

Iran Solar Magazine

Renewable Energy Market Update

Outlook for 2022 and 2023

INTERNATIONAL ENERGY AGENCY

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Abstract

Renewable electricity capacity additions broke another record in 2021 and biofuels demand almost recovered to pre-Covid levels, despite the continuation of logistical challenges and increasing prices. However, the Russian Federation's (hereafter, "Russia") invasion of Ukraine is sending shock waves through energy and agriculture markets, resulting in an unprecedented global energy crisis. In many countries, governments are trying to shelter consumers from higher energy prices, reduce dependence on Russian supplies and are proposing policies to accelerate the transition to clean energy technologies.

Renewable energy has great potential to reduce prices and dependence on fossil fuels in short and long term. Although costs for new solar PV and wind installations have increased, reversing a decade-long cost reduction trend, natural gas, oil and coal prices have risen much faster, therefore actually further improving the competitiveness of renewable electricity. However, how rapidly renewables can substitute fossil fuels hinges on several uncertainties and will depend on many factors. Will renewable electricity sources defy this global energy crisis and continue to expand quickly despite emerging political and macroeconomic challenges? At the same time, growth in biofuels demand faces significant headwinds from both lower transport demand growth and high biofuel prices. Will demand growth resume at historical rates?

In exploring the most recent market and policy developments as of April 2022, our *Renewable Energy Market Update* forecasts new global renewable power capacity additions and biofuel demand for 2022 and 2023. It also discusses key uncertainties and policy-related implications that may affect projections for 2023 and beyond.

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Acknowledgements

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The lead authors of the report were Heymi Bahar (electricity) and Jeremy Moorhouse (biofuels). The report benefited from analysis and input from multiple colleagues: Yasmina Abdelilah, Piotr Bojek, François Briens, Trevor Criswell, Kazuhiro Kurumi, Kartik Veerakumar and Grecia Rodríguez Jiménez (also responsible for data management).

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Diane Munro carried editorial responsibility.

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Highlights

- The current global energy crisis has added new urgency to accelerate clean energy transitions and, once again, highlighted the key role of renewable energy. For renewable electricity, pre-crisis policies lead to faster growth in our updated forecast. Notably, wind and solar PV have the potential to reduce the European Union's power sector dependence on Russian Federation (hereafter, "Russia") natural gas by 2023.
- At the same time, it is too early to assess the potential impact on our 2022 and 2023 forecast of newly announced targets following the Russian invasion of Ukraine, in the absence of rapid policy implementation.
- Annual renewable capacity additions broke a new record in 2021, increasing 6% to almost 295 GW, despite the continuation of pandemic-driven supply chain challenges, construction delays and record-level commodity prices for raw materials.
- Solar PV and wind costs are expected to remain higher in 2022 and 2023 than pre-pandemic levels due to elevated commodity and freight prices. However, their competitiveness actually improves, due to much sharper increases in natural gas and coal prices.
- Renewable capacity is expected to further increase over 8% in 2022, reaching almost 320 GW. However, unless new policies are implemented rapidly, growth remains stable in 2023 because solar PV expansion cannot fully compensate for lower hydropower and steady year-on-year wind additions.
- Globally, forecast additions for 2022 and 2023 have been revised upwards by 8% from December last year, thanks to strong policy support in the People's Republic of China (hereafter, "China"), the European Union and Latin America, and despite downward forecast revisions in the United States.
- Biofuel demand recovered in 2021 from Covid-19 lows, to near 2019 levels, and we expect growth to expand year-on-year by 5% in 2022 and by 3% in 2023. On the other hand, increasing feedstock prices and policy reaction from multiple countries slows growth in the short term, leading to a 20% downward revision of our previous biofuel demand growth forecast. Russia's invasion of Ukraine is also putting upward pressure on an already high-price environment for biofuel feedstocks, in particular vegetable oils.
- While looming market uncertainties increase challenges, the new focus on energy security – especially in the European Union – is also triggering an unprecedented policy momentum towards accelerating energy efficiency and renewables. Ultimately, the forecast of renewable markets for 2023 and beyond will depend on whether new and stronger policies will be introduced and implemented in the next six months.

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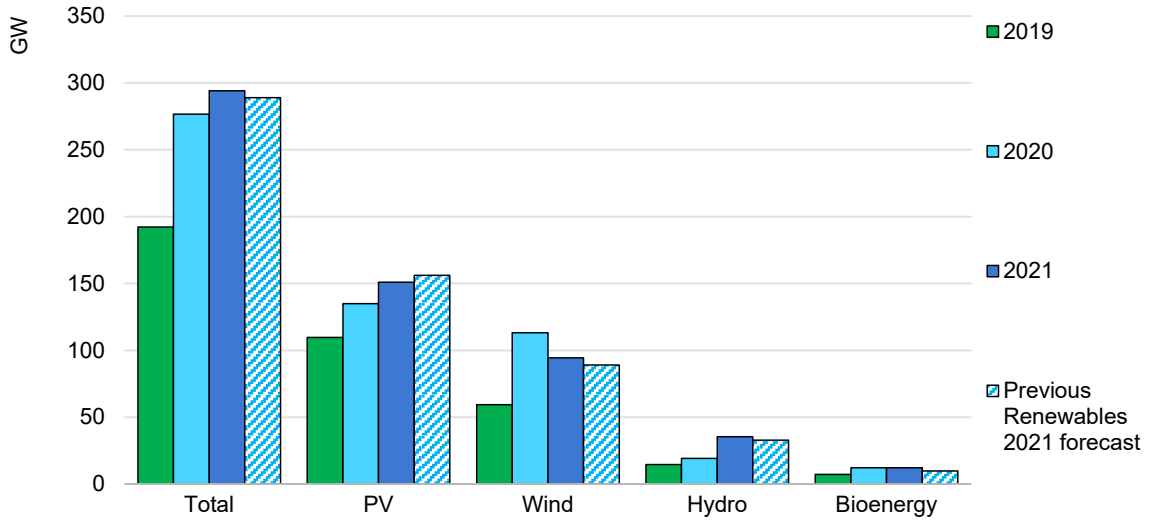
Renewable electricity

A brief look back at 2021

Another record year of growth but with new boom and bust deployment cycles

Despite the persistent pandemic-induced supply chain challenges, construction delays, and record-level raw material and commodity prices, renewable capacity additions in 2021 increased 6% and broke another record, reaching almost 295 GW. This growth is slightly higher than the forecast last year in the IEA's Renewables 2021. Globally, the 17% decline in annual wind capacity additions in 2021 was offset by an increase in solar PV and growth in hydropower installations. The expansion of bioenergy, concentrated solar power (CSP) and geothermal was stable in 2021 compared with 2020. In terms of speed of growth, renewable capacity's year-on-year increase last year was slower, following an exceptional jump in 2020 when Chinese developers rushed to connect projects before the phase out of subsidies, especially for onshore wind.

Renewable net capacity additions, 2019-2021



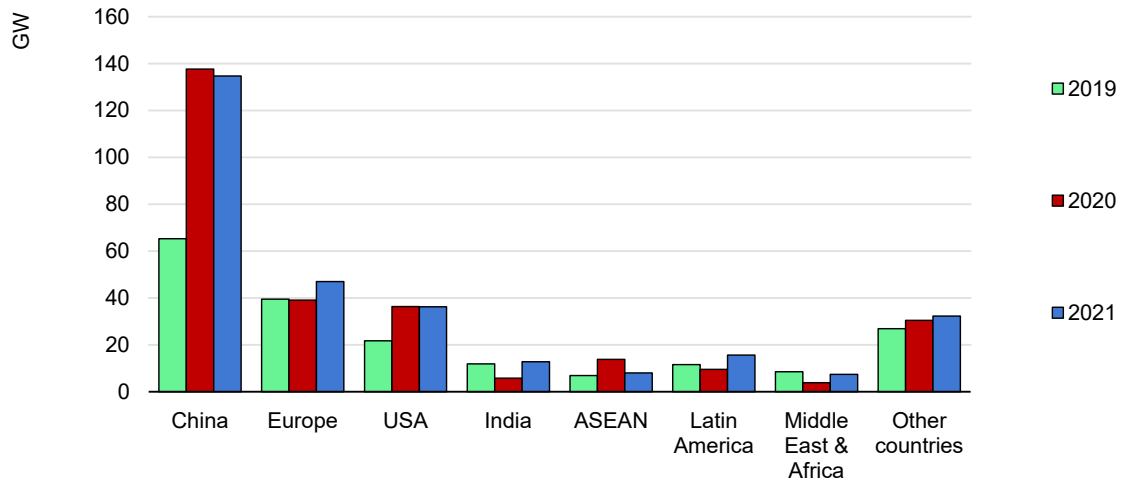
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China largely maintained its market share of deployment in 2021, accounting for 46% of worldwide renewable capacity additions. However, new Chinese capacity declined 2% year-on-year, with onshore wind and utility-scale solar PV installations 55% and 22% lower, respectively, than the record boom cycle levels in 2020 when developers rushed to complete projects before the subsidy expiration deadline. On the other hand, offshore wind, residential solar PV and bioenergy annual additions broke new records thanks to the availability of subsidies through 2021. For instance, offshore wind new installations increased almost six-fold in 2021 compared with 2020. In addition, the commissioning of multiple units at the Chinese Baihetan hydropower plant contributed to the global acceleration of hydropower expansions.

