

Global Energy Review 2020

The impacts of the Covid-19 crisis on
global energy demand and CO₂ emissions

INTERNATIONAL ENERGY AGENCY

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Abstract

In response to the exceptional circumstances stemming from the coronavirus pandemic, the annual IEA Global Energy Review has expanded its coverage to include real-time analysis of developments to date in 2020 and possible directions for the rest of the year. In addition to reviewing 2019 energy and CO₂ emissions data by fuel and country, for this section of the Global Energy Review we have tracked energy use by country and fuel over the past three months and in some cases – such as electricity – in real time. Some tracking will continue on a weekly basis. The uncertainty surrounding public health, the economy and hence energy over the rest of 2020 is unprecedented. This analysis therefore not only charts a possible path for energy use and CO₂ emissions in 2020 but also highlights the many factors that could lead to differing outcomes. We draw key lessons on how to navigate this once-in-a-century crisis.

Key findings

- The current Covid-19 pandemic is above all a global health crisis. As of the 28th of April, there were 3 million confirmed cases and over 200 000 deaths due to the illness. As a consequence of the efforts to slow the spread of the virus, the share of energy use that was exposed to containment measures jumped from 5% in mid-March to 50% in mid-April. Several European countries and the United States have announced that they expect to reopen parts of the economy in May, so April may be the hardest hit month.
- Beyond the immediate impact on health, the current crisis has major implications for global economies, energy use and CO₂ emissions. Our analysis of daily data through mid-April shows that countries in full lockdown are experiencing an average 25% decline in energy demand per week and countries in partial lockdown an average 18% decline. Daily data collected for 30 countries until 14 April, representing over two-thirds of global energy demand, show that demand depression depends on duration and stringency of lockdowns.
- Global energy demand declined by 3.8% in the first quarter of 2020, with most of the impact felt in March as confinement measures were enforced in Europe, North America and elsewhere.
- Global coal demand was hit the hardest, falling by almost 8% compared with the first quarter of 2019. Three reasons converged to explain this drop. The People's Republic of China ("China") – a coal-based economy – was the country the hardest hit by Covid-19 in the first quarter; cheap gas and continued growth in renewables elsewhere challenged coal; and mild weather also capped coal use.
- Oil demand was also hit strongly, down nearly 5% in the first quarter, mostly by curtailment in mobility and aviation, which account for nearly 60% of global oil demand. By the end of March, global road transport activity was almost 50% below the 2019 average and aviation 60% below.
- The impact of the pandemic on gas demand was more moderate, at around 2%, as gas-based economies were not strongly affected in the first quarter of 2020.
- Renewables were the only source that posted a growth in demand, driven by larger installed capacity and priority dispatch.
- Electricity demand has been significantly reduced as a result of lockdown measures, with knock-on effects on the power mix. Electricity demand has been depressed by 20% or more during periods of full lockdown in several countries, as upticks for residential demand are far outweighed by reductions in commercial and industrial operations. For weeks, the shape of demand resembled that of a prolonged Sunday. Demand reductions have lifted the share of renewables in the

electricity supply, as their output is largely unaffected by demand. Demand fell for all other sources of electricity, including coal, gas and nuclear power.

- Looking at the full year, we explore a scenario that quantifies the energy impacts of a widespread global recession caused by months-long restrictions on mobility and social and economic activity. Within this scenario, the recovery from the depths of the lockdown recession is only gradual and is accompanied by a substantial permanent loss in economic activity, despite macroeconomic policy efforts.
- The result of such a scenario is that energy demand contracts by 6%, the largest in 70 years in percentage terms and the largest ever in absolute terms. The impact of Covid-19 on energy demand in 2020 would be more than seven times larger than the impact of the 2008 financial crisis on global energy demand.
- All fuels will be affected:
 - Oil demand could drop by 9%, or 9 mb/d on average across the year, returning oil consumption to 2012 levels.
 - Coal demand could decline by 8%, in large part because electricity demand will be nearly 5% lower over the course of the year. The recovery of coal demand for industry and electricity generation in China could offset larger declines elsewhere.
 - Gas demand could fall much further across the full year than in the first quarter, with reduced demand in power and industry applications.
 - Nuclear power demand would also fall in response to lower electricity demand.
 - Renewables demand is expected to increase because of low operating costs and preferential access to many power systems. Recent growth in capacity, some new projects coming online in 2020, would also boost output.
- In our estimate for 2020, global electricity demand falls by 5%, with 10% reductions in some regions. Low-carbon sources would far outstrip coal-fired generation globally, extending the lead established in 2019.
- Global CO₂ emissions are expected to decline by 8%, or almost 2.6 gigatonnes (Gt), to levels of 10 years ago. Such a year-on-year reduction would be the largest ever, six times larger than the previous record reduction of 0.4 Gt in 2009 – caused by the global financial crisis – and twice as large as the combined total of all previous reductions since the end of World War II. As after previous crises, however, the rebound in emissions may be larger than the decline, unless the wave of investment to restart the economy is dedicated to cleaner and more resilient energy infrastructure.

