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International Renewable Energy Agency

GLOBAL LANDSCAPE OF RENEWABLE ENERGY FINANCE 2020

IRENA
International Renewable Energy Agency

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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. **www.irena.org**

About CPI

Climate Policy Initiative (CPI) is an analysis and advisory organisation with deep expertise in finance and policy. Our mission is to help governments, businesses, and financial institutions drive economic growth while addressing climate change. CPI has six offices around the world in Brazil, India, Indonesia, Kenya, the United Kingdom, and the United States.

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Meeting international climate and development objectives will require a massive re-allocation of capital toward low-carbon technologies, including renewables, and the mobilisation of all available capital sources

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ABBREVIATIONS

°C	degree Celsius
C&I	commercial and industrial
CIP	Climate Investment Platform
COVID-19	Coronavirus disease
CPI	Climate Policy Initiative
CSP	concentrated solar power
DFI	development finance institution
GW	gigawatt
IRENA	International Renewable Energy Agency
LCOE	levelised cost of electricity
LDC	least developed country
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
PAYG	pay-as-you-go
PV	photovoltaic
SDG	Sustainable Development Goal
SHS	solar home system
SIDS	small island developing states
TWh	terawatt-hour
the Lab	Global Innovation Lab for Climate Finance
USD	United States dollars

KEY FINDINGS

- Renewable energy investment reached USD 322 billion in 2018, with modest growth seen to continue through 2019. However, the pace must accelerate considerably for the world to meet internationally agreed climate goals.
- To ensure a climate-safe future, annual investment in renewables – including various types of power generation, solar heat and biofuels – would have to almost triple to USD 800 billion by 2050.
- With the onset of the COVID-19 pandemic, renewable energy investments dropped by 34% in the first half of 2020, compared to the same period the year before.

Five-year trends in renewable energy investment (2013-2018)

- Despite an investment dip seen in 2018 due to lower technology costs, the total installed capacity of renewable power continued growing.
- Solar photovoltaic (PV) and onshore wind power technologies consolidated their dominance in 2013-2018, attracting, respectively, 46% and 29% of the world's renewable energy investments over the five-year period.
- Solar thermal investments (6%), including concentrated solar power (CSP) and solar heating systems, have gradually slackened. They have fallen behind offshore wind (7%), which has held the third-largest investment share among renewables since 2014. Hydropower represented 4% of investments over the period, while other renewables accounted for just 3%.

Capital sources

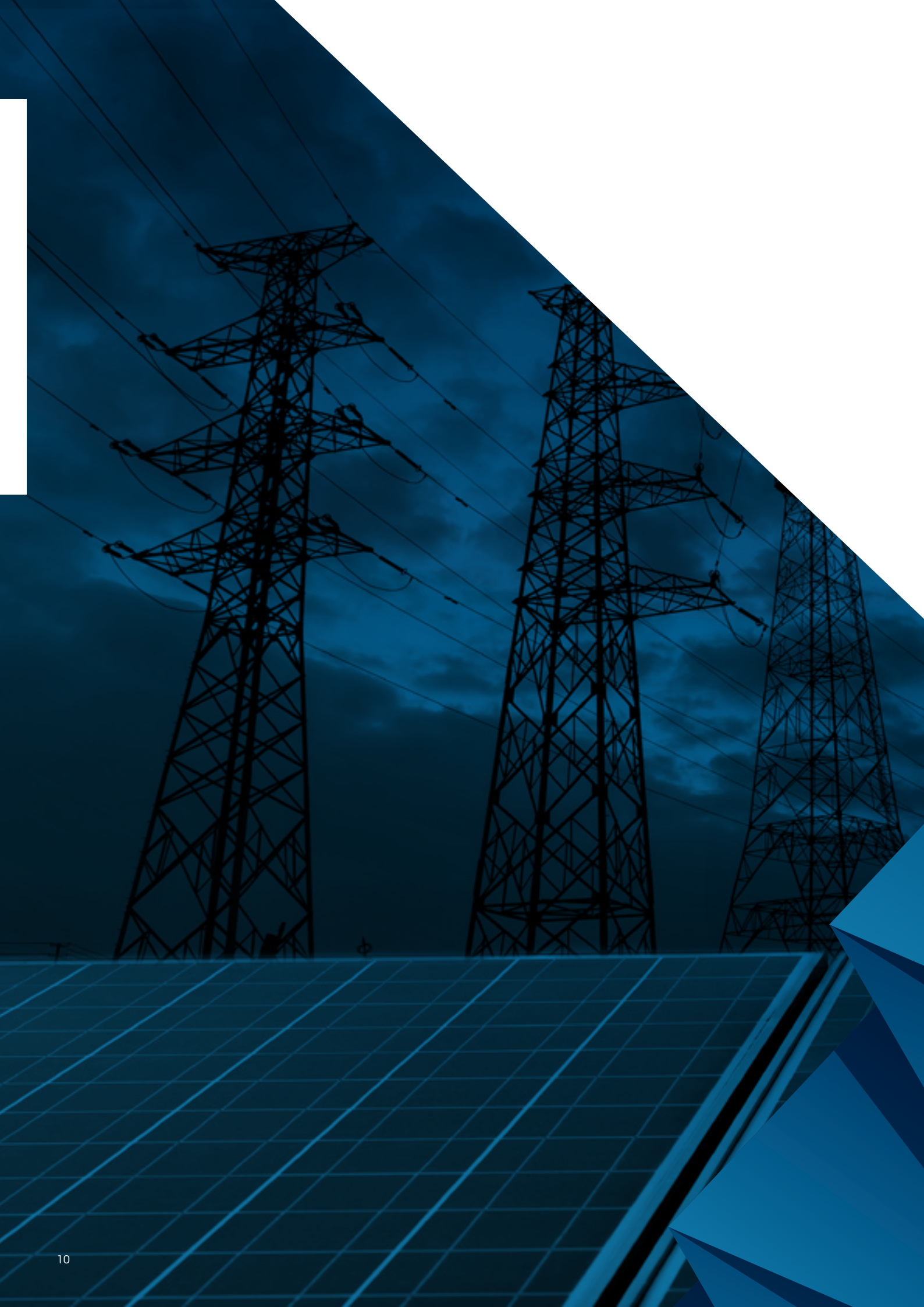
- The private sector remains the main provider of capital for renewables, accounting for 86% of investments in the sector between 2013 and 2018. Project developers provided 46% of private finance, followed by commercial financial institutions at 22%.
- Project-level equity was initially the most widely used financial instrument, linked to 35% of the investments in renewables in 2013-2016. Since 2017, it has been overtaken by project-level conventional debt, which reached 32% in 2017-2018.
- Public finance, representing 14% of total investments in renewables in 2013-2018, came mainly via development finance institutions. Public financing resources, although limited, can be crucial to reduce risks, overcome initial barriers, attract private investors and bring new markets to maturity.

Regional distribution

- East Asia and Pacific attracted the largest share of renewable energy investments, with 32% of global financial commitments over 2013-2018, mainly driven by China. Western Europe and the OECD countries of the Americas – including Canada, Chile, Mexico and the United States – followed, with 19% and 18% of the world's investments in renewables, respectively.
- Regions dominated by developing and emerging economies remained consistently under-represented, attracting only 15% of the global total for 2013-2018, mostly concentrated in Latin America and the Caribbean (5%), South Asia (4%) and the Middle East and North Africa (2%).

Off-grid renewable energy finance

- Annual financial commitments to off-grid renewables reached USD 460 million in 2019, up from USD 429 million the year before, an estimated USD 21 million in 2013 and just USD 250 000 known worldwide in 2007. Yet even now, off-grid renewables still represent only 1% of the overall finance for projects to expand energy access.
- Private investors provided the bulk of financial support for off-grid renewables, accounting for 67% over the last 13 years (2007-2019). Private equity, venture capital and infrastructure funds contributed the most, with 35% of the total. Institutional investors appeared relatively inactive in off-grid renewables, apart from private foundations.
- Development finance institutions were the largest public capital providers, representing 67% of public investment over the period. Conversely, the role of government agencies and intergovernmental institutions declined significantly, from 21% of total investment in 2013 to only 2% in 2018, and further to 1% in 2019. Compared to energy access projects overall, off-grid renewables tended to be financed more with equity and less with debt instruments.
- Sub-Saharan African countries attracted 65% of the world's off-grid renewable energy investments over 2007-2019, with investments concentrated especially in East Africa. Most of this went to off-grid renewables for residential use.



EXECUTIVE SUMMARY

Global investment in renewable energy made significant progress between 2013 and 2018, with a cumulative USD 1.8 trillion invested. The decrease in installation costs, resulting from improvements in technology and the adaptation of procurement mechanisms to changing market conditions, has proven to be an effective catalyst in ramping up investment and building additional capacity.

This second edition of the *Global Landscape of Renewable Energy Finance* presents key global investment trends between 2013 and 2018 by region and sector, maps the role of different financial instruments and explores key differences between private and public actors. While the landscape is encouraging at first sight, the data suggest that the international community still has a long way to go to reach the level of investment necessary to achieve international climate and development goals.

The analysis also paints an unequal picture of the landscape of renewable energy finance, skewed heavily toward private actors operating in a handful of key countries. While investment has held a steady course in China, the United States and Western Europe, regions such as Latin America and the Caribbean, South Asia, and Sub-Saharan Africa remain under-represented in current global renewable energy investments.

For the first time, this report also looks at financial commitments to off-grid renewable energy technologies, which present a compelling cost-effective answer to the challenge of ensuring universal access to sustainable energy, especially for populations and businesses in rural areas. The in-depth analysis of off-grid renewable energy investments presented here offers a distinct perspective on the ever-increasing role of renewable energy in the energy access space.

Following the outbreak of the coronavirus (COVID-19), renewable energy investments saw a 34% decline in the first half of 2020, compared with the same period in 2019 (BNEF, 2020a). Going forward, there is a risk that the impacts of the global crisis on both the energy and financial sectors may negatively affect renewable energy investment, hampering progress toward a global energy transition. Nevertheless, the current pandemic seems to have increased investors' interest in more sustainable assets, such as renewables, as these have proven more resilient than conventional assets to the volatility caused by the COVID-19 crisis. By placing renewables at the core of their green stimulus packages, governments can signal long-term public commitment to the industry, boosting investor confidence and attracting additional private capital to the sector (IRENA, 2020a).

Emerging trends and global overview

Investment in renewable energy continued its steady increase from 2013 levels, peaking at USD 351 billion in 2017 before decreasing to USD 322 billion in 2018. This slowdown in global investment level masks the fact that falling technology costs allowed for more generation capacity installed for each dollar invested. Together with favourable investment in previous years, 2018 ended with an increase in installed renewable generation capacity, with combined solar photovoltaic (PV) and wind (onshore and offshore) capacity additions equal to 149 gigawatts (GW), 6% higher than in 2017.

Increased economies of scale, manufacturing and technology improvements, greater competition in supply chains, support for research and development, and direct deployment policies (*e.g.,* auctions and feed-in tariffs) that have supported the uptake and increased maturity of renewable energy contributed to a 12% decrease in the levelised costs of electricity for solar PV and 14% for onshore wind between 2017 and 2018 (IRENA, 2019a).[1]

While trends in investments, capacity additions and levelised costs all suggest encouraging progress in the renewable energy sector, renewable energy investment still falls short of what would be needed to put the world on a pathway compatible with keeping the rise in global temperatures to well below 2 degree Celsius (°C) and toward 1.5°C in this century (IRENA, 2020b). Annual investment in renewables would need to almost triple from an average of just below USD 300 billion in 2013-2018 to almost USD 800 billion through 2050. Further investments will be required in system integration technologies such as distributed energy resources, batteries and energy storage to enable the integration of new capacity additions into energy systems.

While it is necessary to scale up renewable energy investment, that in itself is not enough. A scale-up of renewable energy investment must be coupled with a significant reduction and redirection of fossil fuel investments. Although investments in renewable energy in the power sector exceeded those in fossil fuels, overall fossil fuel investments (*i.e.,* including investments for infrastructure) far exceeded those in renewables. In 2018, renewables received USD 322 billion, mostly in the power sector, whereas investments in the fossil fuel sector amounted to USD 933 billion, of which USD 127 billion was for power generation.

1 This report includes cost estimates for 2018 as part of the investment period analysed (2013-2018). Costs fell further in 2019. Electricity costs from utility-scale solar PV fell 13% from 2018 to 2019, and the global weighted-average LCOE for onshore and offshore wind both declined about 9% (IRENA, 2020c).

Investment by technology

In 2017 and 2018, solar PV and onshore wind consolidated their dominance in the renewable energy market, representing on average 77% of total finance commitments in renewable energy (Figure ES.1). The highly modular nature of these technologies, their short project development lead times, increasing competitiveness driven by technology and manufacturing improvements, and appropriate policies and measures play an important role in explaining these technologies' large share of global renewable energy investment.

Investment in offshore wind has picked up, attracting, on average, USD 21 billion a year globally between 2013 and 2018, and representing 8% of the total renewable capacity addition in 2018. According to IRENA (2020b), offshore wind holds considerable growth potential and will have a key role to play in achieving a level of deployment to support a decarbonised growth trajectory.

Investment by region

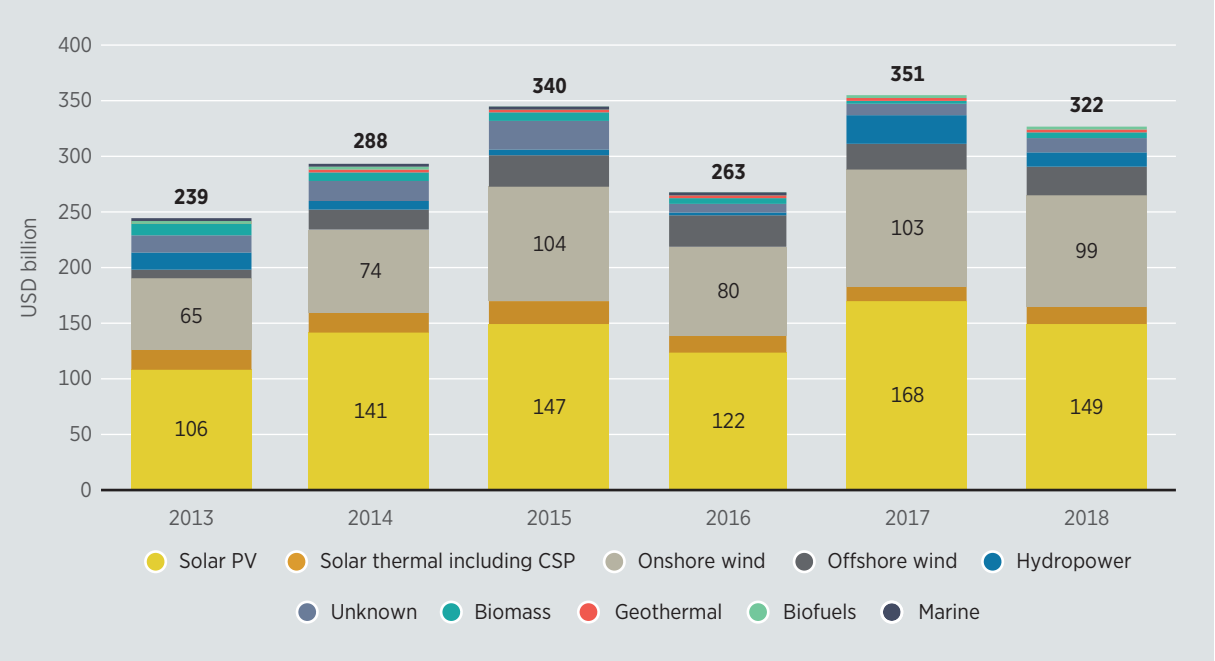
The East Asia and Pacific region attracted, on average, 32% of global renewable energy financial commitments in 2017-2018, peaking at USD 125 billion in 2017.[2] This was mainly driven by increased spending on solar PV and onshore and offshore wind in China, which represented, on average, 93% of renewable energy investment in the region between 2013 and 2018.

Continued investment growth in the United States represented a significant boost to investment in member countries of the Organisation for Economic Co-operation and Development (OECD) located in the Americas. Together, these constituted the second destination for commitments in 2017-2018, attracting 22% of global investments in renewable energy, with a USD 82 billion peak in 2018.

Western Europe continued to be one of the main destinations for renewable energy investment, receiving, on average, USD 51 billion in 2017-2018, or 15% of total investment in the sector. In contrast, investment in OECD countries in Asia dropped in 2017-2018, down 53% compared to 2015-2016 levels, partly due to a decrease in solar PV investments in Japan.

Countries in Central Asia, Eastern Europe, Latin America and the Caribbean, Middle East and

Figure ES.1 Annual financial commitments in renewable energy, by technology, 2013-2018



Source: CPI analysis.
Note: CSP = concentrated solar power; PV = photovoltaic.

2 See Annex II for a list of countries included in each region.

North Africa, South Asia and Sub-Saharan Africa collectively attracted, on average, only 15% of total renewable energy investment between 2013 and 2018, or USD 45 billion.

Financial instruments

Renewable energy projects are financed mainly with project-level conventional (*i.e.*, non-concessional) debt, which peaked at USD 119 billion in 2017 and accounted for 32% of the total investment in 2017-2018, on average.

Balance sheet financing,[3] both equity and debt, also supported considerable investment, each contributing to 27% (or 54% combined) of total commitments in 2017-2018, on average. Balance sheet financing was almost exclusively used to finance the development of solar PV and onshore wind, whereas project-level conventional debt was used for a wider range of technologies, including offshore wind.

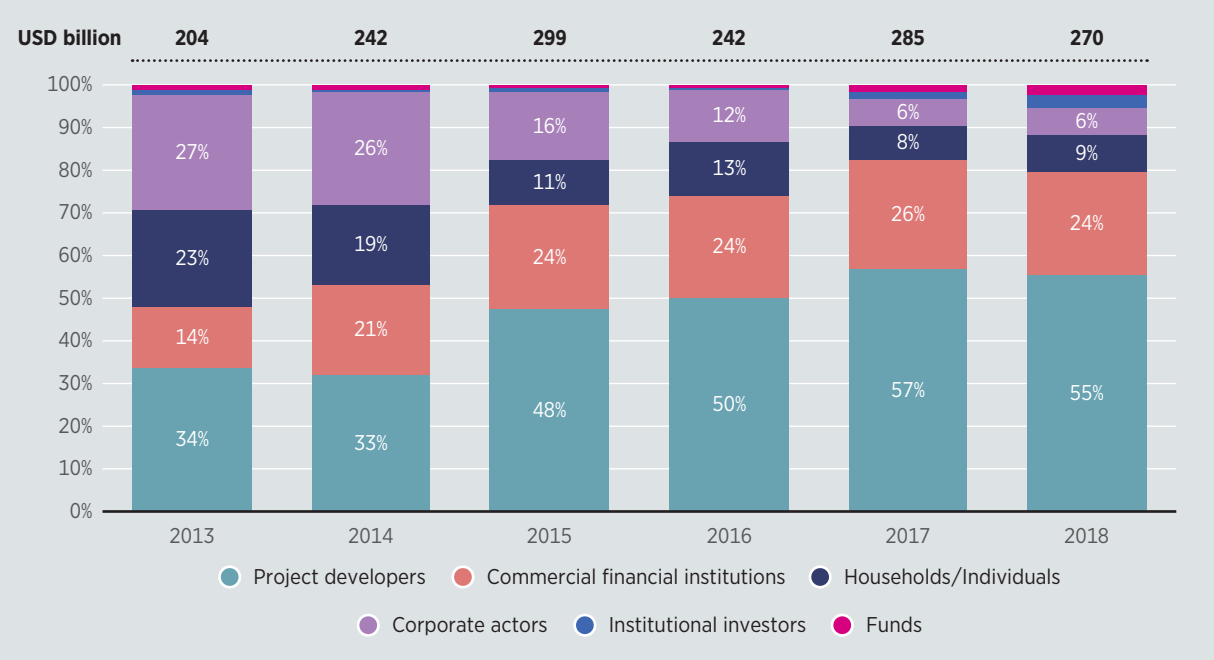
Green bonds[4] have the potential to channel significant volumes of capital into renewable energy. Annual issuance of green bonds solely earmarked to renewable energy experienced a rapid increase in recent years, from USD 2 billion in 2013 to USD 38 billion in 2019. Often used to re-finance existing assets, green bonds can attract institutional investors due to their large ticket sizes.[5]

Public and private finance

Private finance provided, on average, 86% of total investment for renewable energy projects between 2013 and 2018, equivalent to annual commitments of USD 257 billion. Public finance reached an average of USD 44 billion annually in the same period.

Throughout 2013-2018, project developers continued to be the main actors within private finance, providing an average of 56% of total private finance in 2017-2018, mainly through balance sheet finance, either through debt or equity (Figure ES.2).

Figure ES.2 Annual financial commitments in renewable energy, by technology, 2013-2018



Source: CPI analysis.

3 Financing provided by sponsor through direct debt and equity investment in the recipient institution or entity.

4 Green bonds are fixed-income securities whose proceeds are meant to finance sustainable assets, including renewable energy.

5 A ticket size is the sum of money going into a transaction, and in the case of green bonds, corresponds to its face value. A larger ticket size helps lower per-unit transaction costs.

Commercial banks and investment banks represented, on average, 25% of total private finance in 2017-2018, often providing non-concessional debt to mature technologies such as solar PV and onshore wind, as well as offshore wind. Institutional investors (including pension plans, insurance companies, sovereign wealth funds, endowments and foundations), provided, on average, only 2% of private direct investment in new renewable energy projects in 2017-2018.

The role of non-energy-producing corporations in renewable energy has gained attention in recent years, accounting, on average, for 6% of private finance in 2017-2018.[6] Renewable energy investments from non-energy-producing companies are mainly motivated by the cost-saving potential resulting from increasingly price-competitive renewable technologies, long-term price stability and security of supply, in addition to social and environmental concerns. Corporate actors have a significant role to play in decarbonising the energy sector as they account for about two-thirds of the world's energy consumption (IRENA, 2018a).

Public finance, which provided on average 14% of total investments between 2013 and 2018, saw a peak in 2017 with 19%, due to a spike in investment from national development finance institutions (DFIs) in China, Colombia, Mexico and Turkey. National, bilateral and multilateral DFIs have consistently provided the majority of public investment, committing on average USD 37 billion annually between 2013 and 2018. Governments directly provided, on average, 9% of public finance in 2017-2018, up from 5% in 2015-2016, most of which was directed to solar PV and onshore wind projects.

Public finance has a key role to play in providing capital to technologies and regions that still require additional support to reduce the cost of capital, *e.g.*, through the provision of risk mitigation instruments. The public sector can also reduce technology costs by demonstrating the business potential of hard-to-enter sectors and markets, such as off-grid renewables in rural areas.

Off-grid renewable energy investment trends

The world is currently not on track to achieve universal energy access by 2030. As of 2018, approximately 789 million people had no access to electricity, and nearly 620 million people are estimated to remain in this situation until 2030 under current and planned policies (IEA, IRENA, UN, WBG, and WHO, 2020). Decentralised renewable energy can be a cost-effective solution to enable electrification, especially in rural areas where grid expansion may not be viable.

Between 2007 and 2019, off-grid renewables attracted about USD 2 billion of cumulative investment, USD 734 million of which was directed to energy-access-deficit countries[7] that are home to 80% of the world population lacking adequate access to energy.

Annual financial commitments to decentralised renewables increased from USD 250 000 in 2007 to USD 460 million in 2019. Despite this growth, investments in off-grid renewable energy solutions still represent a very small portion of the overall financing for energy access – less than 1% of the total energy access investments in access-deficit countries.

6 *Corporate actors (or non-energy-producing companies) are companies that have activities in the renewable energy sector mainly to source energy for self-consumption or to offset carbon. Their main distinction from project developers is that non-energy-producing corporate actors do not engage in renewable energy projects for the primary purpose of profit making.*

7 *A list of energy access deficit countries is provided in SEforAll and CPI (2019). These include Afghanistan, Angola (only electricity), Bangladesh, Burkina Faso (only electricity), China (only clean cooking), the Democratic People's Republic of Korea, the Democratic Republic of the Congo, Ethiopia, India, Indonesia (only clean cooking), Kenya, Madagascar, Malawi (only electricity), Mozambique, Myanmar, Nepal (only clean cooking), Niger (only electricity), Nigeria, Pakistan (only clean cooking), the Philippines, Sudan, Uganda, the United Republic of Tanzania, Viet Nam (only clean cooking) and Yemen (only electricity).*

Recommendations and conclusion

Meeting international climate objectives, as set by the Paris Agreement, will require an accelerated transformation of the global energy system, encompassing not only renewable energy, but also renewable energy systems integration and enabling technologies, energy efficiency measures and the increased electrification of end-uses (*e.g.*, heating and transport) with renewables-based power. Most importantly, it will require a phase-out of investments into fossil fuels.

The combined efforts of a variety of stakeholders, including policy makers, capital market players, issuers and investors, are needed to shift investments away from fossil fuels and activate all available sources of capital in the renewable energy industry.

1. Use public finance to crowd in private capital

The private sector has dominated renewable energy investments in recent years and will likely fill in most of the financing gap. Nonetheless, limited public resources are key to closing the gap. Public finance should be used strategically with the purpose of crowding in additional private capital, particularly in more difficult sectors and regions. This can, for example, be achieved through capacity building, support for pilot projects and innovative financing instruments, blended finance initiatives and the provision of risk mitigation instruments (*e.g.*, guarantees, currency hedging instruments and liquidity reserve facilities).

2. Mobilise institutional investment in 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).

3. Promote greater use of green bonds for renewables

Green bonds can help attract institutional investors and channel considerable additional private capital in the renewable energy sector to contribute to filling 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).

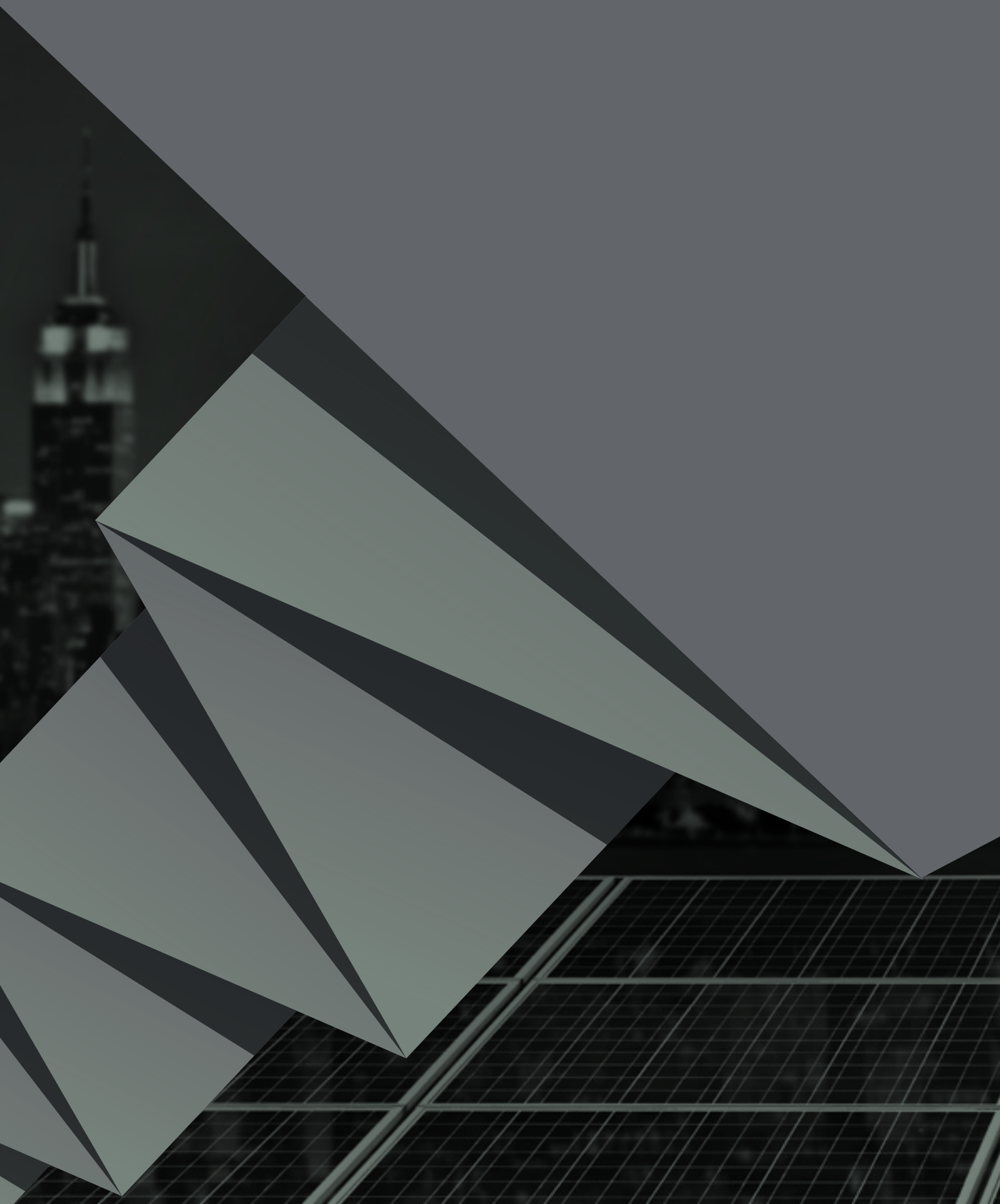
4. Enhance the participation of corporate actors

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, 2018a).

5. Scale up financing for off-grid renewables

Annual investment of USD 45 billion in modern energy is required to achieve universal access by 2030 (IEA, IRENA, UN, WBG, and WHO, 2020). Lack of access to affordable finance remains one of the biggest challenges for off-grid renewable energy projects, both upstream for project developers and downstream for energy users. New financing approaches (*e.g.*, results-based financing) and tools (standardisation of project documentation and aggregation) are therefore needed to ensure improved access to capital and to reach the scale of investment needed to achieve universal energy access by 2030.