Outside of China, the European Union was the second largest market in terms of increased capacity, with the region surpassing for the first time the all-time-record in 2011. Solar PV alone accounted for the majority of the European Union's expansion last year due to project acceleration in Spain, France, Poland and Germany, which was driven by a combination of government-led auctions and distributed solar PV incentives. In the United States, lower production tax credit (PTC) rates led to onshore wind additions declining by one-quarter. Solar PV expansion continued to increase thanks to the investment tax credits (ITC) available until 2023-2024 providing a relatively stable policy environment, even as supply chain and logistical challenges hampered much faster growth.

Renewable net capacity additions by country and region, 2019-2021



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India's renewable energy growth recovered in 2021 following a record slowdown in 2020 due to project delays related to Covid-19 challenges. With the commissioning of already auctioned utility-scale projects and the acceleration of the distributed PV market due to policy improvements, India's renewable capacity additions in 2021 more than doubled compared to 2020. In Brazil, generous net metering incentives for distributed PV application led to a rush in installations while onshore wind additions accelerated because of supportive economics from bilateral contracting in the free market. In Africa, renewable capacity additions resumed growth with the commissioning of previously awarded wind and solar PV projects in South Africa. The phase out of the generous feed-in tariff (FIT) scheme in Viet Nam resulted in a bust in the deployment cycle, with the country's additions halving from 2020 to 2021. As a result, ASEAN's annual installations declined 40% year-on-year, although still slightly higher than in 2019.

2022 and 2023 forecast summary

Renewable capacity additions will break another record in 2022 led by solar PV

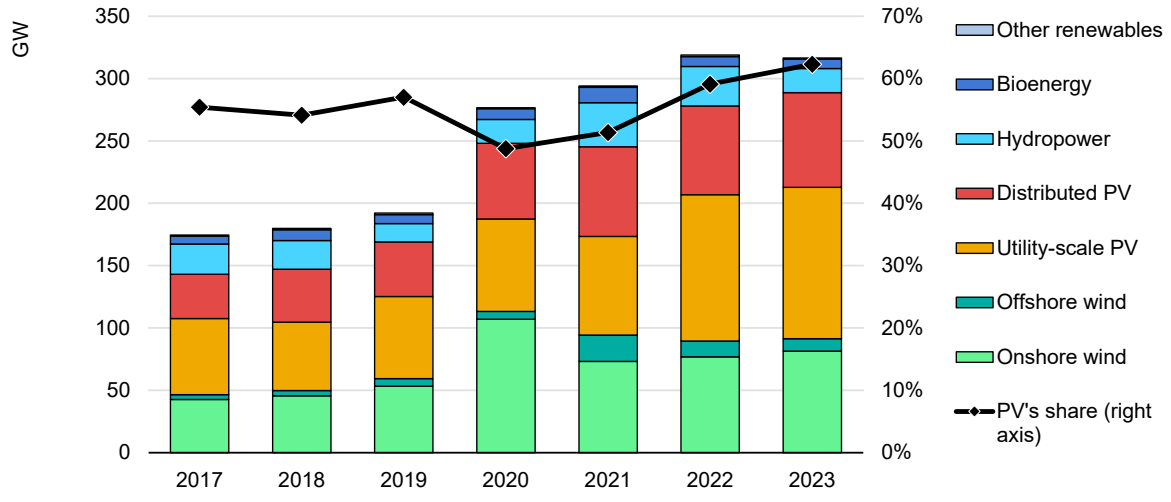
Renewable capacity is expected to increase over 8% in 2022 compared with last year, pushing through the 300 GW mark for the first time. Solar PV is forecast to account for 60% of the increase in global renewable capacity this year with the commissioning of 190 GW, a 25% gain from last year. Utility-scale projects account for almost two-thirds of overall PV expansion in 2022, mostly driven by a strong policy environment in China and the European Union driving faster deployment.

Following a 32% year-on-year decline in 2021, new global onshore wind installations are expected to slightly recover and reach almost 80 GW. Offshore wind growth worldwide is expected to decline 40% in 2022 following the exceptional four-fold jump last year in China due to the national subsidy phase-out deadline. Despite this decline, 2022 global offshore wind capacity additions will still double compared to 2020, thanks to the continuation of provincial incentives in China and the expansion in the European Union. As a result, China is expected to have the largest cumulative installed offshore wind capacity globally and surpass the European Union and United Kingdom combined by the end of this year.

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Unless new and stronger policies are implemented in 2023, global renewable capacity additions are expected to remain stable compared with 2022. While solar PV is forecast to break another record in 2023, reaching almost 200 GW, and with the expansion of wind and bioenergy remaining stable, 40% lower hydropower additions due to a reduced project pipeline in China stymies capacity growth in the global renewable energy market.

Net renewable capacity additions by technology, 2017-2023



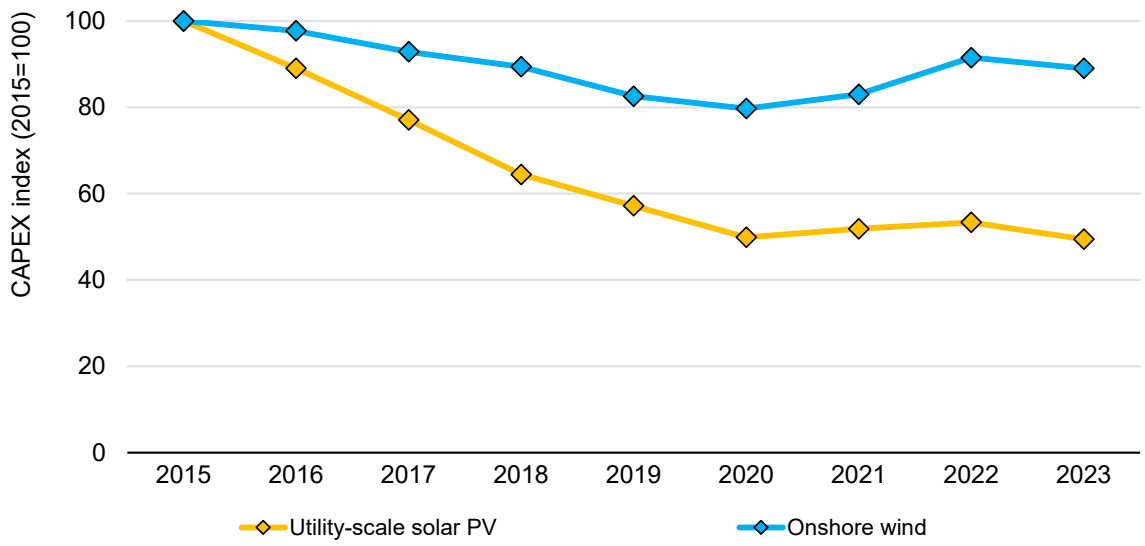
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Higher solar PV and wind costs are here to stay in 2022 and 2023 but they do not challenge competitiveness

Prices for many raw materials and freight costs have been on an increasing trend since the beginning of 2021. By March 2022, the price of PV-grade polysilicon more than quadrupled, steel increased by 50%, copper rose by 70%, aluminium doubled and freight costs rose almost five-fold. The reversal of the long-term trend of decreasing costs is reflected in the higher prices of wind turbines and PV modules as manufacturers pass through increased equipment costs. Compared with 2020, we estimate that the overall investment costs of new utility-scale PV and onshore wind plants are from 15% to 25% higher in 2022. Surging freight costs are the biggest contributor to overall price increases for onshore wind. For solar PV, the impact is more evenly divided among elevated prices for freight, polysilicon and metals.

