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RENEWABLES 2018

Analysis and forecasts to 2023

EXECUTIVE
SUMMARY

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EXECUTIVE SUMMARY

Modern bioenergy, the overlooked giant of renewables

Bioenergy is a special focus of this year's report. Half of all renewable energy consumed in 2017 came from modern bioenergy, which provided four times the contribution of solar photovoltaic (PV) and wind combined. Most of the modern bioenergy (i.e. excluding the traditional use of biomass) contributing to final energy consumption provides heat in buildings and for industry. The rest is consumed in the transport sector and for electricity.

Bioenergy leads growth in renewable energy consumption over the forecast period of 2018-23. Around 30% of the growth in renewables consumption is expected to come from modern bioenergy in the form of solid, liquid and gaseous fuel due to bioenergy's considerable use in heat and its growing consumption and in transport. Other renewables make a negligible contribution to these two sectors, which together account for 80% of total energy consumption. In 2023, modern bioenergy remains the main renewable energy source, although its share of total renewable energy declines slightly as solar PV and wind expansion accelerate in the electricity sector.

Renewables increasingly central to total energy consumption growth

Global renewable energy consumption increased more than 5% in 2017 – three times faster than total final energy consumption. In the power sector, renewables accounted for half of annual global electricity generation growth, led by wind, solar PV, and hydropower.

The share of renewable technologies meeting global energy demand is expected to increase by a fifth, reaching 12.4% in 2023 – a faster rate of progress than in the 2012-17 period. Renewables cover 40% of global energy consumption growth over the forecast period. Their use continues to increase most rapidly in the electricity sector, reaching 30% of total world electricity generation in 2023. But because of weaker policy support and additional barriers to deployment, renewables use expands far more slowly in the transport and heat sectors.

Brazil has the greenest energy mix, but the People's Republic of China leads absolute growth. Of the world's largest energy consumers, Brazil uses the highest share of renewables by far – almost 45% of total final energy consumption in 2023. Bioenergy consumption in transport and industry is significant, and hydropower dominates the electricity sector. Meanwhile, as a result of policies to decarbonise all sectors and reduce harmful local air pollution, China¹ leads global growth in absolute terms during the forecast period, and surpasses the European Union to become the largest consumer of renewable energy. In the European Union, a greater share of renewables is spurred by binding renewable energy targets for 2020 and 2030 as well as by country-level policies and improved energy efficiency. Bioenergy drives renewable energy growth in India due its prominent role in industry followed by rapid solar PV and wind expansion.

Solar PV dominates renewable electricity capacity expansion

Once again, 2017 was a record year for renewable power. For the first time, renewable capacity additions of 178 gigawatts (GW) accounted for more than two-thirds of global net electricity capacity growth. Solar PV capacity expanded the most (97 GW), over half of which was in China. Meanwhile, onshore wind additions declined for the second year in a row, and hydropower growth continued to decelerate.

¹ "China" is used throughout to denote the People's Republic of China.

Solar PV capacity expands almost 600 GW – more than all other renewable power technologies combined, or as much as twice Japan's total capacity, reaching 1 terawatt (TW) by the end of the forecast period. Despite recent policy changes, China remains the absolute solar PV leader by far, holding almost 40% of global installed PV capacity in 2023.

Distributed generation makes the difference in solar PV growth. The expansion of distributed generation, led by commercial and industrial projects, and followed by residential applications, spurs almost half of global PV capacity growth over 2018-23. Homes, businesses and large industrial applications are expected to generate almost 2% of global electricity output by 2023. Without distributed generation, solar PV growth would be comparable to that of wind expansion.

Wind is the second-largest contributor to renewable capacity growth, while hydropower remains the largest renewable electricity source by 2023. Similar to last year's forecast, wind capacity is expected to increase 60% (325 GW), with offshore wind accounting for 10% of this expansion. Growth prospects for both hydropower and bioenergy are more optimistic than last year, mostly as a result of developments in China.

China continues to be the largest growth market for all renewable electricity sources except geothermal and marine as it is responsible for over 40% of global capacity expansion in the 2018-23 period. Despite recent policy changes in renewable support schemes to achieve a more cost-effective expansion and to address grid integration challenges, China is expected to comfortably exceed newly introduced renewable portfolio standard (RPS) targets by 2020 as wind and solar PV technologies become more competitive.