INTRODUCTION



01

The landscape of renewable energy finance has evolved significantly in the past few years. In support of recent record-setting levels of capacity additions in wind and solar technologies, finance for renewable energy represented 63% of total climate mitigation finance in 2017-2018 (CPI, 2019).

This report is the second in a series of analyses of the renewable energy finance landscape.[8] In Chapter 2, it draws out key trends in global investment commitments in 2013-2018 alongside technology and policy developments, dives into regional and sectoral breakdowns, maps the role of different financial instruments and explores key differences in how private and public actors invest.

Chapter 3 of this report puts current investments in renewables into context, comparing them with investments in fossil fuels and provides an estimate of the investments needed through 2050 for an energy transition in line with international climate objectives. Drawing from recent International Renewable Energy Agency (IRENA) work, this chapter also investigates the impacts of the current COVID-19 crisis both on the energy and financial sector, impacts that are likely to affect renewable energy investments in 2020 and in the years to come.

This year's report also features a dedicated in-depth analysis of off-grid renewable energy finance during 2007-2019, outlined in Chapter 4. Off-grid renewables have a fundamental role to play in accelerating energy access, especially in rural areas where grid expansion might be too costly. A scale-up of investments in these solutions will, therefore, be essential to speed progress toward Sustainable Development Goal 7 (SDG7) and the broader 2030 Agenda for Sustainable Development.

Finally, Chapter 5 provides recommendations for various stakeholders, including policy makers and public financial institutions, on how to mobilise investment in renewable energy and accelerate the global energy transition, especially in view of the green stimulus packages being developed and implemented around the world in response to the global COVID-19 crisis.

8 The first edition of this report can be found at www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_Global_landscape_RE_finance_2018.pdf (IRENA and CPI, 2018).

ABOUT THE ANALYSIS IN THIS REPORT

This analysis tracks investment made in new electricity- and heat-generating assets, including in the following technologies: biomass and biogas power, biofuels (including bioethanol and biodiesel), geothermal, hydropower (both large and small scale), onshore and offshore wind, solar photovoltaic (PV), concentrated solar power (CSP), solar heating systems and ocean renewable energies (*e.g.*, wave, tidal, ocean currents, salt gradient, etc.).

In this report, "investment" is defined as a financial commitment, represented by a firm obligation backed by the necessary funds, to provide financing through debt, equity or other financial instruments. A commitment is often accompanied by a decision of a Board or an equivalent body.

As explained in Annex I, investment commitments are just one way of reporting investments and there may be time lags between commitments and actual disbursements. However, such a method provides more comprehensive and granular details given the requirement to maintain methodological consistency across different data sources.

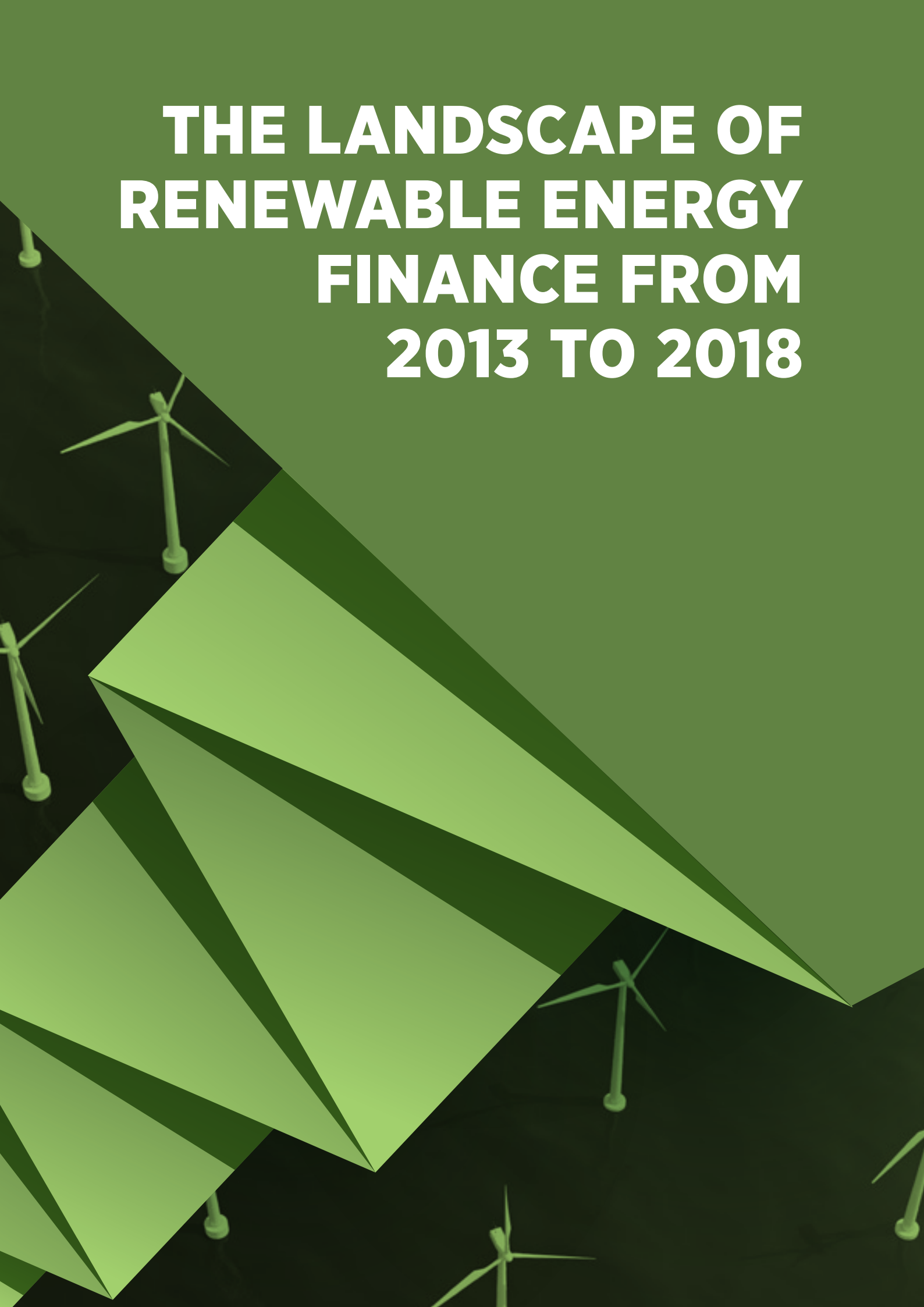
Unless otherwise stated, investment figures in this report are expressed in nominal (current) United States dollars (USD), not taking into account inflation.

Data limitations as well as methodological and definitional issues may lead to misclassifications or gaps in data in some limited instances, which are due to incompletely or inconsistently tracked information across sources of data. The methodology used to track investments attempts to standardise and present data to the greatest extent and granularity possible given the data limitations.

The details of the methodology used to track global renewable energy investment in this report can be found in the background document, *Global Landscape of Renewable Energy Finance, 2020: Methodology* (IRENA and CPI, 2020).

Renewable energy investment continued its steady increase, reaching USD 322 billion in 2018, but remains well below the level needed by 2050 to put the world of a climate-safe future

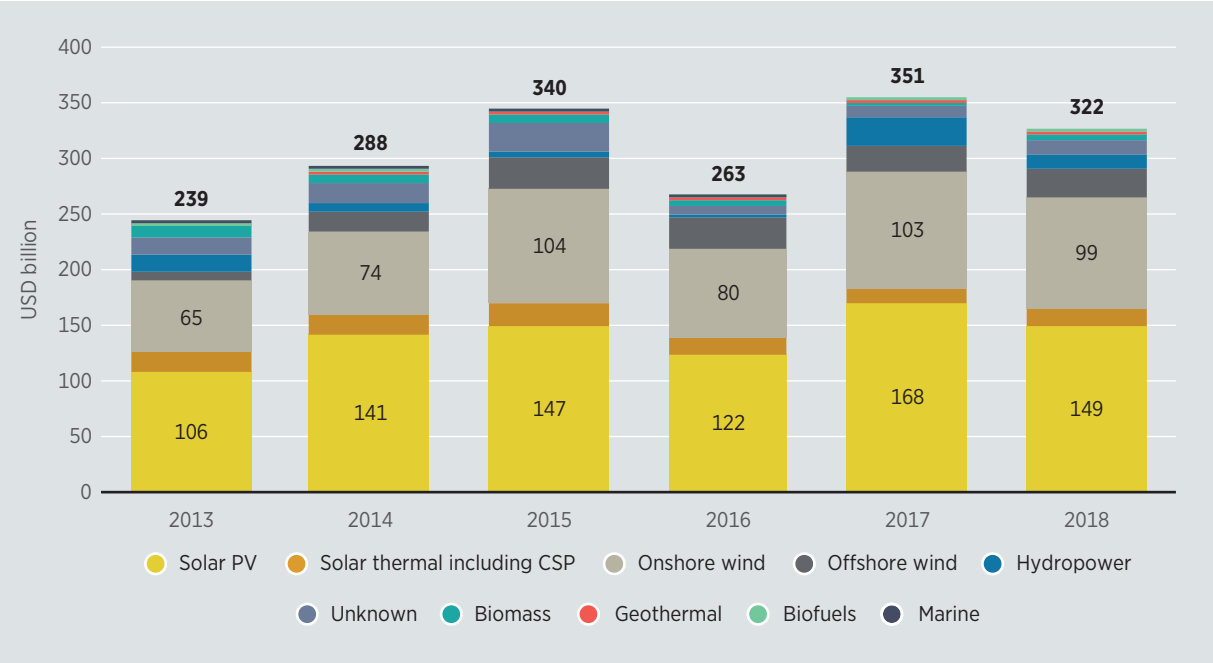
THE LANDSCAPE OF RENEWABLE ENERGY FINANCE FROM 2013 TO 2018



02

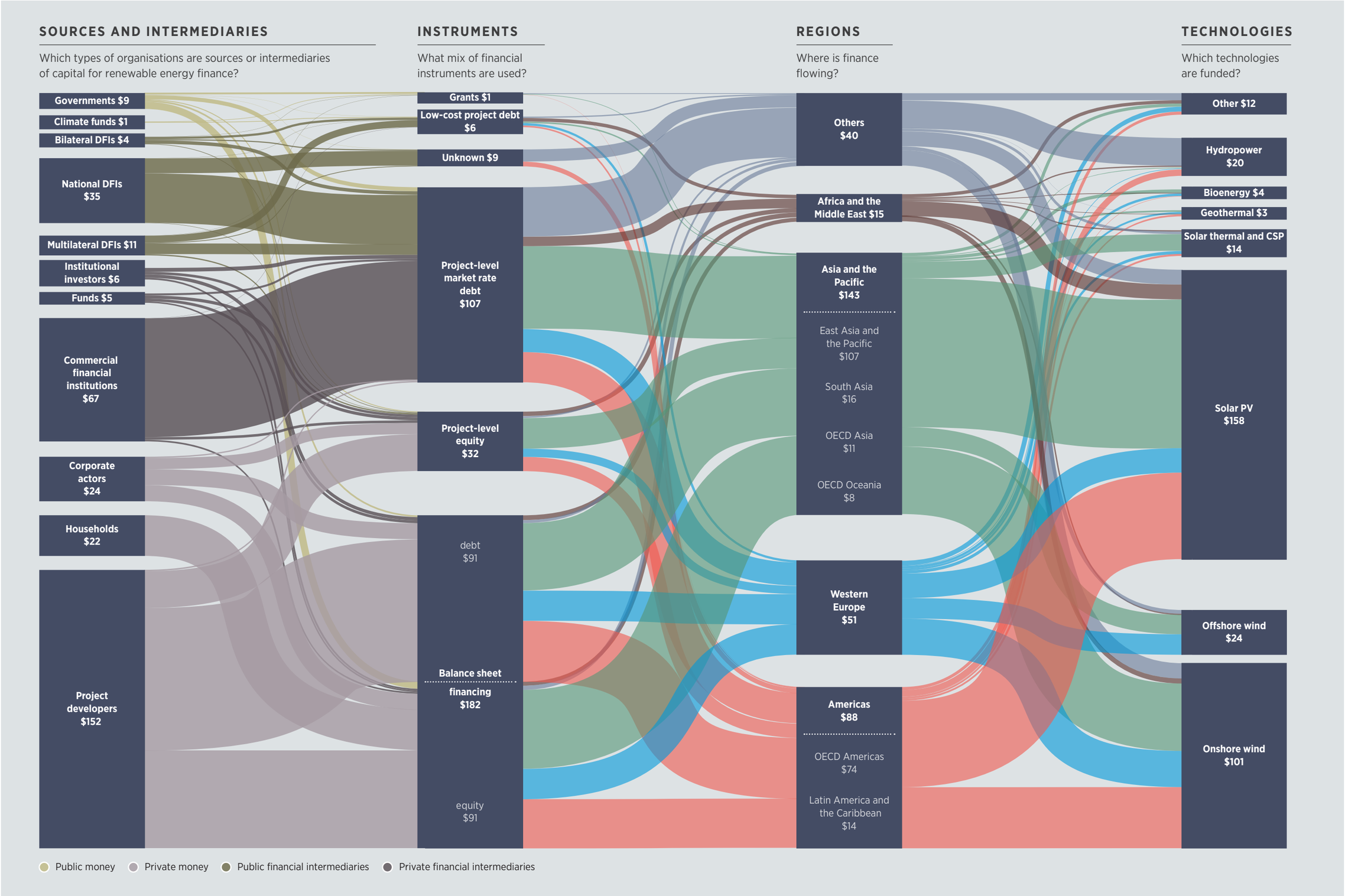
Finance commitments for renewable energy reached an all-time high of USD 351 billion in 2017, representing a 33% increase from 2016 levels (Figure 1), driven by a spike in capacity additions, particularly in China, India and the United States. Following 2017, a retrenchment among some larger institutions, particularly private financial institutions and development finance institutions (DFIs), led to an 8% decline in investments in 2018 to USD 322 billion. In addition to decreasing technology costs, the decline in investments was partly due to regulatory tightening and shifts in some domestic policies toward deleveraging and financial risk management, particularly in East Asia and the Pacific (CPI, 2019).

Figure 1 Annual financial commitments in renewable energy, by technology, 2013-2018



Source: CPI analysis.
Note: CSP = concentrated solar power; PV = photovoltaic.

Figure 2 Global landscape of renewable energy finance in 2017-2018



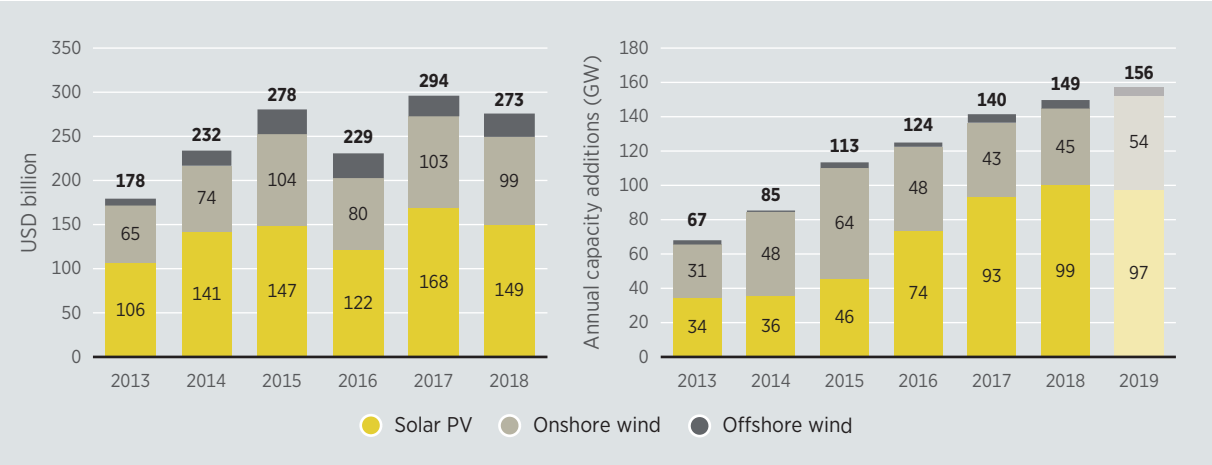
Source: CPI analysis.
Note: CSP = concentrated solar power; DFIs = development finance institutions; OECD = Organisation for Economic Co-operation and Development; PV = photovoltaic.

In 2017-2018, annual renewable energy investment reached, on average, USD 337 billion. The finance and investment landscape for renewables is depicted in Figure 2. The Sankey diagram depicts global renewable energy finance flows along the investment life cycle in 2017 and 2018, taking into consideration the full range of sources, instruments, regions and technologies, as well as the distinction between public and private finance intermediaries. Values are averages of the data from the two years (2017 and 2018), in USD billion. The diagram shows a geographic concentration of investment in East Asia and the Pacific, followed by OECD Americas and Western Europe, with most financing coming from project developers and commercial financial institutions through project-level debt and balance sheet financing (both debt and equity).

Despite the decrease in investment in 2018 (partly reflecting the falling costs of solar and wind technologies), installed renewable generation capacity has continued its positive year-on-year growth trajectory since 2013 (IRENA, 2020f). Figure 3 compares annual investment in solar PV and wind (both onshore and offshore) with annual capacity additions. In 2018, while solar PV and wind investment fell by 7% – from USD 294 billion to USD 273 billion – combined capacity additions were up 6%, reaching 149 gigawatts (GW). In 2019, capacity additions grew further, by 5% (IRENA, 2020f).

The apparent inconsistency between investment and capacity trends is partially due to the time lag between the financing and completion of a project, which means that a certain portion of the capacity financed in a certain year will become operational in the following years (IRENA and CPI, 2018).[9]

Figure 3 Annual investment (2013-2018) vs. capacity additions in solar PV, onshore and offshore wind technologies (2013-2019)

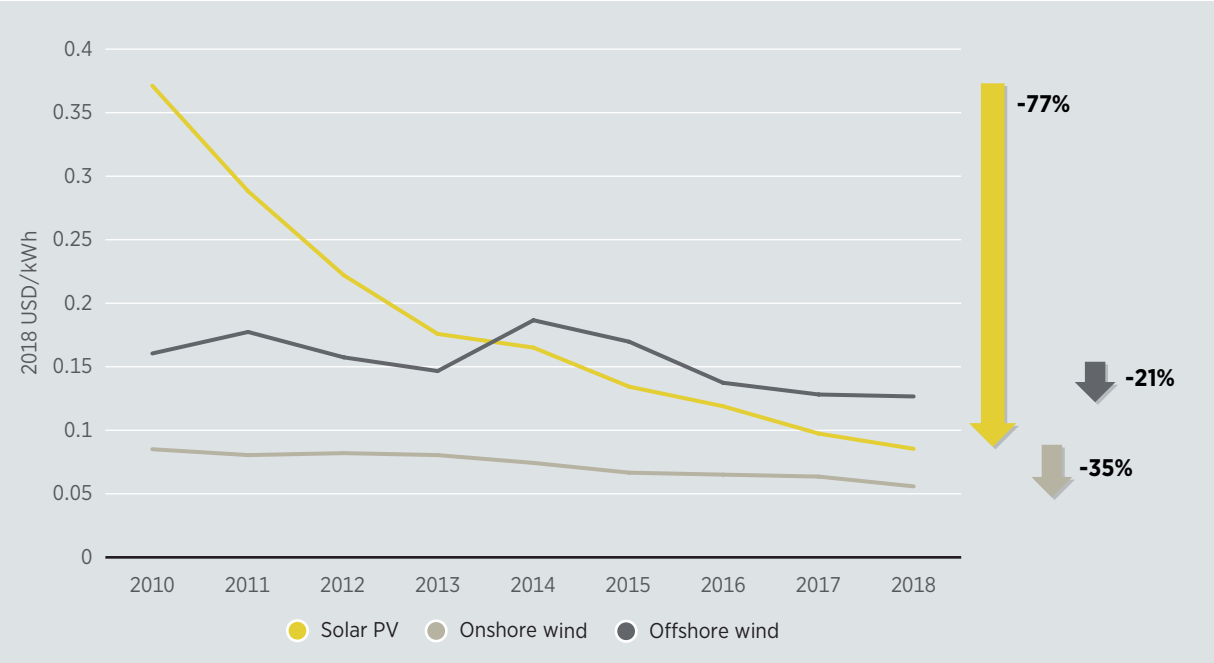


Source: CPI analysis and IRENA,2020f.
Note: PV = photovoltaic.

9 *The time lag between project financing and completion varies depending on a number of factors including geography, technology and project-specific factors. IRENA and CPI (2018) found, for example, that the average difference between the date of financing and commissioning was 0.5 years for solar PV, 0.8 years for onshore wind and 1.7 years for offshore wind projects.*

In addition, declining costs imply that each dollar invested in a certain year bought more generating capacity than in previous years. Because of a combination of competition, innovation and upscaling of production, solar PV and wind technologies have seen their levelised cost of electricity (LCOE) systematically decline over time. In 2010-2018, the LCOE for solar PV, and onshore and offshore wind fell 77%, 35% and 21%, respectively (Figure 4) (IRENA, 2019a).[10]

Figure 4 Global levelised cost of electricity for solar PV and wind, 2010-2018



Source: IRENA, 2019a.
Note: PV = photovoltaic; USD/kWh = US dollars per kilowatt-hour.

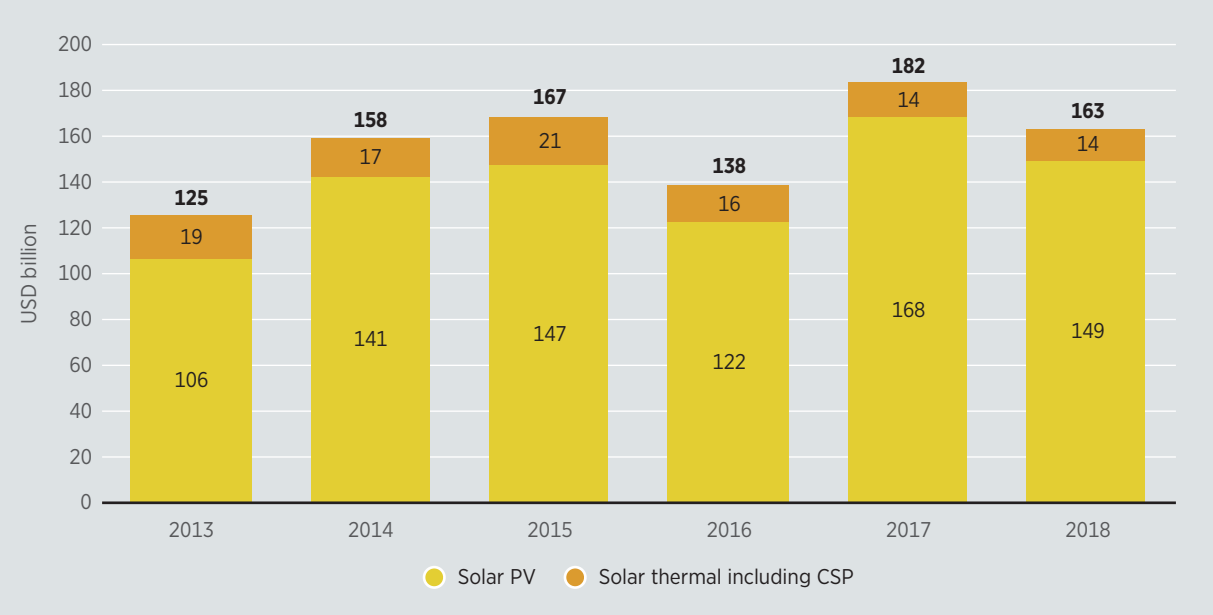
2.1 Investment by technology

Solar PV and onshore wind registered the greatest shares of investment in renewable energy financing between 2013 and 2018. In 2017-2018, solar PV and onshore wind consolidated their dominance in the renewable energy market, representing, on average, 77% of annual investment in the sector. This consistent trend is likely driven by increased maturity of these technologies, falling costs driven by economies of scale, manufacturing and technology improvements, and increasingly sophisticated procurement mechanisms, such as auctions, as a way of further increasing competition.

Investment in solar assets, namely solar PV capacity and solar thermal systems, including CSP plants, represented 52% of the total financial flows in renewable energy between 2013 and 2018. After considerable growth in investment in solar technologies in 2017, the industry experienced a decline in investment volumes, from USD 182 billion down to USD 163 billion in 2018 (Figure 5). This was mainly due to increased competition in the solar industry, consolidation of the solar market, lower technology costs as well as cuts in solar subsidies causing average investment amounts to decrease. For example, subsidies for solar projects were suspended in China in 2018 because of a decline in manufacturing costs (REN21, 2019).

10 *This report includes cost estimates for 2018 as part of the investment period analysed (2013-2018). Costs fell further in 2019. Electricity costs from utility-scale solar PV fell 13% from 2018 to 2019, and the global weighted-average LCOE for onshore and offshore wind both declined about 9% (IRENA, 2020c).*

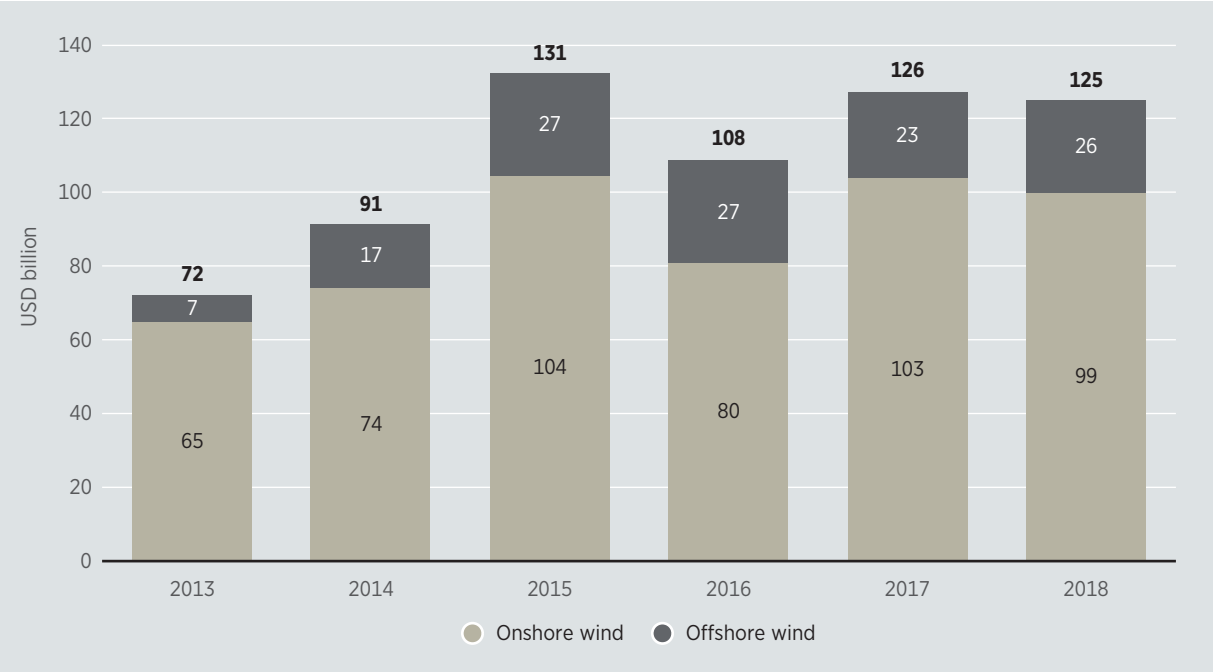
Figure 5 Annual investment in solar energy, 2013-2018



Source: CPI analysis.
Note: CSP = concentrated solar power; PV = photovoltaic.

Over the same period, investments in onshore and offshore wind represented approximately 36% of total financial flows, with onshore wind averaging USD 88 billion per year. With reduced installation costs, improved technology and increasingly sophisticated price mechanisms, onshore wind has attracted, on average, 29% of total investment tracked during 2013-2018. From 2014 onward, offshore wind started to gain traction, surpassing USD 17 billion in investment, constituting 8% of the total investments in 2018 (Figure 6).

Figure 6 Annual investment in wind energy, 2013-2018

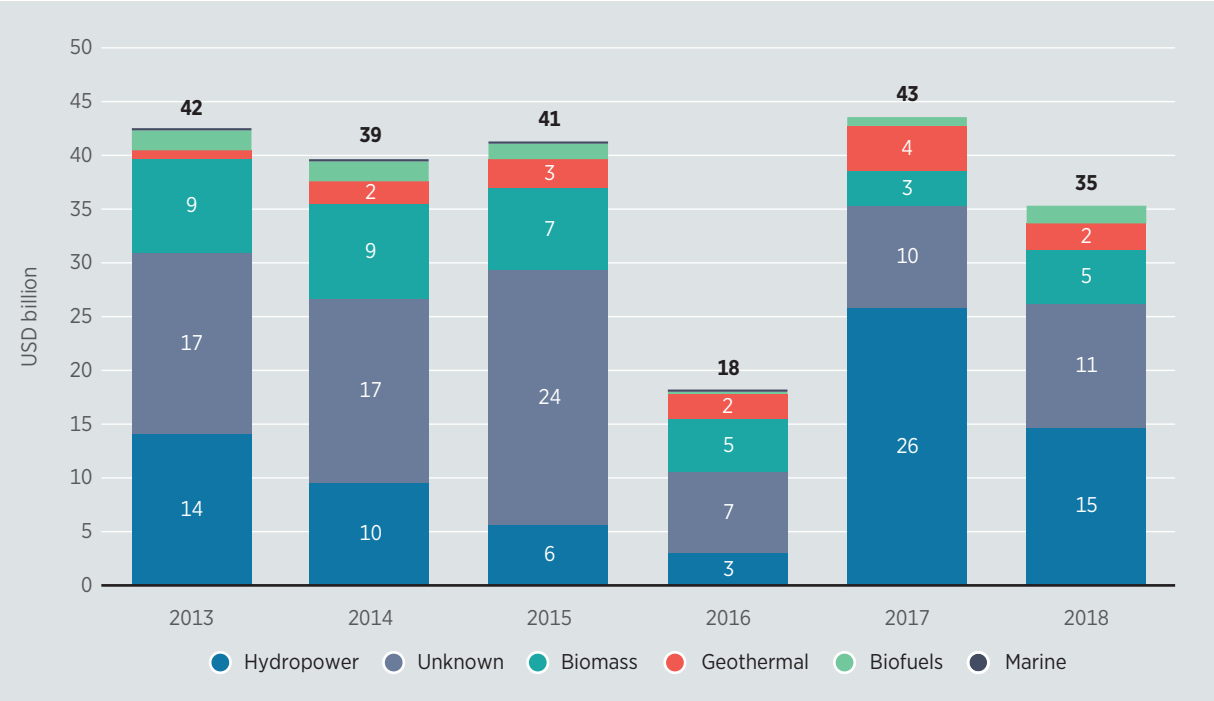


Source: CPI analysis.