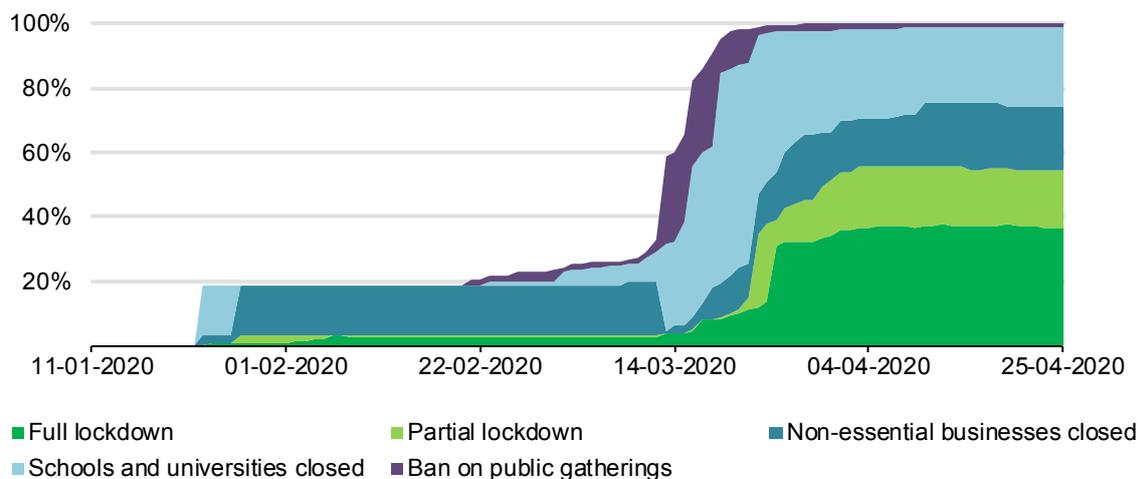
The context: A world in lockdown

The coronavirus pandemic has triggered a macroeconomic shock that is unprecedented in peacetime. As of the 28th of April, the World Health Organization reported 3 million confirmed cases and over 200 000 deaths¹ due to the illness, affecting almost 200 countries and territories. A peak in the number of cases has been observed in only a handful of countries so far. To slow the spread of the virus, governments across the world have imposed restrictions on most social and economic activities. These include partial or complete lockdowns, daytime curfews, closure of educational institutions and non-essential businesses, and bans on public gatherings. About 4.2 billion people or 54% of the global population, representing almost 60% of global GDP, were subject to complete or partial lockdowns as of the 28th of April and nearly all the global population is affected by some form of containment measures.

The crisis has unfolded gradually since December 2019. The People's Republic of China (hereafter, "China"), the country first affected by the virus – and alone representing 16% of global GDP and 24% of energy demand in 2019 – implemented lockdown measures with strong macroeconomic impacts in late January. These were followed by lockdowns in many European countries and India in March, with populations accounting for one-third of global energy demand coming under lockdown. As an increasing number of states in the United States imposed restrictions, a population that represents 53% of global primary energy consumption in 2019 was living in complete or partial lockdown in early April. By this time, China started to lift restrictions and restart factories, but social distancing measures remain in place, hindering the recovery of the service sector. While the total number of registered cases is lower in Africa than in the worst-hit regions of the world, the continent has yet to feel the full implications of the crisis. Almost 50 African countries are affected, the number of cases is still expanding and containment measures are increasing. Worldwide, between mid-March and end-April the share of energy use under full or partial lockdown skyrocketed from 5% to 52%.

