

Global Energy & CO2 Status Report

The latest trends in energy and emissions in 2018

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2019



INTERNATIONAL ENERGY AGENCY

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Key Findings 2018

Global energy consumption in 2018 increased at nearly twice the average rate of growth since 2010, driven by a robust global economy and higher heating and cooling needs in some parts of the world. Demand for all fuels increased, led by natural gas, even as solar and wind posted double-digit growth. Higher electricity demand was responsible for over half of the growth in energy needs. Energy efficiency saw lacklustre improvement.

Energy-related CO₂ emissions rose 1.7% to a historic high of 33.1 Gt CO₂. While emissions from all fossil fuels increased, the power sector accounted for nearly two-thirds of emissions growth. Coal use in power alone surpassed 10 Gt CO₂, mostly in Asia. China, India, and the United States accounted for 85% of the net increase in emissions, while emissions declined for Germany, Japan, Mexico, France and the United Kingdom.

Oil demand rose by 1.3% in 2018, led by strong growth in the United States. The start-up of large petrochemical projects drove product demand, which partially offset a slowdown in growth in gasoline demand. The United States and China showed the largest overall growth, while demand fell in Japan and Korea and was stagnant in Europe.

Natural gas consumption grew by an estimated 4.6%, its largest increase since 2010 when gas demand bounced back from the global financial crisis. This second consecutive year of strong growth, following a 3% rise in 2017, was driven by growing energy demand and substitution from coal. The switch from coal to gas accounted for over one-fifth of the rise in gas demand. The United States led the growth followed by China.

Coal demand grew for a second year, but its role in the global mix continued to decline. Last year's 0.7% increase was significantly slower than the 4.5% annual growth rate seen in the period 2000-10. But while the share of coal in primary energy demand and in electricity generation slowly continues to decrease, it still remains the largest source of electricity and the second-largest source of primary energy.

Renewables increased by 4% in 2018, accounting for almost one-quarter of global energy demand growth. The power sector led the gains, with renewables-based electricity generation increasing at its fastest pace this decade. Solar PV, hydropower, and wind each accounted for about a third of the growth, with bioenergy accounting for most of the rest. Renewables covered almost 45% of the world's electricity generation growth, now accounting for over 25% of global power output.

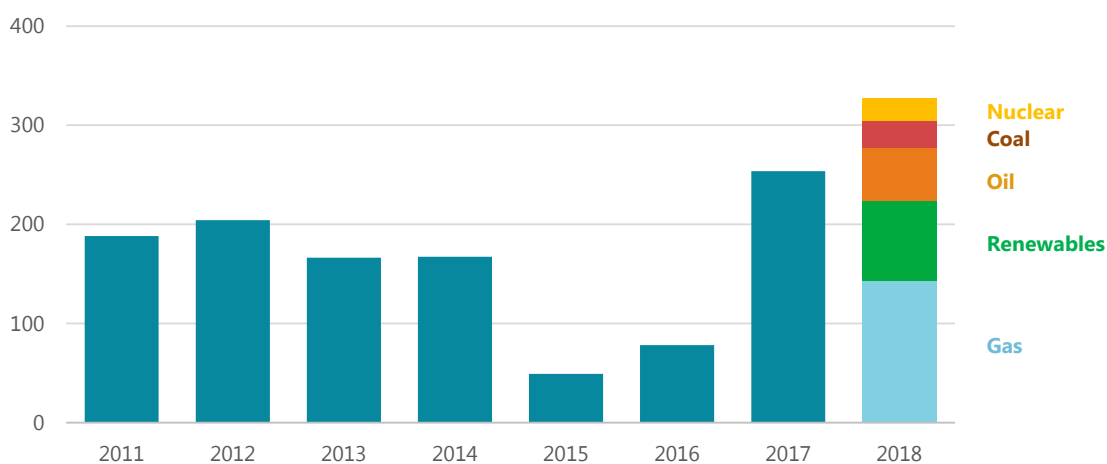
Electricity demand rose by 4%, nearly twice as fast as overall energy demand, and at its fastest pace since 2010. Renewables and nuclear power met the majority of the growth in demand. Still, generation from coal- and gas-fired power plants increased considerably, driving up CO₂ emissions from the sector by 2.5%.

Energy efficiency across the global economy continued to improve, with global primary energy intensity falling by 1.3%. But this was lower than improvement rates seen in recent years. Although efficiency was still the biggest source of carbon dioxide emissions abatement in the energy sector, 2018 marked the third consecutive year in which the improvement rate for energy efficiency slowed.

Energy Demand

Global energy consumption in 2018 increased at nearly twice the average rate of growth since 2010, driven by a robust global economy and higher heating and cooling needs in some parts of the world. Demand for all fuels increased, led by natural gas, even as solar and wind posted double-digit growth. Higher electricity demand was responsible for over half of the growth in energy needs. Energy efficiency saw lacklustre improvement. As a result of higher energy consumption, CO2 emissions rose 1.7% last year and hit a new record.

Figure 1. Average annual global primary energy demand growth by fuel, 2010-18



Energy consumption worldwide grew by 2.3% in 2018, nearly twice the average rate of growth since 2010, driven by a robust global economy as well as higher heating and cooling needs in some parts of the world.

The biggest gains came from natural gas, which emerged as the fuel of choice last year, accounting for nearly 45% of the increase in total energy demand. Demand for all fuels rose, with fossil fuels meeting nearly 70% of the growth for the second year running. Renewables grew at double-digit pace, but still not fast enough to meet the increase in demand for electricity around the world.

As a result of higher energy consumption, global energy-related CO2 emissions increased to 33.1 Gt CO2, up 1.7%. Coal-fired power generation continues to be the single largest emitter, accounting for 30% of all energy-related carbon dioxide emissions.

Higher energy demand was propelled by a global economy that expanded by 3.7% in 2018, a higher pace than the average annual growth of 3.5% seen since 2010. China, the United States, and India together accounted for nearly 70% of the rise in energy demand.

The United States had the largest increase in oil and gas demand worldwide. Gas consumption jumped 10% from the previous year, the fastest increase since the beginning of IEA records in 1971. The annual increase in US demand last year was equivalent to the United Kingdom's current gas consumption.

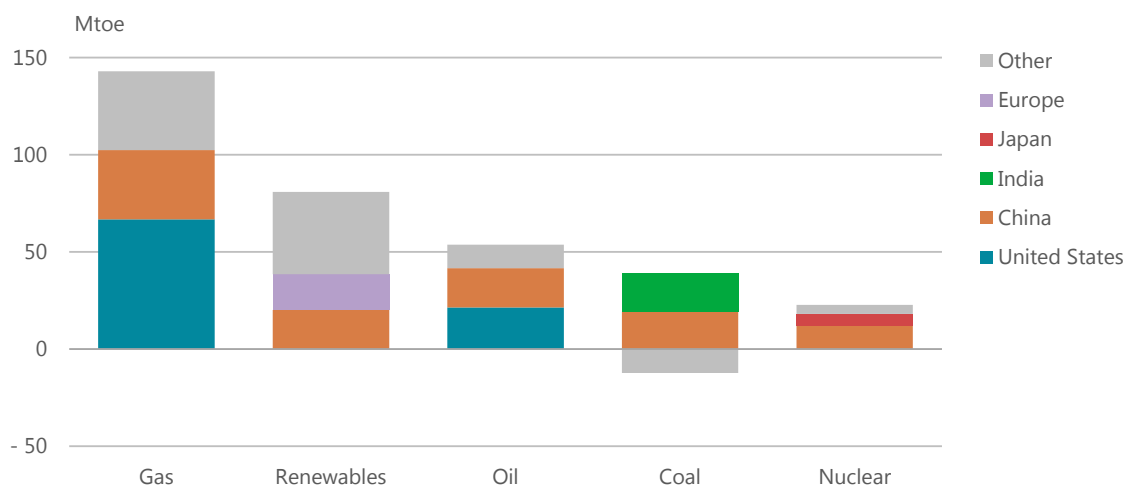
Weather conditions last year were also responsible for almost a fifth of the increase in global energy demand as average winter and summer temperatures in some regions approached or exceeded historical records. Cold snaps drove demand for heating and, more significantly, hotter summer temperatures pushed up demand for cooling.

Trends by technology

Global gas demand expanded at its fastest rate since 2010, with year-on-year growth of 4.6%. Oil demand grew 1.3% and coal consumption rose 0.7%. Oil and coal together accounted for a quarter of global demand growth.

Renewables, which grew by over 4%, met around one-quarter of the growth in total primary energy demand. This was largely due to expansion in electricity generation, where renewables accounted for 45% of the growth in 2018.

Figure 2. Figure: Global primary energy demand growth by fuel and leading regions, 2017-18



Nuclear also grew by 3.3% in 2018, mainly as a result of new capacity in China and the restart of four reactors in Japan. Worldwide, nuclear generation met 7% of the increase in energy demand.

