International Energy Agency

Global Energy & CO_2 Status Report

2017

March 2018

Key findings

- **Energy**: Global energy demand increased by 2.1% in 2017, compared with 0.9% the previous year and 0.9% on average over the previous five years. More than 40% of the growth in 2017 was driven by China and India; 72% of the rise was met by fossil fuels, a quarter by renewables and the remainder by nuclear.

- **Carbon dioxide (CO_2)**: Global energy-related CO_2 emissions grew by 1.4% in 2017, reaching a historic high of 32.5 gigatonnes (Gt), a resumption of growth after three years of global emissions remaining flat. The increase in CO_2 emissions, however, was not universal. While most major economies saw a rise, some others experienced declines, including the United States, United Kingdom, Mexico and Japan. The biggest decline drop came from the United States, mainly because of higher deployment of renewables.

- **Oil**: World oil demand rose by 1.6% (or 1.5 million barrels a day) in 2017, a rate that was more than twice the annual average seen over the last decade. An increasing share of sport-utility vehicles and light trucks in major economies and demand from the petrochemicals sector bolstered this growth.

- **Natural gas:** Global natural gas demand grew by 3%, thanks in large part to abundant and relatively low-cost supplies. China alone accounted for almost 30% of global growth. In the past decade, half of global gas demand growth came from the power sector; last year, however, over 80% of the rise came from industry and buildings.

- **Coal**: Global coal demand rose about 1% in 2017, reversing the declining trend seen over the last two years. This growth was mainly due to demand in Asia, almost entirely driven by an increase in coal-fired electricity generation.

- **Renewables**: Renewables saw the highest growth rate of any energy source in 2017, meeting a quarter of global energy demand growth last year. China and the United States led this unprecedented growth, contributing around 50% of the increase in renewables-based electricity generation, followed by the European Union, India and Japan. Wind power accounted for 36% of the growth in renewables-based power output.

- **Electricity**: World electricity demand increased by 3.1%, significantly higher than the overall increase in energy demand. Together, China and India accounted for 70% of this growth. Output from nuclear plants rose by 26 terawatt hours (TWh) in 2017, as a significant amount of new nuclear capacity saw its first full year of operation.

- **Energy efficiency**: Improvements in global energy efficiency slowed down dramatically in 2017, because of weaker improvement in efficiency policy coverage and stringency as well as lower energy prices. Global energy intensity improved by only 1.7% in 2017, compared with an average of 2.3% over the last three years.

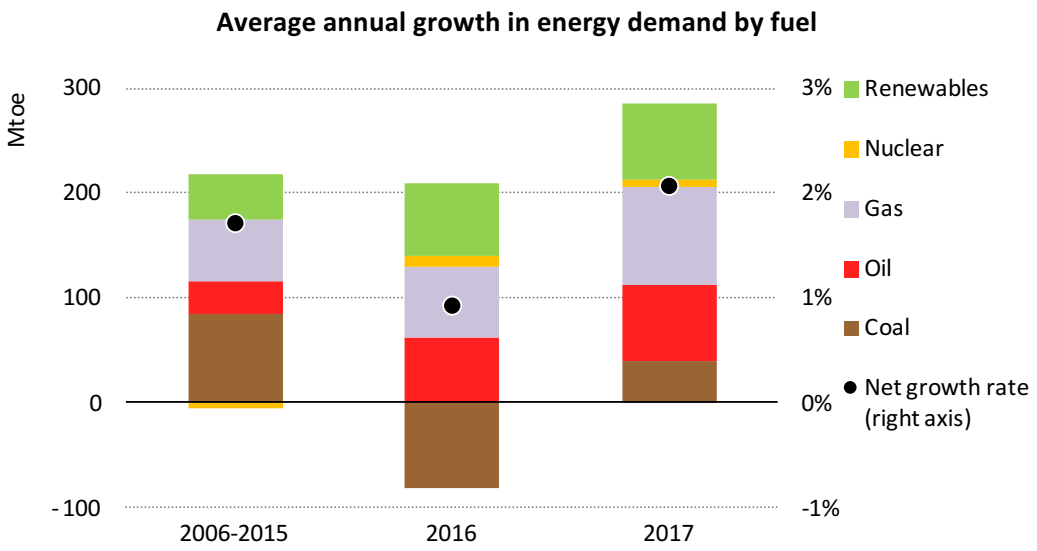
Overview: Global energy demand 2017

Global energy demand grew by 2.1% in 2017, according to IEA preliminary estimates, more than twice the growth rate in 2016. Global energy demand in 2017 reached an estimated 14 050 million tonnes of oil equivalent (Mtoe), compared with 10 035 Mtoe in 2000.

Fossil-fuels met 70% of the growth in energy demand around the world. Natural gas demand increased the most, reaching a record share of 22% in total energy demand. Renewables also grew strongly, making up around a quarter of global energy demand growth, while nuclear use accounted for 2% of the growth. The overall share of fossil fuels in global energy demand in 2017 remained at 81%, a level that has remained stable for more than three decades despite strong growth in renewables.

Improvements in global energy efficiency slowed down. The rate of decline in global energy intensity, defined as the energy consumed per unit of economic output, slowed to only 1.6% in 2017, much lower than the 2.0% improvement seen in 2016.