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Solar PV and onshore wind investment cost estimates for new contracted projects under high commodity prices



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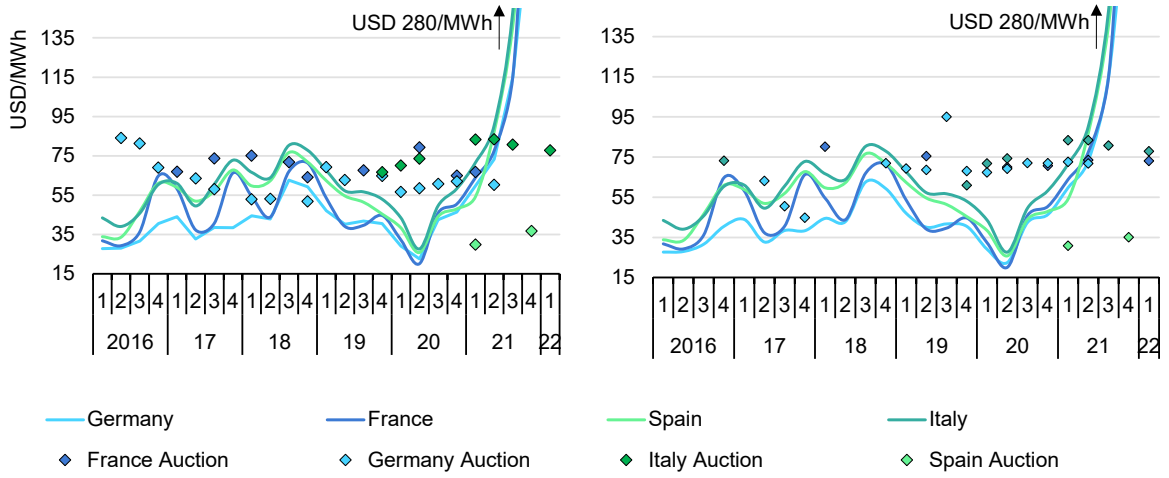
High prices for oil, natural gas and coal also contribute to rising production costs of manufactured materials for renewable electricity technologies since fossil fuels are used in both industrial processes and power generation.

While significant in absolute terms, the increase in renewables costs have not hampered their competitiveness because prices of fossil fuels and electricity have risen at a much faster pace since the last quarter of 2021. Globally, power prices are breaking historic records in many parts of the world, especially where natural gas is the marginal technology setting the final hourly or daily price in many wholesale electricity markets. This is especially prevalent in European Union countries, where wholesale power prices in Germany, France, Italy and Spain have increased more than six-fold on average compared with mean values from 2016 to 2020.

Historically, long-term contract prices from solar PV and wind auctions have been higher than wholesale prices in many large European Union markets. However, even the highest-priced onshore wind and utility scale contracts signed over the last five years are half of the average wholesale prices seen today in the European Union. For newly contracted projects, despite cost increases, onshore wind and solar PV ventures are offering long-term contracts significantly lower than wholesale price averages over the last six months. For instance, prices for utility-scale solar PV and onshore wind projects increased 15-25% in the recent Spanish auction held in December 2021, to USD 37/MWh and USD 35/MWh, respectively. Today, these results are one-tenth of average Spanish wholesale electricity prices over the last 14 months.

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Utility-scale solar PV (left) and onshore wind (right) auction contract and wholesale power prices in selected European Union countries, quarterly averages from 2016-2022



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Forecast additions for 2022 and 2023 have been revised upwards by 8% from last year led by China and the EU

China accounts for the majority of upward forecast revisions for 2022 and 2023 since our last report, despite the phase out of incentives for all renewables last year. The expansion is due to multiple government and market factors. First, the generation costs of solar PV and onshore wind are lower than coal benchmark prices in the majority of provinces. Second, the government announced 450 GW of additional large-scale onshore wind and solar PV megaprojects in the Xinjiang and Inner Mongolia provinces, known as “mega-hubs”, with 100 GW starting development at the beginning of 2022. Third, China’s Ministry of Finance confirmed the payment of outstanding renewable energy subsidies worth USD 60 billion to be paid through 2022, improving the balance sheet of developers and unlocking additional funds for new projects. Fourth, in the absence of national subsidies, provincial governments are still providing tax incentives and low-cost financing to renewable energy projects.

In the European Union, solar PV accounts for the majority of upward revisions, with faster policy implementation driving growth in Germany, the Netherlands, Poland, Italy and France. However, the European Union’s onshore wind growth was revised down due to ongoing permitting challenges slowing deployment in Germany, Poland and Italy. Brazil’s generous net metering scheme results in a distributed PV market boom, supporting upward revisions to the Latin America forecast. In India, delayed projects in 2021 leads to higher growth in 2022, with increased distributed solar PV capacity supporting the overall upward revisions.

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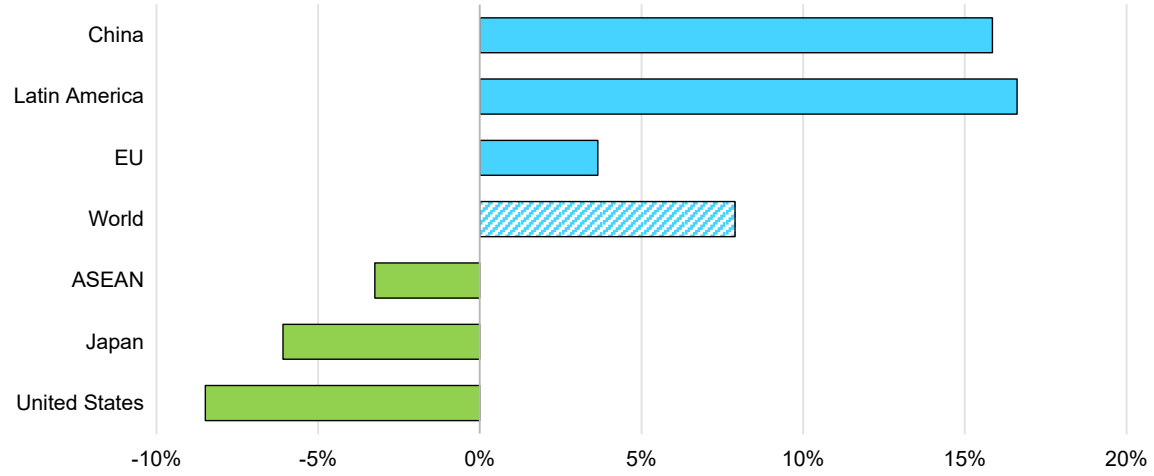
Policy uncertainties and trade measures challenge short-term wind and solar PV growth in the United States

Among large renewable energy markets, the forecast is revised down in the United States due to uncertainty over new incentives for both wind and solar PV. Multiple policy proposals, including long-term tax incentive extensions, have yet to be approved by the House of Representatives and Senate.

New trade policies on solar PV have also increased challenges for developers in the United States. In June 2021, the government banned imports from several polysilicon producers located in Xinjiang, China following the indication from the US Customs and Border Protection agency that these companies use forced labour in their manufacturing. In addition, at the end of March 2022, the US Department of Commerce launched a new investigation to assess whether solar cells produced in Southeast Asia are made with parts manufactured in China that are subject to an import tariff imposed in 2018. Since the introduction of tariffs in 2018, Southeast Asian countries such as Viet Nam, Malaysia, and Indonesia replaced imports from China, supplying over 80% of the country's cell and module imports. The new investigation and the possibility of additional tariffs compounding procurement challenges in the short term, reducing the availability of solar PV modules. As a result, we have lowered our forecast for solar PV by 17% in 2022 and 9% in 2023.