Other renewable energy technologies, such as hydropower (including pumped hydropower), biomass, biofuels, geothermal and marine energy, altogether contributed 7% of total investment in 2013-2018, with hydropower making up a relatively significant portion of the total (Figure 7).[11]

In addition to investment in renewable energy assets, system integration technologies play an important role in enabling the integration of new capacity additions into energy systems. Box 1 provides an overview of the latest developments in system integration technologies.

Figure 7 Annual investment in technologies other than solar and wind, 2013-2018



Source: CPI analysis.

11 In addition, an average of 5% of total annual investment in renewables went to unknown technologies.

Box 1 **The expansion of renewable energy system integration technologies**

Solar photovoltaic (PV) and wind share characteristics that make them substantially different from the prevalent fossil fuel technologies. In particular, they are limited in dispatchability (the ability to control their output). They exhibit variable hourly, daily and seasonal generation patterns depending on weather circumstances, which do not react to price signals. Solar PV and wind power generation can be predicted based on weather forecasts, but some uncertainty in projections always remains. Strategies that can mitigate the adverse effects of variability and uncertainty include various technologies. Overall, the objective of these technologies is to increase system flexibility. Among them, PV trackers, storage and hydrogen technologies present sizable benefits.

PV trackers can facilitate the integration of solar power by increasing production and flattening the power output of solar PV power plants (Bazyari *et al.*, 2014; Ecogeneration, 2017; IEA, 2017). In addition to Europe, the Middle East and North Africa have seen the largest growth in the integration of PV trackers, which are forecasted to climb from use in 25% of global PV projects in 2018 to approximately 33% in 2023. Manufacturers of two-sided bifacial modules are claiming better performance at lower cost, being able to generate up to 30% of additional output in combination with the trackers (IHS Markit, 2019).

Prices of batteries have fallen by around 80% over the past five years, and co-locating batteries with wind and solar installations in order to provide on-demand resilience to the grid has become cost competitive with coal- and gas-fired power generation (BNEF, 2019). Batteries can also be used in microgrids to improve reliability where extreme weather events and natural disasters, such as storms, hurricanes and bushfires affect utility-scale distribution networks (Torbert, 2019). Depending on system circumstances, storage can provide grid services such as frequency control and load management, while reducing the need for network upgrades and additional capacity to address grid congestion. Finally, the storage system can arbitrage electricity, providing essential demand-side flexibility (IRENA, 2019b).

Hydrogen is increasingly featuring in decarbonisation pathways and emissions projections as the focus of hydrogen use is shifting from the transport sector to more energy-intensive and hard-to-abate industries via injection into existing natural gas lines and residential fuel cell use. Hydrogen is also a form of seasonal energy storage, which pairs very well with renewable energy, having the potential to increase its market growth. While uncertainty exists around this technology due to its current fossil-fuel-based sourcing, legislative frameworks are being adapted to overcome the cost and efficiency barriers and to facilitate the rollout of "green hydrogen" (*i.e.,* hydrogen produced via electrolysis powered by renewable electricity). For example, the latest *EU Sustainable Finance TEG Report* provided further clarity on the thresholds required for manufacturing hydrogen to align with energy targets (EU, 2020).

The rapid upscaling of electrolysis technologies and a broadening field of applications, especially those that can help overcome the limitations of electrification, have the potential to enable a hydrogen economy. Better understanding of the potential of green hydrogen as a greenhouse gas mitigation option is needed, in order to include hydrogen options in the revision of Nationally Determined Contributions starting in 2020 (IRENA, 2019c).

Solar PV and onshore wind consolidated their dominance in 2013-2018, attracting, respectively, 46% and 29% of global renewable energy investments

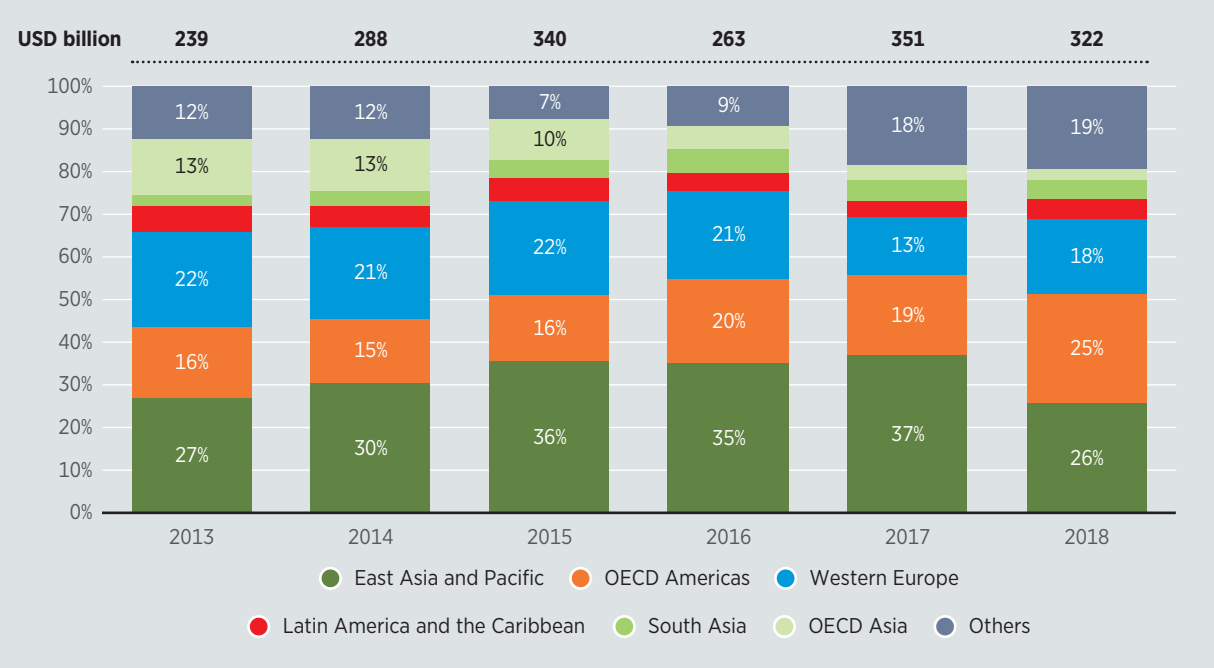
2.2 Investment by region

This section draws out distinctions in investment by region of destination as well as region of origin.[12] When looking into investment disparity by region, the analysis shows that the majority (83%) of renewable energy investment in 2013-2018 originated from and flowed to (78%) a handful of countries in East Asia and the Pacific, the OECD Americas, OECD Asia and Western Europe. In contrast, regions that represent approximately 120 developing and emerging economies (Central Asia, Eastern Europe, Latin America and Caribbean, Middle East and North Africa, South Asia, and Sub-Saharan Africa) attracted only 15% of total renewable energy investments.[13]

2.2.1 Investment by region of destination

The **East Asia and Pacific** region attracted most of the renewable energy investment during 2013-2018, receiving 32% of investment throughout the period (Figure 8). Investment in the region increased from USD 93 billion in 2016 to USD 130 billion in 2017, and subsequently decreased to USD 84 billion in 2018. Nonetheless, the average investment levels in the region between 2015-2016 and 2017-2018 were stable, hovering at around USD 107 billion in both periods. Investment in East Asia and the Pacific continues to be driven by a push for energy transition investments in **China**, a country that consistently attracts 93%, on average, of total investments in the region. Investment in China peaked at USD 125 billion in 2017, driven by increased spending in solar PV and both onshore and offshore wind.

Figure 8 Investment in renewable energy, by region of destination, 2013-2018



Source: CPI analysis.

Note: Others (from largest to smallest contribution over 6 years) = Unknown, Middle East and North Africa, Transregional, Sub-Saharan Africa, OECD Oceania, Central Asia and Eastern Europe. OECD = Organisation for Economic Co-operation and Development.

12 *The geographic origins of climate finance are classified at the country level where possible. When the finance spans multiple countries, the region of origin is prorated by country of origin whenever the data permit it. More details about regional groupings used for this analysis are provided in Annex II.*

13 *This is based on the total tracked data on financial flows by region of destination as disclosed by data providers. Notably, a further 4% of total renewable energy finance was allocated to the "unknown" region, whereby information on the region of destination was not available.*

The group of **OECD Americas** – which includes **Canada**, **Chile**, **Mexico** and the **United States** – attracted the second-highest investment in 2017 and 2018, with USD 67 billion and USD 82 billion, respectively. This represents a 42% increase compared to an average annual investment of USD 52 billion in 2015-2016 – the largest growth rate recorded globally. In 2017-2018, domestic investment in the United States represented 84% of renewable energy investments going to the region, doubling the investment compared to the 2015-2016 average. The appetite for domestic investment in the United States was especially driven by a rush to start new projects before the federal investment tax credit was to begin to phase out in 2020 (REN21, 2019). In addition, tariffs imposed on major sources of solar PV imports in 2018 and increased purchase of renewable energy through power purchase agreements by corporates have made domestic production more attractive (REN21, 2019).

While the group of OECD countries in the Americas attracted fewer commitments than the East Asia and Pacific region in 2017-2018, it significantly reduced the investment gap, especially in the solar PV and onshore wind sectors.

Another significant destination for investment in renewable energy in 2017-2018 was **Western Europe**, which received, on average, 15% of the global total (USD 51 billion), despite a decrease from 2015-2016 levels (USD 65 billion, or 21% of the total) due to lower offshore wind investments and cost reductions in the industry (WindEurope, 2018).

The group of **OECD Asia** countries, consisting of **Japan** and the **Republic of Korea**, saw investment significantly decrease from an annual average of USD 24 billion in 2015-2016, down 54% to USD 11 billion in 2017-2018. This was due to a sharp decrease in investment in Japan, from an annual average of USD 23 billion in 2015-2016 to USD 9 billion in 2017-2018. Particularly, solar PV investments in Japan dropped from USD 34 billion in 2015 to their lowest point at USD 5 billion in 2018, likely the result of a shift from feed-in tariffs to auctions, which did not prove very successful at contracting capacity in their first rounds. This was mainly due to strict compliance rules, such as penalties and project completion bonds, in addition to grid and land constraints that may have deterred developers from bidding (IRENA, 2019b).

Other regions, such as **Latin America and the Caribbean**, **South Asia** and **Sub-Saharan Africa**, representing almost 90 developing and emerging countries, only attracted a combined annual investment of USD 33 billion over the 2013-2018 period, just under 11% of total investment for renewable energy.

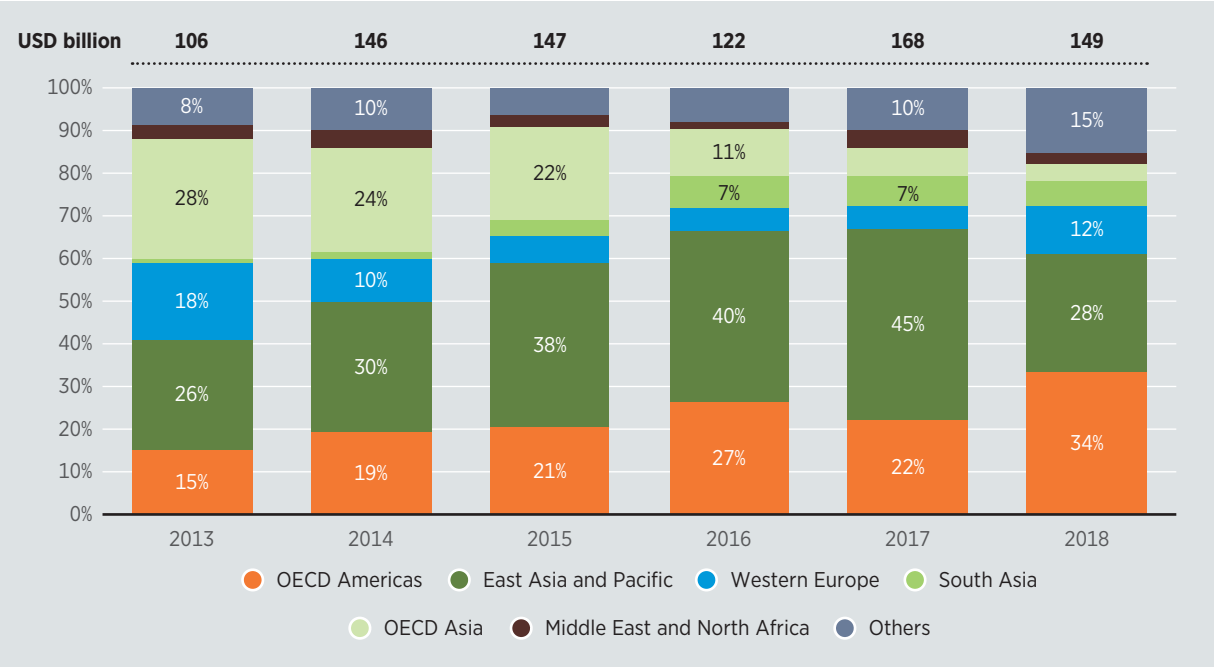
Latin America and the Caribbean attracted an average of USD 14 billion annually in 2013-2018, 63% of which went to projects in **Brazil**. The country attracts a consistently significant portion of public finance, with national DFIs providing, on average, 44% of commitments for renewable energy projects in the country during the 2013-2018 period. These institutions played a more important role in earlier years, providing, on average, 62% of annual renewable energy investment in 2013-2014, compared to 33% in 2017-2018. This gap has been filled by project developers, who provided 36% of investments in 2017-2018, compared to 17% in 2013-2014.

South Asia attracted about 4% of investments each year, or an average of USD 16 billion during 2013-2018. Investment in this region has largely been led by investments in **India** (representing, on average, 84% of the total investment in the region in 2013-2018), which have consisted mostly of domestic project developers investing in solar PV and onshore wind.

The remaining regions, namely **Central Asia**, **Eastern Europe**, **Middle East and North Africa**, **OECD Oceania** and **Sub-Saharan Africa**, have received comparatively low levels of financing for renewable energy, with average annual investment of USD 5-6 billion each during 2013-2018.

In the solar PV industry, 2018 saw countries in the **OECD Americas** overtaking the **East Asia and the Pacific** region as the lead destination for the first time since 2014 (Figure 9). East Asia and the Pacific went from representing, on average, 39% of solar PV investments in 2015-2016, to 45% in 2017, and only 28% in 2018. This trend was likely driven by a drop in investments in **China**, which decreased 56% from USD 73 billion in 2017 to USD 32 billion in 2018, the lowest point since 2013. This could be attributed to decreasing solar PV module costs, and a reduction and gradual phaseout of feed-in tariffs for solar PV. Solar PV investments in **OECD Asia** dropped dramatically, by 74%, from an average USD 32 billion in 2013-2014 to USD 8 billion in 2017-2018. This was mainly driven by a significant decrease in investment in **Japan** due to cost reduction as well as project developers' difficulty in securing land (REN21, 2019).

Figure 9 Investment in solar PV, by region of destination, 2013-2018



Source: CPI analysis.

Note: Others (from largest to smallest contribution over 6 years) = OECD Oceania, Central Asia and Eastern Europe, Latin America and the Caribbean, Sub-Saharan Africa, Unknown, and Transregional. OECD = Organisation for Economic Co-operation and Development.

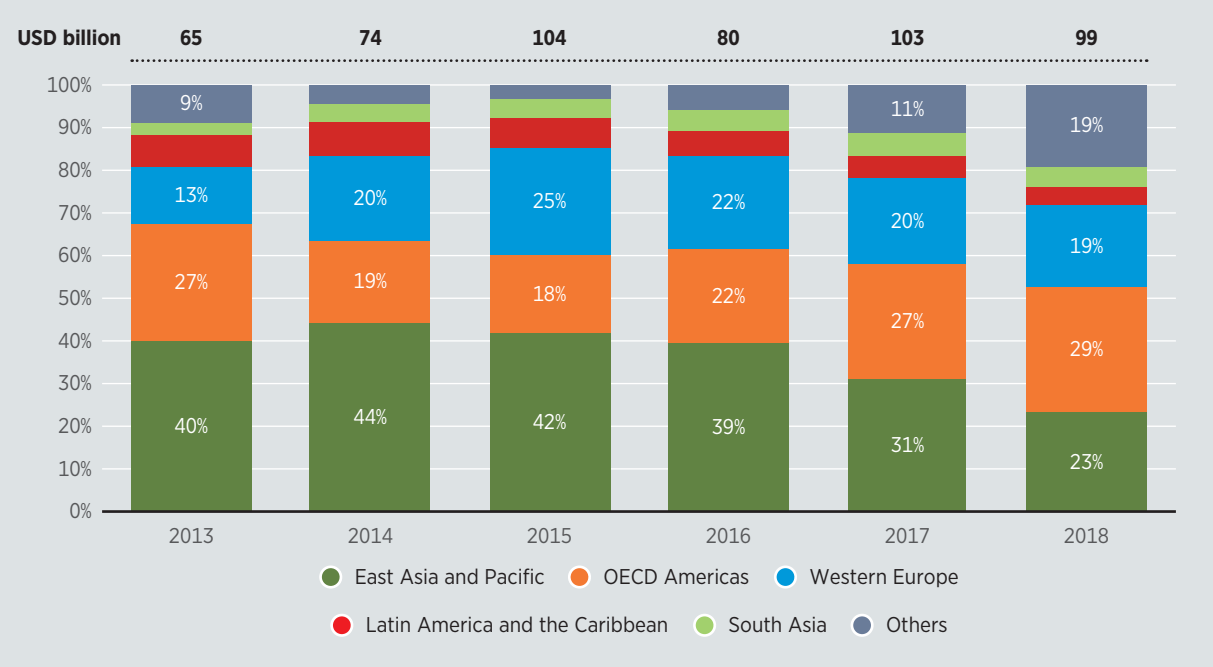
Similarly, in the onshore wind industry, countries in the **OECD Americas** were the leading destination for investments in 2018, after the **East Asia and Pacific** region had dominated for five consecutive years (Figure 10). In 2017-2018, the OECD Americas represented, on average, 28% of total onshore wind investments, followed by the East Asia and Pacific region at 27%. Compared to the solar PV sector, **Western Europe** played a larger role in the onshore industry, representing, on average, 20% of total investment between 2013 and 2018.

2.2.2 Investment by region of origin

During 2013-2018, the breakdown of renewable energy investment by region of origin was in line with that by region of destination. This is not surprising if one considers that domestic investment represented on average 75% of total investment during this period. The East Asia and Pacific region invested most heavily, peaking at USD 163 billion in 2017 before decreasing to USD 101 billion in 2018, representing, on average, 39% of total investment in 2017-2018 (Figure 11).

Another important regional source of finance was the OECD Americas, with investment from the

Figure 10 Investment in onshore wind, by region of destination, 2013-2018

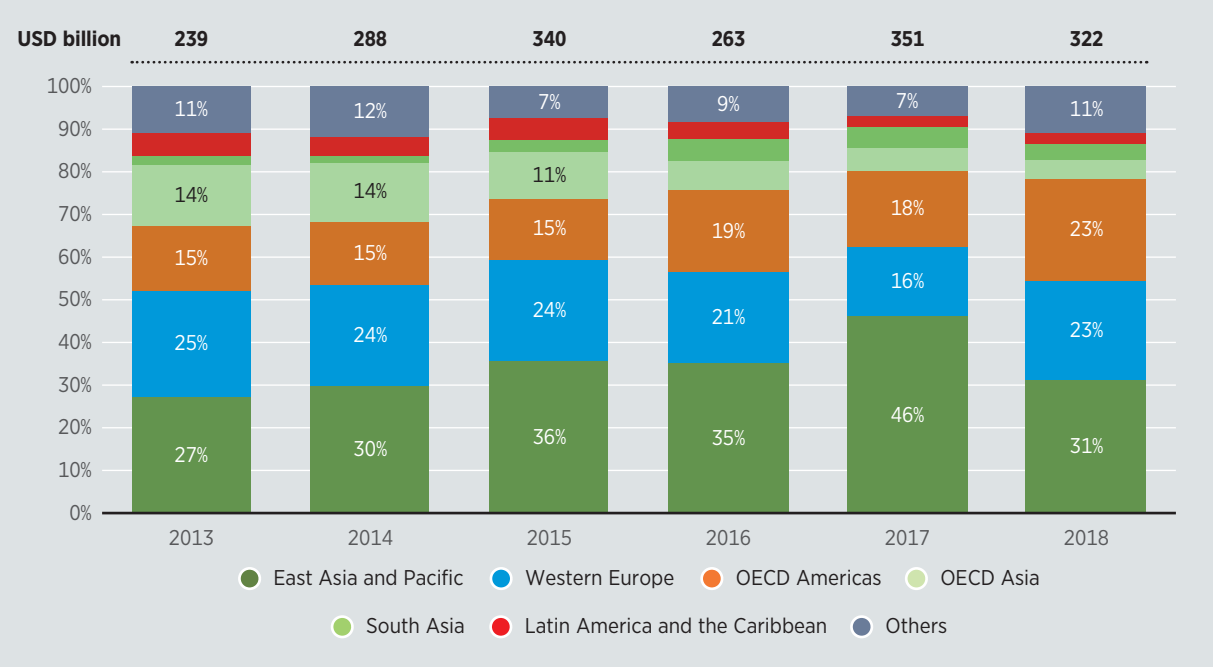


Source: CPI analysis.

Note: Others (from largest to smallest contribution over 6 years) = Unknown, OECD Oceania, Sub-Saharan Africa, Central Asia and Eastern Europe, OECD Asia, Middle East and North Africa, and Transregional. OECD = Organisation for Economic Co-operation and Development.

United States driving the region's average share of total investment at 21% in 2017-2018. Western Europe followed closely, averaging 20% in the same period. In these regions, the majority of financing was sourced and channelled domestically. By contrast, roughly half of investment in Latin America and the Caribbean, and in the Middle East and North Africa, originated from international sources.

Figure 11 Investment in renewable energy, by region of origin, 2013-2018



Source: CPI analysis.

Note: Others (from largest to smallest contribution over 6 years) = Transregional, OECD Oceania, Middle East and North Africa, Central Asia and Eastern Europe, Sub-Saharan Africa, and Unknown. OECD = Organisation for Economic Co-operation and Development.

Countries such as China and the United States invest significantly more than the rest of the world in renewable energy, representing, on average, 29% and 19% of global investment in renewable energy in 2017-2018, respectively. In Box 2, China and the United States were excluded from the analysis to determine whether the investment trends observed are corroborated by investment in the rest of the world or whether they are driven by outlier projects in these two countries.

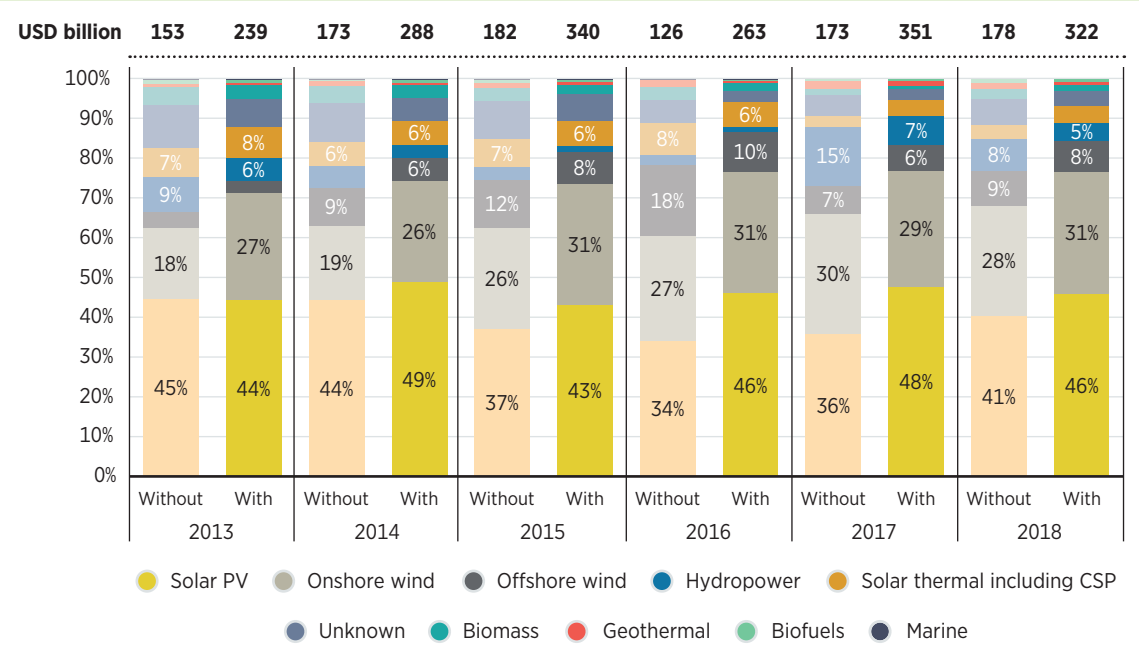
Box 2 Renewable energy investment trends excluding China and the United States

When excluding investments in China and the United States, technology breakdowns are congruent with global trends (Figure 12). While solar photovoltaic (PV) investments in China and the United States drive some of the technology's dominance – representing 47% of total investments in 2018, as opposed to 38% when excluding both countries – the trend remains the same. A more significant difference in investment trends is observed for hydropower, which represents, on average, 12% of total investment during 2017-2018 when excluding China and the United States, as opposed to an annual average of only 6% when these countries are included. This is due to investments in large hydropower projects in Cameroon, Colombia and Brazil in 2017 and 2018.

While the differences do not necessarily point to China and the United States as outliers driving different trends, there are noticeable differences when excluding them from the analysis:

- Public finance plays a more important role in other parts of the world, with national development finance institutions (DFIs) contributing, on average, 20% of total finance in 2017-2018 when China and the United States are excluded. This share drops to 10% when all countries are considered.
- Excluding the two countries also shows a bigger role played by national DFIs in financing international, often transregional, projects representing, on average, 18% of total investments in 2017-2018. When China and the United States are included, this share is only 9%. This space in China and the United States is almost solely occupied by project developers for both solar PV and onshore wind power.

Figure 12 Investment in renewable energy by technology, with and without China and the United States as destination countries, 2013-2018



Source: CPI analysis.
Note: CSP = concentrated solar power; PV = photovoltaic.

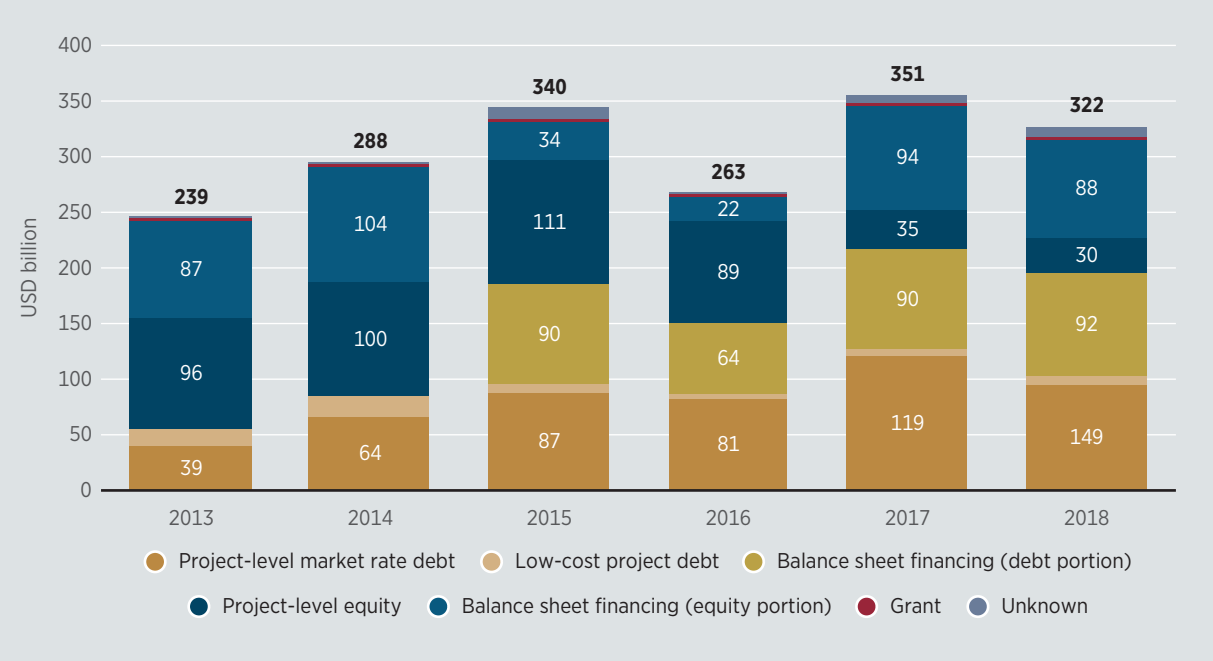
- A stark trend led significantly by outlying investments in China and the United States is the overwhelming role of domestic finance for renewable energy. While domestic finance accounted, on average, for 75% of total investments in 2017-2018, removing the two countries decreases this share by almost 20 percentage points to an average of 57%. The trend observed is thus clearly driven by China and the United States, where domestic finance represented, on average, 94% of total investment between 2013 and 2018.
- Similarly, the dominant role of project developers – accounting, on average, for 45% of total investments in 2017-2018 – is more subdued when excluding China and the United States, representing, on average, 37% of total investments during the same period.