The growth in global energy demand was concentrated in Asia, with China and India together representing more than 40% of the increase. Energy demand in all advanced economies contributed more than 20% of global energy demand growth, although their share in total energy use continued to fall. Notable growth was also registered in Southeast Asia (which accounted for 8% of global energy demand growth) and Africa (6%), although per capita energy use in these regions still remains well below the global average.



CO_2 emissions

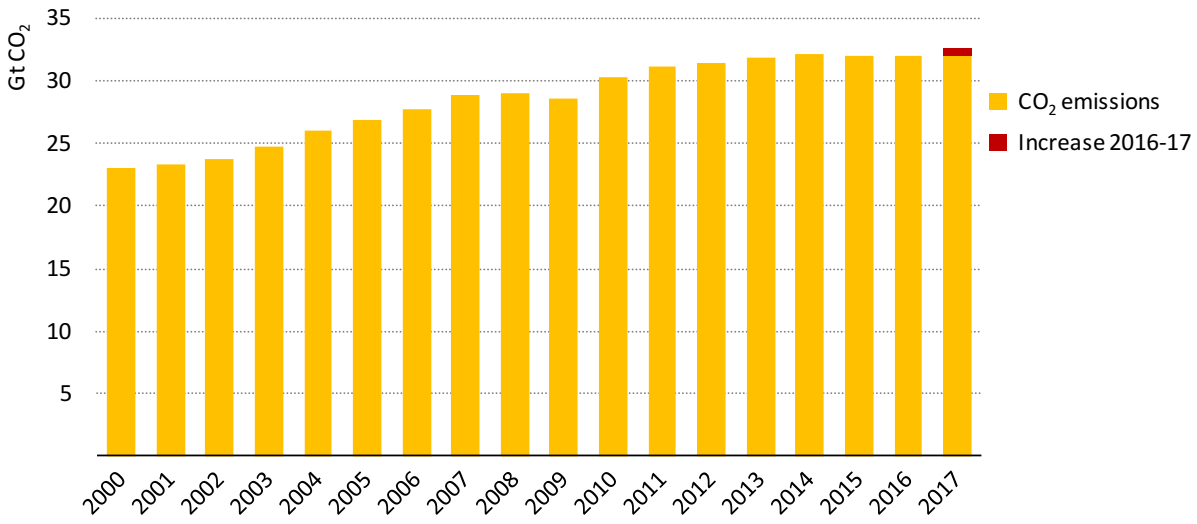
Global energy-related CO_2 emissions rose by 1.4% in 2017, an increase of 460 million tonnes (Mt), and reached a historic high of 32.5 Gt. Last year's growth came after three years of flat emissions and contrasts with the sharp reduction needed to meet the goals of the Paris Agreement on climate change.

The increase in carbon emissions, equivalent to the emissions of 170 million additional cars, was the result of robust global economic growth of 3.7%, lower fossil-fuel prices and weaker energy efficiency efforts. These three factors contributed to pushing up global energy demand by 2.1% in 2017.

The trend of growing emissions, however, was not universal. While most major economies saw a rise in carbon emissions, some others experienced declines, such as the United States, the United Kingdom, Mexico and Japan.

The biggest decline came from the United States, where emissions dropped by 0.5%, or 25 Mt, to 4 810 Mt of CO_2, marking the third consecutive year of decline. While coal-to-gas switching played a major role in reducing emissions in previous years, last year the drop was the result of higher renewables-based electricity generation and a decline in electricity demand. The share of renewables in electricity generation reached a record level of 17%, while the share of nuclear power held steady at 20%.

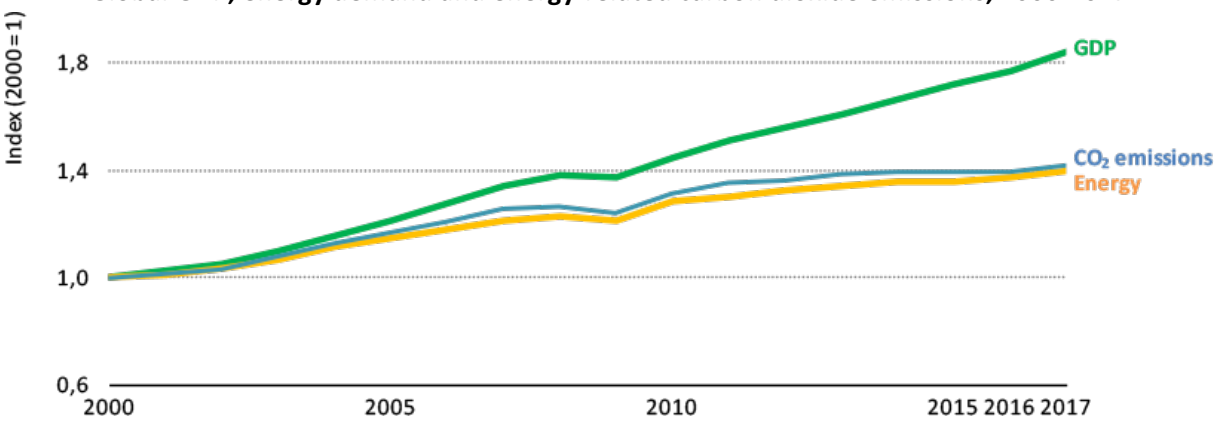
Global energy-related CO_2 emissions, 2000-2017



In the United Kingdom, emissions dropped by 3.8%, or 15 Mt, to 350 Mt of CO_2, their lowest level on record back to 1960. A continued shift away from coal towards gas and renewables led to a 19% drop in coal demand. In Mexico, emissions dropped by 4%, driven by a decline in oil and coal use, efficiency gains in the power system, strong growth in renewables-based electricity generation and a slight increase in overall gas use. In Japan, emissions fell by 0.5% as increased electricity generation from renewables and nuclear generation displaced generation from fossil-fuels, especially oil.