Japan's renewable capacity additions in 2022-2023 are also revised down from last year, mainly due to lower FIT approval for solar PV. The new feed-in premium (FIP) scheme just started in April 2022. This could lead to additional capacity growth for solar PV and onshore wind in the longer term, but forecast uncertainty remains in the short term.

2022 and 2023 renewable capacity forecast revisions, December 2021 vs May 2022



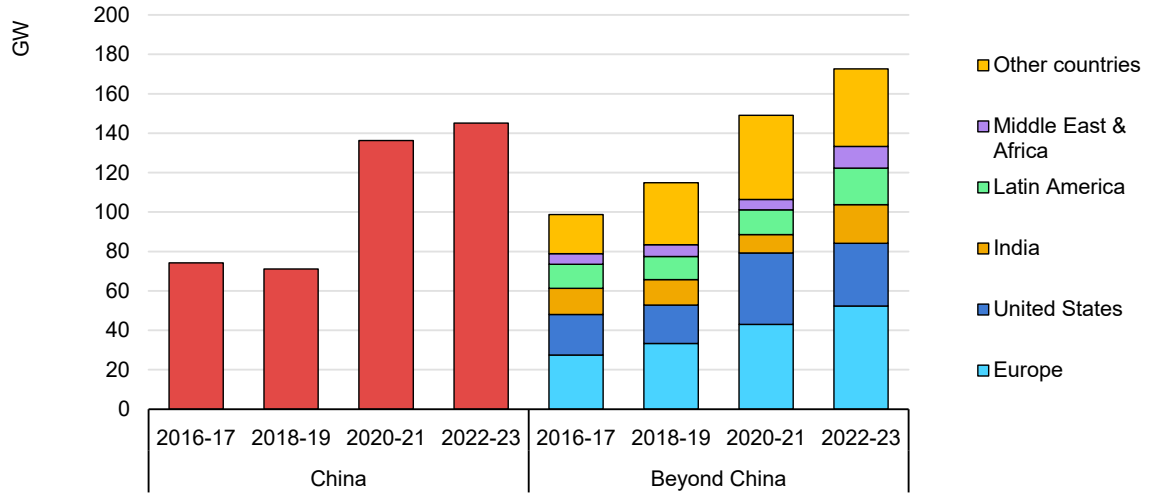
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Faster implementation of policies expedite deployment in the European Union and India, while China maintains lead

China accounts for 45% of global renewable capacity additions in 2022-2023, with the commissioning of over 140 GW on average per year driven mostly by large-scale solar PV deployment. The expansion trend in China is fully in-line with the government's 1 200 GW wind and solar PV target by 2030. Annual additions are expected to remain slightly higher compared with 2020-2021, when the country saw multiple deployment rushes due to incentive phase-out schedules for onshore wind and utility-scale PV in 2020, and offshore wind and residential PV in 2021.

Annual average capacity additions by country and region

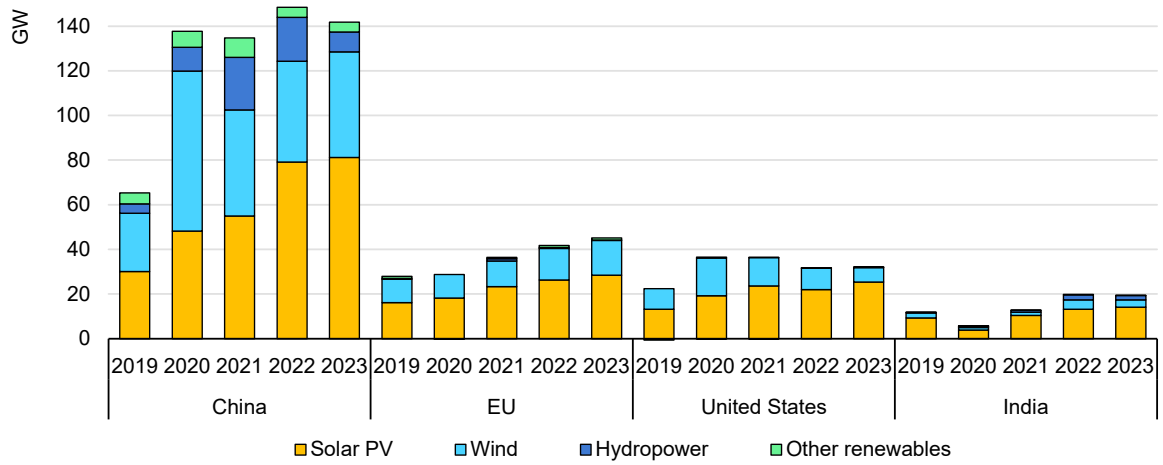


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In the European Union, rapid implementation of previously announced ambitious policy targets and already awarded auctions, combined with continuous incentives for distributed solar PV, drive the expansion. In response to the Russian invasion of Ukraine, many European Union countries announced plans to accelerate renewables deployment aimed at reducing their dependence on Russian natural gas imports. Germany, the Netherlands and Portugal either increased their renewable energy ambitions or moved their initial targets to an earlier date. We expect that the impact of these new policies will be limited by 2023, especially for large-scale projects that require development timelines of more than 18 months. However, our forecast sees some upside on distributed PV as residential and commercial installations enable consumers to reduce their electricity bills through self-consumption.

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Renewable capacity additions in China, European Union, the US and India, 2019-2023



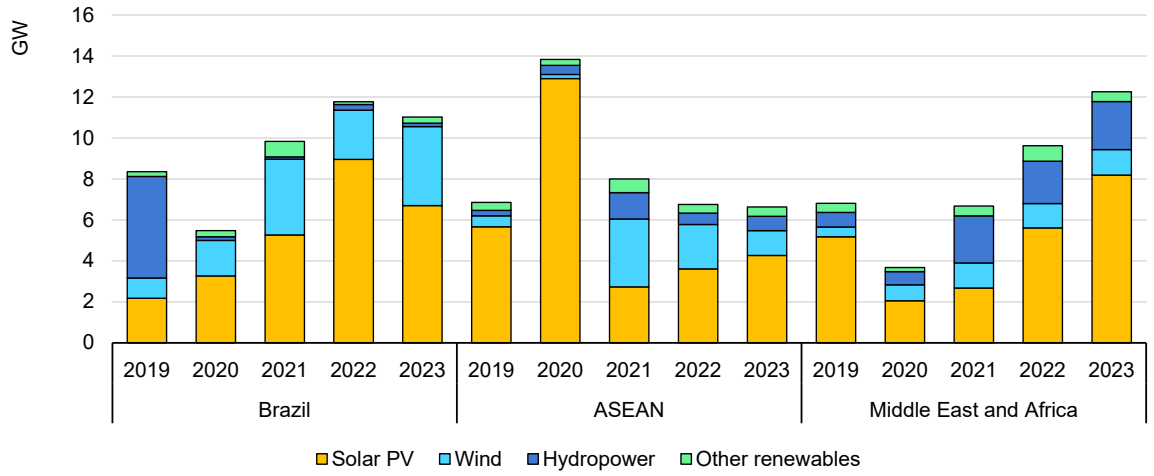
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In India, new records for renewable capacity expansion are expected to be set in 2022 and 2023 as delayed projects from previous competitive auctions are commissioned, especially for solar PV. Nonetheless, the financial health of distribution companies (DISCOMs) remains the primary challenge to renewable energy deployment in India, with potential project cancellations and protracted contract renegotiations.

In the United States, annual capacity additions are expected to slow over 2022 and 2023. Wind and solar PV sectors face two key challenges to achieve faster growth in the short term. First, the lack of long-term visibility on future incentive schemes has reduced the project pipeline for onshore wind developments and the PTCs phased down from the initial rate of USD 19/MWh for projects beginning construction in in 2016 to USD 10/MWh for construction starting in 2019, reducing economic attractiveness. While subsequent extensions of the PTC in 2020 and 2021 have been at higher rates, those years fall outside of our forecast period given development timelines. Second, potential solar PV trade measures against Southeast Asian countries, in addition to China, are reducing the availability of solar modules in the short term and leading to higher prices, which were already inflated due to elevated commodity prices. Current production of modules in the United States can only meet less than 20% of last year's annual demand and there are limited manufacturers outside of Viet Nam, Indonesia, Cambodia, Malaysia and China that can provide PV products to the US market.

