International Energy Agency

Renewable Energy Market Update

Outlook for 2021 and 2022

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Abstract

Renewables were the only energy source for which demand increased in 2020 despite the pandemic, while consumption of all other fuels declined. Will renewable energy source uptake therefore expand more quickly as the global economy recovers from the crisis? In exploring recent market and policy developments, the Renewable Energy Market Update forecasts new global renewable power capacity additions for 2021 and 2022. It also provides updated biofuel production forecasts for these years, as the sector suffered significant losses with declining transport demand during the pandemic.

Acknowledgements

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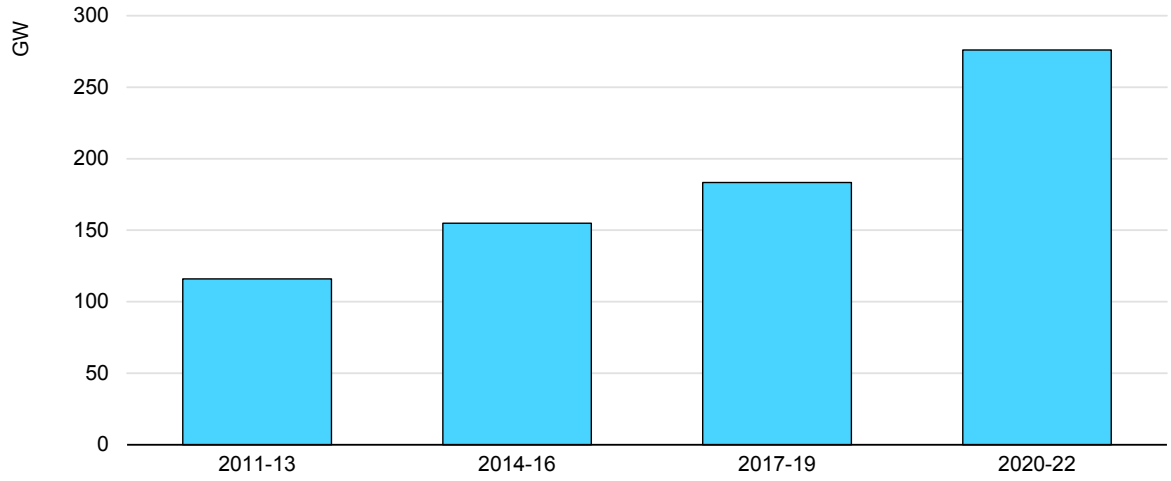
Kristine Douaud carried editorial responsibility.

Highlights

- In 2020, annual renewable capacity additions increased 45% to almost 280 GW – the highest year-on year increase since 1999.
- Exceptionally high capacity additions become the “new normal” in 2021 and 2022, with renewables accounting for 90% of new power capacity expansion globally.

Average annual net renewable capacity additions, 2011-2022



- Solar PV development will continue to break records, with annual additions reaching 162 GW by 2022 – almost 50% higher than the pre-pandemic level of 2019.
- Global wind capacity additions increased more than 90% in 2020 to reach 114 GW. While the pace of annual market growth slows in 2021 and 2022, it is still 50% higher than the 2017-2019 average.
- Annual growth in the People’s Republic of China’s (hereafter, “China”) renewables market will decelerate following the exceptional expansion that resulted from developers rushing to complete projects before subsidy phase-outs. However, the rest of the world compensates for China’s slowdown and maintains the pace of renewables expansion.
- Europe’s capacity growth accelerates thanks to further policy support and a booming corporate PPA market as PV costs continue to decline.
- The updated forecast for the United States is more optimistic because of federal tax credit extensions. New US emissions reduction targets and the infrastructure bill, if passed, will boost renewables expansion after 2022 (beyond the timeframe of this forecast update).

- Although India's capacity additions in 2020 declined almost over 50% from 2019, the country is expected to set new records for renewables expansion in 2021 and 2022 as delayed projects from previous competitive auctions are commissioned. However, the current (April 2021) surge in Covid-19 cases has created short-term forecast uncertainty for this year.
- Transport biofuel production is expected to rebound to 2019 volumes in 2021, after having fallen 8% in 2020. Production is also forecast to expand another 7% in 2022.
- Mainly driven by clean fuel standards and policy support in the US, global Hydrotreated Vegetal Oil (HVO) production capacity is expected to nearly double in the next two years, significantly expanding the capability of producing biofuels from waste and residue feedstocks.

Renewable electricity

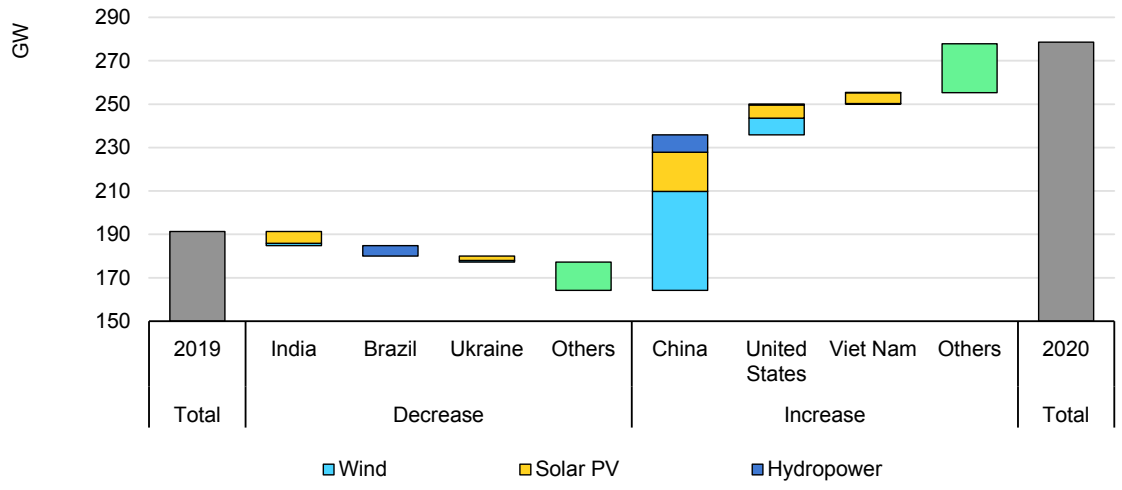
A quick look back at 2020

Policy deadlines in key markets propelled global renewable capacity additions to almost 280 GW in 2020, the highest year-on-year increase in the last two decades

Despite pandemic-induced supply chain challenges and construction delays, renewable capacity additions in 2020 expanded by more than 45% from 2019, and broke another record. An exceptional 90% rise in global wind capacity additions led the expansion. Also underpinning this record growth was the 23% expansion of new solar PV installations to almost 135 GW in 2020.