Overall, Asian economies accounted for two-thirds of the global increase in carbon emissions. China's economy grew nearly 7% last year but emissions increased by just 1.7% (or 150 Mt) thanks to continued renewables deployment and faster coal-to-gas switching. China's CO_2 emissions in 2017 reached 9.1 Gt, almost 1% higher than their 2014 level. While China's coal demand peaked in 2013, energy-related emissions have nonetheless increased because of rising oil and gas demand.

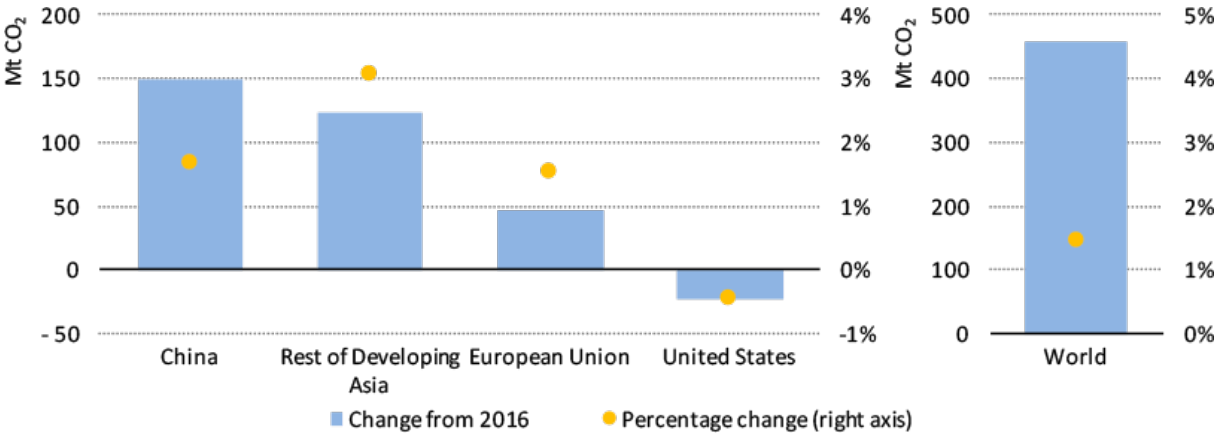
Global GDP, energy demand and energy-related carbon dioxide emissions, 2000-2017



In India, economic growth bolstered rising energy demand and continued to drive up emissions, but at half the rate seen during the past decade. India's per-capita emissions last year were 1.7 tCO_2, well below the global per capita average of 4.3 tCO_2. Emissions in the European Union grew by 1.5%, adding almost 50 $MtCO_2$, reversing some of the progress made in recent years mainly due to robust growth in oil and gas use. The rate of energy intensity improvement slowed to 0.5%, down from 1.3% the previous year. Southeast Asian economies also contributed to the rise in emissions, with Indonesia leading the growth with an increase of 4.5% relative to 2016.

The growth in energy-related carbon dioxide emissions in 2017 is a strong warning for global efforts to combat climate change, and demonstrates that current efforts are insufficient to meet the objectives of the Paris Agreement.