Electricity continues to assert itself as the "fuel" of the future, with global electricity demand growing by 4% in 2018 to more than 23 000 TWh. This rapid growth is pushing electricity towards a 20% share in total final consumption of energy. Increasing power generation was responsible for a little more than half of the growth in primary energy demand.

Oil and coal grew at similar levels, with significant growth in coal-fired power generation more than offsetting declines in coal use elsewhere.

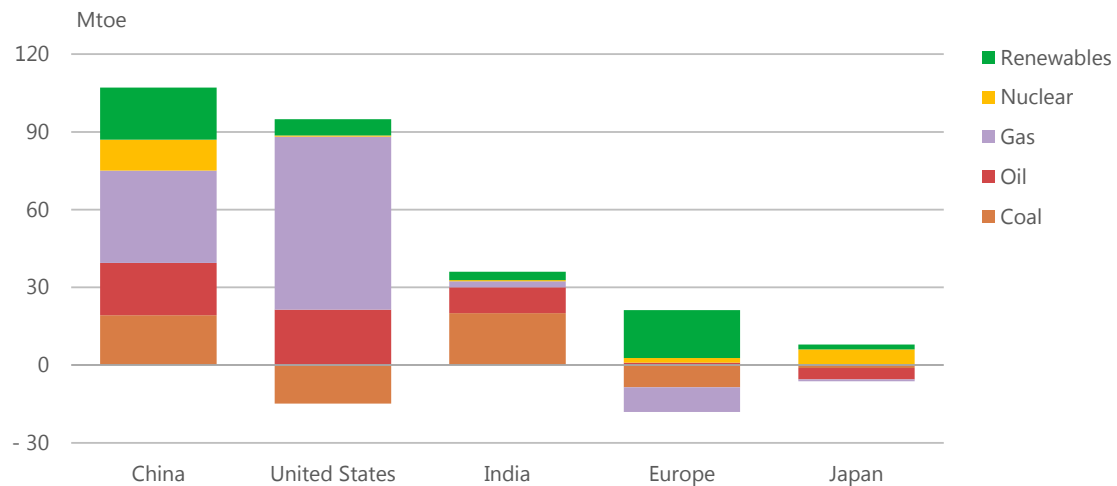
Trends by region

China saw the most substantial increase in energy demand, which grew 3.5% to 3 155 Mtoe, the highest since 2012. This accounted for a third of global growth. Demand expanded for all fuels,

but with gas in the lead, replacing coal to meet heating needs and accounting for one third of growth.

Inputs to the power sector accounted for over 95% of China's growth in energy demand, as generation from all technologies, especially coal, expanded to meet an 8.5% jump in the demand for electricity. In 2018, China also had the world's largest increase in solar and wind generation.

Figure 3. Primary energy demand growth by fuel in major energy markets, 2017-18



After three years of decline, energy demand in the United States rebounded in 2018, growing by 3.7%, or 80 Mtoe, nearly one-quarter of global growth. A hotter-than-average summer and colder-than-average winter were responsible for around half of the increase in gas demand in the United States, as gas needs grew both for electricity generation and for heating.

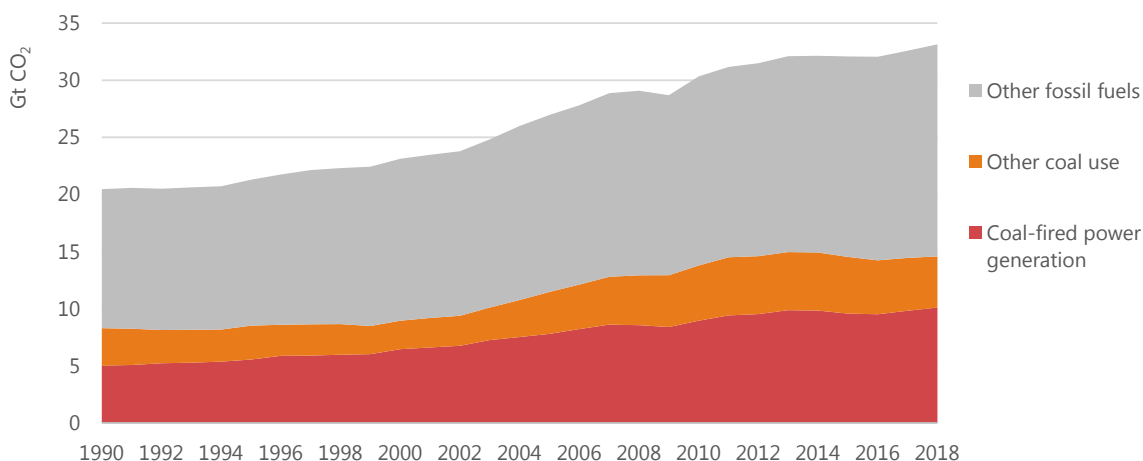
India saw primary energy demand increase 4% or over 35 Mtoe, accounting for 11% of global growth, the third-largest share. Growth in India was led by coal (for power generation) and oil (for transport), the first and second biggest contributors to energy demand growth, respectively.

Energy demand in Europe in 2018 followed a different path. Despite an economic expansion of 1.8%, demand increased by only 0.2%. An increase in energy efficiency in Germany resulted in a 2.2% drop in energy demand, with oil demand decreasing by more than 6%. Demand in France and the United Kingdom increased moderately.

CO₂ Emissions

Driven by higher energy demand in 2018, global energy-related CO₂ emissions rose 1.7% to a historic high of 33.1 Gt CO₂. While emissions from all fossil fuels increased, the power sector accounted for nearly two-thirds of emissions growth. Coal use in power alone surpassed 10 Gt CO₂, mostly in Asia. China, India, and the United States accounted for 85% of the net increase in emissions, while emissions declined for Germany, Japan, Mexico, France and the United Kingdom.

Figure 4. Global energy-related carbon dioxide emissions by source, 1990-2018



Global energy-related CO₂ emissions grew 1.7% in 2018 to reach a historic high of 33.1 Gt CO₂. It was the highest rate of growth since 2013, and 70% higher than the average increase since 2010. Last year's growth of 560 Mt was equivalent to the total emissions from international aviation.

The increase in emissions was driven by higher energy consumption resulting from a robust global economy, as well as from weather conditions in some parts of the world that led to increased energy demand for heating and cooling.

CO₂ emissions stagnated between 2014 and 2016, even as the global economy continued to expand. This decoupling was primarily the result of strong energy efficiency improvements and low-carbon technology deployment, leading to a decline in coal demand. But the dynamics changed in 2017 and 2018. Higher economic growth was not met by higher energy productivity, lower-carbon options did not scale fast enough to meet the rise in demand.

The result was that CO₂ emissions increased by nearly 0.5% for every 1% gain in global economic output compared with an increase of 0.3% on average since 2010. Renewables and nuclear energy have nonetheless made an impact, with emissions growing 25% slower than energy demand in 2018.

For the first time, the IEA assessed the impact of fossil fuel use on global temperature increases. It found that CO₂ emitted from coal combustion was responsible for over 0.3°C of the 1°C

increase in global average annual surface temperatures above pre-industrial levels. This makes coal the single largest source of global temperature increase.

The global average annual concentration of [CO₂ in the atmosphere](#) averaged 407.4 ppm in 2018, up 2.4 ppm since 2017. This is a [major increase from pre-industrial levels](#), which ranged between 180 and 280 ppm.

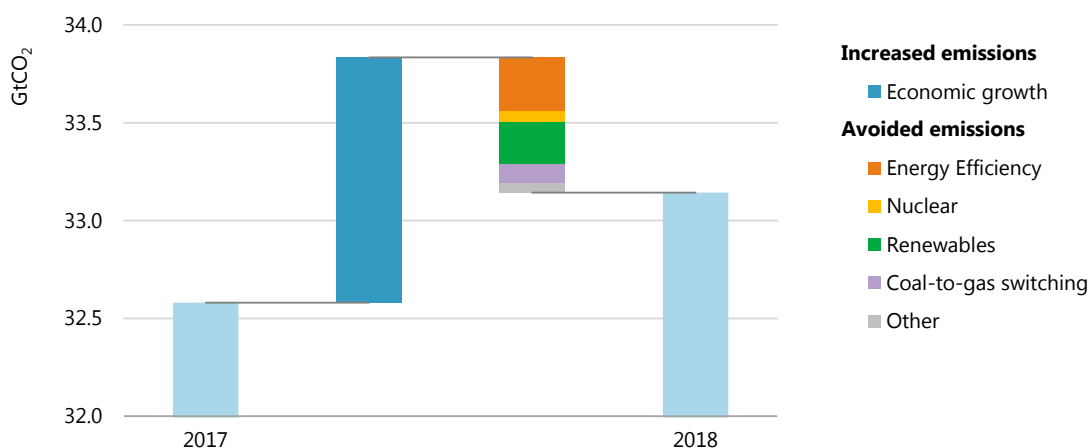
Trends by technology

In fact, coal-fired power plants were the single largest contributor to the growth in emissions observed in 2018, with an increase of 2.9%, or 280 Mt, compared with 2017 levels, exceeding 10 Gt for the first time.