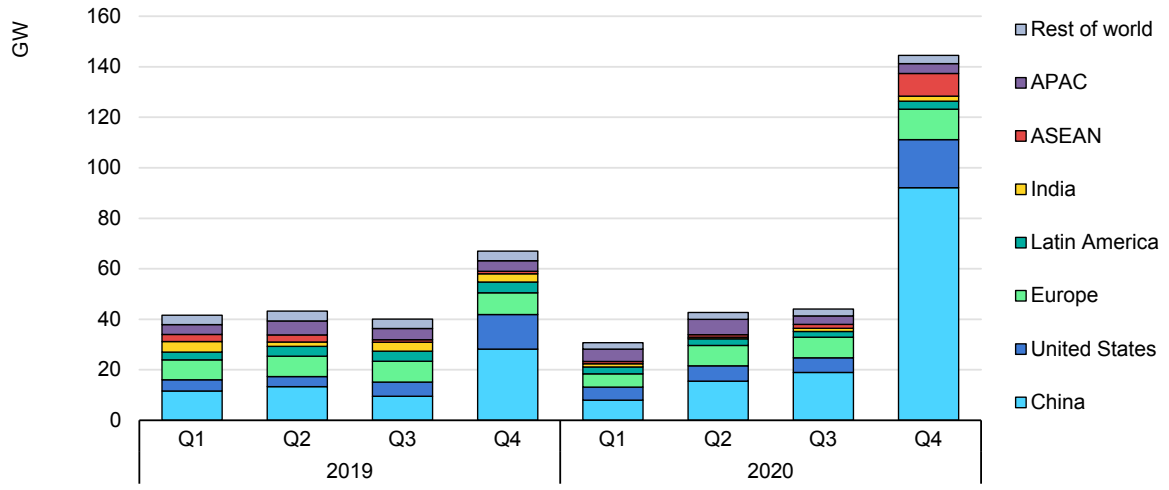
Policy deadlines in China, the United States and Viet Nam spurred an unprecedented boom in renewable capacity additions in 2020. China alone was responsible for over 80% of the increase in annual installations from 2019 to 2020, as onshore wind and solar PV projects contracted under China's former FIT scheme, and those awarded in previous central or provincial competitive auctions, had to be connected to the grid by the end of 2020. In the United States, wind power developers rushed to complete their projects before expiration of the production tax credit (PTC), although it was extended for another year, in December 2020. In Viet Nam, phaseout of the FIT for solar PV projects led to an unprecedented rush in commercial and residential installations.

Renewable capacity addition changes from 2019 to 2020



The rush to commission projects prior to policy deadlines in these countries took place in the last quarter (Q4) of 2020, especially in December. In fact, developers connected almost 150 GW of new renewable capacity in Q4 of 2020 – more than double the number of gigawatts commissioned in Q4 of 2019 and exceeding the amount installed in the first three-quarters of 2020. Overall, IEA quarterly deployment estimates indicate that the slowdown in renewable capacity additions was limited to Q1 2020 only, mainly in China, while construction activity continued strongly in the rest of the world despite continuous movement restrictions and supply chain delays. The December surge in new installations also indicates that solar and wind construction supply chains were able to furnish record numbers of projects in China, the United States, Viet Nam and various European countries.

Quarterly renewable capacity additions, 2019-2020



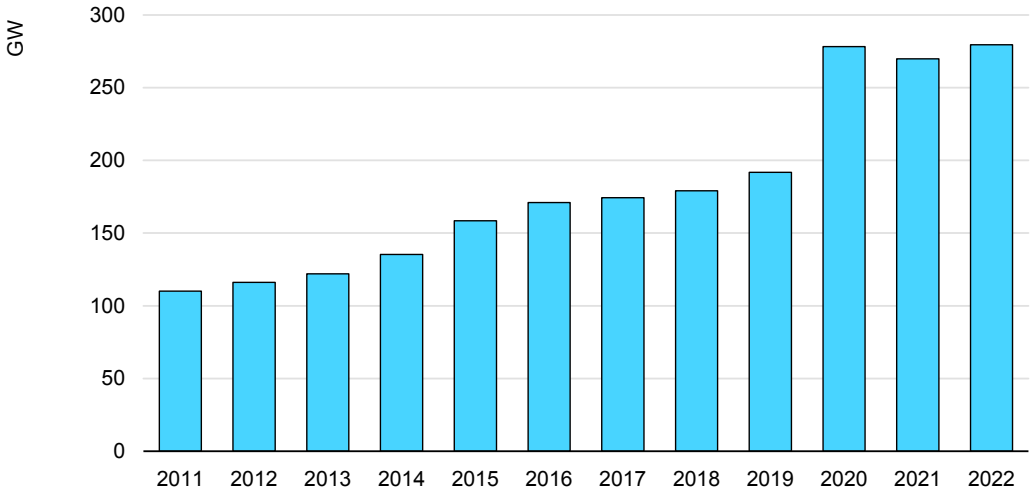
Notes: Quarterly renewable capacity additions may not add up to abovementioned annual capacity additions due to limited availability of granular data for multiple countries. APAC = Asia-Pacific region. ASEAN = Association of Southeast Asian Nations.

2021 and 2022 forecast summary

Renewables deployment geared up in 2020, establishing a “new normal” for capacity additions in 2021 and 2022

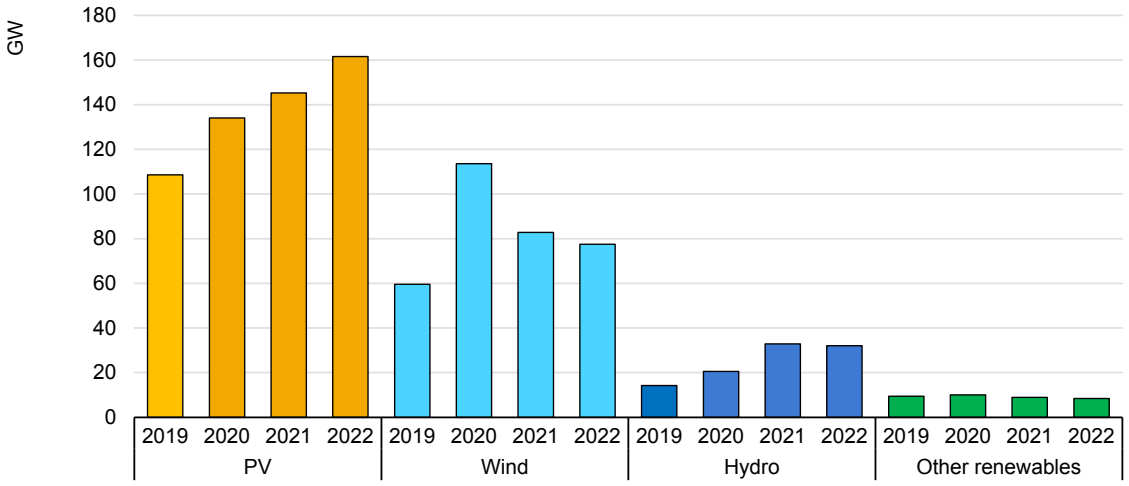
The exceptional level of renewable energy capacity additions is expected to be maintained, with 270 GW becoming operational in 2021 and 280 GW in 2022. This expansion exceeds the record-level annual capacity additions of 2017-2019 by over 50%, such that renewables are expected to account for 90% of total global power capacity increases in both 2021 and 2022.

Net renewable capacity additions, 2011-2022



Although the amount of annual wind capacity additions is expected to decrease in 2021-2022 after the exceptional jump last year in China, 80 GW of annual installations are still anticipated globally, i.e. almost 35% more than in 2019. Continuous growth in solar PV additions, spurred by lower investment costs and ongoing policy support, partly compensates for lower wind capacity additions. We expect annual solar PV expansion to reach 145 GW in 2021 and 162 GW in 2022, breaking records and accounting for almost over 55% of all renewable energy expansion this year and next. The acceleration of hydropower additions through 2022 is driven by the commissioning of mega-scale projects in China. Meanwhile, expansion in other renewables, led by bioenergy, remains stable and represents 3% of total new renewable capacity additions.