The European Union's capacity growth overtakes the United States to become the second-largest growth market after China, with 125 GW of renewable power capacity coming online in 2018-23. This optimistic forecast is based on: approval of the EU-wide target of 32% renewable energy by 2030; the introduction of additional competitive auctions for long-term power purchase agreements (PPAs) in key countries; and a growing corporate PPA market that takes advantage of wind and solar PV cost reductions. Although US renewable capacity is expected to grow 44%, recent changes to the federal tax code, trade policies and energy plans have introduced downside forecast uncertainties. A doubling of India's renewable capacity is anticipated, mostly in solar PV and onshore wind. This is similar to last year's forecast as challenges involving grid integration and the financial health of distribution companies hamper faster growth. Renewables growth accelerates in many other regions, from Latin America to sub-Saharan Africa.

A policy shift towards competitive pricing mechanisms drives renewables growth. For the first time, more than half of renewable electricity capacity is expected to be commissioned through competitive auctions, which continue to slash wind and solar PV bid prices to between USD 20 per megawatt hour (MWh) and USD 50/MWh. For offshore wind, the decline of almost two-thirds that is expected over the forecast period will also improve future prospects for the production of hydrogen, especially in Europe. Overall, continuous cost reductions are expected to make renewables more competitive with new coal and natural gas plants in an increasing number of countries.

Renewable heat potential remains untapped, demanding greater policy attention

Renewable heat consumption is higher than that of renewable electricity in absolute terms, but still represents only 10% of global heat demand. Heat accounts for the largest portion of energy end-use (52% of final energy consumption), given its use for heating buildings and water, for cooking, and for industrial processes. Modern bioenergy, which dominates renewable heat consumption, accounted for over 70% of directly used renewable heat in 2017 as well as most of the renewable heat used for district heating.

Renewable heat consumption is expected to increase 20%, capturing over one-third of global heat demand growth. China, the European Union, the United States and India together account for most of renewable heat growth. China's renewable heat consumption surpasses that of the United States, making it the largest consumer by 2023. Renewable heat shares also continue to expand steadily in member states of the European Union, supported by policies and by the decline in overall heat demand as energy efficiency rises.

Modern bioenergy consumption in the industry sector is anticipated to increase 13%. The use of biomass and waste fuels in the cement subsector is expected to grow almost 40%. However, the potential for further expansion is considerable, as demonstrated by the EU cement industry in which bioenergy and waste meet one-quarter of energy demand in accordance with robust waste management policies. With the exception of pulp and paper, in other energy-intensive industries, bioenergy is expected to make only a minimal contribution.

Renewable electricity for heat is the second-largest contributor to renewable heat growth over the forecast period, owing to two trends: 1) the use of electricity to produce heat is increasing at a faster rate than total heat consumption growth; and 2) the share of renewables in the electricity sector is expanding rapidly. Electrification of industrial processes is also gaining in popularity, while the use of heat pumps in buildings is becoming more widespread.

Biofuels and electric mobility emerge as complementary options in transport

Biofuel production continues to increase, rising 15% to 165 billion litres (L) by the end of the forecast period. However, biofuels only represent less than 4% of total transport energy demand in 2023. Even though electric mobility expands rapidly, biofuels still hold an almost 90% share of total renewables in transport sector energy demand in 2023. Fuel ethanol makes up two-thirds of biofuel production growth, and biodiesel and hydrotreated vegetable oil (HVO) provide the remainder.

Asia and Latin America dominate biofuel production growth. Half of global production growth is forecast to happen in Asian countries, mainly China, India and ASEAN,² where ample feedstocks and the desire to increase security of supply have resulted in greater policy support. Meanwhile, Brazil delivers the largest absolute increase in biofuels output of any country over the forecast period. US ethanol production is forecast to decline slightly owing to greater vehicle fleet efficiency, limited investment in new capacity, and attainment of the allowable limit for corn ethanol under the current policy scheme.

2020 is expected to be a pivotal year for biofuel policies as Brazil and China introduce policy schemes anticipated to significantly boost market prospects. Brazil's flagship RenovaBio policy is expected to strengthen the economics of biofuel production, accelerating investment in new capacity and output from existing plants. In addition, China is extending its 10% ethanol-blending mandate nationwide, resulting in a notable upward revision of the forecast. By 2020, India's recently announced biofuels policy is also anticipated to result in higher biofuel production. However, the turning of the decade coincides with weakening EU policy support for conventional biofuels.

