

Global Energy Review 2019

The latest trends in energy and emissions in 2019

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INTERNATIONAL ENERGY AGENCY

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Abstract

In 2019 global energy demand increased by less than half the rate of growth in 2018, well below the average rate since 2010. This deceleration was due mainly to slower global economic growth and the impact of milder weather on heating and cooling. There was, however, significant variation across energy sources, with coal showing an absolute decline and renewables a record increase. Electricity demand grew at the slowest rate since the financial crisis. Energy efficiency continued to improve but at levels well below those needed to meet the Sustainable Development Goals. Energy-related CO₂ emissions remained flat as emissions from electricity generation in advanced economies declined markedly.

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Global energy trends

Global energy demand increased by 0.9% in 2019, i.e. 120 million tonnes of oil equivalent (Mtoe), 40% the rate of growth observed in 2018. Slower economic growth and weather conditions explain most of the slowdown.

Global GDP growth fell from 3.6% in 2018 to 2.9% in 2019, curbing energy demand growth. The economic slowdown was felt across almost all economies. In advanced economies, average economic growth fell nearly 25% between 2018 and 2019. The economic slowdown restricted energy demand growth particularly in India, where economic growth fell from 6.8% in 2018 to 4.8% in 2019, well below the average of 7% since 2010. In China, economic growth dropped from 6.6% in 2018 to 6.1% in 2019.





Energy demand growth was also pushed down by milder winters in 2019 than in 2018, when colder than average winters and hotter than average summers increased energy demand for both heating and cooling. A milder summer in the United States and the People's Republic of China (hereafter, "China") in 2019 also lowered energy demand for cooling. Reduced energy demand for space heating and cooling cut into demand for all fuels. In total, weather changes reduced global energy demand growth by 0.8% basis points between 2018 and 2019.

Energy trends by fuels and technologies

The decline in energy demand growth between 2018 and 2019 was disproportionately felt by coal and gas, while the absolute growth for other energy sources changed little. Renewables and natural gas both gained market share, with gas breaching 23% and renewables 14%.



Average annual change in energy demand by fuel, 2018 and 2019

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Renewables led the growth in energy demand, followed by gas, while coal declined steeply.

Renewables underwent both the largest absolute growth and the fastest rate of growth in 2019, with their overall use increasing by 75 Mtoe or 3.7%. Wind power and solar photovoltaic (PV) power experienced another year of doubledigit growth, although solar PV growth slowed. While use of renewables expanded in almost all regions, more than 40% of the global growth in electricity generation from renewables was concentrated in China.

Natural gas demand increased by 60 Mtoe, or 70 billion cubic metres (bcm), a 1.8% increase from 2018 levels. The rate of demand growth was well below the 5% increase observed in 2018 but marked a return to the average growth rate between 2010 and 2017. In contrast to 2018, when exceptional weather led to a jump in gas demand, especially in the United States and China, in 2019 milder weather was a key brake on demand growth.

Demand for oil, including biofuels, grew in 2019 by 0.8%, or 0.8 million barrels per day (mb/d), led by growth in China. Coal demand declined by 1.7%, as electricity generation from coal-fired power plants fell by the largest amount ever, with coal challenged by cheap gas prices and expanding renewables and nuclear power.



Share of total primary energy demand by fuel, 2010-19



Nuclear power grew in 2019 by 3.5%, faster than in 2018 and higher than the recent historical average. The fleet of nuclear reactors in Japan had higher output in 2019 and seven large-scale reactors in China recorded their first full year of operation. As a result, global nuclear output set a record high in 2019, exceeding the level before the Fukushima nuclear accident in 2011. Taken together, low-carbon energy sources – renewables and nuclear – accounted for 80% of the net increase in energy demand in 2019.

Electricity demand increased at only a third of the rate of growth seen in 2018, as demand fell in almost all major advanced economies. Demand growth was halved in China. In India, demand fell for the first time in IEA records, owing

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to slower economic growth and reduced electricity use for irrigation, a result of an exceptional monsoon. Global demand growth slowed not only because of lower economic growth, but also because heating and cooling energy demand fell, energy efficiency improved. Lower electricity demand growth underpinned the global decline in coal demand.

Energy trends by sector

In the buildings sector, milder weather in 2019 pushed annual energy demand growth below 1% for the first time since 2015. Industry emerged as the leading sector for demand growth, with use of electricity in the sector overtaking use of coal. The largest energy demand growth in industry came from China, where efforts to stimulate the economy resulted in a breaking of the sevenyear trend of sub-1% growth in the sector. In India, growth of energy demand in industry was well below 2018 levels, as output decreased in some heavy industries in the second half of 2019.

Energy demand growth in the transport sector fell to around half of the average rate since 2010, as the slowdown in economic growth reduced freight and passenger activity. Oil demand declined in advanced economies, but these declines covered less than one-quarter of the increase from the rest of the world. Transport energy demand growth outside of advanced economies accelerated, led by China. Its oil demand growth for transport rose from 3.5% to 5%, the largest increase in recent years.

Car sales in many key markets declined. Global sales fell by 4% as a result, slowing the penetration of more efficient vehicles into the fleet. In the United States, car sales fell by 1.5%, the decline was lower for sport utility vehicles (SUVs) which continued to increase in market share, putting upward pressure on oil demand. Sales of passenger cars fell even further in China (9%) and India (12%). New vehicles in those markets are not necessarily displacing older stock, however, with the slowing in new oil demand in India due more to the slowing of the economy than to sales of more efficient cars.

While the global electric vehicle (EV) fleet continued to expand in 2019, sales grew by only 9%, a clear departure from the growth rates of the previous 6

years, and the 2018 growth rate of around 70%. This drop was a result of the slowdown in car sales in key markets and reduced policy support for EVs in China. Oil demand growth in 2019 would have been 0.1 mb/d higher without the increasing penetration of electric cars.

Trends by region

Regionally, China accounted for a staggering 90% of net global energy demand growth in 2019, with growth of 3.4%, as energy demand declined in almost all advanced economies. Energy demand fell most in the European Union, by 2%, and in the United States, by 0.8%. While demand in Southeast Asia grew strongly, at 3.4%, in India growth fell from 4% in 2018 to 0.9% in 2019, the lowest ever.

Many advanced economies are increasingly experiencing the benefits of energy transitions. While economic growth averaged 1.7%, total energy demand in advanced economies fell by 1% in 2019. Direct savings from energy efficiency contributed the most to this decline, followed by indirect efficiency gains arising from switching to lower-carbon sources of electricity that have lower losses in generation.

China's demand growth of 3.4% was on par with 2018 levels despite lower economic growth. Oil accounted for the largest share of the growth in China, with gas and coal each contributing almost another fifth. Economic stimulus for manufacturing pushed up coal use in industry and oil use in freight.

Modern renewables and nuclear power continued to expand rapidly in China, however, bringing their share in the energy mix to 10%, up from 2% in 2000. China underwent the largest growth ever in low-carbon energy sources in 2019. Generation from solar PV rose by over 50 TWh and from wind by nearly 40 TWh. As a result, China now accounts for 35% of global solar PV generation and 28% of global wind generation.

Nuclear power in China is following a similar trend. Seven large-scale nuclear reactors, commissioned in late 2018, recorded their first full year of operation in 2019. China now accounts for 12% of global nuclear generation, up from only 3% in 2010.