As a result, coal-fired electricity generation accounted for 30% of global CO₂ emissions. The majority of that generation is found today in Asia, where average plants are only 12 years old, decades younger than their average economic lifetime of around 40 years.

Despite growth in coal use, fuel switching between coal and gas accelerated in 2018, reducing the carbon intensity of global energy use. Driven by economics and policies, coal-to-gas switching avoided almost 60 Mt of coal demand, with the transition to less carbon-intensive natural gas helping avert 95 Mt of CO₂ emissions. Without this coal-to-gas switch, the increase in emissions would have been more than 15% greater. This switch, most significant in China and the United States, reduced emissions by 45 Mt and 40 Mt, respectively.

Figure 5. Change in global energy related CO₂ emissions and avoided emissions, 2017-18



Increased use of renewables in 2018 had an even greater impact on CO₂ emissions, avoiding 215 Mt of emissions, the vast majority of which is due to the transition to renewables in the power sector.

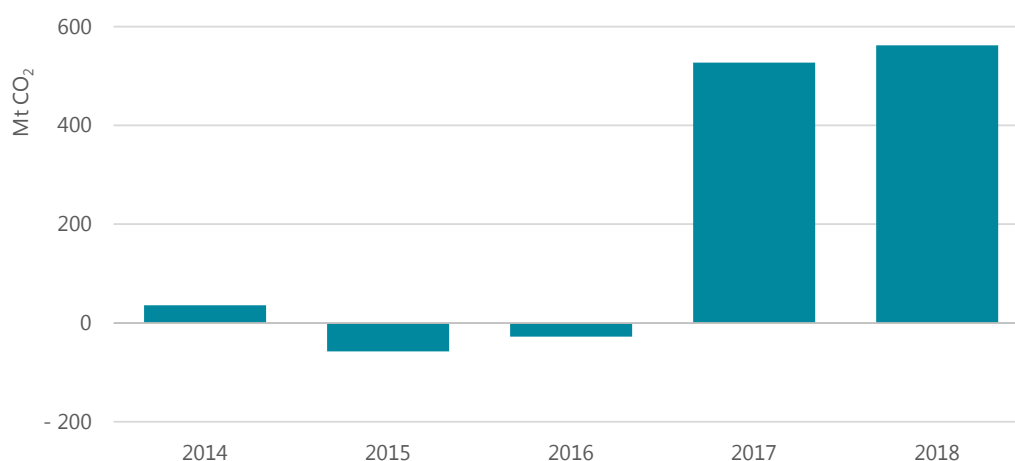
The savings from renewables was led by China and Europe, together contributing two-thirds to the global total. Increased generation from nuclear power plants also reduced emissions, averting nearly 60 Mt of CO₂ emissions. Overall, without the transition to low-carbon sources of energy in 2018, emissions growth would have been 50% higher.

Energy efficiency was the largest brake on emissions growth in 2018, but its contribution was around 40% lower than in 2017, largely because of a continued slowdown in implementing energy efficiency policies.

For the first time in almost a decade, 2018 saw an increase in plans to develop large-scale carbon capture, utilisation and storage (CCUS) facilities. By the end of 2018, the number of projects operating, under construction, or under serious consideration increased to 43. China is operating a new facility to capture CO₂ from natural gas processing for use in enhanced oil recovery, and, in Europe, five new projects are under development.

The new facilities have the potential to capture up to 13 Mt CO₂ annually, a 15% increase in potential CO₂ capture across the global project pipeline. The expansion of tax credits for CO₂ use and storage in the United States is also expected to support [a new wave of investment](#) in CCUS in the coming years.

Figure 6. Change in global CO₂ emissions, 2014-18



Electricity generation from renewable sources increased by over 7% in 2018, injecting an additional 450 TWh into global electricity networks. Increasing output from nuclear contributed another 90 TWh of low-carbon generation.

Yet this increase was not fast enough to keep pace with the rapid growth in electricity demand, which required additional generation of over 1 000 TWh. The resulting increase in generation from fossil fuel-fired power plants saw the power sector account for almost two-thirds of the increase in total emissions. Without accompanying power sector decarbonisation, electrification does not necessarily mean lower emissions.

Despite continued growth in emissions, the power sector has seen [significant transformation in recent years](#). Today the average carbon intensity of electricity generated is 475 gCO₂/kWh, a 10% improvement on the intensity from 2010. Without this, global CO₂ emissions would have been 1.5 Gt higher, or 11% of current power sector emissions. An additional improvement in intensity of 10% would have been needed to avoid any increase in emissions from electricity generation since 2010.

Trends by region

In China, CO₂ emissions grew by 2.5%, or 230 Mt, to 9.5 Gt. A jump of over 5% in electricity generation from coal-fired power stations drove up emissions by 250 Mt, which more than offset the impact of a decline in coal use outside of the power sector. An 80-Mt growth in emissions from gas combustion came predominantly from outside of the power sector, as gas was increasingly chosen as a substitute for coal-based heating.

In the United States, the emission reductions seen in 2017 were reversed, with an increase of 3.1% in CO₂ emissions in 2018. Despite this increase, emissions in the United States remain around their 1990 levels, 14% and 800 Mt of CO₂ below their peak in 2000. This is the largest absolute decline among all countries since 2000.

The impact of weather conditions was especially marked in the United States, driving up cooling and heating needs and accounting for about 60% of the emissions increase in 2018.

India saw emissions rise by 4.8%, or 105 Mt, with the growth split evenly between power and other sectors such as transport and industry. Despite this growth, per capita emissions in India remain low at only 40% of the global average.

Across Europe emissions fell by 1.3%, or 50 Mt. The emissions decline was driven by a drop of 4.5% in Germany, as both oil and coal combustion fell sharply. The drop in coal consumption was concentrated in the power sector, where generation from renewables reached a record high of 37% of the electricity mix. Electricity generation from renewables also saw a record year in the United Kingdom, accounting for 35% of generation, as the share of coal fell to 5%, a record low.

As a result, CO₂ emissions in the United Kingdom declined for a sixth year, hitting some of the lowest levels recorded since 1888. France also saw a significant drop in emissions, as electricity generation from hydroelectric and nuclear power stations meant that coal and gas plants saw lower utilisation in 2018 than in 2017.

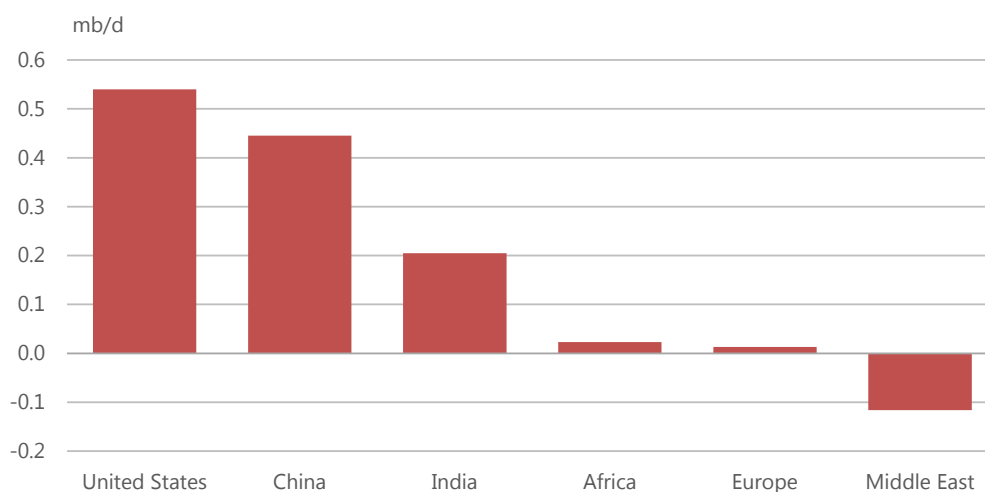
Emissions declined in Japan for a fifth year, with a decline across all fossil fuels largely due to both continued improvements in energy efficiency and the increase in generation from nuclear power stations as reactors came back online. In Mexico, emissions declined for the second consecutive year, after a three-year increase in emissions in the power sector was reversed last year.

Find out more on the IEA's efforts [Tracking Clean Energy Progress](#) and the [United Nations Sustainable Development Goal 7](#).

Oil

Global oil demand rose by 1.3% in 2018, led by strong growth in the United States. The start-up of large petrochemical projects drove product demand, which partially offset a slowdown in growth in gasoline demand. The United States and China showed the largest overall growth, while demand fell in Japan and Korea and was stagnant in Europe.