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Renewable capacity additions in Brazil, ASEAN, Middle East and Africa, 2019-2023



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While smaller in absolute terms, significant growth occurs and accelerates in other world regions, notably Latin America, the Middle East and North Africa. In Brazil, we expect renewable capacity additions to break another record in 2022 due to the generous net metering scheme supporting distributed solar PV expansion. However, net metering incentives begin to phase down in 2023, resulting in slightly lower capacity additions in 2023.

The varying commissioning deadlines of competitive auctions and bilateral contracts in ASEAN can lead to fluctuating utility-scale wind and PV capacity expansion. Viet Nam's policy boom and bust cycles have led to significantly lower capacity additions compared with 2020. Following the solar PV boom in 2020 and onshore wind in 2021, Viet Nam's renewable capacity additions are forecast to decline from 17 GW over 2020-2021 to just 6 GW for 2022-2023.

In the Middle East and Africa, the push for solar PV drives annual capacity additions. Falling system costs, good resource potential, favourable financing conditions and economies of scale make solar PV projects in the Middle East economically attractive. In sub-Saharan Africa, government guarantees or backing from development banks for utility-scale solar PV, wind and hydropower projects are fuelling growth.

Wind and solar PV have the potential to reduce the European power sector dependence on Russian gas by 2023

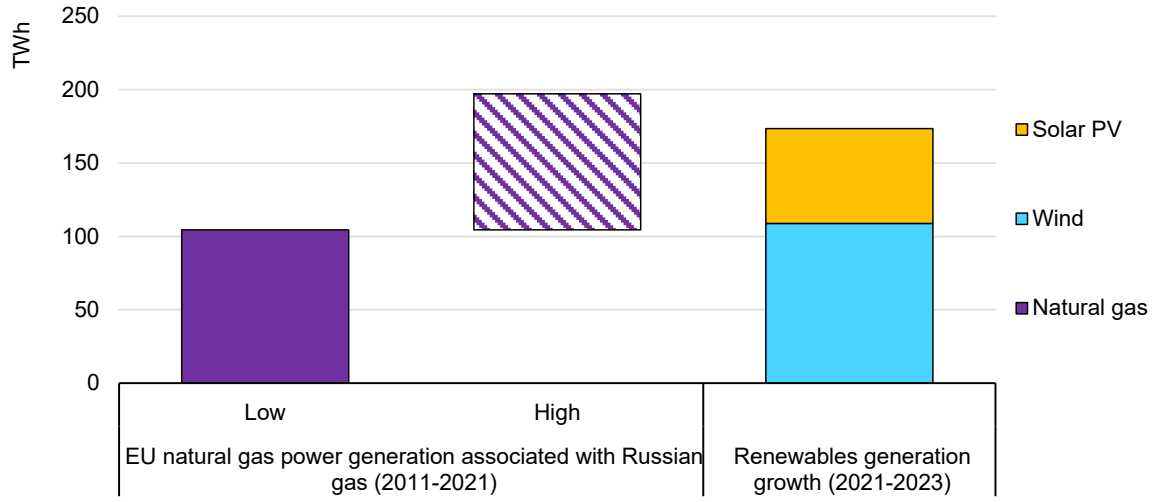
Russia supplies around 45% of the European Union's gas imports for industry, homes and electricity generation. For electricity generation, natural gas accounts for around 16% of the group's total power demand. Over the last decade, natural

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gas-fuelled electricity generation annually ranged from 340 TWh to 600 TWh, depending on the price environment, wind and solar PV penetration, and winter demand.

Considering country-level supply dependencies, we estimate that between 100 TWh to 200 TWh of European Union natural gas-based electricity is provided by Russia. On the other hand, our forecasts indicate incremental growth of renewable electricity generation up to 180 TWh from 2021-2023, almost equal to the highest value of Russia dependent gas-fired generation. With current deployment trends, wind and solar PV expansion in the European Union has the potential to reduce the dependence on Russian gas use in electricity significantly. However, the contribution of variable renewables will also depend on policies on energy efficiency measures keeping demand in check and the phase-out or phase-down policies for coal and nuclear energy in several member states.

European Union natural gas-fired electricity generation for 2011-2021 and renewable electricity generation growth for 2021-2023

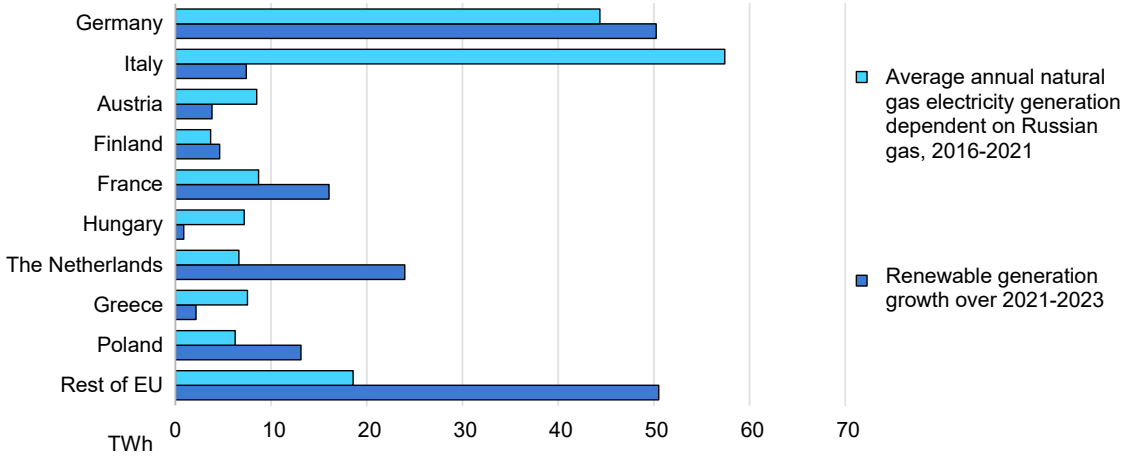


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European Union countries have varying levels of dependency on Russia for their natural gas supply. Among member states, Germany and Italy have the highest dependency on Russia in terms of absolute electricity generation. However, the potential for renewables to reduce dependency in Germany is significantly higher than in Italy based on our wind and solar expectations by 2023 – unless new and stronger policies are introduced and the pace of implementation picks up. France and the Netherlands' dependency on Russia gas is relatively low, enabling a higher potential for renewables to displace natural gas. Conversely, in Austria, Hungary and Greece renewables expansion remains limited to reduce the countries' dependency on Russia.

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Average annual natural gas-fired electricity generation in 2016-2021 and renewable electricity generation growth for 2021-2023 in selected EU member states



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The global energy crisis has introduced more forecast uncertainties and is testing the resilience of renewable electricity

The Russian invasion of Ukraine has added new urgency to accelerate clean energy transitions in order to reduce the dependency of imported fossil fuels from Russia, with deployment of more renewables now a strategic imperative for many countries, especially in the European Union. Indeed, since Renewables 2021 was published last December, the global energy crisis has moved the goal posts for the deployment of solar, wind and other renewable energy sources, and we have updated our forecasts in this new report in response. Many European Union countries have announced plans to advance development of renewables, with wind and solar PV holding the greatest potential to reduce the European Union's power sector dependence on Russia by 2023.