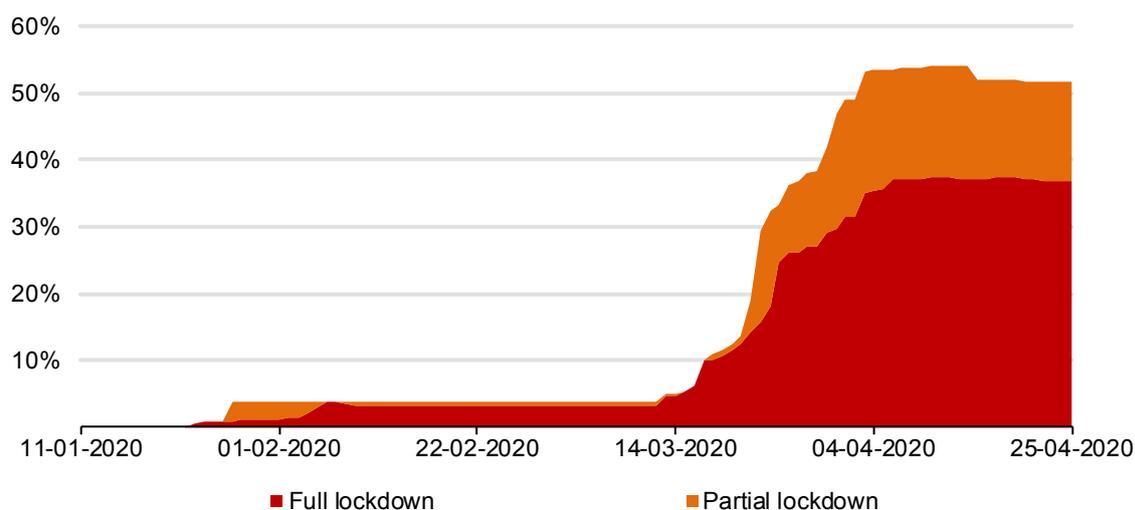
¹ <https://covid19.who.int/>, accessed on April 27, 2020.

Share of global population under containment measures



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Share of global primary energy demand affected by mandatory lockdowns



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Source: IEA analysis based on Oxford Covid 19 Government Response Tracker, UNESCO Covid 19 Educational Disruption Database, UN 2019 Revision of World Population Prospects and coronavirusmeasures.herokuapp.com, last accessed on April 27.

These restrictions represent a challenging combination of a supply and a demand shock. The supply shock arises from the intentional constraints on economic activity: restaurants, shopping malls and, in some countries, factories are closed down to prevent the spread of the virus. To a small extent, this decline is compensated by greater e-business activity as well as some other sectors of the economy, most notably a rise in the sales of medical equipment. On the whole, however, the restrictions substantially constrain the overall supply-side capacity.

The demand-side shock arises from the impact on consumers' disposable income and corporate investment activity. The exact extent of employment loss is determined by country-specific labour market institutions, but in every country lockdowns have been accompanied by a historically unprecedented spike in unemployment. In the United States, initial unemployment claims have been recorded at more than 26 million² since the start of the lockdown, indicating that the rate of employment loss is around 10 times faster than it was in the aftermath of the fall of Lehman Brothers in 2008.

Similarly in the United Kingdom, 1.4 million³ new claims for unemployment benefits have been registered since mid-March when the government first urged people to stay home. Early studies suggest that unemployment could rise to almost 21%⁴ of the total workforce, higher than the ratio recorded during the Great Depression of the 1930s.

Registered unemployment numbers might even understate the impact, given the importance of informal and "gig economy" employment in the exceptionally badly hit tourism sector. Those who have lost their jobs are concentrated in the lower income segments. Even with unemployment support, they are likely to cut their spending beyond what the restrictions would mandate. Similarly, given the uncertainties of consumer demand, companies hold back investment projects even if social distancing measures would still allow the investment.

The importance of the demand-side aspect is especially visible in China. Due to the different timing of the epidemic, the Chinese manufacturing sector is aiming to restart precisely when European and North American demand for Chinese products is sharply falling, creating an additional macroeconomic challenge.

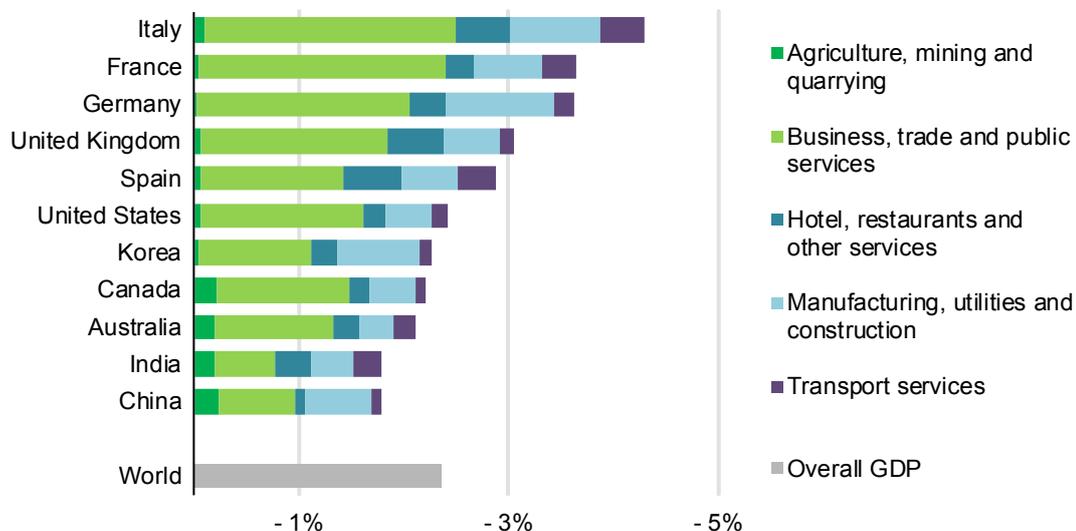
Overall, estimates suggest that during the lockdown phase economies can expect a 20% to 40 % decline in economic output, depending on the share of the most affected sectors and the stringency of measures. At the global level, this translates into a 2% drop in expected annual GDP for each month of containment measures, confirming the 2-3% order of magnitude put forward by the President of the European Central Bank in early April.