Figure 7. Oil demand growth by region (mb/d), 2017-18



Global oil demand growth slowed down in 2018 as higher oil prices partially offset robust economic activity around the world. Demand¹ grew by 1.3 mb/d in 2018, less than the increase of 1.5 mb/d in 2017.

Oil demand in advanced economies remained relatively robust, but, in emerging markets, oil demand slowed markedly in 2018. Average Brent oil prices were 30% higher in 2018 than in 2017.

The United States showed the largest overall growth at 540 kb/d, followed by China. The strong expansion of petrochemical demand in the United States boosted consumption, which also benefited from a rise in industrial production and very strong demand for trucking services.

Oil demand in China was up by 445 kb/d, or 3.5%, with the rate of growth slowing down as the country moved toward a less oil-intensive model of development and curbed vehicle use to improve urban air quality. In particular, environmental policies have reduced diesel demand growth, as provincial governments are keen to develop cleaner transport fuels or electric buses. Total passenger car sales in China, the world's largest auto market, fell 4.1% in 2018 from the previous year's record sales. Electric passenger car sales, meanwhile, more than doubled, from around 600 000 in 2017 to over 1.2 million in 2018.

¹ Oil demand refers to total liquid demand, including biofuels

Indian oil demand grew 5% in 2018 compared to 2017, a year when demand was lower due to the impact of the implementation of the Goods and Service Tax and demonetisation. However, the sharp increase in oil prices in 2018, amplified by currency deterioration, contributed to slowing growth in the second half of the year. Rapid industrialisation and the fast pace of growth in vehicle fleets have caused severe air quality problems, and policies are being put in place to try to tackle the problem.

Oil demand in Japan continued to contract, assisted by energy efficiency efforts in industry and transport and the reduced use of oil-based electricity generators as four nuclear reactors came back online for the first time since the Fukushima Daiichi accident in 2011. Demand also contracted in Korea, especially in the power sector where there was a significant shift in generation from oil to gas.

European oil demand remained stagnant on slowing economic activity and rising prices. Germany saw an important decline in oil demand, falling by 135 kb/d or 5.4% in 2018.

Oil demand in Eurasia rose strongly on a rebound in Russian oil demand, comprising more than 80% of the Eurasia total in 2018. Helped by strong car sales, Russian gasoline demand rose slightly in 2018 after three years of decline. Kerosene demand grew as a result of increased air traffic.

In Africa, low economic growth in South Africa and a switch to natural gas in Egypt put a cap on demand growth in 2018. Egypt started production at Eni's supergiant Zohr gas field in December 2017, displacing oil used in the power sector.

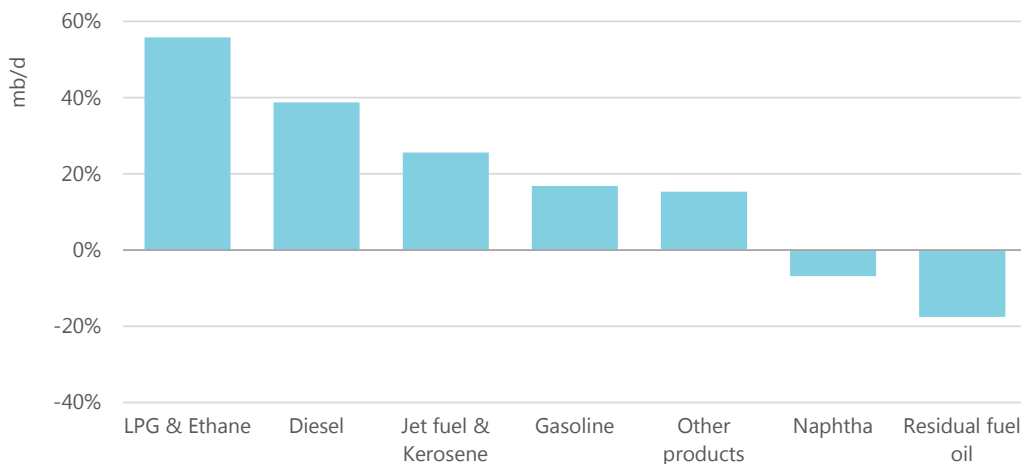
Oil demand in Latin America continues to suffer from economic difficulties in Argentina, Venezuela and Brazil. After two years of steady decline, Brazil's oil demand returned to modest growth in 2017 as the economy emerged from a deep recession. Argentina's oil demand collapsed in 2018 as GDP fell by 2.6%. According to IMF data, Venezuela's GDP fell by 18% in 2018. Oil demand has also declined, although accurate data are difficult to verify.

The Middle East saw a large decline in oil demand in 2018 mainly due to the sharp drop in Saudi Arabia's demand, which resulted from less construction activity, a price reform, a switch to natural gas in the power sector, and high emigration. In January 2018, the government more than doubled the price of gasoline with a knock-on impact on demand.

On the product front, 2018 was the year of booming liquefied petroleum gas (LPG)/ethane demand. Supported by petrochemical developments, the strongest growth among products was posted in 2018. LPG/ethane accounted for 44% of total oil demand growth. In the United States, that share was 60%, with ethane-based steam crackers making a large contribution.

Air traffic volumes have increased significantly in recent years, particularly in China and India. Jet fuel has become a major contributor to higher oil consumption. Last year, it accounted for 20% of total global oil demand growth.

Figure 8. Oil demand growth by product (mb/d), 2017-18



Gasoline demand growth slowed down as prices rose last year, an increase that was amplified by currency depreciation in several emerging markets. As a result, gasoline accounted for 13% of world oil demand growth in 2018, compared to 35% over the period 2014-17.

Diesel oil demand in the United States was extremely strong, supported by robust industrial growth, high imports, and the needs of the shale oil industry. Truck transport benefited from the growth in e-commerce and booming industrial production.

Diesel oil demand growth remains particularly low in Europe, which reflects slowing economic growth and the falling popularity of diesel cars. Part of the fall in diesel oil demand growth is also due to the exceptional water conditions on the Rhine river in 2018 that disrupted deliveries to Germany and Switzerland.

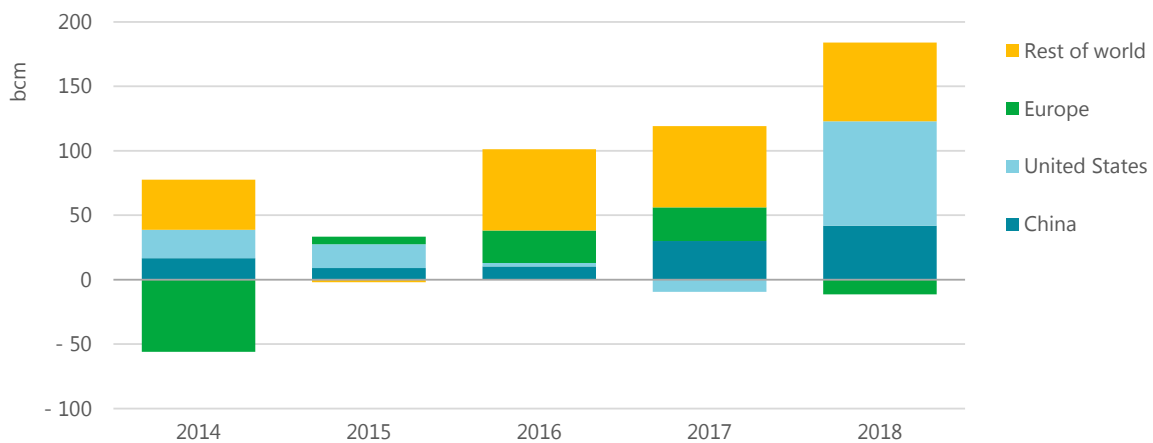
Diesel consumption growth is also slowing in China because of lower coal transportation and the country's shift to a new economic model. Even so, diesel accounted for 30% of world oil demand growth in 2018. Other products posted modest growth while fuel oil and naphtha demand declined slightly in 2018.

Find out more about oil markets in [Oil 2019](#), the IEA's recently published market analysis and forecasts to 2024.

Natural Gas

Natural gas consumption grew by an estimated 4.6% in 2018, its largest increase since 2010 when gas demand bounced back from the global financial crisis. This second consecutive year of strong growth, following a 3% rise in 2017, was driven by growing energy demand and substitution from coal. The switch from coal to gas accounted for over one-fifth of the rise in gas demand. The United States led the growth followed by China.

Figure 9. Natural gas demand growth by region, 2014-18



Natural gas consumption worldwide grew by an estimated 4.6% in 2018, or 170 bcm, its strongest increase since 2010 when gas demand was rebounding from the 2008 global financial crisis. This second consecutive year of strong growth (after a 3% gain in 2017) was nearly three times the average growth of 1.5% over the previous five years.

The United States and China together accounted for 70% of the global growth, which was driven by a strong global economy and by substitution from coal. The switch from coal to gas was responsible for nearly 40 bcm of the increase in gas, more than one-fifth of the total extra demand.

