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Energy Agency

Executive Summary

# Renewables 2019

Analysis and forecast to 2024

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## Solar PV drives strong rebound in renewable capacity additions

**Renewable power capacity additions are expected to increase in 2019 at their fastest pace in four years.** After stalling in 2018 for the first time in almost two decades, additions are set to rise by 12%. This renewed growth is driven by solar photovoltaic (PV), owing to rapid expansion in the European Union, a stronger market in India and an installation boom in Viet Nam. Higher growth in onshore wind also supports this rebound, particularly in the United States, the European Union and the People's Republic of China ("China").

**Renewable power capacity is set to expand by 50% between 2019 and 2024, led by solar PV.** This increase of 1 200 GW is equivalent to the total installed power capacity of the United States today. Solar PV alone accounts for almost 60% of the expected growth, with onshore wind representing one-quarter. Offshore wind contributes 4% of the increase, with its capacity forecast to triple by 2024, stimulated by competitive auctions in the European Union and expanding markets in China and the United States. Bioenergy capacity grows as much as offshore wind, with the greatest expansions in China, India and the European Union. Hydropower growth slows, although it still accounts for one-tenth of the total increase in renewable capacity.

**Falling costs and more effective policies drive a significant upward revision in the forecast for renewable capacity deployment compared with last year's report.** Solar PV generation costs are estimated to decline a further 15% to 35% for both utility-scale and distributed applications by 2024. Recent competitive auction results indicate that the levelised cost of generation for utility-scale solar PV plants will become comparable with or lower than that of new fossil fuel plants sooner than expected in a growing number of countries. Competition and cost reductions also drive expansion in both on- and offshore wind capacity.

**The European Union and the United States are responsible for half of the upward revision in the forecast.** A more optimistic outlook for the European Union results from higher planned renewables auction volumes and faster distributed solar PV growth in member states to meet renewable energy targets. In the United States, wind and solar PV developers are rushing to complete projects before federal tax incentives end, while corporate power purchase agreements (PPAs) and state-level policies contribute to growth. Our forecast for renewable capacity expansion in China to 2024 is higher than last year because of improved system integration, lower curtailment rates, and the enhanced competitiveness of both solar PV and onshore wind. In India, renewable capacity doubles by 2024, mostly in solar PV. But ongoing challenges concerning the operational and financial health of distribution companies, land acquisition, grid reinforcement, and access to financing hamper faster progress. Sub-Saharan Africa is the only region for which our forecast has been revised downwards, as growth is held back by continued delays in implementing announced policies, high investment risks, and weak grid infrastructure.

**Renewable electricity growth still needs to accelerate significantly to meet long-term sustainable energy goals.** This growth is possible if governments address the three main challenges to faster deployment: policy and regulatory uncertainty; high investment risks in many developing economies; and system integration of wind and solar PV in some countries. Tackling these challenges underpins our *Accelerated Case* forecast in which total renewable capacity increases more than 60% to 4 000 GW by 2024, by which time it is twice the size of today's global coal capacity. Annual deployment rises to 280 GW – 50% higher than the current rate and in line with long-term sustainable energy goals.

## Distributed solar PV takes centre stage

**Distributed solar PV systems in homes, commercial buildings and industry are set to take off, bringing significant changes in power systems.** A rapid rise in the ability of consumers to generate their own electricity presents new opportunities and challenges for electricity providers and policy makers around the world. Distributed PV capacity more than doubles to 530 GW by 2024, an increase equal to that of onshore wind or almost half of total solar PV.

**China is forecast to account for almost half of global distributed PV growth, overtaking the European Union to become the world leader in installed capacity as early as 2021.** Nevertheless, distributed PV expansion still picks up significantly in the European Union during 2019-24 as it becomes more economically attractive and the policy environment improves. While Japan remains a strong market, India and Korea emerge as drivers of capacity growth in Asia. Expansion of distributed solar PV in North America is twice as rapid between 2019 and 2024 as it was during 2013-18, mainly driven by the United States.

**Contrary to conventional wisdom, distributed PV growth is dominated by commercial and industrial applications rather than residential.** The economic case for commercial and industrial applications – which represent almost three-quarters of new distributed PV installations through 2024 – is generally better than for residential systems. This is because economies of scale lead to lower investment costs per kilowatt (kW) and because supply and demand are usually better aligned, enabling more self-consumption and larger savings on electricity bills.

**Some 100 million solar rooftop systems for homes could be operating worldwide by 2024.** Residential systems are set to account for one-quarter of total distributed solar PV capacity by then, with deployment expanding rapidly in many countries owing to favourable policy designs and the economic attractiveness of distributed PV. The top five markets for residential PV installations per capita in 2024 are Australia, Belgium, California (United States), the Netherlands, and Austria.