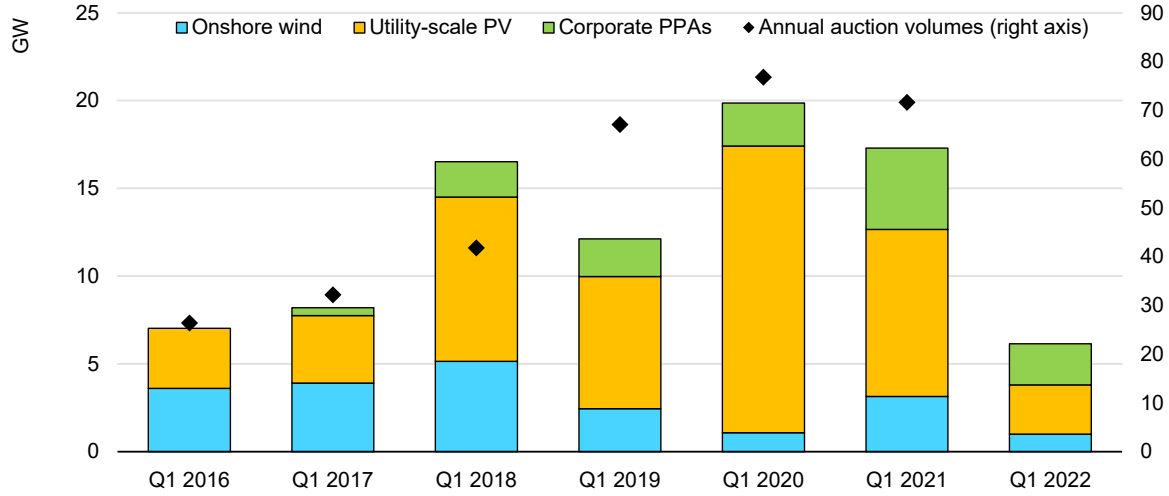
The high fossil fuel price environment has improved the cost competitiveness of renewable electricity technologies against coal and natural gas-fuelled power plants. Meanwhile, residential and commercial solar PV applications are helping consumers reduce their electricity bills. However, despite their potential, an acceleration in new renewables capacity is highly dependent upon a stable policy environment providing long-term revenue certainty and faster permitting.

In our forecast, government-led competitive wind and solar PV auctions in 2019 and 2020 remain a key driver for renewables expansion through 2023. Auction volumes slightly declined in 2021 due to lower awarded capacity in China and India while they increased in the European Union and Latin America.

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However, geopolitical and macroeconomic challenges increase uncertainties over renewable electricity forecasts beyond 2023. Higher wind and solar PV investment costs due to elevated commodity prices in the wake of Russia's invasion and permitting delays resulted in the lowest first-quarter auction volumes globally in 2022 since 2016. In addition, volatility in electricity markets due to sharply higher gas prices has complicated contract negotiations for corporate power purchase agreements (PPA), especially in the European Union, while rising interest rates are compounding challenges for renewable developers.

Utility-scale solar PV and onshore wind auction capacity and corporate PPAs for first quarters, 2016 to 2022



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Source: For corporate PPAs: Bloomberg New Energy Finance.

While some of these difficulties will likely remain in the coming months and into next year, causing looming market uncertainties, the new focus on energy security – in particular in the European Union – is also triggering an unprecedented policy momentum towards accelerating energy efficiency and renewables. Ultimately, the forecast of renewable markets for 2023 and beyond will depend on whether new and stronger policies will be introduced and implemented in the next six months.

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Transport biofuels

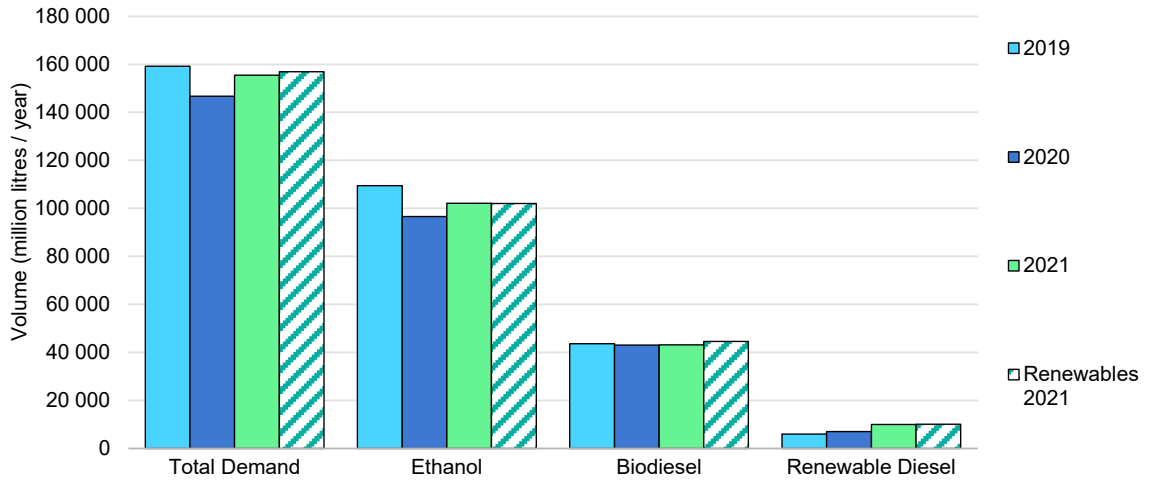
A brief look back at 2021

An uneven recovery as exceptionally higher prices and lower GDP undermine previous growth projections

Biofuel demand recovered in 2021 from Covid lows, to near 2019 levels. However, in 2022 we expect higher prices for oil and biofuels, combined with lower GDP expectations, to slow demand growth by 20% compared to our previous forecast. Growth in transportation fuels, albeit at more modest levels, and strengthening biofuel policies still drive year-on-year biofuel demand higher by 5% in 2022 and 3% in 2023.

Biofuel demand in 2021 reached 155 400 million litres, returning to near 2019 levels. Demand rose 8 700 million litres year-on-year, which is similar to our *Renewables 2021* estimate from December 2021. The recovery across fuel types was uneven, however. Ethanol demand rose 6% year-on-year in 2021 but remained 7% below 2019 levels. By contrast, renewable diesel use expanded by around 70% from 2019 and biodiesel demand rose 0.2% from 2019.

Biofuel demand in 2019-2021 by fuel type compared with Renewables 2021 forecast



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2022 and 2023 forecast summary

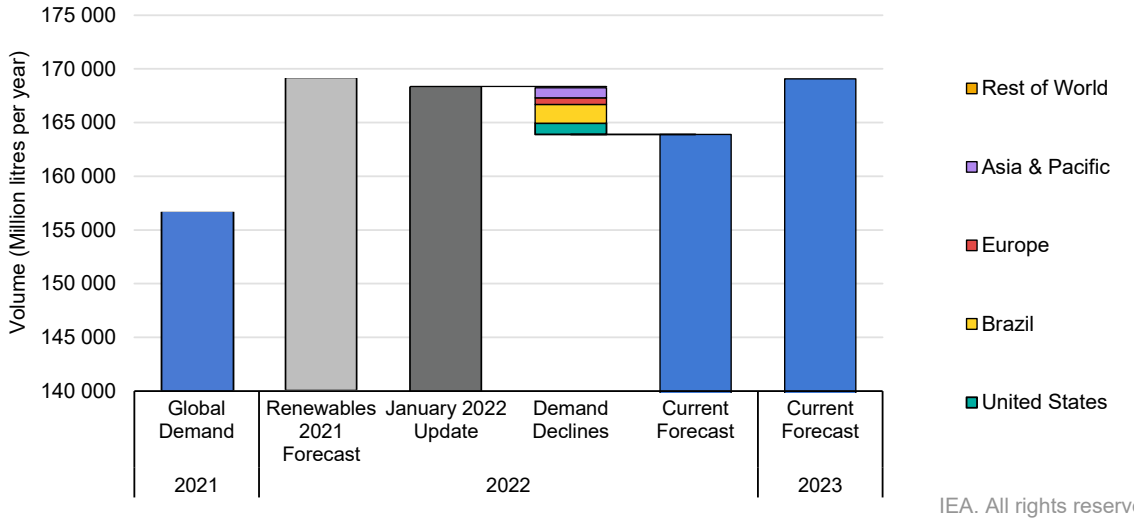
High prices slow biofuels demand growth

Russia's invasion of Ukraine is sending shocks through energy and agriculture markets, worsening already high prices. As a result, biofuel demand growth is now forecast to slow by 20% in 2022, equivalent to 2 200 million litres, compared with our previous forecast of a higher increase of 11 000 million litres. Weaker demand growth for transportation fuels largely underpins our downward revision. As of 4 April 2022, the IEA expects global oil demand growth will be 1.2% lower this year compared to our January forecast. The downward revision is due to a combination of Covid-related mobility restrictions in China and weaker GDP growth. Since biofuels are blended with gasoline and diesel, slower growth in transportation demand directly impacts biofuel demand, with declines deepest in important biofuel markets such as Europe, the United States and Brazil.