² <https://www.nytimes.com/2020/04/23/business/economy/unemployment-claims-coronavirus.html>, accessed on April 23, 2020.

³ <https://www.ft.com/content/e1fcc6cd-ef44-4788-807d-ca534f61c1c1>, accessed on April 20, 2020.

⁴ <https://www.theguardian.com/world/2020/apr/03/coronavirus-uk-business-activity-plunges-to-lowest-ebb-since-records-began>, accessed April 20, 2020.

Impact of each month of containment measures on expected annual GDP by sector in selected regions



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Sources: IEA analysis based on ADB Asian Development Outlook 2020 (April 2020), CEBR (March 2020), Dorn, F. et al. (March 2020), INSEE (April 2020), ISTAT (April 2020), OECD (March 2020).

The direct impact on annual GDP and on energy use therefore depends on the duration of lockdowns, while the indirect impact of the crisis will be determined by the shape of the recovery.

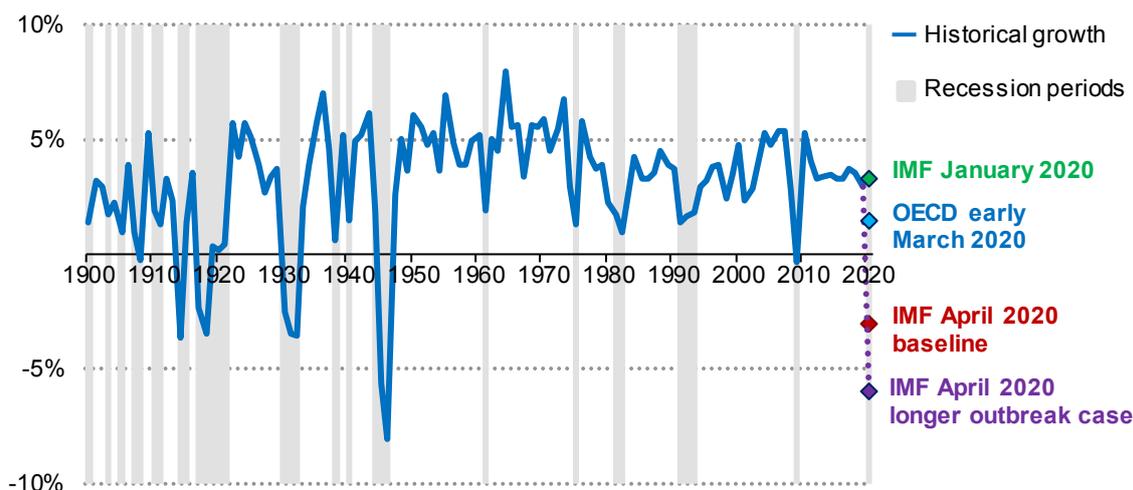
In an ideal case, some economic activity affected by the lockdown will only be delayed, like making necessary repairs on a house, leading to a sharp, V-shaped recovery. In some sectors like tourism, however, the crisis might have a long-term impact. Activities may not even return to the pre-crisis growth path, let alone make up lost ground.

The shape of the recovery will be affected by healthcare factors, like a possible second wave of the pandemic. It will also be greatly influenced by the size and design of macroeconomic policy responses. After the lockdown phase, the challenge will be closer to a “conventional recession” with depressed aggregate demand and potential stress on the financial system. Experience suggests that the depth and duration of a recession can be significantly reduced by anticyclical policy to stimulate demand and measures that prevent spillover effects from triggering a systemic financial crisis.

Governments around the world are responding with an unprecedented wave of fiscal and monetary stimuli. The current focus is to provide direct income support both to affected workers and to companies in order to minimise social and employment impacts. At the same time, stabilising the financial system is a priority.

