



# CLIMATESCOPE 2023

## Power Transition Factbook

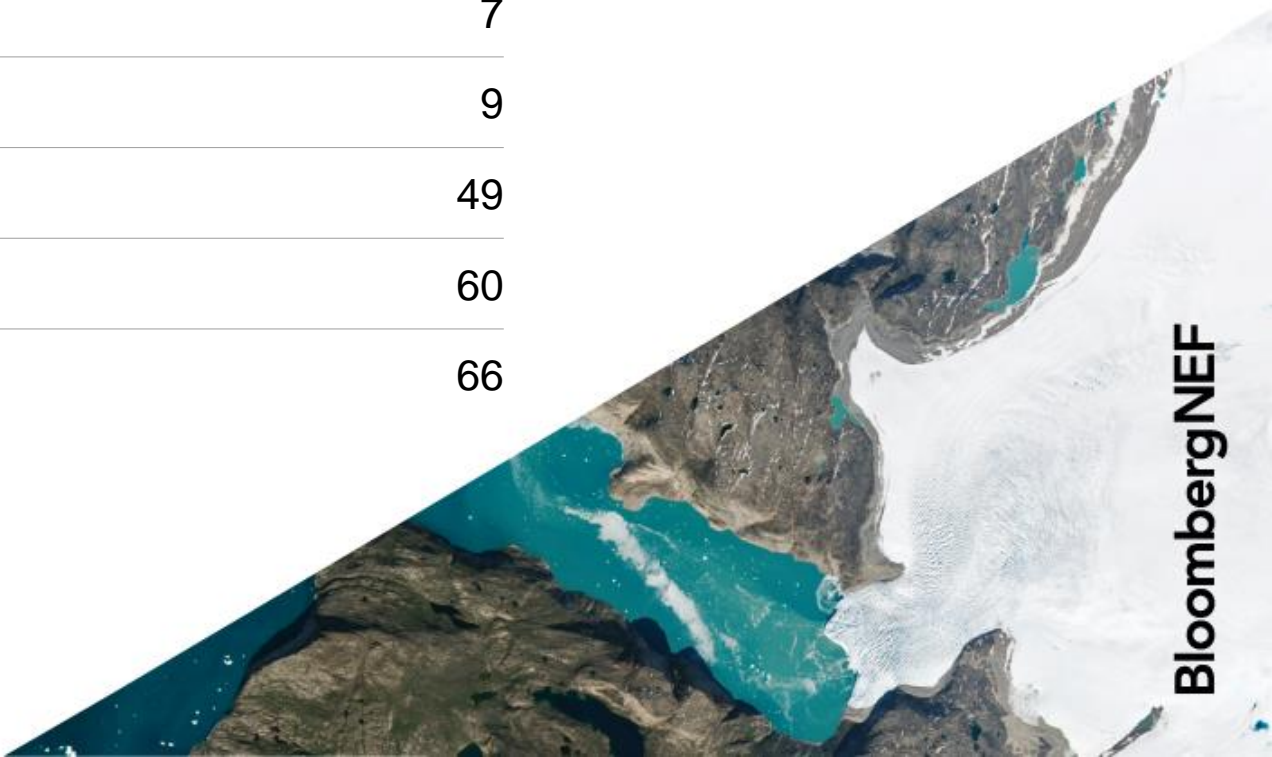
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An aerial satellite-style image of a coastline. The land is brown and textured, with a large, irregularly shaped body of water in the center-right that is a vibrant green color. To the right of the green water is a white, textured area that could be snow or a different type of terrain. The image is cut off by a diagonal white line that runs from the top-left towards the bottom-right.

# 01. Executive summary

# Executive summary

Renewables are gaining traction around the globe, with investment in new projects cracking half a trillion dollars for the first time last year. Wind and solar, which accounted for 80% of new power generating capacity installed in 2022, now make up an eighth of global generation and more than a quarter of overall capacity.

Those are just some of the key findings of the 12th edition of Climatescope, BloombergNEF's annual assessment of individual markets' progress in the energy transition. This is the third year the project has covered not only the power sector but transportation and buildings as well.

Climatescope represents the collective efforts of over 50 BNEF analysts. Each year, these researchers gather detailed data on 140 markets across the globe, including 110 emerging economies and 30 developed ones. This year, Montenegro, Bahrain, Iceland and Venezuela were added to the list. The resulting report assesses macro-level energy transition trends and scores individual markets based on their attractiveness for receiving clean energy capital.

Other conclusions from the 2023 edition of Climatescope include:

**Zero-carbon electricity technologies – including wind, solar, hydropower and nuclear – have now reached 46% of global installed power capacity, up from 33% in 2012.**

- Meanwhile, fossil fuels' share of new build capacity slumped to the lowest level ever in 2022, at just 13%, compared to 50% in 2013. Even a resurgence in coal power additions couldn't halt the slide.

75%

Share of emerging markets' power capacity additions that came from solar in 2022

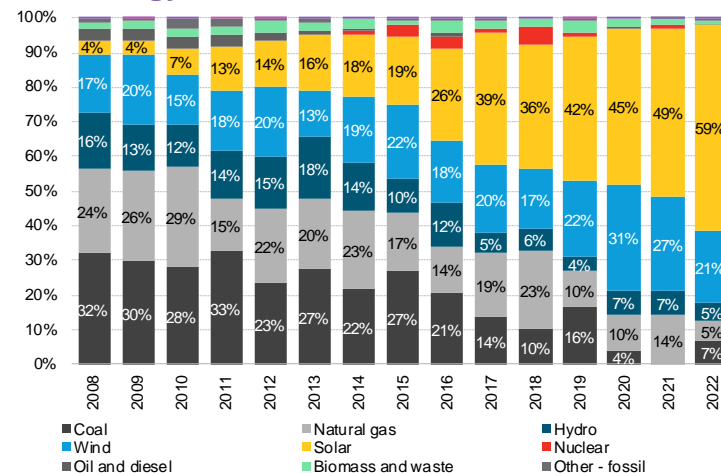
\$560 billion

Global funding for renewable energy projects in 2022, a record high

93%

Share of surveyed emerging markets that have renewable energy targets in force

## Share of global power capacity additions, by technology



Source: BloombergNEF

# Executive summary (2)

- Global investment in renewable energy projects hit a record \$560 billion in 2022, with small-scale photovoltaic solar accounting for over a fifth of the total. Successful net-metering policies and tax incentives have fueled the sector's meteoric rise, which attracted twice as much investment in 2022 as two years prior.
- Utility-scale solar also had a banner year, accounting for 41% of renewable energy investment last year, beating out wind, which received 36% of the total.

**Emerging markets are becoming increasingly important players in the clean-power space. Of the 341 gigawatts of new wind and solar additions in 2022, some 222 gigawatts were added in developing economies.**

- In most emerging markets, levelized costs of electricity for solar and wind – the long-term offtake price that a power plant needs to break even – have fallen dramatically. That means new solar and wind projects can now build more capacity with less investment.
- Out of the 110 emerging markets surveyed in this report, a record 74 had at least 1 megawatt of solar capacity installed last year, compared to just 30 markets a decade ago.
- In line with broader global trends, fossil-fuel additions in emerging markets fell to a record low in 2022.
- Yet, investment remains concentrated in a handful of emerging economies. Just 15 markets attracted 86% of the \$81 billion in clean-energy investments that were directed toward emerging economies (excluding mainland China) last year. Brazil alone received \$25 billion, followed by \$12 billion for India and \$6 billion for South Africa. The list of the top developing-market recipients of clean-energy investment remains essentially unchanged over the past five years.

**Of the emerging markets surveyed by Climatescope, 93% have renewable energy targets in force. But most still face an uphill battle to achieve these targets.**

- Around 60% of emerging markets with a clean energy target have yet to meet even the half-way mark of their ambitions, even though most of these goals are due in 2030.

# Executive summary (3)

- While these markets have improved their policy books over the years, more – and more effective – policies must still be adopted. Net metering, which is now present in 59% of the emerging markets surveyed, is the policy type that has seen the greatest growth since 2021.
- Policy is now particularly relevant as world leaders have expressed interest in tripling global installed renewable energy capacity by 2030. According to BNEF's report *Tripling Global Renewables by 2030* ([web](#) | [terminal](#)), scaling up the right mix of technologies will require measures that address barriers to access, enable competitive auctions and encourage corporate power purchase agreements.

**India has been among the top five most attractive emerging markets for renewable energy investment since 2018, and this year it returned to the highest position in Climatescope's ranking of developing economies. Its ambitious policy framework and extremely competitive renewable energy market have attracted around \$47 billion of clean energy investment over the past five years.**

- Mainland China, which continues to play a key role in the global clean energy story, ranked second this year among emerging markets, having accounted for 52% of global investment in 2022. It presents a wealth of opportunities for the global energy transition, since it is estimated that by 2030, some 35% of the world's installed solar capacity and 50% of wind will be located in the giant Asian market. Chile, which last year stood atop the podium, comes in third, with its well-established clean energy policies, bold targets and overall commitment to greening its grid keeping it in the top three.
- Fourth place goes to the Philippines, which appears in the top-five list for the first time thanks to its auctions, feed-in tariffs, net-metering schemes, tax incentives and strong targets for renewable energy. Brazil, where the small-scale segment is the main driver of clean energy deployment, comes in fifth.

**Global passenger electric vehicle sales hit 10.3 million units in 2022, nearly doubling from 2021. In just six years, the share of EVs in total passenger vehicle sales has jumped more than 10-fold, from 1.4% in 2017 to 15% in 2022.**

- The 6.1 million EVs sold in mainland China accounted for 60% of the global total in 2022 and nearly 96% of sales in emerging markets. Its cumulative EV sales since 2017 now stand at 13 million, some 4.5 million more than the top 10 developed markets for EVs combined.

# Executive summary (4)

- Other emerging markets represent a tiny share of total global EV sales, but their progress should not be overlooked. In 2021, these markets accounted for just 3% of global EV sales, but the number of units sold has nearly doubled for each of the past two years.

**Electrified heating has gained considerable popularity over the past decade, although sales of heat pumps stalled in 2022, rising only 1% year-on-year, compared to a 7% average compound annual growth rate over the past decade.**

- Heat pump demand remains dependent on subsidies or other consumer support mechanisms due to high upfront costs, and in many markets the technology struggles to compete with gas-fired boilers.
- Government bans on the purchase of certain types of boilers have increased in recent years. Of the 29 markets surveyed by Climatescope, 15 have legislated bans on boilers for one or more technology.

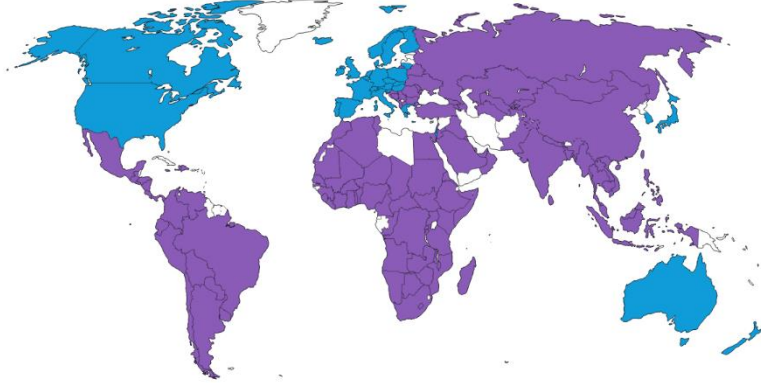
An aerial satellite-style image of a coastline. The land is brown and textured, with a large, irregularly shaped body of water in the center that is a vibrant green color. To the right, there is a large, white, textured area that appears to be a glacier or a large snowfield. The image is cut off by a diagonal white line that runs from the top left towards the bottom right.

# 02. About Climatescope



# About Climatescope

■ Developed markets ■ Developing markets



*\*For further details on how Climatescope has evolved over the years, please visit [global-climatescope.org/about](https://global-climatescope.org/about). Afghanistan, Cuba, Iran, North Korea, Yemen and Libya are not in the coverage due to local conflicts or international sanctions that make them particularly challenging to research.*

Climatescope is an online market assessment tool, report and index that evaluates individual markets' readiness to put energy transition investment to work. A deep dive into how surveyed markets are driving the energy transition, it provides snapshots of current clean energy policy and finance conditions that can lead to future capital deployment and project development.

This is the 12th edition of Climatescope, and the project has evolved significantly since its launch more than a decade ago. It now includes detailed information on 140 markets, including 110 emerging economies and 30 developed ones. This year, four new markets have been added to the coverage: Bahrain, Iceland, Montenegro and Venezuela.

Climatescope's sectoral coverage has also expanded over the years. While early editions of the report focused on just the power sector, in 2021 we began including in-depth investment condition data for lower-carbon transportation and buildings.

The project now encompasses nearly every market in the world\*. Developed markets are defined as OECD countries minus Chile, Colombia, Costa Rica, Mexico and Turkey. These five are part of the OECD but remain attractive emerging markets for clean energy development. Developing markets include all non-OECD markets, plus these five.

Readers are encouraged to explore the complete rankings, datasets, methodology, tools and market profiles on the [Climatescope website](https://www.bloombergenvironment.com/climatescope).

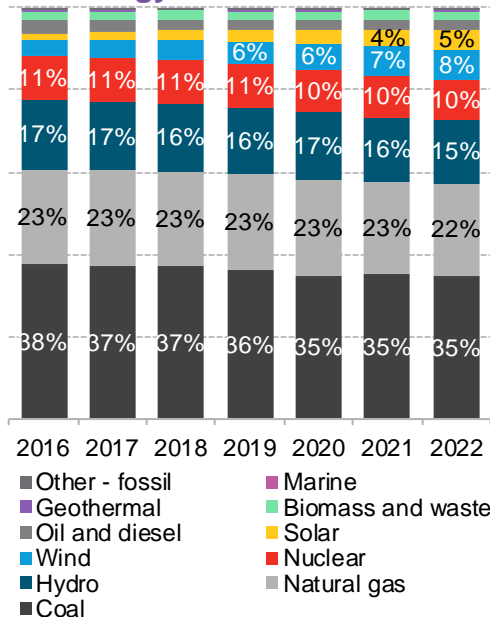
An aerial photograph of a rugged mountain landscape. A prominent feature is a large, vibrant green lake nestled in a valley. To the right, a white glacier flows down a slope. The terrain is rocky and brownish, with some snow patches. The image is split diagonally, with the top-left portion showing the landscape and the bottom-right portion being white.

# 03. Power sector

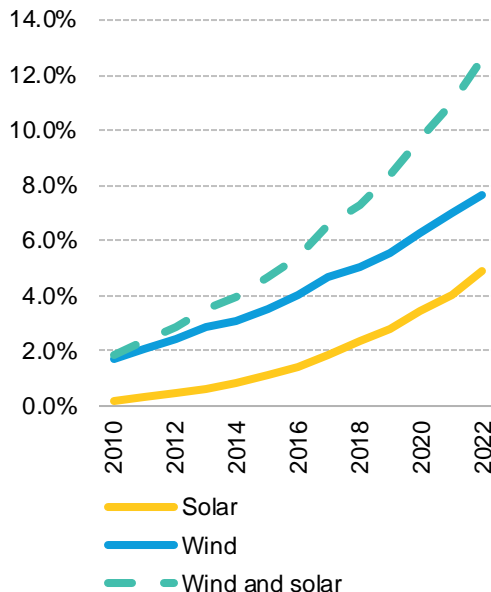
Renewables take the lead

# Wind and solar surpassed 12% of global generation in 2022

## Share of global generation by technology



## Share of wind and solar generation



With nearly 3,500 terawatt-hours (TWh) of power produced in 2022, wind and solar accounted for a combined 12.6% of global generation in 2022. Wind's contribution rose to 8%, up from just 4% six years ago, while solar reached nearly 5%, from less than 1.5% in 2016. Non-hydro renewables (wind, solar, geothermal and biomass) attained 15% of total generation, nearly doubling their 8% share in 2016.

Zero-carbon technologies accounted for 40% of total generation in 2022. Hydro and nuclear represented 15.4% and 9.5% respectively in 2022, but the relative participation of these technologies in the grid has declined over the past decade due to the growing additions of other zero-carbon technologies such as solar and wind.

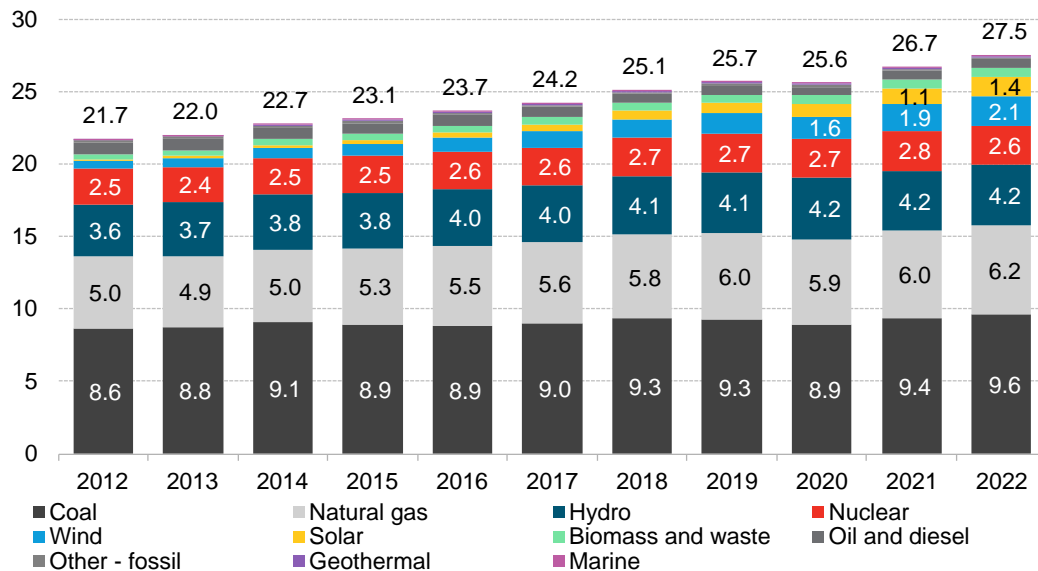
Although fossil fuels still dominate global electricity generation, their share is slowly decreasing. Coal, natural gas, oil and other fossil fuels generated 65% of the world's electricity at the beginning of the decade and now represent 59%.

Source: BloombergNEF. Note: 'Other - fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear. Zero-carbon technologies consist of renewable sources (solar, wind, geothermal, biomass and small hydro), large hydro and nuclear.

# Renewables led the upsurge in global generation

## Global annual generation by technology

Thousand terawatt-hours



Total global power production jumped 3.1% in 2022 in midst of the economic recovery from Covid-19 and the European energy crisis. Generation rose from 26,700TWh in 2021 to 27,500TWh in 2022, marking a new high. Renewables accounted for 75% of the total generation change from 2021 to 2022.

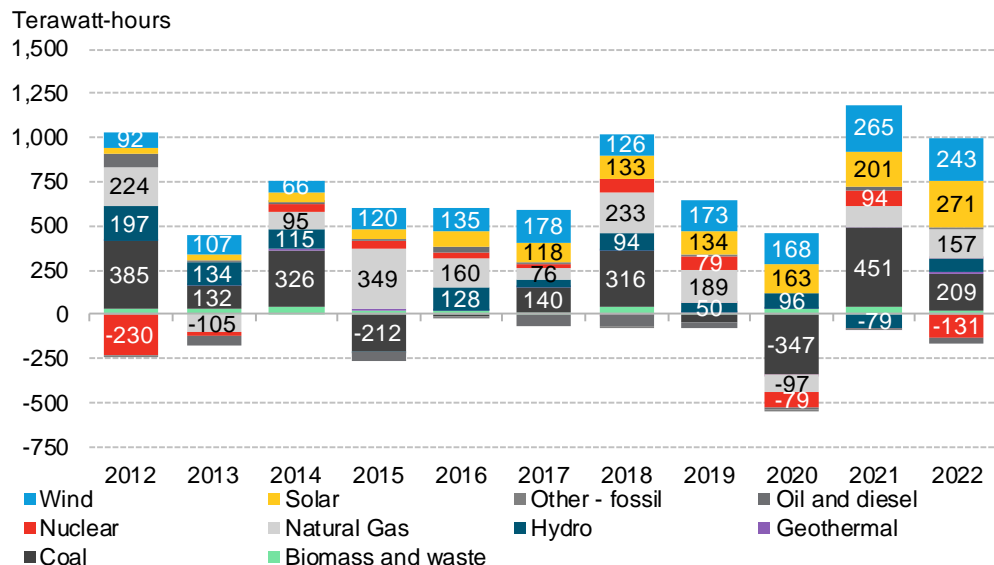
Renewables (including large hydro) led the growth in total electricity production, with an 8% jump from 2021 to 2022. Total global renewable generation reached its highest level ever in 2022, at 8,400TWh, and represented over 30% of global generation for the first time. Solar accounted for 1,350TWh, and wind 2,100TWh.

Fossil fuels remain the main source of electricity generation, at 16,500TWh, or nearly 60% of total power demand. Coal generation reached a new record, generating 9,600TWh in 2022, up 7% compared with 2020 and 2% from 2021. Natural gas topped 6,200TWh, a rise of 3% from 2021. Meanwhile, oil generation slid 6% in 2022, compared with a 3% increase from 2020 to 2021.

Source: BloombergNEF. 'Other – fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear. Renewable includes wind, solar, biomass and waste, geothermal and hydro technologies.

# Wind and solar generation thrive amid the global energy crisis

## Global year-on-year change in generation



Net renewable energy power generation set a record in 2022, led by a particularly strong showing from solar.

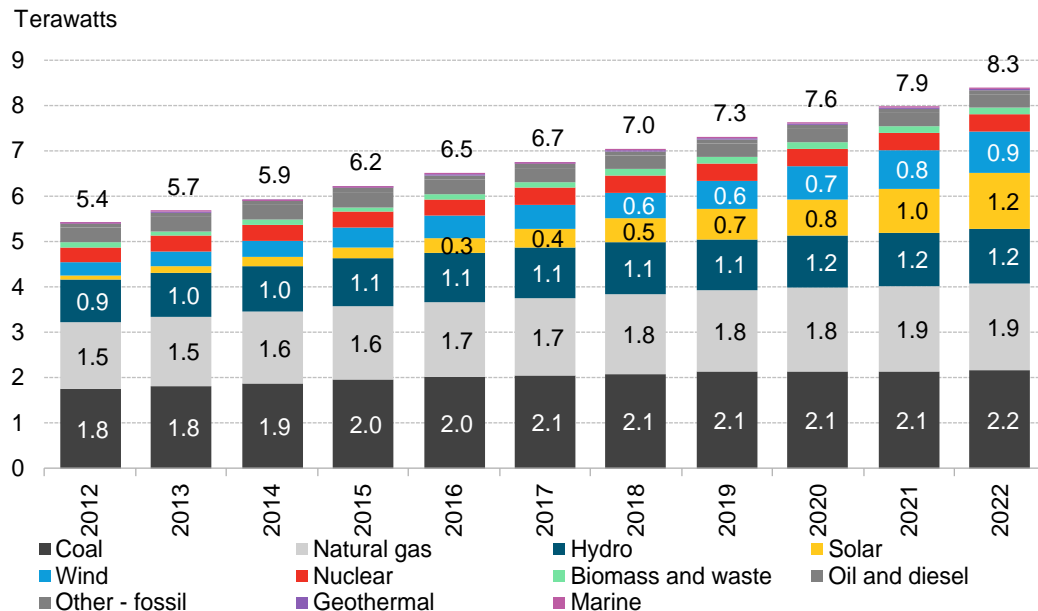
Three main factors explain renewables becoming the most pragmatic option: fast-growing post-pandemic electricity demand overall, a jump in coal and natural gas prices, and lower renewable levelized costs of electricity (LCOEs).