Net renewable capacity additions by technology, 2020-2022

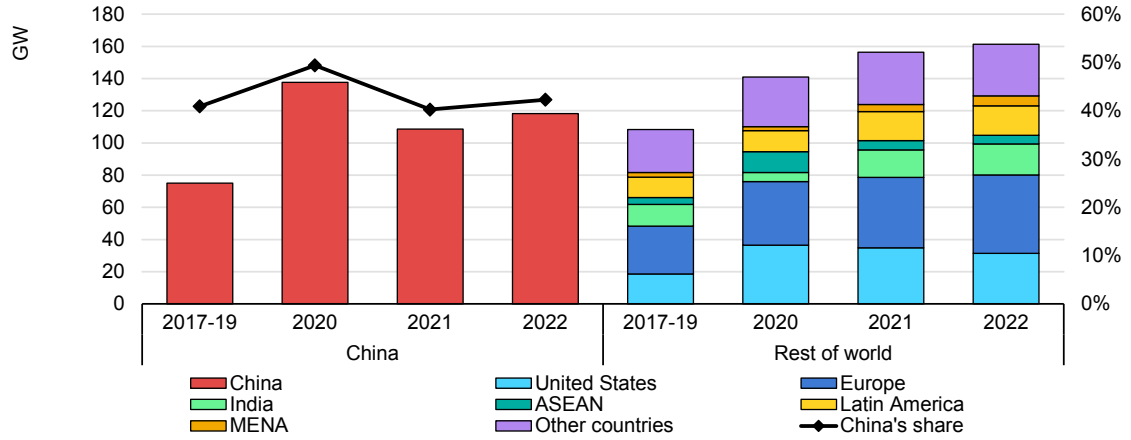


China's policy transition slows expansion, but other countries compensate with faster growth

Although China has accounted for 40% of global renewable capacity growth for several years already, for the first time in 2020 it was responsible for 50% – a record level resulting from the unprecedented peak in new installations in December. We expect China's renewable capacity additions to decline by one-quarter in 2021 compared with last year because of the government's decision to phase out subsidies for both wind and solar PV projects at the end of 2020. There is also uncertainty about the structure of the new incentive schemes that will be announced towards the end of 2021.

Nevertheless, China's anticipated annual renewable capacity additions (+45% in 2021 and +58% in 2022) remain significantly above the 2017-2019 average despite this slowdown. Growth may accelerate again after 2022 only, stimulated by new policy measures aligned with the country's ambitious long-term target to attain net-zero emissions by 2060.

Annual renewable capacity additions by country and region, 2017-2022



Notes: The "2017-19" bar represents average annual capacity additions for that three-year period. ASEAN = Association of Southeast Asian Nations. MENA = Middle East and North Africa.

Europe accelerates deployment, becoming the second-largest renewable power market after China

In Europe, annual capacity additions are forecast to increase 11% to 44 GW in 2021 and 49 GW in 2022. With this expansion, this year the region will break the record for annual additions for the first time since 2011 and become the second-largest market after China. Germany will continue to deliver the largest renewable capacity additions in Europe, followed by France, the Netherlands, Spain, the

United Kingdom and Turkey. This strong growth results from multiple countries extending their policies to meet the EU 2030 climate target, and by corporate power purchase agreement (PPA) markets booming in several countries:

Germany – support for solar PV, wind and bioenergy with higher auction volumes through Germany's Renewable Energy Act 2021 (EEG)

The Netherlands – allocation of the new SDE++ scheme in December 2020

Turkey – extension of feed-in tariff (FIT) scheme for all renewables

Poland – new auction awarded almost 1 GW of PV in December 2020

Spain – record corporate PPA agreements signed in 2020

Sweden – low wind generation costs stimulate a boom in the corporate PPA market; continuation of the PV rebate programme

The United Kingdom – proposal to re-include onshore wind and solar PV in the 2021 contracts for difference (CfD) auction.

While US tax credit extensions improve the outlook for onshore wind, approval of proposed policies would boost renewables deployment beyond 2022

In December 2020, the US government extended production and investment tax credits by one more year for onshore wind and solar PV. These changes will mostly affect the onshore wind sector in 2021 and 2022, as the extensions make new projects starting construction in 2021 eligible for a USD 18/MWh tax credit. As a result, we have revised our onshore wind forecast upwards by 25% for this year and 2022. For solar PV, the investment tax credit (ITC) has little effect on our short-term forecast, as the December extension covers only projects starting construction in 2022 and 2023. Still, declining costs, a recovering distributed PV sector and growing interest in corporate PPAs offer hope for more extensive solar PV expansion.

The new US infrastructure plan presented in March 2021 proposes a "direct-pay" provision for tax-credit-eligible renewables, reducing the need for relatively expensive tax equity. A similar provision passed in 2009 boosted wind deployment significantly during 2010-2014. Furthermore, the plan offers a ten-year tax credit extension, providing unprecedented visibility for wind and PV developers, spurring much faster expansion. However, the legislative process for these policy proposals has not yet been completed and the expected impacts are therefore not

reflected in our forecast for 2021 and 2022. A detailed assessment of the new infrastructure plan, and of other relevant legislation to achieve the announced targets of halving US greenhouse gas (GHG) emissions by 2030 and making US electricity carbon-neutral by 2035, will be included in the full autumn edition of *Renewables 2021*.

India is back on track

The Covid-19 impact on renewable energy deployment has affected India more than any other country: pandemic-induced construction delays and grid connection challenges caused India's capacity additions to decline by almost 50% from 2019 to 2020. Although new records for renewable capacity expansion are expected to be set in 2021 and 2022 as delayed projects from previous competitive auctions are commissioned, the current (April 2021) surge in Covid-19 cases has created short-term forecast uncertainty. While the financial health of distribution companies (DISCOMs) remains the primary challenge to renewable energy deployment in India, the recently proposed reform of USD 40 billion to improve DISCOM operations and finances would offer a more positive outlook.

Viet Nam's PV boom ends, slowing ASEAN growth, while expansion resumes in Latin America following delays

In the **ASEAN** region, rapid solar PV expansion in Viet Nam boosted the region's capacity additions to a record 13 GW in 2020 – 60% higher than in 2019. However, the phasing out of FITs in Viet Nam and relatively sluggish renewable energy growth in Indonesia and Thailand leads to a two-thirds decline in ASEAN expansion in 2021 and 2022 relative to 2020. In **Latin America**, projects delayed from 2020 will become operational in Brazil, Mexico and Chile, while increasingly attractive distributed PV costs drive rapid development thanks to Brazil's generous net-metering policy. A growing corporate PPA market and bilateral contracts outside of auction schemes also support deployment in Latin America.

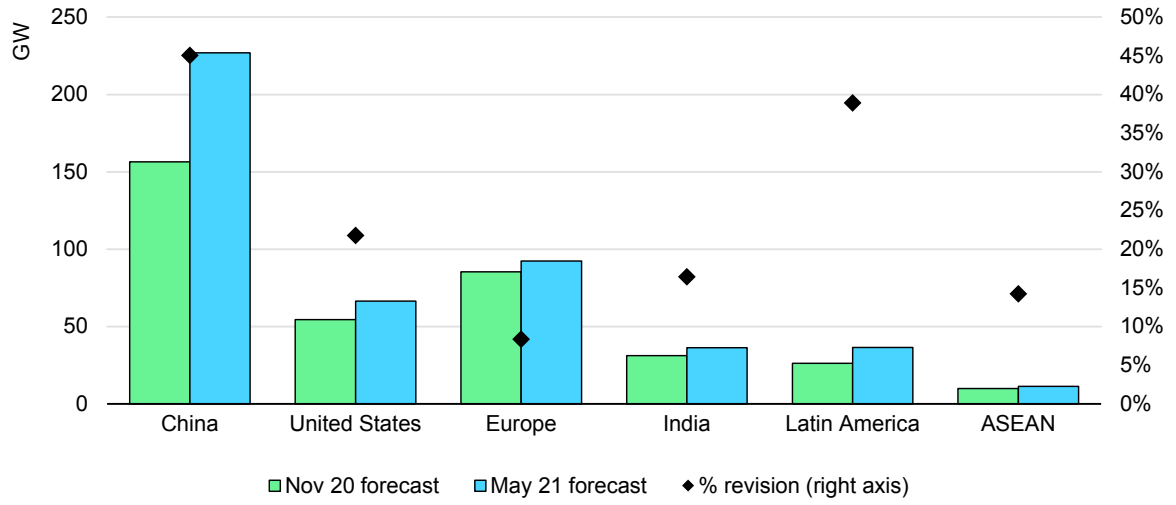
Growth drivers for 2021 and 2022

Forecast additions for 2021 and 2022 have been revised upwards by over 25% from last year

Despite China's phaseout of subsidies and ongoing policy transition, its forecast has been revised the most from last year. The pipeline of solar PV and wind plant projects accepting provincial electricity prices without additional subsidies has

increased since last year, resulting in a more optimistic forecast. In the United States, the extension of tax credits is expected to lead to faster short-term onshore wind growth, while Brazil's generous net metering scheme results in a distributed PV market boom, supporting upward revisions to the Latin America forecast. In the ASEAN region, Viet Nam's policy changes will reduce capacity additions significantly, but growth is not expected to collapse fully thanks to the increasing cost-competitiveness of solar PV. In India, contracted PV auction volumes in 2020 exceeded our predictions, raising forecast expectations.