Despite the scope and ambition of the policy response, it appears likely that the recovery will only be gradual. As a result, even if lockdown periods are limited, 2020 will be the year of deepest post-war recession, markedly exceeding the 2008 financial crisis. Even in 2021, global economic activity might well be below the 2019 level.

Global annual change in real gross domestic product (GDP), 1900-2020



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Sources: IEA based on IMF World Economic Outlook (January and April 2020), OECD Interim Economic Outlook Forecasts (March 2020) and Maddison Project Database (2018).

As this report describes in detail, the impact of this decline in economic activity on energy use is highly asymmetrical and depends on the specific energy use pattern. Traditional relationships between incomes and energy demand have broken due to the nature of the shock. Some energy uses, like residential gas heating or electricity use for server farms and digital equipment, are unaffected or even more pronounced. Others, most notably aviation jet fuel, have collapsed far more steeply than the decline of GDP. This analysis consequently takes a bottom-up, fine-grained approach in assessing the short-term energy impacts.

What might the rest of 2020 look like?

The scenario used for this report quantifies the energy impacts of a widespread global recession caused by months-long restrictions on mobility, social and economic activity. Within this scenario, economies currently in lockdown open up only gradually and economic and social activity resumes only gradually. The economic recovery is U-shaped and is accompanied by a substantial permanent loss

of economic activity, despite macroeconomic policy efforts. Under these assumptions global GDP declines 6% in 2020. This scenario is broadly in line with the IMF longer outbreak case released in April.

Major uncertainties surround the economic outlook, including the trajectory of the pandemic, the effects and duration of virus containment measures, reopening strategies and the shape and speed of recovery as the pandemic recedes. On the positive side, a limited period of lockdown, an effective suppression of the virus, a gradual but speedy lifting of lockdown coupled with ambitious and well-targeted macro-financial policies would allow for a more rapid, V-shaped economic recovery. This outlook is broadly in line with the IMF baseline presented in April.

Downside risks are also present. There lies the possibility of longer lockdown periods, reopening that may lead to spikes of infections and a second cycle of lockdowns, a second wave of infections in the autumn/winter of 2020, and major global supply chain disruptions.

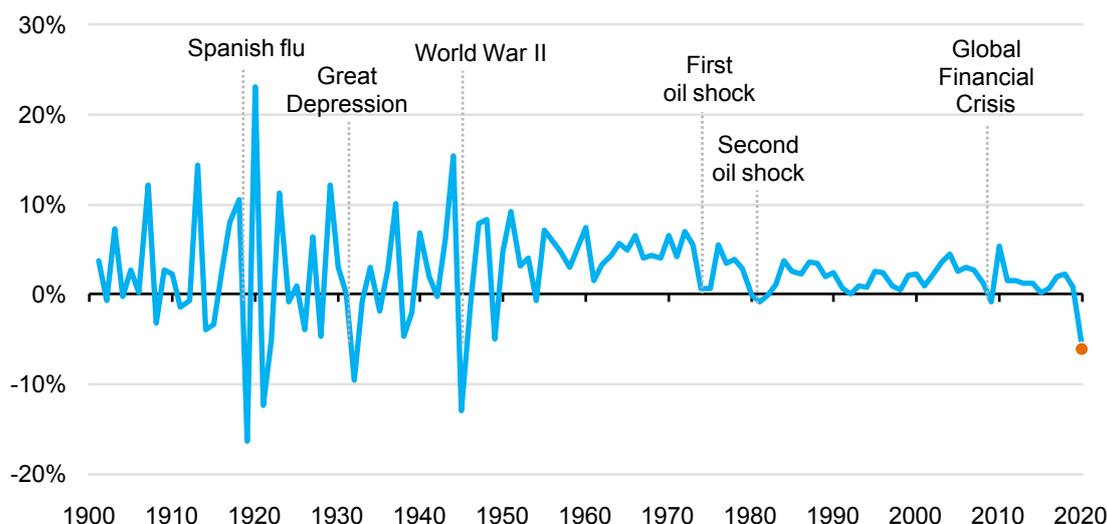
Recognising the many uncertainties, the report presents one base case scenario and discusses for each fuel the main factors that could raise or lower demand.

Global energy and CO₂ emissions in 2020

Energy demand

The latest data show that the drastic curtailment of global economic activity and mobility during the first quarter of 2020 pushed down global energy demand by 3.8% relative to the first quarter of 2019. If lockdowns last for many months and recoveries are slow across much of the world, as is increasingly likely, annual energy demand will drop by 6% in 2020, wiping off the last five years of demand growth. Such a decline has not been seen for the past 70 years. If efforts to curb the spread of the virus and restart economies are more successful, the decline in energy demand could be limited to under 4%. However a bumpier restart, disruption to global supply chains, and a second wave of infections in the second part of the year could curtail growth even further.