Change in primary energy demand by region, 2018-19

Note: China = the People's Republic of China; Russia = the Russian Federation.

China led energy demand growth in 2019, while the majority of advanced economies posted declines in energy demand.

Energy demand in India grew by 0.9% in 2019, considerably lower than the 4% average rate since 2000. Demand was held back by slower economic growth of 4.8%, down from 6.8% in 2018. The economic slowdown disproportionately hit manufacturing output, which fell markedly during the second half of 2019.

India's sharpest changes in demand growth occurred in the power sector. Electricity demand fell in 2019 for the first time on record, as a late monsoon reduced needs for irrigation and lower economic growth reduced demand in the manufacturing sector. Lower irrigation needs also reduced demand for diesel, while the duration of the rains delayed construction projects and restricted wider economic activity.

In the United States, energy demand declined by 0.6% in 2019, pushed down by milder weather conditions and a slowdown in the economy. Fuel-switching

from coal to gas accelerated, bringing coal use down by almost 15% to levels not seen since the 1960s. The continued shale gas revolution contributed to a 20% drop in gas prices, favouring the switch from coal to gas in the power sector and expanding natural gas use by 3%. Renewables grew even faster than natural gas, led by the power sector where the share of renewables in generation increased to 18%.

Energy demand in the **European Union** declined by 2% in 2019, as the use of coal fell 19%, driven by trends in the power sector. Oil demand also fell marginally, for three main reasons. Industrial production declined from 2018 levels. The average efficiency of the EU vehicle fleet continued to improve, albeit at a slower pace as the share of SUVs in sales continued to grow. And uptake of electric cars reduced oil demand by 15 thousand barrels a day (kb/d).

Natural gas demand in the European Union was pushed up by significant fuel switching from coal to gas, driven by a rise in average CO₂ prices from EUR 15/tCO₂eq to EUR 25/tCO₂eq, and a decline in average gas prices of 45%. Continued improvements in energy efficiency made the biggest contribution to the decline in energy demand in 2019, while a slowdown in economic growth also curbed electricity demand.

In Japan energy demand contracted in 2019, returning to the trend of falling demand observed between 2010 and 2016. Demand has now returned to 1990 levels, when Japan's economy was 22% smaller.

Energy efficiency improvements are the driving factor behind lower energy demand in Japan. In addition, a milder winter in 2019 and an increase in output from nuclear reactors that have recently come back on line reduced the use of coal and gas in the power sector. Gas demand declined 8% in 2019 and oil use for power generation was more than 30% lower than in 2018. Generation from renewables increased by only a third of the rate observed in 2018, with output from wind and hydro power both declining.

CO₂ emissions

Global energy-related CO₂ emissions remained little changed in 2019 at 33.2 gigatonnes (Gt), following two years of increases. This stabilisation resulted mainly from a sharp decline in CO₂ emissions from the power sector in advanced economies. Power sector emissions fell thanks to the expanding role of renewable sources (mainly wind and solar PV), fuel switching from coal to natural gas, and higher nuclear power output.



Energy-related CO₂ emissions, 1990-2019

Global CO₂ emissions flattened in 2019 at around 33.2 Gt, after two years of increases. Lower coal-fired generation in advanced economies and rising output from lowercarbon sources underpinned the decline.

Global CO₂ emissions from coal use declined by more than 220 million tonnes (Mt), or 1.5%, offsetting increases in emissions from oil and natural gas. In advanced economies, emissions fell by almost 380 Mt, or 3.2%, with the power sector responsible for nearly 90% of the drop.

Milder weather in many large economies played a key part, reducing emissions by over 200 Mt and reversing some of the increases caused by higher demand for space heating and cooling in 2018. Weaker global economic growth in 2019 also played an important role, moderating the increase in emissions in major emerging economies, especially in India.

The spread of renewables played the biggest role in containing global energy-related CO_2 emissions in 2019. Increasing deployment of renewables in almost all regions reduced potential growth in emissions by over 330 Mt. China alone accounted for over one-third of the savings from renewables, while the European Union contributed to around 70 Mt of savings and the United States 35 Mt.

Improvements in energy efficiency also had a major impact on curtailing emissions growth in 2019. Without the improvements in the average energy efficiency of the world's cars, appliances, industrial processes, power plants and other energy-using equipment, global CO₂ emissions would have been nearly 200 Mt higher in 2019, almost equivalent to the energy-related CO₂ emissions of Spain today. While this is welcome, it is important to note that the rate of energy efficiency improvement sloed again in 2019. Few new energy efficiency policies were implemented and lower economic growth slowed the replacement of old stock with higher-efficiency new equipment.



Change in global energy-related CO₂ emissions and avoided emissions, 2018-19

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Renewables and energy efficiency played the largest role in keeping energy-related CO₂ emissions flat in 2019, alongside coal-to-gas fuel switching, lower demand and higher output from nuclear power.

Fuel switching from coal to gas accelerated in 2019, reducing carbon emissions by 120 Mt, more than 30 Mt higher than the savings from coal to

gas switching in 2018. Emissions reductions from coal to gas fuel switching were concentrated in the European Union and the United States. In these economies, gas became an increasingly attractive alternative to coal for electricity generation because of the evolution of gas and CO₂ prices. Gas consumption also grew substantially in China, where air quality policies continue to encourage the uptake of gas for heating and industrial uses.

Nuclear power also played a significant role in countering further increases in emissions from fossil fuels in 2019. Increases in nuclear output reduced potential emissions growth by close to 100 Mt of CO₂. The majority of the increase in nuclear output was in China, where many reactors commissioned in late 2018 completed their first full year of operation in 2019.

In Japan, reactors restarted in recent years increased their output in 2019. Nuclear output also increased in Korea. Electricity generation from the world's nuclear fleet reached a record level of 2 800 TWh, meeting 10% of global electricity demand with output higher than pre-Fukushima levels.

As economies expanded in 2019, increasing demand for energy services put upward pressure on emissions. But the combined impact of growing deployment of renewables, energy efficiency improvements, coal to gas fuel switching, and greater output from nuclear generators was sufficient to offset this pressure. The importance and scale of many of these effects suggests clean energy transitions are under way, led by the power sector.

Global power sector emissions declined by more than 170 Mt, or 1.3%, in 2019. The biggest falls took place in advanced economies, where CO_2 emissions have sunk to the levels of the late 1980s, when electricity demand was one-third lower.

Trends by region

The trajectories of CO_2 emissions differed from region to region in 2019. In advanced economies, emissions declined by 380 Mt, led by declines in the power sector. In the rest of the world there was an overall increase, of 360 Mt. In many major economies, however, such as India, Indonesia, and to a lesser extent China, emissions growth did slow.



Change in energy-related CO₂ emissions by region, 2018-19

Note: China = the People's Republic of China; Russia = the Russian Federation.

Emissions declined across advanced economies, led by lower emissions from the power sector. In the rest of the world, especially in India, emissions grew more slowly because of lower economic growth.