Capacity additions forecast revisions for 2021 and 2022



Note: ASEAN = Association of Southeast Asian Nations.

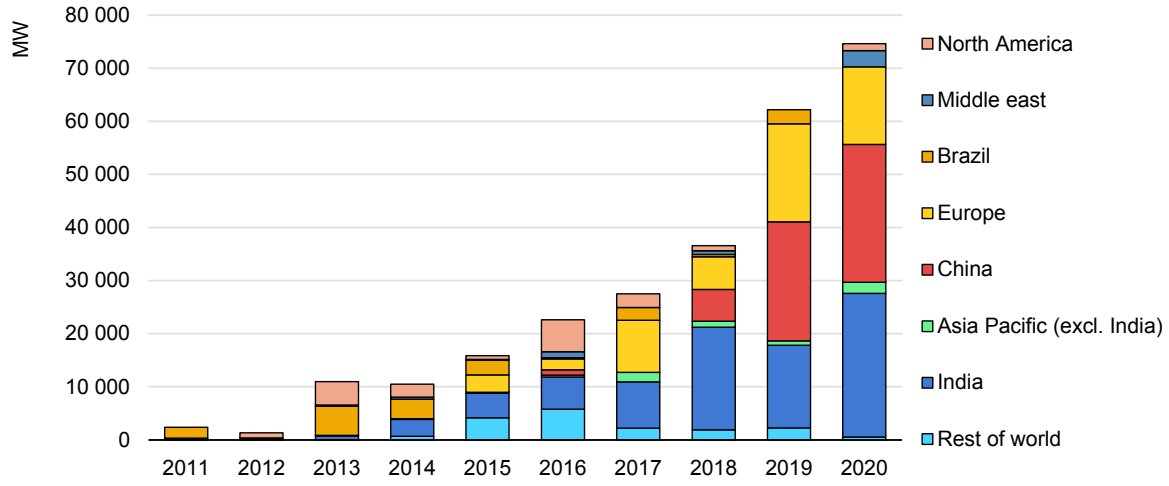
Record-breaking competitive auctions volumes boost renewables deployment in 2021 and 2022

Despite declining electricity demand and wholesale power price drops due to the impacts of pandemic, governments around the world auctioned a record amount of renewable energy capacity, awarding almost 75 GW of onshore wind, offshore wind, solar PV and bioenergy last year – 20% more than in 2019.

Auctions held in 2020 (and 2019) remain the main basis of our forecast for 2021 and 2022, in addition to FIT and net-metering policies for smaller applications. India and China together auctioned almost 55 GW of wind and PV capacity at average contract prices of USD 60/MWh for wind and USD 47/MWh for PV. Auction activity slowed slightly in Europe, but this was because smaller volumes of offshore wind were contracted, whereas in Latin America the drop was significant as Brazil, Chile and Argentina postponed their 2020 auctions due to

lack of demand and financing challenges. For the first time, wind and PV hybrid auction volumes were over 6 GW, mainly because India is offering new opportunities for developers.

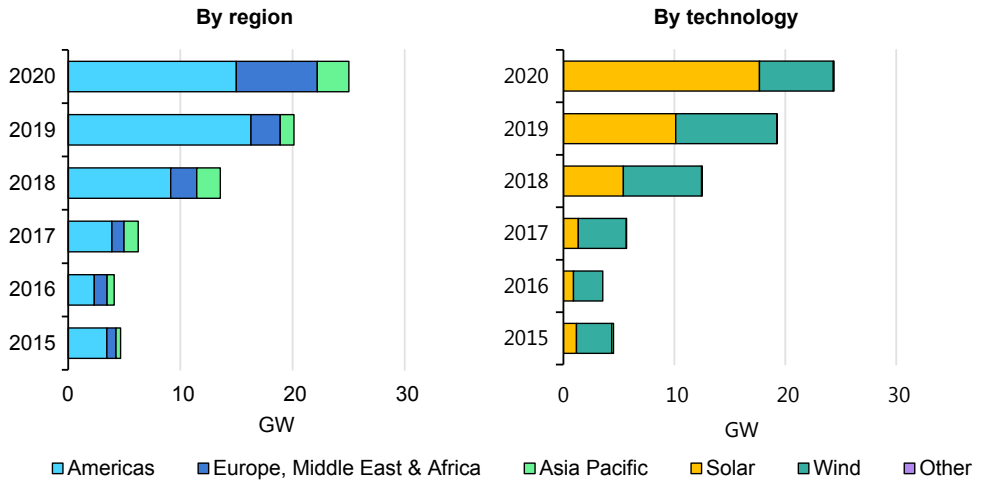
Renewable electricity competitive auction capacity by award date, 2011-2020



Corporate procurement expands as wind and PV costs continue to decline

Like competitive auctions, corporate power procurement also had another record-breaking year in 2020, with a 25% year-on-year increase credited to declining costs. While the United States remains the world's largest corporate PPA market, activity in Europe almost tripled with Spain signing large contracts with multiple PV developers and Sweden contracting considerable wind projects. In the Asia-Pacific region, new developments are emerging in Korea, India and some provinces in China when allowed. In Latin America, Brazil continues to be the largest corporate PPA market with an increasing number of projects relying on long-term contracts outside the government's auction scheme. Elsewhere in Latin America, PPA activity in Chile and Mexico declined last year as a result of curtailed economic activity and growing financing challenges.

Corporate PPA volumes by region and technology



Source: Bloomberg New Energy Finance (2021), Corporate PPA database.

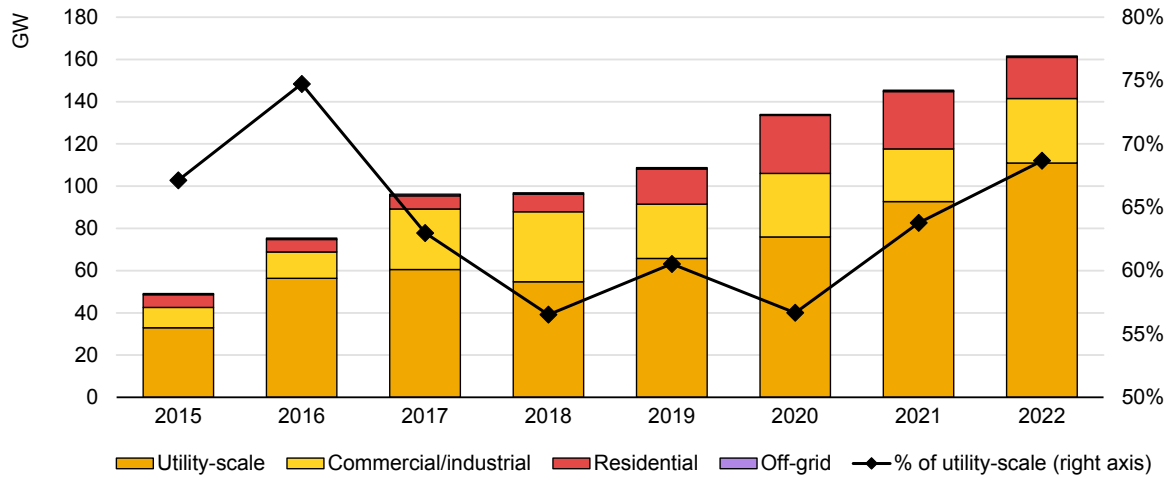
Solar PV

Solar PV capacity additions are expected to increase 8% to over 145 GW in 2021. PV has become the lowest-cost option for electricity generation in many countries, especially those with good resource availability and affordable financing. As a result, corporations are increasingly opting for bilateral contracts with large-scale solar PV plants to meet their energy demand. Thanks to further cost reductions and continuous policy support from 120 governments globally, PV capacity additions are forecast to expand further to 162 GW in 2022.