2.3 Investment by financial instrument

Financial instruments captured in this analysis consist of project-level finance (debt and equity), balance sheet financing (debt and equity) and grants.[14,15] Project-level financing is usually provided by sponsors relying on the project's cash flow for repayment, whereas balance sheet financing is provided through equity and debt investments in the recipient institution or entity. The financing can be further categorised as conventional finance (referring to non-concessional finance, including debt and equity instruments at the project level or balance sheet) and concessional finance instruments (including grants and low-cost project-level debt, either at the project level or balance sheet).

During 2013-2018, project-level financing, both equity and debt, accounted, on average, for 56% of annual renewable energy investments, though shares decreased significantly in 2017-2018 (Figure 13).

Figure 13 Investment in renewable energy, by financial instrument, 2013-2018



Source: CPI analysis.

Note: Approximately 2% of total finance was allocated to "unknown" instruments.

14 While investment by financial instrument provides a useful insight into the renewable energy finance landscape, this does not provide a full picture of how renewable energy projects are financially structured. This is because the Climate Policy Initiative's data capture primary investments in renewable projects and exclude secondary market transactions (money changing hands) such as refinancing or acquisitions to make sure financial flows are not double counted in our analysis.

15 Definitions of each financial instrument included in this analysis are provided in the methodology document (IRENA and CPI, 2020).

Over time, there has been a trend toward higher leverage in project-level financing structures, which can be observed in increasing debt-to-equity ratios. This may be linked to the maturation and consolidation of main technologies such as solar PV and onshore wind over the years, making lenders more comfortable with the risks involved in such projects. In fact, 65% of project-level debt was directed to these two technologies. In addition, higher debt-to-equity ratios may be driven by stronger competition (*e.g.*, in auctions), which requires developers and independent power producers to minimise the cost of capital.

Throughout 2013-2018, renewable energy projects were increasingly financed through project-level conventional debt, averaging USD 81 billion annually during this period. Project-level equity was popular in the earlier years (2013-2016) providing, on average, USD 99 billion – or 35% of total investments in renewable energy. Since 2017, this trend has been overtaken by project-level debt, which in 2017-2018 accounted, on average, for 32% of total investments, as opposed to project-level equity representing 10% (Figure 13).

Balance sheet financing, both equity and debt, accounted, on average, for 42% of total renewable energy investments during 2013-2018, with the largest shares in 2017-2018 (Figure 13). Balance sheet debt financing saw an increasing trend between 2015 and 2018. In particular, in 2017-2018, 51% and 41% of balance sheet debt investments went to solar PV and onshore wind projects, respectively, while other technologies received 5% or less.

In 2017-2018, balance sheet equity investment almost doubled, after a dip in 2015-2016 (Figure 13). This could be partly explained by the US tax reform introduced in 2017 that encouraged keeping profits and activities within the country (AEI, 2018), thus shepherding more equity investments domestically. In 2017-2018, 49% and 32% of balance sheet equity financing went to solar PV and onshore wind, respectively.

The majority of financing to renewable energy was provided at the market rate (*i.e.*, conventional finance) – on average 95% during 2013-2018. Concessional finance, including grants and low-cost project-level debt, constituted a mere 4% of total investments in renewable energy, almost all of which was provided by the public sector.[16] Regions with less mature markets in certain renewable technologies were more likely to access concessional finance. For example, investments in hydropower, chiefly in developing countries, attracted USD 1.3 billion in 2017-2018, representing, on average, 19% of total concessional finance. Project-level low-cost debt still provided a large majority (86%) of concessional finance, and only a handful of countries such as Belgium, Morocco, Portugal and Spain received relatively significant amounts of concessional finance. Even Spain, the country that received the most finance out of this group, received a modest USD 0.8 billion in 2018, only 10% of the investment received by the country that year.

The dominant role of the private sector in financing renewable energy is likely to explain the overwhelming role of conventional debt provided via project-level and balance sheet financing, although data gaps may translate to an understatement of the role of concessional finance. This observation is also in line with the important role played by project developers, corporate actors and commercial financial institutions, which depend on access to capital markets – a stark difference from the off-grid renewable energy picture presented in Chapter 4.

Further analysis is needed on the relationship between primary and secondary financial markets for project finance and capital markets to understand how capital is formed and allocated to new, additional investments. Box 3 presents a deep dive into green bonds, which hold the potential to channel additional capital into renewables.

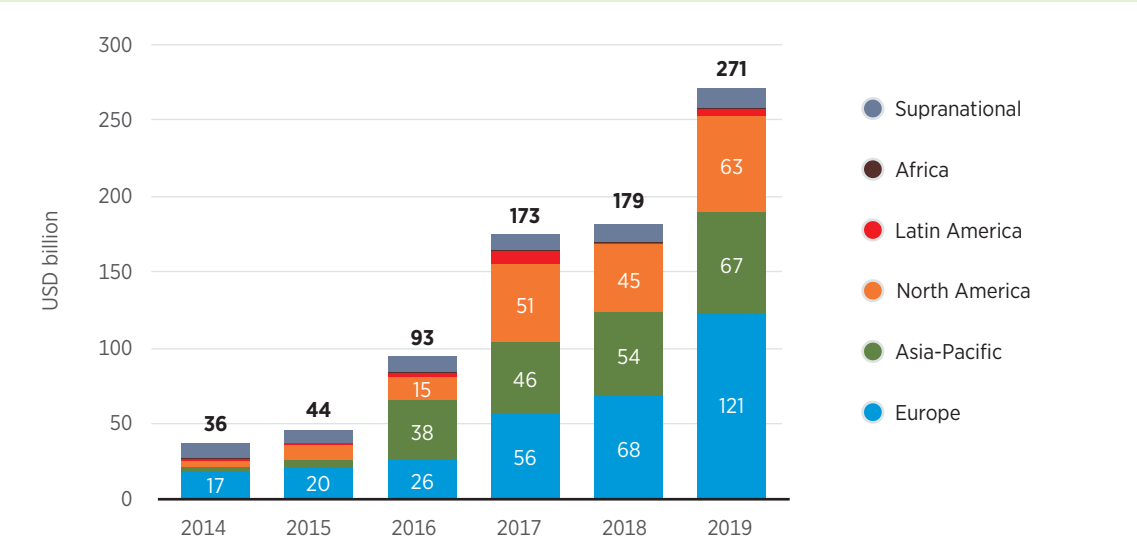
16 In addition, an average of 1% of total annual investment was made through unknown instruments.

Box 3 The use of green bonds to finance renewables

New capital market instruments can help channel a greater amount of financial capital toward sustainable solutions like renewable energy. The green bond market holds much promise in this regard.[17]

Green bonds have undergone a rapid transformation over the past five years. Annual issuances rose from USD 44 billion in 2015 to USD 271 billion in 2019. Their geographic reach has increased considerably from Europe to the Asia-Pacific and North America, with exciting new developments in Africa and Latin America. In 2019, European issuers accounted for 47% of the issuance volume (in USD), followed by issuers from the Asia-Pacific (26%) and then North America (25%) (Figure 14).

Figure 14 Annual green bond issuances, per region, 2014-2019



Source: IRENA analysis based on Environmental Finance (2019).
Note: "Supranational" issuances include multilateral development banks and development finance institutions.

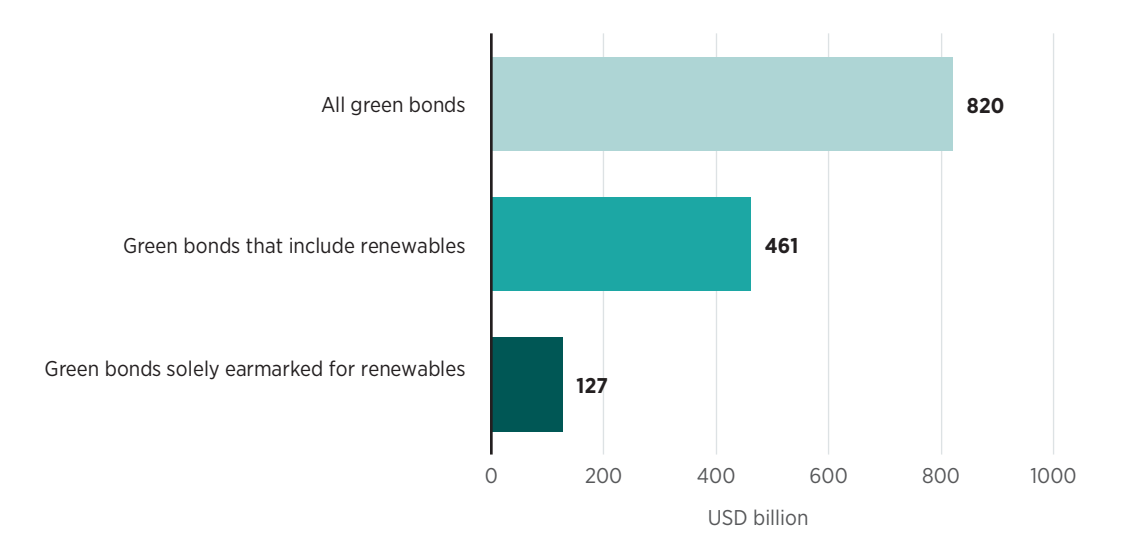
From a market fully supported by development finance institutions and multilateral development banks, the main types of issuers in 2019 were corporations (40% of 2019 issuances by volume, in USD), followed by financial institutions (23%), agencies (18%) and sovereigns (8%) who can use green bonds to raise financing for national climate targets. Green bonds are now issued in over 30 currencies.

Future growth potential is still large as the cumulative green bond issuances of about USD 820 billion are less than 1% of the global bond market, which is estimated at about USD 100 trillion.

Most green bonds fund multiple green categories, such as renewable energy, energy efficiency, clean transportation, climate change adaptation and others. Of the 4 557 green bonds analysed by IRENA that were issued in the 2007-2019 period, 56%, or USD 461 billion by the issuance amount, had renewable energy as one of the use-of-proceeds categories and 350 green bonds were earmarked solely for renewable energy. The cumulative issuance amount for such renewables-dedicated bonds was about USD 127 billion for the 2007-2019 period, or about 16% of the cumulative issuance amount of all the green bonds in the sample (Figure 15). The issuance amount of renewables-dedicated green bonds was USD 38 billion in 2019, compared to USD 2 billion in 2013.

17 Green bonds are fixed-income securities whose proceeds are meant to finance sustainable assets, including renewable energy.

Figure 15 Volume of issuances of all green bonds, green bonds that include renewable energy and renewables-dedicated green bonds, 2007-2019



Source: IRENA analysis based on Environmental Finance (2019).

Anecdotal evidence suggests that most green bonds, including those issued for renewable energy, are used to re-finance existing assets as opposed to funding new assets. Compared to other green bonds, those that are dedicated to renewable energy tend to have larger issuance sizes. The average size of green bonds issued in the 2007-2019 period and analysed by IRENA was USD 180 million whereas those dedicated to renewables are twice as large, with an average issuance size of USD 364 million. This makes renewables-dedicated green bonds particularly attractive to larger investors, like institutional investors (discussed in Box 6), who prefer larger transactions to lower their per-unit transaction costs and more easily disburse their substantial assets. In addition, by investing in renewables-dedicated green bonds, these investors can lower their investment risks by gaining access to a diversified portfolio of already operating renewable energy assets.

Innovative financial instruments can also be used to address barriers that limit access to capital markets for some investors. Box 4 shows an example of a new securitisation instrument developed by the Climate Policy Initiative's Global Innovation Lab for Climate Finance to finance clean energy infrastructure projects in Brazil.

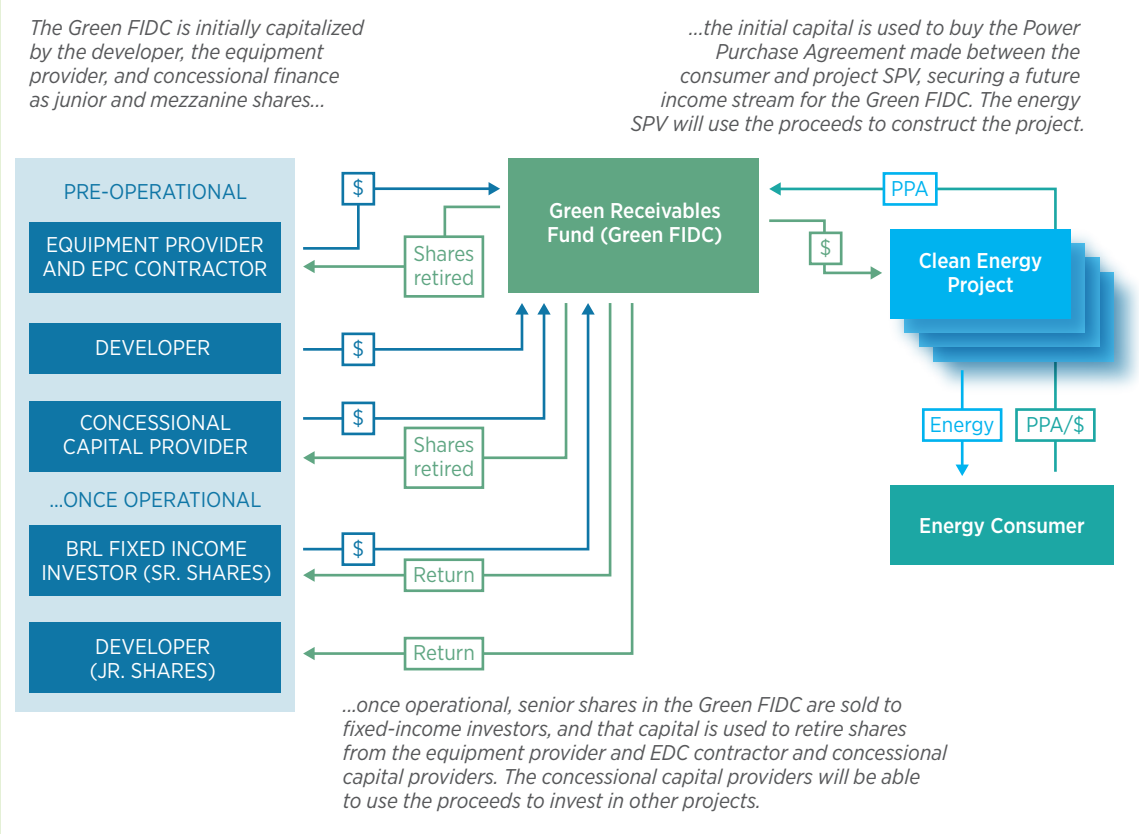
Box 4 **Innovative financial instruments to scale up investment for renewable energy: lessons and opportunities from the Global Innovation Lab**

To accelerate investment in renewable energy and tackle investment barriers in the most critical sectors and regions for action on climate change, new innovative financial instruments are needed. Since 2014, the Climate Policy Initiative's (CPI's) Global Innovation Lab for Climate Finance (the Lab) has mobilised more than USD 2 billion through 41 instruments for climate action in developing countries, 19 of which are in renewable energy.

The Lab's instruments are designed to tackle specific barriers, enable investment at scale, and replicate and accelerate private sector investment. These instruments include concessional or subordinated debt and structured funds, equity and structured funds, bonds, securitisation, guarantees, insurance, foreign exchange, conditional lending, results-based payments, pay-per-service model, data modelling tools and platforms, and technical assistance.

Figure 16 is an example of a securitisation instrument developed in the Brazilian market aimed at selling long-term revenue streams of one or more green projects against a contract, with the proceeds being used to finance the project itself or additional clean energy infrastructure projects. This model was initially designed for renewable energy projects, but pilots are now also being developed for forestry projects. The securitisation instrument addresses the barriers of lack of long-term finance, illiquidity of assets and high foreign exchange, macroeconomic and project risks.

Figure 16 Securitisation instrument for renewable energy projects



Source: CPI and Global Innovation Lab for Climate Finance, 2017.
Note: EPC = engineering, procurement and construction; FIDC = Fundo de Investimento em Direitos Creditórios.

The benefits of the model depicted in Figure 16 are as follows:

- It provides initial investors with an exit from the project and liquidity that enables investment in additional projects.
- The defined use of proceeds maximises impact.
- The concessional portion of this model is targeted toward (i) covering the risk of non-realisation of the revenue stream (for the buyer), which reduces the volume of the discount that needs to be given to the buyer of the revenue stream, and (ii) providing concessional equity or debt financing to a fund structure in order to facilitate fund raising from senior investors.

CPI analyses of the Lab's instruments show that there is a strong need for a broad and consistent narrative based on the interplay of knowledge and financing. This means that models based on a multi-stakeholder approach, sectoral and regional investment plans, programs and integrated (multi-instrument) investments can bring benefits and more sustainable solutions.

For more information on the Green Receivables Fund, please visit www.climatefinancelab.org/project/green-receivables-fund-green-fidc/

2.4 Investment by source

Renewable energy investments tracked in this report are provided from a broad range of private and public actors. Public and private actors normally have distinct roles and approaches in renewable energy finance. The private sector, for example, while providing the majority of finance (Figure 17), tends to focus more on regions and technologies with favourable investment environments. Public finance, in contrast, concentrates on areas that still require more work to reduce the cost of capital (for example, through risk mitigation instruments) and technology costs by demonstrating the business potential of hard-to-enter sectors and markets.

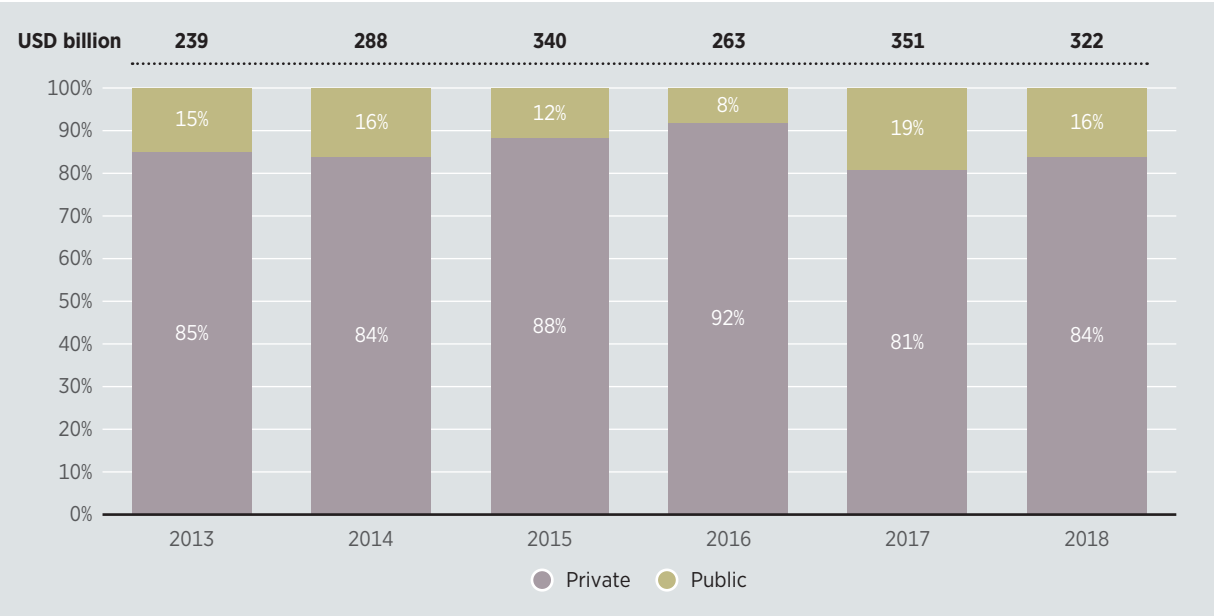
2.4.1 Private Investment

Private sources have continued to be the dominant source of financing for renewable energy projects, accounting for 86% of total investments between 2013 and 2018, with an average of USD 257 billion per year (Figure 17). Private investment actors in this analysis include project developers, non-energy-producing companies (corporate actors), commercial financial institutions, households, institutional investors and private equity, venture capital and infrastructure funds.[18]

Throughout 2013-2018, project developers continued to be the main actors within private finance, providing an average of 56% of total private finance in 2017-2018, mainly through balance sheet finance, either through debt or equity (Figure 18). Project developers invested a record sum of USD 158 billion in 2017, a 33% increase from the USD 118 billion invested in 2016, with only a slight decrease to USD 146 billion in 2018.

In 2017-2018, 33% of project developers were situated in East Asia and the Pacific, while 30% were in the OECD Americas, and 17% in Western Europe. These were, by and large, project developers from China, France, Germany, the Netherlands, Spain and the United States. For the three regions, however, investment by project developers was overwhelmingly domestic and targeted toward solar PV and onshore wind.

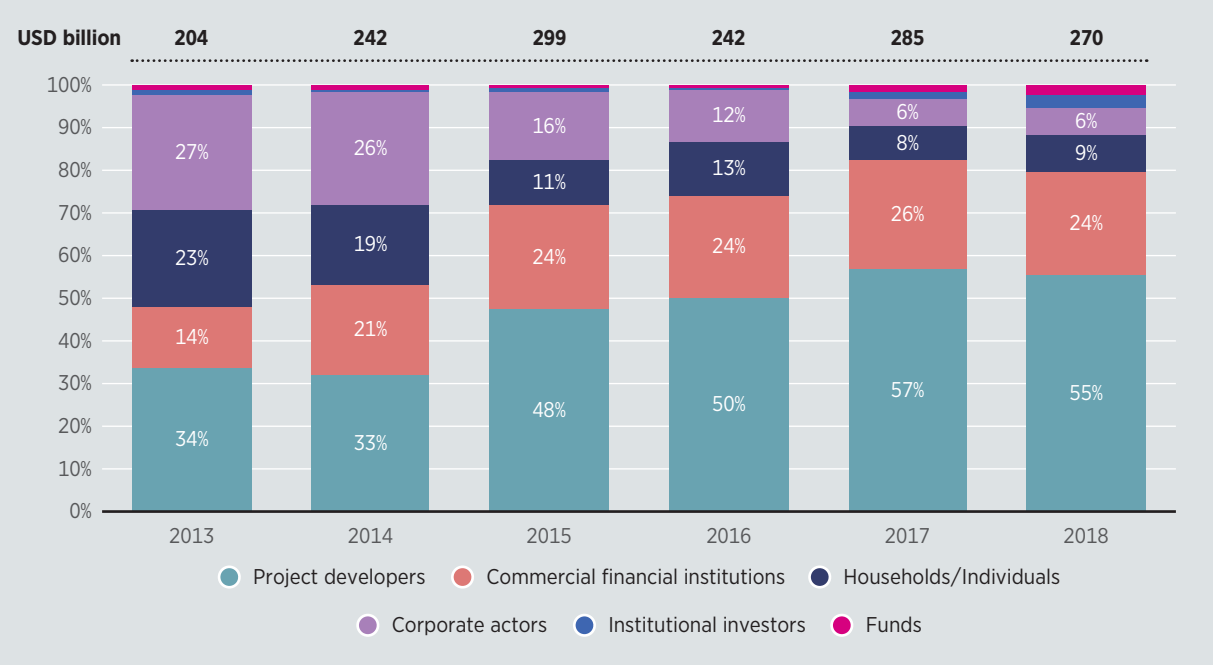
Figure 17 Public and private investment in renewable energy finance, 2013-2018



Source: CPI analysis.

18 *Institutional investors include asset management firms, pension funds, insurance companies, sovereign wealth funds, foundations and endowments. Further definitions of each private sector actor included in this analysis are provided in the methodology document (IRENA and CPI, 2020).*

Figure 18 Private investment in renewable energy, by investment source, 2013-2018



Source: CPI analysis.

Commercial financial institutions continued to contribute a significant amount, representing, on average, 25% of total private finance in 2017-2018 (Figure 18). This category includes commercial and investment banks, mostly providing project-level market rate debt to mature technologies such as solar PV and onshore wind, as well as offshore wind. In 2018 alone, solar PV and onshore wind received USD 21 billion and USD 22 billion from commercial financial institutions, respectively, while offshore wind received USD 14 billion.

In recent years, non-energy-producing corporate actors have played a considerable role in private finance for renewable energy, providing, on average, USD 17 billion a year in 2017-2018. As opposed to project developers, who produce and distribute electricity as their main business activity, corporate actors most often produce electricity for self-consumption (CPI, 2012). As presented in Box 5, non-energy-producing corporate actors can have an important role in driving additional investment for the energy transition.

Box 5

Role of non-energy-producing companies in driving additional investment in renewable energy assets

Active corporate sourcing of renewables, the process through which non-energy companies procure or invest in the self-generation of renewable energy for their own operations, is growing around the world (IRENA, 2018a).[19] The dramatic cost reductions experienced by renewable energy technologies, especially solar PV and wind, have increased the attractiveness of renewables as an energy source for corporations. Companies that choose to procure their energy from renewables (including for power, heat and transport) are increasingly motivated by economic benefits such as cost savings, long-term price stability and security of supply, rather than by pure social and environmental concerns (IRENA, 2018a).

At the end of 2017, non-energy-producing companies in more than 75 countries actively sourced renewables, encompassing both developed and developing economies. In a survey conducted by IRENA in 2017, over 200 companies reported to have actively sourced at least half of their power needs from renewables and more

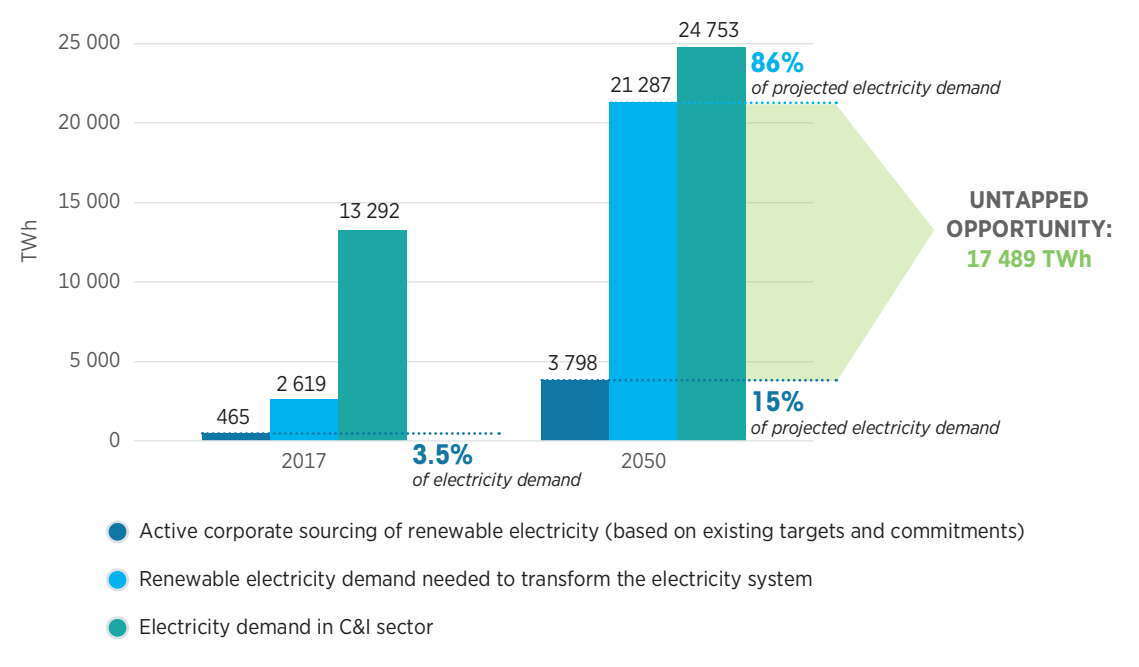
19 Active corporate sourcing differs from a passive approach in which a company's consumption is based on the average renewable electricity content available in the grids from which it sources its electricity.

than 50 sourced 100% of their energy from renewables. Production for self-consumption was the most common sourcing mode. However, renewable energy was also procured either through power purchase agreements, utility green procurement programs or unbundled energy attribute certificates (IRENA, 2018a).

In 2018, about 6% of new renewable energy investment coming from the private sector, or about USD 15 billion, originated from these companies. Corporate actors account for about two-third of the world's end use of electricity, with the materials sector (*e.g.*, mining, pulp, paper and chemicals) being the largest electricity consumer. The participation of these companies in the energy transformation is therefore critical to achieve a decarbonised energy system.

IRENA (2018a) found that in 2017 non-energy-producing companies actively consumed about 465 terawatt-hours (TWh) of renewable electricity, accounting for about 3.5% of total electricity demand in the commercial and industrial (C&I) sector (13 500 TWh).[20] As shown in Figure 19, electricity demand in this sector is projected to reach over 24 750 TWh by mid-century. IRENA (2020b) estimates that 86% of this projected demand, or about 21 300 TWh, would need to come from renewables to be in line with global climate objectives. Existing company targets, commitments and ambitions would lead to only 3 800 TWh generated from renewables in 2050, leaving some 17 500 TWh of untapped opportunity in the sector.

Figure 19 Potential for corporate sourcing of renewable electricity in the C&I sector



Source: IRENA, 2018a; figures have been updated based on IRENA (2020b).
Note: C&I = commercial and industrial; TWh = terawatt-hour.