The agricultural industry is struggling with its own price shocks, which in turn have driven up biofuel prices in most markets. Increases vary by region and by fuel. For example, Brazil's ethanol prices are up 20% while in the United States they are up 30% since January 2022. Globally, biodiesel prices have risen between 20-30% this year alone. Price increases are on top of already lofty levels reported in December's Renewables 2021. In response, several governments are relaxing or delaying policies, which also contribute to slowing demand growth.

To estimate the impact on biofuels since Russia invaded Ukraine, we compared our current forecast against a pre-invasion January assessment. This forecast incorporated changing oil demand and price developments since the annual *Renewables 2021* was published in December 2021. The update led to a slight 0.5% downward revision to our new 2022 forecast.

Price and policy impacts on the 2022 forecast



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Brazil accounts for the majority of the decline in global biofuel demand growth. Demand has been revised lower across all transport fuels from pre-invasion January estimates, with gasoline now -0.2% and diesel at -0.7% in 2022 versus 2021 levels. Lower transport fuel use slows 2022 Brazilian biofuel demand growth by 40% compared to January projections.

In the **United States,** we have revised down our 2022 biofuels growth by 15% from January's forecast. In 2022, gasoline and diesel demand are expected to be 1.5% and 2% respectively, lower than forecasted in January of this year, which in turn drives down ethanol, biodiesel and renewable diesel blending. It is unclear how rapidly changing market dynamics will influence the US Environmental Protection Agency's (EPA) decision on renewable volume obligations (RVO) set to be released in June. The EPA shared proposed requirements earlier this year, but since then transport fuel demand has declined and biofuel prices have increased, which may influence the EPA's final recommendation On the upside, the US government expanded the right to blend 15% ethanol during summer months to help lower gasoline bills. However, only 2% of fuelling stations provide 15% blending and so we expect this policy change will only slightly increase ethanol demand in 2022.

In **Europe,** 2022 gasoline and diesel demand are expected to be 1.5% and 1.1%, respectively, lower than forecasted in January of this year. Several governments are also proposing, or have already, reduced blending obligations because of high biofuel prices. At the time of writing, Belgium, Croatia, the Czech Republic, Finland, Germany and Sweden had all announced changes that, if implemented, will contribute to reduced biofuel demand in 2022 and 2023. For instance, Finland will lower blending obligations by 7.5 percentage points, on an energy basis, in 2022 and 2023. The impact of these changes in various regions remains unclear, however, as states will still have to comply with other policies like the EU's Fuel Quality Directive (FQD), which mandates greenhouse gas reduction targets. In our forecast, we estimate Finland and Sweden's plans lead to lower biofuel demand equal to 320 million litres in 2022. Combined, biofuel demand growth expectations are reduced by 16% compared to January levels.

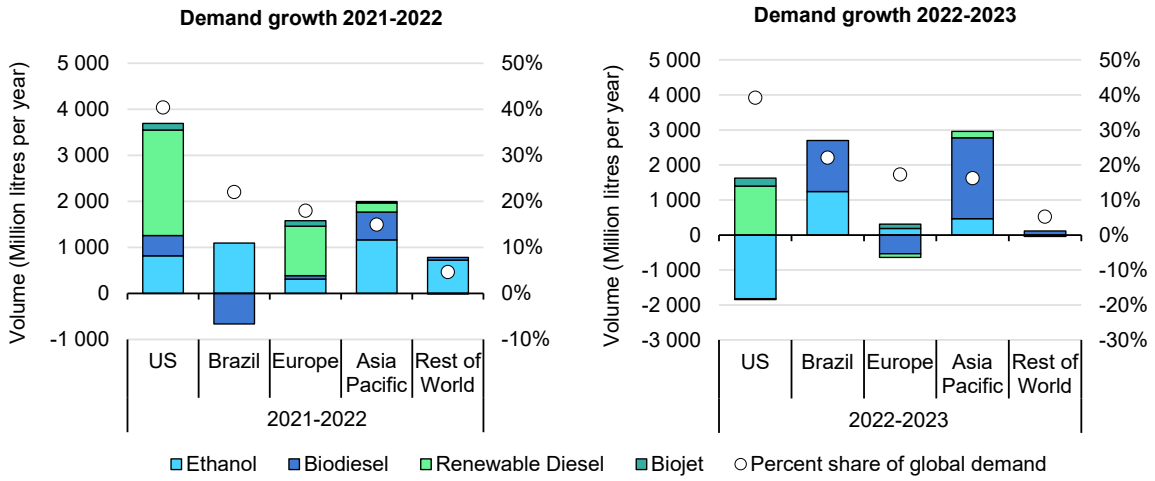
In the **Asia and Pacific** region we estimate biofuel demand growth is down 36% in 2022 compared to our January forecast. **Indonesia** accounts for almost all of this decline. In January, we had expected Indonesia would begin implementing its 40% blending mandate this year. Given higher prices and uncertainty surrounding the starting date for its new blending requirements, we have pushed increases in biofuel demand well into 2023.

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Biofuel demand grows in 2022 and 2023 despite disruptions

While growing more slowly than previously forecast for 2022, global biofuels demand is still expected to increase year-on-year by 5%, or 8 500 million litres, and rise by a further 3%, or 5 200 million litres, in 2023. Transport fuel demand growth, although at a slower pace, and government policies continue to drive demand higher for global biofuels.

Year-on-year biofuels demand growth and percentage of global market share



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The **United States** leads global biofuels growth, with demand expected to increase by 6% in 2022 compared to 2021 despite our downward revision from January. The recovery in gasoline and diesel use to pre-Covid levels, California's low carbon fuel standards (LCFS), implementation of renewable fuel standards (RFS) and the federal biodiesel blenders' tax credits will all combine to drive this expansion. We expect US biofuel demand in 2023 to remain near 2022 levels as ethanol demand declines slightly due to stable blending levels and lower gasoline demand growth. Lower ethanol use is offset by continued policy driven growth in renewable diesel demand.

In **Brazil,** we forecast 1% growth in biofuels demand in 2022 relative to 2021. Ethanol use expands slightly, despite weaker gasoline demand over the time period. Ethanol prices remain more attractive than gasoline, which should lead to a higher blending share. This growth is partially offset by lower biodiesel demand driven by a 0.7% decline in diesel use in 2022. Biofuels demand is expected to rise by a sharper 8% in 2023, led higher by stronger gasoline and diesel consumption and expectations that Brazil will reach its 15% biodiesel blending target by the end of 2023.

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Europe biofuel demand is expected to expand by 6% or 1 600 million litres in 2022 relative to 2021. Growth is supported by stronger state-level policies and rising gasoline and diesel demand recovering from Covid lows, albeit at a slower rate than forecast earlier in the year. Biofuel demand growth slows in 2023, however, as gasoline and diesel demand ease on energy efficiency gains and expanding electric vehicle fleets, which outpace demand growth from strengthening policies.

In the **Asia and Pacific** region biofuel demand continues to grow, at 9% in 2022 and 12% in 2023, due to robust gasoline and diesel growth, strengthening government policies in **India** and higher biodiesel blending requirements in **Indonesia**. India continues to raise ethanol blending, reporting a 9.7% blending rate for ethanol in gasoline in April 2022. **China** contributes little to demand growth since there is no visibility on new support policies. China's 14th Five-Year Plan provided little insight on its biofuel plans other than reiterating its intent to "vigorously support advanced biofuels".