Advanced economies

Although economic growth in advanced economies averaged 1.7% in 2019, total energy-related CO_2 emissions fell by 3.2%. The power sector led the decline. It now accounts for 34% of energy-related emissions across advanced economies, down from a high of 38% in 2012. The average CO_2 emissions intensity of electricity generation declined by nearly 6.4% in 2019, almost three times faster than the average rate over the past decade. In absolute terms, the average emissions intensity of electricity generation in 2019 was 340 grams of CO₂ per kilowatt hour, lower than all but the most efficient gas-fired power plants.

Generation from coal-fired plants in advanced economies declined by nearly 15%. The drop was due to continued growth of renewables, coal-to-gas fuel switching, a rise in nuclear power and lower electricity demand.

The growth of renewables in electricity generation in advanced economies delivered 140 Mt of CO₂ emissions savings. Wind accounted for the biggest share of the increase, with output expanding 12% from 2018 levels. Among

renewable sources, solar PV grew the fastest, helping to push renewables' share of total electricity generation close to 28%.

Coal-to-gas fuel switching for power generation, which avoided 100 Mt of CO₂ in advanced economies, was particularly strong in the United States due to record low natural gas prices. Higher nuclear power generation in advanced economies, particularly in Japan and Korea, avoided over 50 Mt of CO₂.

The **United States** was the country that experienced the largest decline in energy-related CO_2 emissions in 2019 – a fall of 131 Mt, or 2.7%, to 4.8 Gt. US emissions are now down almost 1 Gt from their peak in 2000, the largest absolute decline by any country over that period. A 15% reduction in the use of coal for power generation underpinned the decline in overall US emissions in 2019.

US coal-fired power plants faced even stronger competition from natural gasfired generation, with benchmark gas prices an average of 20% lower than 2018 levels. As a result, gas increased its share in electricity generation to a record high of 38%. Overall electricity demand declined because demand for air-conditioning and heating was lower as a result of milder summer and winter weather.

Energy-related CO_2 emissions in the **European Union**¹ dropped by 175 Mt, or 5.7%, to reach 2.9 Gt. The power sector drove the trend, with a decline of 120 Mt of CO_2 , or 12%, resulting from increasing renewables and switching from coal to gas. Output from coal-fired power plants dropped by more than 25% in 2019, while gas-fired generation increased by close to 13% to overtake coal for the first time.

Germany spearheaded the decline in emissions in the European Union. Its emissions fell by 8% to 620 Mt of CO₂, a level not seen since the 1950s, when the German economy was around 10 times smaller. Output from the country's coal-fired power fleet fell by more than 25% as electricity demand declined and generation from renewables increased, especially wind, which rose 12%.

¹ Including the United Kingdom.

With a share of over 40% in 2019, renewables for the first time generated more electricity than Germany's coal-fired power stations.

The **United Kingdom** continued its strong decarbonisation progress as output from coal-fired power plants fell to only 2% of electricity generation. Rapid expansion of output from offshore wind, as additional projects came on line in the North Sea, was a driving factor behind this decline. Renewables provided about 40% of electricity supply in the United Kingdom, with gas supplying a similar amount. The share of renewables rose even higher in the latter part of the year, with wind, solar PV and other sources generating more electricity than all fossil fuels combined during the third quarter.²

Electricity generation and power sector CO₂ emissions in advanced economies, 1971-2019





In Japan, energy-related CO_2 emissions fell 4.9% to 1 025 Mt in 2019, the fastest pace of decline since 2009. The power sector experienced the largest drop in emissions as reactors that had recently returned to operation contributed to a 32% increase in nuclear power output. This allowed Japan to reduce electricity generation from plants fired by coal, gas and oil.

² <u>www.gov.uk/government/statistics/electricity-section-5-energy-trends#history</u>

Rest of the world

In the rest of the world, CO₂ emissions rose by 361 Mt in 2019, or 1.7%. These economies now account for two-thirds of global CO₂ emissions, an increase of over 7 percentage points since 2010. The rate of emissions growth in 2019 was markedly slower than the increase of 2.6% in 2018, however, and the average annual rise of 2.2% since 2010. The main reason for the slowdown was a stalling of emissions growth in India (adding 95 MtCO₂ less to global emissions than in 2018) and a slowdown in China, where low carbon sources underwent their largest ever increase. In other developing economies in Asia, the Middle East and North Africa, emissions growth was also slower in 2019 than in 2018.

The biggest change of pace took place in the power sector. In China, emissions from the sector grew aroundhalf the rate of 2018, and well below the average during the last decade. In India, emissions from the power sector declined in 2019, in stark contrast to the average 4.2% growth rate since 2010. While lower economic growth was the main factor behind this slowdown, renewables also had a major impact, reducing the potential increase in emissions by over 200 Mt.

Asia accounted more than 90% of the increase in emissions outside of advanced economies. Asian coal demand continued to expand, accounting for over 50% of energy use in 2019, and producing around 10 Gt of emissions. Nonetheless, low-carbon sources of energy met 30% of energy demand growth in 2019, up from 25% in 2018.

In **China**, emissions rose 2.3% but were tempered by slower economic growth and higher output from low-carbon sources of electricity. Low-carbon sources met 36% of energy demand growth, up from 30% in 2018. Renewables continued to expand in China, and 2019 was also the first full year of operation for seven large-scale nuclear reactors in the country.

Emissions in **India** rose by 0.6% in 2019, a moderate increase that marked a major decline from average annual growth of around 4% since 2010. This decline was the result of a slowdown in economic growth from 6.8% in 2018 to 4.8% in 2019. Heavy industry and manufacturing activity declined,

especially in the latter half of the year, reducing demand for electricity and other fuels. A late monsoon also curbed emissions, as it reduced electricity and diesel demand for irrigation and increased generation from hydroelectricity. As a result, coal use in the power sector fell and emissions from coal-fired power were down 2% on 2018 levels. Continued growth in fossil fuel demand in other sectors of the Indian economy, notably industry, offset the decline in the power sector.

Emissions increased by 85 Mt in **Southeast Asia**, where the growth rate of 5.8% was only slightly below 2018 growth. Coal demand drove the increase, with emissions from coal use across Southeast Asia up 80 Mt, not too distant from the 110 Mt increase in China.

Oil

World oil demand, including biofuels, rose by 0.8% (or 0.8 mb/d) in 2019. The growth was the third-lowest rate in the last ten years and lower than the 1.1% rate in 2018. Lack of growth in US domestic demand in 2019, after 2.7% growth in 2018, lowered global oil demand growth. Demand growth in China remained robust, however, accounting for more than 80% of the net growth in oil demand in 2019.



Global oil demand growth slowed from 1.1 mb/d in 2018 to 0.8 mb/d in 2019, despite some support from lower prices, as economic activity weakened.

Trends by region

Oil demand in the United States contracted slightly in 2019, by 30 kb/d, after strong growth in 2018. Delays in the start-up of large ethane-based petrochemical projects and a slowdown in industrial production in the second half of the year both played a role. LPG/ethane demand growth slowed to 60 kb/d from 330 kb/d in 2018. Gasoline demand fell by 50 kb/d and diesel demand by 60 kb/d, reflecting a slowdown in manufacturing activities and a fall in car sales of 1.3%.

In China, oil demand rose by 680 kb/d, its highest growth since 2015, even though economic growth slowed to 6.1% from 6.6% in 2018. The country benefited from economic stimulus to support growth, investments in infrastructure expanded and oil demand from transport, especially freight, grew rapidly. There was strong growth in demand for gasoil/diesel (230 kb/d) and gasoline (120 kb/d).