Although coal generation grew less in 2022 than it did in 2021, it still saw a considerable increase, reaching 209TWh on a year-on-year change basis. This surge is backed by China, India and Europe. Thanks to energy security concerns, coal was brought back into power systems.

Source: BloombergNEF. Note: Generation change accounts for net generation change. 'Other – fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear. Renewables include wind, solar, biomass and waste, geothermal and hydro technologies. For more, see BNEF's [1H 2023 LCOE Update](#).

# Wind and solar accounted for over a quarter of global capacity for the first time in 2022

## Global installed capacity by technology



Global installed power-generating capacity reached a new high of 8.3 terawatts (TW) in 2022, representing a year-on-year growth of over 5% from 2021 to 2022. Global installed capacity in 2022 also represented a growth of over 50% from the 5.4TW installed 10 years ago.

Wind and solar accounted for over a quarter of global capacity for the first time in 2022. Together, these technologies represented nearly 26% of global capacity as of year-end 2022. Zero-carbon technologies reached 46% of global capacity, up from 33% in 2012.

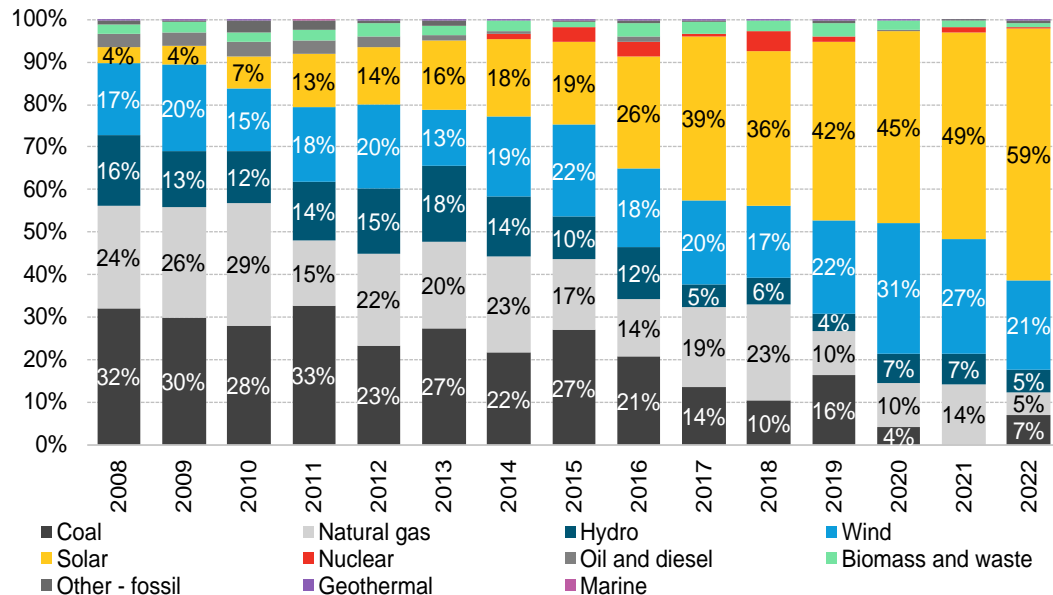
Wind and solar saw the fastest growth of any type of generation. Solar capacity in 2022 jumped 20% from the year prior, to 1,228 gigawatts (GW) – more than 11 times the 101GW that was online in 2012 and 176 times the 6GW that was installed in 2006. Global wind capacity bounced 10% over 2021-2022 to reach 930GW, tripling in a decade.

Coal still accounts for the largest individual share of global capacity, with 2.2TW, or 26% of the global power matrix. Online coal capacity continues to rise in absolute numbers even as its share on a percentage basis declines.

Source: BloombergNEF. 'Other - fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

# Solar and wind accounted for 80% of global capacity additions

## Share of global capacity additions by technology



New power-generating capacity added globally reached a record 424GW in 2022, with solar and wind accounting for 80% of the total. This was up 14% from 371GW in 2021, and up more than 80% compared with the 231GW added in 2012.

Solar accounted for 59% of all capacity added, followed by wind, at 21%. Solar photovoltaic (PV) additions in 2022 were nearly 40% higher than in 2021.

Wind capacity additions dropped by 10% compared with 2021, held back by challenges around permitting, interconnection, supply chains and profitability. Supply chain bottlenecks have limited late-stage project deployment as well as rising costs for developers.

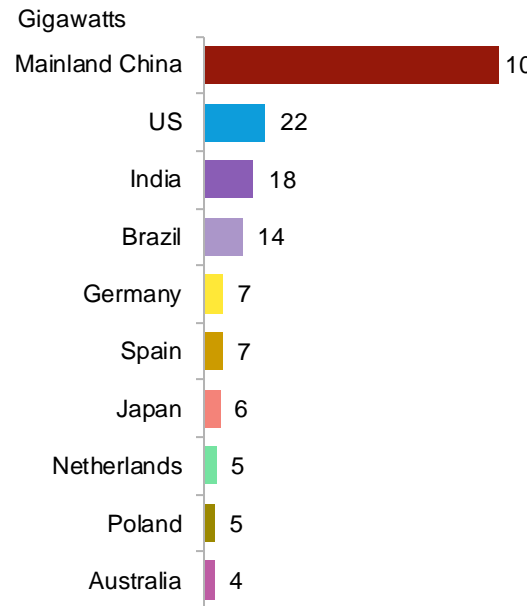
Renewables (including hydro) encompassed 86% of total capacity additions in 2022. This was up from just 52% in 2012.

Coal's contribution to year-on-year growth rebounded to 7%. Natural gas accounted for 5% of new capacity in 2022, down from 14% in 2021.

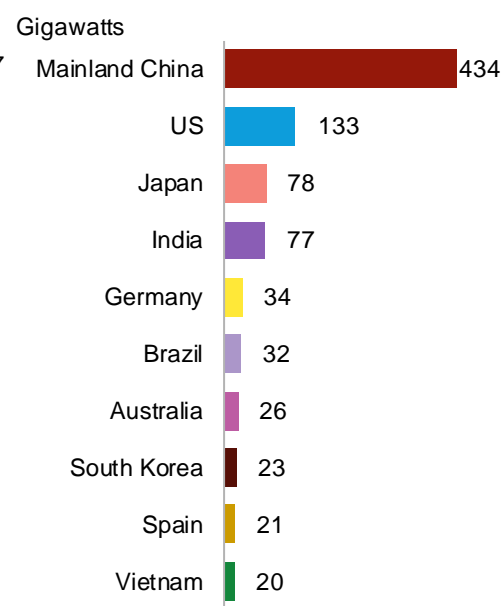
Source: BloombergNEF. Note: Share of global capacity additions excluding retirements. See more in the [4Q 2022 Global PV Market Outlook](#), [1H 2023 Offshore Wind Market Outlook](#) and [1H 2023 Global Wind Market Outlook](#). 'Other – fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

# Mainland China installed 42% of total solar additions in 2022

## Top 10 markets for solar capacity additions, 2022



## Top 10 markets for solar capacity additions, 2013-2022



Ten markets were responsible for 78% of all solar capacity added in 2022. Mainland China alone added 107GW in 2022, or 42% of total additions. Mainland China and the US accounted for half of global capacity added over 2013-2022, while also being the top two markets for solar additions over the past decade.

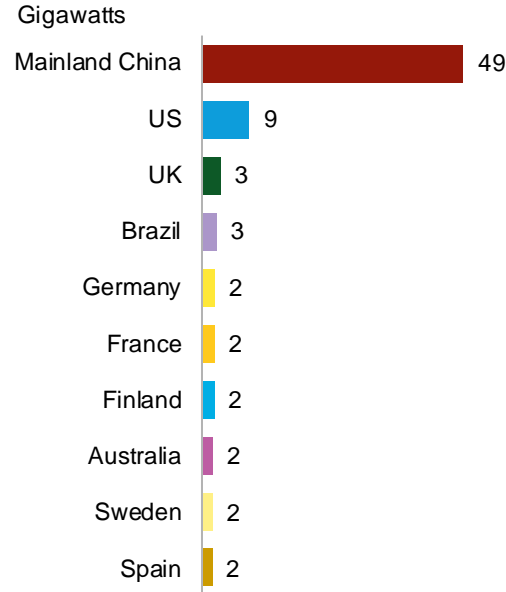
New solar markets are emerging quickly as enabling policy frameworks improve. Brazil, India and Vietnam are developing economies where solar has boomed in recent years. India's auctions, Brazil net metering policy and Vietnam's feed-in tariff were the main policy instruments that helped kick-start these economies' solar markets. Despite these efforts, these markets represented only 11% of solar additions in 2022.

Source: BloombergNEF. Note: The charts show gross capacity additions.

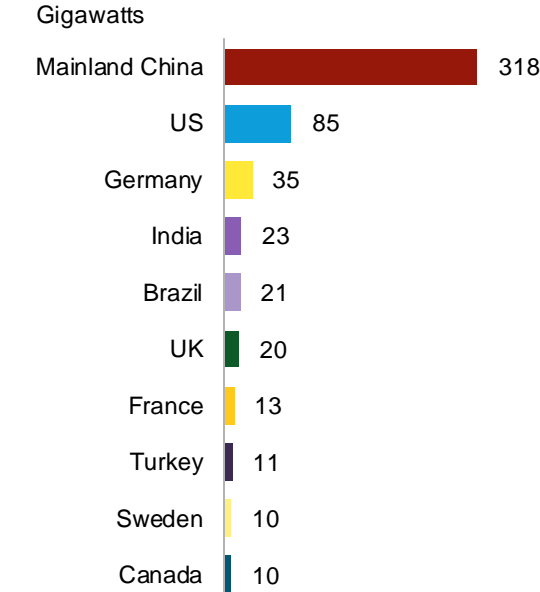


# Some 85% of wind capacity additions are concentrated in 10 economies

## Top 10 markets for wind capacity additions, 2022



## Top 10 markets for wind capacity additions, 2013-2022



Wind installations are concentrated in a relatively small number of economies, the top ten of which accounted for 85% of global capacity additions in 2022. Mainland China alone represented 55% of all wind built in 2022 and 49% of global cumulative wind installed capacity as of year-end 2022.

The US, the second biggest market for wind, accounted for 10% of the total capacity added in 2022. Yet, the market installed 32% less in 2022 than in 2021. The UK followed, with 3GW installed in 2022, representing 4% of all wind capacity added in the year.

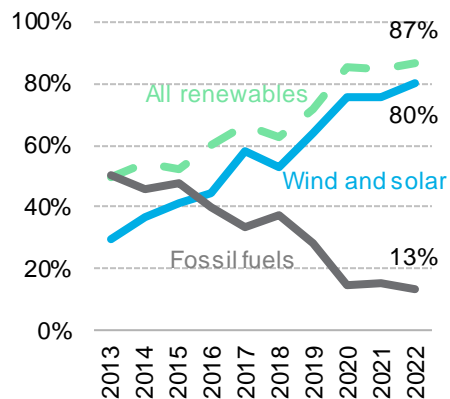
Excluding mainland China, Brazil and India led wind additions in developing markets over 2013-2022.

Together, they accounted for 7% of the global cumulative installed capacity. Brazil saw a greater-than-sevenfold increase, and India accounted for over 22GW added over that same period.

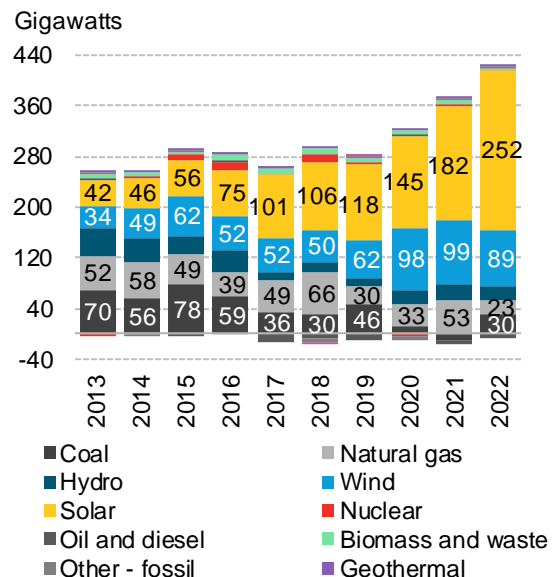
Source: BloombergNEF. Note: The charts show gross capacity additions.

# Globally, fossil fuels' net capacity additions dropped to their lowest level ever

## Global share of net capacity additions



## Global year-on-year capacity change



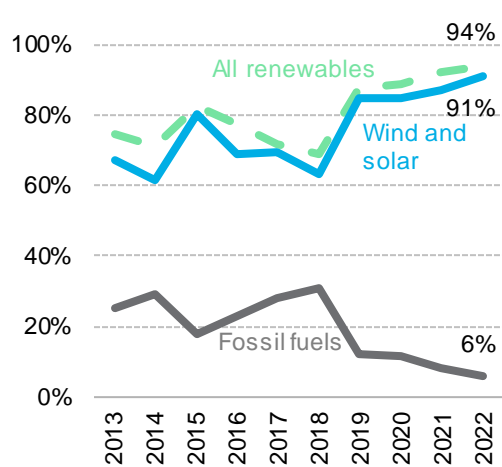
Fossil fuels' share of new build slumped to 13% in 2022, their lowest level ever and a steep decline from 50% in 2013. Natural gas led this drop, sliding to 23GW added in 2022 compared with 53GW in 2021. Coal was the top fossil fuel added in 2022, accounting for a net growth of 30GW; that addition represents a steep drop from the 70GW added in 2013 but a resurgence from net-negative figures in 2021.

Led by wind and solar, renewables now represent 87% of net capacity additions. Solar saw a 252GW addition in 2022, more than double the capacity added in 2019. Despite changes in tax incentives and policies, as well as commodity inflation and supply chain issues worldwide, solar remains one of the cheapest new-build technologies for producing electricity in economies that make up two-thirds of world population and three-quarters of global GDP.

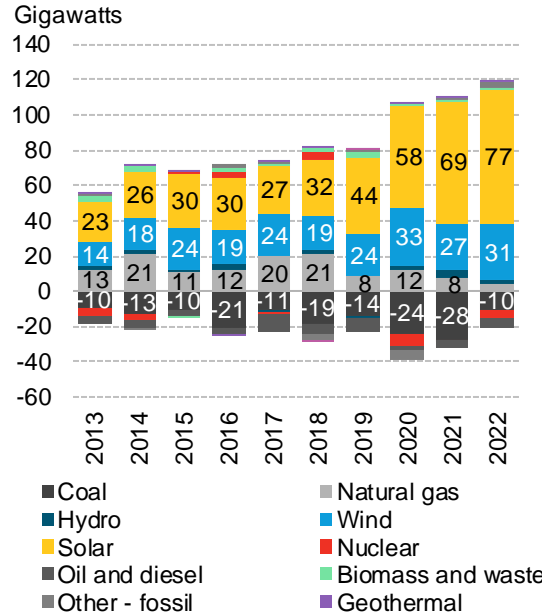
Source: BloombergNEF. Note: Graph shows net capacity additions. 'Other – fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

# Developed markets shuttered 10GW of coal-fired power plants in 2022

## Developed markets' share of net capacity additions



## Developed markets' year-on-year capacity change



Developed markets shuttered around 28GW of coal capacity in 2021 and 10GW in 2022. Fossil fuels' net additions in developed economies shrank in 2022, totaling just 6% of new build, compared with 8% in 2021 and 28% in 2017. Natural gas accounted for just 4GW, compared with 21GW in 2018.

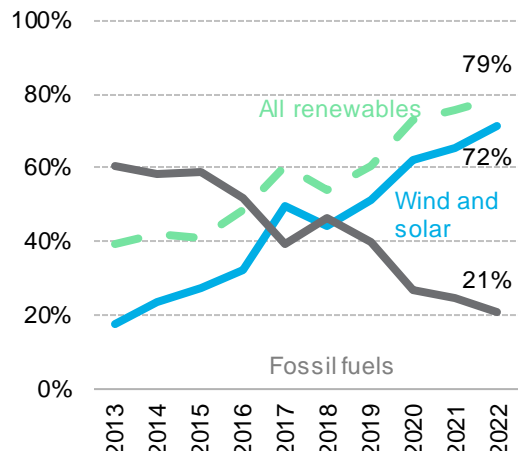
Developed markets saw coal retirements slow down in 2022. As Europe struggled with droughts and gas supply cuts from Russia, coal has turned into a short-term crutch to meet energy needs. As result, many economies have delayed coal phase-out plans and even restarted capacity that had been mothballed.

Across all technologies, a record near-110GW of renewable capacity was added in developed markets in 2022. Solar leads with 77GW, while wind was the second-most-added technology, at 31GW. Renewables, including large hydro, totaled 111GW.

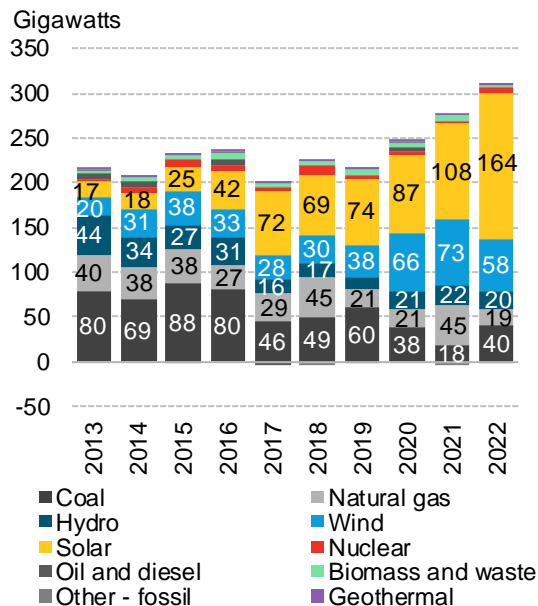
Source: BloombergNEF. Note: Graph shows net capacity additions. 'Other - fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

# Coal rebounded in developing markets in 2022, but wind and solar still represented over 70% of capacity additions

## Developing markets' share of net capacity additions



## Developing markets' year-on-year capacity change



Developing markets added 59GW of fossil fuel capacity to their grids in 2022, with coal alone accounting for 40GW.

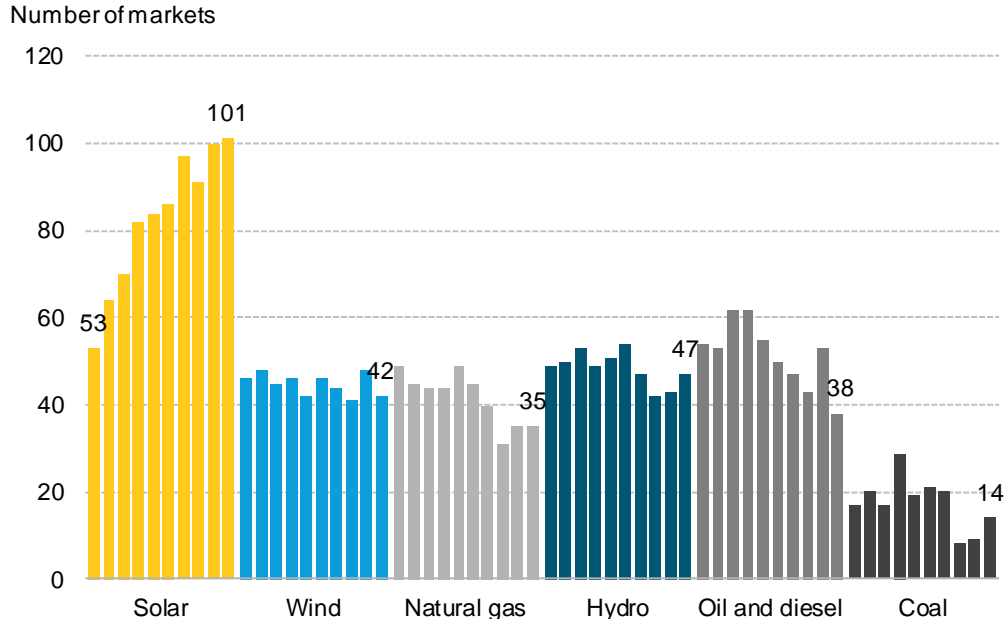
This is the biggest increase in coal net additions since 2019, when it accounted for 60GW. This is mainly attributed to mainland China, which added 33GW of coal capacity in 2022 alone. After a rise in 2021, net additions from natural gas dropped to 19GW in 2022, down from 45GW the year prior.

With solar and wind taking the lead, developing markets have added more capacity than ever. These markets saw 13% growth in net additions in one year, to 310GW in 2022. Solar added a record 164GW, 57% more than in 2021. Wind dropped considerably, adding 58GW in 2022 compared with 73GW in 2021.

Source: BloombergNEF. Note: Graph shows net capacity additions. 'Other – fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear. Developing markets include mainland China.

# Solar is by far the most popular technology added worldwide

## Markets with at least 1 megawatt installed per year, 2013-2022



Source: BloombergNEF. Note: Data considers only 140 markets covered by Climatescope.

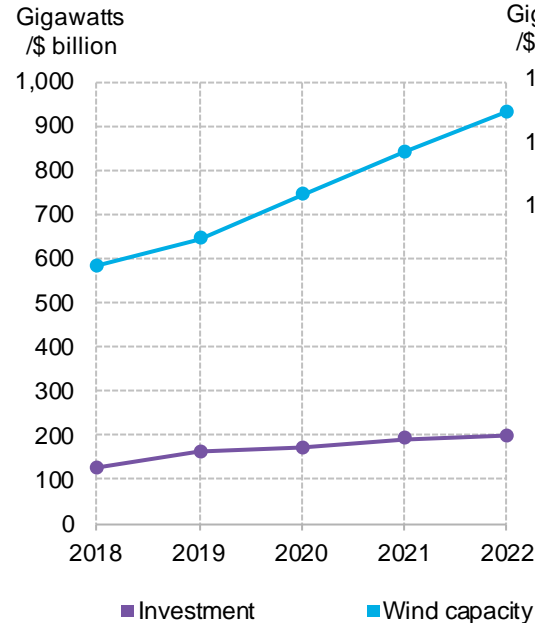
In 2022, at least 101 markets installed at least 1 megawatt (MW) of solar capacity – a new high. This figure is nearly double the 53 markets that did so in 2013. The modular nature of PV, along with steep equipment price declines over the course of the past decade, explain the technology's proliferation.

Hydro saw 47 markets adding over 1MW in 2022, the highest number in the last three years and four more than in 2021. Wind, on the other hand, dropped to 42 markets adding at least 1MW, compared to 48 in 2021.

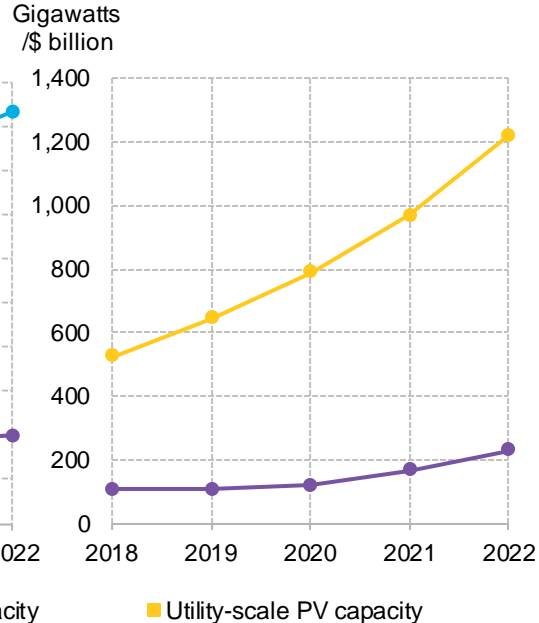
Coal saw an uptick in markets that installed at least 1MW of this technology in 2022, while oil plummeted to its lowest level since at least 2013 and natural gas kept stable. Despite the drop, oil was the fossil fuel technology installed in the greatest number of markets (38), followed by gas (35) and coal (14).