Change in energy-related carbon dioxide emissions by selected region, 2017

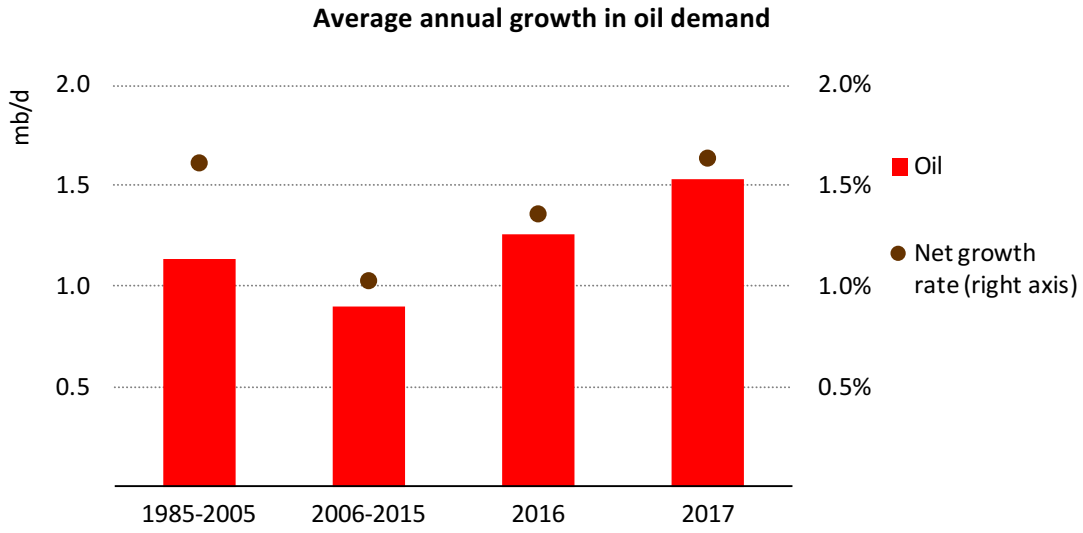


The IEA's **Sustainable Development Scenario** charts a path towards meeting long-term climate goals. Under this scenario, global emissions need to peak soon and decline steeply to 2020; this decline will now need to be even greater given the increase in emissions in 2017. The share of low-carbon energy sources must increase by 1.1 percentage points every year, more than five-times the growth registered in 2017. In the power sector, specifically, generation from renewable sources must increase by an average 700 TWh annually in that scenario, an 80% increase compared to the 380 TWh increase registered in 2017. Carbon Capture, Usage and Storage (CCUS) plays an important role for reducing emissions in the industry and power sectors.

Oil

Global oil demand rose by 1.5 million barrels a day (mb/d) in 2017, continuing a trend of strong growth since prices fell in 2014. The rate of growth of 1.6% was more than twice the average annual growth rate seen over the past decade.

One of the main drivers of growth was the transport sector. Vehicle ownership levels increased in 2017, as did the share of Sport Utility Vehicles (SUVs) and other large vehicles. This was particularly visible in the United States, where the share of SUVs and light trucks increased from 47% in 2011 to around 60% of total sales in 2017, bringing up the share of these vehicles in the total passenger car fleet to almost half. It is also a factor in the European Union, where oil demand increased by 2%, the highest rate of growth since 2001.



The trend towards larger vehicles has also slowed the pace of decline in average vehicle fuel use, partly offsetting energy efficiency policy efforts. Electric cars are making rapid inroads in many markets, particularly in China, which is leading global sales. For now, however, the strong growth in electric-car sales remains too small to make a dent in oil demand growth. (An updated analysis will be included in the IEA's next *Global EV Outlook*, to be released in May).

Another reason behind robust demand growth is oil used as a petrochemicals feedstock. Petrochemicals are the fastest-growing source of oil demand, notably in the United States, where the shale revolution has created very cost-competitive domestic supplies, as well as in China and in other emerging economies, where demand for plastics and other petrochemical products is growing rapidly. It should be noted, however, that the oil use in the petrochemicals sector only has a very small impact on emissions trends as most of the oil is not combusted but transformed into other products, such as plastics.

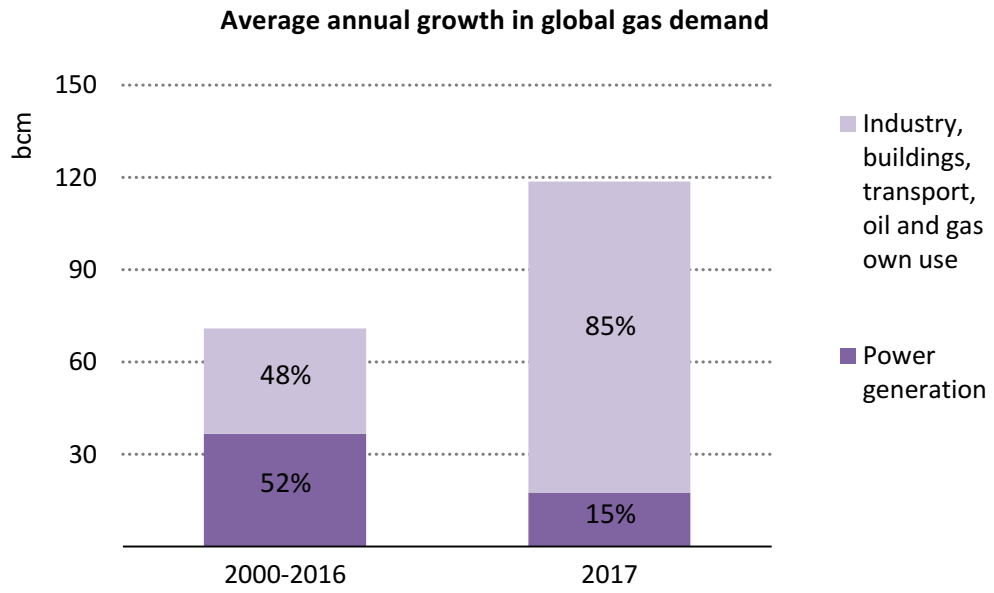
Around 60% of the growth in oil demand came from Asia. Although China is the leading global market for the sales of electric cars, it was also the top contributor to oil demand growth, followed by India. Meanwhile, oil demand in the Middle East, a recent source of demand growth, was flat due to oil-to-gas switching in the power sector and efforts to reform oil product prices and phase out subsidies.

While a slowdown in oil demand growth may be likely in coming years, there are no signs of a peak in demand anytime soon. As noted in the IEA's recent *World Energy Outlook* and *Oil 2018* reports, it is too soon to write the obituary for oil.

Natural gas

Natural gas demand grew by 3% in 2017 thanks to abundant and relatively low-cost supplies, as well as fuel switching in key economies, significantly above the average growth of 1.5% of the last five years. China alone accounted for nearly 30% of global growth – with more than 30 bcm out of a total of nearly 120 bcm. This signals a structural shift in the Chinese economy away from energy-intensive industrial sectors as well as a move towards cleaner energy sources, with both trends benefiting natural gas.