Oil demand growth by selected countries/region, 2009-19

Note: China = the People's Republic of China.

The pace of global oil demand growth slowed in 2019 as demand growth stagnated in many advanced economies, while an increase in demand growth in China limited the global slowdown.

In India, oil demand growth slowed to 2.8% (or 140 kb/d) in 2019, down from 4.3% (200 kb/d) in 2018. The deceleration was driven by a sharp slowdown in GDP growth, from 6.8% to 4.8%. Oil demand was also curbed by the monsoon in 2019, the heaviest in 25 years, which boosted hydropower production to record levels and reduced gasoil use for irrigation in agriculture. Heavy rains and flooding also reduced oil demand by delaying construction work and slowing overall economic activity.

Oil demand in Japan continued to fall, by 140 kb/d in 2019, as a result of energy efficiency efforts in industry and transport. In addition, temperatures were very warm in the fourth quarter, reducing heating oil demand in northern Japan. Oil demand also fell in the fourth quarter after an increase in the consumption tax in October 2019 curbed economic activity. Demand also contracted in Korea as exports slowed significantly. Both Japan and Korea were affected by the slowdown in Chinese imports during the year.

European oil demand fell by 120 kb/d. The drop was due to slower economic activity, weaker industrial production in Germany and efficiency improvements, though efficiency improved at a slower pace than recent years. German GDP growth has dropped from 1.5% in 2018 to 0.5% in 2019. Petrochemical feedstocks demand declined. Gasoline demand and diesel demand both posted small growth, however.

Russia's oil demand rose 70 kb/d in 2019 following an increase of 80 kb/d in 2018. Kerosene demand grew as air traffic increased.

In Africa, low economic growth in South Africa (0.4%) and a switch to natural gas in Egypt put a cap on oil demand growth in 2019. Nigeria, however, contributed to increased growth.

Oil demand in Latin America continues to suffer from economic difficulties in Argentina and Venezuela. Argentina's oil demand carried on declining, by 20 kb/d in 2019. Brazil posted a strong growth of 70 kb/d, however, on as economic activity increased.

In the Middle East, oil demand rose by 30 kb/d in 2019, after a drop of 30 kb/d in 2018, as Saudi Arabia switched to growth of 20 kb/d after a decline of 180 kb/d in 2018. Elsewhere in the region, activity remained subdued because of geopolitical tensions and social unrest.

Trends by oil products

On the oil product front, diesel posted strong growth of 460 kb/d while growth of petrochemical feedstocks (LPG and naphtha) slowed. The slowdown in global industrial activity, particularly in car manufacturing, reduced economic activity and demand for petrochemical products.

Growth in jet/kerosene demand slowed because of very warm winter conditions in the northern hemisphere, particularly in Japan and Korea where kerosene is used as a heating fuel. Jet kerosene accounted for roughly 15% of world oil demand growth in 2019. Gasoline demand rose by 210 kb/d worldwide. The small oil price drop of 10% in 2019 helped to support gasoline demand, which is very responsive to price changes. Gasoline accounted for a quarter of demand growth in 2019.



Gasoline demand slowed due to efficiency improvements.

Diesel oil demand slowed in the United States after a very strong 2018. Lower needs from the US shale industry curbed gasoil demand, which fell by 60 kb/d after strong growth in 2018 of 210 kb/d. Diesel oil consumption is estimated to have significantly increased in China, however, more than offsetting the United States slowdown. Diesel oil represented more than half of total demand growth in 2019.

The forecast for 2020 is strongly affected by the coronavirus pandemic (<u>Oil</u> <u>Market Report and Oil 2020</u>).

Natural gas

After two years of very strong gains, natural gas consumption growth cooled down in 2019 to 1.8%, or 70 bcm. This was less than half the growth observed in 2018 and on a par with average growth between 2010 and 2017. Gas demand growth in 2019 was nonetheless second only to growth in demand for renewables, pushing the share of gas in the global energy mix to a historic high of 23%.

While demand rose by over 55 bcm because of fuel switching from coal to gas and by around 50 bcm due to market expansion in 2019, these increases were partly offset by switching away from gas to other fuels (-23 bcm), and milder temperatures (-11 bcm). The United States and China remained the main growth markets in 2019, accounting together for over two-thirds of the increase in global natural gas consumption, although gas demand growth rates returned to single digits in both countries.



Average annual change in gas demand and breakdown of gas demand growth by main drivers in 2019

Fuel switching and Asian growth were the main gas demand drivers.

Fuel switching from coal to natural gas was the largest contributor to consumption growth in 2019 accounting for more than 55 bcm of additional

demand. Average annual US gas prices declined by 20% in 2019 reaching USD 2.6 per million British Thermal Units (mmbtu), while in Europe average prices declined by 45%, reaching USD 4.5/mmbtu. Low US and European spot prices drove fuel switching for power generation, while air pollution policy remained the main reason for fuel conversion in China. Yet part of this increase was offset by switching from gas to nuclear, hydro and other renewables in power generation.

In the United States, gas-fired generation output reached new highs in 2019, rising to a record share of about 38% of total generation. It increased by 8% in 2019, or 123 TWh, while coal-fired output fell sharply (-181 TWh). Growth of gas-fired generation was lower than the 172 TWh recorded in 2018, however. Gas-fired generation also increased in Canada and Mexico, in both markets at the expense of coal.

In Europe, output from gas-fired power plants increased by about 11%, or almost 70 TWh, while coal declined steeply (-24%). Spain was the largest contributor to gas burn, with an annual increase of almost 50%. Spain accounted for about 40% of the European Union's growth, followed by France (14% of EU increase), Germany (13%), the Netherlands (12%) and Italy (10%).

In China, the coal-to-gas switching programme launched in 2017 to battle air pollution helped to further increase the share of natural gas in industrial and residential sectors. Growth was slower than in 2018, however, as rules were introduced in mid-2019 to moderate demand growth. Fuel switching in industry and city gas distribution accounted for an estimated 15 bcm growth in natural gas consumption.

Growth in China, Europe and the United States was partly offset by a reduction in natural gas consumed in several markets. A rebound in nuclear output led to an estimated decrease in gas for power of 12% in Japan and 2% in Korea. Turkey experienced record hydro generation, which sharply diminished gas needs for power generation. Hydro output also surged in Iran, which had to switch back to oil products for power generation at the end of the year due to natural gas supply constraints.

Consumption growth outside of fuel switching was concentrated in the Asia Pacific region and led by China. Growth was slower than in 2018, however, because economic growth was more modest.

China's economic growth reached an estimated 6.1% in 2019 according to the IMF, its lowest annual increase since 1990. Natural gas demand kept growing but returned to a single-digit rate at 8.6%, less than half the 18.1% increase of 2018. Consumption growth was mainly driven by city gas distribution and industry, spurred in turn by fuel-switching and network expansion to increase the country's gasification rate.

The rest of the Asia Pacific region played an important part in natural gas market expansion in 2019. Expansion in South Asia was mainly driven by growth in LNG deliveries, especially in India and Bangladesh, though Pakistan's imports almost stagnated. Natural gas consumption also increased in most Southeast Asian markets. Consumption rose in Australia mainly because the energy industry's needs grew as the country expanded its LNG export capacity.