# As capex costs for renewables fall, each dollar invested has a greater impact

## Global wind capacity and investment 2018-2022



## Global solar capacity and investment 2018-2022



Solar and wind now have the lowest levelized cost of electricity (LCOE) of any technology. Solar and wind LCOEs increased slightly in 2021 and 2022, due to a rise in commodity and freight prices and higher interest rates imposed by central banks, yet fossil fuels saw their costs rise even further.

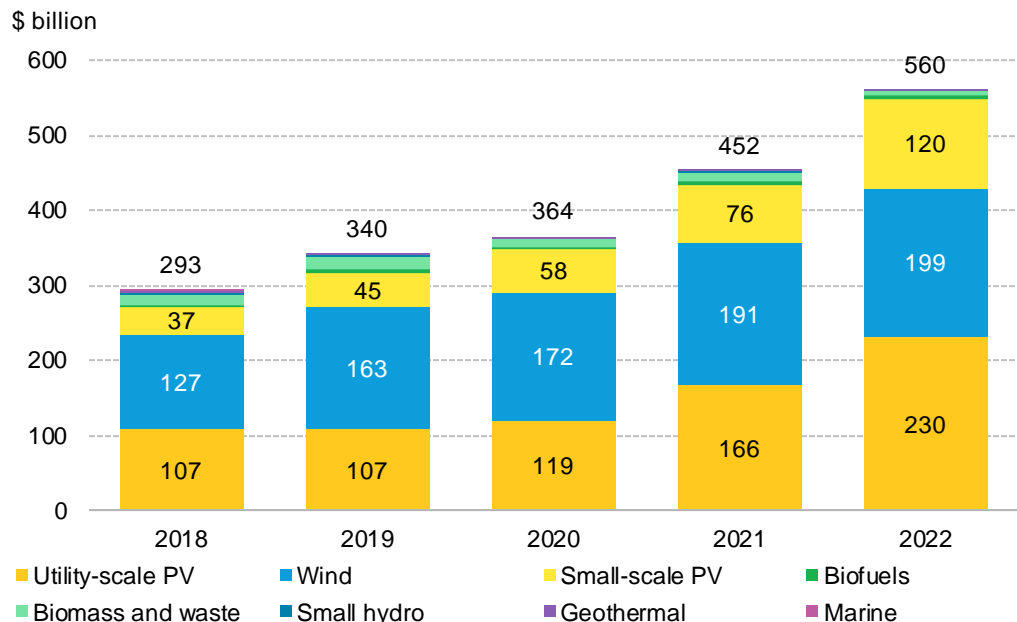
Solar modules and wind turbine installations are intensifying as equipment costs fall. This year, solar module prices hit an all-time low, decreasing capital expenditures – or the sum of development, equipment and construction costs – for PV projects. This means that each dollar invested can support more capacity.

Since 2022, renewables have become cheaper than coal even in Japan, Malaysia and the Philippines. For the first time ever, building an offshore wind project is roughly the same price on average as building a coal-fired power plant – and cheaper than building one fired by gas. Offshore wind and coal now boast an LCOE of \$74 per megawatt-hour (MWh), compared with \$92/GW for natural gas. In markets representing 60% of global electricity generation, it is now cheaper to build solar and wind power plants than to keep running existing plants fired by gas and coal.

Source: BloombergNEF. Note: For more, see BNEF's [1H 2023 LCOE Update](#). Wind data include both onshore and offshore wind.

# In 2022, global investment in renewable energy surpassed half a trillion dollars for the first time

## Global new-build renewable energy investment by technology



Source: BloombergNEF. Note: Data includes new-build asset finance and small-scale PV investment globally.

The funding of renewable energy projects and infrastructure reached a record \$560 billion in 2022, a 24% increase from the year before. Clean energy investment almost doubled from 2018 to 2022, with mainland China accounting for the largest share of investment post-2020, with 52% in 2022.

Wind and solar reached new highs in 2022, together accounting for 98% of the year's renewable energy investment. Solar alone represented 63% of the total.

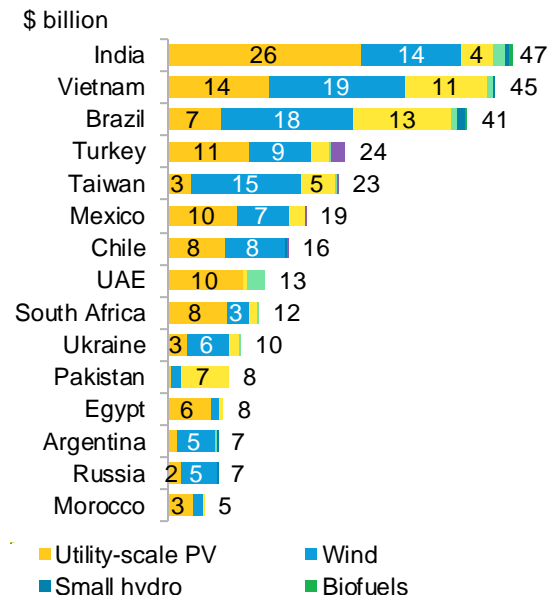
Investment in utility-scale solar projects saw a 38% increase from 2021 to 2022, while wind increased 4% over the same period.

For the first time since 2018, utility-scale photovoltaic solar (PV) raked in more than wind, with \$230 billion – or 41% of global renewable energy investment – in 2022. Wind received nearly 36% of global investment, or \$199 billion. Small-scale PV projects came in third, with 21%, while other renewables together accounted for the remaining 2%.

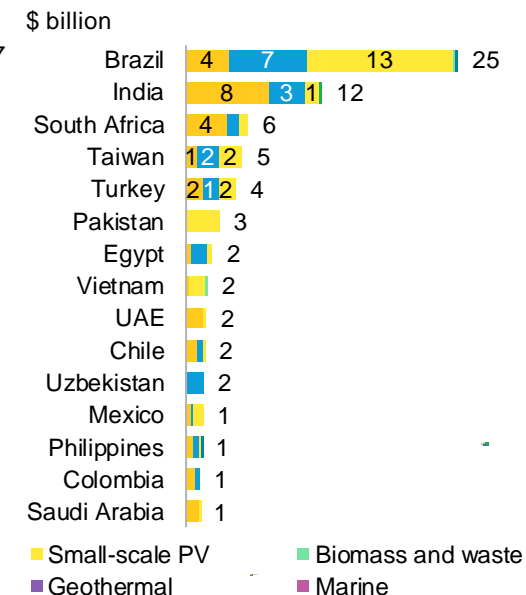
Investment in small-scale PV projects soared to a record high in 2022, growing 57% year-on-year and more than tripling compared to 2018. This growth was mainly driven by net-metering and tax incentive policies in key emerging markets.

# However, investment is still concentrated in a few emerging markets

## Top 15 emerging markets for renewable energy investment ex-mainland China, 2017-2021



## Top 15 emerging markets for renewable energy investment ex-mainland China, 2022



Renewable energy investment remains highly concentrated in a relatively small number of markets. In 2022, the top 15 emerging markets (excluding mainland China) for new-build clean energy investment attracted \$70 billion, or 87% of all investment in emerging markets. The list remains largely unchanged from the top 15 markets for cumulative renewable energy investment over 2017-2021, although in 2022 Uzbekistan, the Philippines, Colombia and Saudi Arabia edged out Ukraine, Argentina, Russia and Morocco.

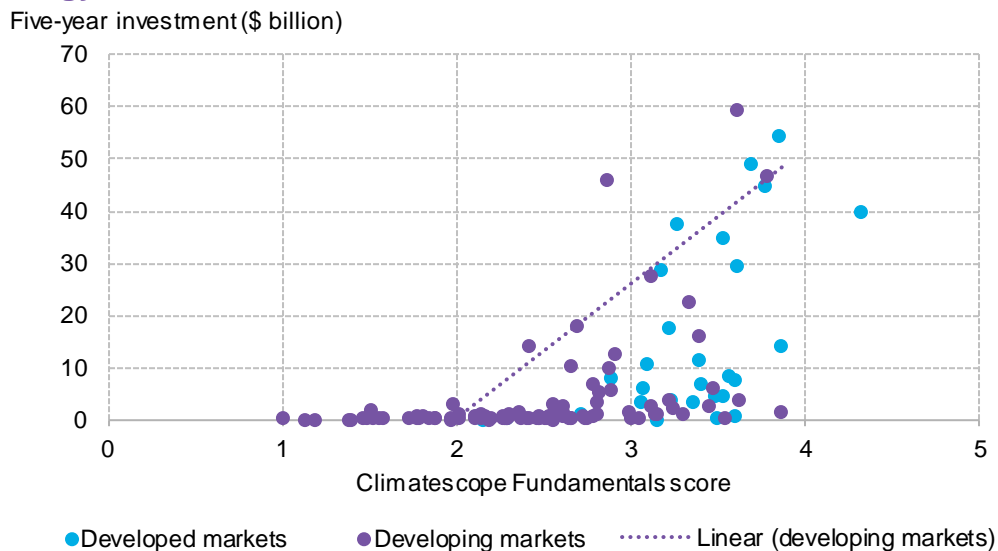
Investment in renewable energy skyrocketed in Brazil in 2022, when the market attracted \$25 billion – compared with a cumulative \$41 billion over the five preceding years. This jump was mainly thanks to a successful net-metering policy aligned with tax incentives benefitting small-scale PV projects, which attracted \$13 billion in 2022, the same amount the technology had received over 2017-2021 combined. Furthermore, Brazil attracted the third-highest investment in renewables globally, behind only mainland China and the US.

Source: BloombergNEF. Note: Includes new-build asset finance and small-scale PV investment.



# Policy plays a major role in clean energy investment and deployment

## Climatescope fundamentals score versus five-year renewable energy investment



Over the past five years, the majority of clean energy investment was directed to developed countries, while only 27 developing countries (including mainland China) attracted more than \$2 billion.

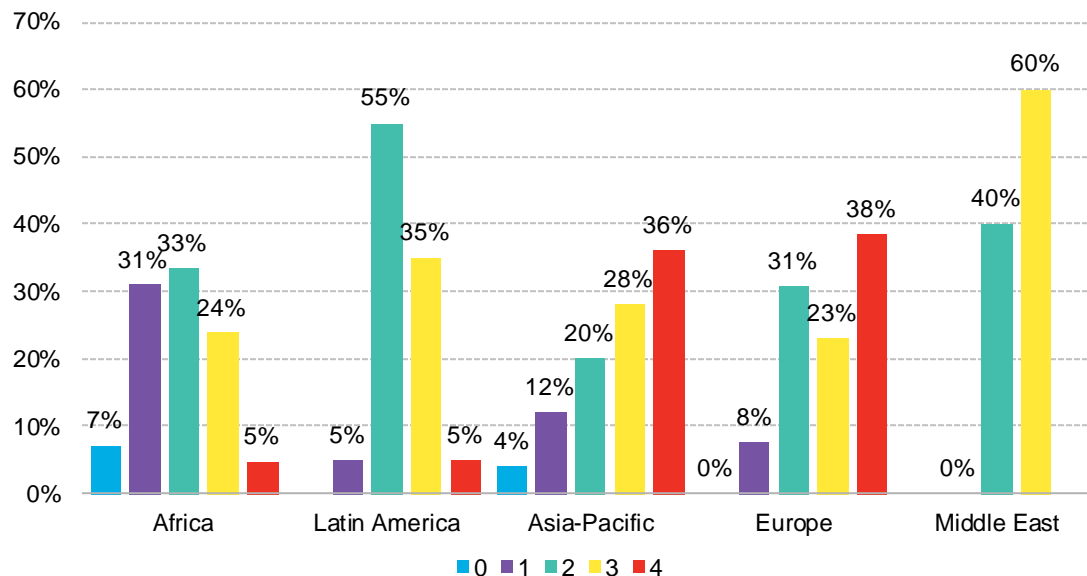
Among the 15 developed and emerging markets that finished at the top of the Climatescope scoring table, the average cumulative investment over the last five years was \$24 billion. Meanwhile, the 15 markets that finished at the bottom of the ranking averaged \$291 million. Comparing countries' policy scores with levels of attracted investment reveals the key role policies can play in mobilizing capital.

Difficulty in diversifying investment across emerging markets is directly linked to the absence of environments conducive to attracting such investments. Having effective policies and a mature, transparent power market that is open to private players, for example, renders a market more attractive to clean energy investment.

Source: BloombergNEF, Glasgow Financial Alliance for Net Zero (GFANZ). Note: The chart excludes mainland China and the United States due to outlier values. Climatescope Fundamentals score encompasses a market's key policies, market structure and barriers that could hinder investment. Investment includes new-build asset finance and small-scale PV.

# Policy adoption rates vary widely by region

Share of emerging markets in each region with a specific number of policy mechanisms in force



Renewable energy targets are the most popular policy choice in Africa, where 38 markets out of 42 have them on the books. Due to an increase in the adoption of these targets, only 7% of the continent's markets have no clean energy policy in force; one year ago this share was of 12%. Nevertheless, many markets in the region have yet to implement the necessary policies that would propel their power sectors toward a cleaner and more sustainable future. Among regions, Africa has the lowest adoption of other kinds of renewable energy policies, and only 24% of its markets have at least three mechanism in force.

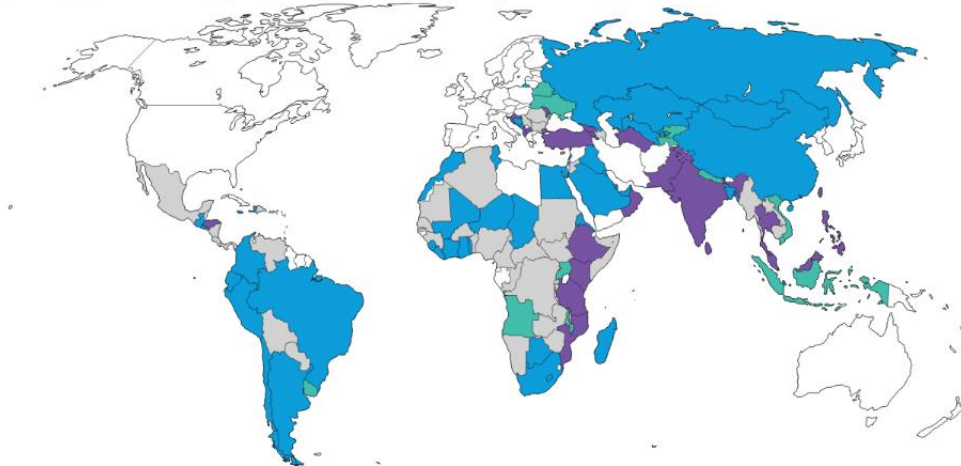
In Europe, more than a third of emerging markets have at least four clean power policies in force, the largest share of any region. All markets in the Asia-Pacific region have renewables targets, and 36% have at least three policies in place, while in the Middle East, 60% of markets have three policies on the books. And more than half of the markets in Latin America have two policies, often a renewable energy target and an auction or net-metering policy.

Source: BloombergNEF. Note: Data includes renewable energy targets, feed-in tariffs, net metering/billing and auction/tender policies for emerging markets only.

# More than half of emerging markets conduct auctions for renewable energy contracts

## Emerging markets with auctions, feed-in tariffs or both

■ Both ■ Auctions ■ Feed-in tariff ■ No policy



Reverse auctions for clean power delivery contracts and feed-in tariffs have proved to be two of the more effective policies for spurring renewable energy build. As of 2023, 63 of the 110 emerging markets surveyed in this report have auction mechanisms, while 32 have feed-in tariffs. Twenty markets have both.

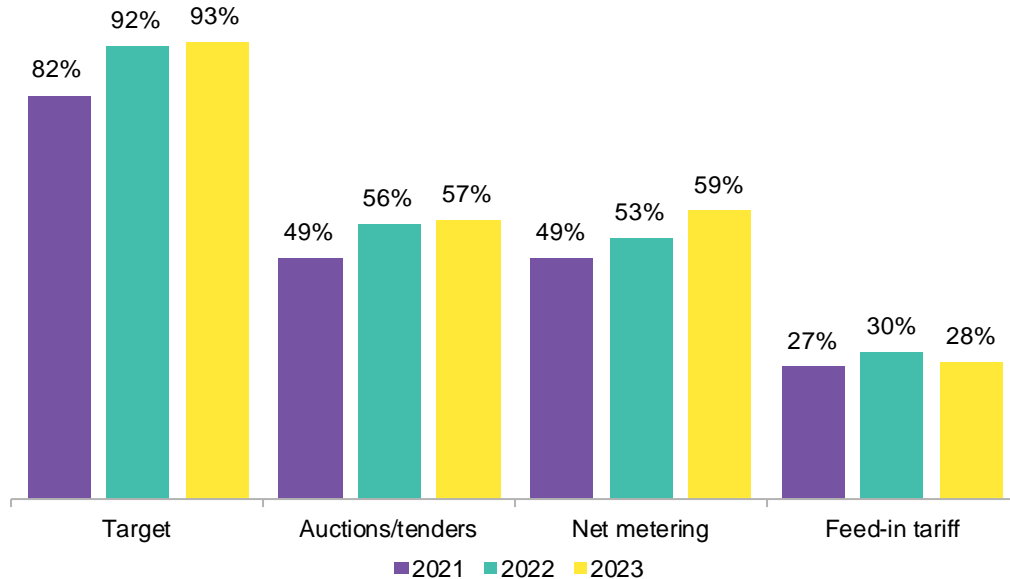
Among regions, emerging Europe has the highest share – 77% – of developing countries with such policies. In Latin America, auctions are the most popular mechanism for enabling the development of renewables; these are present in more than half of the region’s markets.

African markets were initially slow to adopt these policies but have recently made significant strides: now, almost half have auctions in place. The adoption of such policies has helped support clean energy investment and capacity deployment across the continent.

Source: BloombergNEF. Note: Includes 110 emerging markets surveyed through the end of July 2023.

# Clean power policies have made progress in emerging markets – but are still not on track for meeting targets

Share of emerging markets surveyed where key renewable power policies are present, 2021-2023



Source: BloombergNEF. Note: Includes 110 emerging markets surveyed through the end of July 2023.

In 2023, 93% of the emerging markets covered by Climatescope have renewable energy targets in place.

This represents a leap of 11 percentage points in just two years. Renewable energy targets are by far the most popular type of policy, but most of these markets lack the mechanisms to help deliver them.

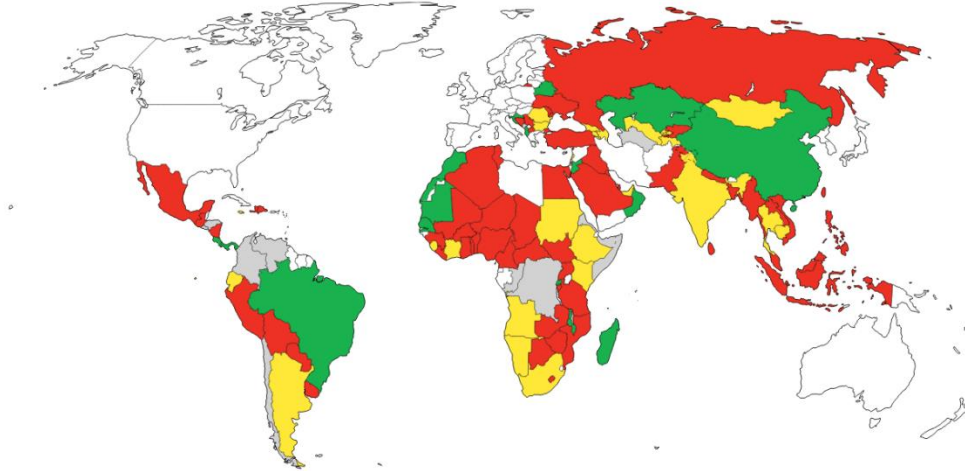
Reverse auctions for clean power delivery contracts and net metering to support rooftop solar are also rapidly gaining traction. In 2023, 57% of markets surveyed had auction policies in force, compared to 49% in 2021. Net metering is now present in 59% of emerging markets, compared to 49% in 2021, and the growth of this kind of incentive is helping distributed solar spread to more markets.

Feed-in tariffs are the only type of policy losing ground. In 2023, they are available in 28% of emerging markets, compared with 30% in 2022. The reasons for renouncing an incentive may vary. While it's common to move from feed-in tariffs to reverse auctions, retroactive changes may happen due to regulatory issues or governmental changes.

# Strong renewable energy targets signal ambition – but not always effectiveness

## Gap to achieving renewable energy targets in emerging markets

■ Large ■ Medium ■ Small ■ Not applicable



The last decade was marked by notable surges in climate ambitions, with markets consistently improving their renewable energy targets and pledging to accelerate carbon emission reductions. Currently, the majority of emerging markets covered by Climatescope have such targets. The increased rate of these policies' adoption can be attributed mainly to international commitments and the pressure imposed by events such as the Conference of the Parties (COP).

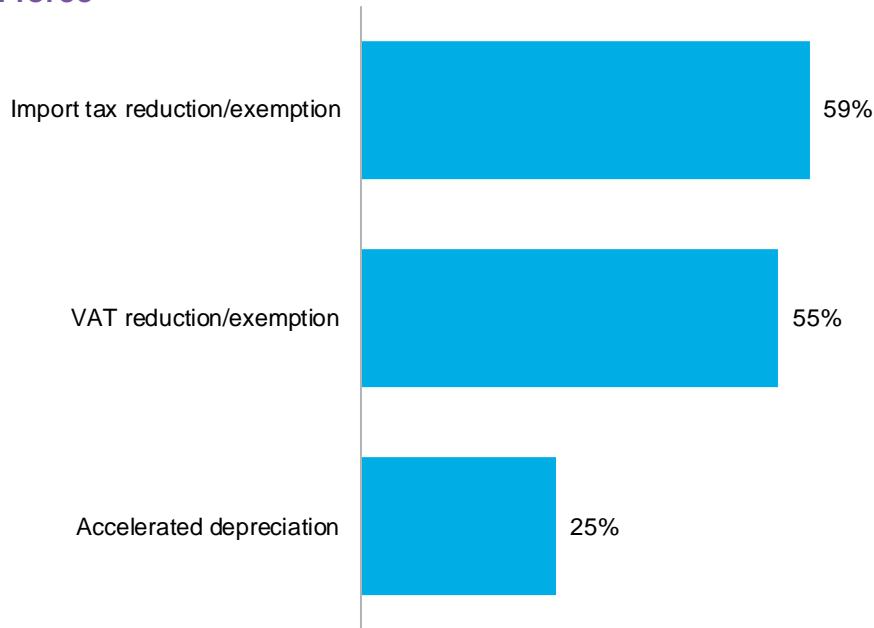
However, among the markets that have a renewable energy target in force, almost 60% have yet to meet even the half-way mark, even though most of these goals are set to come due in 2030.

Governments must thus balance ambition with feasibility when it comes to setting targets. Achieving targets also requires setting effective policies, such as tax incentives, auctions, feed-in tariffs and net metering.

Source: BloombergNEF. Note: Data shows only the 110 emerging markets covered by Climatescope. Parameters are: up to 20% - Small, 20% - 50% - Medium, over 50% - Large. 'Not applicable' indicates the target has already been achieved, or the market does not have a target in force.

