022).

[7] *In figure 3.6, the Latin America and the Caribbean region consists of these sub-regions: Central America; South America; and the Caribbean.*

With smaller shares of the population living in off-grid locations, these regions represent relatively small markets for decentralised energy systems.

Finally, **the Pacific** has received minimal investments, even though developing countries in this region, especially small island developing states, are prime candidates for off-grid services, particularly in remote areas where the costs of extending the main grid may be prohibitive. However, mini-grids and SHS solutions continue to lack access to economically financing options. Access to more patient and adaptable low-cost financing solutions is required to provide affordable energy access to implement these solutions at scale (Malhotra, 2022).

Off-grid companies are gradually expanding their services across new geographies as the share of commitments going to multiple regions has grown from 12% in 2015 to 58% in 2021. Venturing into new markets is often a strategic step to capitalise on unexplored opportunities and harness further growth, while accelerating the achievement of universal access to electricity.

**Country-specific commitments** were highly concentrated, with 12 countries accounting for 90% of these investments. The majority of these countries are in Sub-Saharan Africa. **Nigeria** and **Kenya** are the two countries attracting the largest off-grid investments globally (USD 287 million and USD 243 million, respectively) over 2010-2021.

**Box 3.2 Off-grid renewable energy investments and enabling policy frameworks**

An enabling policy framework is crucial to attracting off-grid renewable energy investments. Figure 3.7 shows that countries with the highest "Regulatory Indicators for Sustainable Energy" (RISE) scores for electricity access in 2019 attracted the largest share of investments.[8, 9] The RISE scores for electricity access encompass multidimensional aspects of electrification planning policies and regulations, including the scope of the officially approved electrification plan, a framework for mini-grids, a framework for stand-alone systems and consumer affordability of electricity (RISE, n.d.).

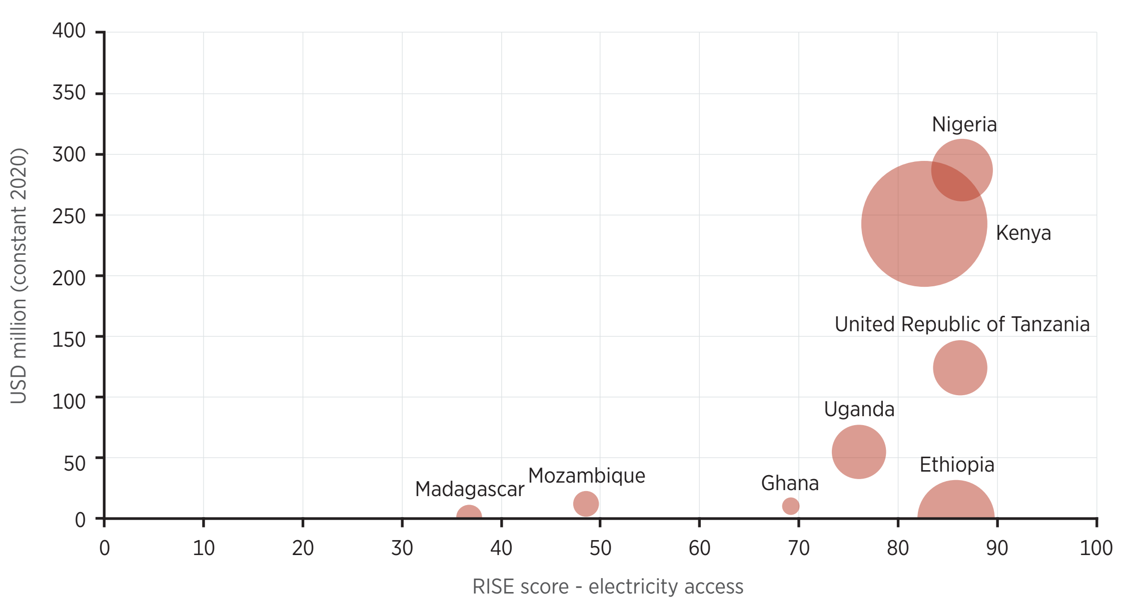
By mid-2022, **Nigeria** and **Kenya** had some of the highest RISE scores for off-grid electricity access (86 and 83 out of 100, respectively). This indicates that both countries have a relatively mature policy environment, even though there is still some room for improvement. For instance, Kenya had an objective of reaching universal electricity access by 2022, supported by its National Electrification Strategy, and has dedicated guidelines for mini-grids, which were published under the provisions of the 2006 Energy Act. A revised draft of these guidelines is in discussion and is expected to cover aspects such as tariff approval, licensing requirements, interconnection arrangements, technical guidelines, and performance and reporting guidelines. Similarly, in 2016, Nigeria enacted a dedicated regulatory framework for mini-grids, with subsequent revisions to also cover emerging technologies such as interconnected mini-grids (IRENA, 2022f).

**Tanzania** and **Uganda** have similar RISE scores but attract less investment compared with Nigeria and Kenya. Although these two countries have higher RISE scores for grid electrification and utility creditworthiness and transparency than Nigeria and Kenya, such scores are not necessarily prerequisites for off-grid investments. In contrast, countries like **Madagascar** and **Mozambique** have relatively low RISE scores, but also low investments.

[8] *For the purpose of this analysis, a high RISE score encompasses the elements of electrification planning, scope of the officially approved electrification plan, a framework for mini-grids, a framework for stand-alone systems and consumer affordability of electricity (Regulatory Indicators for Sustainable Energy, n.d.).*

[9] *Indicators on policies and regulations for grid electrification and utility credit worthiness and transparency were not used, although these are a part of the RISE scores on electricity access (Regulatory Indicators for Sustainable Energy, n.d.).*

**Figure 3.7** Investment with respect to RISE scores and populations served by off-grid renewables in access-deficit countries in Sub-Saharan Africa, 2010-2021




**Notes:** The size of the bubbles represents the population served by off-grid renewable energy. Since these are related to household access, and the majority of the investments in Nigeria are for mini-grids for C&I purposes, the bubbles are relatively small.
**Based on:** Wood Mackenzie (2022a) and RISE (n.d.).

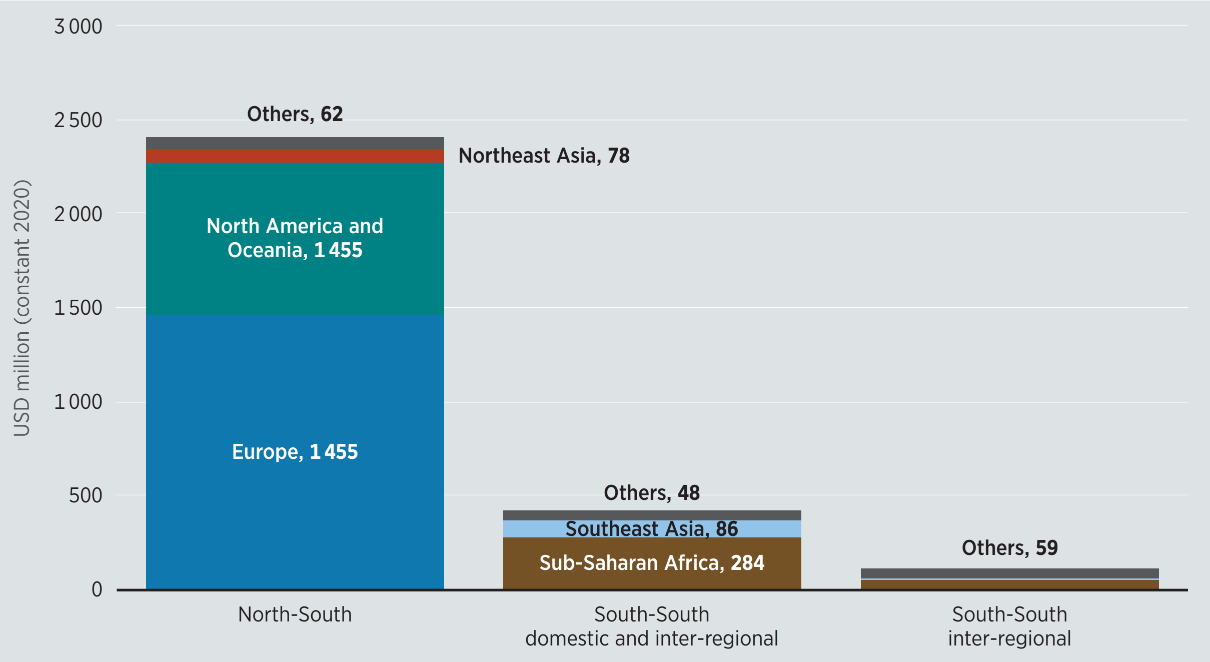
### 3.3.2 Investments by region of origin (based on the investor's primary location of operations)

As with overall renewable energy investment trends, the majority of the off-grid renewable investments in emerging and developing economies comprises of North-South flows, *i.e.* from developed countries to developing and emerging markets. At least 78% of the total commitments between 2010 and 2021 involved **North–South flows** (Figure 3.8). Of the total commitments, European investors committed USD 1.46 billion, or 47% of the total. An additional USD 812 million came from North America and Oceania (26% of the total), while Northeast Asian investors (mainly Japan) accounted for 2.6% of the total commitments (*i.e.* USD 78 million).

**South–South flows** made up less than 20% of the overall financing between 2010 and 2021, although their contribution has been increasing gradually. About two-thirds of South–South flows have come from investors based in Sub-Saharan Africa – contributing USD 337 million, primarily through local institutional investors, and private equity firms and venture capitalists. Meanwhile, Southeast Asia–based investors contributed USD 92 million over the same period, equivalent to 17% of South–South flows. The majority of South–South flows are invested domestically and/or inter-regionally, although since 2014, some inter-regional investments have arisen primarily from investors based in Sub-Saharan Africa.