As part of the official policy drive to "make China's skies blue again," there has been a strong push to phase out the practice of burning coal in industrial boilers (especially those in and around major cities) as well as reduce coal use for residential heating. China's surging gas demand means that it absorbed much of the slack in LNG markets, pushing up international spot prices for gas in the latter part of the year.



The European Union also saw strong growth in gas demand, with consumption up around 16 bcm in 2017, albeit less than in 2016. Some of this increase was weather-related, for instance due to a poor year for hydropower. Demand from industry also reportedly picked up on the back of stronger economic activity. Gas consumption in the European Union is still more than 10% below the peak seen in 2010. Gas imports were near historical highs as domestic production tapered off, for example in the Netherlands.

In the United States, gas-fired generation in 2017 fell by 8%, or 110 TWh, offsetting half of the increase in gas demand for electricity generation elsewhere. The case of the United States last year highlights the importance of relative prices in determining emissions intensity trends in the power sector: a slight rise in the natural gas price in 2017 saw gas-fired generation squeezed by both renewables and coal.

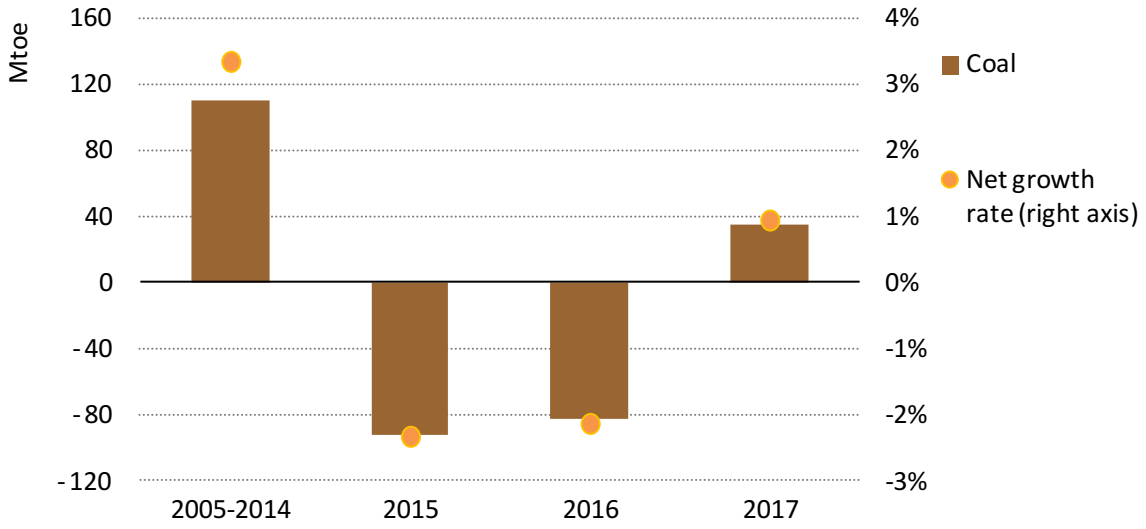
The composition of gas demand growth is changing. In the past decade, half of global gas demand growth came from the power sector. In 2017, over 80% of the growth came instead from industry and buildings. The power sector remains the largest single component of global demand, but this share is likely to decline gradually.

Coal

Global coal demand rose in 2017 by 1% to 3 790 Mtoe after two years of decline, the main change in global energy demand trends last year.

Coal demand decreased by 2.3% in 2015 and 2.1% in 2016, led by lower demand in the power sector in key markets such as China and the United States. The rebound in coal demand in 2017 was driven entirely by an increase in coal-fired electricity generation, which drove up coal demand for power by nearly 3.5% compared to the previous year, while declining global coal use in industry and buildings offset half of the growth in coal use in electricity generation.

Average annual growth in global coal demand



Asia accounted for the largest increase in coal demand, up 35 Mtoe relative to 2016. China coal-fired electricity generation increased to meet a 6% growth in electricity demand, even as the economy is moving towards a less energy-intensive model, as discussed in the *World Energy Outlook 2017*.

Around 15% of the increase in China's electricity demand was due to higher demand for cooling, driven by a particularly hot summer. (This topic will be the focus of a forthcoming IEA report on how the projected growth in air conditioning usage around the world will affect global electricity demand). Despite continued reductions of coal use in buildings and industry, the growth in the power sector pushed up coal demand in China by 0.3%, after three years of declining demand. Despite this rebound, coal use in China remains below its 2013 peak.

In India, coal demand rose at a slower rate than in 2016, while in other economies in Asia – such as Korea – coal usage increased in the power sector. Demand fell by 1.6% in the United States, and 0.5% in the European Union, after dropping by around 10% in 2016, as coal demand for electricity generation stabilised. The decline was insufficient to offset growth in other regions. Despite last year's uptick, global coal demand remains well below its peak of 3 927 Mtoe in 2014.

The compatibility of coal use with stringent climate goals hinges critically on the development of Carbon Capture, Usage and Storage (CCUS), as shown in the IEA's **Sustainable Development Scenario**. Some projects are already underway. The Boundary Dam power station in Saskatchewan, Canada, started operations in 2014. In addition, the Petra Nova Carbon Capture project in Houston, Texas was commissioned in 2017. CCUS

deployment started in China with the construction of the Yanchang CCUS Project. China accounts for about half of all CCUS projects under serious consideration or planning, including four projects which will apply CCUS to coal-fired power generation.