# Tax incentives serve as foundation to renewables deployment

## 2023 share of emerging markets surveyed with tax incentives in force



Tax incentives are another important measure adopted mainly in emerging markets. Governments in these markets use tax reductions or exemptions in order to attract project developers and subsidize upfront costs.

The most common type of tax incentive in the emerging markets surveyed by Climatescope is an import tax, which is available in 59% of the 110 markets. Value-added tax (VAT) exemptions/reductions, present in 55%, come in a close second. Accelerated depreciation – by which renewable energy asset book values decrease at a faster rate than they would using traditional depreciation methods – is the least common, but still present in 25% of the emerging markets.

Source: BloombergNEF. Note: Includes 110 emerging markets surveyed through the end of July 2023.

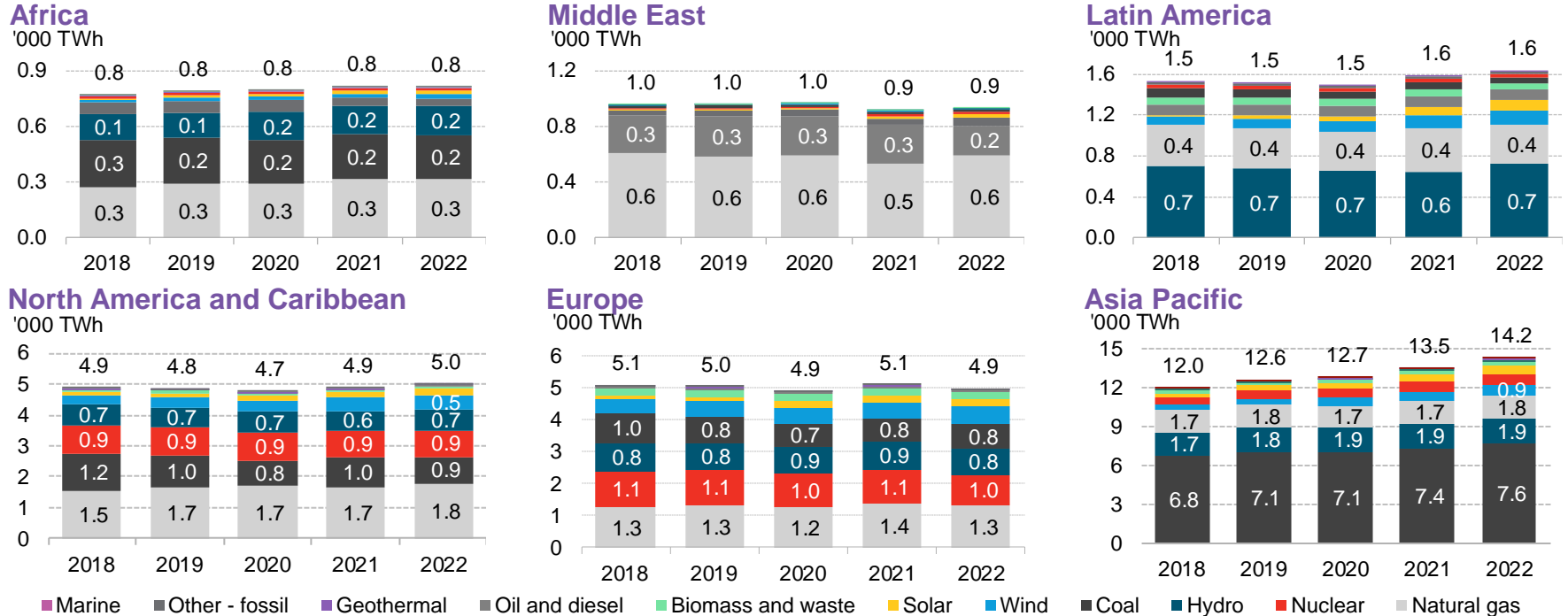


# Regional analysis

Renewables leading worldwide

30 November 29, 2023

# Generation by region and technology, 2018-2022

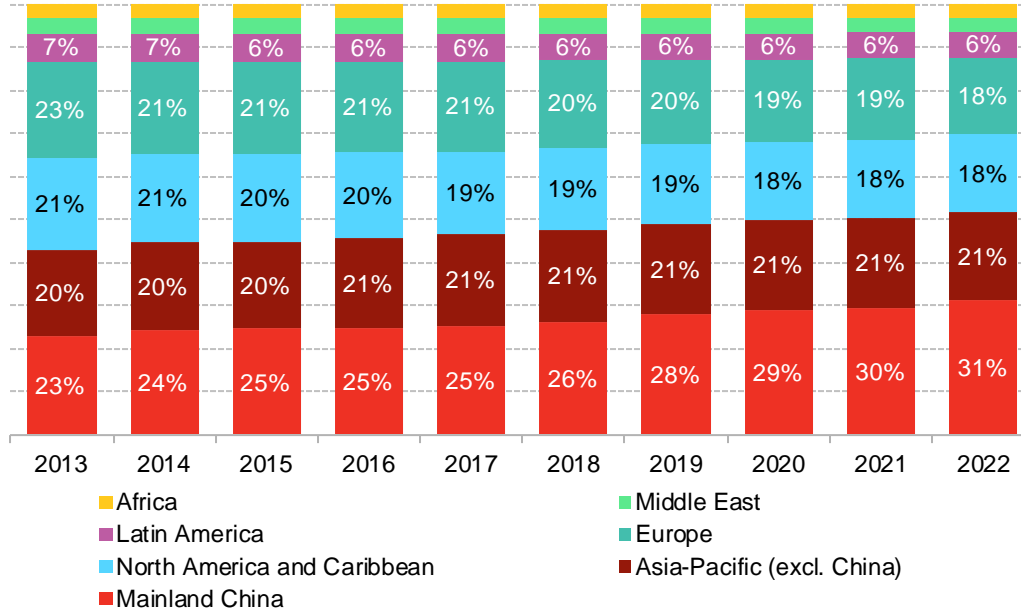


Source: BloombergNEF. Note: Graph shows total generation by region. '000 TWh is thousand terawatt-hours. 'North America and Caribbean' includes the US, Canada and the Caribbean islands of American Samoa, Bermuda, Cayman Island, Puerto Rico and the US Virgin Islands.



# APAC steers the wheel in global generation growth...

## Share of annual generation by region



Demand for electricity from the Asia-Pacific region (including mainland China) has risen swiftly over the past decade, and the area now accounts for over 50% of global generation. Mainland China alone accounts for 31% of global power generation.

Demand in Europe declined in 2022, due to an increase in electricity prices attributed to the energy crisis and the Russia-Ukraine war. Europe accounted for 18% of the world's electricity production in 2022 and has seen, alongside North America, its share of global generation decrease consistently since 2013.

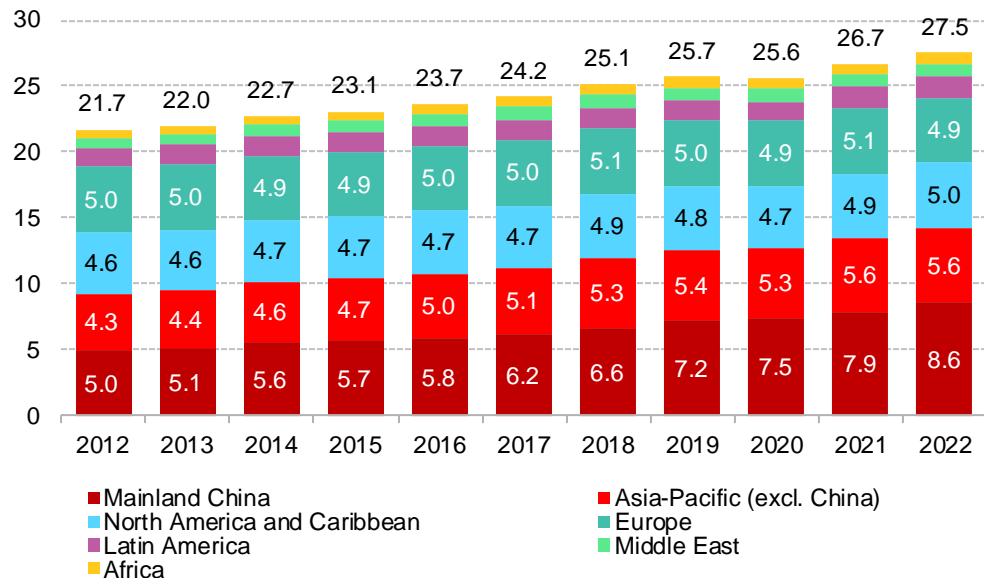
The Middle East, Latin America and Africa have broadly held their shares of global generation, as the rate of demand growth these regions has generally matched the global growth rate. The Middle East and Africa each accounted for 5% of global electricity generation in 2022, while Latin America represented 6%.

Source: BloombergNEF. Note: 'North America and Caribbean' includes the US, Canada and the Caribbean islands of American Samoa, Bermuda, Cayman Island, Puerto Rico and the US Virgin Islands.

# ...with China accounting for the greatest increase

## Global annual generation by region or economy

Thousand terawatt-hours



Source: BloombergNEF. North America and Caribbean includes United States, Canada and Caribbean islands of American Samoa, Bermuda, Cayman Island, Puerto Rico and US Virgin Islands.

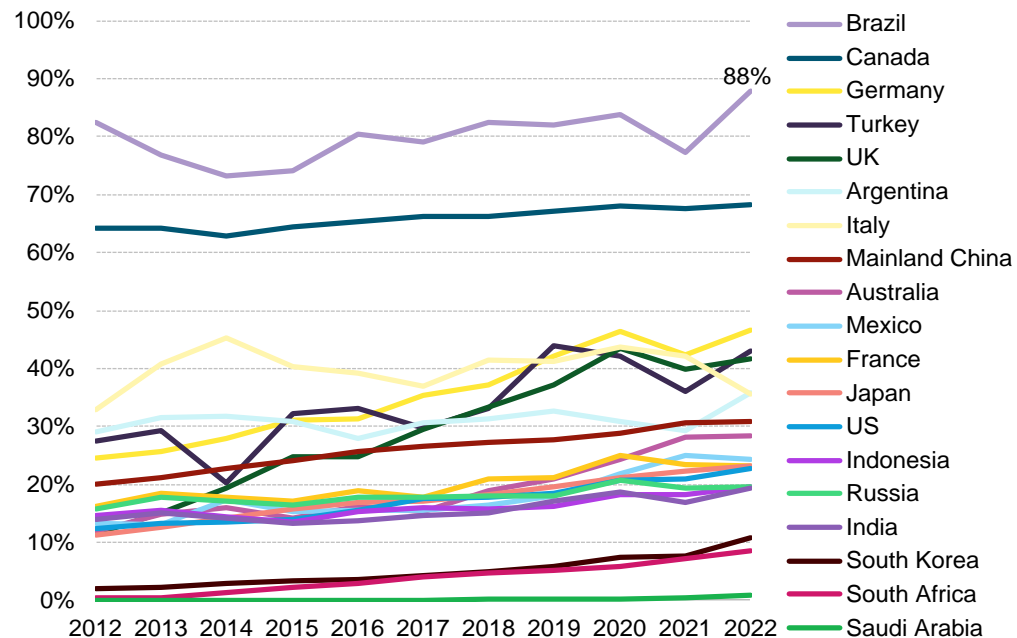
The Asia-Pacific region led the spike in global electricity production, with a 6% jump from 2021 to 2022. Thanks to strong economic growth, mainland China saw generation rise about 9%, to 8,600TWh, and accounted for nearly 85% of the global generation change over the same period.

Power production in Asia-Pacific (including mainland China) markets now represents over 50% of global generation. These economies achieved the largest growth in power production over a decade and jumped nearly 6% from 2021 to 2022, to reach 14,200TWh.

Generation in Europe fell 3% from 2021 to 2022, as the energy crisis and Russia-Ukraine war led to an increase in electricity prices and a related drop in consumption. Meanwhile, North America, Latin America and the Middle East saw generation rise 2.6%, 3% and 1.5%, respectively. In the African continent, power demand has remained roughly flat, continuously accounting for around 3% of global generation.

# Brazil leads G-20 economies on renewable generation

## Share of renewable energy generation in G-20 economies



Source: BloombergNEF. Note: Renewable energy includes biomass and waste, geothermal, hydro, marine, solar and wind technologies.

Around 30% of G-20 economies' electricity generation came from renewables in 2022. This marks an all-time high, and a jump of 10 percentage points from the 20% share in 2012. In absolute numbers, G-20 economies saw renewable generation almost double over the last decade, from 3,300TWh in 2012 to 6,500TWh in 2022.

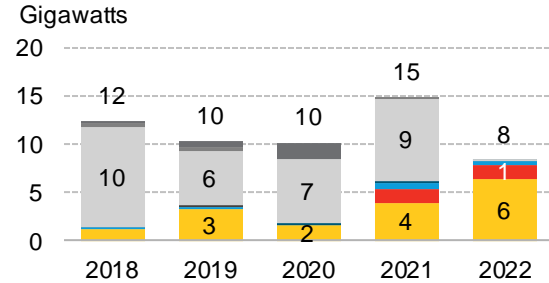
Among G-20 economies, only Brazil and Canada have more than 60% of their generation coming from renewable energy sources; in both cases, the high share is thanks to large hydro fleets. The other 17 economies are still lagging when it comes to adding more renewables to the grid and meeting their often-ambitious renewable energy targets.

Saudi Arabia, South Africa and South Korea are still falling behind most of their peers. Such markets are highly reliant on fossil fuels for electricity generation and have a long way to go to be on track to meet their 2050 net-zero pledges.

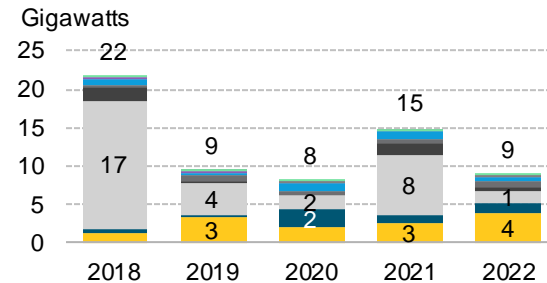
Brazil has one of the world's cleanest energy matrixes. This is mainly attributable to its natural resources, especially hydro power. In 2022, renewable generation in Brazil reached an all-time high thanks to abundant rainfall and solar and wind installed capacity growth as a result of effective policies and incentives.

# Installed capacity additions by region and technology, 2018-2022

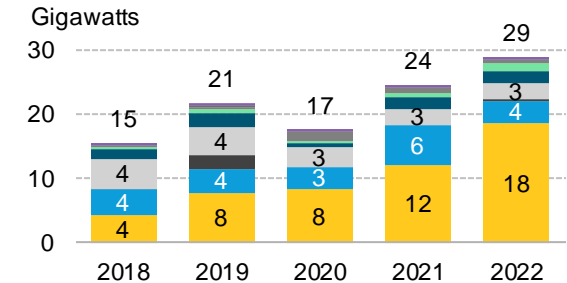
## Middle East



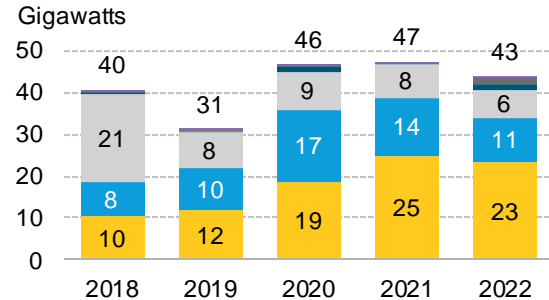
## Africa



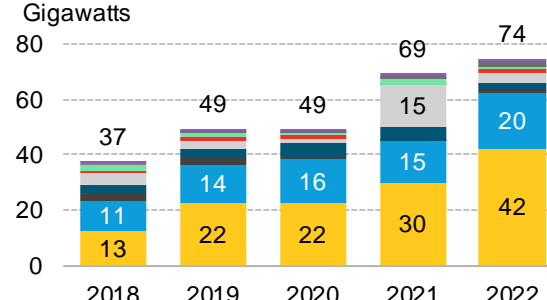
## Latin America



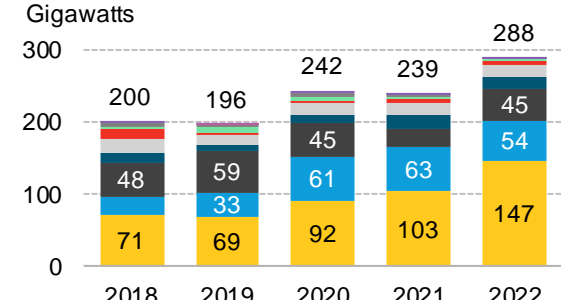
## North America and Caribbean



## Europe



## Asia Pacific

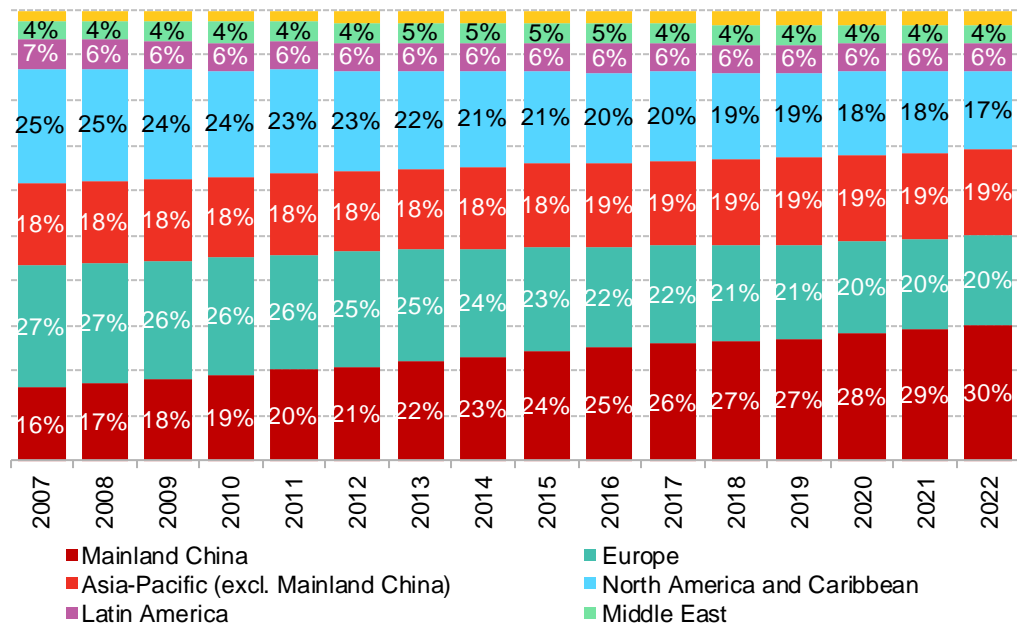


■ Marine ■ Geothermal ■ Other - fossil ■ Oil and diesel ■ Biomass and waste ■ Nuclear ■ Natural gas ■ Hydro ■ Coal ■ Wind ■ Solar

Source: BloombergNEF. Note: Graphs show net capacity additions. GW is gigawatts. 'North America and Caribbean' includes the US, Canada and the Caribbean islands of American Samoa, Bermuda, Cayman Island, Puerto Rico and the US Virgin Islands.

# APAC is home to half of global installed capacity

## Share of global installed capacity by region or economy



The role of the Asia-Pacific region (APAC) in the global power mix was reaffirmed in 2022, as the region now is home to 49% of global installed capacity. As of year-end 2022, APAC had 4.1TW installed, with mainland China alone accounting for 30% of the global total. Mainland China's capacity has more than doubled over the decade, from 1.1TW in 2012 to 2.5TW in 2022.

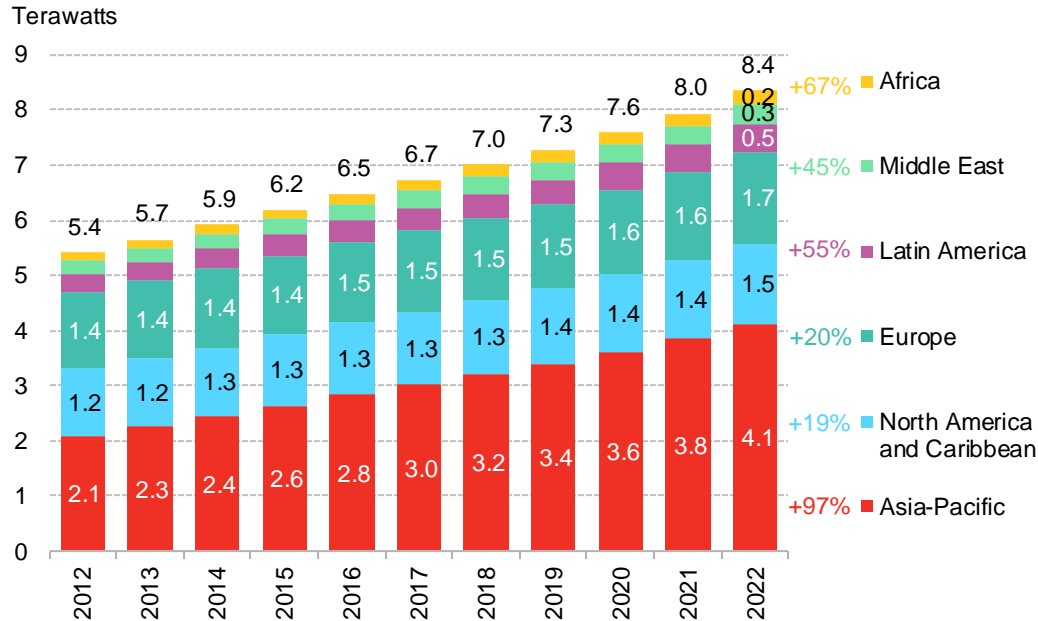
All regions broadly held their respective shares from 2021 to 2022. Europe remaining the second largest region for installed capacity with 20% of the global share, followed by North America at 17%. However, these are the only two regions that have seen a sharp drop in their capacity shares since 2006, when each accounted for around 26% of global capacity. This is mainly attributed to the steep increase in mainland China's installed capacity.

Despite being home to around 16% of the world's population, Africa has just 3% of installed global capacity. This share has remained stable over the past 15 years.

Source: BloombergNEF. Note: 'North America and Caribbean' includes the US, Canada and the Caribbean islands of American Samoa, Bermuda, Cayman Island, Puerto Rico and the US Virgin Islands.

# Africa has seen the fastest capacity growth in the past 10 years

## Global installed capacity by region



APAC's total installed capacity has nearly doubled in a decade. Capacity jumped from 2.1TW in 2012 to 4.1TW in 2022. In absolute terms, mainland China, India and Japan led the region's growth, accounting for 1,729GW added in the last decade. Ambitious deployment goals and enabling policy frameworks have allowed APAC to consistently expand the deployment of renewables.

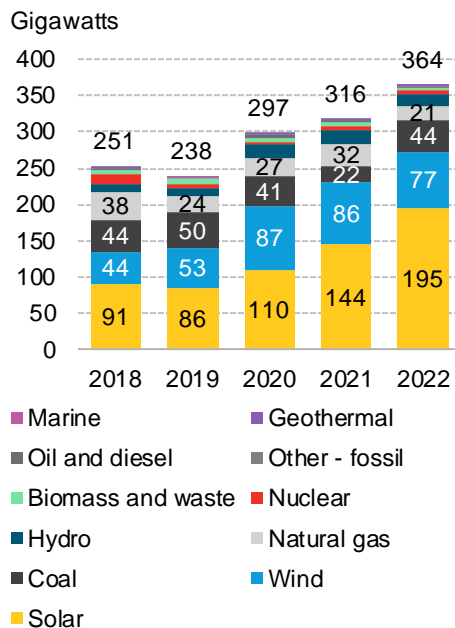
Africa followed, with a 67% jump over the same period. In 2022, the continent reached 237GW of capacity, up from 121GW in 2012. Egypt, South Africa and Algeria are among the African markets that saw their installed capacity grow most over the period, together adding nearly 57GW in a decade.