Larger projects dominate the solar PV market

The share of utility-scale applications in annual PV additions is forecast to increase from over 55% in 2020 to almost 70% in 2022. Although the share of distributed projects in overall PV deployment increased from 25% in 2016 to nearly 45% in 2018 owing to China's attractive support scheme, this trend was reversed in 2019 when the Chinese government reduced its generous FITs for commercial and industrial PV projects. Nevertheless, sustained support doubled the deployment of residential applications from 2019 to 2020. Outside China, expanding competitive corporate PPA markets in United States and Europe have made larger utility-scale projects more economically attractive.

Annual solar PV capacity additions by application segment, 2015-2022

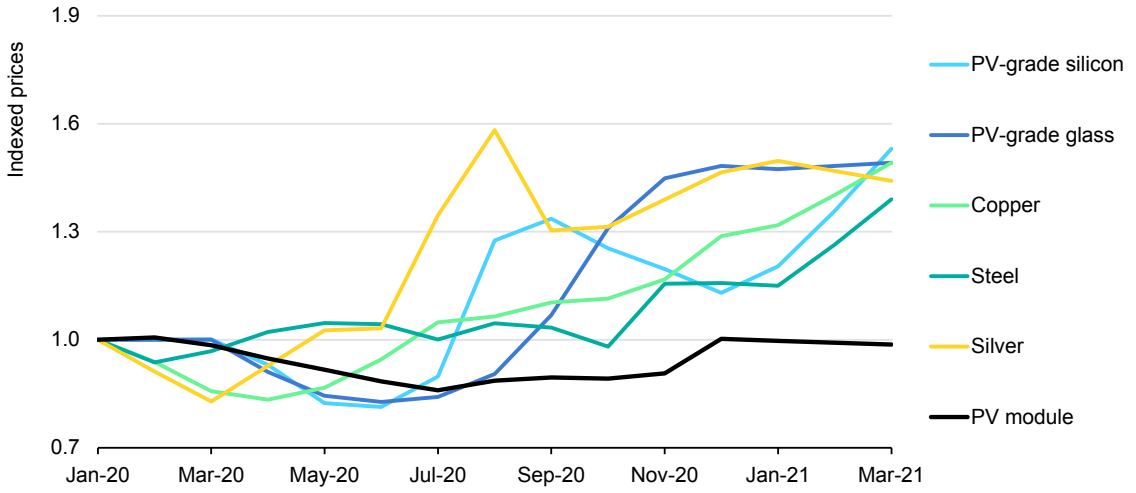


Supply chain constraints and rising commodity prices provoke short-term PV price uncertainties

Solar PV module prices climbed from July 2020 to April 2021 due to supply chain complications and rising commodity prices, erasing the 25% price reduction achieved between January and June 2020. Fires in two PV-grade silicon manufacturing plants in the Xinjiang province in July 2020 almost halved China's total silicon output and pushed silicon prices up 60% in September 2020. Although manufacturing capacity has since recovered gradually and the cost of silicon materials has begun to fall, prices at the end of 2020 were still significantly higher than earlier in the year due to a tight supply-demand balance and delays in commissioning new manufacturing capacity in other Chinese provinces.

Meanwhile, the value of several key input materials for PV panel manufacturing also increased considerably. In the second half of 2020, PV-grade glass prices surged 50%, mainly due to growing demand for bifacial modules and delays to the modernisation of high-cost production lines. Steel and copper prices also rose 40% from September 2020 to March 2021, boosted by rapid economic recovery in China and other emerging economies. In addition, relatively higher oil prices and the global economy's recovery from the pandemic tripled global freight costs, raising the price of Chinese modules exported around the world.

Indexed prices for solar PV module, silicon, glass and other commodities, 2020-2021



Sources: pvxchange (2021), Solar price index, https://www.pvxchange.com/Price-Index; FBX (2021), Freight index, https://fbx.freightos.com/.

In the short term, relatively high PV prices pose a challenge for developers who won auction bids at tight margins (betting on declining module costs) but did not purchase panels. However, as modules account for only 20-30% of a PV system, recent price developments will have only a limited effect on total project costs. In addition, the impact of supply chain constraints and higher commodity prices on module prices is not expected to last through 2021.

First, several new polysilicon plants outside of Xinjiang province will become operational in 2021 and 2022, augmenting supplies and geographically diversifying China's production. Second, PV-grade glass producers have already scaled up manufacturing (in April 2021) to meet growing demand, with additional glass capacity expected to become operational in China. Overall, despite relatively high commodity and freight prices, we expect module prices to be lower at the end of 2021 than the average Chinese price in 2020, which was around USD 0.205 per watt.

Forecasts for key PV markets

In **China**, despite the phaseout of subsidies last year for utility-scale and commercial/industrial PV projects, an estimated 40 GW of subsidy-free developments are planned under 20-year contracts at provincial electricity prices; we expect most of these projects to become operational in 2021. China is also expected to maintain its residential solar PV subsidies in 2021, driving another installation boom similar to last year's, while the number of commercial

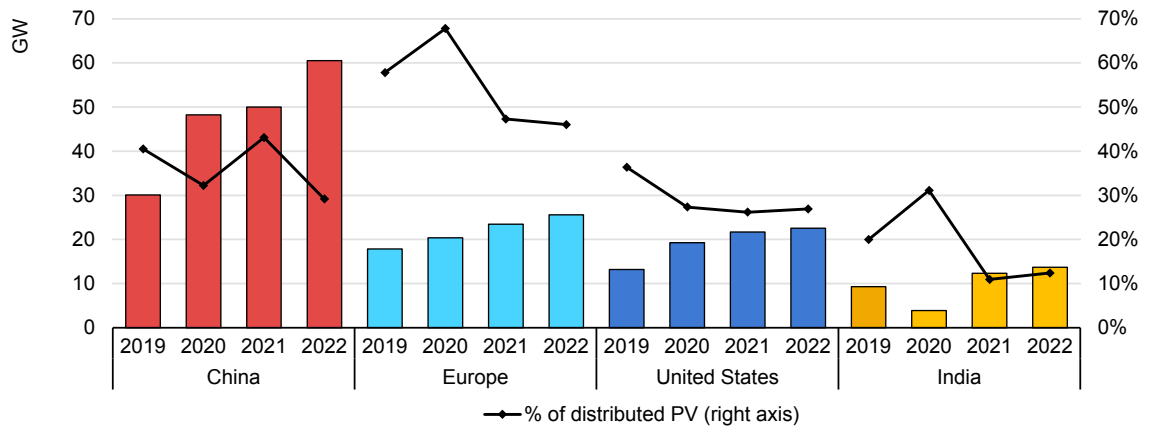
installations continues to increase slowly. In 2022, the 14th Five-Year Plan's new target and policy scheme, as well as further cost reductions, should support PV expansion, the majority being utility-scale projects.