It should be noted that the analysis in this section is based on where an investor is domiciled. In other words, investors are given a "North" or "South" classification based on their operations' location, as opposed to where funding first originated, since this is often more difficult to track, especially because funding may have originated from multiple sources. So, even in cases where an investor may be based in the Global South, part of the funding may have first originated from the Global North. Given this limitation, the actual share of South–South flows is probably smaller than indicated in this section.

**Figure 3.8** Cumulative off-grid renewable energy investments by type of flow and region of origin, 2010-2021




**Note:** Others include Latin America and the Caribbean, the Middle East, South Asia and Multiple. This excludes USD 154 million for which the region of origin could not be identified. Also note that for this analysis, investors are given a "North" or "South" classification based on their operations' location, as opposed to where funding first originated, since this is often more difficult to track, especially because funding may have originated from multiple sources.

**Based on:** Wood Mackenzie (2022a).

## 3.4 Off-grid renewable energy investments by type of financing instrument

Between 2010 and 2021, **debt and equity investments** contributed about 47% and 48% of the overall financing, respectively, with an additional 5% contributed by **grants**. While equity investments were almost entirely utilised to finance company operations or expansion of activities, debt (primarily term loans and venture debt /convertible debt / bonds) is often directed at both companies and projects. By technology, debt financing constituted the majority of the investments in SHSs and solar lights over 2010-2021 (54% of the total, and rising over time) – a finding confirmed by ESMAP *et al.* (2022b). On the other hand, equity financing dominated the micro-/mini-grid space, constituting 74% of the overall financing over the same period.

Overall, prior to the COVID-19 pandemic of 2020, the majority of off-grid renewable energy financing came from equity investments owing to the domination by private equity, venture capital and infrastructure funds and the lack of access to debt for the sector. The share of equity has seen a relative decline in part due to the uncertainties posed by the pandemic, and the limited track record of exits and capital recycling in the sector, which may explain the limited number of new equity investors entering the sector in recent years (see Section 3.5 and Box 3.3). At the same time, the contribution of debt has increased sharply over the past two years, particularly as debt-preferring DFIs bolstered their support during the pandemic (Figure 3.9) and major off-grid companies were able to capitalise on their strong market position to secure large-size predominantly debt-based deals from both public and private investors (ESMAP *et al.* 2022b).

In addition, relatively established markets such as Kenya and Nigeria are seeing more **local currency debt** financing. During 2020-2021, about 28% of debt was denominated in local currencies (primarily the Kenyan shilling, followed by the Nigerian naira), compared with just 11% during the pre-pandemic years (Figure 3.9). This included a USD 75 million equivalent Sustainable Finance Facility for Greenlight Planet Kenya (now known as Sun King) and the USD 127 million equivalent financing vehicle called Brighter Life Kenya 1 Limited. Although the volumes of local currency financing were lower before 2020, a more diverse mix of countries was receiving this financing, including some relatively underdeveloped markets, such as Côte d'Ivoire, Mozambique, Rwanda and Uganda, among others. In 2018, for example, Zola Electric received an equivalent of USD 9 million to provide access through SHSs to approximately 100 000 rural households in Côte d'Ivoire.[10]

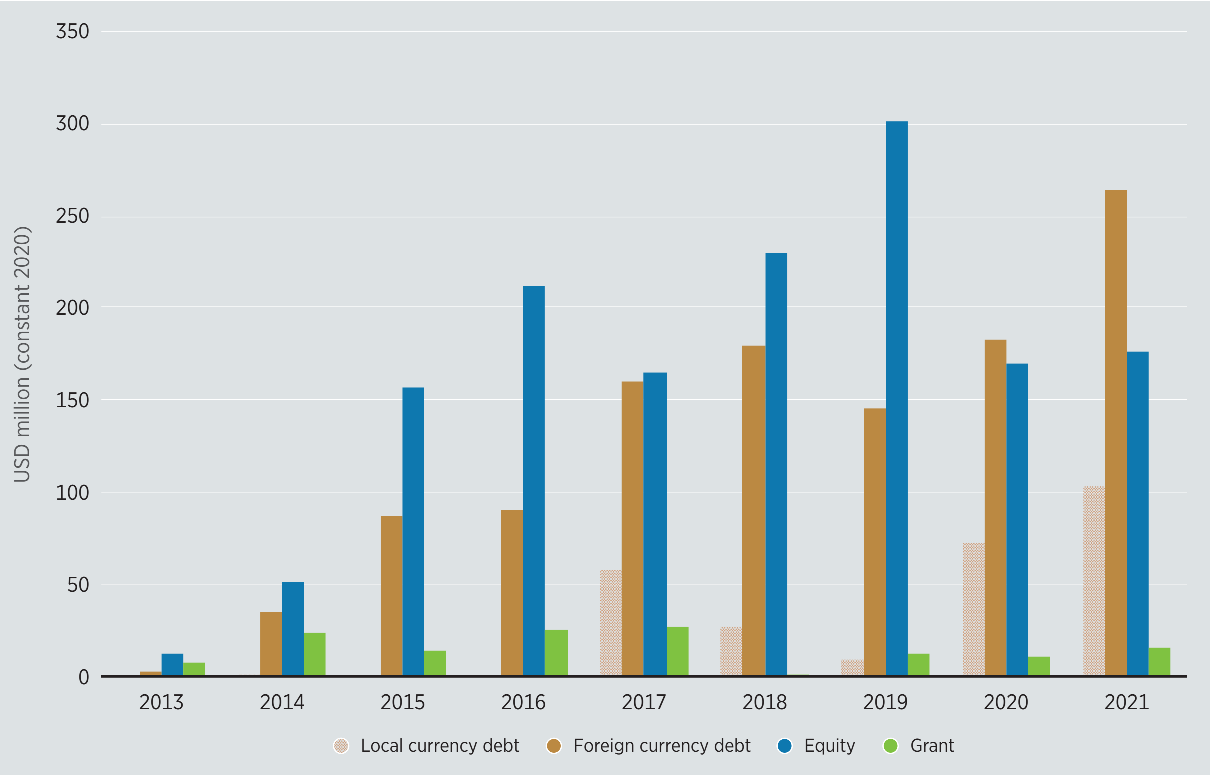
Going forward, low-cost local currency financing will be preferred for the next phase of the off-grid renewable energy sector's development. Established companies are looking to finance the next phase of their development, while younger companies would benefit from the low cost of capital to build profitable businesses and attract equity investors. In the absence of low-cost financing, the burden may fall disproportionately on low-income households as companies seek to increase profitability, and maintain healthy cash flows, to service their debt obligations or satisfy the expectations of equity investors. To date, however, local currency financing available from local commercial banks is often more expensive than foreign-currency-denominated debt available from DFIs,[11] since the former often see the sector as nascent and riskier, and have limited appetite for such investments given the availability of alternatives, *e.g.* government securities (AfDB, 2020). Opportunities for DFIs to partner with local financing institutions to deliver local-currency debt are also emerging. Husk Power Systems, for instance, raised INR 310 million (USD 4.2 million) in debt to develop 140 mini-grids in India from the state-owned non-banking financing institution India Renewable Energy Development Agency (IREDA) utilising a line of credit provided by KfW.

[10] *Notably, Ziz Energie was the only relatively underdeveloped off-grid market to receive a local currency loan of USD 6 million equivalent from the Development Bank of Central African States (BDEAC) to fund hybrid solar mini-grids.*

[11] *Furthermore, AfDB (2020) reports that even with the provision of guarantees, there are limited to no benefits on borrowing costs, although this can reduce collateral requirements.*

The 2020-2021 period was also marked with some sizeable deals under a **blended financing mechanism.** At least 26.5% of the USD 996 million committed during this period was mobilised through a blended financing approach comprising a mix of debt, equity and grants, as well as risk mitigation instruments. This included the USD 90 million raised by Zola Electric from more than eight investors, including SunFunder, Total Energies Ventures and FMO (a Dutch development bank), each bringing in unique attributes suited for various related risks and opportunities. In this way, blended finance combines the unique attributes of DFIs, private investors and governments to address different investment-related risks. These structures have great potential to attract private financiers to transactions that by themselves might have difficulty obtaining commercial financing (IRENA, 2022f).

**Figure 3.9** Annual investment in off-grid renewable energy, by financing instrument and local versus foreign currency debt, 2013-2021




**Based on:** Wood Mackenzie (2022a).

## 3.5 Off-grid renewable energy investments by financing source and type of investor

**Private investments** grew by a compound annual growth rate (CAGR) of 33% during 2014-2019, but this growth was slightly reversed in 2020-2021 due to the economic impacts of the COVID-19 pandemic. Private investors' contribution fell from USD 361 million in 2019 to USD 277 million in 2021. Despite their declining contributions over the past two years, private sources continue to provide substantial volumes of investments to the sector.

Over time, the sector has drawn in substantial private financing from private equity and venture capitalists, as well as asset managers who are looking to diversify their portfolios (Falchetta *et al.* 2022; Wood Mackenzie, 2019). **Private equity, venture capital and infrastructure funds**[12] provided 32% of off-grid renewable investments between 2010 and 2021, having committed USD 985 million. Their appetite for ventures with a limited track record but high-growth potential makes these types of investors (especially venture capitalists) a particularly suitable source of capital for the off-grid sector (Figure 3.10). In 2020-2021, their share of investments fell slightly, likely due to the COVID-19 pandemic and the fact that most of them had initially invested through equity and had yet to realise sufficient capital gains through successful exits (Acumen, 2019) (also see Box 3.3 on limited exits and capital recycling in the off-grid sector). A limited track record of successful exits and capital recycling may be deterring new equity investors from coming in, which may further explain the declining share of equity (as seen in Figure 3.9 on financing instruments).