Europe and North America have grown least since 2012. These regions each saw their power matrix grow by just 20%. However, despite the European energy crisis and the Russia-Ukraine war, Europe saw a slight increase in installed capacity in 2022. In North America, the uptake was mainly led by the US with the establishment of the Inflation Reduction Act (IRA), which will kickstart an upsurge of renewables.

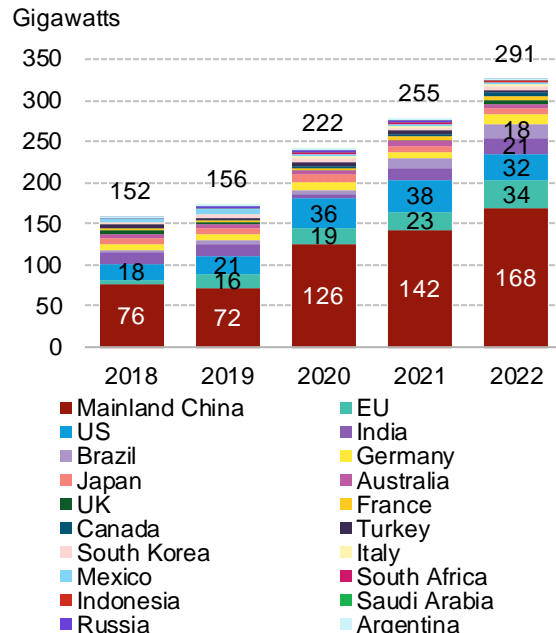
Source: BloombergNEF. Note: 'North America and Caribbean' includes the US, Canada and the Caribbean islands of American Samoa, Bermuda, Cayman Island, Puerto Rico and the US Virgin Islands. The % change in global installed capacity by region refers to the 2012-2022 period.

# The G-20 represents 86% of global installed capacity additions

## Additions by technology



## Renewable additions by economy



Renewable energy additions from G-20 economies account for 80% of such additions worldwide. Wind and solar alone accounted for 74% of additions, while hydro covered just 4%. Biomass and geothermal together summed around 1% of additions in 2022. The G-20 economies account for 85% of the global GDP, over 75% of the global trade and around two-thirds of the world population.

However, renewable additions in the G-20 are mostly concentrated in four markets: mainland China, the US, India and Brazil. Together, these economies accounted for 81% of G-20 renewable additions in 2022. These four also saw the biggest growth in renewable capacity additions in 2022, almost tripling such additions compared to 2012 numbers.

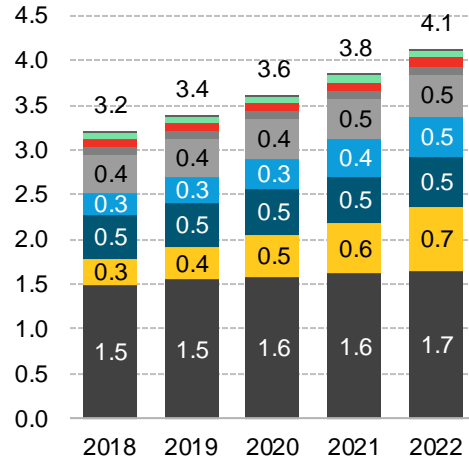
Among G-20 economies, net coal additions rose considerably in 2022, reaching 44GW, from 22GW in 2021. Mainland China accounted for most coal additions, at 68% of the global figure.

Source: BloombergNEF. Note: Graph shows net capacity additions. 'Other – fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear. 'EU' excludes Germany, France and Italy, which are listed individually.

# APAC's installed capacity of renewables has overtaken that of coal

## APAC installed capacity by technology

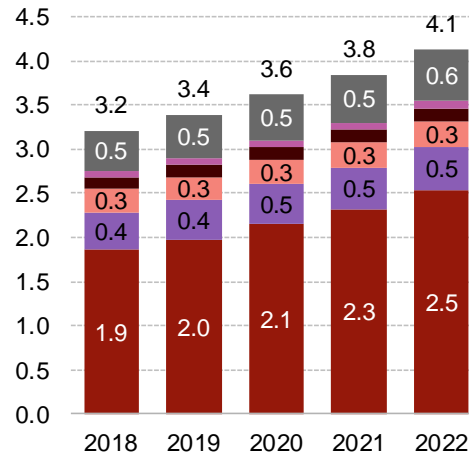
Terawatts



Source: BloombergNEF

## APAC installed capacity by market

Terawatts



The cumulative installed capacity of renewable energy (including large hydro) in the APAC region surpassed that of coal for the first time in 2022, as the two sources reached 1.8TW and 1.7TW respectively. Coal is still the main source of power production in APAC, due mainly to extensive coal reserves in mainland China and India.

Apart from coal, fossil fuels' installed capacity additions have remained relatively stable. In the last three years, fossil fuels have risen an average of 2% yearly, with coal accounting for 60% of the fossil fuel additions.

APAC holds the biggest coal reserves in the world. However, despite renewable energy goals, coal phase-out targets in the region's main economies are still far away.

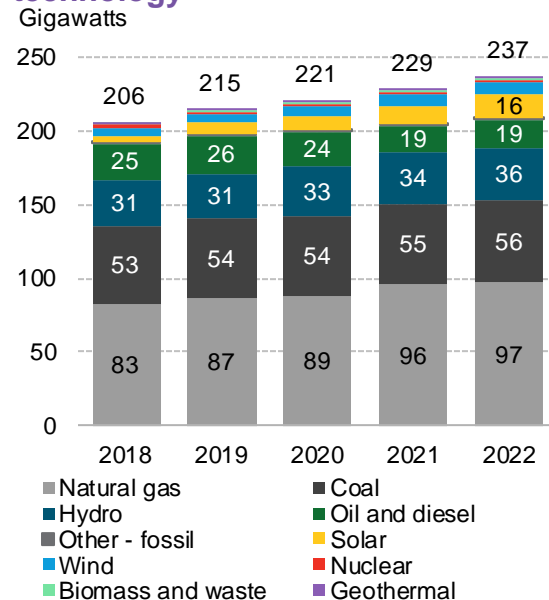
APAC's total installed capacity is heavily concentrated in five markets. Mainland China, India, Japan, South Korea and Australia account for 89% of the region's power matrix, at a combined capacity of 3.5TW.

Solar additions reached a new high of 47GW in 2022. Meanwhile, wind saw a slowdown, with 54GW of capacity added in 2022 against 62GW in 2021. To quickly meet rising demand, mainland China and India are focusing on solar deployment.

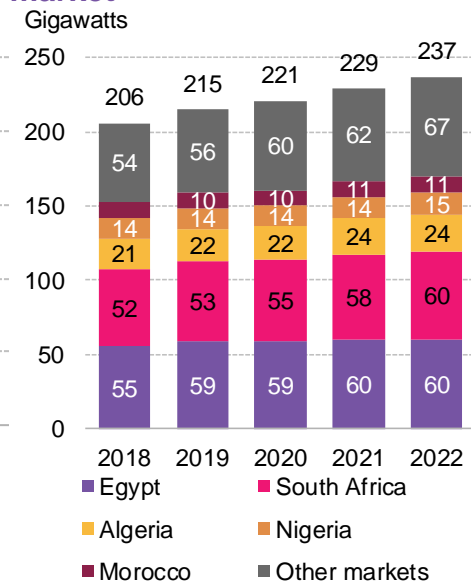


# Africa's abundant resources are an energy transition opportunity still waiting to be tapped

## Africa installed capacity by technology



## Africa installed capacity by market



The global energy transition represents a window of opportunity for Africa's development. The continent's abundant natural resources could drive the energy transition not only there but also internationally, by exporting clean power (especially to European markets) and thereby improving Africa's own economic growth. However, so far, limited progress has been made.

Fossil fuels dominate Africa's power matrix, with natural gas accounting for 41% of capacity installed, followed by coal with 24%. Renewables have consistently grown over the decade and now account for 12% of the continent's total capacity. Solar jumped from near-zero levels in 2012 to 16GW in 2022.

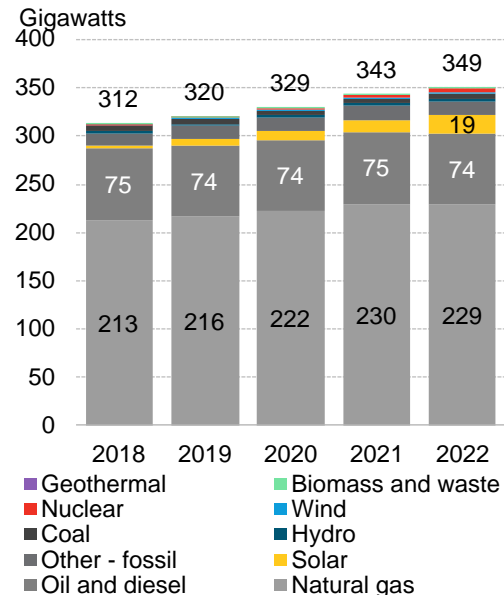
Solar has the potential to help close Africa's electrification rate gap, as around three-quarters of the population of Sub-Saharan Africa still lacks access to reliable electricity. However, to allow PV to flourish, financial and regulatory barriers must be addressed.

Africa's total installed capacity is concentrated in just five economies, accounting for 72% of the region's installed capacity, or 170GW. South Africa, Egypt, Ethiopia, Morocco and Angola represented 51% of the region's installed renewables capacity in 2022.

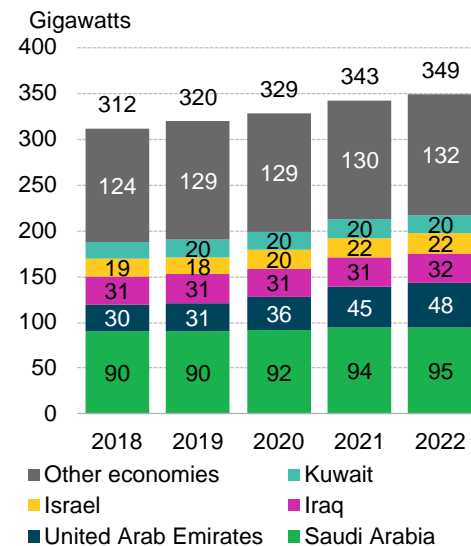
Source: BloombergNEF. Note: For more, see [Scaling-Up Renewable Energy in Africa](#). 'Other - fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

# The Middle East has the world's lowest share of renewable capacity

## Middle East installed capacity by technology



## Middle East installed capacity by market



Home to some of the world's largest fossil fuel reserves, the Middle East has a total installed capacity of 349GW, of which 93% is attributed to fossil fuels. Saudi Arabia, the United Arab Emirates, Iraq, Israel and Kuwait accounted for 217GW of installed capacity in 2022, or over 60% of the region's capacity.

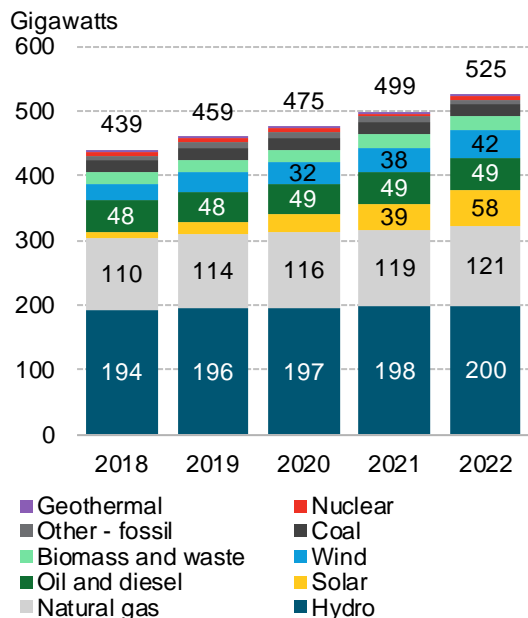
Nevertheless, solar is the renewable source with the greatest potential in the region and has seen a consistent increase over the past years. The region boasts some of the best solar irradiation in the world. Solar jumped from basically nothing in 2012 to 19GW in 2022. Renewables overall have jumped sevenfold in just a decade.

None of the five biggest Middle Eastern economies in terms of capacity have net-zero pledges. However, progress is expected in the region, as these economies intend to improve renewable deployment as one of their main mitigation measures.

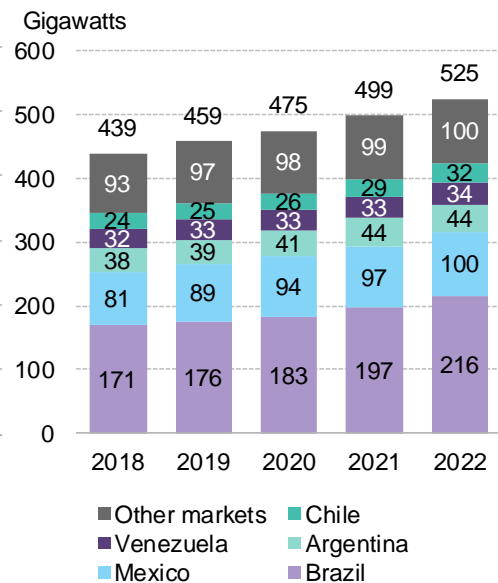
Source: BloombergNEF. Note: 'Other - fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

# Latin America has the cleanest power matrix in the world

## Latin America installed capacity by technology



## Latin America installed capacity by market



Led by hydro power, Latin America's power matrix is the cleanest of any region, with over 60% of its total installed capacity coming from renewable sources. Of this, two-thirds (200 GW) is represented by hydro. Solar follows in second place, having jumped to nearly 58GW in 2022, while wind accounts for around 41GW.

Solar and wind are the main bets for responding to rising demand. Aligned with natural resources, growing incentives and policy frameworks, uptake is expected to keep rising in Latin American markets. BNEF expects Latin America to add over 115GW of wind and solar in the next five years.

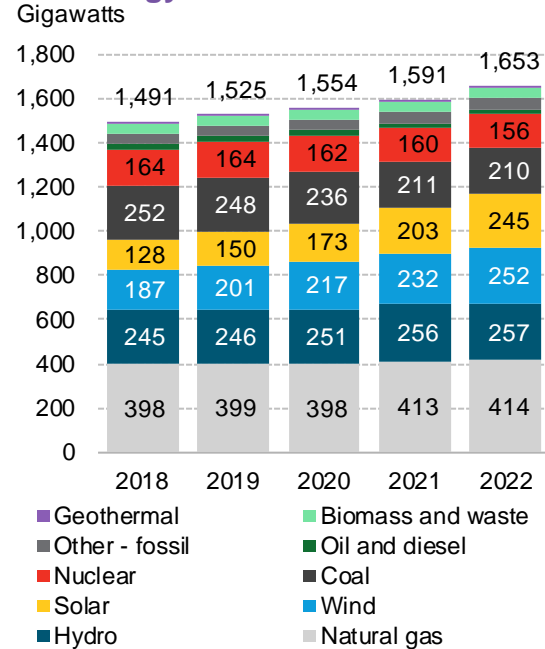
Brazil leads renewables growth in the region. The market's net-metering-fueled sub-5MW PV market continues to make an outsized contribution, accounting for nearly a third of all investment in renewables and half of all wind/solar build in 2022.

Brazil, Mexico, Argentina, Chile and Venezuela represent 80% of the region's installed capacity. Together they account for 82% of renewable installed capacity in the region.

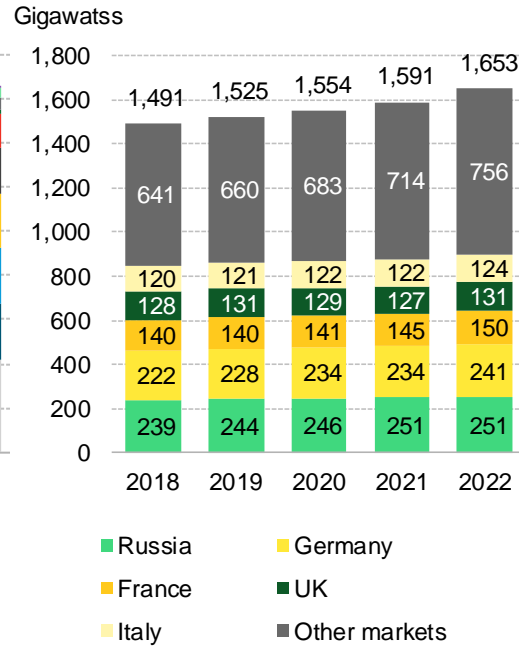
Source: BloombergNEF. Note: For more, see [1H 2023 Latin America Market Outlook](#). 'Other - fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

# Europe's renewables penetration rises as energy-security concerns hit the continent

## Europe installed capacity by technology



## Europe installed capacity by market



Natural gas, hydro and coal have historically dominated the European electricity mix, but renewables are closing in. Renewables (including large hydro) have consistently grown over the past decade and now account for 23% of the continent's total capacity. Solar jumped from under 80GW in 2012 to 245GW in 2022, while wind grew from 110GW to 252GW over the same period.

The Russia-Ukraine war impacted Europe's short-term energy transition. The European energy crisis led several economies to delay fossil-fuel phase-outs and apply clawbacks to clean energy generators' revenues, given high electricity prices. Nevertheless, renewable energy additions in the region reached a record high of 64GW in 2022.

Source: BloombergNEF. Note: 'Other - fossil' accounts for plants that use more than one fuel or fuels other than coal, oil, gas, hydro and nuclear.

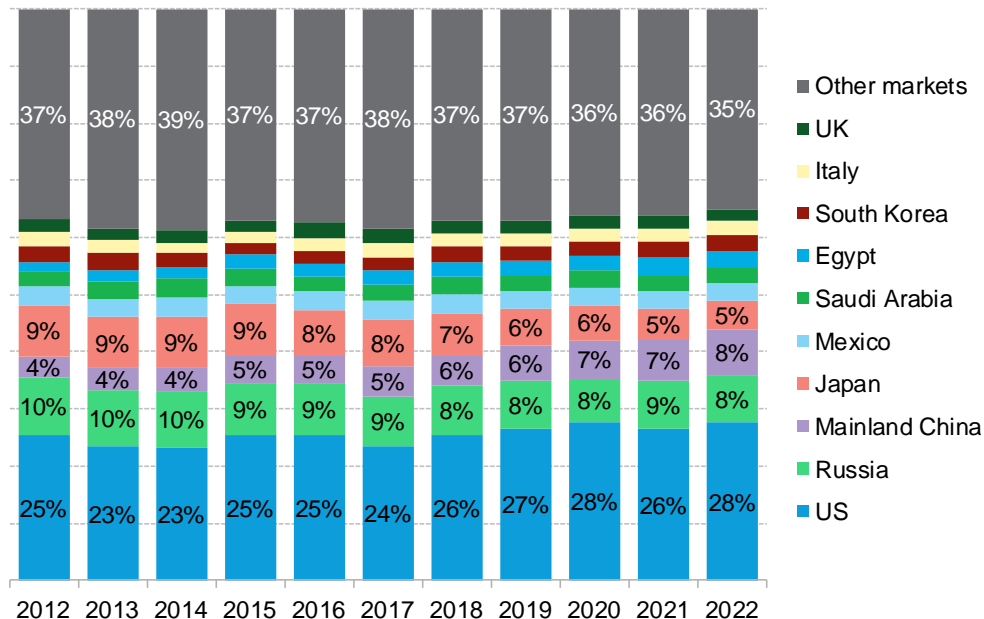


# Fossil fuels and emissions

Fossil fuels' flame is still very much alive

# Natural gas grows slightly despite supply constraints

## Top economies for natural gas generation



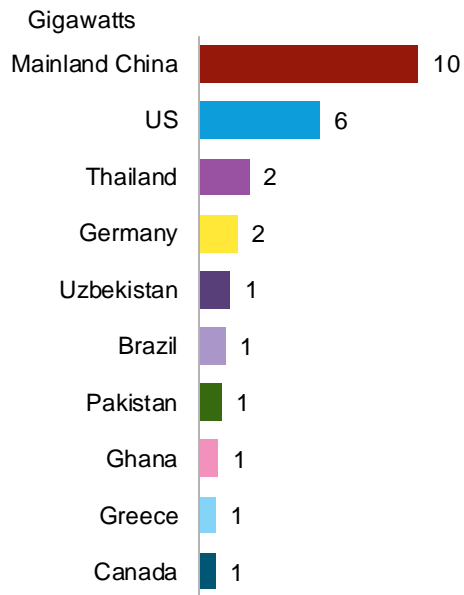
Ten economies accounted for 65% of the total natural gas power produced globally in 2021. However, none of these had natural gas as the main technology choice when compared with other fossil fuels and renewable technologies.

The US has been the top natural gas generator for at least the last 15 years, and in 2022 was responsible for 28% of natural gas generation, up from 23% in 2013. Its natural gas power production reached an all-time high of 1,703TWh in 2022, after slowing down in 2021.

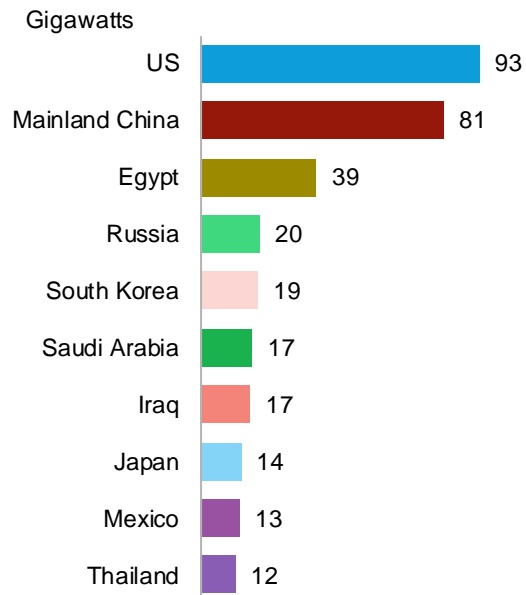
Source: BloombergNEF

# Mainland China and the US push for natural gas

## Top 10 markets for natural gas capacity additions, 2022



## Top 10 markets for natural gas capacity additions, 2013-2022



The US and mainland China represent nearly 54% of all natural gas generating capacity added from 2013 to 2022. The two economies are home to some of the largest natural gas reserves in the world, and together they accounted for 51% of new additions in 2022.

Mainland China alone added 10GW of natural gas in 2022 – or 33% of the global share – as it focuses on ensuring energy security by promoting domestic production.

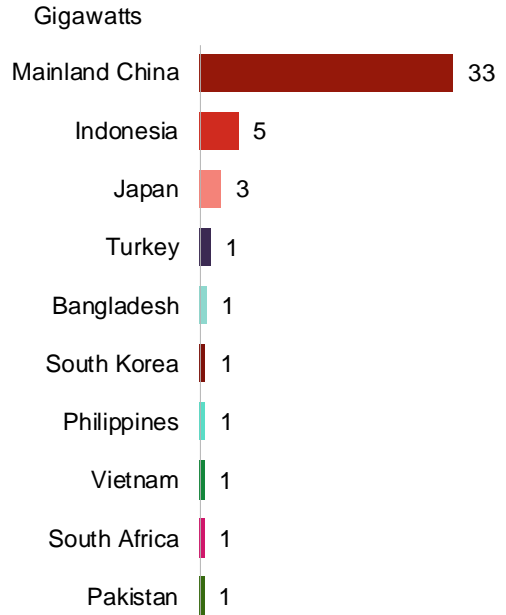
The US installed 6GW in 2022, accounting for 18% of the global figure, as the fracking boom pushed gas forward as a cheaper alternative for meeting demand.