In addition, in the United States, the 2018 Budget Bill and the extension and expansion of the "45Q" tax credits is expected to provide a significant boost for CCUS investment. This could lead to capital investment on the order of USD 1 billion over the next six years, potentially adding 10 to 30 million tonnes or more of additional CO_2 capture capacity. This would increase total global carbon capture capacity by around two-thirds from today's levels.

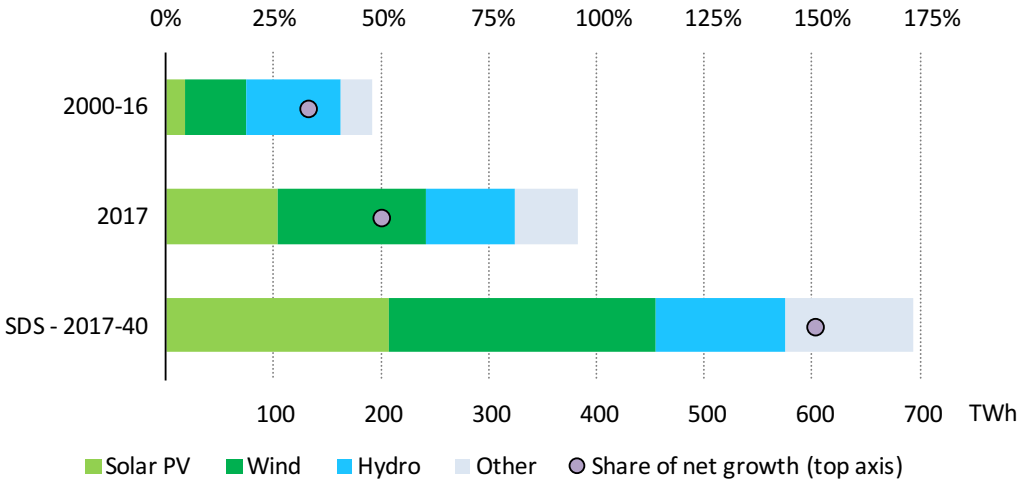
Renewables

Renewables saw the highest rate of growth of any energy source in 2017 and met around a quarter of global energy demand growth last year. The power sector played the most important role in the growth of low-carbon energy, with renewables-based electricity generation increasing by 6.3% (380 TWh) in 2017. Renewables now account for 25% of global electricity generation.

China and the United States together accounted for half of the increase in renewables-based electricity generation, followed by the European Union (8%), Japan and India (with 6% of growth each). The growth of wind power and solar PV in 2017 was unprecedented; wind power accounted for the largest share of overall renewables growth, at 36%, followed by solar PV (27%), hydropower (22%) and bioenergy (12%).

China accounted for 40% of the combined growth in wind and solar PV, with new record capacity additions and a reduction in the rate of curtailment. Nearly 40% of the increase in hydropower was in the United States, while climatic conditions in the European Union reduced hydro output by nearly one-tenth. The European Union, China and Japan accounted for 82% of global bioenergy growth in power.

Average annual global growth in renewables-based generation by technology, historically and in the Sustainable Development Scenario



Note: SDS = Sustainable Development Scenario.

China overtook the United States to become the world leader for non-hydro renewables-based electricity generation. Global solar PV capacity approached 400 GW by the end of 2017. It was an extraordinary year for solar PV additions in China, with over 50 GW of new capacity, exceeding the combined capacity additions of coal, gas and nuclear, and up from 35 GW in 2016. The new solar PV capacity added in China in 2017 alone is equivalent to the total solar PV capacity of France and Germany combined.

In the United States, 10 GW of solar PV was added in 2017, down 30% relative to 2016, but still the second-highest year on record. In India, a record 8 GW of solar PV capacity was added in 2017, double the additions seen in 2016. In the European Union wind saw a record year with 15.6 GW of capacity additions, of which 3.1 GW was offshore, also a record. With continued growth in onshore wind power, global wind capacity (onshore and offshore) reached about 510 GW.

Outside of the power sector, only a modest increase of biofuels output of 2% (50 thousand barrels per day [kb/d]) was observed in 2017, slightly lower than the previous year's growth, reflecting a longer-term downward trend in new production capacity investment. Increased ethanol output in the United States and Europe was partially offset by lower production in Brazil, while biodiesel output remained broadly stable. Renewable heat has been growing modestly over the last years.

In December 2017, China, the world's largest heat consumer, announced a five-year clean heating plan focused on northern cities. This policy change could significantly cut the use of coal for heating and replace it with cleaner sources including renewables (biomass, geothermal and solar heat). Although renewables grew rapidly in 2017, the pace of deployment falls short of that needed to meet the global climate goals in the IEA's **Sustainable Development Scenario**. Carbon emissions intensity in 2017 improved by less than one-third of what would be needed to fulfil the global transition towards climate goals.