Despite stronger policy support, advanced biofuel production remains low. Several advanced biofuel plants that use newer technologies are under construction or announced, mostly in Europe, India and the United States, where supportive policy frameworks are in place. However, without enhanced policy support, novel advanced biofuels account for only 1% of all biofuel output by 2023. Biofuel demand in the aviation

² Association of Southeast Asian Nations.

sector is growing, mostly driven by voluntary initiatives. However, despite the availability of some technically mature fuels, production of aviation biofuels is expected to remain constrained unless production costs decrease or policy support is strengthened.

Renewable electricity in transport is anticipated to expand by two-thirds. Electric cars, two- and three-wheelers, and buses lead this growth; their electricity consumption almost triples over the forecast period. However, rail still accounts for the majority of renewable consumption in 2023. Overall renewables provide almost one-third of global electrified transport demand by the end of the forecast period.

Policies continue to remain critically important for the future of renewables

To meet long-term climate and other sustainability goals, renewable energy development in the heat, electricity and transport sectors must accelerate. Should progress continue at the pace currently forecast, the share of renewables in final energy consumption would be roughly 18% by 2040 – significantly below the International Energy Agency (IEA) Sustainable Development Scenario's benchmark of 28%.

Renewables expansion in the electricity sector could be 25% higher under the IEA accelerated case. Even with renewable energy technologies becoming increasingly competitive, appropriate policies and market design are critical. The accelerated case assumes that governments introduce measures to tackle policy and regulatory uncertainties as well as grid integration and financing challenges before 2020. China, the European Union, India and the United States together account for almost two-thirds of potential upside in the accelerated case. As a result, renewable capacity growth could reach 1.3 TW over 2018-23, putting the renewable electricity sector fully on track to meet long-term climate and sustainability goals.

With the more favourable market and policy conditions assumed under the accelerated case, global transport biofuel output could be 25% higher than in the main case. Stronger implementation of blending mandates would boost ethanol production by over 20%, with Brazil, China and the United States making the greatest contributions. Biodiesel and HVO output could climb more than 30%, mainly in Brazil, India and ASEAN. Novel advanced biofuel technologies that use non-food crops, wastes and residues for feedstocks could expand by two-thirds, assuming a higher proportion of announced projects become operational.

Untapped potential to increase bioenergy use in the cement subsector as well as the sugar and ethanol industry is significant. Cement production holds the largest potential as two-thirds of the bioenergy used in this industry is from waste. Robust waste management in key cement-producing countries could therefore double the share of energy demand met by bioenergy and waste to 13% by 2023. In the sugar and ethanol industry, renewable energy generation could rise significantly if all sugar cane-cultivating countries exploited the potential of high-efficiency co-generation, sugar cane straw and new energy cane varieties.

Bioenergy growth in the heat, transport and electricity sectors combined could be as considerable as that of other renewables in the electricity sector. A significant proportion of this potential relies on wastes and residues that offer low lifecycle greenhouse gas (GHG) emissions and mitigate concerns over land-use change. In addition, using these resources can improve waste management and air quality.

Robust sustainability frameworks are key to bioenergy growth. Only bioenergy that reduces lifecycle GHG emissions while avoiding unacceptable social, environmental and economic impacts has a future role in decarbonising the energy system. Robust sustainability governance and enforcement must therefore be a central pillar of any bioenergy support policy.

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The electricity sector remains the brightest spot for renewables with the exponential growth of solar photovoltaics and wind in recent years, and building on the significant contribution of hydropower generation. But, electricity accounts for only a fifth of global energy consumption, and the role of renewables in the transportation and heating sectors remains critical to the energy transition.

This is why *Renewables 2018*, the annual IEA market analysis and forecast on renewable energy, takes an in-depth look at bioenergy, the largest source of renewable energy globally. Often overlooked, the contribution of sustainable bioenergy represents a “blind spot” in the global debate about renewables. Bioenergy makes a significant contribution across the energy system, particularly in the heat and transport sectors.

In addition to looking at renewable energy across the entire energy system, *Renewables 2018* provides a detailed market analysis and overview of renewables in the electricity, heat and transport sectors as well as forecasts for the period between 2018 and 2023. The report also highlights policy and market improvements that can unlock further growth of renewable energy in electricity and transport biofuels, as well as underlines the untapped potential of sustainable bioenergy and other renewable sources in greening the industry and transport sectors. For the first time, *Renewables 2018* also includes a chapter dedicated to answering some of the key questions raised by the latest developments in renewable energy markets.