Rate of change in global primary energy demand, 1900-2020



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First quarter of 2020 (compared with first quarter of 2019)

Global energy demand in the first quarter of 2020 (Q1 2020) declined by 3.8%, or 150 million tonnes of oil equivalent (Mtoe), relative to the first quarter of 2019, reversing all the energy demand growth of 2019. The drop in global economic activity cut demand for some energy sources much more than for others, with impacts on demand in Q1 2020 going well beyond declines in GDP for certain sectors and fuels.

In Q1 2020, restrictions on economic activity, as well as changes in weather, hit global **coal** demand hardest, pushing it down by almost 8% from Q1 2019. The decline took place mainly in the power sector as a result of significant reductions in electricity demand (-2.5%) and competition from very cheap natural gas. The curtailment of industrial production also had an important impact on coal demand over the first three months of the year, with industrial coal demand declining notably in China.

Global **oil** demand was down nearly 5%. Restrictions on travel and the closing of workplaces and borders sharply reduced demand for personal vehicle use and air travel, while the curtailment of global economic activity put a brake on fuel oil use for shipping.

Output from the world's **nuclear power** plants also declined in Q1 2020 as they adjusted to lower electricity demand levels, particularly in Europe and the United States.

Demand for **natural gas** declined by around 2% in Q1 2020, with China, Europe and the United States experiencing the most significant declines. The drop in demand in major markets was softened by continued low prices for gas, shifting much of the impact of lower electricity demand onto coal. Gas storage levels rose markedly in Q1 2020 because of increases in year-on-year trade in liquefied natural gas (LNG) combined with lower demand.

Renewable energy demand increased by about 1.5% in Q1 2020, lifted by the additional output of new wind and solar projects that were completed over the past year. In most cases, renewables receive priority in the grid and are not asked to adjust their output to match demand, insulating them from the impacts of lower electricity demand. As a result, the share of renewables in the electricity generation mix rose considerably, with record-high hourly shares of variable renewables in Belgium, Italy, Germany, Hungary and eastern parts of the United States.

Not all of the declines in demand in Q1 2020 were a result of the response to Covid-19. The continuation of milder than average weather conditions throughout most of the Northern Hemisphere winter also pushed down demand. The impact of weather was particularly strong in the United States, where the majority of the 18% decline in residential and commercial gas consumption can be attributed to a milder winter than in 2019.

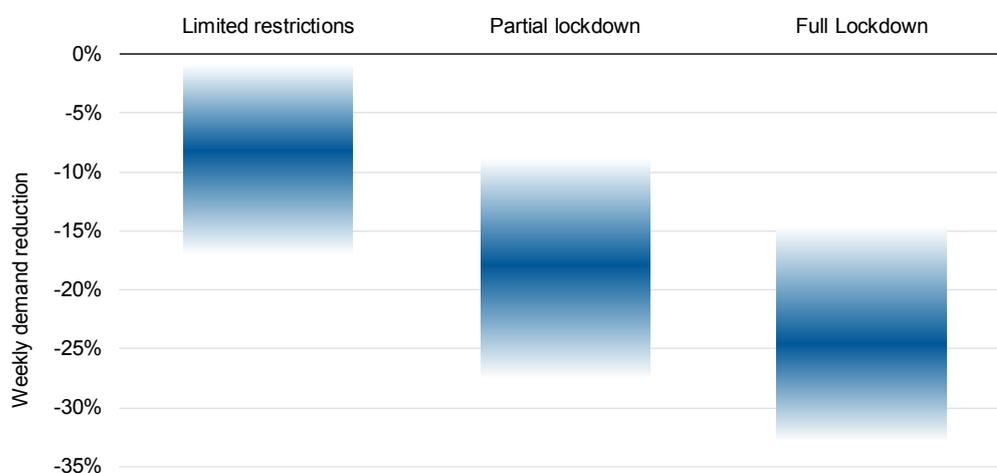
Differing demand trends for each fuel resulted in significant changes in the global energy mix in Q1 2020. As a result of the drop in global coal demand, the share of

coal in the mix declined almost 1 full percentage point to below 23%. There was little change in the share of oil and natural gas, however. Renewables experienced the largest increase, with their share jumping to almost 13%, over half a percentage point above Q1 2019. The change in the power sector mix was even more marked, with renewables increasing their share from 26% in Q1 2019 to 27.5% in Q1 2020.