Outside of the Asia Pacific region, most of the consumption growth not due to fuel switching occurred in natural gas-producing regions. In the United States, non-power growth was primarily driven by the energy industry's own consumption to support the expansion of domestic natural gas production, which increased by 10% in 2019. Natural gas consumption further developed in the Middle East and North Africa due to increases in electricity demand and network expansion for residential customers in Algeria and Iran. In Egypt, however, consumption growth slowed significantly after two years of strong increases.

Natural gas consumption decreased in Eurasia and South America in 2019. After three consecutive years of growth, Russia's consumption was curtailed by the country's low economic growth. Consumption fell by 2% in the first nine months of 2019 (i.e. excluding the impact of mild temperatures at the end of the year). Consumption decreased slightly in South America, as gas needs for power stagnated in Argentina and Brazil, domestic production fell in Colombia, and Venezuela's output declined further.



Change in gas demand by region in selected region, 2018-19

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Note: China = the People's Republic of China; Russia = the Russian Federation.

The United States and China remained the two main driving markets in 2019, both returning to single-digit growth rates, and accounting together for over two-thirds of global natural gas consumption increase.

Gas demand is likely to have been curbed by the winter of 2019/20, one of the warmest on record in most countries of the northern hemisphere. Mild temperatures in December reduced energy consumption needs for heating, especially natural gas needs. Preliminary estimates suggest that European consumption from residential and commercial customers decreased by 2% to 3%. Residential consumption declined by almost 20% in Ukraine.

The conjunction of slower demand growth – in particular, lower weatherrelated consumption – and a well-supplied market led to a sharp increase in storage inventory. The end-of-year US underground storage level increased by 15 bcm as production growth outpaced domestic and export market demand. In Europe, LNG imports surged by almost 70%, as LNG supply increased faster than demand in emerging markets, especially over the second half of 2019. Algeria, Norway and Russia faced lower demand for their competing pipeline supplies. The end-of-year level of underground storage also increased, by 22 bcm. Net injections into US and European storage together accounted for the equivalent of half of the global natural gas consumption increase in 2019.

Coal

Global coal demand declined 1.7% in 2019, the third decline in the last five years, more than offsetting the 0.9% growth in 2018. Coal still represents the second-largest source of primary energy in the world, but its share has fallen from over 29% in 2012 to the current 26%, with annual fluctuations due to developments such as economic growth, weather conditions and fuel price changes. Coal continues to be the largest single source of electricity generation with a share of 36%; however 2019 is the first year in which lowcarbon generation, i.e. renewables and nuclear, produced more electricity than coal.



Global annual change in coal demand and coal power generation, 2010-19

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The drop in coal demand in 2019 was driven by a decline in coal use for power generation, while uses in industry were broadly stable. Coal power generation declined by 3.1% or 315 TWh globally. It experienced its largest drop ever in Europe (20%), one of its largest in the United States (15%) and its first decline in India since 1973.

Overall, the main trend of coal demand, the shift to Asia, continues as demand declines in Europe and the United States. The European Union and

the United States together represented 40% of the global coal demand in 1990 and 20% in 2010, now account for hardly 10%.

Trends by region

China remains the centre of global coal demand. Economic growth and electricity demand growth slowed in 2019, and strong rainfall contributed to hydro output growth of nearly 6%. These factors reined in coal power generation growth to only 1.7%, the third-lowest growth in the decade. Steel, cement and chemicals production increased significantly, and hence, coal consumption in those sectors. In small industrial and residential sectors, however, the coal-to-gas switch continued. As a result of these different trends, overall coal consumption increased 1%.

In India, a significant slowdown of economic growth in 2019 has dented electricity use. A heavy monsoon increased hydro output significantly and reduced electricity demand for irrigation (agriculture accounts for almost 20% of India's electricity use). As a result, electricity consumption and coal power generation declined for the first time in decades, driving a decline in coal consumption despite some increase in the industrial sector.

In the European Union, coal power generation experienced the almost perfect storm: a big fall in electricity demand, increasing wind generation, plummeting spot gas prices and higher CO₂ prices. In some periods of the year, the cost of the CO₂ allowances for coal generators was higher than the fuel plus CO₂ costs for natural gas combined cycles. As a result, coal generation almost disappeared from the mix in places with enough gas power capacity, like Spain. Coal power generation in the European Union dropped by 26% or 175 TWh, the largest drop ever both in percentage and absolute values. Coal supplied 15% of the European Union electricity generation and was overtaken by gas. Overall, coal consumption in Europe declined almost 20%.



Share of coal-fired generation in total electricity generation, 2010-19

Note: China = the People's Republic of China.

In 2019, the decline of coal-fired power generation in advanced economies accelerated. The share of coal in total generation declined in China and India while in Southeast Asia coal's share continues to increase.

In the United States, the shift away from coal continued: very low gas prices, expansion of wind and solar, and sluggish electricity demand squeezed coal in the power sector, where more than 90% of coal is consumed. With a fall of around 200 TWh (still a smaller decline than in 2012 and 2015), the United States was the main contributor to the drop in global coal power generation. The share of coal in the United States power mix has dropped to 25%, the lowest share ever.

The only region in which coal demand increased significantly was Southeast Asia, where coal use grew over 10%, pushed mainly by Viet Nam, Indonesia and, to a lesser extent, the Philippines. For instance, in Viet Nam, electricity generation grew by 9%, cement production by 8% and steel production by more than 30%, underpinning the use of coal.

Electricity

Global electricity demand increased by just 1.4% in 2019, a significant drop from the 3.9% year-on-year growth the previous year. Slow demand growth paired with the strong growth of renewables and nuclear power drove down fossil-fuelled generation globally for the first time in four decades during times of economic expansion. Global power sector CO₂ emissions declined by more than 170 Mt, a 1.3% reduction year-on-year, helping to stabilise global energy-related CO₂ emissions in 2019.

Sluggish electricity demand growth in 2019 was due to slower global economic growth and relatively mild weather conditions in major economies. China, the world's largest consumer of electricity, saw demand grow by just 4.7% in 2019, down from 8.5% in 2018, with a notable slowdown in electricity demand growth for industry and lower cooling and heating needs thanks to milder temperatures. The slowdown in India was even starker as electricity demand contracted by 0.3% in 2019 on the back of an economic slowdown and a sharp decline in manufacturing activity in the later half of the year. Lower demand for irrigation due to a late monsoon also pushed electricity demand lower. The demand decline in 2019 in India marked a step change from the 6.4% growth in 2018 and 7.1% over the previous decade, and was the first time electricity demand in India has falled in 50 years. Most advanced economies also saw declines in electricity demand in 2019, shifting from recent growth in the United States (-1.6%) and Japan (-3.3%), while continuing a downward trend in the European Union (-1.4%).

The growth of low carbon sources of generation outpaced overall electricity demand growth, re-shaping the power mix in 2019. Low carbon generation exceeded that of coal for the first time, providing 37% of global electricity supply in 2019, with the strong growth of renewables (440 TWh) and nuclear power (95 TWh). Renewables growth was driven by the expansion of wind power (150 TWh), solar PV (140 TWh) and hydropower (100 TWh). The increase in nuclear power output was driven primarily by a full year of operations for seven reactors in China (+54 TWh) and more reactors

in operation on average in Japan (+22 TWh). Nuclear power output in Korea bounced back in 2019 (+15 TWh), after a temporary step down in 2018.