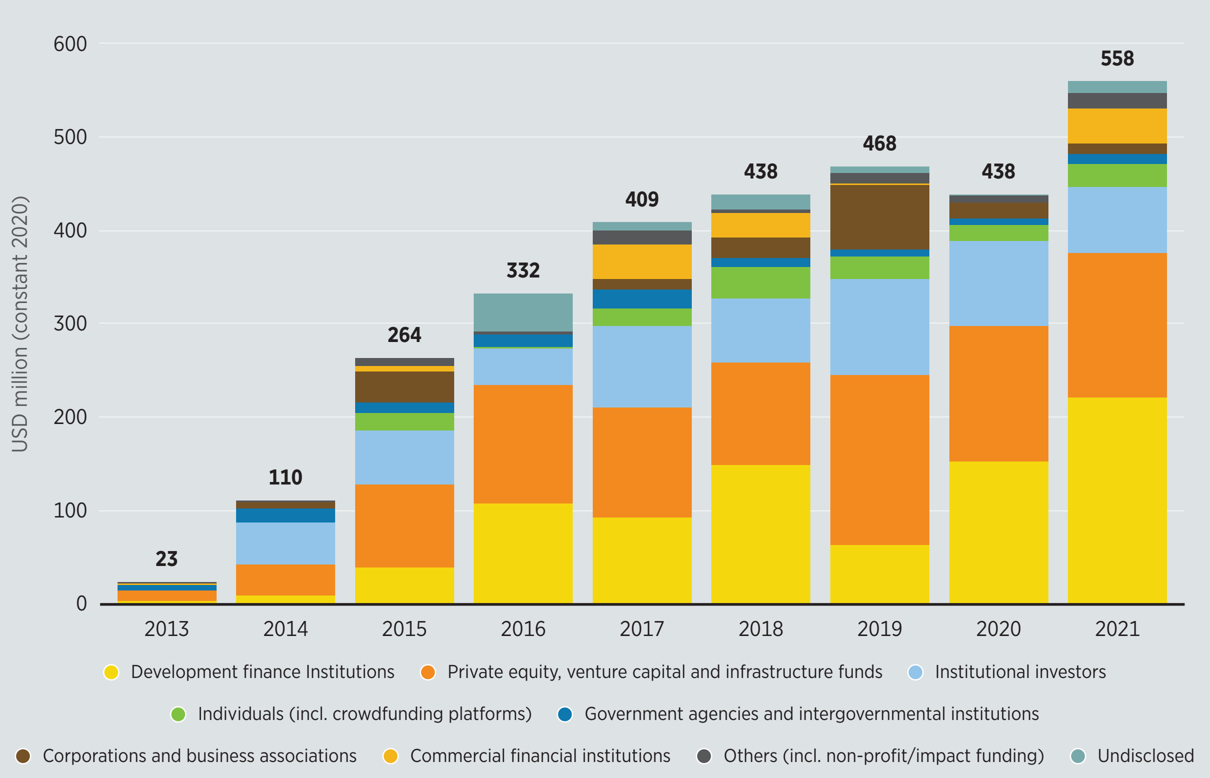
**Institutional investors** provided 19% of the investments in the off-grid space – equivalent to USD 583 million – although this has primarily come from foundations,[13] as opposed to the likes of pension funds, sovereign wealth funds and asset managers that have a strong preference for larger transaction sizes and well-proven technologies and business models. In 2020-2021, their contributions shrank slightly, both in terms of magnitude and share (Figure 3.10). Foundations are increasingly playing an active role in the sector bridging the funding gaps in the sector focusing on end-user and enterprise financing, as well as broader market development (*e.g.* capacity building, piloting nexus applications). Institutional investors can help bridge some of the funding gap in the sector, although this will require addressing barriers related to small ticket sizes, underdeveloped policy and regulatory environments, and market uncertainty, which give rise to a range of real and perceived risks. The strategic use of blended financing mechanisms will be key for addressing these challenges and tapping institutional investors' balance sheets.

**Corporations and business associations'** investments peaked in 2019 at USD 68 million, as shown in Figure 3.10, but they were less than half of this amount over the following two years combined. Similarly, investments from **commercial finance institutions** (*e.g.* banks) remained sporadic throughout this period, and tended to come from multi-national commercial banks that have sufficient access to foreign exchange (AfDB, 2020). For example, in 2021, the Standard Bank Group and Citi, two multi-national commercial banks, partnered together with the CDC Group and Norfund to provide a USD 75 million equivalent local-currency financing facility for Greenlight Planet Kenya, an off-grid solar home solutions company (British International Investment, 2021).

*[12] Definitions of all investor types included in this analysis are provided in the accompanying methodology document (Appendix).*

*[13] Foundations (including non-profits set up by private companies) are given a private designation as in the majority of cases. This represents private money that is flowing to off-grid companies and projects, although the primary purpose of these investments is often to support a social or environmental cause, as opposed to solely making financial returns, in which regard they behave like a public investment serving a larger "public" goal.*

**Figure 3.10** Annual commitments to off-grid renewable energy by type of investor, 2015-2021




**Note:** Definitions of all investor type included in this analysis are provided in the accompanying methodology document (Appendix).
**Based on:** Wood Mackenzie (2022a).

## Box 3.3 Limited exits and capital recycling in the off-grid sector

Profitable exits (*e.g.* an event in which an investor may sell a company to realise a financial gain) serve as proof points for later-stage commercial investors to gain confidence in the sector, while also allowing early-stage investors to recycle their capital into new, pioneering off-grid companies. This is a critical component of building the robust capital market needed to support continued innovation and scale in the off-grid energy sector. However, there have been few exits in off-grid energy to date. Some estimates show that between 2012 and 2017, only USD 50 million of the USD 1.4 billion invested via equity was returned to investors, through 12 exits. This is primarily due to issues related to:

**Profitability.** Many companies are not yet profitable to date, which has deterred later-stage investors from entering the market. Low profitability is primarily due to complex business models and higher-than-expected operating costs.

**High valuations of off-grid companies due to over-reliance on equity in the early days of the sector.** This has resulted in a mismatch between the valuations that early-stage investors need to generate a return and the valuation that potential investors are willing to accept, in turn limiting secondary capital from coming in.

As companies look to scale their operations, improving their unit economics will go a long way in facilitating exits and capital recycling in the sector. More recently, in 2022, Apis Partners was able to realise a full exit from its initial investment of USD 60 million (both debt and equity) in Sun-King (formerly known as Greenlight Planet) made five years prior (Africa Capital Digest, 2022). The company recently raised USD 260 million in Series D financing – the largest deal seen in the sector – which enabled the exit and serves as a model for other companies and investors.

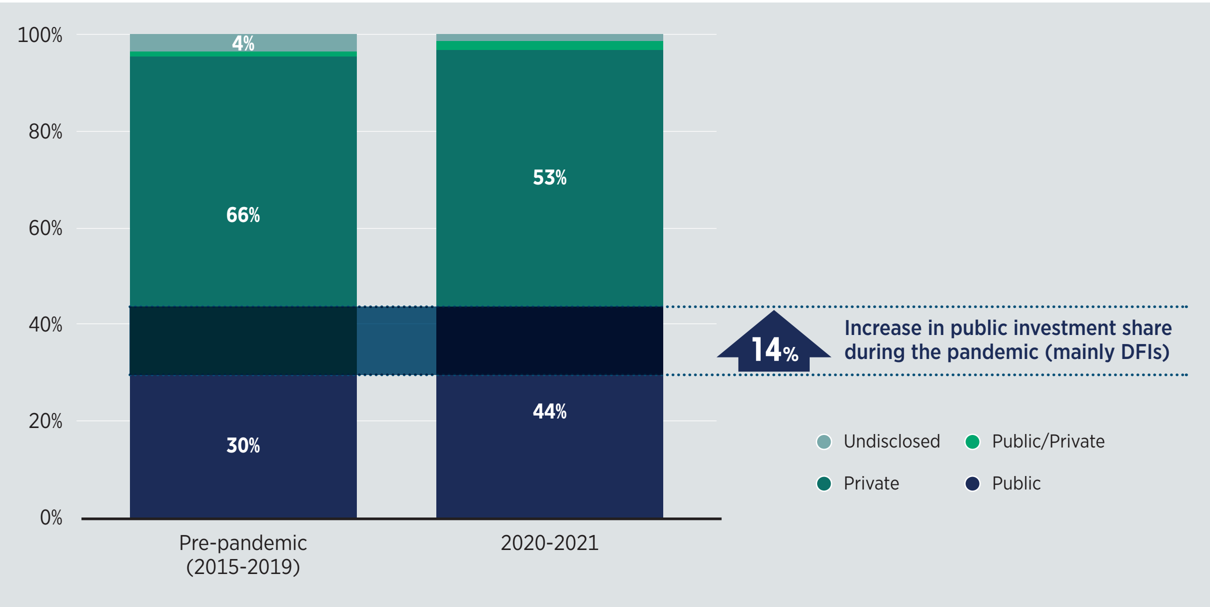
**Source:** Acumen (2019).

**Individuals** (high-net-worth individuals, families or households) invested an average of USD 20 million per year during 2015-2021. This was primarily through dedicated crowdfunding platforms, where a number of companies launched fundraising campaigns especially in the past two years to refinance existing debt or continue operating, since many customers defaulted on payments or delayed them due to the economic pressures of the pandemic (IRENA, 2022f). Overall, off-grid renewable energy access has received a total of USD 117 million in investments via crowdfunding platforms such as TRINE, Energise Africa and Lendahand, more than 85% of which was debt.