Forces of uncertainty – fuel, feedstocks and policies

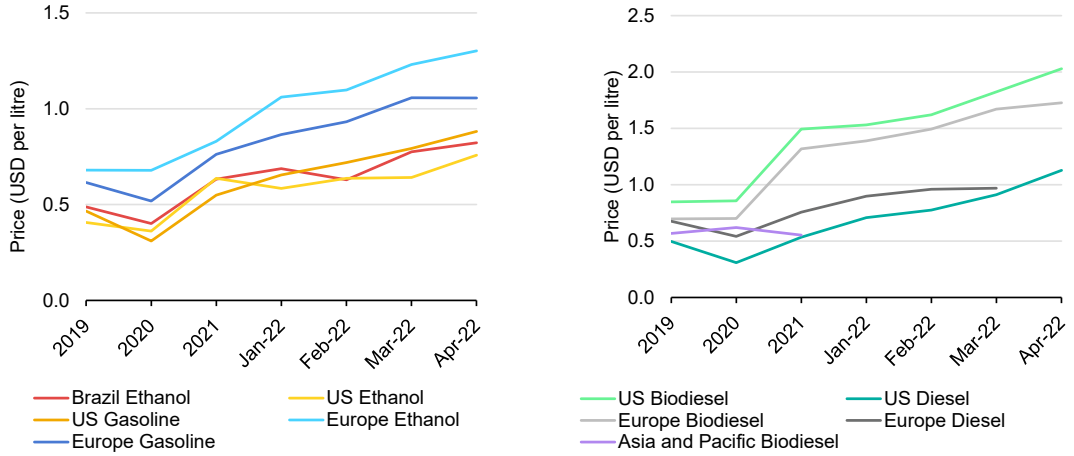
Oil and biofuel prices, energy and food security, and greenhouse gas objectives are all in flux, introducing multiple uncertainties into our forecast. The main factors that influence biofuel demand in the coming years are oil prices, biofuel prices and how governments evaluate the role of biofuels in navigating energy security, food security and greenhouse gas objectives.

Oil prices, GDP growth and demand

In the wake of Russia's invasion of Ukraine, prices for international benchmark Brent crude rose to highs of almost USD 140 bbl/d and ranged from USD 100-120 bbl/d from March through April. In addition to high oil prices, the economic fallout from the escalated Covid crisis in China is undermining the outlook for the global economy. As a result, GDP growth assumptions have been lowered to 3.4% in April compared to 4.3% in January. Higher oil prices and weaker GDP growth have combined to curb transportation demand globally, especially in key biofuel markets like the United States, Europe and Brazil. If the higher price and lower economic environment persist, already modest growth in transport demand may weaken further, which in turn would reduce our current biofuel demand estimates. These downward pressures may partially be countered by an increase in demand for biofuels stemming from its lower prices relative to other fuels such as ethanol in the United States and Brazil.

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Biofuel and fossil fuel prices 2019 to April 2022



Sources: Bloomberg and Argus.

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Feedstocks and biofuel prices

Biofuel and feedstock prices continue to climb as well. Biofuels are primarily made from corn, sugar, vegetable oils and used cooking oil, which are all near or at all-time highs. However, some feedstocks are more affected than others. For instance, vegetable oils rose across the board and prices as of April 2022, are up 65-164% since 2019, which in turn has fuelled higher prices for biodiesel and renewable diesel. Corn prices are also up, putting upward pressure on ethanol prices. On the other hand, sugar, used primarily in Brazil and India, is less impacted.

According to the USDA, a number of factors are propelling global agricultural commodity prices to near-record levels, including the potential loss of exports from Ukraine, increased global demand, weather-related supply disruptions, lofty energy prices, increased fertilizer costs and countries imposing export restrictions on certain food crops which exacerbate the impacts on markets. For example, Indonesia's decision in April to temporarily ban some components of palm oil put further upward pressure on biodiesel feedstocks.

It is unclear how or when commodity prices will come down, especially since the impact on markets are interrelated and widespread. While higher prices should encourage farmers to grow more crops, equally costly fertilizer supplies could limit overall yields, undermining the benefits of more planting. Export barriers could also limit increased production from these countries since farmers would be less able to capture export benefits.

Policy reactions

Beyond market responses, governments are also considering whether biofuels help or hinder volatile fuel prices, energy and food security, and GHG reduction policies.

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These forces are playing out differently in various countries and regions, and by individual fuels. For instance, in India, ethanol policies are moving ahead as planned since ethanol helps reduce oil demand, decrease greenhouse gas emissions and sugar prices have increased less than other crops. In Brazil, biodiesel blending requirements remain relaxed because of high feedstock prices, despite higher GHG emissions and the need for more oil to make up for biodiesel reductions.

To date, ten governments have, or are proposing, relaxed, delayed or postponed biofuel blending requirements or GHG quotas this year, in addition to actions taken in 2021 because of already high prices. The stated rationale for these policy decisions is to reduce additional fuel costs borne either by consumers or by governments. The two exceptions are a proposal in Belgium which specifically targets crop-based feedstocks and statements from Germany's Minister of Environment stating her intention to reduce crop biofuel use in Germany. Should high prices persist, other governments may also pause or delay mandates. Biodiesel and renewable diesel will likely be under the most pressure since prices for these fuels have risen faster than oil prices, and the vegetable oil market, which most of these fuels are produced from, continues to see high price increases. While some production may shift to wastes like used cooking oil and tallow, these feedstocks are already at high prices and in limited supply. On the other hand, the United States will temporarily extend its 15% ethanol blending mandate over the summer months with the aim of reducing gasoline prices for consumers.

Food security is also top of the agenda for many governments, but to date only Belgium and Germany are considering relaxing biofuel mandates to address this issue. This is primarily because there are better and more effective tools to address food security concerns. The FAO has recommended ten actions to manage current high prices, including maintaining trade policies, diversifying food supplies and supporting vulnerable groups. Nevertheless, China has warned ethanol producers that it will "strictly control processing of fuel ethanol from corn" and the European Union Commission has noted it will support member states that reduce mandates in the name of food security.

Governments are expected to tread carefully when considering reducing mandates, however. Any reduction in biofuel demand comes with an increase in both oil deliveries and GHG emissions, which runs counter to priorities for most governments with biofuel requirements. These policy priorities will likely make any changes temporary in order to address short-term challenges. Finland for example relaxed its targets for two years, while also increasing its long-term target blending target from 30% to 34% by 2030.

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Policy reactions to high biofuel and oil prices

Country	Policy proposal, change or continuation
Argentina	Argentina passed a law to reduce the biodiesel blend rate from the original 10% to 5% because of high crop costs. The law also authorises the government to lower the biodiesel blend rate to 3%, and to halve the ethanol volume entering the fuel sector from corn ethanol if necessary.
Brazil	Brazil will maintain its biodiesel blending mandate at 10% for biodiesel, from an intended 15% target for 2022. The move to 10% was made in 2021 and then continued this year to reduce diesel prices.
Belgium	Belgium's green coalition has shared a proposal to remove current biofuel mandates temporarily to reduce fuel and food costs and then slowly fade out crop-based fuels by 2030.
Colombia	The Colombian government reduced its ethanol blending mandate from 10% to 4% from April 2021, with the aim of returning blending to 10% in September 2021. However, in August, Colombia extended the 10% increase to January 2022 but is now proposing a 6% target until August 2022.
Czech Republic	The Czech government has proposed removing blending targets, but this will not be confirmed until the end of the year and greenhouse gas reduction requirements would still apply.
Finland	Finland will reduce its renewable energy requirement to 12% from 20% for 2022. It estimates this will reduce fuel prices by 12 cents per litre.
Germany	Germany's Environment Minister proposed to "further reduce the use of agro-fuels from food and feed crops," in response to high food prices resulting from the Russia/Ukraine war. There is of yet no proposal.
Sweden	Sweden is proposing a pause to its GHG targets for the transport sector for 2022 and 2023 levels. Increases will continue post-2023.
Indonesia	Indonesia still plans on increasing its 40% blending mandate, but this is now not likely until 2023.
Croatia	Croatia will remove penalties on blenders that miss their targets.
United States	The United States is allowing 15% ethanol blending during summer months.

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Annex

Abbreviations and acronyms

CSP	concentrated solar power
DISCOM	distribution company
FIP	feed-in premium
FIT	feed-in tariff
GHG	greenhouse gas
ITC	investment tax credit
PPA	power purchase agreement
PTC	production tax credit
ASEAN	Association of Southeast Asian Nations

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
g CO_2	gramme of carbon dioxide
g CO2/kWh	grammes of carbon dioxide per kilowatt hour
GJ	gigajoule
Gt/yr	gigatonnes per year
Gt CO_2	gigatonne of carbon dioxide
Gt CO_2/yr	gigatonnes of carbon dioxide per year
GW	gigawatt
GWh	gigawatt hour
kWh	kilowatt hour
MWh	megawatt hour
TWh	terawatt hour

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