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2019 marked a key turning point in the global power mix, with electricity generation from low carbon sources exceeding that of coal for the first time.

Coal-fired electricity generation decreased by 3.1% globally in 2019, a significant change from 2.8% in the previous year and only the second decline ever in a year of global economic growth. Coal remained the largest single source of electricity worldwide in 2019, though its share of 36% was the lowest since 1975. Advanced economies saw a 14% decline in coalfired output in 2019, accelerating the recent pace of reductions. In the United States and European Union, coal-fired generation fell by record rates (15% in the United States and 26% in the European Union), in both cases reducing output to half the historical peaks. These reductions were driven by challenging market conditions and progress towards EU coal phase-out policies. In developing economies, coal-fired generation continued to grow in 2019, but at just 1.3%, the lowest rate in the last 50 years. Slower electricity demand growth and rising contributions from low carbon sources reduced the need for coal. China accounts for nearly half of global coal use in power and saw the growth of coal-fired output slow to 1.6% in 2019 from 5.3% in 2018. India saw a 2.6% reduction in coal-fired generation in 2019, the first

reduction in over 40 years and a reversal of 7.5% annual growth over the past decade. Contrary to the overall trend, coal-fired output in Southeast Asia increased by 11.4% in 2019, up from 8.4% in 2018, mainly to meet higher electricity demand growth.

Global gas-fired generation grew faster than demand in 2019 at 2.7%, though down from 3.6% in 2018. Natural gas prices pushed further down in several markets in 2019, spurred on by expanding the United States shale gas production, creating favourable conditions for coal-to-gas switching. In advanced economies, gas-fired generation increased by 4.1% or 130 TWh in 2019, while coal-fired generation decreased by some 400 TWh. In emerging economies, gas-fired electricity output was lifted by 1.1% in 2019 to meet growing demand, though this was the lowest rate in two decades during times of economic expansion. Most of the growth happened in China and Indonesia, which both saw gas-fired generation rise by 10% or more.

Global CO₂ emissions from the power sector declined by over 170 Mt in 2019, offsetting increases in energy-related CO₂ emissions in other sectors. Lower coal use in power globally reduced related CO₂ emissions by 220 Mt, more than reversing the 310 Mt increase in 2018. Expanded use of natural gas in the power sector raised related CO₂ emissions by nearly 50 Mt, down from a 90 Mt rise in 2018. Oil use in power remained largely unchanged globally, lowering associated emissions by just 4 Mt.

Trends by region

In the Asia Pacific region, electricity demand growth slowed to 3.2% in 2019, down from 6.5% in 2018, met by higher output for all sources except oil. The pace of electricity demand growth was cut by half in China and by one-quarter in Indonesia. Total demand declined for the first time in 50 years in India and Korea, and continued to decline in Japan. Across the region, renewables growth covered two-thirds of new demand in 2019 led by hydropower, solar PV and wind, complemented by nuclear power meeting over 20%, coal 18% and gas 2%. Hydro remained the largest renewable source of electricity at 14% of the power mix, while wind and solar together provided 7%. The low carbon share of electricity supply reached 29%, up from a low of

20% in 2011, though coal remained the foundation of electricity supply (58% of the total). Power sector CO_2 emissions in the region increased by 1.4% in 2019, well below the 20-year average of 5.5%.

China expanded the use of all sources to meet electricity demand growth of 4.8% in 2019, down from 7.4% over the past decade. Low carbon sources met 70% of new demand, up 240 TWh year-on-year, helping their share of the power mix climb to its highest level ever (32%). Renewable electricity increased by 10% year-on-year, led by gains for hydropower, solar PV and wind power. Nuclear power output rose by 16%, with the first full year of operations for seven large-scale reactors and two new reactors operating for half of 2019. Coal-fired generation increased by 2% in 2019 and remained the primary source of electricity in China (64% of the total). Gas-fired power output climbed 10% year-on-year, but remained a minor part of electricity supply. Power sector CO_2 emissions edged up by 135 Mt in 2019, the 2.8% rise was well below the 5% average growth over the past decade. Still, China's share of global power sector CO_2 emissions climbed to 37% in 2019.

In India, the first reduction of electricity demand in the past 50 years enabled renewables growth (+30 TWh) to directly displace coal-fired generation. Twothirds of the renewables growth came from higher output from existing hydropower sites, complemented mainly by new solar PV projects. 2019 marked the first time in India's history that coal-, gas- and oil-fired generation all declined in the same year. Coal-fired generation declined by 2.6%, a sharp correction from 5.4% growth in 2018, but still provided over 70% of total electricity supply. Oil-fired generation fell below 1% of electricity supply for the first time in the modern era. Power sector CO₂ emissions in India declined by 37 Mt in 2019 (-3%), the largest single-year reduction in India's history.

In the **United States**, the power mix was re-shaped by market forces pushing a shift from coal to gas, government policy supporting wind and solar PV, and the weather. The United States electricity demand declined by 1.5% in 2019, a sharp correction from 3.6% growth in 2018, in part due to milder weather in summer and winter. At the same time, the power mix underwent a significant change. Coal-fired generation declined for the fifth consecutive year, falling to just 25% of electricity supply. With natural gas prices 45% below 2018 levels on average, coal-to-gas switching accounted for the majority of coal's decline, complemented by the contraction of electricity demand, and a small increase in low carbon generation. Natural gas-fired generation increased by 7.2% in 2019, hitting a record high share of 37% in the mix. Renewables output increased by only 2%, as lower hydro output offset half the gains for wind and solar. While the United States grew in 2019, power sector CO_2 emissions fell by 7.6%, to the lowest level since 1986.



Electricity generation mix in advanced economies, 1971-2019

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Across advanced economies, output from coal power plants dropped 14% to a share of only 23% in total electricity demand, while gas and renewables growth have absorbed most of the market share shed by coal.

In the **European Union**, a strong shift away from coal-fired power led to record-low power sector CO₂ emissions in 2019, 40% below the high-water mark set in 2007. In 2019 alone, CO₂ emissions declined by 13% through a combination of declining electricity demand, coal-to-gas switching and rising renewables. Electricity demand fell by 1.4% year-on-year on the back of energy efficiency efforts and mild weather. Policies and market conditions drove down EU coal-fired generation by one-quarter in 2019, to just 15% of the power mix. Germany alone made up one-third of the decline for coal-fired power. Half of coal's decline in the European Union was covered by higher gas-fired generation. Renewables increased by just 4% in 2019, as lower

hydropower output offset one-third of gains for wind power and solar PV. Among renewables, hydro remains the largest source (41% of total renewables), followed by wind (31%), bioenergy (16%) and solar PV (10%). Nuclear power remained the largest source of electricity in the European Union at 26% of generation.

Renewables

Renewable energy use increased by 3.7% in 2019 at the global level, up slighty from the previous year. The use of renewable energy in electricity supply accounted for the vast majority of the overall growth, due to widespread policy support and falling technology costs. Renewable energy use in transport and heat production made incremental gains as well.