**Rapid cost reductions could lead to a distributed PV boom.** In most countries, commercial and residential systems already have electricity generation costs that are lower than the variable portion of retail electricity prices. Residential and commercial solar PV costs are forecast to decline a further 15% to 35% by 2024, making the technology more economically attractive and spurring adoption worldwide. Our *Accelerated Case* shows that a combination of increasingly favourable economics, enhanced policies and more effective regulation could push the global installed capacity of distributed PV above 600 GW by 2024 – almost double the total installed power capacity in Japan today. However, based on available rooftop area, even this is only 6% of distributed PV's technical potential. The increasing economic attractiveness of distributed PV systems could therefore lead to a massive expansion in the coming decades, attracting hundreds of millions (or even billions) of private investors.

**Major policy and tariff reforms are required to make distributed PV growth sustainable.** Currently, some distributed solar PV policies – such as buy-all, sell-all and annual net metering with retail-price remuneration – can have undesired effects. Unmanaged growth can disrupt electricity markets by raising system costs, challenging the grid integration of renewables and reducing the revenues of distribution network operators. Tariff reforms and appropriate policies will be needed to attract investment in distributed PV while also securing enough revenues to pay for fixed network assets and ensuring that the cost burden is allocated fairly among all consumers.

## Renewable electricity uptake benefits the heat sector

**Heat generated from renewable energy is set to expand by one-fifth between 2019 and 2024.** Buildings account for over half of global renewable heat growth, followed by industry. China, the European Union, India and the United States are responsible for two-thirds of the global increase in renewable heat consumption over the forecast period. However, renewables' share of global heat consumption increases only marginally, from 10% today to 12% in 2024. Overall, renewable heating potential remains vastly underexploited and deployment is not in line with global climate targets, calling for greater ambition and stronger policy support.

**Renewable electricity used for heat is forecast to rise by more than 40%,** a similar increase to that of bioenergy, accounting for one-fifth of global renewable heat consumption by 2024. This growth results mainly from a rising share of renewables in electricity generation and, to a lesser extent, greater electrification of end uses. Modern bioenergy remains by far the largest source of renewable heat by 2024. More than two-thirds of bioenergy growth is forecast to occur in the industry sector, mostly in India, China and the European Union.

## China to lead biofuel production growth for the first time

**Total biofuel output is forecast to increase 25% by 2024.** In 2018, production grew at its fastest pace for five years, propelled by a surge in Brazil's ethanol output. Overall, Asia accounts for half of the growth, as its ambitious biofuel mandates aimed at reinforcing energy security boost demand for agricultural commodities and improve air quality. In addition to biofuels, renewable electricity provides around 10% of renewable energy in transport by 2024, most of which is in China.

**China is set to have the largest biofuel production growth of any country.** By 2024, ethanol production is expected to triple, driven by the rollout of 10% ethanol blending in a growing number of provinces and increasing investments in production capacity. Brazil registers the second-largest growth, boosted by the introduction of the Renovabio programme in 2020. The United States and Brazil still provide two-thirds of total biofuel production in 2024.

**Hydrotreated vegetable oil (HVO) production is set to accelerate, raising competition with biodiesel.** HVO output more than doubles, accounting for one-fifth of biofuel production growth to 2024, comparable with the contribution of biodiesel and making it by far the largest source of advanced biofuels. HVO offers higher flexibility for blenders, the possibility to use of waste and residue feedstocks, and higher-value co-products such as renewable propane and chemicals. Over the next five years, policy-driven demand in the European Union and the

United States is forecast to stimulate USD 5 billion of investment in new HVO plants, a number of which will also produce aviation biofuels.

**Sustainable biofuel production and consumption need to accelerate considerably to be in line with long-term climate targets.** In our main forecast, renewable energy still meets only 5% of transport energy demand by 2024. Our *Accelerated Case* indicates a possible 20% additional growth by 2024, which requires enhanced policy support to demonstrate sustainability, spur the consumption of higher biofuel blends in key markets, and open up new markets in aviation and marine transport. Financial de-risking measures are also needed to encourage investment in less mature advanced biofuel technologies that can use a wider range of waste and residue feedstocks.

# INTERNATIONAL ENERGY AGENCY

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## **Renewables 2019 – Analysis and forecast to 2024**

Solar photovoltaics (PV) is driving the growth of renewable power capacity around the world. At the same time, it is raising the prospect of a significant shift in the role of electricity consumers. This is the result of distributed solar PV: the use of solar power systems by households, businesses and industry to generate their own electricity.

Distributed solar PV capacity is set to more than double in the next five years, accounting for almost half of all solar PV growth, according to a new in-depth focus in Renewables 2019, the annual IEA market analysis and forecast on renewable energy. The report assesses the current state of play of distributed solar PV and maps out its huge growth potential in the coming years. It also considers the implications for policy makers, utilities and consumers.

More broadly, this report analyses the role of renewable energy across the entire energy system – including the electricity, heat, and transport sectors – and provides forecasts for the period from 2019 to 2024.