As private investment activity declined in 2020-2021, **public financing (especially from DFIs)** provided the sector with a much-needed boost. DFIs' contribution increased by 67% from USD 93 million in 2019 to USD 260 million in 2021. Overall, the share of public financing increased from 30% during 2015-2019 to 44% during 2020-2021 (Figure 3.11), compensating for the shortfall in private investment activity.

Although about a fifth of the financing during 2010-2021 came from public sources of capital,[14] their "true" contribution goes beyond the mere provision of capital for projects but also in creating an enabling policy and regulatory environment, building capacity, bridging affordability gaps and creating market awareness (see Box 3.4 on the public financing framework for energy access). To date, public investment has been essential to kick-start new markets and advance early phases of development, for instance, by supporting pilot projects for emerging technologies and business models, or by mitigating early-stage project risks.

**Figure 3.11** Shares of annual off-grid renewable energy investments by public/private investor, pre-pandemic years (2015-2019) versus 2020-2021




**Note:** DFI = development finance institution.
**Based on:** Wood Mackenzie (2022a).

[14] *The remaining coming from "public-private" capital providers.*

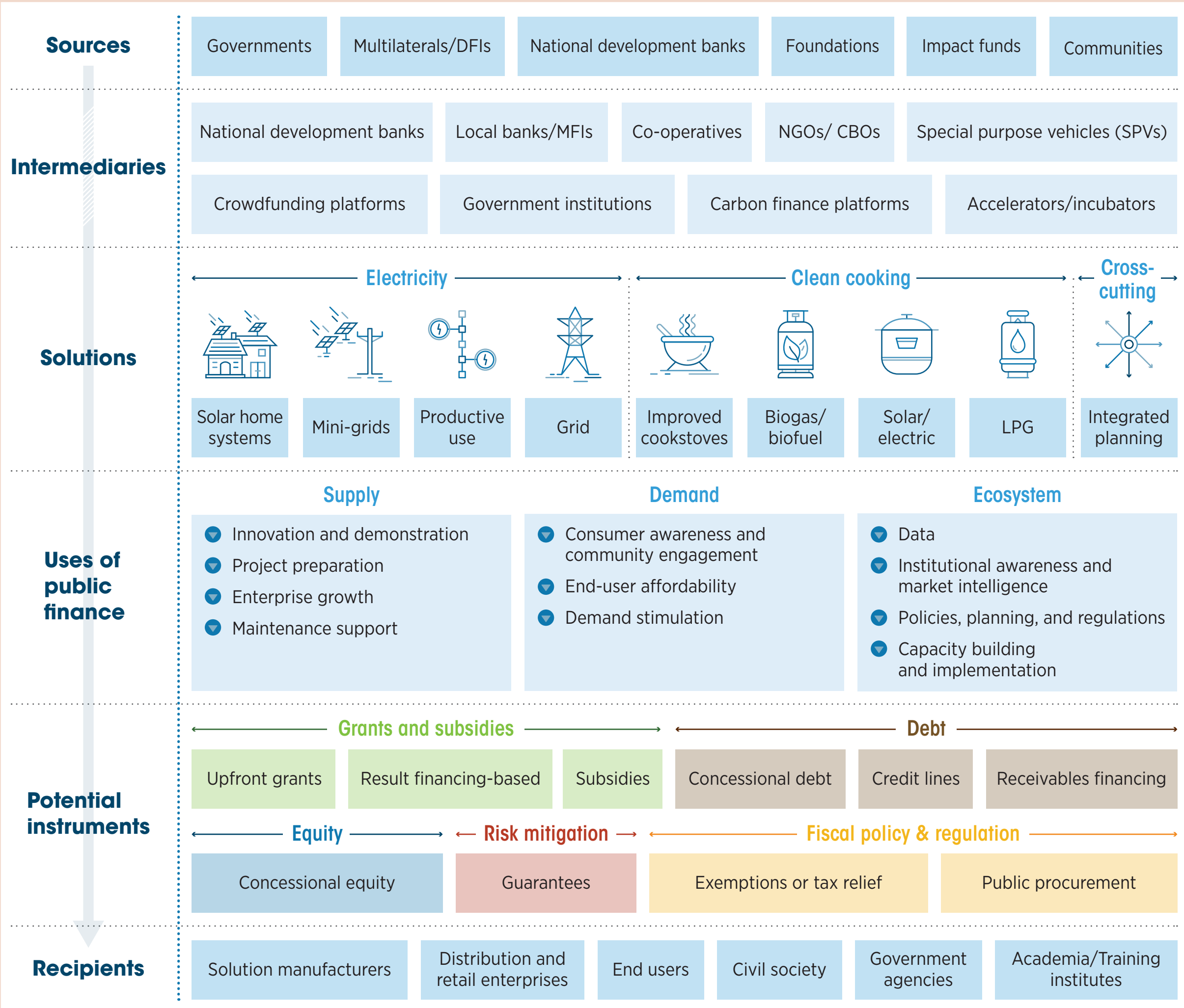
## Box 3.4 Public financing framework for energy access

An estimated USD 45 billion in annual funding is required to achieve universal energy access by 2030, and public finance is the key to closing this gap. Besides de-risking and catalysing private capital into projects and solutions, public finance has a key role to play in investments in public goods unaddressed by the market (*e.g.* education and training, awareness raising, planning), and in ensuring access to underserved and marginalised communities and end users where/for whom affordability gaps are the most significant.

Public financing commitments and appropriate instruments have to be scaled significantly to achieve the SDG 7 goals. Public financing needs vary depending on the technology solution (stand-alone systems, mini-grids, clean cooking solutions) and the stakeholders in the ecosystem, including end users and enterprises. Ensuring access to tailored financing instruments will be key to building sustainable markets and creating local value.

Existing frameworks do not adequately track or analyse public financing for energy access to ascertain whether sufficient magnitude is being mobilised and deployed through the right instruments. An upcoming analysis by IRENA offers a tool (referred to as the framework) to guide policy makers and public financers to track and optimise public financing in advancing energy access (Figure 3.12). It seeks to 1) map the public financing needs across the energy access ecosystem; 2) identify challenges in scaling modern energy access that public finance must address; and 3) understand stakeholder preferences across public finance instruments, intermediaries and recipients.

**Figure 3.12** Public finance framework for universal energy access




**Note:** CBO = community-based organisation; DFI = development finance institution; LPG = liquefied petroleum gas; MFI = microfinance institution; NGO = non-governmental organisation.

**Source:** IRENA (forthcoming).

**DFIs** were the largest public capital providers, having committed USD 818 million in 2010-2021, which represents 79% of the overall public investments for off-grid renewables (or 27% of the overall total investments). Notably, DFIs' contributions in the last two years of 2020-2021 constitute half of their overall contributions since 2010. During 2020-2021, these investments slightly exceeded those made by private equity, venture capitalists and infrastructure funds (Figure 3.10). Some recent investments include:

- In October 2022, the US International Development Finance Corporation (USDFC) announced a USD 40 million investment in the Energy Entrepreneurs Growth Fund, a fund created by UK aid and FMO (the Dutch Entrepreneurial Development Bank) with an objective to expand (off-grid) energy access in Sub-Saharan Africa. Since its creation in 2019, the fund has invested patient capital in off-grid energy companies with a focus on mezzanine instruments combined with technical assistance. By the end of 2022, the fund was expected to have committed USD 31.5 million across ten companies (USDFC, 2022).

- In 2021, Zola Electric raised USD 90 million (split almost equally between debt and equity) through a blended financing mechanism and split between several private equity firms and venture capitalists as well as the likes of FMO and SunFunder (Energy Capital and Power, 2021).

- In 2021, the Facility for Energy Inclusion (FEI) structured its inaugural transaction of a EUR 60 million multi-country facility for ActivCo SAS to construct renewable energy power plants for telecommunications providers, in turn replacing polluting diesel generators (FEI, 2021). The FEI is a specialised renewable energy debt fund headed by the African Development Bank, Norfund, KfW and others. The fund has an objective of enhancing energy access through small-scale independent power producers and mini-grid projects in Africa (GET.invest, n.d.).

In addition, many COVID-related relief funds were announced, including the Electricity Access Relief Fund managed by Social Investment Management and Advisors (SIMA). Among many of its recent initiatives, in 2020, the United States Agency for International Development (through its Power Africa programme) provided USD 2.6 million in grant money to power nearly 300 health-care facilities in Sub-Saharan Africa. However, despite the announcement of several COVID-related relief funds, only a small amount has actually been disbursed to date. This may be a result of drawn-out approval procedures, which can often take up to a year for most DFIs (Falchetta *et al.* 2022; Wood Mackenzie, 2019).

**Government agencies and intergovernmental institutions** provided additional public funding, primarily in the form of grants. In 2021, an off-grid rural electrification project was launched in Cambodia with funding from the Government of Australia. The project would provide USD 1.54 million in grants under the broader Mekong-Australia Partnership (Niseiy, 2021). Provision of more grants will be essential in nascent markets with substantial access deficits and high (real or perceived) risks that may deter traditional equity and debt investors.

Although off-grid renewable energy investments currently represent a small part of the overall energy access financing landscape, they are crucial to closing the world's large energy access gap (of 733 million people) and engendering just and inclusive economic development. Current investment levels fall far short of the USD 2.3 billion needed annually in the sector between 2020 and 2030 (ESMAP *et al.* 2022b), including on the consumer side to ensure affordability. Improving access to affordable finance, both upstream for project developers and downstream for energy users, will be critical to scaling up the penetration of off-grid renewable energy solutions. New financing approaches and instruments are required to this end, with public sector playing a far larger role (see Chapter 4).