The United States was the single largest driver of higher demand, with a gain of 80 bcm, up 10.5% from the previous year – its highest increase since the early 1950s. This higher consumption, the equivalent of the United Kingdom's annual consumption, absorbed the majority of the growth in domestic gas production, which also hit record levels in 2018.

Such historic demand growth was mainly driven by power generation and buildings. A colder winter and hotter summer than average was responsible for around half of the extra gas demand in both sectors. The ongoing switch from coal to gas in power generation also contributed strongly to the growth, adding 18 bcm to gas demand. The share of gas in power generation hit an all-time record of 34%.

Gas demand in China increased by almost 18%, or 42 bcm, the fastest growth rate since the introduction of its 13th Five-Year Plan (2016-2020) and its more ambitious promotion of the use

of natural gas relative to previous Plans. Gas now accounts for 8% of primary demand in China, double its share at the start of the decade.

The country became the world's largest natural gas importer in 2018, ahead of Japan, and was the second-largest contributor in volume to global demand growth after the United States. This results from the country's policy framework in favour of cleaner energies (known as the "Three-Year Action Plan for Winning the Blue Sky War") and, in particular, by restricting the use of coal boilers for industrial and residential use. Across all sectors, the switch from coal to gas contributed 17 bcm to demand growth.

In the Asia-Pacific region, natural gas demand was also pushed by growing industry and power generation needs in South Asia as well as by nuclear reactor shutdowns in South Korea.

In the Middle Eastern and North African oil and gas producing countries, reducing oil burn for power generation through the development of natural gas-fired combined cycles contributed to the global gas demand trend. Egypt, which achieved self-sufficiency in its gas supply in late 2018, inaugurated the world's largest combined cycle gas-fired power plant, with a capacity of 14.4 GW. In Iran, the region's largest natural gas consumer, consumption growth is driven by power generation growth and the phasing out of fuel oil burn.

After several years of decline, consumption rose in Russia for a third consecutive year. The increase in gas sales was driven mainly by power generation as the use of coal for power decreased slightly.

Europe experienced a decline in natural gas consumption in 2018 after two years of growth. This is partly due to the temperature sensitivity of gas demand, with demand for space heating reduced by a mild fourth quarter (in spite of cold snaps over the first quarter).

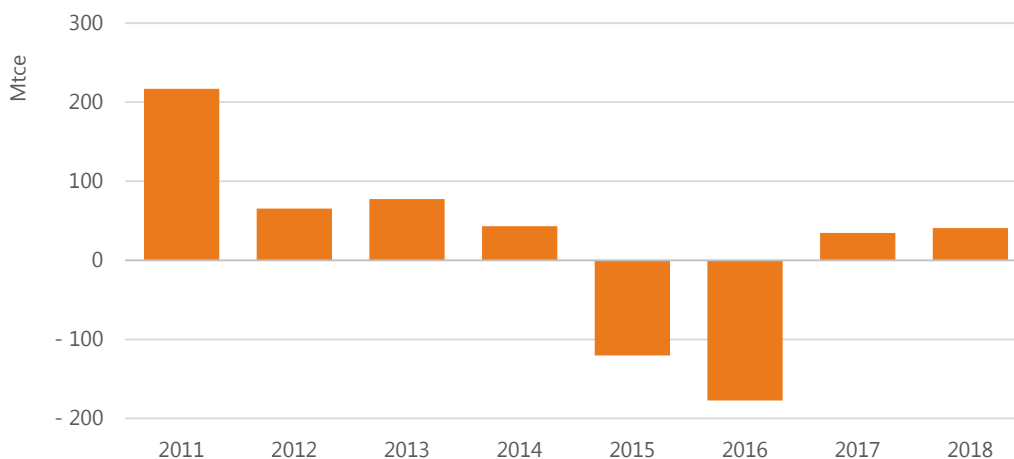
Additionally, 2018 saw lower gas use for power generation, especially in some of the largest consumers such as Germany, Italy, Spain, Turkey and the United Kingdom. Despite lower demand, the combination of declining domestic production and urge to replenish storage after massive withdrawal over the first months contributed to a record of over 200 bcm of imports from Russia.

For more IEA gas market analysis and forecasts to 2023 see [Gas 2018](#). The next edition will be released in June 2019.

Coal

Global coal demand grew for a second year in 2018, but its role in the global mix continued to decline. Last year's 0.7% increase was significantly slower than the 4.5% annual growth rate seen in the period 2000-10. But while the share of coal in primary energy demand and in electricity generation slowly continues to decrease, it still remains the largest source of electricity and the second-largest source of primary energy.

Figure 10. Figure: Annual global change in coal demand, 2011-18



Global coal demand increased by 0.7% in 2018, or 40 Mtce, growing for a second year as higher demand in Asia outpaced declines everywhere else.

But the role of coal in the global mix continues to slowly decline. Last year's increase was significantly slower than the 4.5% annual growth rate seen in the last decade (2000-10). Nevertheless, coal remains the largest source of electricity and the second-largest source of primary energy.

Coal's shift to Asia continued in 2018. The growth in demand for coal took place in only some countries in Asia – China, India and a few countries in South and Southeast Asia – primarily because of the increased demand for electricity in these countries, for which coal generally outcompetes natural gas.

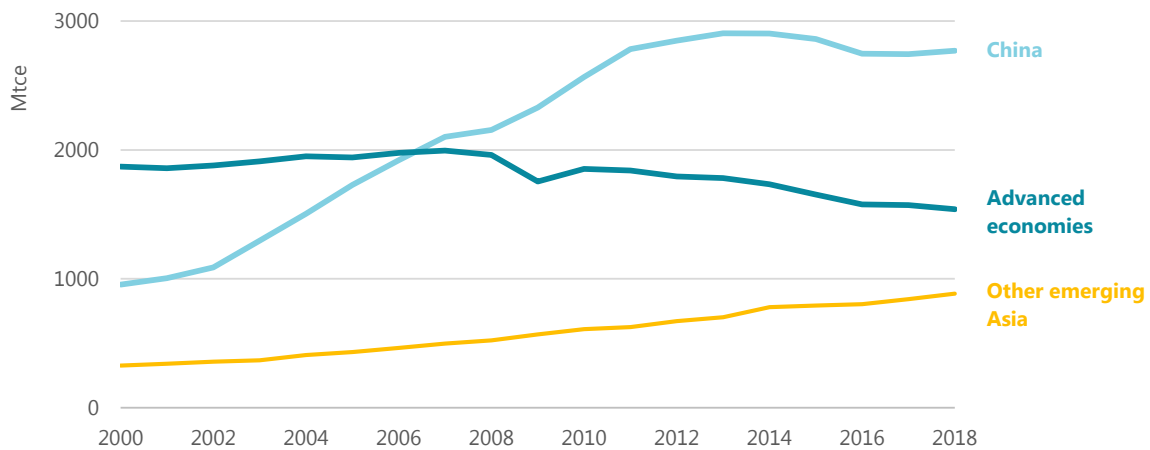
In Europe and North America, the decline in coal demand continued, as coal was pushed out by environmental policies, cheaper renewables, and, in the case of the United States, abundant natural gas supplies.

In China, coal consumption rose by 1% last year, although the strong growth in the power sector was partially offset by a drop in the residential and industrial sectors.

Despite the rapid expansion of non-coal sources of electricity, particularly renewables, coal power generation increased by 5.3% in 2018 to meet China's strong power demand growth. In

contrast, coal use in residential and industrial sectors is plummeting, replaced mainly by gas and electricity, owing in part to governmental policies to curb air pollution.

Figure 11. Coal demand by selected economies, 2000-18



India's 7% economic growth, the highest among large economies, created strong coal demand, especially for electricity generation and steel production as India surpassed Japan to become the world's second-largest steel producer behind China. New solar and wind capacity met less than a third of the growth in electricity demand, while coal supplied the bulk of additional electricity generation. As a result, coal demand in India grew by around 5%.

In Southeast Asia, coal use in Indonesia, Viet Nam, the Philippines and Malaysia increased significantly, driven by the increase in electricity use and the reliance on coal for power generation. With coal generation growing faster than power generation, this is the only region where coal's share in the power mix increased in 2018.