Non-energy-producing corporations have tremendous potential to drive further investment into renewables and contribute to the achievement of global climate goals. To meet the future electricity demand of these companies, an estimated 105 gigawatts of new solar and wind capacity would need to be added by 2030, requiring the mobilisation of almost USD 100 billion (BNEF, 2020b).

Based on IRENA (2018a), only 17% of non-energy-producing companies had a renewable energy target in place in 2017, and three-quarters of those targets expired before 2020. This represents a significant opportunity for corporations to develop new medium- to long-term renewable energy targets that factor in the advancements and cost reductions of renewable energy technologies.

20 *The commercial and industrial (C&I) sector is comprised of all industry plus commercial and public (C&P) services, with the assumption that overall demand for electricity in C&P is proportional to the projected share of residential electricity demand in 2050. Calculations are based on the assumption that the projected share of renewable electricity in the C&I sector in 2050 is the same as the projected global share of renewable electricity in 2050.*

Between 2013 and 2018, the role of households and individuals in financing renewable energy projects declined significantly, moving from 21% of total private investments in 2013-2014 to 8% in 2017-2018.

Finally, institutional investors, which have a key role to play in financing the energy transition, only accounted, on average, for 1% of annual investments during 2013-2018, though their share slowly increased to 2% in 2017-2018. Building on analysis and data gaps observed in the previous edition of the *Global Landscape of Renewable Energy Finance*, Box 6 includes a deep dive into the role of institutional investors and funds in driving private finance into the sector.

Box 6 **The role of institutional investors in financing renewables**

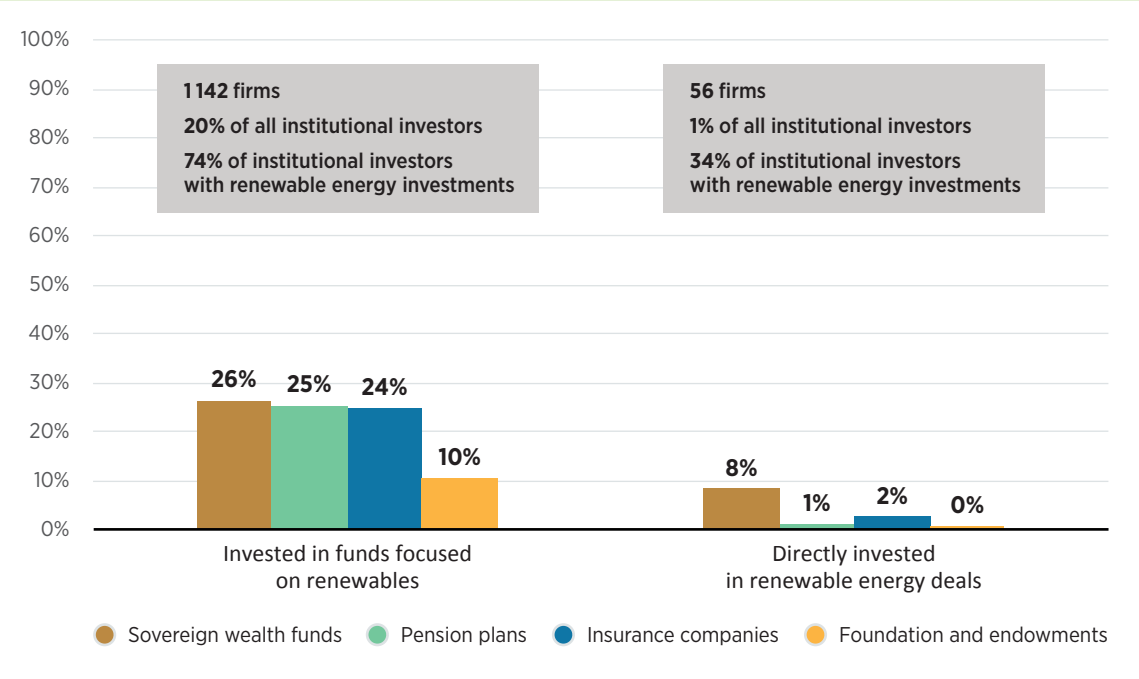
Activating underutilised capital pools is necessary to achieve the scale of investment required for a transition toward a more sustainable, low-carbon economy. The International Renewable Energy Agency's (IRENA's) report *Mobilising Institutional Capital for Renewable Energy* highlights the great potential represented by institutional investors that has so far been largely unfulfilled (IRENA, 2020g).[21]

The group of investors composed of pension funds, insurance companies, sovereign wealth funds, endowments and foundations manages about USD 87 trillion of assets. Given their size, these investors have a potential key role to play in channelling additional capital into new renewable projects, either directly or indirectly, but also, more importantly, in re-financing already operating renewable energy assets (*e.g.*, through green bonds) to free up capital for new investments.

Yet IRENA's analysis of over 5 800 such institutions and their activities in renewables over the past two decades reveals that about 20% have made indirect investments via renewable-focused funds, while only about 2% of such institutions have invested directly in renewable energy projects (Figure 20). While institutional investments in renewable projects have grown over time, such investments amounted to only about USD 6 billion in 2018, while another USD 6 billion is estimated to have been invested in renewable-focused funds (CPI, 2019; IRENA, 2020d). Together, such investments represent a minor share of the total institutional capital.

21 *Although there is no universally accepted definition of "institutional investors", this category of investors often includes a broad variety of financial institutions such as pension funds, insurance companies, sovereign wealth funds, foundations and endowments, asset managers, wealth managers, commercial and investment banks, and other funds (e.g., mutual funds, hedge funds, funds of funds, exchange-traded funds and private equity funds). To avoid double counting of assets, IRENA's analysis focuses on a core group of institutional investors composed of pension funds, insurance companies, sovereign wealth funds, foundations and endowments.*

Figure 20 Number of institutional investors with investments in renewable energy (projects and renewable-focused funds), 1990 to Q2 2019



Source: IRENA analysis based on Preqin (2019).

While they form a heterogeneous group, institutional investors face common trends and exhibit shared characteristics concerning their activities in the renewable energy sector which can help identify solutions to activate this important capital pool. Shared characteristics include a notable preference for:

- **Indirect investments,** as such investments are typically easier and faster to execute compared to direct project investments. Indirect investments can also provide greater liquidity and credit assurance when done via listed and rated securities such as bonds or funds.
- **Larger ticket sizes,** as they help lower the per-unit transaction costs. The average renewable energy transaction size increases from USD 199 million to USD 424 million when institutional investors are involved. Also, larger institutional investors are more likely to invest in renewables compared to their smaller peers. While the average assets under management of institutional investors in the sample analysed by IRENA was USD 12 billion, this grows to USD 24 billion for institutional investors who have made indirect investments via renewable-focused funds, and further to USD 34 billion for those who have invested directly in renewable projects. Larger investors seem to have an advantage in terms of having greater financial and human resources at their disposal for investments in relatively new sectors like renewables, compared to their smaller peers who may need to rely on third-party managers, if they make any renewable investments at all.
- **Already operating assets,** as they enable institutional investors to avoid early-stage development and structuring risks. Over 75% of all direct investments made by institutional investors in renewable energy projects over the 2009 to the Q2 2019 period were in secondary-stage transactions, *i.e.*, investments in already operating assets that do not require further funding.
- **Wind and solar PV assets**, reflecting the global technological trend in the renewable energy sector in the recent past. Institutional investors, however, favour wind more strongly as this technology has accounted for the largest share (45%) of direct institutional investments in renewables over the 2009-2018 period while trailing solar in terms of total renewable energy investments over the same period. This is predominantly because wind power is considered a more established technology and transaction sizes are often quite large. In the sample analysed by IRENA, the average transaction size for a wind project was USD 211 million, compared to USD 124 million in the case of solar PV.

2.4.2 Public investment

Financing from public sources in renewable energy has increased, on average, by 34%, year-on-year between 2013 and 2018, amounting, on average, to USD 44 billion a year. Public finance contributed an annual average of 14% of total investment between 2013 and 2018. Public finance for the renewable energy sector consists of investments from DFIs, governments and their agencies, and national and multilateral climate funds.[22] Compared to private finance, public finance plays an important role in directing investments toward sectors and regions that are relatively not matured or hard to invest in. These can include, for example, projects to scale up access to affordable clean energy for off-grid households, small-scale hydropower or urban infrastructure investments, *e.g.* renewable-sourced public lighting in disadvantaged areas.

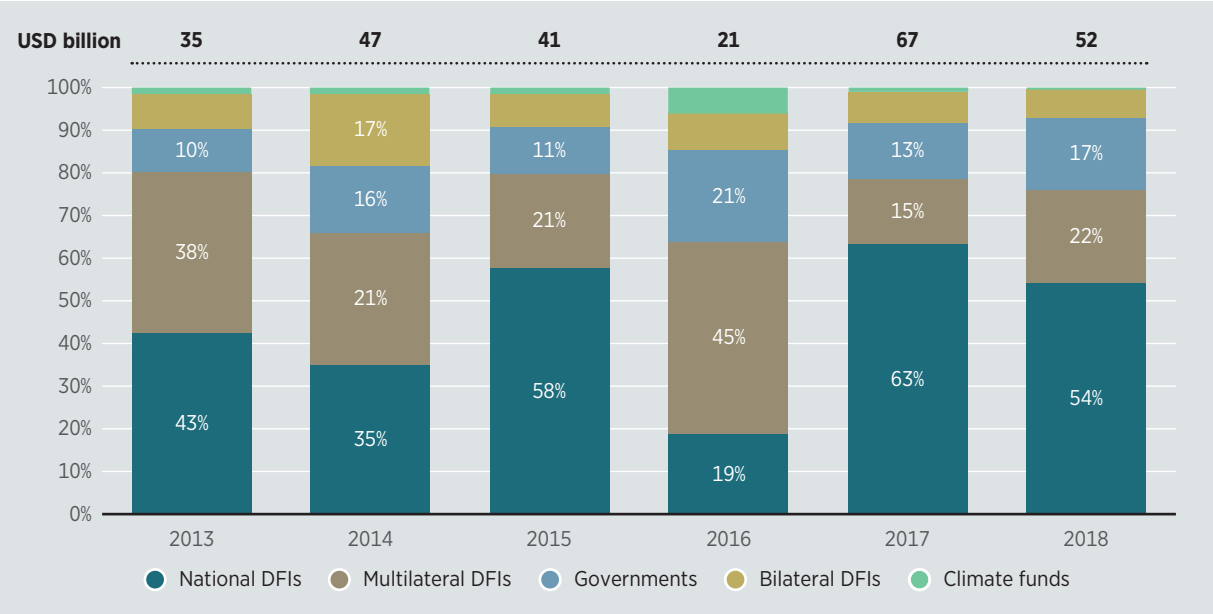
Out of the total USD 52 billion invested by the public sector in 2018, USD 27 billion was provided as project-level conventional debt, USD 7 billion as project-level concessional debt, USD 5 billion as balance sheet financing (debt and equity) and under USD 2 billion as grants.[23]

Between 2013 and 2018, national, multilateral and bilateral DFIs have consistently provided the majority (83%) of public investment, averaging USD 37 billion per year (Figure 21). After a steep decrease in contributions in 2016, DFI investment peaked in 2017, reaching USD 57 billion. This increase was mainly facilitated by investments from national DFIs hiking from USD 4 billion in 2016 to USD 42 billion in 2017, more than a tenfold increase driven by China, Colombia, Mexico and Turkey. Multilateral DFI investment gained momentum in 2017 and 2018 after a decline in investment in 2013-2016, totalling USD 11 billion in 2018 compared to USD 9 billion in 2016.

Direct finance from governments[24] significantly increased in 2017-2018, averaging USD 16 billion per year compared to USD 4.5 billion in 2015-2016 (Figure 21). Most of this increase in financing was directed to solar PV and onshore wind. In addition, governments facilitated grants and low-cost debt instruments for technical assistance projects in international destinations.

National and multilateral climate funds cumulatively invested around USD 0.5 billion during 2013-2018,

Figure 21 Public investment in renewable energy, by investment source, 2013-2018



Source: CPI analysis.
Note: DFI = development finance institution.

22 *Definitions of each public sector actor included in this analysis are provided in the methodology document (IRENA and CPI, 2020).*
23 *The remaining USD 10 billion consists of unknown instrument types.*
24 *That is, excluding expenditures for feed-in tariffs and other policy support measures. An estimation of government expenditures for renewable energy support policies (e.g., feed-in tariffs, feed-in premiums and green certificates) was conducted by IRENA and CPI (2018) for Japan and 27 Western European countries.*

mostly deploying funds in strategic programs for renewable energy development as well as solar PV and geothermal technologies (Figure 21).

While the share of public finance remains relatively unchanged due to a general increase in total renewable energy finance, absolute investment numbers increased for every technology. Public finance for onshore wind, for example, increased threefold from an annual average of USD 4 billion during 2015-2016 to USD 12 billion during 2017-2018. Solar PV attracted an annual average of USD 12 billion during 2017-2018, four times the average of USD 3 billion recorded during 2015-2016.

In the context of tracking progress toward the achievement of the SDGs, IRENA and the OECD have been tracking international public financial flows to developing countries in support of clean and renewable energy (SDG indicator 7.a.1).[25] Over the past decade, these financial flows have grown steadily each year, peaking at over USD 21 billion in 2017. While in 2017, about 34% of this support went to countries with the lowest rates for electricity access, the data show that international public financial flows are not necessarily targeting those countries that need the most support. In 2017, only 12% of total international support went toward least developed countries, while small island developing states received only 4% of the total (see Box 7).

Box 7

Tracking SDG 7.a.1: International public financial flows to developing countries in support of clean and renewable energy

The United Nations Sustainable Development Goals (SDGs) provide a powerful framework for international cooperation and point to the need of increasing financial flows to developing countries in support of various development objectives. As one of the co-custodian agencies of SDG 7 on energy, IRENA together with OECD has been appointed to track annual progress toward SDG indicator 7.a.1 – measuring international financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems.

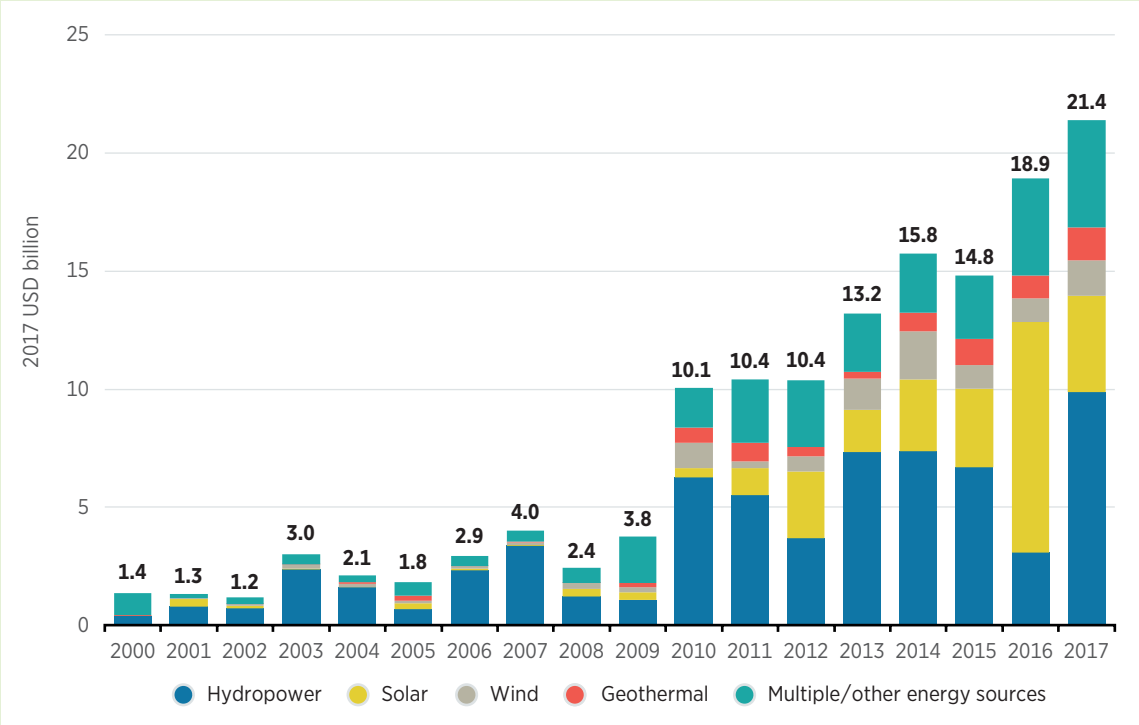
The latest findings, published in the *Tracking SDG 7: Energy Progress Report 2020*, show that international public investment in renewable energy has been growing steadily in recent years, reaching USD 21.4 billion in 2017, up 13% from 2016 levels. The broad trend shows a fifteenfold increase in annual international public flows over the period 2000-2017, reflecting an increasing focus of development aid on clean and renewable energy (Figure 22) (IRENA and OECD, 2020).

During 2000-2009, annual international public flows to developing countries remained low, ranging from USD 1 to 4 billion per year. Significant growth was registered in 2010, when international public financial flows more than doubled compared to 2009, reaching USD 10 billion. Between 2010 and 2017, annual international public flows experienced a twofold increase, growing by around USD 1.6 billion per year (IRENA and OECD, 2020).

In 2017, almost half of international public support went to hydropower projects, followed by solar (which received 19%), wind (7%) and geothermal (6%). Asian public financial institutions contributed a considerable portion of international public financial flows in the same year. Out of 65 donors, four Asian institutions committed 52% of total international public investments in 2017. The China Development Bank and Ex-Im Bank of China were the largest investors with USD 9 billion each, followed by the Asian Development Bank with USD 1.1 billion and the Government of Japan with USD 1.0 billion (IRENA and OECD, 2020).

25 *These comprise two different types of financial flows. The first one includes public financial support that OECD's Development Assistance Committee (DAC) donors provide to developing countries for renewable energy, as tracked by official development assistance (ODA) and other official flows. The second type of financing tracked includes additional flows to non-ODA recipients in developing regions, as well as flows from countries and other public institutions not currently reporting to the DAC. More details about the methodology can be found at https://unstats.un.org/sdgs/metadata/files/Metadata-07-0a-01.pdf.*

Figure 22 International financial flows to developing countries in support of renewable energy, 2000-2017



Source: IRENA and OECD, 2020.

Note: Financial flows are drawn from the Renewable Energy Public Investments database, a joint OECD/IRENA database on international financial flows to developing countries in support of clean and renewable energy. Financial flows are reported in constant USD at 2017 prices and exchange rates.

Since 2010, Sub-Saharan Africa and Latin America have attracted the majority of international public renewable energy investments each year. In 2017, these two regions accounted for 37% and 21% of the total, respectively. Countries with the largest electricity-access gaps globally received USD 7.2 billion – or 34% of the total – in the same year. Only a small portion of international public flows to developing countries, however, targeted the most vulnerable countries, namely least developed countries (LDCs) and small island developing states (SIDS). In 2017, LDCs received only USD 2.7 billion (or 12% of the total), while SIDS received less than USD 0.8 billion (or 4% of the total) (IRENA and OECD, 2020).

The private sector is the main provider of capital for renewables but public resources remain crucial to reduce risks for private investors and bring new markets to maturity

To boost the flow of capital to meet climate ambitions in developing countries and fulfil SDG 7, IRENA has joined with the United Nations Development Programme and Sustainable Energy for All, in co-operation with the Green Climate Fund, to establish the Climate Investment Platform.

The initiative creates a virtuous cycle, whereby countries can set up ambitious energy and climate targets, including Nationally Determined Contributions (NDCs) under the Paris Agreement, mitigate residual risks and help projects attract funding (see Box 8).

Box 8 **The Climate Investment Platform**

The services of the Climate Investment Platform (CIP) cover four key building blocks in the climate finance value chain:

- "Track 1, Targets": Helping governments to set ambitious targets and scale up their NDCs.
- "Track 2, Policies and Regulations": Establishing well-designed, fully implemented and consistently enforced clean energy policies and regulations.
- "Track 3 Financial De-risking": De-risking clean energy projects to ensure financial access and bankability.
- "Track 4, Market Place": Providing a forum in which clean energy investors and project sponsors can connect.

The "IRENA for CIP" framework (www.irena.org/irenaforcip/) puts CIP objectives into operation. With IRENA leading CIP risk-mitigation and matchmaking activities, project proponents (developers or sponsors) can register on the web to connect with potential financial backers.

Registered project proponents can submit requests for project development support or financing for a renewable energy project.

Partnerships

To implement CIP objectives, IRENA collaborates with a wide range of public and private stakeholders committed to supporting and advancing renewable energy projects. The partners that have registered to date include United Nations agencies, multilateral and bilateral development financial institutions, commercial banks, investment funds, donor initiatives, non-governmental organisations, local financial institutions, and private project developers.

Since the initiative's launch in January 2020, more than 200 partners have expressed interest. These include the European Bank for Reconstruction and Development, the Global Environment Facility, the Islamic Development Bank, the United Nations Industrial Development Organization, the World Bank Group, the Dutch development bank FMO, Enel Green Power, the Italian investment bank CDP, the RES4Africa Foundation, and other companies and organisations.

Projects

"IRENA for CIP" now hosts more than 170 projects spread across the world, with a significant concentration in Sub-Saharan Africa. Projects vary in size from utility scale to off-grid and are at all stages in the project cycle.

For more information on CIP, visit www.climateinvestmentplatform.com.

RENEWABLE ENERGY INVESTMENT IN CONTEXT

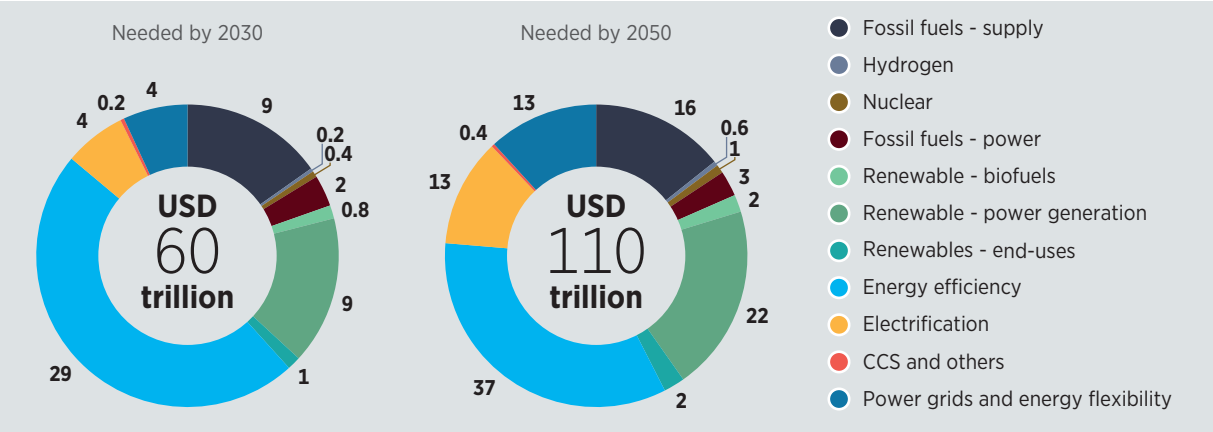
03

3.1 Investment needs for the energy transition

IRENA (2020b) has explored global energy development options under two broad future pathways. The Planned Energy Scenario is the reference case and provides a perspective on energy system developments based on governments' energy plans, targets and policies, including Nationally Determined Contributions. The Transforming Energy Scenario describes an ambitious, yet realistic, energy transformation pathway – largely based on accelerated renewable energy deployment and energy efficiency improvements – that is climate-compatible.

In its Transforming Energy Scenario, IRENA estimates the required cumulative investment in the energy sector at USD 60 trillion by 2030 and USD 110 trillion by 2050 (Figure 23). Particularly, to set the world on a more climate-friendly trajectory by 2050, over USD 37 trillion will be required for energy efficiency solutions, USD 27 trillion for renewables, USD 13 trillion for electrification of end-use sectors (*e.g.*, for electric vehicles and railways), and USD 13 trillion for power grids and energy flexibility measures, such as smart meters and energy storage (Figure 23) (IRENA, 2020b).[26]

Figure 23 Cumulative energy-sector investment needed through 2030 and 2050 under IRENA's Transforming Energy Scenario



Source: IRENA, 2020b.

Note: hydrogen = electrolysers for hydrogen production; CCS and others = carbon capture and storage for use in industry and material improvements.

26 Power grids and energy flexibility encompass more-flexible generation, stronger transmission and distribution systems, greater storage capacity, and more-flexible demand (IRENA, 2018b).

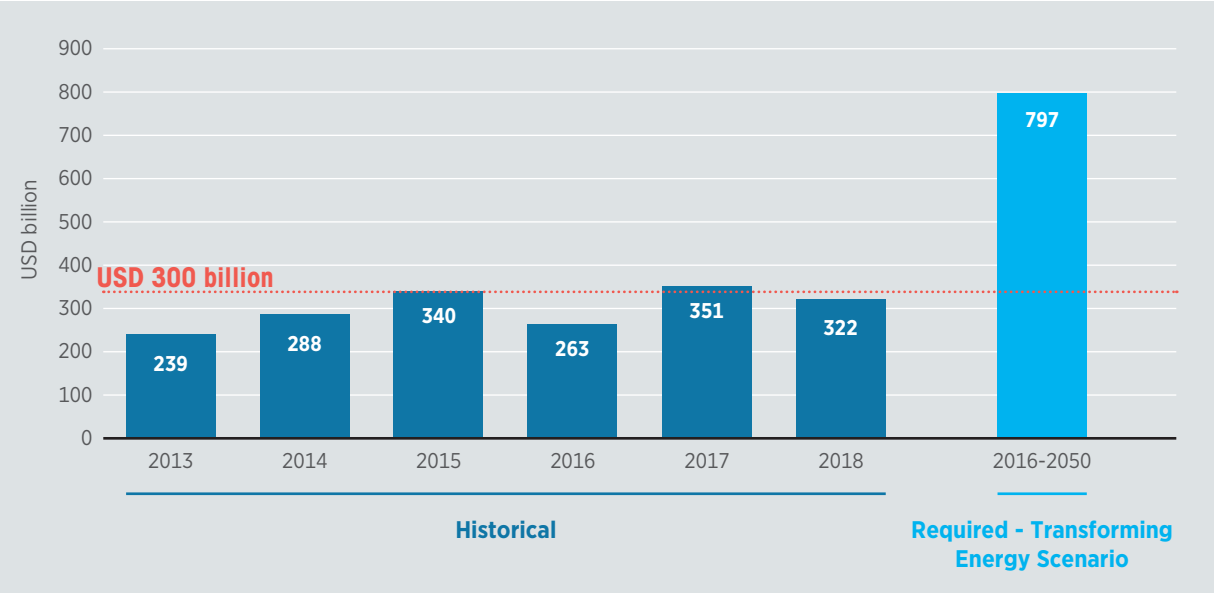
In annual terms, a renewable energy investment of almost USD 800 billion would be needed through 2050 under the Transforming Energy Scenario (Figure 24) (IRENA, 2019d). As discussed in Chapter 2, global annual investment in the renewable energy sector has increased almost steadily over time, averaging USD 300 billion in 2013-2018. However, despite an overall growing trend, current investment levels are not nearly enough to put the world on a climate-compatible pathway. Global annual renewable energy investment needs to almost triple between now and 2050 (Figure 24) (IRENA, 2020b).

Investments in renewable energy will need to be ramped up in both developed and developing economies to achieve an energy mix compatible with a 1.5°C pathway (IRENA, 2020b). Significant investment opportunities exist in developing economies. For example, USD 40 billion would need to be directed each year through 2050 toward renewable energy projects in Sub-Saharan Africa, a fourfold increase compared to the USD 10 billion invested in 2018 (IRENA, 2020b). Investment in Latin America and the Caribbean would need to double, from USD 16 billion to over USD 30 billion annually between now and 2050.

A scale-up of renewable energy investment should be coupled with a significant reduction and redirection of fossil fuel investments. During 2015-2018, annual investments in renewable power generation consistently exceeded investments in fossil fuel power generation. In 2018, while renewables received USD 322 billion, investments in fossil fuel power generation only reached less than half of that – or USD 127 billion (Figure 25).