Regional impacts on Q1 2020 energy demand depended on when lockdowns were implemented and how lockdowns affected demand in each country. Drawing on real-time energy demand, mobility and lockdown stringency data, the IEA has assessed the impact of lockdowns and other restriction measures on weekly energy demand compared with corresponding weeks in 2019.

Less stringent restrictions in Korea and Japan have limited the impact on demand to below 10% on average. In China, where Covid-19 lockdowns were first implemented, not all provinces experienced restrictions of the same stringency. Nonetheless, the virus containment measures resulted in weekly energy demand across China falling by around 15%. Lockdowns in Europe were more gradual, going from partial to full lockdown. Periods of partial lock down cut weekly demand by 17% on average. Countries with higher share of services in the economy and the greater stringency of lockdowns resulted in weather corrected demand reductions averaging close to 25%, reaching above 30% in some cases. India’s full national lockdown has reduced energy demand by almost 30%, meaning that with each additional week of lockdown, annual energy demand is reduced by 0.6%. Overall we estimate that an additional month of the restrictions in place as of early April would reduce global annual energy demand by around 1.5%.

Impact of Covid 19 containment measures on weekly total energy demand



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China faced the Covid-19 crisis earlier than other regions, with around eight weeks of lockdown during Q1 2020, more than any other region. As a result, China had the most significant drop in total energy demand, which fell by over 7% compared with Q1 2019.

Across **the United States**, energy demand fell by 6% compared with Q1 2019. While the response to Covid-19 impacted demand in March, much of the fall in quarterly demand can be attributed to milder weather.

Energy demand in the **European Union** declined by over 5% relative to Q1 2019. The decline in activity and energy demand was concentrated in March after lockdowns were implemented. Demand fell most in regions that implemented lockdowns earlier, imposed more stringent lockdowns, and where tourism represents a significant part of the economy.

The impact on Q1 2020 energy demand in **India** was modest, with demand increasing by 0.3 relative to Q1 2019. The major impact of India's lockdown on weekly energy demand was only felt after the country moved into lockdown towards the end of March. As the lockdown continues, the impacts on energy demand are set to be notably larger Q2 2020.

Full-year projections

The evolution of energy demand through the remainder of 2020 will depend most notably on the duration, stringency and geographical spread of lockdowns, and the speed of recoveries. Initial IEA evaluations indicate that full-year energy demand could decline by around 6%, equivalent to the combined energy demand of France, Germany, Italy and the United Kingdom in 2019. The projected 6% decline would be more than seven times the impact of the 2008 financial crisis on global energy demand, reversing the growth of global energy demand over the last five years. The absolute decline in global energy demand in 2020 is without precedent, and relative declines of this order are without precedent for the last 70 years.

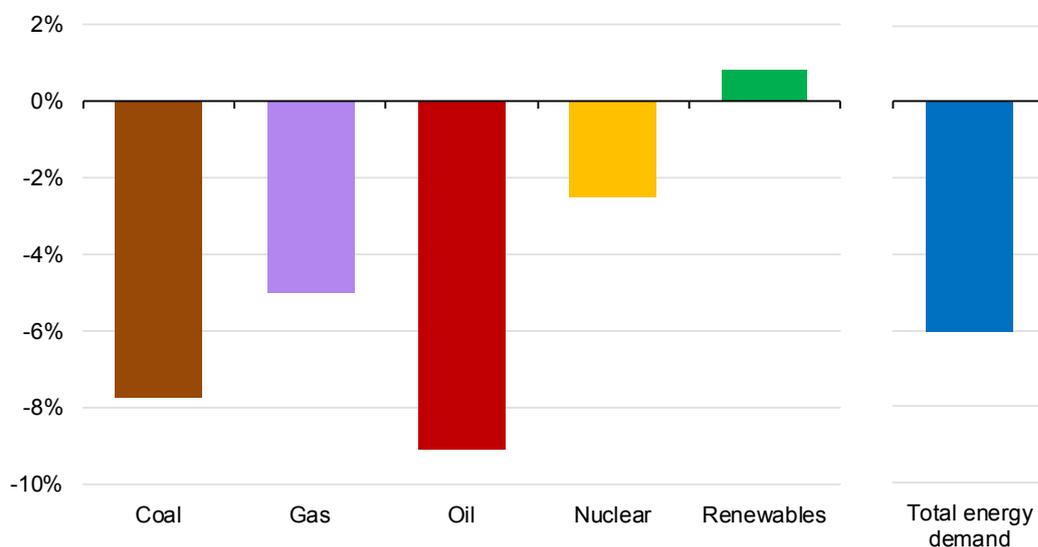
All fuels except renewables are set to experience their greatest contractions in demand for decades. In some cases, annual declines will be stronger than those in the first quarter.