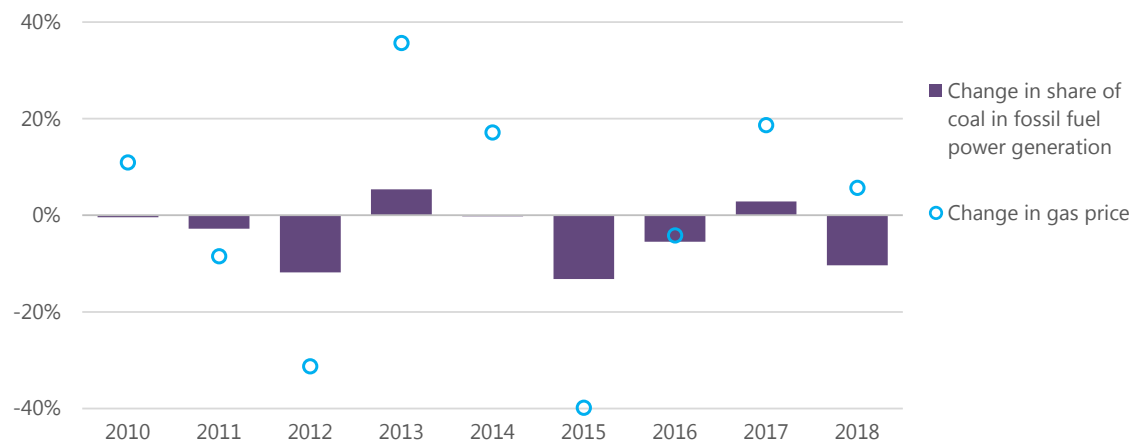
In Japan and Korea, coal demand posted a small decline in 2018, a change from the substantial growth in demand in 2017. After the significant increase of over 6% in 2017, coal power generation declined slightly by around 1%, as no new coal power capacity was commissioned and utilisation declined slightly in Japan.

In the United States, the retreat of coal continues. Despite the current administration's support and an uptick in electricity demand, the availability of cheap abundant gas, the ongoing expansion of renewables, and an ageing stock of coal-fired plants have all contributed to the continued retirement of coal-fired power generation.

In 2018, coal use declined by over 4% while gas demand grew by over 10%, despite the rise in average gas prices in 2018 from the previous year. This marked the first time since the start of the shale revolution that gas demand has grown at the expense of coal while gas prices increased.

Last year also saw the second-largest coal power capacity closure in a single year since 2015. Overall, US coal consumption declined to levels not seen since the mid-1970s, and the share of coal in the electricity mix dropped below 29%, its lowest share ever.

Figure 12. Change in the share of coal in fossil fuel power generation and change in the gas price in the United States, 2010-18



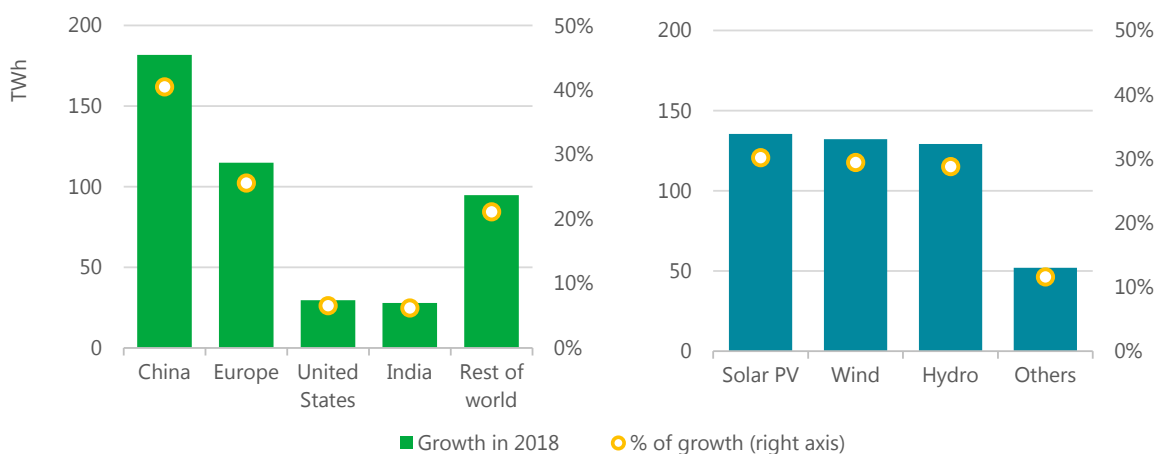
In Europe, coal demand continues to fall, with a drop of 2.6% in 2018. In Germany, coal lost its dominance in 2018 as renewables took over as the top source for power generation. The last hard coal mine in Germany closed last year, ending a very important chapter in German industrial history. In all major European countries – notably France, Spain, Italy and the United Kingdom – coal use declined, mainly owing to higher renewable generation.

All these trends are consistent with the five-year IEA forecast in which global coal demand stagnates through 2023, with some growth to 2020, followed by a plateau. Find out more in [Coal 2018](#).

Renewables

Renewables increased by 4% in 2018, accounting for almost one-quarter of global energy demand growth. The power sector led the gains, with renewables-based electricity generation increasing at its fastest pace this decade. Solar PV, hydropower, and wind each accounted for about a third of the growth, with bioenergy accounting for most of the rest. Renewables covered almost 45% of the world's electricity generation growth, now accounting for over 25% of global power output.

Figure 13. Figure: Growth in renewable electricity generation by region and technology, 2017-18



Demand for energy from renewable sources increased by 4% in 2018, accounting for almost one-quarter of global energy demand growth, second only to natural gas.

The power sector led the growth, with renewables-based electricity generation increasing by 7%, almost 450 TWh, equivalent to Brazil’s entire electricity demand. This was faster than the 6% average annual growth since 2010.

Solar PV, hydropower, and wind each accounted for about a third of the growth, with bioenergy accounting for the majority of the rest. Taken together, renewables were responsible for almost 45% of the world's increase in electricity generation. They now account for almost 25% of global power output, second after coal.

China accounted for over 40% of the growth in renewable-based electricity generation, followed by Europe, which accounted for 25%. The United States and India combined contributed another 13%. Renewables have also grown rapidly outside of these major markets.

Solar PV electricity generation had another record year, growing 31%. Since 2015, annual solar PV capacity additions have more than doubled, reaching close to 100 GW in 2017.

China’s annual solar PV capacity additions were at 44 GW in 2018, which was lower than the increase of 53 GW in 2017. This followed a new government policy that aims at a sustainable and cost-effective solar PV expansion and slowed down growth.

In the United States and India, solar PV annual capacity additions remained similar to 2017 levels while additions in Europe have resumed growth for the first time since 2015.

Electricity generation from wind grew by an estimated 12% in 2018, keeping its spot as the largest non-hydro renewable technology. The global growth was similar to 2017, despite the decreasing global capacity expansion over the period 2015-17.

China's wind capacity expansion increased from 15 GW in 2017 to 20 GW in 2018 as the government lifted a development ban in certain regions after improvement in curtailment levels since 2016. In Europe, wind capacity expansion was lower last year compared to record-level installations in 2017, while the US market showed a slow rebound.

Hydropower output increased by an estimated 3%, a faster growth than in 2017 despite declining global capacity additions since 2015. This is the result of continuous drought recovery and stable economic growth in Latin America, as well as strong capacity expansion and good water availability in China.

After a record-level increase in 2017, hydropower generation in the United States returned to normal levels in 2018. Overall, hydropower remains the largest renewable energy technology, accounting for around 60% of all electricity supply from renewables.

Renewable electricity generated from other technologies grew by 7%, dominated by bioenergy. Geothermal electricity increased mostly in Turkey, with some gains also seen in Indonesia and the United States.

In transport, global biofuels production increased 6% in 2018. Brazil's ethanol production rose 12%, boosted by low international sugar prices that favoured ethanol output. It was also helped by higher price competitiveness at the pump at a time of higher oil prices in the first three quarters of the year.

Ethanol production in the United States continued to grow in 2018, supported by an abundant corn crop and high capacity utilisation by domestic ethanol facilities. China saw a record growth of 24% as it increased efforts to implement nationwide consumption of 10% ethanol blended with gasoline. India's production rebounded, driven by a large supply of feedstocks and relatively higher oil prices.

Bioenergy, including its traditional uses in developing countries, remains the largest renewable source. While a decline in traditional uses would improve global health, modern use of bioenergy in industry and buildings holds great potential. Solar thermal energy remains the second-largest renewable heat source, mostly deployed in buildings for water heating. However, capacity expansion has slowed since 2013, a trend that is expected to continue in 2018 as a result of expiring incentives and a weaker housing market in China.

Overall, the use of renewables needs to expand much more quickly in all three sectors to be on track to meet long-term climate goals, cleaner air objectives, and aims to provide access to modern energy sources, as demonstrated in the IEA Sustainable Development Scenario (SDS).