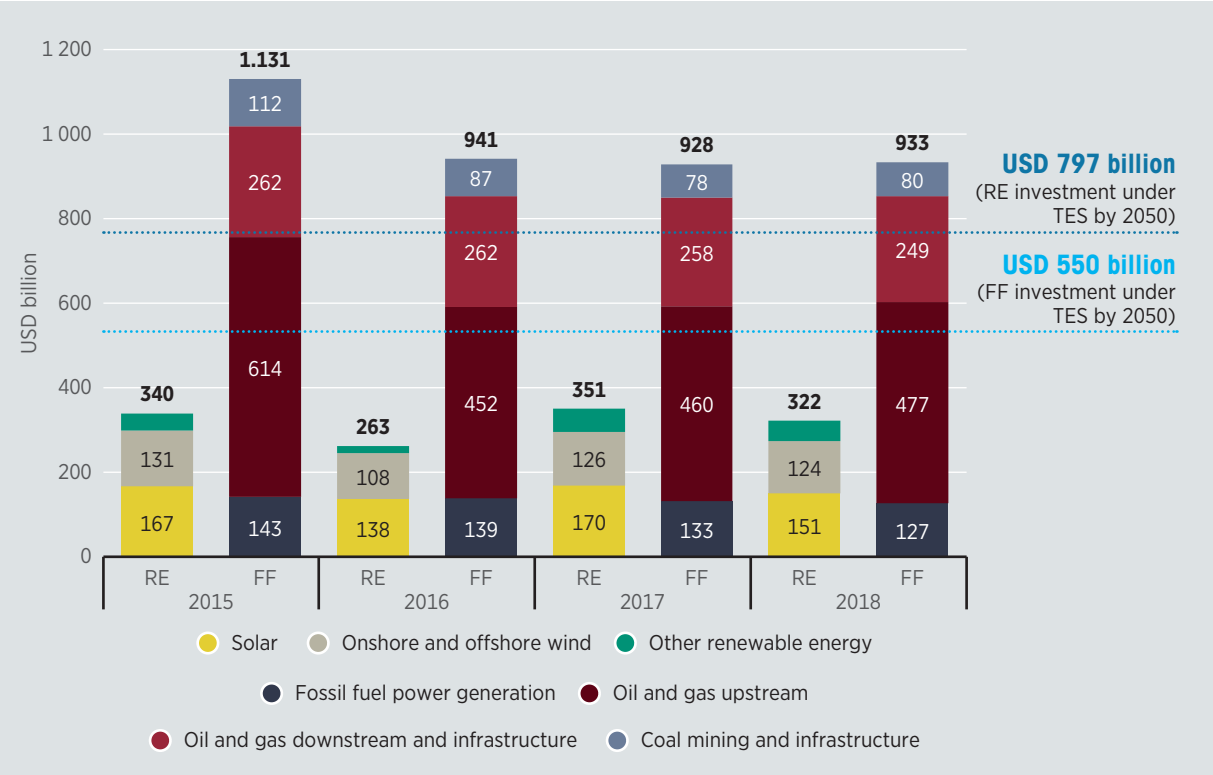
However, a large share of investment for fossil fuel infrastructure does not flow to the power sector; for example, the majority of oil demand (85%) was for transportation and other high-emission energy uses. When investments in fossil fuel power infrastructure are considered, including coal mining and related infrastructure (*e.g.*, transformation and transportation) as well as oil and gas upstream and downstream infrastructure, annual fossil fuel investments clearly eclipse investment in renewable energy. In 2018, for example, the fossil fuel sector received a total of USD 933 billion, almost three times as much as what was invested in renewables in the same year (Figure 25).

Figure 24 Annual renewable energy investment during 2013-2018 vs. annual required investment by 2050 under IRENA's Transforming Energy Scenario



Source: IRENA, 2019d and CPI analysis.

Figure 25 Renewable energy vs. fossil fuel annual investment (2015-2018) and needed under IRENA's Transforming Energy Scenario by 2050



Source: IRENA, 2019d and CPI analysis.
Note: RE= renewable energy; FF= fossil fuel; TES= Transforming Energy Scenario.

These fossil fuel investments can create a high-emissions pathway lock-in that could increase the risk of stranded assets. According to IRENA, moving from a Planned Energy Scenario to a Transforming Energy Scenario, USD 18.6 trillion would have to be redirected from fossil fuels to low-carbon technologies between now and 2050. Annually, this figure implies that the total fossil fuel investments should not exceed USD 550 billion – about half of what was invested by the fossil fuel industry each year during 2013-2018 (IRENA, 2019d). Delaying action in shifting investments away from fossil fuels is projected to result in USD 19.5 trillion of stranded assets by 2050 (IRENA, 2019d).

3.2 Impacts of COVID-19 on renewable energy investments

The global economy has been thrown into disarray as a result of the COVID-19 pandemic. The lockdown measures implemented by most countries to curb the spread of the virus have resulted in plummeting economic growth and tightening financial conditions, triggering widespread uncertainty in virtually every country and economic sector.

Although the renewable energy industry as a whole has been affected far less by the pandemic than the conventional energy sector (IRENA, 2020a), it has still felt the brunt of the crisis. In the first half of 2020, financial commitments in the sector dropped by 34% compared to the first half of 2019 (BNEF, 2020a). Throughout the second half of 2020 and in the years to come, the impacts of the global crisis on both the energy and financial sectors can further negatively affect renewable energy investment, hampering progress toward a global energy transition.

One of the largest impacts felt by energy markets has been the substantial drop in energy and power demand. Following the drastic slowdown in global economic activity, energy demand fell by 3.8% in the first quarter of 2020, while electricity demand declined by almost 20% (IEA, 2020). The decrease in electricity use has led to the curtailment of costly fossil fuel generators, with utilities favouring renewable energy generators due to their lower operating costs.

While this has given rise to a temporary increase in the share of renewables in the electricity mix of many countries, it has also caused wholesale electricity prices to fall dramatically. Lower electricity prices have led to lower earnings for power utilities, with the average downward earnings revision of the top 220 utilities standing at 9% as of March 2020 (FactSet, 2020). Utilities' reduced financial health can lead to the delay or suspension of ongoing or planned projects, impacting their credibility with investors and diminishing their ability to attract future investments for new power generation projects (IRENA, 2020a).

In the financial sector, the economic impact of the global pandemic has caused disruptions and instability in financial markets. Concerns about the impacts of the global pandemic led to significant losses in equity markets, which declined 30% in just a matter of weeks in mid-February (WEF, 2020). This has led to major losses in balance sheets for many businesses around the world, including in the renewable energy sector. This has negatively impacted their creditworthiness, acting as a barrier to attracting investment.

Through green recovery packages, governments can signal their long-term commitment to renewables to investors, increasing their confidence and attracting additional investments in the sector

Furthermore, higher market uncertainty and volatility in financial markets have made investors more risk averse. This could cause a reduction or delay in their investments in renewable energy, which is already perceived as a high-risk investment by some investors. The difficulty in assessing potential risks in the current climate will likely make financing more expensive in the short term and restrict the entry of new market participants. With higher costs of capital, project developers would probably refrain from seeking new investment in the short term, opting to wait for markets to stabilise and financing rates to drop (Power Technology, 2020; Renewables Now, 2020).

There are, however, some redeeming signs that suggest that renewable energy investment can undergo a relatively speedy recovery. Monetary and fiscal policies undertaken by central banks and governments across the world in response to the crisis have slowly restored investor confidence and some segments of the financial sector are already showing signs of recovery (WEF, 2020).

In addition, despite the uncertainty caused by the COVID-19 pandemic, in the first quarter of 2020, foreign direct investment in renewable energy reached record-high levels – with over USD 23 billion of cross-border investment announced – while such investments in fossil fuels plummeted (fDi Markets, 2020).

In general, the pandemic has shifted investors' focus toward more reliable and sustainable assets, including renewables. These assets have proven to be more resilient to the global shock compared to conventional assets (Morningstar, 2020). As many institutional investors are re-evaluating their portfolio strategies with a greater focus on a sustainable energy future, greater investment in renewable energy assets can be expected in the future (IRENA, 2020a).

Finally, green stimulus packages, which place renewable energy at the core of the economic recovery, can signal long-term public commitment to the industry, boosting investor confidence and attracting additional private capital in the sector. Focusing recovery plans on the energy transition represents a far-sighted investment opportunity as it can help overcome the economic downturn and create much-needed jobs in the short term and beyond (IRENA, 2020a).

IRENA analysis finds that in the post-COVID recovery phase between 2021 and 2023, investments related to the energy transition should reach nearly USD 2 trillion per year, and then continue to grow to an annual average of USD 4.5 trillion in the decade to 2030. Government funds can leverage private investments by a factor of 3-4 and should be used strategically to steer investment decisions and financing in the directions most likely to maximise the socio-economic benefits of the energy transition (Box 9) (IRENA, 2020a).

Box 9 **The socio-economic benefits of the energy transition**

With the added investment stimulus of IRENA's Transforming Energy Scenario, energy transition-related technologies would add 5.5 million more jobs by 2023 than would be possible under the less ambitious Planned Energy Scenario, which is based on nations' current plans and commitments. Renewables would account for 2.5 million of these additional jobs, energy efficiency for 2.9 million, and grids and energy system flexibility for 0.1 million.

In the longer term, investing in the energy transition would result in 100 million people being employed in the energy sector by 2030 under the Transforming Energy Scenario, up 74% from today's 58 million – and 15 million more than under the Planned Energy Scenario. Jobs in renewables would grow to almost 30 million in 2030 from about 12 million in recent years. Employment in energy efficiency would expand from under 10 million to 29 million, while grids and energy system flexibility would likely see an increase from 7.4 million to 12 million workers.

Source: IRENA, 2020b.

THE LANDSCAPE OF OFF-GRID RENEWABLE ENERGY INVESTMENT

04

Ensuring access to affordable, reliable, sustainable and modern energy for all is the seventh of the United Nations' SDGs. Energy access has an immediate transformative impact and can accelerate progress toward all other SDGs. Despite progress in energy access, approximately 789 million people had no access to electricity at the end of 2018, while nearly 620 million would still be without electricity and 2.3 billion would lack access to clean cooking facilities in 2030 under current and planned policies (IEA, IRENA, UN, WBG, and WHO, 2020). This shows that the world is currently not on track to achieve universal energy access by 2030.

Off-grid renewable energy technologies – both stand-alone systems and mini-grids – represent a cost-effective solution to accelerate electricity access for households and productive uses in the short to medium term. This is particularly true in rural areas that are too costly to reach through grid expansion and where 85% of the population without electricity (668 million people) lived at the end of 2018. The same year, off-grid renewable energy technologies were providing below Tier 1 electricity services to 136 million people around the world, compared to about 1 million people in 2010 (IEA, IRENA, UN, WBG, and WHO, 2020).[27]

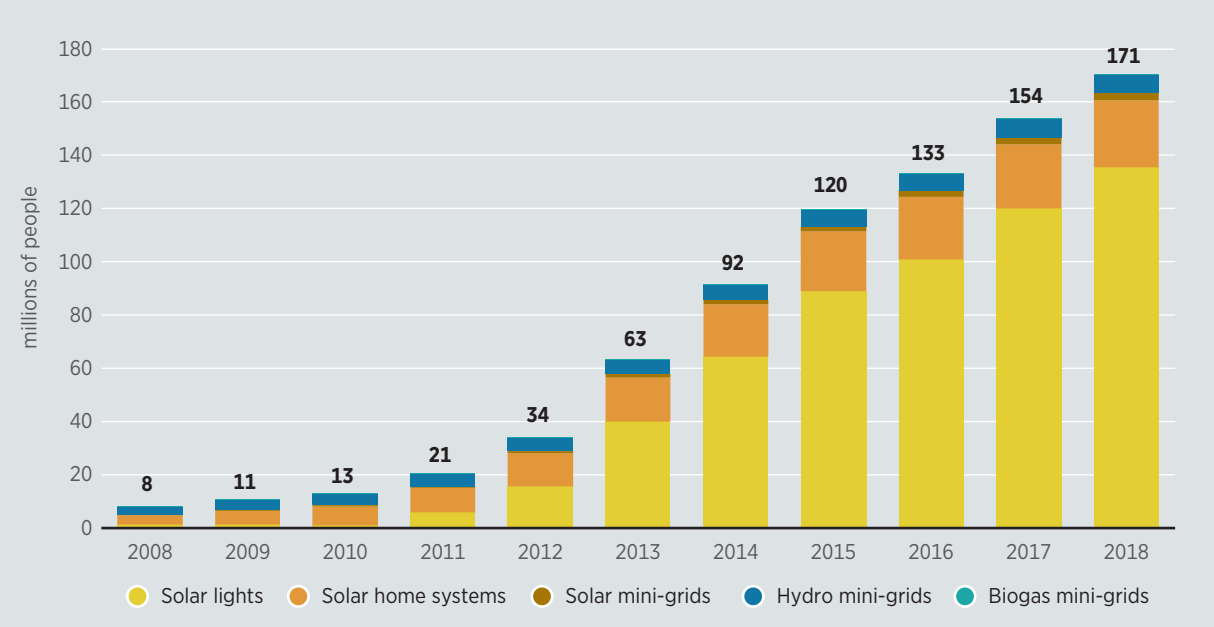
In 2018, global off-grid renewable electricity capacity, for both residential and commercial purposes, reached 8.2 GW, up from less than 4 GW in 2009 (IRENA, 2020f). This growth was particularly driven by the rapid decline in technology costs and the innovation in delivery and financing models, such as pay-as-you-go (PAYG) systems (IRENA, 2018c).[28]

At the same time, the population served by off-grid renewables has expanded eightfold since 2011, reaching over 170 million people in 2018 (Figure 26). About 80% of them, or 136 million people, had access to Tier 0 solutions (*i.e.,* solar lights), while about 35 million people had access to Tier 1 and above (Tier 1+) off-grid sources. Countries in Asia and Africa accounted for most of the increase in the number of people served by off-grid renewables. At the end of 2018, 111 million of the people benefitting from such solutions were in Asia and over 50 million were in Africa (IRENA, 2019e).

27 This refers to the Multi-Tier Framework developed by the World Bank in which tiers are used to measure levels of energy access, ranging from Tier 0 (no access) to Tier 5 (very high level of energy access). More details are available at www.esmap.org/node/55526.

28 The PAYG model involves energy consumers (e.g., households or individuals) procuring a solar home system from a supplier through a down payment, followed by periodic payments that are set at affordable levels. This could take the form of a perpetual lease or eventual system ownership after a defined period. The payments are usually collected through mobile payment platforms (IRENA, 2017). The system provides the basic energy needed to power general lighting, small appliances and phone charging.

Figure 26 Population served by off-grid renewable energy solutions globally, 2008-2018



Source: IRENA, 2019e.

Note: Data on the number of people with access to these forms of electricity supply are gathered by IRENA (2019e) based on sales of solar panels, project reports and other publicly available sources.

This chapter of the report aims to provide a comprehensive overview of the financing landscape for off-grid renewable energy solutions in developing countries. Unless otherwise noted, the analysis in this chapter is based on Wood Mackenzie data. The detailed methodology for the analysis can be found in the background document, *Global Landscape of Renewable Energy Finance, 2020: Methodology* (IRENA and CPI, 2020). Examples of complementary analyses of financial flows in the context of energy access conducted by SEforAll and are presented in Box 10.

Box 10 **Complementary analyses of energy access financial flows**

Since 2017, Sustainable Energy for All (SEforALL) together with partner institutions has analysed financial flows in the energy access space. Due to its different focus, this work complements the analysis of the landscape of off-grid renewable energy finance included in this report.

The *Energizing Finance* research series examines supply and demand for finance across two key areas of energy access: electricity and clean cooking. This year's report, *Understanding the Landscape 2020,* delves deep into financial commitments intended to increase access to electricity and clean cooking solutions in 20 countries of Africa and Asia suffering from high energy-access deficits. The report offers insight into the disparity between the investment needs of these countries and levels of financial commitments. It also examines commitments to fossil fuels and trends over a six-year period.

The report *Missing the Mark 2020* explores the gap between commitments of international development finance and disbursements for energy sector projects, including clean cooking projects, in countries with a high energy-access deficit over the 2013-2018 period. It highlights how volumes of committed investment can differ considerably from the volumes actually disbursed, recognising that impact can only be achieved when financial commitments are disbursed.

This year's Energizing Finance reports will be released in November 2020. For more information, please visit www.seforall.org/energy-finance

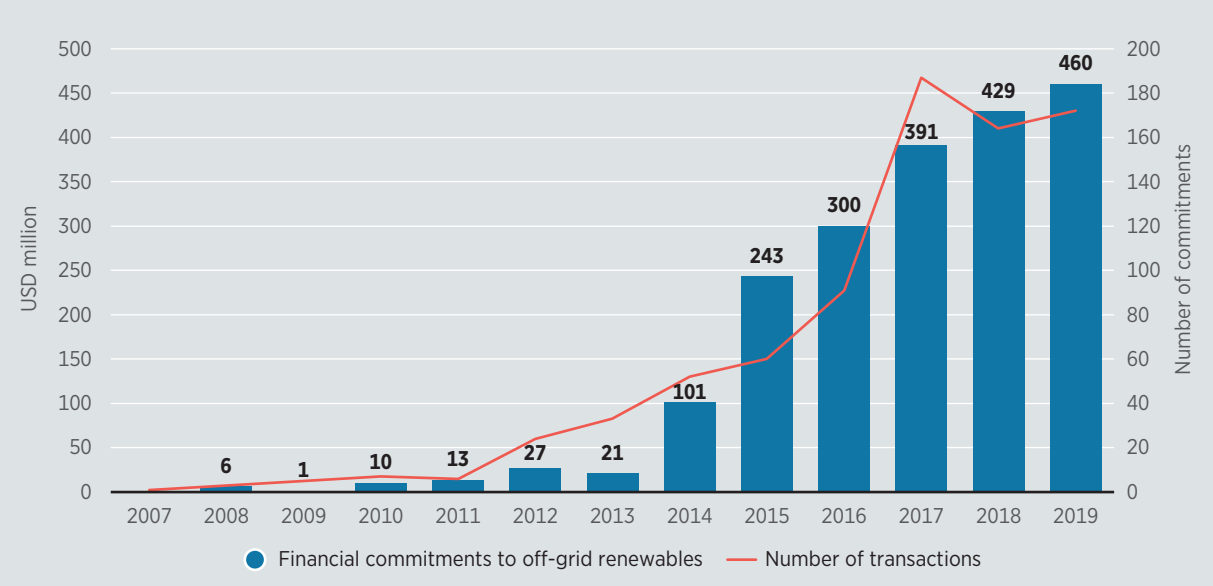
4.1 Overview of the off-grid financing landscape

Between 2007 and 2019, off-grid renewables attracted slightly more than USD 2 billion (IRENA analysis based on Wood Mackenzie, 2020). About 36% of total commitments during this period, or USD 734 million, was directed uniquely to access-deficit countries, *i.e.*, countries that were home to about 80% of people currently lacking energy access (SEforAll and CPI, 2019).[29] An additional USD 812 million went to companies or projects operating in several locations, including access-deficit countries, though the share of financing flowing to these countries is not specified.

Annual financial commitments to decentralised renewables increased from just USD 250 000 in 2007 to USD 460 million in 2019 (Figure 27). Remarkable growth was recorded in 2014, when annual commitments quadrupled compared to 2013 and reached over USD 100 million. This growth was driven by a staggering increase in commitments in Sub-Saharan Africa, particularly in East Africa. Since then, commitments have grown steadily at an average rate of 35% a year (IRENA analysis based on Wood Mackenzie, 2020).

The number of new financial commitments remained low until 2011, at an average of less than four per year, before growing exponentially to 187 in 2017, driven by an increase in crowdfunding activities. Over the past two years, while amounts committed continued to grow, the number of annual commitments plateaued, suggesting an increase in market concentration with less and less new investors coming into the sector. In addition, the average ticket size almost tripled from just above USD 1 million before 2015 to nearly USD 3 million during 2015-2019, indicating an increase in the size of individual businesses toward levels and volumes that increasingly attract the attention of professional investors. At the same time, the number of commitments involving more than one investor also grew quite steadily after 2014 (IRENA analysis based on Wood Mackenzie, 2020).

Figure 27 Annual commitments to off-grid renewable energy and number of annual transactions, 2007-2019

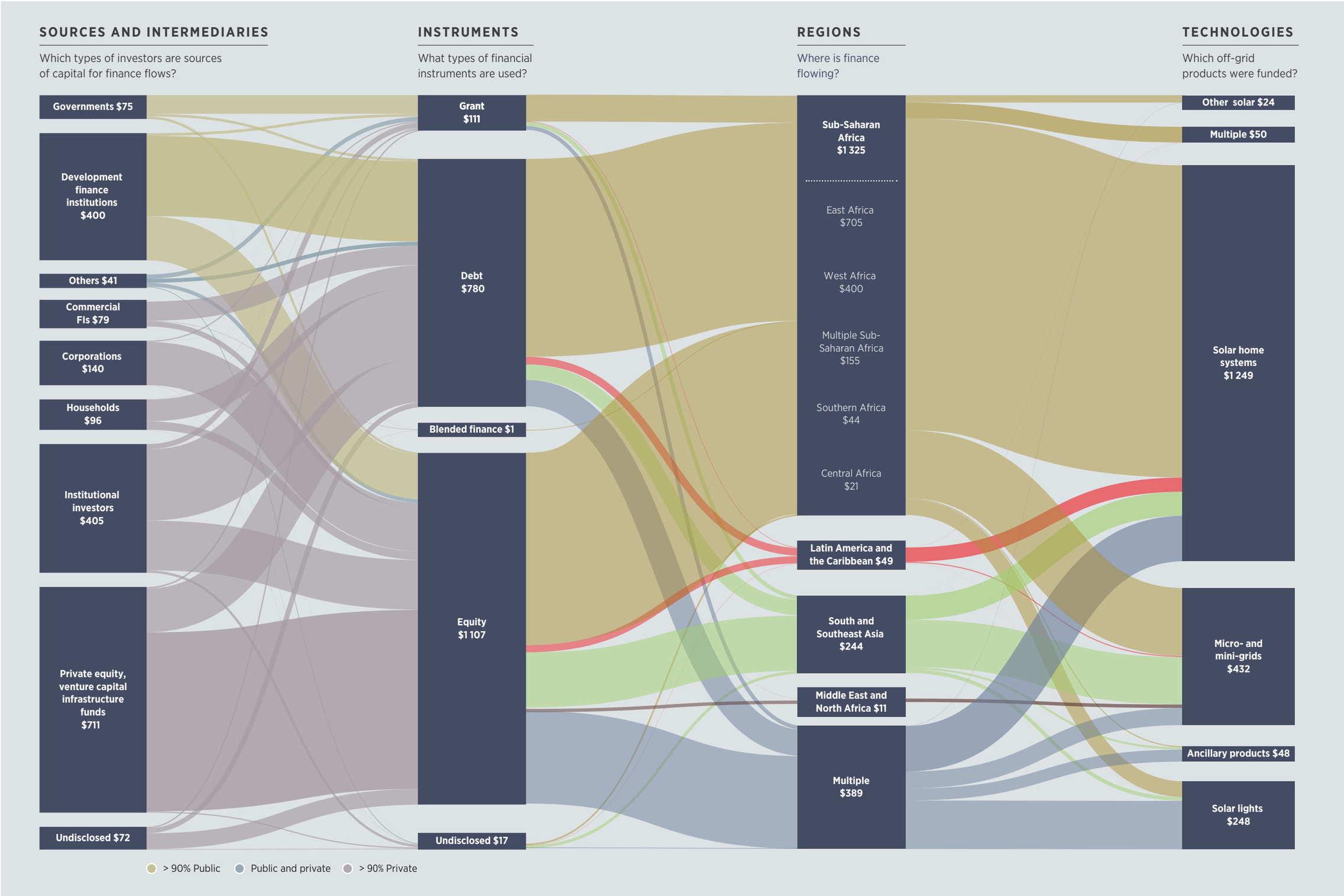


Source: IRENA analysis based on Wood Mackenzie (2020).

Note: The figure excludes 12 commitments for which the year was not specified, representing USD 15.7 million.

29 *A list of energy-access-deficit countries is provided in SEforAll and CPI (2019). These include Afghanistan, Angola (only electricity), Bangladesh, Burkina Faso (only electricity), China (only clean cooking), the Democratic People's Republic of Korea, the Democratic Republic of the Congo, Ethiopia, India, Indonesia (only clean cooking), Kenya, Madagascar, Malawi (only electricity), Mozambique, Myanmar, Nepal (only clean cooking), Niger (only electricity), Nigeria, Pakistan (only clean cooking), the Philippines, Sudan, Uganda, the United Republic of Tanzania, Viet Nam (only clean cooking) and Yemen (only electricity).*

Figure 28 Landscape of off-grid renewable energy finance in 2007-2019



Source: IRENA analysis based on Wood Mackenzie (2020).
Note: FIs = financial institutions.

Despite the growth observed over time in off-grid renewable energy financing, investments in these solutions still represent a very small portion of the overall energy access financing landscape.[30] In access-deficit countries, for example, USD 85.8 billion was committed for access to electricity and clean cooking during 2013-2017 (SEforAll and CPI, 2019). Off-grid renewables attracted less than 1% of the total (IRENA analysis based on Wood Mackenzie, 2020), with the remainder being invested in grid-connected power assets – both renewables and fossil fuels – and transmission and distribution infrastructure, among other purposes (SEforAll and CPI, 2019).

Figure 28 provides a snapshot of the investment landscape for off-grid renewable energy between 2007 and 2019. The Sankey diagram follows the life cycle of commitment flows from sources, to instruments employed, regions and technologies targeted. As evidenced by the diagram, off-grid renewable energy investments were concentrated in Sub-Saharan Africa, with the majority of financing coming from private equity, venture capital and infrastructure funds, followed by institutional investors (mainly foundations) and development finance institutions. Solar home systems were the most-funded off-grid product, accounting for about 60% of cumulative investments during this period.

The analysis of financial flows in the following sections encompasses two different time periods. When investigating cumulative investments, the analysis takes into consideration financial commitments made throughout the period 2007-2019. However, when looking at annual trends, the analysis focuses on the years between 2013 and 2019, as investments remained low and sporadic before 2013.

4.2 Off-grid renewable energy commitments by financing source

4.2.1 Private vs. public finance

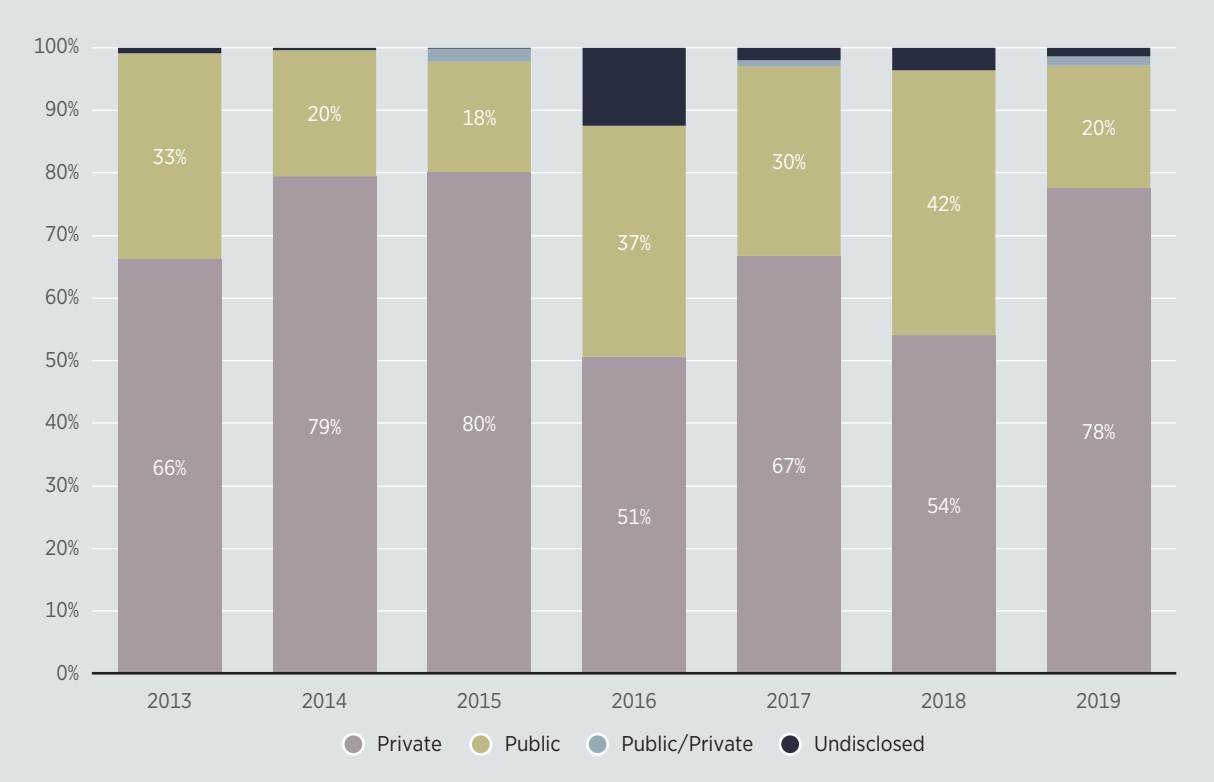
About 67% of cumulative commitments to off-grid renewables from 2007 to 2019 came from private investors, and 30% from public capital providers (IRENA analysis based on Wood Mackenzie, 2020). Higher shares of public participation compared to the 15% observed in the wider renewable energy sector (see section 2.4) are not surprising. Off-grid renewables are still relatively new and involve specific risks for investors associated to the location of such investments – rural areas in developing countries – and the nature of customers – low-income households and businesses with limited or no credit history. Public capital can play a pivotal role in kick-starting new markets and supporting sectors in their initial stages of development, for example, by promoting pilot projects for new technologies and business models or by covering early-stage project risks to mobilise affordable private capital.

Over time, both public and private annual commitments grew steadily, with isolated falls in private commitments in 2016 and 2018. However, in 2019 public financing halved compared to the previous year, mainly driven by less DFI activity in Latin America and the Caribbean, taking the share of annual private commitments to 78% (Figure 29).

Financing for off-grid renewables reached USD 460 million in 2019 though it still represents only 1% of overall energy access finance

30 *In addition to decentralised renewable energy solutions (both stand-alone systems and mini-grids), the energy access landscape includes grid-connected plants (both renewable energy and fossil fuel), transmission and distribution infrastructure as well as clean fuels and technologies for cooking, such as cookstoves, biogas and liquefied petroleum gas.*

Figure 29 Shares of annual commitments to off-grid renewable energy, by public/private investor, 2013-2019



Source: IRENA analysis based on Wood Mackenzie (2020).

4.2.2 Commitments by investor type

Private equity, venture capital and infrastructure funds were responsible for 35% of investments in off-grid renewables from 2007 to 2019, having committed more than USD 710 million (IRENA analysis based on Wood Mackenzie, 2020).[31] Their appetite for small businesses and start-ups with a short track record but exceptional growth potential makes these types of investors (especially venture capital providers) a particularly suitable source of capital for off-grid renewable energy companies operating in developing and emerging markets.[32]

With the exception of the small sub-group of private foundations, institutional investors have not been particularly active in the off-grid renewable energy sector. This is not surprising as foundations usually have a different investment rationale compared to the typical institutional investors, emphasising more social or environmental impact than stable financial returns. During 2007-2019, these investors cumulatively committed USD 405 million and together with private equity, venture capital and infrastructure funds represented about 76% of private commitments (IRENA analysis based on Wood Mackenzie, 2020).