In **Europe**, utility-scale projects will dominate the accelerated expansion of solar PV in 2021 and 2022 for the first time since 2017. In addition to Spain's corporate PPAs, capacity awarded through auctions in Germany, France, Poland and Turkey stimulate utility-scale expansion in Europe. As for distributed PV, a generous net-metering scheme in the Netherlands and FITs and feed-in premiums (FIPs) in France and Germany support additions in 2021 and 2022.

In the **United States,** capacity additions will continue to expand in 2021 and 2022 owing to another year's extension of the 26% ITC, which renders projects more economically attractive. Higher corporate demand through PPAs driven by declining costs leads to a greater number of planned utility-scale projects. Following the pandemic-induced slowdown of the first half of 2020, US residential and commercial markets recovered fully and even grew in the latter part of the year. With sustained cost declines and tax credits, distributed PV will continue to account for almost 30% of US PV growth in 2021 and 2022.

In **India,** PV capacity additions more than triple in 2021 compared with 2020 as delayed large-scale utility projects become operational. Moreover, the government awarded 27 GW of PV in central and state auctions in 2020, which is the primary driver of PV growth this year and next. Distributed PV expansion remains sluggish due to administrative and regulatory challenges in multiple states, while the reluctance of DISCOMs to adopt commercial PV remains a key barrier to faster growth.

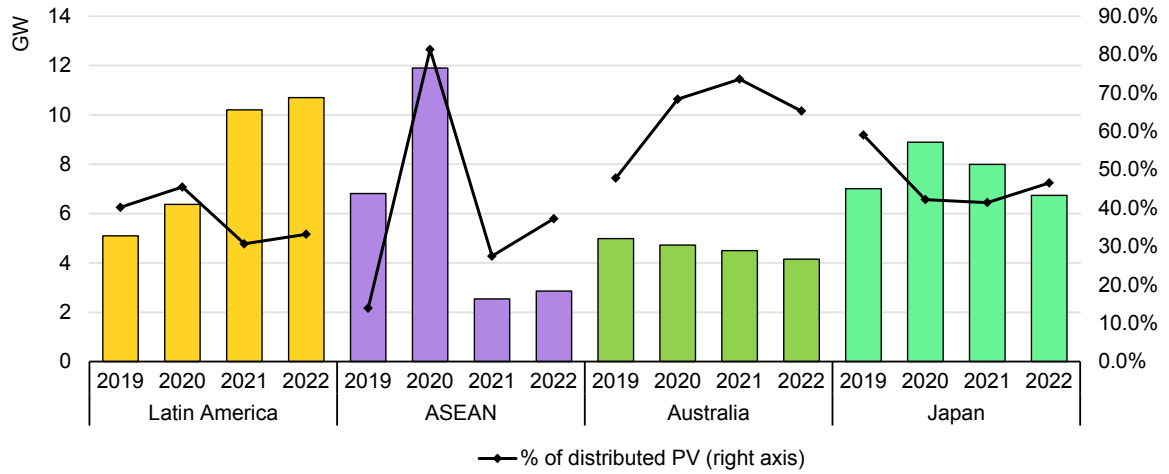
Annual solar PV capacity additions by country, 2019-2022



In **Latin America,** distributed PV expansion in Brazil accounts for almost 40% of the region's increase in 2021-2022, stimulated by the country's generous net-metering scheme. Outside Brazil, forecast expansion is based on a boom in Chile's utility-scale market, driven by previous auctions. In Mexico, we expect utility-scale projects that have already been financed to become operational in 2021 and 2022 despite recent regulatory changes in the country, but the outlook for new projects remains pessimistic with the cancellation of clean energy certificate auctions.

In the **ASEAN region**, Viet Nam's policy deadline for 12 GW of new solar PV, mostly distributed, led to a boom in 2020. However, we do not expect this anomaly to be repeated in 2021 or 2022, as Viet Nam's government has scaled back incentives, and regulatory and administrative challenges in other ASEAN countries hamper faster PV expansion.

Annual solar PV capacity additions by application segment, 2019-2022



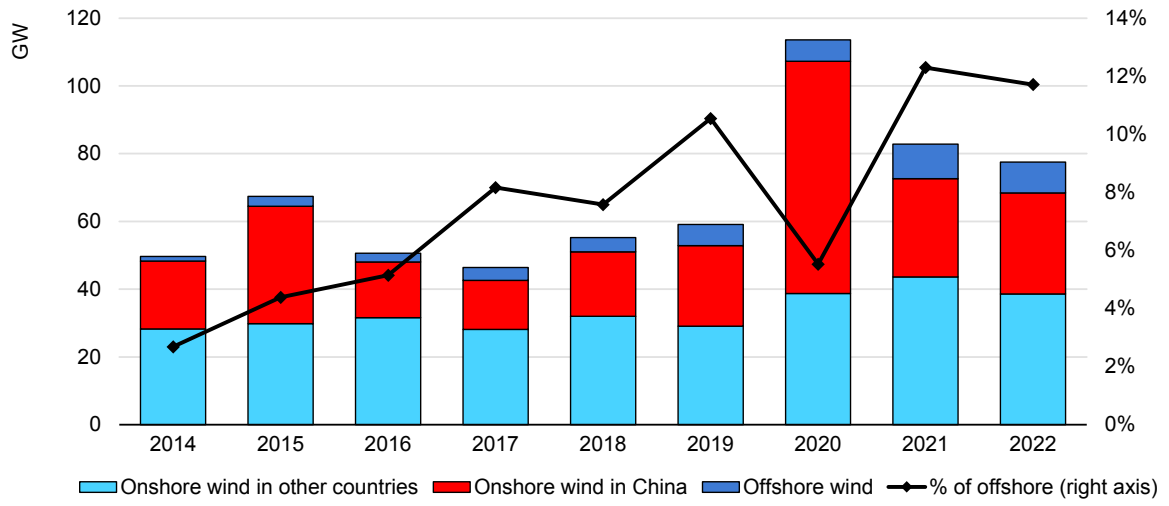
Note: ASEAN = Association of Southeast Asian Nations.

Japan and **Australia** remain the drivers of growth in Asia outside of China and India. Australia exceeded its large-scale renewable energy target (LRET) in 2020, and the resulting oversupply of certificates negatively affected the business case for utility-scale PV projects. As a result, some developers are seeking to sign corporate PPAs to ensure stable remuneration. Meanwhile, state-level incentives are prompting distributed PV growth with the rapid adoption of battery storage, especially in the residential sector. In Japan, around 21 GW (AC) of PV projects received FIT approval but were not operational as of September 2020. We expect a portion of these projects to be commissioned in 2021 and 2022.

Wind

Wind capacity additions reached almost 114 GW in 2020, almost doubling 2019 expansion. China alone accounted for two-thirds of global wind growth, with Chinese manufacturers supplying turbines for most of the country's installations. At 80 GW, the 2021 wind market is expected to be 30% weaker than last year's, although still significantly exceeding 2019 additions. We expect slightly lower onshore and offshore growth in 2022. Having reached a record 10% in 2019, the offshore share of total wind additions declined in 2020 but is forecast to rebound to a record-breaking 12% in 2021-2022.