In 2019, global electricity generation from renewables increased 440 TWh (6.5% year-on-year), the second-highest rise after 2018. Combined with weak electricity demand growth, 2019 marked the first time that renewables outpaced the total rise of electricity generation in times of global economic expansion. The year-on-year growth of renewables generation was 6.5%, faster than any other fuel including coal and natural gas. The share of renewables in global electricity supply reached 27% in 2019, the highest level ever recorded. Wind power, solar PV and hydropower together made up over 85% of renewables growth, complemented mainly by bioenergy.



Electricity demand and renewables generation growth, 2010-19

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2019 marked the first time that renewables-based generation outpaced the total rise of electricity generation during times of economic expansion.

The rise of renewables-based electricity generation continued to be widespread in 2019, with growth in all corners of the world. China once again led the way with a 190 TWh increase in renewables-based electricity generation in 2019 (over 40% of the global total). The European Union and India saw year-on-year increases of 40 TWh and 30 TWh respectively. Brazil recorded the fourth-largest increase in renewable output, with higher hydropower generation as the country continues to recover from the severe drought and new projects came online in both 2018 and 2019.

Wind power increased by about 150 TWh year-on-year, the most of any renewable power generation technology, raising its share of electricity supply from 4.7% to 5.2% in 2019. The European Union, China and United States led wind output growth with a combination of offshore and onshore projects coming online and favourable weather conditions. China's wind capacity additions increased for the second year in row, exceeding 25 GW in 2019, and curtailment rates across all wind projects continued to decline. In both the European Union and United States, annual capacity additions increased as policy deadlines approached, the European Union's 2020 target on one hand and the expiration of the United States production tax credit (PTC) on the other.

Solar PV electricity generation increased by about 130 TWh globally in 2019, second only to wind in absolute terms, reaching 2.7% of electricity supply. Solar PV's year-on-year growth of 22% far exceeded that of wind power, though this growth was significantly lower compared to 2018 as global solar PV capacity additions stalled in 2018, and China's deployment further contracted in 2019. Meanwhile, the European Union, India and the United States contributed similarly to the solar output increase. South East Asia region saw a sharp rise in solar PV generation driven by a surge in new capacity in Viet Nam (6 GW in 2019, up from 0.6 GW in 2018). Solar PV accounts for almost 3% of global electricity mix.



Annual growth of renewable electricity generation by region and technology, 2019

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The rise of renewables-based electricity generation continued to be widespread in 2019, with China once again leading the way.

Hydropower contributed over 100 TWh to the 2019 global increase in renewables generation, lifting its share of electricity supply to 16% and remaining the largest source of renewable electricity. Compared to the previous year, 2019 was a wet year, boosting hydropower output in several key markets. In China, Brazil and India, hydropower increased more in 2019 in absolute terms than the ten-year average due to water availability and new hydropower projects. In contrast, the United States and European Union saw hydropower output decline by about 7% each. Hydropower will continue to play a key role in clean energy transitions by providing cost-effective low-carbon electricity and flexibility services that improve the reliability of power systems. IEA's Renewables 2020 market forecasts report will focus on hydropower and shed light on recent developments, investment and policy trends

Electricity generation from bioenergy rose 8%, maintaining its global share of electricity supply at about 2.5%. Growth was mainly driven by new projects in China, thanks to the country's policy target of 23 GW by 2020, specified in

the 13th Five-Year Plan. Other growth occurred in the European Union, with full-year operations of recently completed large-scale biomass projects in the United Kingdom, Netherlands and Denmark.

In addition to activity in the electricity sector, renewables consumption increased by almost 8% in transport in 2019. Growth was largely the result of a 13% jump in ethanol output in Brazil, a leading biofuel market, achieved by mills maximising ethanol production at the expense of sugar due to low international sugar prices. Strengthened policy support for domestically produced biofuels in China also supported the 2019 growth of biofuels consumption.

Heat is the largest energy end-use before transport and electricity, accounting for half of global final energy consumption. Renewable energy use for heat increased slightly in 2019, with bioenergy remaining the largest source followed by solar thermal and geothermal. The traditional uses of solid biomass, which has low efficiency and result in negative human health, socioeconomic and environmental impacts, still make up the majority of bioenergy use in heating. Solar thermal mostly use in small domestic solar water heaters in the residential sector continued to increase last year but the growth has slowed down due to reduced construction activities, market saturation, competition with other technologies, and the phase-out of incentives.

Efficiency

Global energy intensity improved by 2% in 2019, but when adjusted for weather, the improvement was only 1.6%, roughly in line with 2018. This improvement is below the average between 2010 and 2017 and well below the rate of 3.6% between 2020-40 required to achieve the IEA Sustainable Development Scenario (SDS) that shows how the world can deliver on the three main energy-related Sustainable Development Goals. Nonetheless, energy efficiency improvements in 2019 avoided an increase of 170 MT in global emissions almost equivalent to the fuel combustion-related CO₂ emissions of the Ukraine 2017.

Average annual change in primary energy intensity, historically and in the IEA Sustainable Development Scenario, reflecting weather adjustment for 2018 and 2019



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Annual improvements in energy intensity have flatlined when adjusting for the exceptional weather in 2018 and 2019.

The global economy required an average of 2% less energy input for every unit of GDP in 2019 than it did in 2018. This improvement in energy intensity offset around 70% of the potential increase in global energy demand that would have occurred due to economic growth. This change can be largely attributed to improvements in energy efficiency, representing almost 70% of the effects that decreased energy demand.

More temperate weather in key geographies contributed more than 20%, mostly in the form of reduced heating and cooling demand, normalising for the weather impact the improvement in the energy intensity of the global economy was 1.6% in 2019. Fuel switching also created additional energy efficiency gains of about 10%. These gains were almost entirely from changes in power generation composition in China, Europe and the United States, which displaced thermal power generation with a collection of renewables, efficient natural gas, and nuclear, and thereby reduced energy losses in the combustion and conversion processes. Changes to the structure of the global economy had a small negative effect on the rate of global energy intensity improvement in 2019.

Although energy efficiency contributed the most to energy intensity improvements in 2019, total energy savings from efficiency were 11% lower than in 2018. This decline reflects, in part, stagnation in the passing of new energy efficiency policies in recent years. In addition, slower growth in global economic activity reduced purchases of new equipment covered by energy efficiency regulations, thereby slowing the replacement of inefficient stock.

Only a little over one third of final energy use is covered by policies that mandate energy efficiency improvements, according to current estimates. Building energy codes, appliance standards, and vehicle fuel efficiency standards make up the bulk of current energy efficiency policies globally. Policy coverage has grown steadily but marginally in recent years, therefore most gains in efficiency are due to replacement of equipment covered by current policies, not new policies. Increasing the coverage and strength of codes and standards is essential to improve energy intensity fast enough to achieve the SDS. The required annual rate of over 3% is nearly double the effective rate of structual improvement in 2019.



Change in global final energy demand and causes, 2018-19

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Energy efficiency makes up around 70% of all factors contributing to limiting energy demand growth in 2019.

The major global energy users – in order, China, the United States, Europe and India – contributed the most to global energy efficiency savings in 2019, owing to their size. In the United States, Japan, India and Russia, savings from energy efficiency increased substantially in terms of gross primary energy reductions. Europe's annual energy efficiency savings also increased from 2018 levels. In China, energy efficiency savings dropped substantially in 2019, greatly reducing the global average given China's size.