# CONCLUSIONS AND WAY FORWARD


Ground Picture © Shutterstock.com

# 04

Global investments in the energy transition including renewable energy continued to increase in the past couple of years, despite macroeconomic, geopolitical and supply chain challenges. Yet, their scale and scope need to expand significantly to achieve climate and socio-economic development goals.

The current pace of investment is not sufficient to put the world on track towards meeting the climate objectives outlined in IRENA's 1.5°C Scenario. While global investment in renewable energy reached a record high in 2022 (at USD 0.5 trillion), it was less than 40% of the average investment needed each year between 2021 and 2030 (about USD 1.3 trillion in renewable power and the direct use of renewables – see Table 1.1) according to IRENA's 1.5°C Scenario. Investments are also not flowing at the pace or scale needed to achieve the improvements in livelihoods and welfare under the 2030 Agenda for Sustainable Development. For example, investments in off-grid renewable energy solutions in 2021 (at USD 0.5 billion) fell far short of the USD 2.3 billion needed annually in the sector between 2021 and 2030 to accelerate progress towards universal energy access (ESMAP *et al.,* 2022a).

Moreover, investments have become further concentrated in specific technologies and uses, and in a small number of countries/regions. In 2020, solar photovoltaic alone attracted 43% of total investment in renewables, followed by onshore and offshore wind (at 35% and 12% respectively). To best support the energy transition, more funds need to flow to less mature technologies and to sectors beyond power (*e.g.* heating and cooling, transport, energy efficiency and system integration).

More importantly, about 70% of the world's population, mostly residing in developing and emerging countries, received only 15% of global investments in 2020. Sub-Saharan Africa, for example, received less than 1.5% of the amount invested globally between 2000 and 2020. Investments in the region dropped considerably in 2021, to one-quarter of what they were in 2020 even though the world emerged from the pandemic supposedly recognising the critical role energy plays in enabling health care, sanitation and resilient livelihoods. The disparity in renewable energy financing received by developed versus developing countries has increased significantly over the past six years.

In 2015, the renewable energy investment per capita in Europe and North America (excluding Mexico) was about 22 times higher than that in Sub-Saharan Africa, for example. In 2021, investment per capita in Europe was 127 times that in Sub-Saharan Africa, and in North America it was 179 times more (see Section 2.3).

For the energy transition to have a positive impact, governments and development partners need to play a more active role in ensuring a more equitable flow of finance recognising the different endowments and starting conditions of countries. More public funds need to flow to regions and countries that have a lot of untapped potential but find it difficult to attract investment. These funds need to go into supporting energy transition infrastructure development, enabling policy frameworks as well as address persistent socio-economic gaps.

This chapter begins with a discussion on the limitations of using public funds mainly for de-risking investments and highlights the need for a much stronger role for public financing. Recognising the limited public funds available in the developing world, the need for stronger international collaboration including a substantial increase in financial flows from the Global North to the Global South is discussed. The chapter then goes into the different sources, intermediaries and policy instruments that can channel public financing into the energy sector and the whole economy, to support a just and inclusive transition. The chapter discusses how lending to developing countries must be reformed and how the way public investment can be used to crowd in private investment needs to be more innovative.

## 1 Investments have been primarily led by the private sector while public policy and funds have focused on derisking investments. Although this approach has proven effective in many countries, it has its limitations.

Private investments made up almost 70% of the total investments in 2020 (USD 240 billion)[1] and went mainly to relatively advanced economies. The disproportionate flow of investments towards mature technologies/applications and specific markets reflects a key characteristic of mainstream private capital: it favours lower-risk investments and prioritises financial returns over social, environmental, and climate-related gains. As such, private capital tends to go to countries with lower real or perceived risks, or into frontier markets only when effective risk mitigation facilities are provided, while a large portion of the world's population remains underserved. When capital does flow to higher-risk environments, it generally does so at a much higher cost (see Box 4.3). This means that the lowest income populations end up paying the most for (often basic) energy which is universally recognised as essential for alleviating poverty and promoting socio-economic advancement. This necessitates a much stronger role for public financing in these contexts and not fully relying on private capital which may keep widening the disparities.

[1] *Investment data by source of funding are available only up to 2020.*

But public funds are limited, so governments have been focusing what is available on derisking projects and improving their risk-return profiles to attract private capital. Risk mitigation solutions have been used to lower the risks associated with renewable energy projects' ability to repay obligations. Such risks stem from uncertainties regarding government actions (political, regulatory, policy), macroeconomic conditions (*e.g.* currency risks), off-taker creditworthiness, force majeure events, and others. Among risk mitigation instruments, sovereign guarantees have been preferred for lenders looking to obtain a "one-size-fits-all" solution for credit risks. But such guarantees are treated as contingent liabilities by regulators, credit-rating agencies and international institutions such as the International Monetary Fund and may hamper a country's ability to take on additional debt for critical infrastructure development and other investments (IRENA, 2020a).

Moreover, sovereign debts are already stressed to their breaking point in many emerging economies grappling with high inflation and currency fluctuations or devaluations in the wake of the COVID-19 pandemic. In 2020, sovereign debt defaults hit a record high, three times greater than in 2019. Among the defaulting countries were Argentina, Ecuador, Lebanon, Suriname and Zambia (Fitch Wire, 2021); many other countries are at high risk of sovereign default. In this macroeconomic environment, many countries cannot access affordable capital in international financial markets or provide sovereign guarantees as a risk mitigation instrument. Given the urgent need to step up the pace and geographic spread of the energy transition, and to capture its full potential in achieving socio-economic development goals, more innovative instruments are needed that help underinvested countries reap the long-term benefits of the energy transition without putting their fiscally constrained economies at a further disadvantage (see Sections 4.5 and 4.6).

Moreover, a more comprehensive way of defining risk (including risk sharing) is needed. The narrow focus on the risk of investment in energy assets not paying off - from the perspective of returns-to-investors only - needs to be broadened to include environmental, planetary, and social risks. These include the risk of leaving a large part of the population out of the energy transition and locked in underdevelopment, and the risk of Sustainable Development Goals remaining far from being met. This is how investment risks must be viewed from the perspective of governments and the international community. And with the very limited public funds available in the developing world, the international community must step up.

## 2 The majority of public investments are made from national sources with relatively little international collaboration. The international flow of public money to renewable energy has been in decline since 2018.

State-owned financial institutions (SOFIs), national development finance institutions (N-DFIs) and state-owned enterprises (SOEs) were the main sources of public finance for renewables in 2020, providing more than 80% of public finance (which totalled USD 108 billion).

Public finance flows to the Global South are essential to achieving the 1.5°C Scenario along with the socio-economic benefits that can be achieved (together with progressive fiscal measures and other government programmes such as distributional policy, as outlined in IRENA [2022a]). For instance, almost 80% of investments in off-grid renewables between 2010 and 2021 involved North–South flows (see Section 3.3.2). However, the international flow of public finance going to renewable energy has been in decline since 2018 (IEA, IRENA *et al.* 2022). Multilateral DFIs provided less than 2% of total renewable energy investments in 2020, while commitments from bilateral DFIs fell 70% from 2019 to USD 2.3 billion, or less than 0.5% of total investments. The minuscule shares of investment coming from multilateral and bilateral DFIs are cause for concern given the pressing need to increase investments to drive a just and equitable energy transition. Even debt financing at market rates (requiring repayment with interest rates charged at market value) is on a decline while grants and concessional loans amounted to just 1% of total renewable energy finance. The Just Energy Transition Partnership (JETP), launched at COP26 as an innovative model for providing funding baskets from donor countries – mainly G7 countries – to support developing countries in their energy transitions, but it mainly provides loans with very few grants (Box 4.1).

### Box 4.1 The Just Energy Transition Partnership

The Just Energy Transition Partnership (JETP) is an example of financing cooperation mechanism presented as a package to support developing countries in their energy transitions in a just way. It aims for early retirement of coal-fired power plants and mobilising private sector capital to decarbonise the economy while ensuring a just transition for citizens.

The JETP provides funding baskets from donor countries and relies on self-defined pathways developed by beneficiary countries to address their energy transition needs. Its emphasis on justice includes a focus on skills training and job creation for those adversely affected by the energy transition. More than one year into the implementation of the JETP, the following points were noted:

**The majority of existing JETP financing packages consist of loans. Beneficiaries of the JETP must stand firm on the appropriate financing terms to avoid increased sovereign indebtedness.** South Africa's JETP financing package comprises 81% loans and only 4% grants, while the rest are guarantees. The indicative mix for Viet Nam's JETP financing package is 1.3% grants, and the remainder loans (Chinh, 2022). Grants should play a bigger part of the financing packages in order to give beneficiary countries a socially just funding scheme. The skewed grant/loan mix can be addressed by providing funding from donor countries largely in the form of grants; opting for debt-for-climate swaps;[a] raising loans to private sector entities commercially instead of giving companies funding from the JETP scheme (Naudé, 2022).

**Relying solely on the JETP's financing support will not be enough to meet each beneficiary's investment requirement for a just energy transition.** This is evidenced in the case of South Africa's Just Energy Transition Investment Plan (JET-IP), which laid out a USD 98 billion requirement for its energy transition. The JETP deal will make up less than 10% with 8.5 billion. Meanwhile, Indonesia's USD 20 billion deal is only a small fraction of its indicative requirement of USD 3.5 trillion for a sustainable energy overhaul. The Indonesian government is pursuing multiple energy transition packages from different sources and donors simultaneously to attract funding (Gunfaus *et al,* 2022).