Eight other economies accounted for 34% of global additions in 2022. Top European economies added 3GW, while markets in Asia, Africa and the Americas contributed another 8GW.

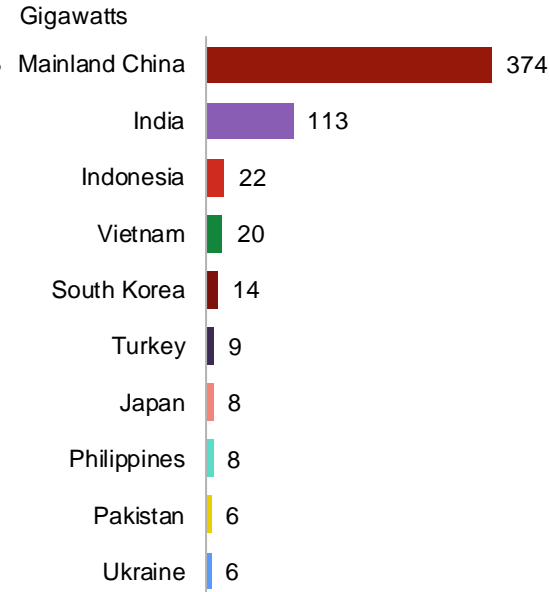
Source: BloombergNEF. Note: The charts show gross capacity additions.

# Emerging markets dominate coal additions

## Top 10 markets for coal capacity additions, 2022



## Top 10 markets for coal capacity additions, 2013-2022



Mainland China led the building of new coal-fired power generating capacity in 2022. The economy accounted for 68% of new coal additions in 2022 and added 374GW of coal over 2013-2022, or 59% of the total global. Meanwhile, India installed 113GW over the same period.

Excluding mainland China, seven other Asian markets are among the top 10 economies for coal additions in 2022, representing 24% of the total. Indonesia, Japan, Bangladesh, South Korea, the Philippines, Vietnam and Pakistan together added 12GW last year.

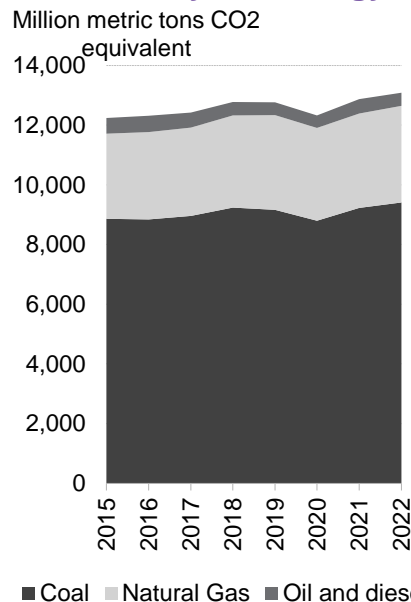
The Asia-Pacific region holds the biggest coal reserves in the world and was responsible for over 95% of global coal additions in 2022. Some 93% of additions between 2013 and 2022 also came from the APAC region.

Source: BloombergNEF. Note: The charts show gross capacity additions.

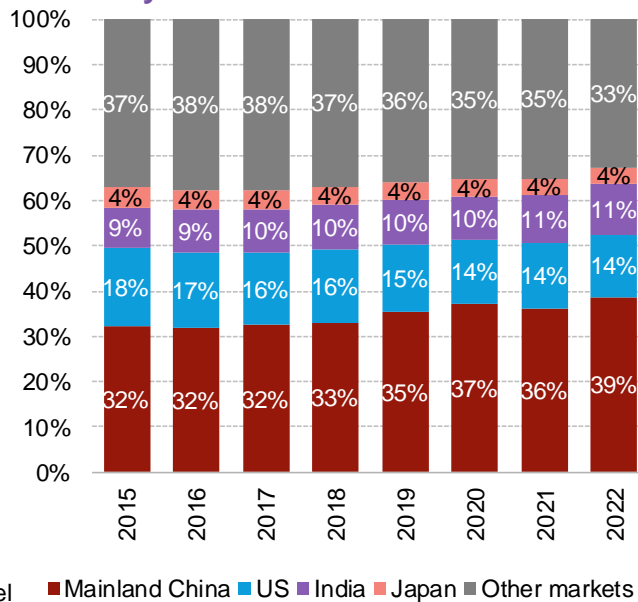


# Power sector emissions reached a record high in 2022

## Global power sector emissions by technology



## Global power sector emissions by economy



Power sector CO<sub>2</sub> emissions set a new record in 2022, at 13 billion metric tons of CO<sub>2</sub> (GtCO<sub>2</sub>). Emissions rose around 2% compared to 2021 levels, and over 4% from 2020. This was mainly due to the year-on-year jump in coal and natural gas generation once economies worldwide started to recover from the pandemic. Emissions from coal-fired power plants and natural gas rose 2% each in 2022 from the prior year. However, emissions from oil saw an 8% decrease compared to 2021, attributed to the spike in global petrol prices.

Mainland China, the US and India are responsible for 64% of global power sector emissions, largely due to their reliance on coal generation. Japan follows far behind, with 4%.

While emissions remained flat or slid slightly from 2021 to 2022 in absolute terms for most economies, mainland China saw a rise of 8.5% over 2021-22, compared to 1.6% over 2020-21. Since 2015, the economy has consistently raised its share of total global power sector emissions: in just five years, mainland China's power-sector emissions have soared 20%.

Source: BloombergNEF "New Energy Outlook 2022"



04.

# Transport trends

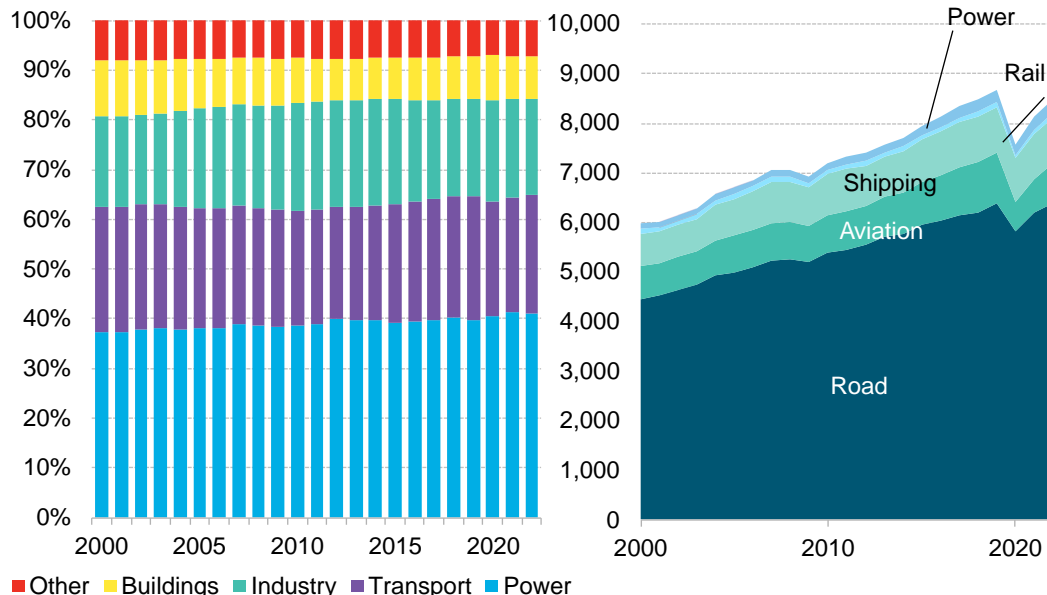
Strong growth, concentrated in wealthy markets

# One-quarter of global emissions come from the transport sector

Direct emissions in CO2 equivalent by sector

Transport emissions by subsector

Million metric tons of CO2 equivalent



Transportation accounted for 24% of the world's emissions in 2022 – second only to the power sector, which was responsible for 41%. Few developing markets have the infrastructure, incentives and policies to adequately support the scale-up of clean transportation.

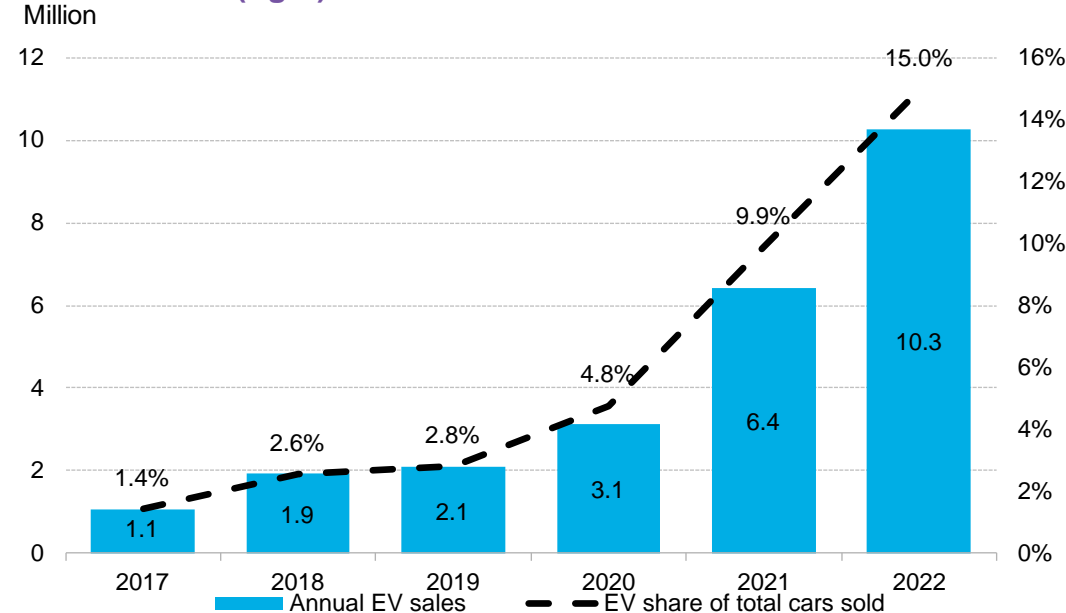
Within the sector, road transportation accounts for three-quarters of total emissions. Shipping and aviation come in a distant second and third place, while rail and transport-related power emissions account for the slim remainder.

Climatescope focuses on road transportation, especially passenger vehicles and buses, as most policy efforts related to electrifying transport have focused on this area to date.

Source: BloombergNEF, NEO 2022. 'Other' includes agriculture, forestry, fishing, energy industry own energy consumption, and other final energy consumption not further specified.

# Global EV sales topped 10 million for the first time in 2022

Global passenger EV sales (left axis) and share of passenger EVs in total car sales (right)



Global passenger EV sales hit 10.3 million in 2022, more than triple the number sold two years earlier. BNEF's *Electrified Transport Market Outlook* projects 2023 to be yet another record year with over 14 million vehicles sold in total.

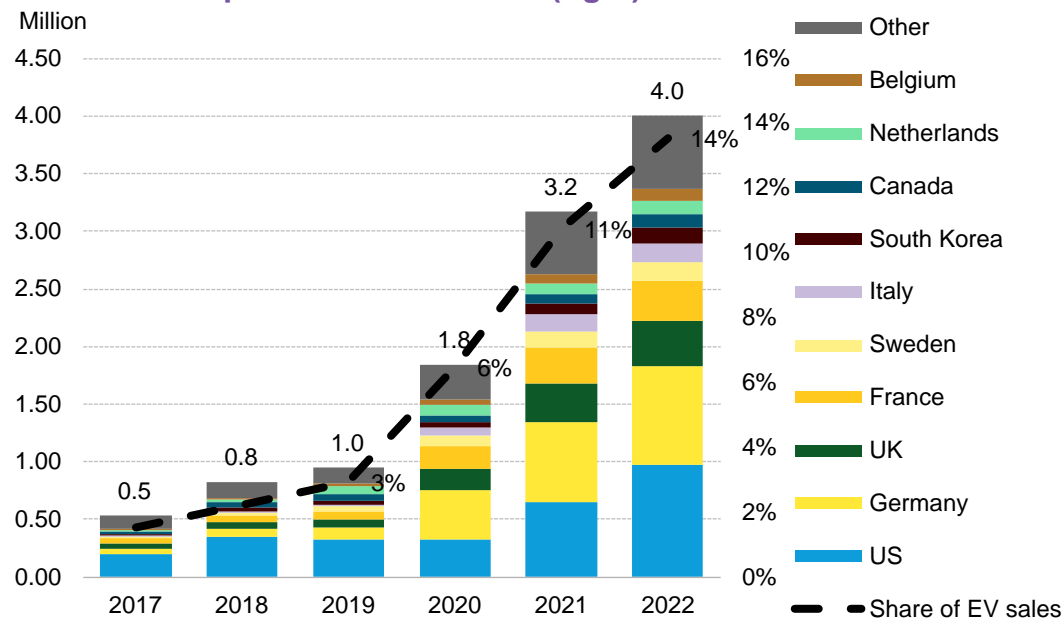
In six years, EV penetration in total passenger vehicle sales jumped 10-fold. EV sales accounted for 15% of global car sales in 2022, up from 1.4% in 2017.

Record-high EV sales in 2022 put a dent in the market for internal combustion engine (ICE) cars, although global vehicle demand continues to grow. According to BNEF's *Long-Term Electric Vehicle Outlook 2023*, annual passenger vehicle sales will peak at just over 100 million in 2037. Despite Russia's invasion of Ukraine, chip shortages and high inflation all putting additional pressure on an already strained automotive supply chain, the EV market shows no signs of plateauing. This growth is mainly attributed to mainland China's local-level subsidies, combustion vehicle restrictions, consumer demand and fleet operators.

Source: BloombergNEF. Note: Includes passenger battery-electric and plug-in hybrid vehicles. For more, see BNEF's *Electric Vehicle Outlook 2023*.

# Nearly 15% of all passenger vehicle sales in developed markets were EVs in 2022

EV sales in developed markets (left axis) and EV sales as a share of total developed-market car sales (right)



In developed markets, EV sales jumped 21% year-on-year, from 3.2 million in 2021 to 4 million in 2022. Sales have grown more than eightfold since 2017.

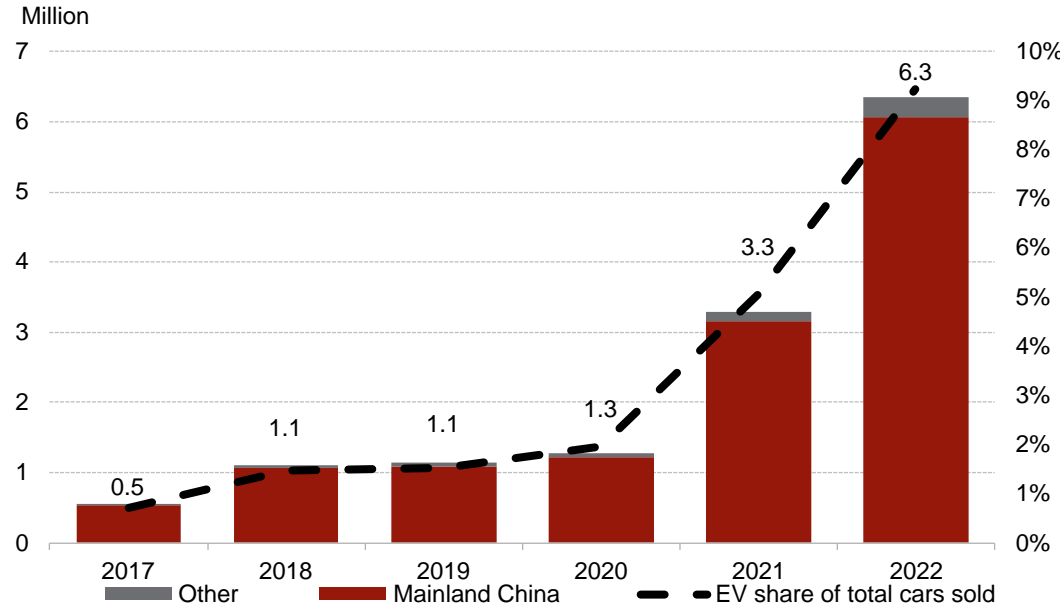
The US regained its position as the group's top market for EV sales in 2022, with over 970,000 EVs sold – a year-on-year growth rate of 49%. From 2019 to 2021, the crown was held by Germany, which saw sales jump sevenfold – to nearly 680,000 – in just two years. The US had previously been the largest developed market for EVs for at least a decade.

EVs reached over 14% of total car sales in developed markets in 2022. This was up from 10.7% in 2021 and just 1.5% in 2017.

Source: BloombergNEF. Note: Includes passenger battery-electric and plug-in hybrid vehicles. Developed markets include OECD countries minus Chile, Colombia, Costa Rica, Mexico and Turkey. 'Other' includes all other developed markets covered by Climatescope.

# China is home to 60% of global EV sales... and nearly 96% of EV sales among emerging markets

EV passenger vehicle sales in emerging markets (left axis) and EV share of total car sales in emerging markets (right)



Mainland China accounted for nearly 96% of EV sales in emerging markets in 2022, with 6.1 million vehicles sold.

Since 2017, the market has seen 13 million EV sales – significantly more than the combined totals of the top 10 developed electric-vehicle markets, which together posted a cumulative 9.5 million EV sales from 2017 to 2022.

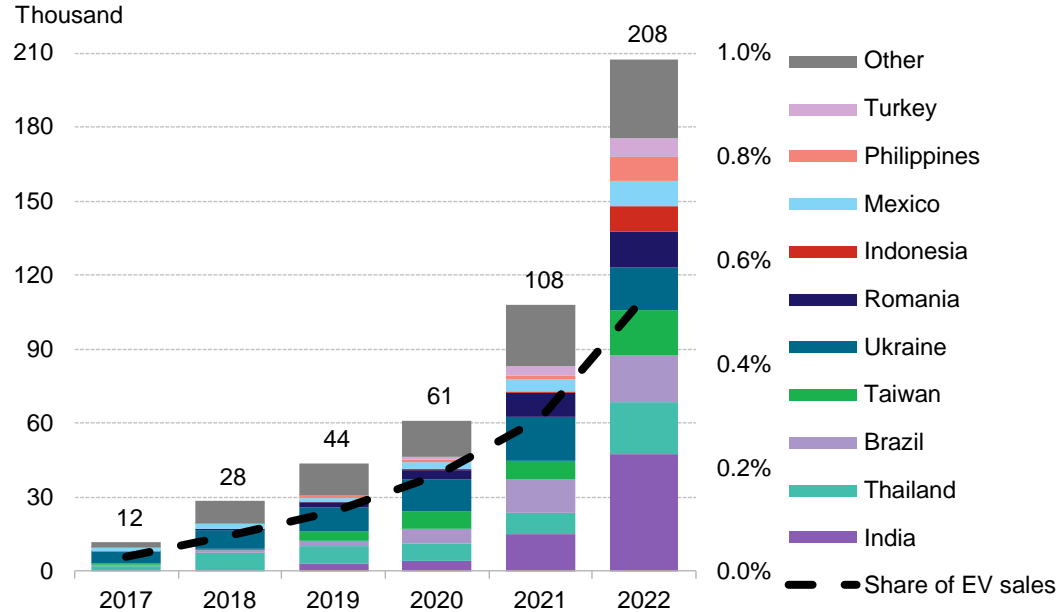
Mainland China drove global EV sales growth in 2022, accounting for 60% of global sales. EV sales in the market nearly doubled year-on-year.

Other emerging markets represent a tiny share of total global EV sales, but their progress should not be overlooked. In 2021, these markets accounted for nearly 3% of global EV sales and 4.3% of sales among emerging markets. However, the number of units sold in these markets nearly doubled each year from 2020 to 2022.

Source: BloombergNEF. Note: Includes passenger battery-electric and plug-in hybrid vehicles. Developed markets include OECD countries minus Chile, Colombia, Costa Rica, Mexico and Turkey. 'Other' includes all other developing markets covered by Climatescope.

# EV sales in emerging markets ex-mainland China also spiked in 2022

EV sales in emerging markets (left axis) and EV share of total emerging markets car sales (right), both excluding mainland China



Emerging markets (excluding mainland China) saw steep EV sales growth from 2021 to 2022, nearly doubling to reach a combined 208,000 units. Sales spiked 71% from 2020 and have grown over 17 times since 2017, though the overall figures remain small.

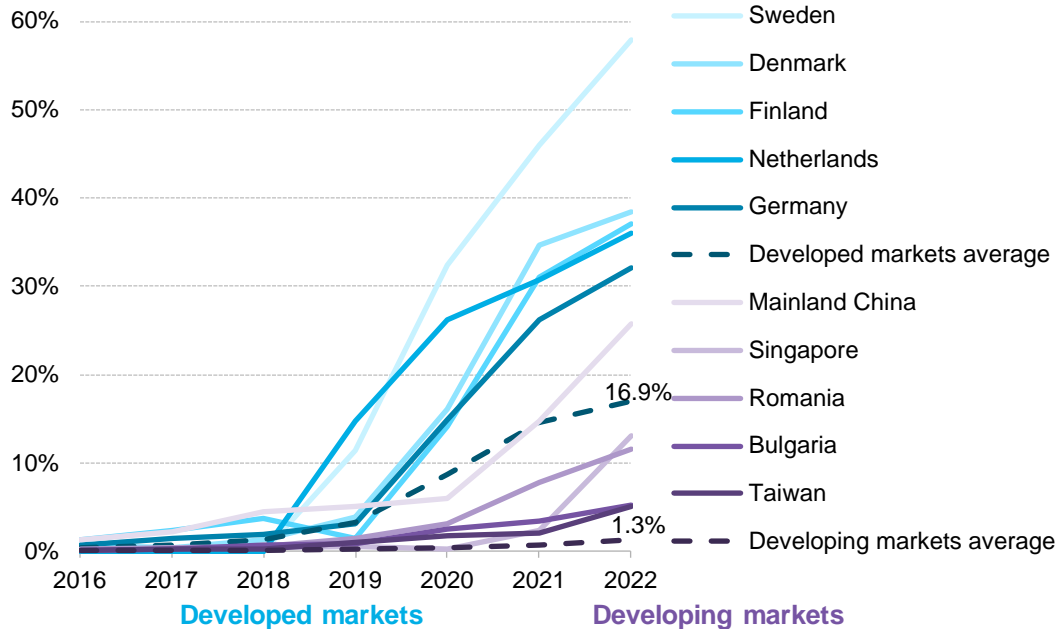
Excluding mainland China, India, Thailand and Brazil were the biggest sources of EV demand among developing markets in 2022. Together, these three accounted for over 40% of emerging-market EV sales.

Despite the strong growth, EVs were just 0.5% of emerging markets' total car sales in 2022. This was up from 0.1% in 2019 and nearly nothing in 2017.

Source: BloombergNEF. Note: Includes passenger battery-electric and plug-in hybrid vehicles. Developed markets include OECD countries minus Chile, Colombia, Costa Rica, Mexico and Turkey. 'Other' includes all other developing markets covered by Climatescope.

# The EV adoption gap between developed and developing markets is wide

## EVs' share of total national sales in the top five developed and developing markets



Among the top five developed markets for EV adoption, the share of EVs in overall sales in 2022 averaged 40%. Among the top five emerging markets with the highest sales rates, the average is 12%. Yet EV activity is gearing up in these emerging markets, driven in part by improvements in policies and tax incentives.