Electricity

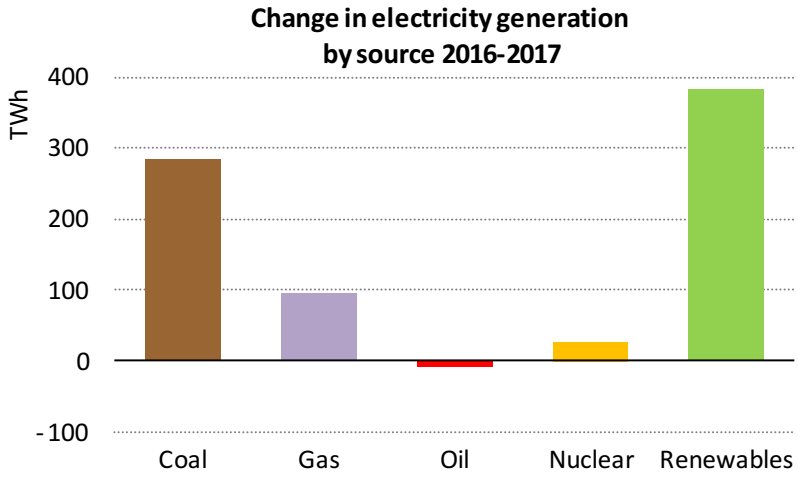
Electricity generation increased by 3.1%, or 780 TWh, worldwide in 2017 as electricity demand rose faster than overall global energy demand growth.

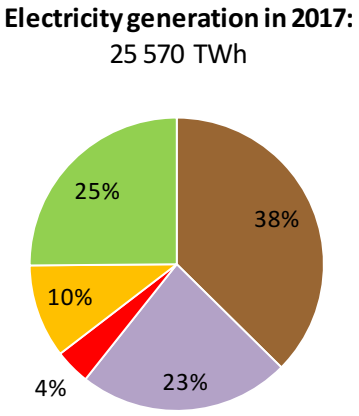
Electricity demand growth in emerging economies remains strongly linked to rising economic output. In China, robust economic growth of nearly 7% and a warm summer drove electricity demand up by 6% (or 360 TWh). In India, demand growth of over 12% (or 180 TWh) outpaced the 7% growth in economic activity. Together, China and India accounted for 70% of global electricity demand growth worldwide, with another 10% coming from other emerging economies in Asia. India has made significant strides in improving access to electricity, with half a billion people having gained electricity since 2000 and a near-doubling of the access rate, to 82% of the population now, up from 43% in 2000.

Advanced economies accounted for 10% of electricity demand growth, with average demand rising by less than 1%. In the United States, electricity demand fell by almost 80 TWh compared with 2016. In the European Union, electricity demand growth of 2.3% (or 75 TWh) matched the estimated 2.3% growth in economic output. Electricity demand in Japan also increased by around 15 TWh.

Renewables accounted for nearly half of the global additional generation (at 380 TWh) required to meet increasing demand, bringing their share in global generation to a record high of 25%. Generation from renewables was second only to coal in 2017, and ahead of gas for the third year in a row. Despite strong increases in wind and solar PV generation, hydropower remains the largest source by far of renewables-based electricity generation, with a major share of 65% in overall renewables output. A strong year for hydropower in the United States and Canada more than offset a drop in hydropower generation in the European Union.

Among other low-carbon technologies, nuclear generation increased by 26 TWh in 2017, as a significant amount of the new nuclear capacity commissioned in 2016 saw its first full year of operation last year. Nuclear generation accounts for 10% of global power generation and grew by 3%, relative to 2016, with Japan contributing to 40% of this growth. Nonetheless nuclear capacity additions globally only just exceeded retirements in 2017.





Coal generation increased by 3% (280 TWh) in 2017 at a global scale, accounting for a third of the total growth and more than cancelling a 250 TWh decline seen in 2016. The growth of coal-fired generation was mostly in Asia, with an increase of 365 TWh. Although China and India dominated the increase, Korea, Japan and

Indonesia also contributed significantly. Growth in Asia was only partially offset by declining coal use for electricity generation in the United States, the European Union, Russia, Brazil and South Africa.

Gas-fired generation increased by 1.6% (95 TWh) accounting for almost 15% of the total growth. This results from a decline of 7.6% (110 TWh) in the United States and a growth of 4.6% (or 205 TWh) in the rest of the world, with the most important contributions coming from the European Union, China and Southeast Asia.

2018 is the year of electricity at the IEA, in recognition of the rapid growth of electricity demand and the global transformation of electricity systems. For the first time, electricity will be the focus fuel of the forthcoming *World Energy Outlook*, shedding light on the key uncertainties of the ongoing transition – including the impact of digitalization and the integration of renewables – and analysing the implications for energy security, investment and environmental concerns.