**The "just" elements are the hardest to establish and finance.** This can be seen in South Africa's JET-IP, where economic diversification and innovation and skills development make up only 0.4% of the total amount planned. In addition, grants account for only 4% of the JETP funding package, making South Africa vulnerable to risks associated with privatisation which might also apply for other beneficiary countries.

The JETP's proposed reforms align with a power sector restructuring agenda promoted across the Global South since the 1990s, albeit with uneven success (Hadley, 2022; Sward, 2022; WWF, SACAN and IEJ, 2022). IRENA's study *RE-organising power systems for the transition* shows the need for a different power system organisational structure that can support the energy transition and the power systems of the future while avoiding potential misalignments (IRENA, 2022f; 2022h).

**To live up to the expectations of an innovative funding mechanism, the JETP's financing packages must strive to adopt a holistic approach and be country-owned.** Historically, donors have chosen piecemeal projects that catered to their preferences, leading to fragmented development and investment plans across developing countries. The JETP is expected to be comprehensive, covering all sectors and all citizens. Thus, negotiations for JETP financing packages must not skew to donor preferences, and accompanying plans must be country led and country owned (Gunfaus *et al.* 2022).

[a] **Debt-for-climate swaps** *involve a bilateral or multilateral donor, private investor, or non-governmental organisation, writing off or paying off a portion of a country's foreign debt in exchange for the country financing climate change adaptation and mitigation projects using local funds. Between 1991 and 2003, debt-for-nature swaps generated almost USD 1.1 billion for conservation measures, in return for debt with face value volumes of almost USD 3.6 billion (Naudé, 2022).*

Public funding for renewable energy finance (and climate finance more broadly) has faced several challenges in a deteriorating global economic context, especially in the past three years. The recent macroeconomic and geopolitical challenges have required both developed and developing countries to divert attention and funds towards adjustment policies to tackle inflation, disruptions of supply chains, food shortages and slow growth, creating a very challenging economic context where renewable energy investments are competing for increasingly scarce public resources. Renewable energy investments are therefore facing increasing constraints as governments consolidate and rebuild the fiscal space and tackle high public debt. This has led to additional challenges in mobilising public, concessional and blended financing, particularly in the developing world.

Yet, even in this context, as shown in IRENA's report *Post-COVID Recovery: An Agenda for Resilience, Development and Equality*, energy transition investments can pave the way for equitable, inclusive and resilient economies (IRENA, 2020d). For that, international collaboration between the Global North and the Global South, and North-South flows of public financing will be key (see Section 4.4). Such financing can take the form of capital transfers through official development assistance (ODA) including donations and grants, concessional and market rate financing from DFIs and export credit agencies (ECAs); capitalisation of multilateral and UN-linked funds (such as the Green Climate Fund) or programmes from international organisations (such as IRENA's Energy Transition Accelerator Financing – Box 4.2) to support renewable investments in less-developed countries, including guarantees; and issuance of commercial and debt obligations (government, N-DFIs and DFIs) such as power purchase agreements (PPAs). Carbon emission permits and off-setting markets play a secondary but relevant role in complementing financing.

**Box 4.2 Energy Transition Accelerator Financing**

The Energy Transition Accelerator Financing (ETAF) platform is an inclusive, multi-stakeholder climate finance platform managed by IRENA that facilitates capital mobilisation to finance feasible renewable energy projects in developing countries. As of February 2023, the platform had received pledges from four institutions, amounting to USD 900 million to deploy approximately 1.5 GW of renewable energy projects by 2030. The ETAF aims to:

- Facilitate and build a geographic and technologically diversified pipeline of bankable renewable energy projects in developing countries;
- Provide technical assistance to eligible projects to ensure bankability regarding economic, environmental, and social sustainability and implementation readiness; and
- Mobilise funding resources from international financial institutions, such as multilateral development banks, development finance institutions and the private sector, to fund eligible projects' capital expenditures.

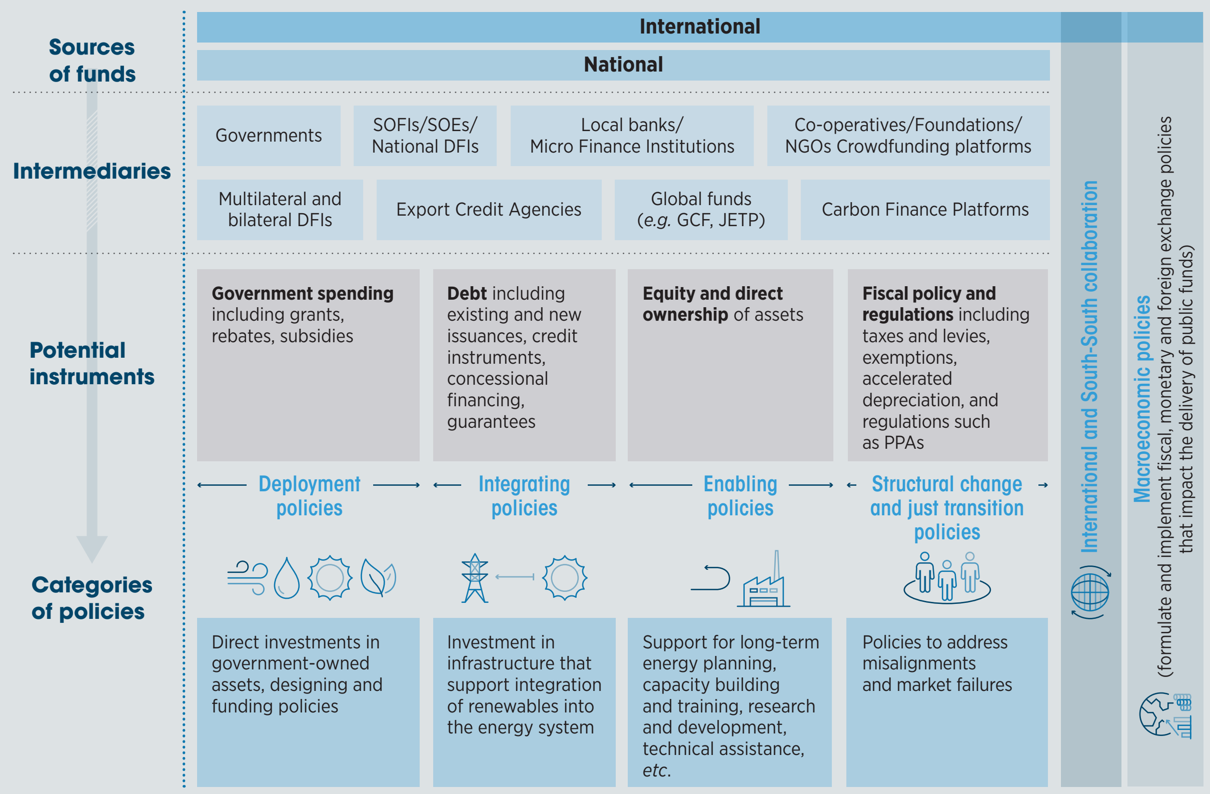
**Source:** (IRENA, 2022i).

## 3 To achieve a just and inclusive energy transition, public financing - including through international collaboration - has a critical role to play across a broad spectrum of policies.

Public funding must flow into the renewable energy sector (covering all segments of the value chain), the wider energy sector and the economy as a whole, for a just and equitable energy transition. Public funds can be mobilised and provided using a variety of instruments. Figure 4.1 shows the types of instruments that can be used to channel public finance, the sources of public funds (either national government or international through collaboration), and the intermediaries that can help channel them (N- DFIs, local banks, multilateral and bilateral DFIs, ECAs, special purpose vehicles and funds including UN-linked funds such as the Green Climate Fund).

These instruments can be existing or newly designed and may include (1) government spending such as grants, rebates and subsidies; (2) debt including existing and new issuances, credit instruments, concessional financing and guarantees; (3) equity and direct ownership of assets (such as transmission lines or land to build projects); and (4) fiscal policy and regulations including taxes and levies, exemptions, accelerated depreciation, deferrals, and regulations such as PPAs (especially when the tariffs paid to producers – in addition to the cost of running the system - are lower than what is collected by consumers and the difference is paid through a government subsidy).

**Figure 4.1** The flow of public finance for a just and inclusive energy transition




As show in in Figure 4.1, public finance flows via instruments in various policy categories of IRENA's broad policy framework. Examples include the following:

a. Under **deployment policies**, public funds can flow as direct investments in government-owned energy transition-related assets, public-private partnerships, or in designing and funding policies that can attract or support private investment (*e.g.* capital subsidies, grants and tariff-based mechanisms such as auctions, FiTs and FiPs).

b. Under **integrating policies**, public investments can go into infrastructure and assets that support the integration of renewables into the energy system (*e.g.* regional and national transmission lines, pumped hydroelectric energy storage facilities).

c. Under **enabling policies,** public money can support long term energy planning, capacity building and training, research and development, as well as technical assistance offered via multilateral development banks (MDBs) and inter-governmental organisations such as IRENA.

d. Under **structural change and just transition policies**, public funds can go into the redesign of power markets to make them more conducive for large shares of variable renewable energy, towards the development of local industry and value chains, or towards compensation for the phasing-out of fossil fuels, as well as policies to ensure that the energy transition promotes gender equality and social inclusion, among many other priorities.

e. **The global policy framework defines** international and South-South collaboration which is key to structuring and ensuring the international flows from the Global North to the Global South.

f. In addition, although not directly related to any specific sector, there are **macroeconomic policies** (fiscal, monetary and currency exchange policies) that affect the delivery of public funds towards the energy transition (Table 4.1)

**Table 4.1** Macroeconomic policies that affect the delivery of public funds

| Macroeconomic policies that impact the flow of public finance | |
|---|---|
| **Fiscal policies** | Set out the size and scope of a country's "credit line" (government funds) through spending and taxes to finance, incentivise and guarantee economic activities including Official Development Assistance programmes. |
| **Monetary policies** | Establish the pace of economic activities by controlling money supply to the economy to influence interest rates. They influence the cost of a country's "credit line", its stability and credit rating. |
| **Foreign exchange policy** | Connects the country's economic activities with the rest of the world through the exchange rate, indicating the relative comparative advantage of a country vis-à-vis its partners and competitors. It also affects international trade and current accounts where investments are repaid (loans, hard currency denominated power purchase agreements, *etc*). |

Some elements presented in the framework (Figure 4.1) might overlap. For example, tax incentives are at the same time fiscal policies while acting as deployment policies, and funding grid infrastructure can be viewed as an enabling or an integrating policy. While funding capacity building is part of an enabling policy, these funds also facilitate structural change, being part of social development programmes, and education, social protection and compensation policies, *etc.* Thus, there are complex inter-linkages and feedback loops between the different policies and instruments. By understanding the broad structural workings underlying the renewable energy "economy", public policy and financing can be strategically used to advance the energy transition.