**Many barriers hinder EV growth in emerging markets.** Inadequate regulatory support, lack of EV models, high upfront costs, the popularity of used cars and sparse charging infrastructure are all to blame.

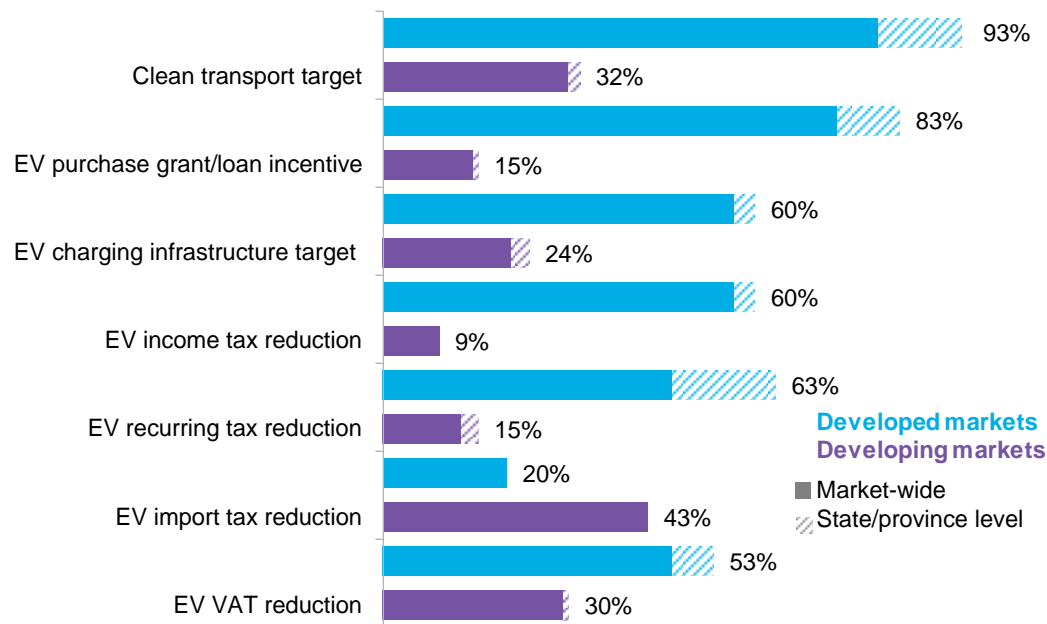
On average, developed markets' EV share of sales was nearly 17%, 17 times higher than the figure registered for emerging economies. Despite the huge gap between those numbers, both developed and developing markets are progressing at roughly the same rate, with average EV share of total sales growing 40-fold in both cases since 2016.

Source: BloombergNEF. Note: Includes passenger battery-electric and plug-in hybrid vehicles.



# Import tax exemption for EVs is the most popular policy in emerging markets

Share of Climatescope markets with clean-transport policies in place



Clean-transport policies are coming into force in more emerging economies every year, but the gap between developed and developing markets remains wide. Some 93% of developed markets surveyed by Climatescope have clean transport targets on the books. In emerging markets, the total is just 32%, although this represents a 10-percentage-point increase over last year's figure.

Direct purchase incentives, which lower the upfront costs of buying EVs, are effective at kick-starting markets, but are still limited to a small share of developing economies. Such subsidies are expensive for governments and thus harder to introduce. They typically include EV purchase incentives, and income/import tax reductions.

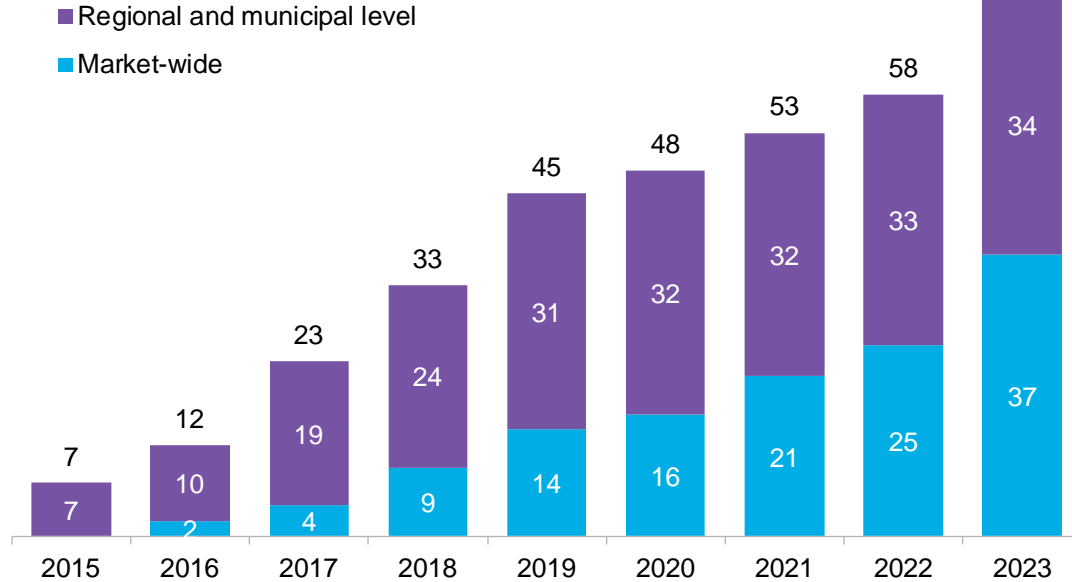
Import tax incentives are the first to be embraced by emerging markets. Duty taxes in emerging markets usually hold a considerable share of the final cost for consumers, as most of these markets are not vehicle makers and have to import them.

Source: BloombergNEF, Climatescope. Note: Tax reduction incentives include tax exemptions. Developed markets include OECD economies minus Chile, Colombia, Costa Rica, Mexico and Turkey. Developing markets include all other economies. VAT is value-added tax.

# More markets than ever are implementing internal combustion engine phase-outs

## ICE phase-out targets by market

Cumulative number



Source: BloombergNEF. Note: Data as of July 2023. Graph considers only markets covered by Climatescope.

Some 37 central governments have set dates to eliminate sales of internal combustion engine (ICE) vehicles. Another 34 regional and municipal authorities have such goals in force. The European Commission's proposal to phase out ICE vehicle sales in the EU by 2035 adds another 11 markets to the former list.

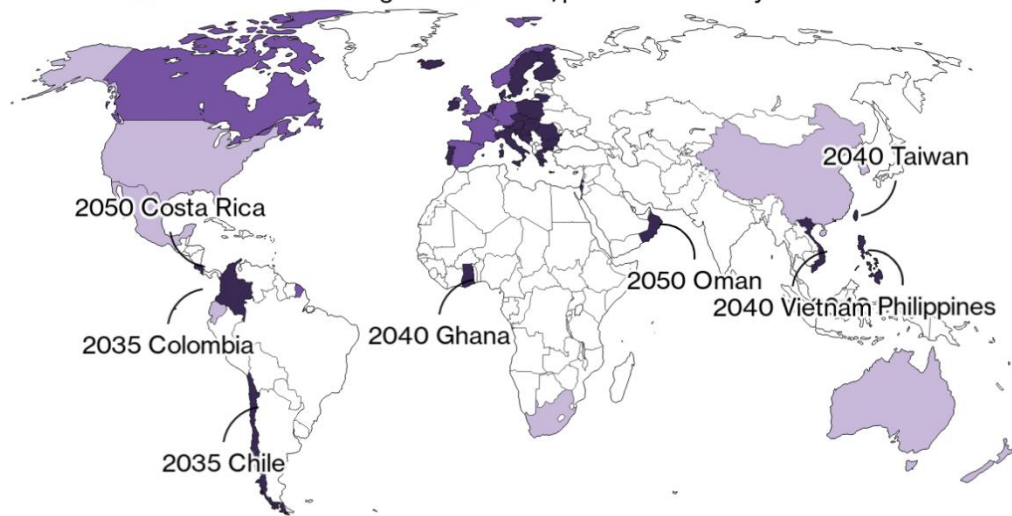
**Regional and state-level ICE phase-out targets matter.** Even targets that affect smaller geographical regions can signal to automakers and consumers the need to shift to zero-emission vehicles, especially in areas where market-wide mandates have yet to be implemented.

**Progress in setting ICE phase-out targets is slow in emerging markets.** Of the five emerging markets with the biggest vehicle fleets – mainland China, India, Brazil, Mexico and Thailand, which together represented nearly 45% of global passenger vehicle sales in 2022 – only Mexico has an ICE phase-out on the books. This policy applies only to Mexico City, and it aims to ban ICE vehicles in 2040.

# Thirteen emerging markets have set ICE vehicle phase-out targets

## ICE vehicle phase-out targets by market

■ Market-wide ■ Market-wide and regional ■ State/province level only



Chile, Colombia, Costa Rica, Ghana, Oman, Philippines, Taiwan and Vietnam are some of the emerging markets that have recently set ICE phase-out targets.

Chile and Colombia aim to reach 100% EV sales by 2035.

Costa Rica is targeting 100% zero-emission vehicle sales by 2050.

Vietnam, the Philippines, Taiwan and Ghana have set targets to phase out ICEs by 2040.

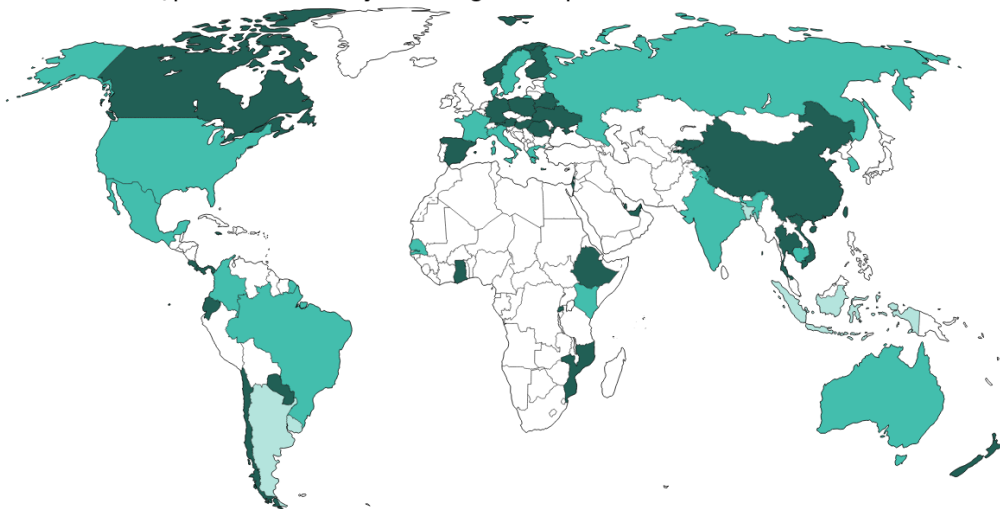
Oman is the latest addition to this list, having this year introduced a target to phase out ICEs by 2050.

Source: BloombergNEF. Note: Climatescope surveys 110 emerging markets. Mapped data show target type for distinct economies. Data as of July 2023. Represented on the map are all markets with national or regional targets, with emerging markets highlighted with the legend.

# Mainland China leads the push to electrify public transport

## E-bus targets in force by market

■ In force ■ State/province level only ■ In legislative process



Among the 35 economies that have set market-level targets to expand e-bus adoption, 21 are emerging markets. An additional 16 markets have regional or provincial targets on the books.

Global e-bus sales are growing briskly, largely thanks to mainland China. E-buses accounted for 40% of all new bus sales globally in 2022, according to BNEF's *Long-Term Electric Vehicle Outlook 2023*.

E-bus sales are also growing in Latin America and elsewhere in the Asia-Pacific region. Chile and Colombia combined accounted for 98% of Latin America's e-bus sales and 2% of global sales in 2022. India and South Korea are Asia-Pacific's second- and third-largest markets, respectively, both trailing well behind mainland China.

Source: BloombergNEF. Note: Mapped data show target type for distinct economies. Data as of July 2023. Represented on the map are all geographies with market-level or regional targets. For more, see BNEF's *Electric Vehicle Outlook 2023*.



05.

# Electrified heating

A year of stalled sales growth for heat pumps

60 November 29, 2023

# Markets with cold climates have substantial heating needs

## Markets covered by Climatescope's buildings sector report

■ Covered by Climatescope - Building Sector



Generating heat for buildings represents a major source of energy demand in 'cold' markets, or those with annual average annual temperatures below 54F/12C.\*

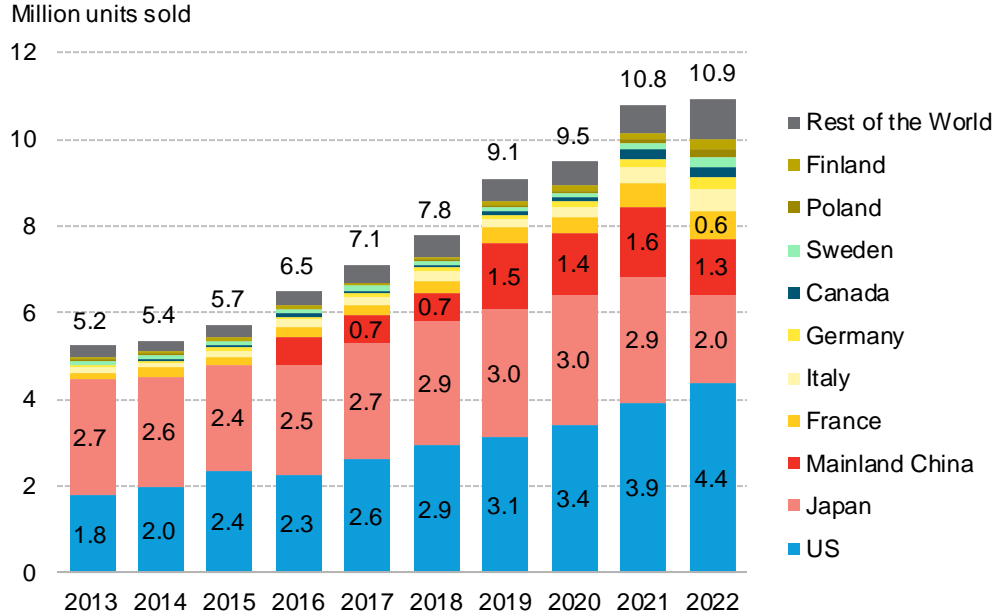
Decarbonizing heat in these geographies could substantially lower global greenhouse gas emissions.

The Climatescope report only assesses heating data and policies in these designated 'heating markets', which number 29 in this year's edition of the report. Markets with warm or hot climates are excluded from this section, as are markets where heating data is unavailable.

Source: BloombergNEF. Note: \*Heating needs based on 'heating degree days' data, which are based on temperatures and the number of days with average temperatures below 62F (17C).

# The shift to cleaner heating sources has yet to get on track

## Heat pump sales by market



Source: BloombergNEF. Note: Data for Mainland China only available from 2016.

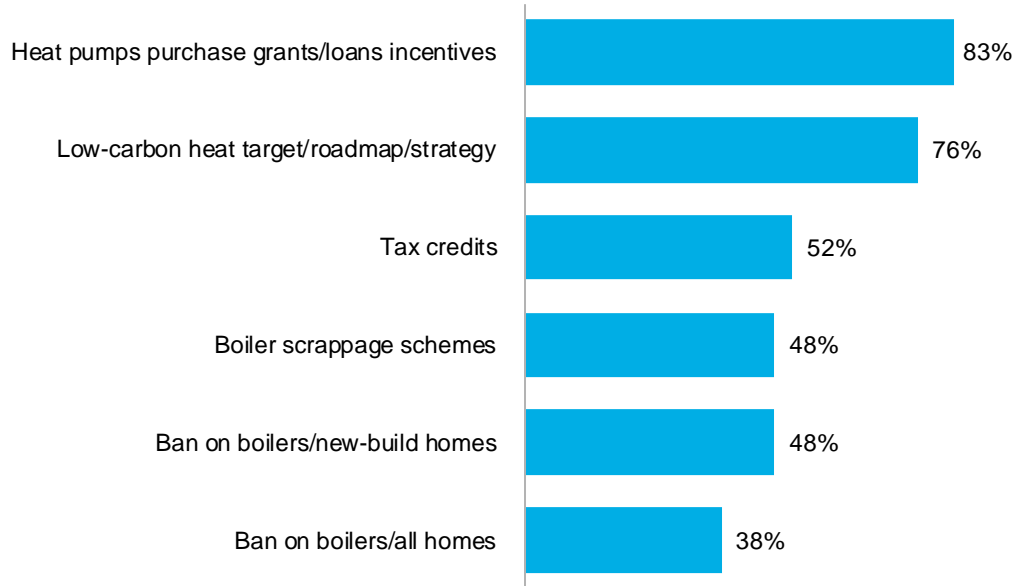
Even though the popularity of electrified heat has grown over the past decade as countries seek lower-carbon solutions for boosting building temperatures, heat pump sales in 2022 stalled compared to the year prior. Heat pump sales rose only 1% from 2021 to 2022, to reach to 11 million units sold. That's 7 percentage points less than the average compound annual growth rate (CAGR) since 2012. In addition, heat pumps remain concentrated in just five markets – the US, Japan, mainland China, France and Italy – which together accounted for 81% of 2022 sales.

Gas heating is typically cheaper than heat pumps for European households. However, the recent global energy crisis and subsequent volatility in electricity and gas prices have boosted heat pump sales, as have targeted subsidies.

When compared to traditional electric heaters, heat pump uptake usually leads to reduced energy consumption, as the technology produces two to three times more heat using the same amount of electricity.

# Heat pump incentives and low-carbon heat targets are the most popular policies surveyed

Share of Climatescope markets with a clean buildings policy in place



Heat pump purchase incentives are present in 24 of the markets surveyed, making them the most popular such policy on the books. Low-carbon heat targets or roadmaps, which are in place in 76% of covered markets, are a close second. Tax credits and boiler scrappage are also relatively popular, with roughly 50% of markets using these to support heat pump adoption.

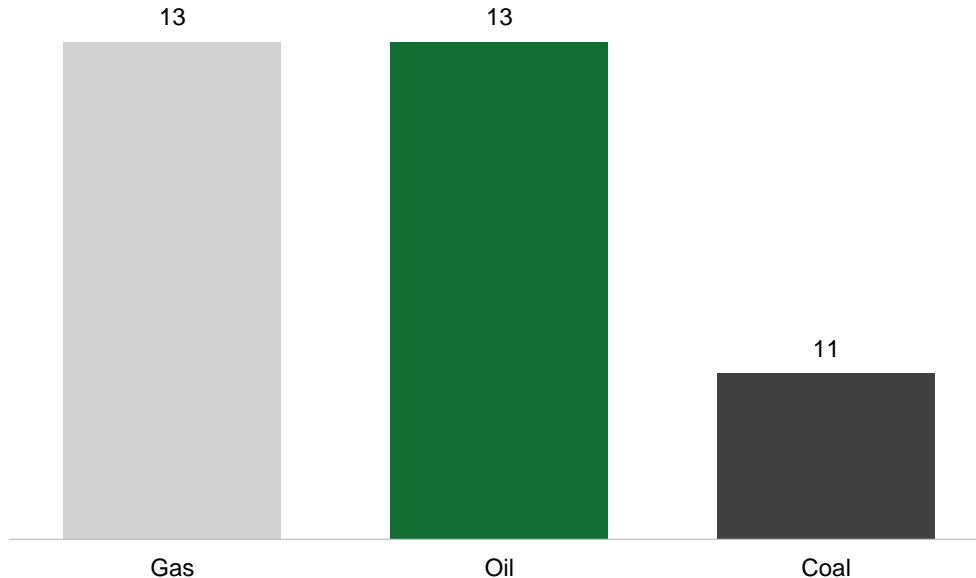
Government bans on the purchase of certain boilers have also grown in recent years. No fewer than 15 countries have announced bans set to be in force by 2030. However, due to high upfront costs, heat pump demand remains quite dependent on subsidies or other consumer-support mechanisms, and in many markets the technology still struggles to compete with gas-fired boilers.

Source: BloombergNEF



# Governments lean on boiler bans in new homes

## Markets with boiler bans in force, by technology type



Source: BloombergNEF. Note: Countries with bans planned in more than one technology are counted twice.

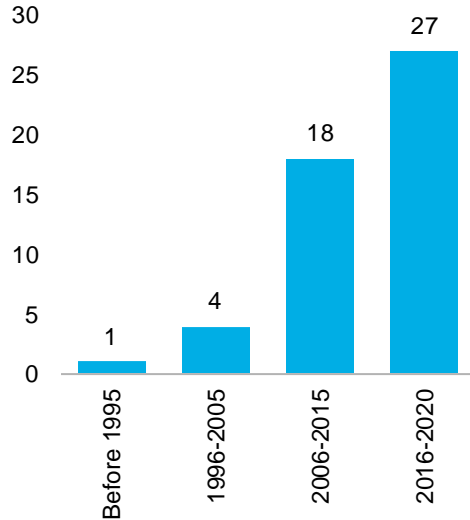
Government bans on the purchase of certain types of boilers have increased in recent years. Out of the 29 markets surveyed by Climatescope, 15 have legislated bans on boilers for one or more type of fuel.

Bans on boilers are somewhat balanced among the different technologies. Thirteen markets have bans on gas and oil boilers scheduled to come into force in or before 2030, while eleven markets plan coal boiler bans by then. These bans are typically guided by a combination of cost and environmental factors, including goals to phase out fossil-fuel-intensive heating systems.

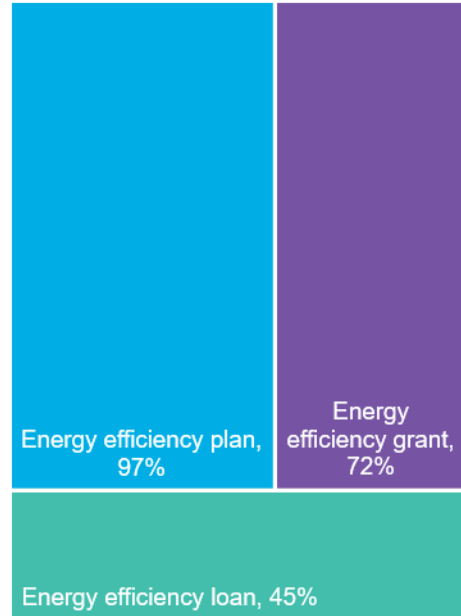
In 14 of the markets surveyed, boiler bans affect only new buildings, exempting most of the existing housing stock, while 11 markets have announced bans that will apply to all existing homes.

# An enabling environment is necessary for smoothing the transition to clean heating

Number of markets with energy performance standards in force



Energy efficiency measures



Energy efficiency measures and performance standards are conventional steps for transitioning to a cleaner building environment. These standards determine a maximum acceptable level for buildings' final energy use. Where such policies are in place, building assessments, conducted by verified assessors at a set frequency, are usually mandatory. While performance standards are not new, they are becoming much more common, especially for newly built structures. Out of the 29 markets surveyed, only 18 had a standard in force in or before 2015; five years later, that number had risen to 27.

Energy efficiency strategies and financial incentives help move a market's building stock toward better efficiency ratings. These strategies typically include policy support for improving insulation and draft-proofing, upgrading or changing to more efficient types of heating and fitting new heat controls, among other measures. While 97% of the surveyed markets have energy efficiency ambitions, just 72% actually provide grants to support them. Loans are an even less common option, with only 45% of markets using this approach.