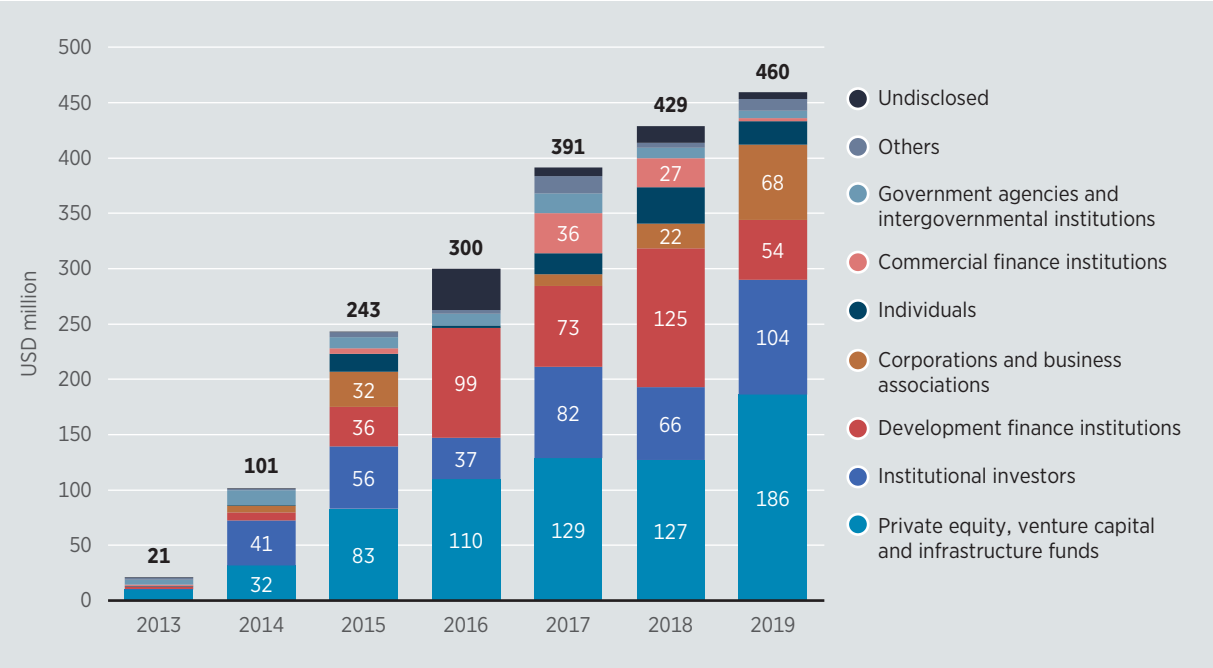
DFIs were the largest public capital providers, having committed USD 400 million, which represents 67% of total public investments for off-grid renewables. Financing from other investors was comparatively limited. Investments by corporations and business associations were rather sporadic during this time, with peaks in 2015 (USD 32 million) and 2019 (USD 68 million). Annual commitments from commercial finance institutions (*e.g.*, banks) remained low throughout the period, with 90% of the total invested only in 2017 and 2018 (IRENA analysis based on Wood Mackenzie, 2020).

31 Shares of cumulative investments in this chapter refer only to commitments for which investors were disclosed, amounting to USD 1.4 billion. Information on investors was not available for the remaining USD 72 million committed during 2007-2019.

32 Definitions of each type of investor included in this analysis are provided in the methodology document (IRENA and CPI, 2020).

As other investors increased their participation in the sector over time, the share of commitments attributable to government agencies and intergovernmental institutions significantly declined from 21% in 2013 to only 1% in 2019. Starting in 2015, individuals (*i.e.*, high-net-worth individuals, families or households) became a permanent feature of the financing landscape for decentralised renewables, having invested an average USD 18 million per year during 2015-2019 (Figure 30). This was primarily due to an increase in investment made through specialised crowdfunding platforms, which offer a unique opportunity for individuals to be directly involved in the funding of renewable energy projects and invest in a variety of asset classes (including equity) from which they were previously excluded (Baeck *et al.*, 2017) (see Box 11).

Figure 30 Annual commitments to off-grid renewable energy, by type of investor, 2013-2019



Source: IRENA analysis based on Wood Mackenzie (2020).
Note: "Individuals" includes investment through crowdfunding platforms; "Others" includes non-profit finance and impact funding.

The year 2019 saw a 57% drop in commitments from DFIs compared to 2018 (Figure 30). This reduction was driven by a drop in activities in Latin America and the Caribbean and Sub-Saharan Africa. By contrast, annual investment from private corporations more than tripled in 2019, and was directed mainly to East Africa and Southeast Asia. Compared to 2018, institutional investors, private equity, venture capital and infrastructure funds also raised their commitments to Central Africa, Southern Africa, Southeast Asia and West Africa (IRENA analysis based on Wood Mackenzie, 2020).

Box 11 Financing off-grid renewables through crowdfunding

Crowdfunding is the practice of financing an initiative, project or venture by raising relatively small amounts of capital from a large number of individuals or legal entities (the "crowd"), typically via an internet-based platform (Massolution, 2015). This tool thus allows project proponents to raise funds directly, bypassing traditional intermediaries such as commercial banks. Based on the funders' primary motivation for investing (financial or non-financial) and type of expected return, crowdfunding models can be classified into four main types: donation, reward, debt, and equity, as summarised in Table 1.

Table 1 Types of crowdfunding models

Motivation	Model	Description
Non-financial crowdfunding	Donation	Funders donate money without expecting any return
	Reward	Funders receive non-monetary rewards in exchange for their contribution
Financial crowdfunding	Debt	Funders lend money in return for interest
	Equity	Funders invest money in exchange for equity shares

Source: IRENA analysis.

In 2018, IRENA conducted research on the use of crowdfunding to finance energy access and found that, at the time, over 45 different platforms had raised funds for at least 4 800 renewable energy campaigns in emerging and developing countries. Most were for the development or purchase of off-grid renewable energy systems, mainly involving solar and bioenergy technologies. Over a third of the platforms identified were based in emerging and developing countries. In such markets, non-financial crowdfunding models (*i.e.*, donation and reward) tend to dominate, in contrast to developed-country platforms, which predominantly offer debt crowdfunding.

Although the potential of such instruments in the sector has yet to be closely investigated, it does appear that crowdfunding can be an effective tool to address the financing challenges faced by off-grid renewable energy projects. In addition, it can deliver a range of other benefits, often non-monetary, for entrepreneurs, capital providers and recipient countries, as described below.

Benefits for campaign organisers

- **Access to affordable finance.** Crowdfunding offers an opportunity for campaign organisers in developing countries to raise money outside the traditional banking system.[33] In countries with underdeveloped financial markets, crowdfunding may be the only available financing option or represent a cheaper and faster alternative to traditional financing. In addition, it allows campaign organisers to access a significantly broader pool of investors, both in terms of geographical reach and risk appetite, thereby lowering the overall cost of capital. In the case of domestic platforms, crowdfunding can further reduce capital costs by facilitating access to financing in local currency and minimising the currency exchange risk for project developers and consumers.
- **Easier and faster access to financing.** Crowdfunding can generally provide faster and easier access to finance. Applying for funding typically takes only a few minutes and can be done at any time from a distant location and with limited documentation, depending on the platform. Capital can then be raised in a matter of days or weeks, as opposed to months or years (MIF, 2015).

31 Campaign organisers may include entrepreneurs seeking to raise funds for the development of off-grid renewable energy projects, as well as low-income individuals seeking to secure microloans for the purchase of energy products (e.g., solar home systems).

- **Lower infrastructure and transaction costs.** Compared with traditional financing sources, online crowdfunding platforms entail considerably lower infrastructure and transaction costs. The online nature of such platforms implies little need for a physical presence. This aspect, coupled with the use of innovative algorithms to determine the creditworthiness of applicants and streamlined application and approval processes, allows platforms to operate at a relatively low infrastructure cost (Baeck *et al.*, 2017). In addition, the lack of financial intermediaries between project proponents and funders increases transparency and lowers transaction costs (Ottinger and Bowie, 2015).

- **Marketing benefits and increased acceptance of renewable energy projects.** Crowdfunding allows entrepreneurs to assess market demand and validate their products or services before turning to traditional investors (MIF, 2015). It can also provide better visibility for entrepreneurs, which can be used to build partnerships with buyers, suppliers and vendors. Additionally, project developers can receive early feedback from their community and revise their product or service accordingly, before significant capital is invested (Baeck *et al.*, 2017). Finally, as it closely involves local communities in the development and financing of campaigns, crowdfunding can ensure better acceptance of renewable energy projects, thus reducing a potentially significant risk for developers.

Benefits for capital providers

- **Access to new asset classes and markets.** Through crowdfunding, capital providers can gain access to new asset classes from which they were previously excluded (*e.g.*, equity) and, in the case of debt and equity crowdfunding, they can potentially earn higher returns than they could through savings and bonds (Baeck *et al.*, 2017). International platforms also open up a new investment opportunity for individuals who wish to invest in emerging and developing countries.

- **Lower individual risk.** Crowdfunding can help spread the risk of financing small-scale off-grid renewable energy projects among investors. Campaigns usually raise multiple small contributions from a large pool of investors, significantly diluting individual risk. At the same time capital providers can benefit from the so-called crowd due diligence, whereby a large number of funders reviews a campaign (UNDP, 2018).

- **Increased transparency.** Crowdfunding platforms enable investors to directly engage with project developers and monitor their progress. In addition, they facilitate the flow of information to potential investors and allow them to explore numerous offerings at once and to quickly determine the opportunities that best match their portfolio strategy, risk appetite and interests (MIF, 2015).

- **Direct participation and community engagement.** Crowdfunding offers a unique opportunity for individuals to be directly involved in the funding of renewable energy projects, participate in online communities, provide suggestions and stay closely in touch with the projects they support (Baeck *et al.*, 2017).

Benefits for recipient countries

- **Additional aid and remittance flows.** Through crowdfunding, emerging and developing countries can help attract additional direct aid flows from other regions, primarily following a North-South trajectory (AlliedCrowds, 2016). Additionally, this instrument can play an important role in channelling diaspora investments back into a country. A number of platforms have already been set up around the world for the purpose of capturing remittance flows, including Homestrings for African countries, Zafen for Haiti and ISupportJamaica, among others (AlliedCrowds, 2015).

- **Strengthened local industry.** By facilitating access to affordable finance for off-grid renewable energy projects in emerging and developing countries, crowdfunding can also stimulate local industrial capacity (especially when international and domestic partners are both involved) and support the creation of domestic jobs.

- **Higher domestic demand for renewables.** Crowdfunding can raise consumer awareness and increase demand for renewable energy projects in recipient countries, while also promoting public acceptance and ownership of such projects (in the case of local crowdfunding).

4.2.3 Commitments by investor location

About 76% of total finance commitments between 2007 and 2019 involved North-South flows, *i.e.,* from developed countries to developing and emerging markets (Figure 31). European investors committed USD 883 million, or 44% of the total. An additional USD 573 million came from North America and Oceania (28% of the total), while Japanese investors accounted for 4% of the total, with USD 71 million (IRENA analysis based on Wood Mackenzie, 2020).

Nevertheless, South-South commitments to decentralised renewables reached at least USD 273 million, most of which was domestic and/or intraregional. Investors from Sub-Saharan Africa and Southeast Asia accounted for 9% and 4% of cumulative finance commitments during this period, respectively. As shown in Figure 31, commitments within the same country and/or region accounted for the majority of investments in the Middle East (100%) and Southeast Asia (63%).

Inter-regional South-South flows during this period amounted to USD 35 million and were directed almost entirely to Sub-Saharan Africa (IRENA analysis based on Wood Mackenzie, 2020).

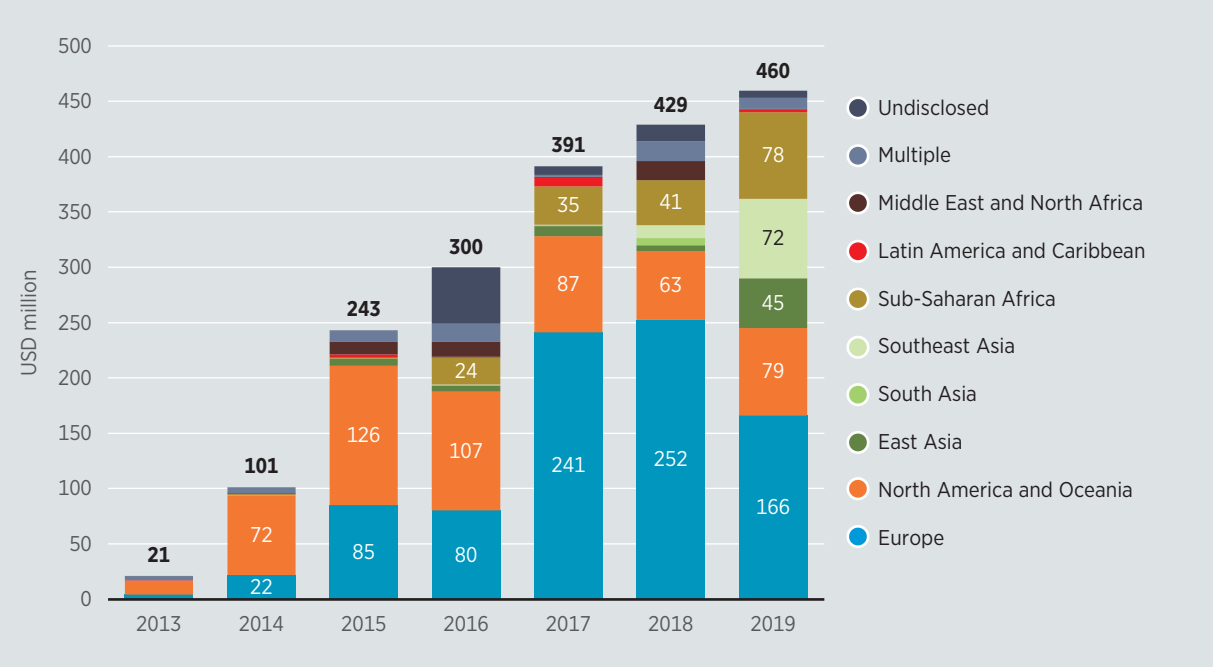
During 2013-2019, investors from Europe and North America and Oceania were responsible for over half of the investments each year. The share of commitments from North America and Oceania, however, has declined over the past few years, mainly driven by lower activities from private equity and venture capital investors. Investors from the Middle East (specifically Israel, Saudi Arabia and the United Arab Emirates) only started investing in the sector in 2014, while 2015 recorded the first commitments from East Asian investors (mainly from Japan) (Figure 32).

The share of investment attributable to investors from Southeast Asia and Sub-Saharan Africa grew steadily, from just 1.6% in 2014 to over 33% in 2019, driven by a surge in private investors' activities investing domestically or within the same region (Figure 32).

Figure 31 Shares of cumulative commitments to off-grid renewable energy, by type of flow and region of source of investment, 2007-2019

Source: IRENA analysis based on Wood Mackenzie (2020).

Figure 32 Annual commitments to off-grid renewable energy by investor region, 2013-2019



Source: IRENA analysis based on Wood Mackenzie (2020).
Note: "Multiple" denotes financial commitments that benefit more than one region simultaneously.

4.3 Off-grid renewable energy commitments by type of financing instrument

Off-grid renewables saw a much larger use of equity and a much lower use of debt instruments, compared to the overall energy access sector. Between 2013 and 2017, about 17% of annual commitments, on average, went to access-deficit countries in the form of equity and 64% in the form of debt (SEforAll and CPI, 2019). Conversely, the share of annual equity commitments to off-grid renewables during the same period was, on average, 57% while debt accounted for less than 30% each year, globally (IRENA analysis based on Wood Mackenzie, 2020).

While equity continued to be the preferred type of financing during 2007-2019, annual debt commitments grew steadily between 2013 and 2017, possibly pointing at the increased maturity of off-grid renewable energy markets. However, in 2018 and 2019, the use of both debt and grant instruments declined steadily, driven by a decline in the use of such financing instruments in East Africa and Southeast Asia, where these were replaced by a growing deployment of equity (IRENA analysis based on Wood Mackenzie, 2020).

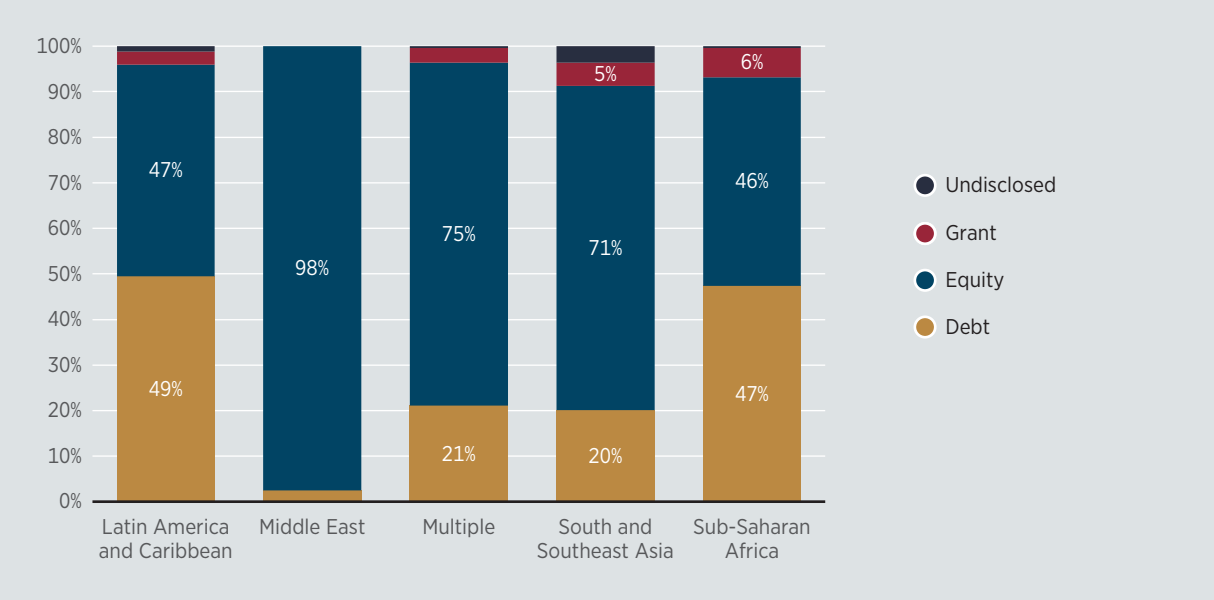
In cumulative terms, over half of the financial commitments made to off-grid renewables between 2007 and 2019 were in the form of equity, which went almost entirely to finance companies' operations or expansion of activities, rather than specific projects. Debt, either bonds, convertible loans,[34] or term loans and venture debt, accounted for 39% of the total and were the preferred option for investing in specific projects (accounting for 82% of cumulative financial commitments to off-grid renewable energy projects). Only in Latin America and the Caribbean and Sub-Saharan

34 Convertible loans are short-term debt instruments that convert into equity, usually at the next investment round. This conversion option makes convertible loans closer to equity, making the share of equity investment in the off-grid renewable energy sectors de facto even higher.

Africa, debt instruments accounted for about half of total investments (Figure 33). This is driven by a combination of greater participation from DFIs, which usually provide financing in the form of concessional loans, and lower shares of equity commitments from private equity and venture capital investors in these regions. Overall, grants and blended finance made up only 6% of all cumulative commitments (IRENA analysis based on Wood Mackenzie, 2020).[35]

Sub-Saharan Africa was the main destination for off-grid renewable energy investment, attracting 65% of the total in 2007-2019

Figure 33 Shares of cumulative commitments to off-grid renewable energy, by financing instrument and region of destination, 2007-2019



Source: IRENA analysis based on Wood Mackenzie (2020).
Note: "Multiple" denotes financial commitments that benefit more than one region simultaneously.

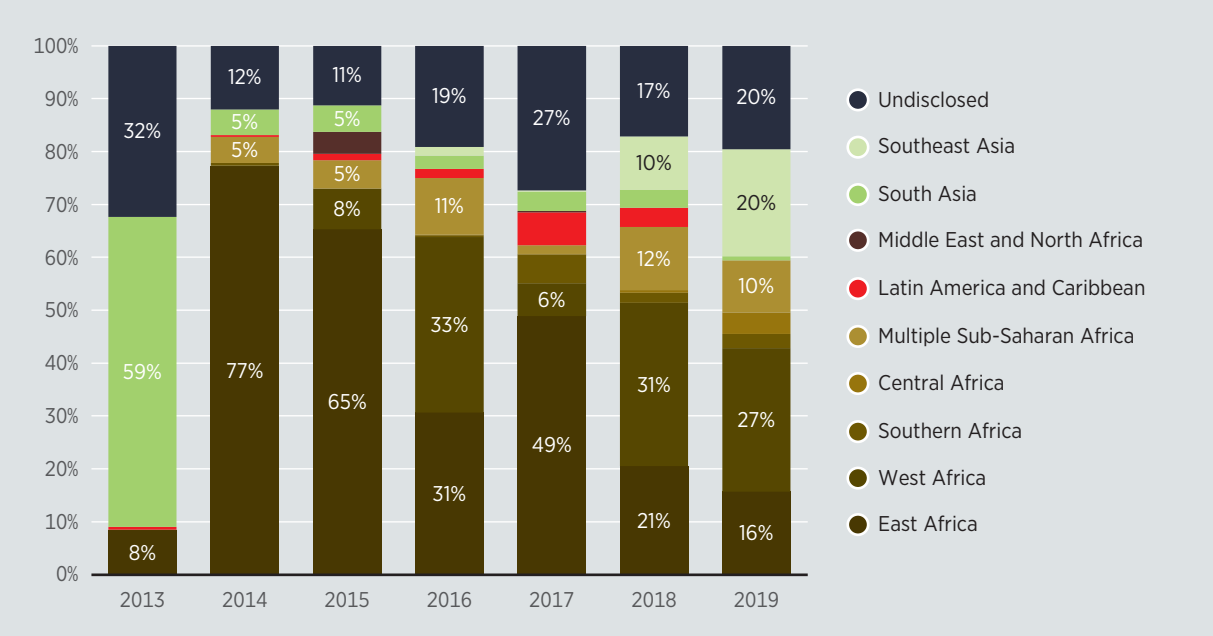
4.4 Off-grid renewable energy commitments by destination

Sub-Saharan Africa is the main destination for investment in off-grid renewables due to electrification rates in these countries being among the lowest in the world, with 573 million people in the region still lacking access to electricity (IEA, IRENA, UN, WBG, and WHO, 2020). The region attracted at least USD 1.3 billion of the cumulative USD 2 billion committed to off-grid renewable energy during 2007-2019, accounting for large shares of annual investments starting in 2014. Since then, Sub-Saharan Africa accounted, on average, for 71% of investment each year (Figure 34).[36]

Within Sub-Saharan Africa, **East Africa** attracted 53% of total cumulative investment, receiving USD 704 million. Four out of the top five recipient countries in Sub-Saharan Africa were in East Africa, namely the **United Republic of Tanzania**, **Rwanda**, **Kenya** and **Uganda**. Compared to other sub-regions, countries in East Africa generally have a highly developed mobile money industry, which is a

35 In this report, blended finance is defined as the use of public and philanthropic funds to mobilise additional private capital.
36 Details about regional groupings used for this analysis are provided in Annex III.

Figure 34 Shares of annual commitments to off-grid renewables, by sub-region of destination, 2013-2019



Source: IRENA analysis based on Wood Mackenzie (2020).

prerequisite for PAYG systems. In fact, 83% of total cumulative commitments in off-grid renewables during 2007-2019 – or USD 1.5 billion – involved the use of PAYG, with East Africa accounting for USD 682 million (IRENA analysis based on Wood Mackenzie, 2020).

In recent years **West Africa** has begun closing the financing gap. Investment in West African off-grid renewable energy outpaced East Africa in 2016, 2018 and 2019. **Nigeria** is the largest single recipient country, both in Sub-Saharan Africa and globally. **Central and Southern Africa** combined attracted a total of USD 65 million, which is less than what East or West Africa received in 2019 alone. However, off-grid renewable energy remains a nascent industry in Central and Southern Africa, with 64% of all investment coming in 2018 and 2019.

During the same period, **South and Southeast Asia** were able to attract over USD 244 million in investment, reaching an all-time high of USD 97 million in 2019. In South Asia**, India** received the lion's share of investment, attracting 94% of all investment in the sub-region. Conversely, investment in Southeast Asia was more equally distributed and half of all investment in the sub-region went to companies that operate in multiple countries.

Latin America and the Caribbean and the **Middle East** together attracted only USD 60 million, or 3% of cumulative commitments during 2007-2019. With smaller shares of the population living off the grid, these regions represent comparatively smaller markets for decentralised renewable energy solutions.

Nearly 60% of cumulative commitments to off-grid renewables were not specifically directed to a single country. This is mainly because many of the companies receiving funds, especially in Sub-Saharan Africa, often operate at the regional or sub-regional level and investments end up benefitting more than one country at once. Country-specific commitments were highly concentrated, with 11 countries accounting for 90% of total country-specific capital flows, as listed in Table 2. The majority of these countries are in Sub-Saharan Africa, with seven of them being access-deficit countries.

Table 2 Top recipient countries and cumulative investment in off-grid renewables, 2007-2019

Rank	Country	Total country-specific commitments during 2007-2019 (USD million)	Share of country-specific commitments	Sub-region	Access-deficit country
1	Nigeria	203.3	24%	West Africa	Yes
2	United Republic of Tanzania	112.4	13%	East Africa	Yes
3	India	85.9	10%	South Asia	Yes
4	Rwanda	73.4	9%	East Africa	No
5	Kenya	72.7	9%	East Africa	Yes
6	Myanmar	64.8	8%	Southeast Asia	Yes
7	Uganda	39.3	5%	East Africa	Yes
8	Guatemala	38.8	5%	Latin America	No
9	Côte d'Ivoire	28.2	3%	West Africa	No
10	Zambia	19.0	2%	Southern Africa	No
11	Mozambique	11.4	1%	Southern Africa	Yes

Source: IRENA analysis based on Wood Mackenzie (2020).

4.5 Off-grid renewable energy commitments by energy use and product

4.5.1 Commitments by energy use

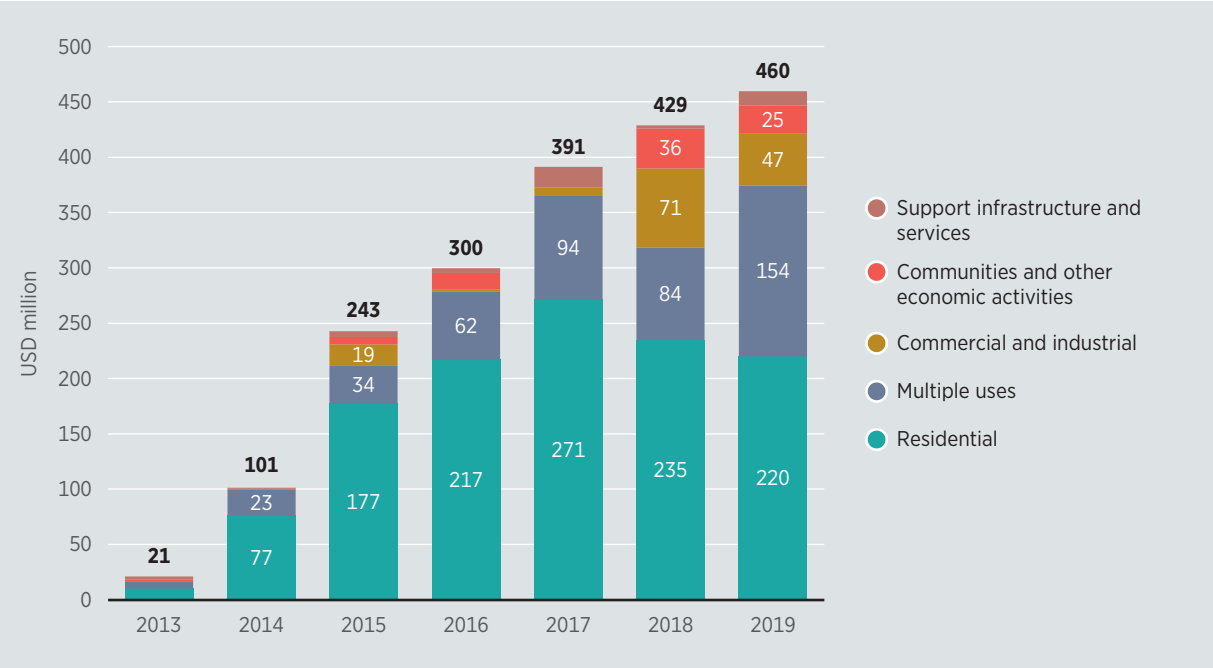
Decentralised renewable energy technologies can serve a variety of purposes, from providing basic access to electricity for rural households (*e.g.,* through solar lanterns) to powering operations of commercial and industrial (C&I) consumers. Between 2007 and 2019, 61% of cumulative investment – or USD 1.3 billion – went to residential uses of energy. C&I uses, ranging from small-scale entrepreneurs to larger businesses, were the second-highest recipients of investment, accounting for 8% (USD 168 million) of total investment in the same period (IRENA analysis based on Wood Mackenzie, 2020). Investment in C&I consumers is vital for promoting decent work and economic growth, bringing the world closer to achieving SDG8 (decent work and economic growth) and SDG12 (responsible consumption and production) (UN, 2018).