## 4 The availability of capital for public investments in renewable energy will need to be increased, and lending to developing nations transformed.

Today's environment calls for a fundamental shift in how lending is made to developing nations, especially those affected by economic and climate crises, and how countries in the Global North support countries in the Global South to cope with and adapt to crises related to climate change, the cost of living and debt (which has been compounded following the COVID-19 pandemic and climate-related disasters). The situation in developing countries is being made more difficult amid tightening monetary policies and a strengthening US dollar. One in five countries is experiencing fiscal and financial stress, which if left unaddressed would deepen hardship, increase debt defaults, widen inequality and delay the energy transition. The Bridgetown Initiative, proposed at COP27 (Box 4.4), offers a roadmap for navigating such complexities.

Meanwhile, a decision was reached at COP27 to establish a loss and damage fund, particularly for those nations most vulnerable to climate events. Details regarding the amounts involved, and how the facility will be set up and operationalised are yet to be negotiated. The fund is expected to address adverse effects of climate impacts such as droughts, floods, rising seas and other disasters, which also impair the deployment of renewable energy.

### Box 4.3 The Bridgetown Initiative

Barbados is one of the most vulnerable nations to climate change. To address these vulnerabilities, the island's first woman prime minister Mia Mottley is championing the Bridgetown Initiative, a proposal to reform development finance including from the World Bank and the International Monetary Fund, which were set up in 1944 to repair economies and promote co-operation after World War II and the Great Depression of the 1930s. This comes at a time when rich countries are able to borrow capital with interest rates of between 1% to 4% while poorer countries – which are seen as riskier investments – pay interest rates of around 14%. Without access to concessional funding there is no way developing countries can fight climate change.

The initiative calls upon global leaders to act now to save countries:

1. **Providing emergency liquidity and changing some of the terms around how funding to developing countries is loaned and repaid.** The initiative calls upon the Board of the International Monetary Fund to: (i) return access to its unconditional rapid credit and financing facilities to previous crisis levels; (ii) temporarily suspend its interest surcharges; (iii) re-channel at least USD 100 billion of unused Special Drawing Rights to those that need it and (iv) operationalise the Resilience and Sustainability Trust. At the same time the initiative urges G20 members to approve an ambitious Debt Service Suspension Initiative encompassing multilateral development bank loans to the poorest countries, and COVID-related loans to middle-income countries. The aim is to stop developing nations from spiralling into a debt crisis, especially when their borrowing is forced by disasters like floods, droughts and storms.

2. **Expanding multilateral lending to governments by USD 1 trillion to address systemic challenges that are the heart of the current crises.** Multilateral development bank shareholders are asked to increase their risk appetite and provide new guarantees to expand lending to governments by USD 1 trillion. New concessional loans should prioritise achieving the Sustainable Development Goals and building climate resilience in vulnerable countries.

3. **Activating private sector savings for climate mitigation and fund reconstruction after a climate disaster through new multilateral mechanisms.** Most climate-vulnerable countries do not have the fiscal space to adopt new debt. There is a need for a global mechanism for raising reconstruction grants for any country hit by a climate disaster.

**Sources:** Barbados Ministry of Foreign Affairs and Foreign Trade (2022); Masterson (2023).

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Tapping pools of public funds for both developed and developing countries without burdening the fiscal space remains a key priority. Governments should adopt a *"doing more with what is available"* approach through enhanced collaboration among DFIs and MDBs, and by exploring the following mechanisms:

**Capital release from balance sheets of DFIs.** Balance sheets of investors and financial institutions in general disclose rights and obligations connected to the owning and lending of assets. It is possible for DFIs to use those elements to raise additional funds through two mechanisms: (1) posting existing assets as collateral (provided their value is free-and-clear of any encumbrances *i.e.* when assets such as shares are not pledged to any other lender as financial collateral); and (2) partially repackaging receivables from guaranteed loan repayments (*e.g.* loans that are guaranteed by insurers) into new financial structured products in the market. In practice, the DFIs could offer a (high rated) new debt product (*e.g.* a collateralised debt obligation)[2] guaranteed and managed by a bank such as an MDB to qualified investors (*e.g.* pension funds, insurers, institutional investors, *etc.*) and traded on international exchanges. The new debt obligation product's proceeds would be used in new investments.

The process is not new to lending institutions, but still practiced below prudent levels by public financial institutions, leaving unused sources of public funds that could become available to governments. Developed countries investing in renewable energy could further monetise current loan receivables which in turn can be accounted as *de facto* additional donors' contributions to ODA/DFI/ECA programmes. However, the use of such products should be done with rigorous due diligence.

**Product innovation among MDBs.** Multilaterals benefit from the convening power granted by shareholders in both developed and developing countries, to craft, implement and operate innovative frameworks to mobilise capital and mitigate risks. In particular, liquidity facilities can be scaled up to assist renewable energy investors fulfilling their business obligations by ensuring an uninterrupted flow of payments from off-takers without posing a burden on the fiscal space of developing countries (local- currency-denominated PPAs can also benefit from this facility). These liquidity facilities can evolve to incorporate the role of guarantor supported by MDBs and DFIs in compliance with guidelines issued by multilaterals and agreed by shareholders. The highly capitalised guarantor becomes a supranational facility to mitigate credit and foreign exchange risks for renewable energy investors and lenders. MDBs, under the approval of host governments, can allocate funds and credit lines to the facility up to prudent limits determined by Ministries of Finance and Central Banks. Box 4.4 showcases liquidity facilities supported by the World Bank, the German development bank KfW and the Nairobi-based African Trade Insurance.

[2] *Collateralised debt obligations are asset-backed securities that bundle together a diversified portfolio of instruments (e.g. loans, bonds). Cash flows from underlying assets are used to repay investors.*

**Box 4.4** **Liquidity facilities supported by the World Bank and KfW-ATI**

The West African Power Pool (WAPP) was launched in 1999, inspired by the Energy Chart and responding to accelerating electricity access in the Economic Community of West African States (ECOWAS). The Member States adopted the Energy Protocol in 2003, followed by two critical energy programmes to address energy shortage, and fast-track the energy security and economic integration of the sub-region. The WAPP programme set out to promote and develop power generation and transmission facilities, a regional electricity market and the co-ordination of power trade between the Member States. The integration benefits bring together resources in the east and hydropower in the west, and more recently renewable energy from the northeast (sun corridor). Resource development was carried out by the private sector and national utilities, interconnected by projects financed by the World Bank and African Development Bank over 20 years of an investment programme.

The WAPP has faced significant payment arrears and led ECOWAS to approve a Directive on Securitization of Cross-Border Power Trade in 2018. Payment arrears triggered the intervention of Member States several times, jeopardising the intrinsic nature of the regional integration market. The directive established the security of cross-border power trade through secured supplies and payments and entered into force in January 2020. It steered finance and economic ministries to pursue the power sector's financial sustainability and creditworthiness of counterparties. The decision also invited multilaterals to support implementation of the directive, freeing up budgetary funds for other productive purposes.

The World Bank approved a Development Policy Financing (DPF) in June 2020 to support ECOWAS's directive on the securitisation of contracts. The USD 300 million facility was established in consultation with the affected Member States and included grants and loans. The DPF provides access to currency and payments, cushioning ministries of finance to back utilities and fulfil payment obligations. Burkina Faso, Guinea, Ivory Coast, Liberia, Mali and Sierra Leone are the participating concessional borrowers.

The DPF is based on prior actions (enabling policies) connected to clear objectives and measurable indicators. Its objective is to "increase energy security, reduce vulnerability to international oil price fluctuations and reduce the fiscal burden of the electricity sector through increased energy trade" in the six participating countries (World Bank, 2020). The DPF created a *de facto* liquidity facility for participant sovereigns to improve electricity exchange with indicators reflecting governments' enabling policies.

A Regional Liquidity Support Facility (RLSF) has also been spearheaded by the German development bank KfW and African Trade Insurance (ATI). This is another example of a facility that provides short-term liquidity support for power producers in Africa via letters of credit issued by local banks who are in turn backed by the RLSF. It covers short-term liquidity risk in case of an off-taker's non-payment of electricity to the power producer, improving the overall project's creditworthiness.

The RLSF has two components – a cash collateral and an on-demand guarantee. The cash collateral is used by qualified banks to immediately pay the independent power producer if the letter of credit supporting electricity payments is called. The German government, through KfW, made EUR 31 million available to ATI for this purpose. The on-demand guarantee has the same amount as the cash collateral component and is provided by ATI. The guarantee is used in the event the cash collateral is exhausted.