Annual wind capacity additions, 2014-2022



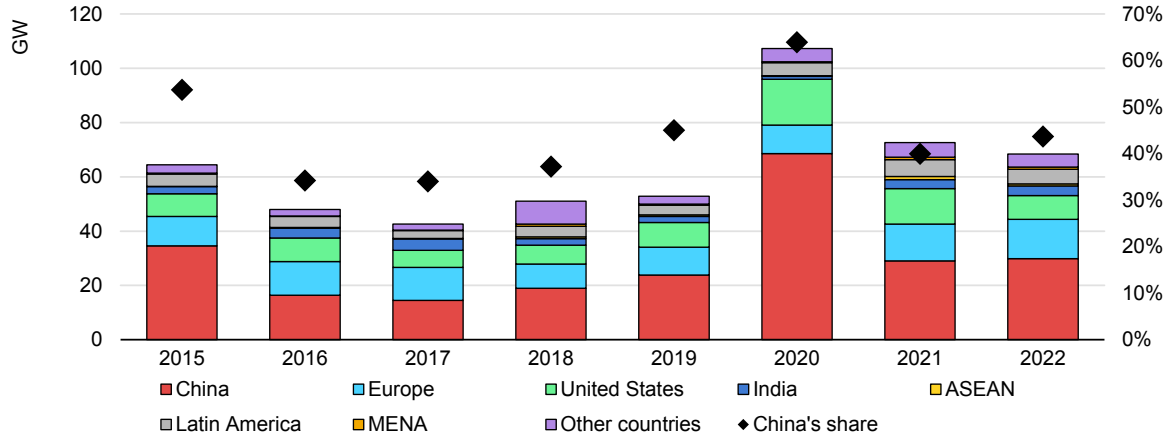
Following the 2020 boom, annual onshore wind additions will slacken this year

China's policy-driven onshore wind market surge last year recalls a similar event of five years ago. In 2015, Chinese onshore wind installations increased almost 75% year-on-year, then halved in 2016 and 2017. Wind developers had been rushing to commission projects before the incentive scheme expired with closure of the 12th Five-Year Plan in 2015, leaving the project pipeline empty in subsequent years. Similarly, uncertainty surrounding the 14th Five-Year Plan's new incentive scheme for 2021-2025 follows on the heels of last year's boom, forecasting significantly lower additions in 2021 and 2022 with the commissioning of some delayed projects as well as onshore plants contracted outside the subsidy scheme. Nevertheless, new installations over 2021-22 remain higher than in 2019.

In the **United States**, onshore additions are also expected to decline this year because a large number of projects eligible for full tax credits were commissioned in 2020, reducing the project pipeline for 2021 and 2022. Although the extension of tax credits in December 2020 raised our 2021-2022 forecast slightly, approval of the new proposal for a longer-term tax credit extension would probably boost growth beyond 2023.

Europe's onshore wind growth is expected to accelerate in 2021 and 2022 as multiple large developments in France, Sweden and the Netherlands become operational while projects awarded in previous large-scale auctions are commissioned in Germany.

Annual onshore wind capacity additions by country/region, 2015-2022



Notes: MENA = Middle East and North Africa. ASEAN = Association of Southeast Asian Nations.

In **Latin America**, record-breaking capacity additions in 2021 and 2022 are expected thanks to the commissioning of projects from previous auctions schemes in Brazil, Argentina, Mexico and Colombia. Corporate PPA market growth also supports wind project deployment. Having stalled in 2020, wind capacity expansion will resume in **India** with the commissioning of many projects that had been delayed by the pandemic.

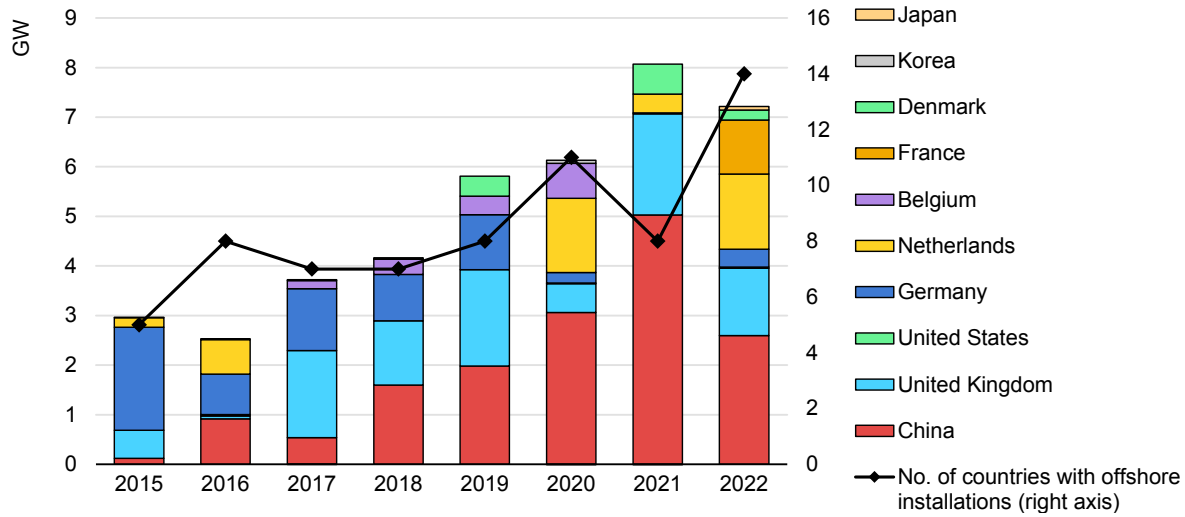
China dominates offshore wind markets in 2021 while geographical diversity increases in 2022

In 2021, global offshore wind capacity additions are expected to increase 60% to over 10 GW. Exceptionally, China is expected to account for nearly 60% of the expansion as developers rush to commission projects before the FIT expires at

the end of 2021, similar to what happened with onshore wind last year. As a result, China's offshore additions are forecast to decline 50% in 2022, leading to lower annual global market activity.

However, geographical diversity in offshore wind markets is expected to increase with the most countries ever (14) set to commission projects in 2022. While China remains the largest annual market for offshore wind, considerable capacity is expected in the Netherlands, France, the United Kingdom, Germany and Denmark as a result of previous auctions. In Asia, Japan and Korea are expected to commission smaller projects for the first time in 2022, contributing to the diversity of offshore wind markets globally.

Annual offshore wind capacity additions by country/region, 2015-2022



Transport biofuels

2021 and 2022 forecast summary

Total biofuel demand for transport declined 8% to 150 billion litres (2 590 kb/d) from 2019 to 2020, surpassing the *Renewables 2020* forecast of 144 billion litres (2 480 kb/d) for 2020. The largest year-on-year drops in output were in Brazilian and US ethanol production, and in biodiesel production in Europe. Lower output in these markets accounted for 90% of biofuel production declines from 2019 to 2020.

Global biofuel production is expected to recover to the 2019 level in 2021, as forecast in *Renewables 2020*, but this recovery will be uneven. Biodiesel and hydrotreated vegetable oil (HVO) production increases globally and ethanol expands in India. HVO capacity is also expected to be 50% higher in 2021 than in 2020 if new projects are built on schedule. However, the ongoing effects of the Covid-19 crisis on demand, as well as price uncertainty for ethanol relative to sweeteners in Brazil, continue to keep ethanol production in both the United States and Brazil below the 2019 levels.

In Brazil, sugar mill operators can produce either ethanol or sweeteners, depending on which promises the greatest return. The Covid-19 pandemic has also delayed biofuel policy implementation in Indonesia, Malaysia, Thailand and Brazil, for which production growth had previously been anticipated. Nevertheless, biofuel production is expected to be 7% higher in 2022 than in 2021 owing to HVO and biodiesel expansion in the United States and Indonesia, and a return to 2019 ethanol production levels in Brazil.