Investment in communities and other economic activities, including streetlights and energy access for schools and hospitals, accounted for 4% of cumulative commitment toward off-grid renewables. Support for infrastructure and services, such as smart meters and research and development, attracted only 2% of total investment; however, their use is instrumental in the proliferation of off-grid renewable energy technologies.[37]

During 2013-2019, residential uses attracted the majority of annual off-grid renewable energy investment, with shares ranging between 48% and 76% (Figure 35). Over this period, annual commitments to residential purposes grew at a staggering average rate of 135%, resoundingly outpacing the remaining uses. Commitments to decentralised renewables for communities and other activities, as well as to support infrastructure and services, reached almost USD 40 million in 2019. The past two years also saw an unprecedented growth in commitments directed to C&I uses, with USD 71 million and USD 47 million invested in 2018 and 2019, respectively. Finally, the 84% growth in commitments with multiple purposes in 2019, coupled with the decline in all the other specific uses, might suggest an ongoing diversification of off-grid renewable energy investments with respect to energy uses (IRENA analysis based on Wood Mackenzie, 2020).

37 *Details and examples regarding the type of activities included under each energy use are provided in the methodology document (IRENA and CPI, 2020).*

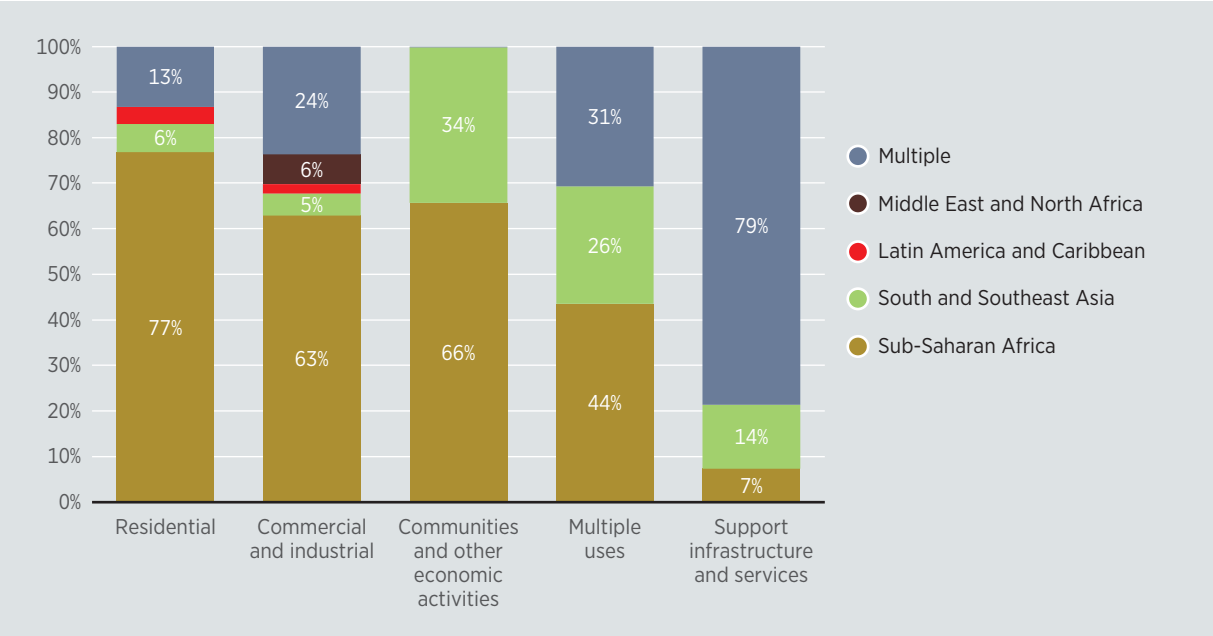
Figure 35 Annual commitments to off-grid renewables, by energy use, 2013-2019



Source: IRENA analysis based on Wood Mackenzie (2020).

In terms of geographical destinations, Sub-Saharan Africa was responsible for at least 77% of the cumulative investment into residential uses, likely because this region has the lowest levels of household electricity access and large populations that live off the grid. Next was Southeast Asia, which accounted for 6% of cumulative investment directed to residential uses, followed by Latin America and the Caribbean (4%) (Figure 36).

Figure 36 Shares of cumulative commitments to off-grid renewable energy, by energy use and region, 2007-2019



Source: IRENA analysis based on Wood Mackenzie (2020).
Note: "Multiple" denotes financial commitments that benefit more than one region simultaneously.

Sub-Saharan Africa was also responsible for the majority (63%) of cumulative investment in C&I uses. The Middle East accounted for 6% of total C&I investment, followed by South and Southeast Asia (5%) and Latin American and the Caribbean (2%) (Figure 36). Agriculture and fishing form a large part of income-generating opportunities for many living in developing countries. Between 2007 and 2019, 12% of C&I investment went into these productive uses. Sub-Saharan Africa, mainly East and Southern Africa, was responsible for almost all of agriculture and fishing investment (IRENA analysis based on Wood Mackenzie, 2020).

During 2007-2019, 4% of the total commitments went to communities and other economic activities, such as streetlights and clean energy for hospitals and schools. Once again, Sub-Saharan Africa was responsible for the largest portion of this investment – 66% of total cumulative investment, while South and Southeast Asia accounted for the remaining 34% (Figure 36).

An increasingly important application of decentralised renewable energy solutions is the provision of energy for refugee settlements. Refugees often face limited access to fuel and energy, resulting in a wide range of environmental, health, gender and livelihood issues, in addition to conflicts over natural resources (IRENA, 2019f). Off-grid renewables offer the prospect of safe, affordable and sustainable power to those living in refugee camps. For the first time in 2019, USD 1.8 million was committed (mainly by government agencies and intergovernmental institutions) to off-grid renewable energy investment for refugee settlements, all of which went to Kenya and Uganda (IRENA analysis based on Wood Mackenzie, 2020).

4.5.2 Commitments by energy product and service

Solar PV and other solar products (*e.g.,* solar water heaters) are responsible for the majority of off-grid renewable energy investment. The modular and distributed nature of solar PV enables it to be adapted to a wide range of off-grid applications (IRENA, 2018c). However, almost USD 57 million was directed toward other off-grid renewable energy sources through 2019 (IRENA analysis based on Wood Mackenzie, 2020). Bioenergy and mini/micro hydropower have proven to be useful technologies to connect those living off the grid with energy services. The South and Southeast Asia region has vast experience in harnessing mini/micro hydropower (IRENA, 2018c).

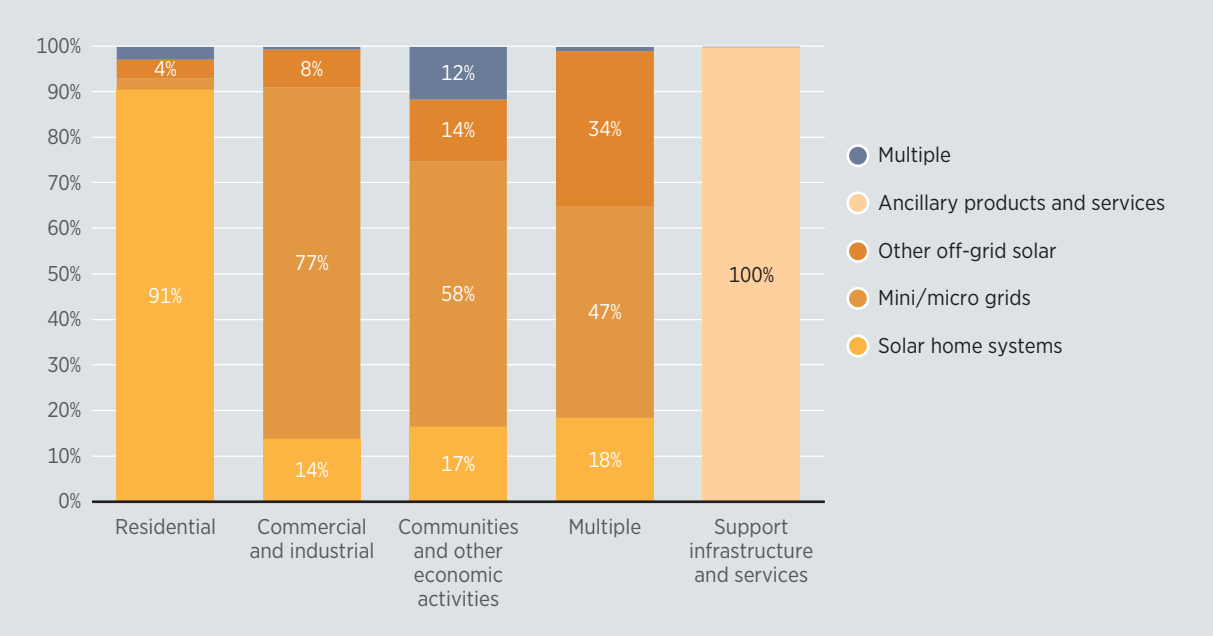
The type of product employed in a project can be an indication of the level of energy access provided.[38] Commitments in solar lanterns and clean cookstoves are usually targeted at those at the bottom of the pyramid without basic electricity connections and no access to clean cooking appliances. The use of solar kiosks also shows that the level of electricity in households and communities is insufficient to sustain energy needs throughout the day. These products represent an important first step in the energy ladder and were responsible for 4% of total investment in residential uses during 2007-2019 (Figure 37).

An overwhelming 91% of total off-grid investment for residential uses – or USD 1.1 billion – was committed to solar home systems (SHSs). Compared to solar lanterns, SHSs provide a more adequate and reliable level of energy access (up to Tier 3) and allow for more applications of energy, including refrigeration and other home appliances. Similarly, micro- and mini-grids can provide an adequate level of energy access (up to Tier 5) to multiple households and buildings simultaneously. Micro- and mini-grids were responsible for only 2% of total residential commitments, mainly because these products are more capital intensive and usually reserved for productive energy uses (Figure 37) (IRENA analysis based on Wood Mackenzie, 2020).

However, micro- and mini-grids accounted for 77% of cumulative C&I investment. This is not surprising since, compared to SHSs,

38 Definitions of each energy product and service included in this analysis are provided in the methodology document (IRENA and CPI, 2020).

Figure 37 Shares of cumulative commitments to off-grid renewable energy, by energy use and off-grid product, 2007-2019



Source: IRENA analysis based on Wood Mackenzie (2020).
Note: "Multiple" denotes financial commitments that benefit more than one energy use or off-grid product simultaneously.

these products enable more intensive use of energy and offer a wider range of electricity applications, including powering carpentry tools and large-scale agricultural processes. SHSs, solar lanterns and solar refrigerators accounted for 14% of cumulative commitments to C&I purposes, mainly providing energy access for small-scale businesses, such as barber shops and restaurants. Solar water pumps were responsible for 8% of cumulative C&I investment, mainly for commercial and irrigation purposes (Figure 37) (IRENA analysis based on Wood Mackenzie, 2020).

Micro- and mini-grids also attracted over half (58%) of cumulative off-grid renewable energy commitments for communities and other economic activities. SHSs were responsible for 17% of total investment, usually reserved for less-energy-intensive community uses, such as energy access for schools and information centres. Commitments to solar streetlights and solar kiosks accounted for 14% of the total and were often directed toward communities without basic access to electricity (Figure 37) (IRENA analysis based on Wood Mackenzie, 2020).

Going forward, efforts will be needed to unlock financing for income-generating activities and productive uses of off-grid renewables to improve the livelihoods and resilience of billions of people globally and to promote other socio-economic benefits. The deployment of technologies for productive uses will depend on the availability of consumer financing and long-term concessional debt and risk capital for innovators and enterprises.

Access to affordable and tailored financing for project developers and energy users is a critical piece of the enabling ecosystem needed to locally develop and scale up off-grid renewable energy solutions for livelihood applications. The tried and tested innovations in financing include guarantee mechanisms, downpayment refinancing and group lending, among others. However, an approach centred on specific technologies or forms of finance is likely to have only limited efficacy. To meet the broader goal of livelihood development, a user-centric ecosystem is needed, one that embraces multiple actors in the policy, technology, financing and market realms and that takes into account the specificities of decentralised energy solutions (IRENA, forthcoming).

RECOMMENDATIONS AND WAY FORWARD

05

A global energy transition, in line with international climate and development objectives, will require a massive re-allocation of capital toward renewables and the mobilisation of all available capital sources. This chapter provides actionable recommendations targeting policy makers and other stakeholders, on how to mobilise additional investment in the sector.

5.1 Increase national climate ambitions and raise renewable energy targets

In the post-COVID recovery period through 2021, measures should be taken to induce a decisive shift toward resilient energy systems – partly to avoid locking in unsustainable practices. Energy investments undertaken as a short-term response to the pandemic's impacts can have the effect of supporting increasingly ambitious longer-term targets for renewables and efficiency in all sectors, reinforcing enhanced climate pledges, creating employment, and fostering economic growth.

Governments therefore have an immense opportunity, as they devise their recovery programmes, to pair recovery with more ambitious plans to transform the energy system. A more resilient future will depend on ambitious pledges from states to accelerate the energy transition. IRENA's analysis shows that governments could increase their renewable electricity pledges by 64% and reach 5.2 terawatts of renewable power capacity in 2030 by simply aligning the next round of NDCs with other national energy plans (IRENA, 2019g).

Setting **ambitious renewable energy targets consistent with long-term national energy strategies and plans** can send a strong signal to investors and help attract additional capital. If policy makers decide to deploy more renewables-fuelled capacity to generate employment and economic growth following the pandemic, then renewable energy targets should be adjusted upward to account for the procurement of new capacity in the short term.

A holistic policy approach rooted in climate objectives would help set the stage for a just transition and reap multiple benefits.

5.2 Use public finance to crowd in private capital

With the COVID-19 crisis putting additional constraints on public resources, limited public capital (*i.e.*, from governments and DFIs) should primarily be used with the specific purpose of crowding in additional private finance.

Limited public resources should focus on systematically crowding in private capital through **capacity building, support for pilot projects** and

for new investment instruments such as green bonds, **blended finance initiatives** and tailored **innovative financial instruments** designed to replicate and scale up financing from the private sector (Global Innovation Lab for Climate Finance, 2020). Public capital could also focus on **reducing technology costs** for renewable energy and energy efficiency and supporting business model development for market uptake.

The provision of **risk mitigation instruments** (*e.g.*, guarantees, currency-hedging instruments and liquidity reserve facilities) by governments and public financial institutions can be particularly effective in mobilising private capital while at the same time reducing public capital requirements (IRENA, 2016). Risk mitigation instruments seem to be even more important in the context of the current crisis, as investors have become more risk averse. These instruments are key to attract investments in developing and emerging markets, which were hit the hardest by the crisis.

In addition, governments have the unique opportunity to drive ambition and increased investment in renewable energy and off-grid renewable energy solutions by explicitly adjusting the **mandates and risk appetites of national institutions and development banks**, including references to the Paris Agreement and the SDGs.

5.3 Mobilise institutional investment in renewables

With about USD 87 trillion of assets under management, institutional investors represent one of the largest capital pools in the world and have a key role to play in the ongoing global energy transition. Mobilising a greater share of institutional capital in renewables will necessitate a range of coordinated actions that combine effective regulations and policies, capital market solutions and a host of internal changes on the part of institutional investors (IRENA, 2020):

- **Policy and regulatory solutions** that can activate institutional capital in renewables include direct, integrating and deployment policies to support the overall growth and integration of renewables. Also needed are the review of investment restrictions faced by institutional investors, the addition of clear long-term sustainability mandates, and development of the sustainable finance sector, including disclosure of climate-related risks.
- **Capital market solutions** can channel institutional capital toward renewable assets via investment vehicles such as project bonds, project funds and green bonds. The supply of such instruments can be increased through stakeholder cooperation, adoption of green bond frameworks aligned with leading standards and economic incentives that lower new instruments' transaction costs.
- **Renewables' project pipelines** can be enhanced through greater provision and use of risk mitigation instruments by public providers of capital, standardisation of processes and contractual agreements, aggregation of assets and blended finance transactions among providers of public capital and institutional investors.
- **Internal capacity building** within institutional investors in the areas of financial and legal structuring, as well as in climate change impacts, regulations and the renewable sector's progress should occur in tandem with the above proposed actions. Collaboration with other institutional investors via institutional investor groups, and indirect and co-financing investments, can help institutional investors to manage new risks and share best practices.

If successful, these actions will not only help scale up renewable investments but also allow institutional investors to realise many important benefits. These include greater asset diversification, access to potentially higher and relatively stable long-term returns that match institutional investors' liabilities, lowered risk of stranded assets and an improved ability to meet the growing regulatory and social scrutiny that is increasingly calling for the inclusion of sustainability aspects into institutional mandates (IRENA, 2020g; 2020d).

5.4 Promote greater use of green bonds for renewables

Green bonds represent a major opportunity to attract institutional investors in the renewable energy sector and channel considerable additional private capital in support of the global energy transition (IRENA, 2020e).

Coordinated action among policy makers, capital markets, issuers and investors is needed to further increase green bond issuances and strengthen their credibility among market participants. Some recommended actions for policy makers and public finance providers include:

- Adoption of **green bond standards** that are aligned with global climate targets, such as the Climate Bonds Standard, to lower the risk of greenwashing[39] (CBI, 2020).
- Support for the **green bond market development** via technical assistance and economic incentives (*e.g.*, grants to cover issuance and reporting costs, co-financing, seed capital, funding of demonstration issuances).
- Addition of **long-term sustainability mandates for institutional investors**, ideally with minimum asset allocation for green sectors.
- Creation of **bankable project pipelines** via de-risking of renewable energy assets (*e.g.*, provision of risk mitigation instruments, documentation standardisation, asset aggregation).

5.5 Enhance the participation of corporate actors

Non-energy-producing corporations should seize the opportunity to drive renewable energy demand through the development of new medium- to long-term renewable energy targets that factor in the advancements and cost reductions of renewable energy technologies.

By setting up the right enabling framework, governments can encourage active corporate sourcing and unlock additional capital in the sector. Measures include, for example, setting up a transparent system for the **certification and tracking of renewable energy attribute certificates**, allowing for **third-party sales** between companies and independent power producers, and creating **incentives for utilities** to provide green procurement options for companies (*e.g.*, green labels and green tariffs) (IRENA, 2018a).

These measures need to be coupled with improved transparency regarding the additionality[40] of corporate sourcing, to ensure that this results in investment in new renewable energy projects, rather than existing installed capacity (IRENA, 2018a).

5.6 Scale up financing for off-grid renewables

As off-grid renewable energy solutions are key to ensure universal energy access and just and inclusive economic development, investment in these technologies needs to be scaled up. Achieving universal access by 2030 requires annual investment in modern energy estimated at USD 45 billion (IEA, IRENA, UN, WBG, and WHO, 2020).

Lack of access to affordable finance remains one of the biggest challenges for decentralised renewable energy projects, both upstream for project developers, and downstream for energy users. Lack of affordable finance for productive uses, in particular, represents the main barrier to scaling up the adoption of off-grid renewable energy solutions. New financing approaches and instruments are therefore needed to ensure improved access to capital, especially long-term concessional debt.

39 *Greenwashing is defined as the process of providing misleading information to deceive the public into believing that a product or service is environmentally friendly.*

40 *Additionality refers to the net incremental capacity added to the energy system as a direct result of corporate sourcing, beyond what would have occurred in its absence (IRENA, 2018a).*

Public financing will continue to play a fundamental role in the sector and should be employed to scale up financial solutions, such as **results-based financing**, that can increase the viability of intervention and mobilisation of private capital.

High-risk innovation capital and affordable financing for working capital and equity should be made available to enterprises working in the sector, as these can help elicit additional philanthropic and public funding for research and development. Lending portfolios of local and national-level financial institutions can be earmarked specifically to deliver financing at lower interest rates and longer payment periods for end users who want to acquire livelihood products (*i.e.*, any equipment that improves livelihood). These should be treated as assets and not as consumer loans (IRENA, forthcoming).

Standardisation of project documentation and aggregation of small-scale projects can allow smaller off-grid renewable energy projects to be pooled together. This can significantly reduce transaction and due diligence costs for traditional financial institutions. Bundling off-grid renewable energy projects can help increase the overall deal size, attract large-scale investors and reduce the cost of capital (IRENA, 2016). Special incentives and financial resources should be allocated to motivate small and mid-size technology manufacturers to create and supply products that make the connection between decentralised renewables and sustainable livelihoods.

Capacity building for local financial institutions is needed to enable the latter to evaluate investment opportunities related to renewable energy and to expand access to financing for off-grid energy solutions for residential and productive uses, especially in rural and peri-urban areas. The nature of financing and its design should depend on the cash flows of consumers, ownership structures and the business models followed in the application of various technologies.

Off-grid renewable energy products and services may not always be affordable to low-income households in rural areas. With low incomes and no credit history, many of these consumers are unable to secure loans from commercial banks. In this context, an approach centred on livelihoods – one that puts people's needs and livelihoods at the centre of the energy access ecosystem – is likely to maximise long-term development impact. Such an ecosystem would be made up of actors in the policy, technology, financing and market fields who together would be able to deliver decentralised energy solutions tailored to the livelihood needs of end users (IRENA, forthcoming).

Grassroots financing institutions and intermediaries are fundamental for channelling funds and ensuring the availability of livelihood-oriented products for project developers and energy users. **Microfinance institutions** can enhance financial inclusion for low-income communities by providing credit and financial services at affordable costs.

Policy makers should support a holistic ecosystem that puts the needs of end users first. Such an approach offers an important bottom-up development opportunity to ensure that the energy transition is just and equitable, and that it maximises socio-economic benefits, especially for communities left behind by the current energy system. This is imperative to improving livelihoods and achieving the SDGs (IRENA, forthcoming).

WAY FORWARD

Meeting international climate objectives, as set by the Paris Agreement, will require an accelerated transformation of the global energy system, encompassing not only renewable energy, but also energy efficiency measures and the increased electrification of all end uses. Such a transformation calls for a significant scaling-up and re-directing of energy sector investments from fossil fuels and other high-carbon activities to low-carbon technologies, including renewable energy (IRENA, 2019d).

To put the world on a climate-compatible pathway, considerable additional capital needs to be urgently mobilised toward renewables. In annual terms, renewable energy investments need to almost triple, from an average of just below USD 300 billion in 2013-2018 to almost USD 800 billion through 2050 (IRENA, 2019d). A regional balance of these additional investments should be prioritised, ensuring that investments are also directed toward developing economies.

In filling the investment gap, the private sector is expected to continue to provide the majority of financing, but new sources of capital must be activated, including large institutional investors and non-energy-producing companies. Limited public resources should focus chiefly on lowering risks and barriers for private investors and crowding in additional private capital through, *e.g.*, capacity building, blended finance initiatives and risk mitigation instruments.

Annual finance commitments to off-grid renewable energy solutions are also well below what would be needed to ensure universal energy access by 2030. To effectively attract capital into the sector and ensure the rapid uptake of these technologies, financing challenges affecting project developers and consumers in emerging and developing countries will need to be addressed.

The recovery from the COVID-19 crisis presents governments and investors with an opportunity to accelerate the energy transition. Now more than ever, policy makers need to place renewable energy and other low-carbon solutions at the centre of their stimulus packages, ramping up the ambition of targets included in national strategies and Nationally Determined Contributions. Long-term public commitment to renewables enhances investor confidence and can help accelerate investment in the sector (IRENA, 2019g, 2020b).

ANNEX I

INVESTMENT METRICS: A RANGE OF INSIGHTS

Renewable energy investment can be tracked using a variety of metrics that may be chosen depending on the relevant insights that can be drawn, or the ease with which data can be accessed. In this report, investment is tracked by the year that a financial commitment is undertaken, *i.e.*, through a decision of the board or an equivalent body. However, the use of other metrics can yield different insights. For instance, investment data could be apportioned over the years when the investment is expected to be disbursed, while some estimates of the investment may also include the volume of mergers and acquisitions of already existing renewable energy assets.

Each case provides different insights and one metric is not necessarily better than another. However, differences between the metrics need to be understood so they can be compared in a robust way.

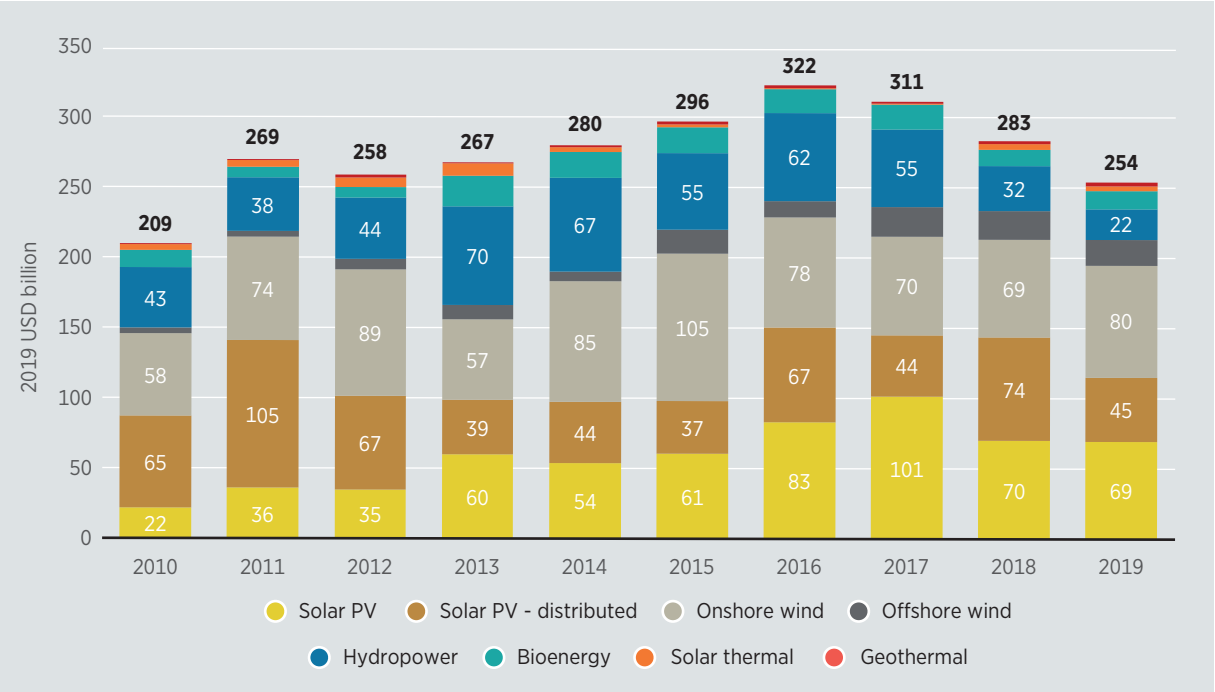
IRENA combines its renewable capacity statistics and technology cost data to estimate the value of annual investment in new renewable energy assets (IRENA, 2019a, 2020f).[41] Figure 38 presents the IRENA data for the value of the investment in the year that the new capacity is added. This differs from Figure 1 in several important ways:

- Figure 38 does not include data for solar thermal heat or biofuels, as capacity data for these technologies are not currently collected by IRENA.
- There are significant differences in the annual values for onshore wind, solar PV and hydropower investment in most years.
- The decrease in committed investment in 2016 that can be observed in Figure 1 is not visible when examining the value of the new capacity added in that year. This dip may appear in future values for annual new installed capacity if they are affected by the decline in investment commitments in 2016.

Part of these differences stems from the temporal difference in the metrics underlying investment data. Figure 1 is based on allocating the value of investment to the year of its commitment, while Figure 38 allocates this to the year capacity is deployed. Given that the lead time for projects varies from less than a year for distributed solar PV to up to 10 years for hydropower, this has a significant impact. Ideally, both sets of data would spread investment over the years in which it is disbursed, as actual disbursement data are rarely available.

41 Annual renewable energy investment, in this case, is calculated as annual capacity additions (MW)×unit technology cost (USD/MW).

Figure 38 Global renewable energy investment estimates based on new renewable installed capacity and technology costs, 2010-2019



Source: IRENA, 2020f, 2019a.
Note: Annual investment volumes are reported in constant USD at 2019 prices. PV = photovoltaic.

Another important difference is that financial commitments may not always translate into actual capacity additions, which generally means that annual committed investments are larger than annual delivered investments. This might explain why investment data in Figure 1 for onshore wind and solar PV tend to be on average higher than in Figure 38, although the exact reasons for this are likely to remain unknown.

ANNEX II

GEOGRAPHICAL CLASSIFICATION USED IN CHAPTER 2

Table 3 shows the regional grouping used for the analysis of the global landscape of renewable energy finance in Chapter 2 of this report. The designations employed do not imply the expression of any opinion on the part of IRENA or the Climate Policy Initiative concerning the legal status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Table 3 Regional grouping used for the analysis in Chapter 2 of this report

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

Note: OECD = Organisation for Economic Co-operation and Development

ANNEX III

GEOGRAPHICAL CLASSIFICATION USED IN CHAPTER 4

Table 4 shows the regional grouping used for the analysis of off-grid renewable energy financing landscape in Chapter 4 of this report. The designations employed do not imply the expression of any opinion on the part of IRENA or the Climate Policy Initiative concerning the legal status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Table 4 Regional grouping used for the analysis in Chapter 4 of this report

Region	Sub-region	Country
Latin America and the Caribbean	Caribbean	Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands
	Central America	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama
	South America	Argentina, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela (Bolivarian Republic of)
Middle East and North Africa	Middle East	Bahrain, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, Yemen
	North Africa	Algeria, Egypt, Libya, Morocco, Sudan, Tunisia
Sub-Saharan Africa	Central Africa	Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, São Tomé and Príncipe
	East Africa	Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Mauritius, Rwanda, Seychelles, Somalia, South Sudan, Uganda, United Republic of Tanzania
	Southern Africa	Botswana, Eswatini, Lesotho, Madagascar, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe
	West Africa	Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo
South and Southeast Asia	Southeast Asia	Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Timor-Leste, Viet Nam
	South Asia	Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka

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