**Source:** Barbalho *et al.* (2022); African Trade Insurance (2022).

**Broadening capitalisation routes for MDBs.** Capital calling from shareholders has been the common approach adopted by multilaterals to expand technical assistance and lending programmes - *e.g.* triennial capital replenishment by donors to fund the International Development Association investment programme managed by the World Bank. The new capital increases MDBs' fund availability and enables them to place bonds in the global capital market, thereby raising additional capital. Bonds are placed as AAA-rated obligations guaranteed by MDBs – *de facto*, such institutions have an enviable track record recognised by countries and market participants in managing risks - that can be placed in the market, if appropriate financing vehicles are used and target markets are identified.

MDBs should now consider risk-tiered debt obligation placements with a different investment grade (BBB+ and above, *e.g.* multi-rated green bonds), implying different level of returns to bondholders. The initiative broadens access to the investor base – from institutional investors and sovereign wealth funds to corporate/qualified investors – increasing the amount of capital that could become available and deployed in renewable energy investments.

## 5 Meanwhile, public finance and policy should continue to be used to crowd in private capital. Policies and instruments beyond those used to mitigate risks are needed.

Public finance should continue to be used strategically to crowd in additional private capital. Risk mitigation instruments (*e.g.* guarantees, currency hedging instruments and liquidity reserve facilities) will still play a major role, but public finance and policy must go beyond risk mitigation. Examples include funding capacity building, support for pilot projects and innovative financing instruments such as blended finance initiatives, *etc.* In addition, policy makers may consider the following:

**Incentivise an investment swap from fossil fuels to renewable energy by banks and national oil companies**. Swapping significant investment from fossil fuels to renewable energy is necessary for achieving IRENA's 1.5°C Scenario.

Since the Paris Climate Agreement, large multi-national banks maintained (and even increased) their investments in fossil fuels, spending an average of USD 750 billion dollars a year. On a cumulative basis, the world's 60 largest commercial banks invested around USD 4.6 trillion in fossil fuels between 2015 and 2021. Incentivising investors to divert funds towards the energy transition can be done through measures such as phasing out of fossil fuel subsidies and adapting fiscal systems to account for the environmental, social, and health impacts of a fossil fuel-based energy system (IRENA, 2022a). This will help level the playing field between fossil fuels and energy transition technologies, and factor into investment decision-making. A supplemental way of incentivising this shift is through highlighting and recognising the leadership role of those institutions that are paving the road through investments in the energy transition. More than 30 significant financial institutions including banks, insurers, asset owners, and asset managers have committed to stop financing fossil fuels. Governments and civil societies can take steps to reward their leadership and encourage other institutions to take similar steps. After that, public pressure, along with policy and regulation, can further influence financial decision-making in favour of renewable energy and other energy transition technologies. (Environmental Finance, 2022).

As for national oil companies, on the long run, the transition could be facilitated if royalties/ government-take associated with hydrocarbon production, for example, could be partially offset by royalties/levies from the use of land and ocean areas for renewable energy projects, once the sector matures and no longer requires support. As an example, the expected growth of offshore wind assets could potentially contribute to generating royalties to replace those from fossil fuels and support the reallocation of public funds towards the energy transition. As renewable energy is at early stages of becoming the "new normal" for energy companies, governments and project investors would be able to fully transition to a low-carbon environment while sustaining returns.

**Mobilise institutional investment and promote greater use of green bonds for renewables.** With about USD 87 trillion of assets under management, institutional investors have a key role to play in reaching the investment levels required for the ongoing global energy transition. Greater participation of institutional capital will require a combination of effective policies and regulations, capital market solutions that address the needs of this investor class (*e.g.* green bonds), as well as a variety of internal changes and capacity building on the part of institutional investors (IRENA, 2020d).

Green bonds can help attract institutional investors and channel considerable additional private capital in the renewable energy sector, helping to fill the significant outstanding investment gap. Some recommended actions for policy makers and public finance providers to further increase green bond issuances include the adoption of green bonds standards in line with international climate objectives, the provision of technical assistance and economic incentives for green bond market development, and the creation of bankable project pipelines (IRENA, 2020e).

**Implement regulatory sandboxes for broadening access to capital and credit instruments.** Regulatory sandboxes designed to serve broader social and environmental goals can help unlock more investments. In recent years for example, retail investors (*e.g.* Charles Schwab International) have used digital technology to connect investment opportunities to broader pools of capital, whereas previously these were only available to financial institutions and qualified investors. Many of these innovations were initiated through a regulatory sandbox which creates a space for entrepreneurs and companies to test innovative solutions, as they are granted (temporary) regulatory waivers and exemptions (EMA, n.d.). Such an approach can be used to further experiment and pilot new approaches towards financing renewable energy.

By enacting regulatory sandboxes for start-ups and investors for both grid and off-grid initiatives, new solutions may emerge towards enabling access to pools of capital/credit instruments. Such initiatives can benefit from MDBs support (Barbalho *et al.* 2022) in connection with other available funding agencies at local, regional and global levels. Furthermore, companies can be invited to participate in the sandbox with a view to pilot innovative concepts that facilitate risk mitigation, including foreign exchange risks in electricity exchanges. For example, in the off-grid renewable energy sector, the advent of innovative technologies (blockchain, Internet of Things), business models (*e.g.* PAYG) and financing platforms (*e.g.* crowdfunding) (see Chapter 3) helped connect a larger pool of customers, investors and solution providers.

**Facilitate local currency lending and denominate PPAs (at least partially) in local currencies.** Local currency PPAs are helpful to address the risks of currency devaluations which may otherwise cripple power off-takers' ability to make payments to power producers in hard currency (such as the USD) at times when the domestic currency plummets. The approach has two significant advantages: mitigate impacts of foreign currency fluctuations on PPA payments and stimulate local financial markets and investors to engage in renewable energy investments. Such an arrangement is more readily acceptable if project financiers are also domestic, such as the national development bank, local lenders and institutional investors – for example, pension funds and insurance companies (IRENA, 2020a). MDBs have participated in such endeavours with considerable experience in assisting borrowers and lenders to address foreign currency fluctuation through liquidity and risk mitigation facilities (Box 4.5). A complementary mechanism to address foreign currency risks is to facilitate local currency lending for projects with development capital channelled through intermediaries including national banks or non-banking financial institutions. Several countries, including Bangladesh, Brazil and Jordan, have piloted such approaches to catalyse investment into the renewable energy sector.

**Enhance the participation of corporate actors.** Although companies that produce renewable energy are already providing substantial investment in the sector, non-energy-producing corporations have a preeminent role to play in the energy transition by driving demand for renewable energy. By setting up the right enabling framework, policy makers can encourage active corporate sourcing and unlock additional capital in the sector. Recommended actions include, for example, establishing a transparent system for the certification and tracking of renewable energy attribute certificates, enabling third-party sales between companies and independent power producers, and creating incentives for utilities to provide green procurement options for companies (IRENA, 2018b).

**Box 4.5 Risk mitigation in partially denominated PPAs in local currency**

The Nan Theun 2 (NT2) hydropower project in Lao PDR utilised one of the most advanced credit enhancement and foreign exchange risk mitigation structures designed by multilateral development banks in 2005. The hydropower dam developed on the Nam Theun River has an installed capacity of 1,070 megawatts (MW) of which 995 MW are destined for export to Thailand through a power purchase agreement with the Electricity Generating Authority of Thailand (EGAT). The cost of the project amounted to USD 1.45 billion, with USD 1 billion of debt and USD 450 million of equity. The debt structure had two tranches: (1) USD 500 million obtained through various loans with multilateral/bilateral agencies and commercial financial institutions; and (2) USD 500 million denominated in Thai bhat (THB) provided by Thai banks.

The Nan Theun 2 (NT2) hydropower project in Lao PDR mitigated foreign exchange risks through market-based instruments and liquidity facilities. EGAT's PPA payment for electricity imports has two components: the THB-denominated tranche is paid directly to Thai banks, and the USD-denominated portion is paid in accordance with the rules of the Central Bank of Thailand. In addition, NT2 has a facility to mitigate foreign exchange risk through guarantees of USD 295 million from export credit agencies and multilateral development banks, of which USD 90 million is for a short-term revolving liquidity facility provided by the Asian Development Bank and the International Development Association. The Multilateral Investment Guarantee Agency also provided USD 45 million of guarantees as convertibility and currency transferability insurance.

**Source:** Barbalho *et al.* (2022).

**Incentivise the participation of philanthropies**. According to Oxfam's report titled *Survival of the Richest: How we must tax the super-rich now to fight inequality*, the richest 1% own almost half of the world's wealth while the poorest half of the world own just 0.75% (Oxfam, 2023). To tap into the existing wealth, governments should look at incentivising philanthropies to mobilise additional funds into support for renewable energy that can help fight poverty, inequality, climate change, and humanitarian crises. Philanthropies are playing an increasingly important role in bridging funding gaps, especially in the energy access context, where funds have gone into market development (*e.g.* technology innovation funds) and delivering financing for end users and enterprises through various instruments, such as results-based grants and equity. In 2021, individuals, bequests, foundations and corporations gave an estimated USD 485 billion to charities in the United States alone. These were distributed towards education, human services, foundations, public-society benefit organisations, health, international affairs, environmental and other social services (Giving USA 2022, 2022). The energy transition being tied to all these objectives, tapping into these funds can help fill gaps left by governments to help poorer populations grow without relying on fossil fuels (Dennis, 2022).

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