An uneven rebound for biofuels in 2021

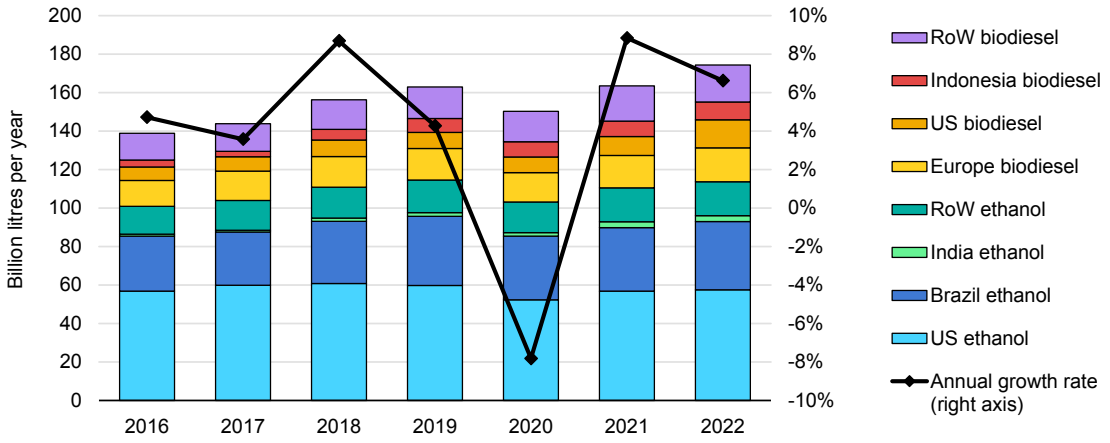
Although total biofuel production returns to the 2019 level in 2021, ethanol production is forecast to remain 3.6% below the 2019 amount, largely due to a slow rebound in the United States and Brazil. Production will remain lower by 8% in Brazil and 5% in the United States in 2021.

The US drop in production results from weaker gasoline demand and the absence of new policy drivers at the time of writing. In Brazil, a combination of reduced gasoline demand, a potentially less abundant sugarcane harvest and lower returns on ethanol relative to sweeteners will likely keep production below the

2019 level, at 33 billion litres (570 kb/d) in 2021. However, the impact of competition between ethanol and sugar production remains uncertain, as a change in the relative price of sweeteners in favour of ethanol would encourage greater ethanol production. These declines are partially offset by gains in India, which has already announced 7% ethanol blending in 2021, a 2.5 percentage-point increase from 2019.

Biodiesel production, including HVO, is 10% higher in 2021 than in 2019 thanks to significant capacity expansions.

Biofuel production by country/region and fuel type, 2016-2022



Note: RoW = rest of world.

The Covid-19 pandemic and high feedstock prices delay policy deployment

Policy implementation in Indonesia, Malaysia, Thailand and Brazil has been slower since the beginning of Covid-19 crisis. In some cases, these policy delays are directly related to the pandemic's disruption of fuel demand, government prioritisation of Covid-19 concerns, and the drop in fossil fuel costs relative to biofuels early in the pandemic. However, while oil prices have recovered, the costliness of soybean and palm oil feedstocks continues to keep the price of biodiesel high relative to fossil diesel.

Biofuel policy implementation delays in selected countries

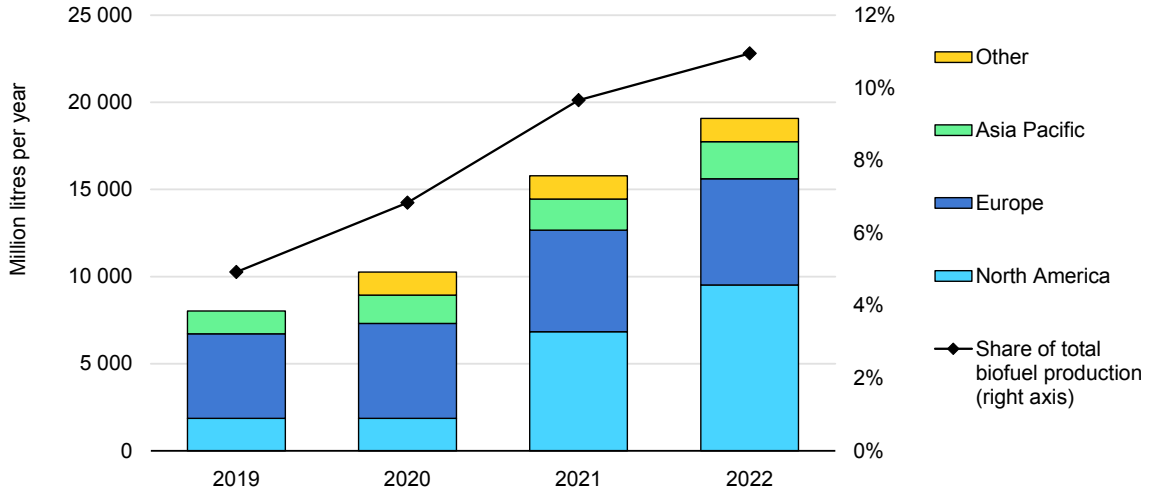
Country	Description*
Indonesia	Indonesia's government has delayed implementation of its 40% biodiesel mandate from 2021 until at least 2022 because of Covid-19-related disruptions of testing and capacity expansions, as well as the high cost of palm oil for biodiesel production.
Malaysia	Malaysia has delayed its 20% biodiesel blending mandate in some regions by at least six months. The government expects to extend 20% biodiesel blending to Sabah in June and to peninsular Malaysia in December.
Thailand	Thailand has postponed enforcement of its 20% ethanol blending mandate indefinitely due to cost concerns. In February 2021, the price of ethanol was 80% higher than that of gasoline.
Brazil	In September 2020, Brazil's National Petroleum Agency scaled back GHG emissions reduction targets by 50% because fuel market uncertainties may have made it difficult for fuel suppliers to meet the goals. In April 2021, Brazil temporarily reduced its biodiesel obligation from 13% to 10% in response to a spike in biodiesel prices, which have nearly doubled since July 2020 due to rising costs for the soybeans that are used to make biodiesel.

* Based on government announcements for each country.

HVO capacity is expected to nearly double in the next two years

US policies are behind 85% of HVO capacity additions globally, as the renewable fuel standard, California's low-carbon fuel standard and a biodiesel blender credit make HVO projects economically attractive. Outside the United States, new projects will expand capacity 12% from 2020 to 2022 in Europe, and by 32% in the Asia-Pacific region. At full production capacity HVO facilities account for 11% of forecast global biofuel production in 2022, more than doubling the 2019 HVO share.

Global HVO production capacity, 2019-2022



Note: Based on planned capacity expansions, conversions and new builds
Source: IEA analysis based on IHS Markits.

HVO projects offer other benefits as well, including providing new life for oil refineries (6 of the 18 projects and expansions are refinery conversions). HVO is also a “drop-in” fuel, meaning it can be directly substituted for diesel without the need for engine modifications, facilitating its broader use.

Annexes

Abbreviations and acronyms

CAES	compressed air energy storage
CAPEX	capital expenditure
CCGT	combined-cycle gas turbine
CfD	contract for difference
CO	carbon monoxide
CO_2	carbon dioxide
DISCOM	distribution company
EAF	electric arc furnace
EEG	Germany's Renewable Energy Act
EOR	enhanced oil recovery
FIP	feed-in premium
FIT	feed-in tariff
FLH	full load hours
GHG	greenhouse gas
HVO	hydrotreated vegetable oil
ITC	investment tax credit
LRET	large-scale renewable energy target
PPA	power purchase agreement
PTC	production tax credit

Units of measure

bbl	barrel
bbl/d	barrels per day
bcm	billion cubic metres
bcm/yr	billion cubic metres per year
cm/s	centimetres per second
gCO_2	gramme of carbon dioxide
gCO2/kWh	grammes of carbon dioxide per kilowatt hour
GJ	gigajoule
Gt/yr	gigatonnes per year
$GtCO_2$	gigatonne of carbon dioxide
$GtCO_2$/yr	gigatonnes of carbon dioxide per year
GW	gigawatt
GWh	gigawatt hour
MWh	megawatt hour----------

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