Although many factors reduced China's efficiency savings, a key cause was a stimulus package implemented in 2019 to stabilise economic growth and bolster competitiveness amid US-China trade tensions. Stimulus drove up energy consumption in some of the most energy-intense segments of the economy (5% growth in cement and 7% in steel). China had been improving efficiency by shifting production to the most efficient units, but under the stimulus package, some of the less efficient plants increased operation. Nonetheless, China's energy intensity improvement rate was 2.6%, higher than the historical global average but the lowest energy intensity improvement rate since 2015. In the United States, energy intensity improved by 2.9% in 2019, following 2018 when energy intensity worsened. This rate of improvement is higher than the average rate over the past decade and was driven largely by energy efficiency improvements. Weather was also a major factor, however, both in the 2018 deterioration and the improvements in 2019.



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The rate of energy intensity improvement increased in most major economies, while in China, stimulus efforts in heavy industry sectors contributed to a marginal slowdown.

The rate of energy intensity improvement also increased in both Europe and India. In Europe, the rate of improvement rose to 3.3% in 2019 from 2.5% in 2018. In India, primary energy intensity improved by 3.8%, better than in 2018 despite lower economic growth. India's improvement can be attributed to a slowdown in heavy industry output, lower use of energy for irrigation and a higher share of electricity generation from hydroelectricity, while intensity improvements also benefited from an increasingly comprehensive set of policies and measures.

The IEA Global Commission for Urgent Action on Energy Efficiency seeks to catalyse an acceleration of energy efficiency improvement: <u>www.iea.org/topics/energyefficiency/global%20commission</u>.

Annexes

Data tables

GDP PPP summary

	GDP PPP growth rate (%)
	2018-19
United States	2.3%
China	6.1%
India	4.8%
Europe	1.5%
Rest of the World	1.9%
WORLD	2.9%

World summary

	Energy Demand (Mtoe)	Growth rate (%)	Share	s (%)
	2019	2018-19	2000	2019
Total Primary Energy Demand	14 385	0.9%	100%	100%
Coal	3 762	-1.7%	23%	26%
Oil	4 512	0.7%	37%	31%
Gas	3 320	1.8%	21%	23%
Nuclear	732	3.3%	7%	5%
Hydro	373	2.4%	2%	3%
Biomass and waste	1 362	2.2%	10%	9%
Other renewables	326	12.2%	1%	2%

	Electricity Generation (TWh)	Growth rate (%)	Share	s (%)
	2019	2018-19	2000	2019
Total Generation	26 951	1.3%	100%	100%
Coal	9 819	-3.1%	39%	36%
Oil	789	-1.4%	8%	3%
Gas	6 246	2.5%	18%	23%
Nuclear	2 806	3.3%	17%	10%
Hydro	4 333	2.4%	17%	16%
Biomass and waste	688	7.8%	1%	3%
Wind	1 405	11.9%	0%	5%
Solar photovoltaics	720	22.3%	0%	3%
Other renewables	144	5.3%	0%	1%

Regional summary

	Total Primary Energy Demand (Mtoe)	Growth rate (%)
	2019	2018-2019
United States	2 213	-0.6%
China	3 291	3.4%
India	924	0.9%
Europe	1 952	-1.9%
Rest of the World	5 590	1.0%
WORLD	14 385	0.9%

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	Coal Primary Energy Demand (Mtce)	Growth rate (%)
	2019	2018-2019
United States	393	-14.2%
China	2 855	1.0%
India	585	-0.3%
Europe	387	-13.6%
Rest of the World	1 155	0.8%
WORLD	5 374	-1.7%

	Oil Primary Energy Demand (mb/d)	Growth rate (%)
	2019	2018-2019
United States	18	0.0%
China	13	5.0%
India	5	2.7%
Europe	13	-0.8%
Rest of the World	48	0.1%
WORLD	97	0.7%

	Gas Primary Energy Demand (bcm)	Growth rate (%)
	2019	2018-2019
United States	884	3.1%
China	306	8.5%
India	65	4.5%
Europe	608	0.1%
Rest of the World	2 177	0.8%
WORLD	4 038	1.8%

	Electricity generation (TWh)	Growth rate (%)
	2019	2018-2019
United States	4 371	-1.4%
China	7 508	4.7%
India	1 613	-0.3%
Europe	4 053	-2.0%
Rest of the World	9 406	1.8%
WORLD	26 951	1.3%

	Renewables generation (TWh)	Growth rate (%)
	2019	2018-2019
United States	768	2.0%
China	2 050	10.1%
India	327	10.7%
Europe	1 493	4.9%
Rest of the World	2 616	5.5%
WORLD	7 255	6.5%

Energy Intensity (toe per \$1000,PPP)		Growth rate (%)
	2019	2018-2019
United States	0.105	-2.9%
China	0.120	-2.6%
India	0.084	-3.8%
Europe	0.087	-3.3%
Rest of the World	0.097	-0.8%
WORLD	0.103	-2.0%

	Total CO ₂ emissions (Mt CO ₂)	Growth rate (%)
	2019	2018-2019
United States	4 768	-2.7%
China	9 737	2.3%
India	2 279	0.6%
Europe	3 742	-4.9%
Rest of the World	11 451	0.5%
WORLD	33 267	-0.1%

Regional summary for energy-related CO₂ emissions from fuel combustion

Methodological notes

This release is based on data for 2019 from numerous sources available as of mid-March 2020. These include the latest monthly IEA country data submissions until the end of December when available; other statistical releases from national administrations around the world; and recent market data from upcoming IEA market reports on coal, oil, natural gas, renewables and electricity.

Definitional note 1: Fossil fuel demand tables

- Oil demand is expressed in million barrels per day (mb/d) and excludes biofuels.
- Natural gas demand is expressed in billion cubic metres (bcm).
- Coal demand is expressed in million tonnes of coal equivalent (Mtce).
- World includes both international marine and aviation fuel bunkers.

Definitional note 2: Energy demand, electricity and CO₂ emissions tables

- Total primary energy demand (TPED) is equivalent to power generation plus "other energy sector" excluding electricity and heat, plus total final consumption (TFC) excluding electricity and heat.
- Electricity generation data are provided on a gross basis (i.e. includes own use by the generator).
- CO₂ emissions and energy demand from international marine and aviation bunkers are included only at the world level. CO₂ emissions do not include emissions from industrial waste and non-renewable municipal waste.

Abbreviations and acronyms

bcm	billion cubic metres
CO_2	carbon dioxide
EU	European Union
GDP	gross domestic product
Gt	gigatonnes (1 tonne x 109)
GW	gigawatt
kb/d	thousand barrels a day
mb/d	million barrels per day
mmbtu	million British Thermal Units
Mt	million tonnes (1 tonne x 106)
MtCO ₂	million tonnes of CO ₂
Mtce	million tonnes of coal equivalent (equal 0.7 Mtoe)
Mtoe	million tonnes of oil equivalent
tCO2eq	tonnes of CO ₂ equivalent
TFC	total final consumption
toe	tonnes of oil equivalent
TPED	total primary energy demand
TWh	terawatt-hour
US	United States

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