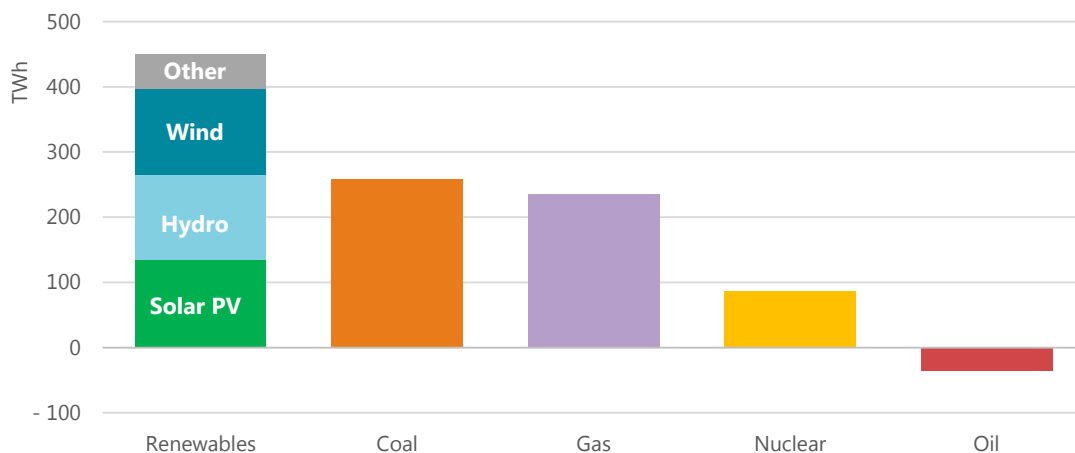
In this scenario, the share of renewables in the power mix needs to rise from one-quarter today to two-thirds in 2040. In the provision of heat, renewables need to rise from 10% today to 25%. In transport, renewables need to rise from 3.5% today to 19%, including both direct and indirect use, e.g. renewable electricity for heating and electric vehicles.

For more IEA renewables market analysis and forecasts to 2023 see [Renewables 2018](#), explore the role of renewables in the IEA's [Sustainable Development Scenario](#).

Electricity

Global electricity demand rose by 4% in 2018, nearly twice as fast as overall energy demand, and at its fastest pace since 2010. Renewables and nuclear power met the majority of the growth in demand. Still, generation from coal- and gas-fired power plants increased considerably, driving up CO₂ emissions from the sector by 2.5%.

Figure 14. Change in electricity generation by source, 2017-18



Global electricity demand in 2018 increased by 4%, or 900 TWh, growing nearly twice as fast as the overall demand for energy. This was also the fastest increase since 2010, when the global economy recovered from the financial crisis. Together, renewables and nuclear power met a majority of the increase in power demand.

Still, generation from coal- and gas-fired power plants also rose considerably to meet higher electricity demand, driving up CO₂ emissions from the sector by 2.5%. Emissions from power generation reached about 13 Gt, or 38% of total energy-related CO₂ emissions last year.

Half of the growth in global energy demand came from the power sector, in response to higher electricity consumption.

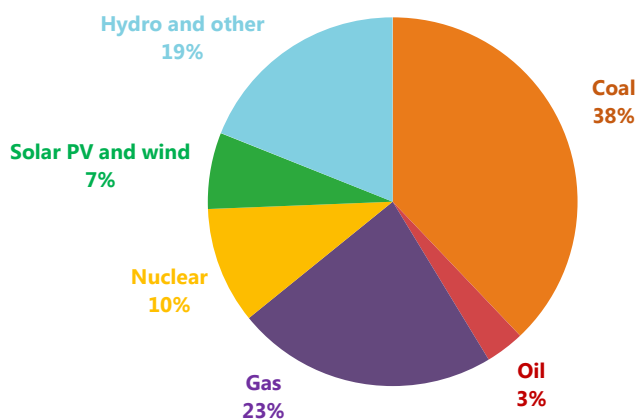
About a fifth of the growth in electricity demand last year can be attributed to weather conditions. Demand for air-conditioning during the summer jumped last year, which ranked as the fourth hottest year on record. Likewise, colder-than-average winters in North America increased the call for heating.

China and the United States, the world's two largest power markets, accounted for 70% of global demand growth. In China, electricity demand increased by 8.5%, a notable uptick compared with recent years. This was led by the industrial sector, including iron, steel and other metals, cement and construction, as well as higher demand for cooling.

In the United States, after stable consumption in recent years, demand jumped by nearly 4% to a record level of almost 4 000 TWh, 17% of the global total. The majority of the growth was attributable to a hotter summer and a colder than average winter, which increased power demand in buildings.

India's power demand increased by around 65 TWh, or 5.4%, a slower rate than the previous year. The increase was driven by higher demand in buildings, especially coming from air conditioning, as well as higher access to electricity. Last year, India completed the [electrification of all its villages](#), with electricity connections extended to around 30 million people in the last 2 years.

Figure 15. Electricity generation mix, 2018



In Europe and Japan, power demand grew by less than 1%, while in Australia demand fell. South Korea saw demand growth of around 3% due to higher-than-average summer temperatures.

Renewables generation growth accelerated to 7% in 2018, from 6% in 2017, and met 45% of global electricity demand growth. It reached record highs in several countries, such as Germany, where for the first time, generation from renewables exceeded coal-fired generation. In the United Kingdom, renewables produced a record 35% of the total generation of 335 TWh.

Solar PV, hydro and wind each account for 30% of the growth in renewable generation globally, with bioenergy accounting for most of the rest.

Nuclear power generation increased by 3.3%, or 90 TWh. Half of that was due to new plants entering service in China. Restarting four nuclear power plants for the first time since the 2011 Fukushima Daiichi accident in Japan and higher availability in France together added 38 TWh. Production in Switzerland, Taiwan, Pakistan and Sweden also increased. Generation fell in South Korea, because of new maintenance regulation, and in Belgium, because of shutdowns caused by safety-related concerns.

Despite the important increase in generation from low-carbon sources, coal- and gas-fired generators were also called upon in 2018 to meet higher electricity demand.

Coal grew more than any other single source of generation in 2018, accounting for 26% of total additional generation. With a 38% market share, it remains the largest source of electricity generation. The highest increase in coal power generation took place in China, followed by India. These countries more than offset significant reductions in the United States, Europe and Japan.

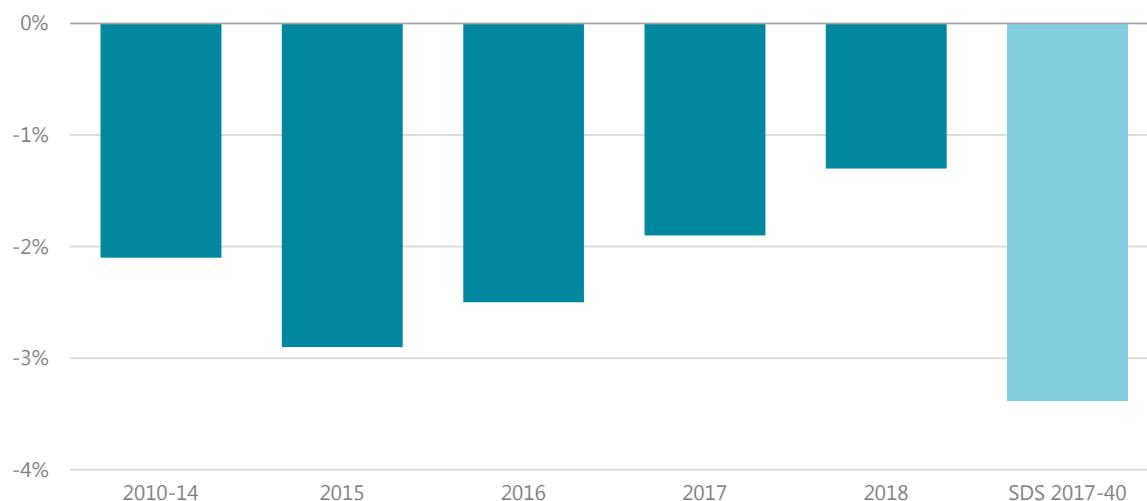
Natural gas was the second-largest single source of global electricity generation and grew by almost 240 TWh, nearly as much as coal. Most of the increase came from the United States, where gas-fired generation rose by 15% to overtake coal as the largest source of generation.

Find out more about the IEA work on [electricity](#) and [tracking progress towards universal electricity access](#).

Efficiency

Energy efficiency across the global economy continued to improve in 2018, with global primary energy intensity falling by 1.3%. But this was lower than improvement rates seen in recent years. Although efficiency was still the biggest source of carbon dioxide emissions abatement in the energy sector, 2018 marked the third consecutive year in which the improvement rate for energy efficiency slowed.

Figure 16. Average annual change in primary energy intensity, historically and in the Sustainable Development Scenario (SDS)



Energy efficiency continued to show improvements in 2018, with the global economy requiring an average of 1.3% less energy inputs for every unit of GDP than in 2017. However, the annual rate of improvement in global primary energy intensity has been falling in recent years, dropping from a high of nearly 3% in 2015 to 1.9% in 2017, and falling again in 2018.

The slowdown in the rate of energy efficiency improvement means that efficiency offset 40% less CO₂ emissions in 2018 relative to 2017, although it remains the largest contributor to emissions abatement. The progressive step-down since 2015 is in stark contrast to the acceleration required in the IEA Sustainable Development Scenario.