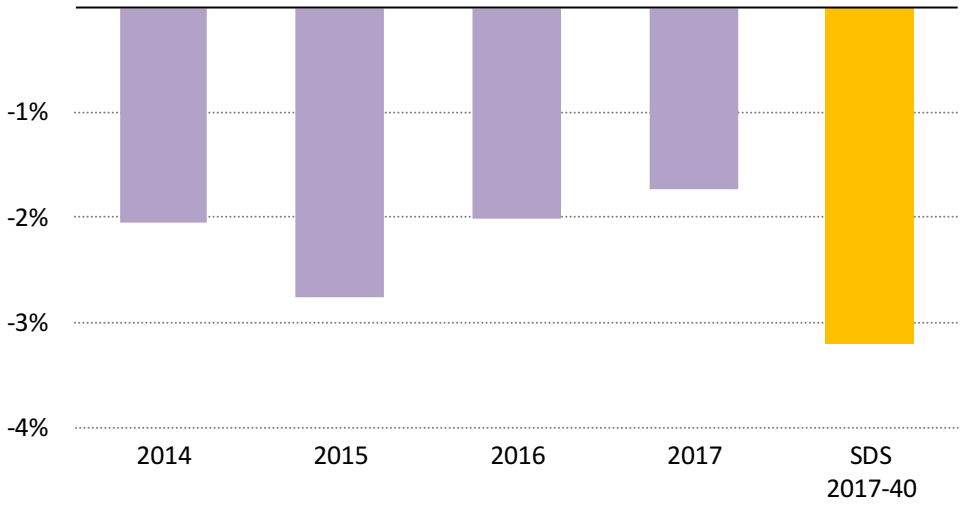
Energy efficiency

Improvements in global energy efficiency slowed down dramatically in 2017, broadly caused by an apparent weakening of efficiency policy coverage and stringency, and by lower energy prices.

Global energy intensity, defined as the energy consumed per unit of economic output, has been decreasing for two decades. But the rate of decrease slowed in 2017. Globally, energy intensity in 2017 fell by only 1.7%, much less than the 2.3% registered on average over the last three years, and half of what is required to remain on track with the Paris Agreement.

Energy intensity is one of the two drivers of carbon emissions, the other being carbon intensity (defined as CO_2 emitted per unit of energy consumed). While global carbon intensity declined less in 2017 than in 2016, the rate remains similar to the average rate of improvement in 2014-16 – partly driven by the increasing expansion of renewables. However, the slower improvement in the energy intensity of energy demand in 2017 was not sufficient to counteract the effect of higher economic growth, leading to the increase in global energy related carbon emissions in 2017. Understanding the reasons for this slowdown in energy intensity improvements is therefore crucial for understanding the future direction of global carbon emissions.

Average annual change in global energy intensity

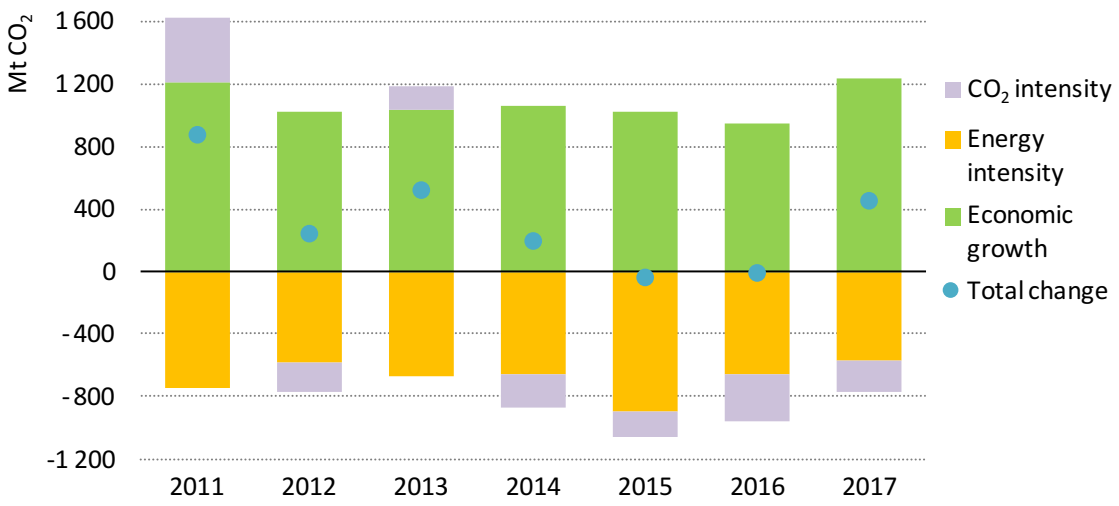


Note: Energy intensity is per unit of economic output in purchasing power parity terms.
SDS = Sustainable Development Scenario.

Coverage of policies targeting energy efficiency has been steadily increasing in recent years, and 31.5% of final energy consumption was subject to mandatory energy policy in 2016, up from only 14% in 2000. However, the rate of increase of coverage slowed in 2016 and early indications are that it slowed again in 2017. Further, the increased coverage in 2017 appears to have come mostly from extensions to existing policies, rather than new policies in previously uncovered sectors and countries.

Another important element is the stringency of these policies. The increase in policy stringency also slowed in 2016 with an increase of just 0.3%. Governments need to redouble efforts to take a strategic approach to energy efficiency, anchoring it as the basis of long-term energy transition plans and pursuing a balanced approach of regulations, standards and market-based policies.

Change in global energy-related CO_2 emissions by driver



Note: Calculations are based on economic output in purchasing power parity terms.

The slowing in energy intensity improvement is also a symptom of the sustained low fossil-fuel price environment of recent years. For example, low fuel prices have been potentially supported a shift in consumer preferences towards larger vehicles such as Sport Utility Vehicles (SUVs). However, as global fossil-fuel consumption subsidies remain high, reaching $260 billion in 2016, the low price environment can be an opportunity for governments to reform their subsidy policies, effectively counteracting price drops and bolstering intensity improvements. There are some indications of those reforms having rapid impacts. For example, following energy subsidy reforms in several Middle Eastern countries in recent years, demand for oil in the Middle East did not increase in 2017.

This 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 2017 data is unavailable, this report uses market data and analysis by fuel and sector. For question and comments, please contact weo@iea.org.