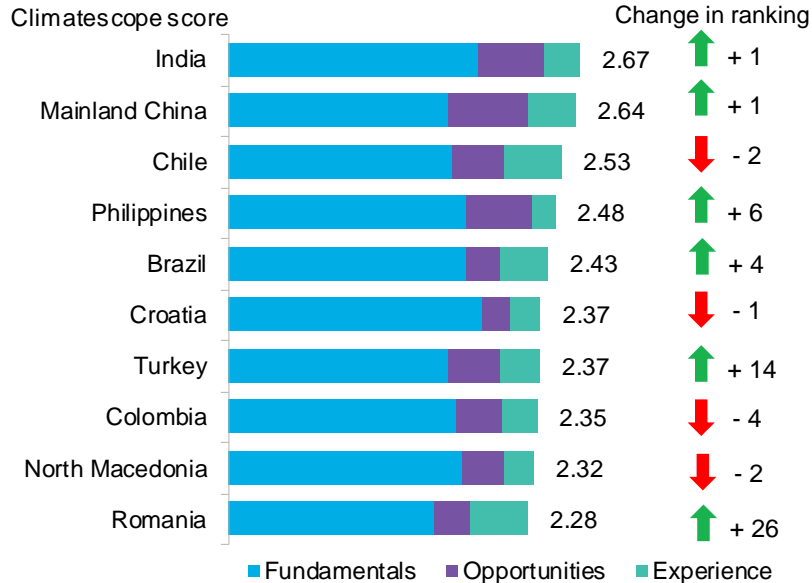
Source: BloombergNEF



# 06. Results: Power sector

# India is the most attractive emerging market for investment in the power sector

## Top 10 emerging markets in the power sector, by Climatescope score

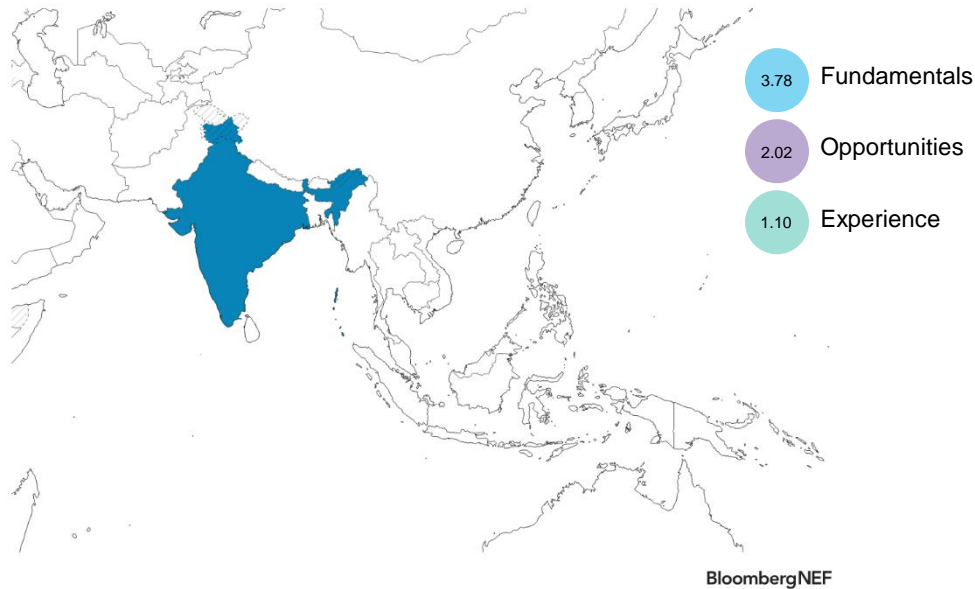


Climatescope considers over 100 indicators across three parameters – *fundamentals*, *opportunities* and *experience* – to assess markets’ relative attractiveness for renewable energy investment. We then use these indicators to generate composite overall scores for each of the 140 markets surveyed. These key topic areas encompass each market’s previous accomplishments, as well as the current environment and future opportunities for investment. The 2023 edition of Climatescope covers 110 emerging markets and 30 developed economies – the highest count yet.

Since 2018, India, mainland China and Chile have consistently stood atop the podium, although their precise ranking has varied. The trend continues in 2023, when India tops the ranking, followed by mainland China, Chile, the Philippines and Brazil.

Source: BloombergNEF. Note: Maximum score is 5. Fundamentals, opportunities and experience are the parameters that add up to a market’s overall score for clean power. Between them, the parameters encompass over 100 indicators, or individual data inputs collected by Climatescope researchers.

# 1. India



India's ambitious policy framework and extremely competitive renewable energy market pushed it to the top of the podium this year. India boasts the largest and most competitive auctions in the world, as well as one of the world's highest renewable energy targets: 175GW by March 2022, and 500GW by 2030. As of year-end 2022, installed renewables capacity had reached 140GW – made up of 78GW of solar, 41GW of wind and 21GW from other clean sources excluding large hydro – or 80% of the 175GW goal. Since 2017, capacity additions from renewables have exceeded those of coal.

India's position in the Climatescope ranking mainly reflects its fundamentals. Since 2012, it has implemented specific and efficient policies such as auctions, renewable energy targets and feed-in tariffs. These transparent mechanisms and ambitious government targets have attracted many domestic and foreign players, garnering around \$47 billion in clean energy investment over the past five years.

Source: BloombergNEF. Note: Investment figures include small-scale PV.

## 2. Mainland China



Mainland China continues to play a key role in the global clean energy story, receiving a top-five Climatescope score for each of the past four years. While it comes in second overall this year, it boasts the top score for Opportunities, a reflection of its massive potential for growth. We expect that by 2030, 35% of the world's installed solar capacity and 50% of wind will have originated in the Asian giant. At the end of 2022, mainland China had 440GW of solar and 393GW of wind online, representing 33% of total installed capacity.

However, coal still dominates mainland China's power system and accounted for nearly 44% of total installed capacity in 2022. Currently, 64% of the market's generation comes from thermal sources, with coal alone accounting for almost 60% of that figure.

Mainland China attracted 78% of emerging markets' clean energy asset investment last year. Among top five markets on the Climatescope ranking, Mainland China attracted almost seven times as much as the four other markets together.

Source: BloombergNEF. Note: Investment figures include small-scale PV.

# 3. Chile



BloombergNEF



Chile's well-established clean energy policies, bold targets and overall commitment to greening its grid all contributed to its third-place finish. Moreover, significant volumes of renewable energy investment have helped make Chile attractive to clean energy investors.

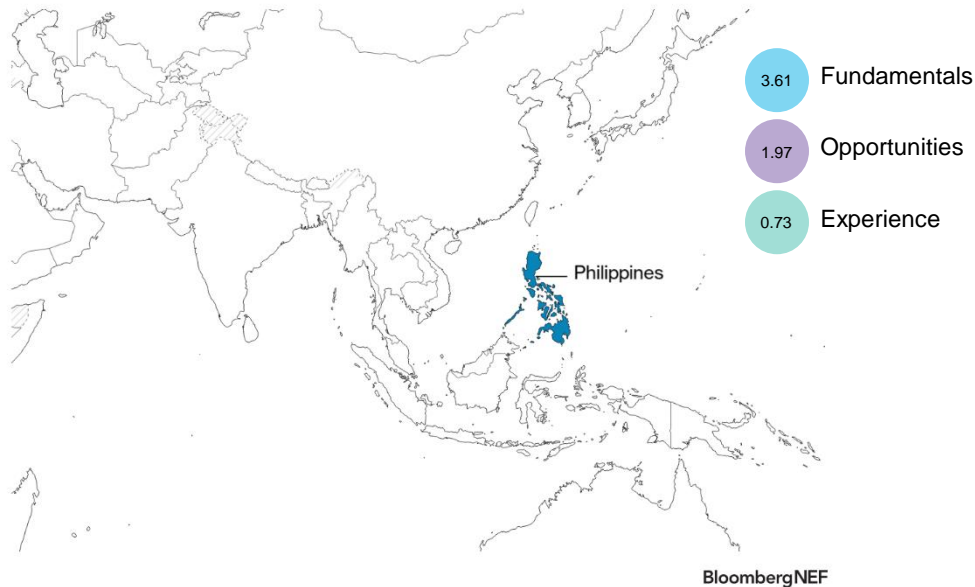
The market has a goal of reaching 60% clean power generation by 2035 and 70% by 2050. While 44% of Chile's generation currently comes from thermal sources, the market has committed to shuttering 1.7GW of coal-fired power by 2024 and completely phasing out coal by 2040.

At the end of 2022, Chile had 7.3GW of solar and 3.9GW of wind online, representing 35% of its total installed capacity.

Chile has attracted around \$16 billion of clean energy investment over the past five years. This is mainly due to its well-structured power sector, which allows developers to sign bilateral contracts with large customers outside the regulated market, among other benefits.

Source: BloombergNEF. Note: Investment figures include small-scale PV.

# 4. Philippines



Over the past two years, the Philippines' significant progress in transitioning to renewable energy propelled the market into Climatescope's top five. The market stands out as one of the few that have implemented auctions, feed-in tariffs, net-metering schemes, tax incentives and a strong target for renewable energy. In its second green energy auction, the Philippines awarded 3.4GW of renewable capacity out of the 11.6GW offered. From this, 1.2GW is earmarked for 2024-25 and will target ground-mounted and rooftop solar and onshore wind, and 2.2GW is earmarked for 2026. Currently, around 18% of the market's total installed capacity comes from renewables, with wind accounting for 8%.

The Philippines' release of an offshore wind roadmap and no foreign ownership restrictions have encouraged growth in offshore wind investment. The market's clean energy investment grew 41% from 2021 to 2022, to reach \$1.34 billion.

Source: BloombergNEF. Note: Investment figures include small-scale PV.



# 5. Brazil



BloombergNEF



After a two-year absence, Brazil has returned to the top five emerging markets in the Climatescope ranking. The small-scale segment is the main driver of clean energy deployment in the market, adding a remarkable 10.7GW in 2022 to bring cumulative small-scale capacity to 23GW.

Brazil added a record 6.2GW of utility-scale solar and wind capacity in 2022, up 10% from the year prior. Moreover, clean energy investment grew from \$14 billion in 2021 to almost \$25 billion – or 81% of Latin America’s total – in 2022.

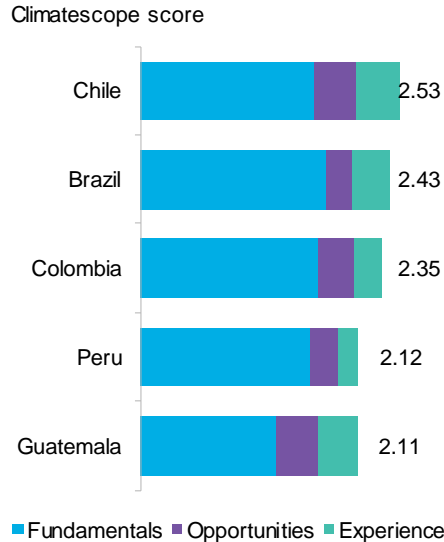
Brazil has the cleanest electricity matrix among G-20 economies, and one of the largest fundamentals scores amid emerging markets, due to generous net-metering legislation and a pioneering renewables auction scheme.

Brazil’s renewable energy success was further enabled by consistent investment in grid infrastructure and an active role from national development banks.

Source: BloombergNEF. Note: Investment figures include small-scale PV.

# The top five Latin American markets all feature in the top 20 emerging economies worldwide

## Climatescope scores of top five emerging markets in Latin America



Chile, Brazil, Colombia, Peru and Guatemala are the most attractive countries for renewable energy investment in Latin America, according to the Climatescope survey.

These five are all among the 20 most attractive markets for clean energy investment worldwide, out of 110 emerging markets surveyed. One common factor is that all of them have well-established and effective policies, in addition to structured power sectors open to private investors.

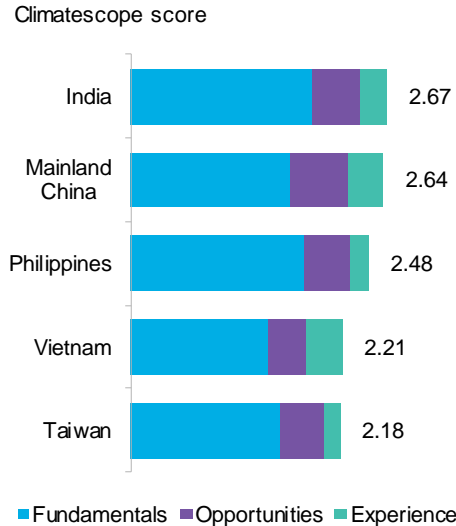
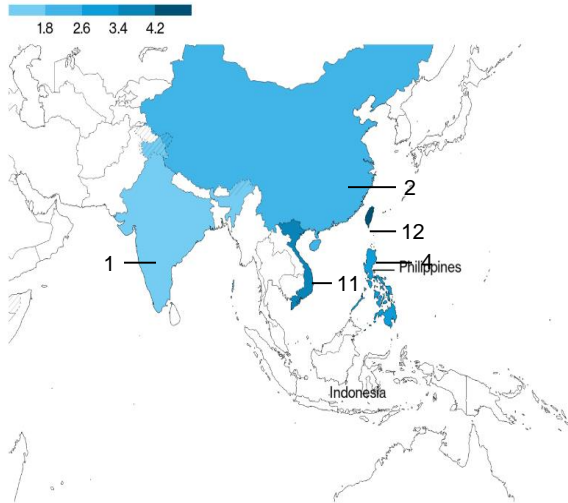
Latin America accounted for 8% of emerging markets' clean energy investment in 2022, or \$30.5 billion. The region saw its investment in renewables jump \$9 billion from 2021 to 2022, mainly due to Brazil, which attracted 81% of the region's total. Chile followed with \$1.6 billion, and Colombia accounted for \$1.2 billion.

Solar power has been skyrocketing in the region since 2016, and the technology attracted a record 59% of total new clean energy investment in 2022. This is mainly due to the strong net-metering and auctions policies that most of the region's markets have in place

Source: BloombergNEF. Note: Map shows the overall position in the Climatescope ranking among emerging markets.

# Asian markets raised their climate ambitions

## Climatescope scores of top five emerging markets in Asia-Pacific



Asia-Pacific economies dominate the top 15 emerging markets in the Climatescope 2023 ranking, with India, mainland China, the Philippines, Vietnam, Taiwan and Kazakhstan all appearing in this upper echelon. The region is home to 4.1 terawatts (TW) – or nearly 50% – of the world’s total installed capacity, with renewables accounting for 1.2TW in 2022. The top five Asian markets account for 82% of the region’s total capacity.

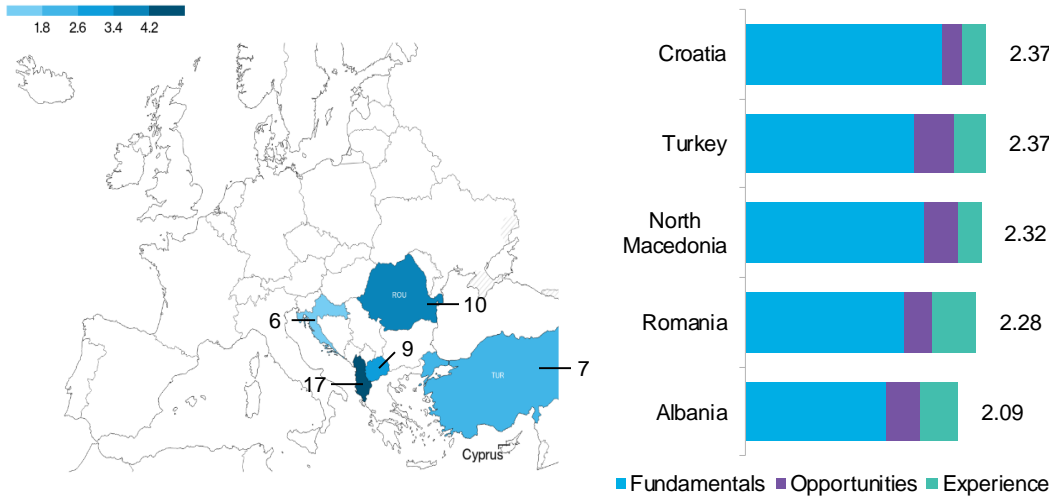
Asian governments raised their climate ambitions in 2022, with more funding and new schemes for renewables. For the first time, all Asian markets had established renewable energy targets last year. Vietnam, for example, is set to surpass Indonesia to become Southeast Asia’s leader in renewables capacity. In 2021, Vietnam’s prime announced a 2050 net-zero target at COP26 that remains the most advanced climate commitment in Southeast Asia.

In 2022, the region attracted \$319 billion, or 86% of emerging markets’ renewables investment. Just five Asia-Pacific markets accounted for 98% of the region’s total. Excluding mainland China, the top markets attracted just \$20 billion, more than half of which went to India.

Source: BloombergNEF. Note: Map shows the overall position in the Climatescope ranking among emerging markets.

# Strong policies create an enabling environment for renewables in Europe

## Climatescope scores of top five emerging markets in Europe



Source: BloombergNEF. Note: Map shows the overall position in the Climatescope ranking among emerging markets.

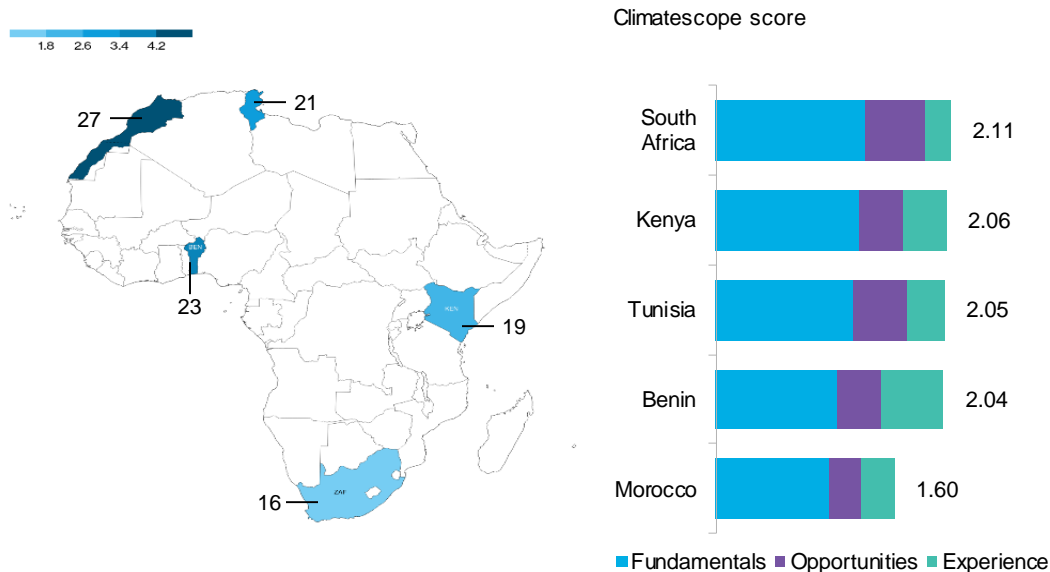
Croatia, Turkey, North Macedonia and Romania rank among the top 10 emerging markets overall. European markets reveal the importance of establishing solid policies for encouraging renewables development. As a result, Europe boasts the highest average Fundamentals among all regions, at 2.77, compared with 2.35 globally.

Europe's developing economies boast 20% of the global share of installed capacity among emerging markets. Of this, 14% comes from clean energy sources, having increased to 66GW in 2022 from 41GW in 2018.

Emerging markets in Europe attracted \$7.3 billion in renewable energy investment in 2022, the lowest level since 2016. Russia used to attract the biggest share of investment among Europe's emerging markets, but clean energy investments in Russia have fallen since 2018, and the Russia-Ukraine conflict has dragged them down even further.

# A lack of efficient policies and reliable power markets penalizes the African continent

## Climatescope scores of top five markets in Africa



Source: BloombergNEF. Note: Map shows the overall position in the Climatescope ranking among emerging markets.

South Africa, Kenya, Tunisia, Benin and Morocco are the top five most attractive markets for renewable energy investment in Africa, under Climatescope's scoring.

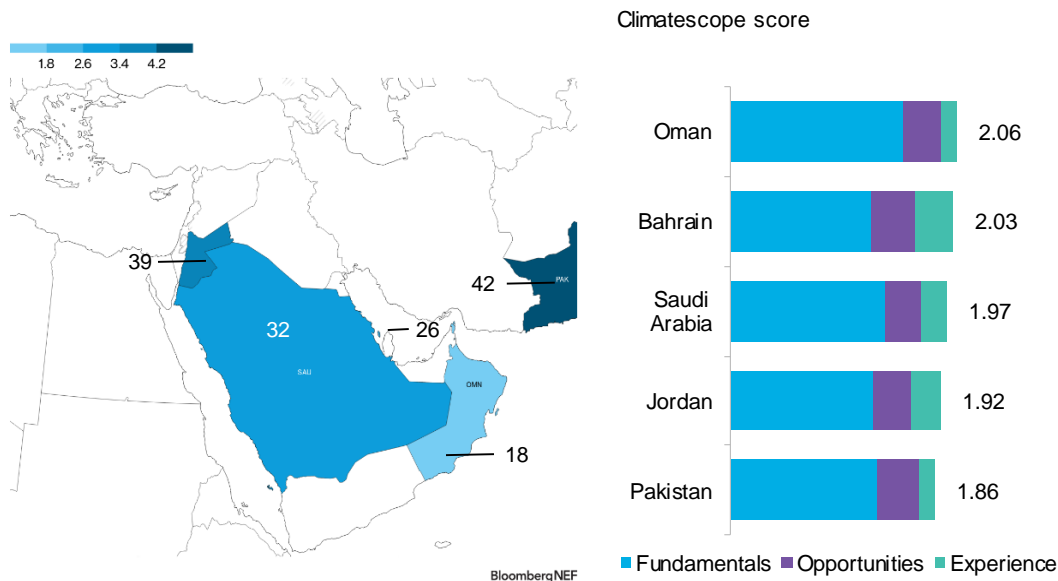
Despite encompassing the largest number of emerging markets within a region, Africa has no entries among the top 15. This is mainly due to the lack of supportive policies and well-structured, reliable power markets.

However, the region still boasts the highest scores for the Opportunities parameter, with four of the top 10 markets by this ranking. With 63% of Africa's installed capacity coming from fossil fuels, the continent has a long way to go to transition to a cleaner economy. Coal alone accounts for more than half of the continent's electricity generation, although coal generation decreased 11% from 2018 to 2022.

In 2022 the region attracted \$10.1 billion, compared to just \$4.5 billion in 2021. Yet African markets attracted only 3% of emerging markets' renewable energy investment in 2022, with South Africa accounting for 55% of the region's total.

# The Mideast's fossil fuel surplus slows renewables growth

## Climatescope scores of top five markets in the Middle East



Source: BloombergNEF. Note: Map shows the overall position in the Climatescope ranking among emerging markets.

Only one Middle Eastern market – 18th-place Oman – figures among the top 20 Climatescope scores for emerging markets, as the region struggles to change its fossil fuel reserves into renewables. Building thermal power plants in the Middle East remains far cheaper than building renewables, meaning the region would have to invest massively to transition to a cleaner economy. The Middle East also has the lowest average electricity prices in the world, further hindering the deployment of renewables projects. However, this picture is slowly changing, as countries set ambitious targets for renewable energy.

Despite bold targets and new policies, the region saw renewable energy investment fall from 2021 to 2022. In 2022 the region attracted just \$4.3 billion, compared to \$5.6 billion in 2021.

The United Arab Emirates and Jordan both saw a boom in renewables investment in the past years, but that has now stalled. Since 2019, the lack of new auction rounds and small clean energy capacity additions have stood between these markets and their clean energy targets, slowing down the energy transition.

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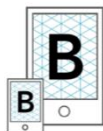
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