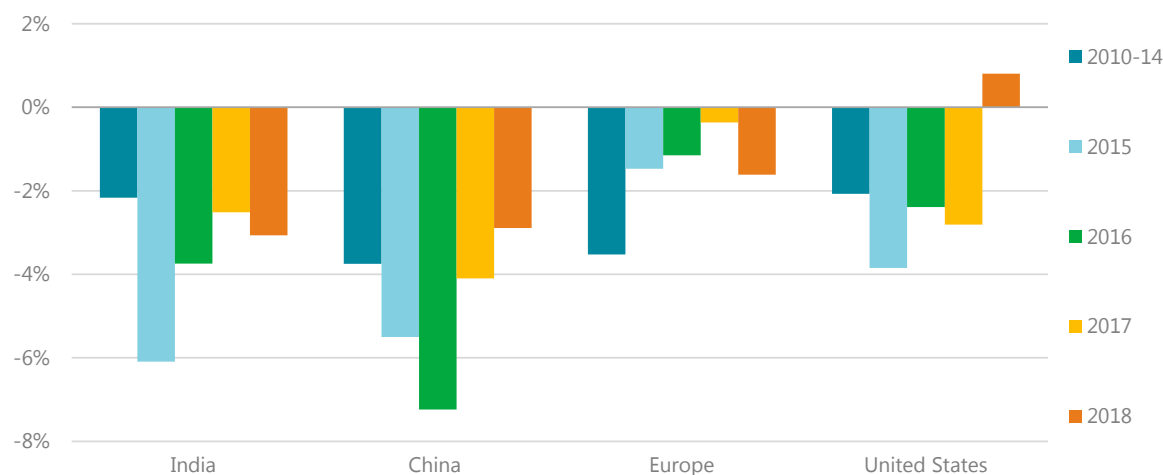
Limited improvement in global energy efficiency in 2018 can be attributed to a number of factors. Among these is the static energy efficiency policy environment in 2018, with lacklustre progress on implementing new energy efficiency policies or increasing the stringency of existing policies.

Today only around one-third of final energy use is covered by mandatory energy efficiency policies, such as codes and standards, with only marginal coverage growth in recent years. Efforts to strengthen existing energy efficiency policies also remained weak in 2018. Increasing the coverage and strength of codes and standards is a key lever of energy efficiency gains.

Progress on policy measures such as financial incentives, market-based instruments, and information and capacity building programmes also remains limited. For example, many countries drive efficiency gains by placing an obligation on utilities to meet energy saving targets. However, these targets have not changed since 2014 in over half of the obligation schemes, globally.

The global trend regarding energy efficiency hides significant regional disparities, including certain bright spots. Europe and India both saw an increase in the rate of improvement for energy efficiency in 2018 relative to 2017. Nonetheless, slowdowns in other major regions dictated the direction of the global average.

Figure 17. Average annual change in primary energy intensity, by region



In China, where robust policies implemented in recent years have increased levels of efficiency and limited emissions growth, primary energy intensity improved by 2.9% in 2018. Although more than double the global average rate of energy efficiency improvement, this was the slowest rate of improvement in China since 2011. Energy efficiency gains were not enough to offset the effects on energy demand of increased coal-fired electricity generation, called upon to service economic growth of 6.6%.

In the United States, long-standing policies and technological change underpinned efficiency gains. However, in 2018 the impact of these policies was outweighed by unusually high gas consumption on the back of a colder than average winter and hotter than average summer. Strong economic growth (2.9%) fueled energy use in more energy-intensive sectors of the economy. The result was a 0.8% increase in primary energy intensity. Weather was responsible for around half of the increase in energy demand in the United States in 2018. Without this increase, energy intensity would have continued to improve in 2018, albeit at a rate well below that seen in 2017.

Primary energy intensity declined in both Europe and India. In Europe, mild weather conditions at the end of the year reduced gas demand. This contributed to a flattening of total primary energy demand and an intensity improvement of 1.6%. In India, primary energy intensity improved by just over 3% although energy demand was still 4% higher.

Economic growth, particularly in emerging economies, will continue to put upward pressure on energy demand and emissions. To curb the impact of growing energy service demand and unlock the significant cost-effective energy efficiency potential, governments need to scale up the use of all policy tools at their disposal. Examples of these policies, as outlined in the IEA's Efficient World Strategy, have been implemented in some form, providing the basis for further development.

Examine global energy efficiency trends, outlooks to 2040 and the Efficient World Strategy in [Energy Efficiency 2018](#), the IEA's [Global Exchange for Energy Efficiency](#), and explore the role of energy efficiency in the IEA's [Sustainable Development Scenario](#).

Data Tables

Global Energy and CO₂ 2019 Status Report annex data

Table 1. Global energy demand and electricity generation by source

Energy Demand (Mtoe)	Growth Rate (%)		Shares (%)	
	2018	2017-2018	2000	2018
Total Primary Energy Demand	14 301	2.3%	100%	100%
Coal	3 778	0.7%	23%	26%
Oil	4 488	1.3%	36%	31%
Gas	3 253	4.6%	21%	23%
Nuclear	710	3.3%	7%	5%
Hydro	364	3.1%	2%	3%
Biomass and waste	1 418	2.5%	10%	10%
Other renewables	289	14.0%	1%	2%

Electricity Generation (TWh)	Growth Rate (%)		Shares (%)	
	2018	2017-2018	2000	2018
Total Generation	26 672	4.0%	100%	100%
Coal	10 116	2.6%	39%	38%
Oil	903	-3.9%	8%	3%
Gas	6 091	4.0%	18%	23%
Nuclear	2 724	3.3%	17%	10%
Hydro	4 239	3.1%	17%	16%
Biomass and waste	669	7.4%	1%	3%
Wind	1 217	12.2%	0%	5%
Solar photovoltaics	570	31.2%	0%	2%
Other renewables	144	4.2%	0%	1%

Table 2. Energy related CO₂ emissions from fuel combustion by regions

	Total CO ₂ emissions (Mt CO ₂)		Growth Rate (%)	
	2018	2017-2018	2017-2018	
United States	4 888	3.1%		
China	9 481	2.5%		
India	2 299	4.8%		
Europe	3 956	-1.3%		
Rest of world	11 249	1.1%		
World	33 143	1.7%		

Table 3. Regional summary

	Total Primary Energy Demand (Mtoe)	
	2018	Growth Rate (%) 2017-2018
United States	2 227	3.7%
China	3 155	3.5%
India	933	4.0%
Europe	2 010	0.2%
Rest of world	5 568	1.8%
World	14 302	2.3%

	Oil Primary Energy Demand (mb/d)	
	2018	Growth Rate (%) 2017-2018
United States	20	2.7%
China	13	3.5%
India	5	4.5%
Europe	15	0.1%
Rest of world	46	0.2%
World	99	1.3%

	Gas Primary Energy Demand (Bcm)	
	2018	Growth Rate (%) 2017-2018
United States	854	10.5%
China	279	17.7%
India	60	4.7%
Europe	599	-1.9%
Rest of world	2 137	2.8%
World	3 928	4.6%

	Coal Primary Energy Demand (Mtce)	
	2018	Growth Rate (%) 2017-2018
United States	451	-4.5%
China	2 771	1.0%
India	600	5.0%
Europe	462	-2.6%
Rest of world	1 113	1.4%
World	5 397	0.7%

	Renewables-based generation (TWh)	
	2018	Growth Rate (%) 2017-2018
United States	744	4.1%
China	1 854	10.9%
India	291	10.6%
Europe	1 462	8.5%
Rest of world	2 449	4.0%
World	6 800	7.1%

Energy Intensity improvements (toe per USD 1000,PPP)	Y-on-Y change (%)	
	2018	2017-2018
United States	0.112	0.8%
China	0.125	-2.9%
India	0.092	-3.1%
Europe	0.079	-1.6%
Rest of world	0.109	-1.1%
World	0.108	-1.3%

Sources: Data for energy demand, gross electricity generation and CO₂ emissions from fuel combustion are based on IEA estimates derived from a number of sources, including the latest monthly data submissions to the IEA's Energy Data Centre, other statistical releases from national administrations, and recent market data from the IEA Market Report Series that cover coal, oil, natural gas, renewables and power. These are based on information available up to March 2019.

Definitional note 1: 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.

Definitional note 2: Fossil fuel demand tables

Oil demand is expressed in million barrels per day (mb/d). In the oil primary energy demand table, oil demand refers to total liquids, including 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 fuels bunkers.

Definitional note 3: Economic growth assumptions

2017 and 2018 GDP PPP growth based on IMF global economic trends: "World Economic Outlook Update, January 2019: A Weakening Global Expansion"

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This IEA analysis uses the latest monthly and annual data available from national statistical offices, energy ministries and international organisations to build full energy balances by region. Where complete data is unavailable, this report uses market data and analysis by fuel and sector. For question and comments, please contact weo@iea.org.

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