- **Oil demand** could drop by 9%, or 9 mb/d on average across the year, returning oil consumption to 2012 levels.
- **Coal demand** could decline by 8%, in large part due to a fall in electricity demand of nearly 5% over the course of the year, pushing down output from coal-fired

generators by more than 10%. The recovery of coal demand for industry and electricity generation in China limits the global decline in coal demand.

- **Gas** demand across the full year could fall much further than in Q1 2020, because of reduced demand in power and industry applications.
- **Nuclear** power demand would also fall in response to lower electricity demand.
- **Renewables** demand is expected to increase because of low operating costs and preferential access to many power systems. Recent growth in capacity, with some new projects coming online in 2020, will also boost output. Biofuels however, are likely to see demand decline, directly impacted by lower transport activity.

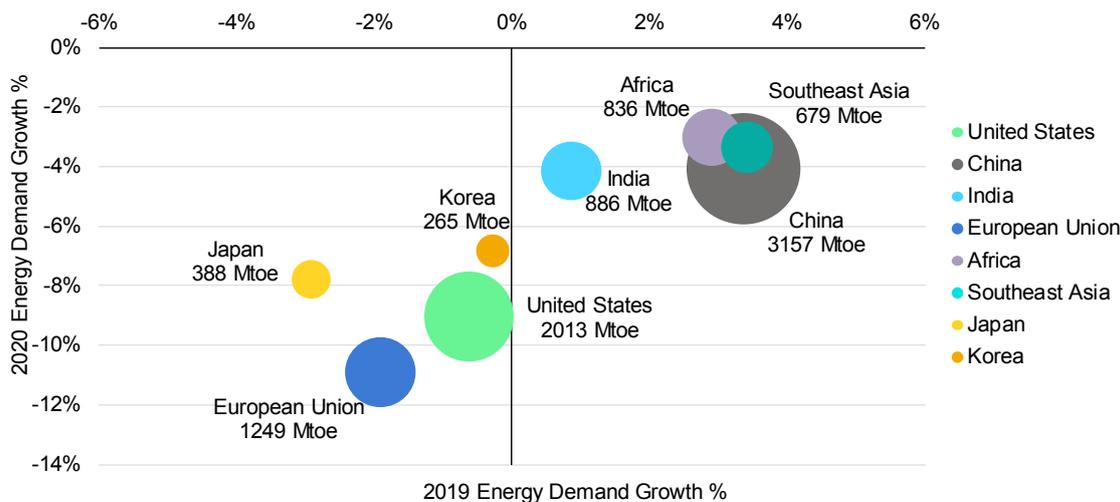
Projected change in primary energy demand by fuel in 2020 relative to 2019



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Energy demand is set to decline in all major regions in 2020. Demand in China is projected to decline by more than 4%, a reversal from average annual demand growth of nearly 3% between 2010 and 2019. In India, energy demand would decline for the first time, following on from low demand growth in 2019. However, it is advanced economies that will experience the greatest declines in energy demand in 2020. In both the European Union and the United States, demand in 2020 is likely to fall around 10% below 2019 levels, almost double the impact of the global financial crisis.

Energy demand growth by region in 2019 and 2020



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If lockdowns are shorter and the global recovery is more rapid, the decline in global energy demand across 2020 could be limited to 3.8% (which is still four times the decline during the global financial crisis). Shorter lockdowns and a more rapid recovery would limit the decline in full-year oil demand to around 6% – with Q2-Q4 averaging a greater decline than in Q1 – and halve the impact on full year energy demand for coal, gas and nuclear, signalling a recovery of demand in Q2-Q4.

On the other hand, a possible second wave of the pandemic or a slower recovery could exacerbate the potential declines by fuel in 2020. Renewables are the only energy source likely to experience demand growth across the remainder of 2020, regardless of the length of lockdown or strength of recovery.

CO₂ emissions

The stunning declines in energy demand in Q1 2020 resulted in a major drop in global CO₂ emissions, surpassing any previous declines. Not only are annual emissions in 2020 set to decline at an unprecedented rate, the decline is set to be almost twice as large as all previous declines since the end of World War II combined.

First quarter of 2020 (compared with first quarter of 2019)

Global CO₂ emissions were over 5% lower in Q1 2020 than in Q1 2019, mainly due to a 8% decline in emissions from coal, 4.5% from oil and 2.3% from natural gas. CO₂ emissions fell more than energy demand, as the most carbon-intensive fuels experienced the largest declines in demand during Q1 2020.

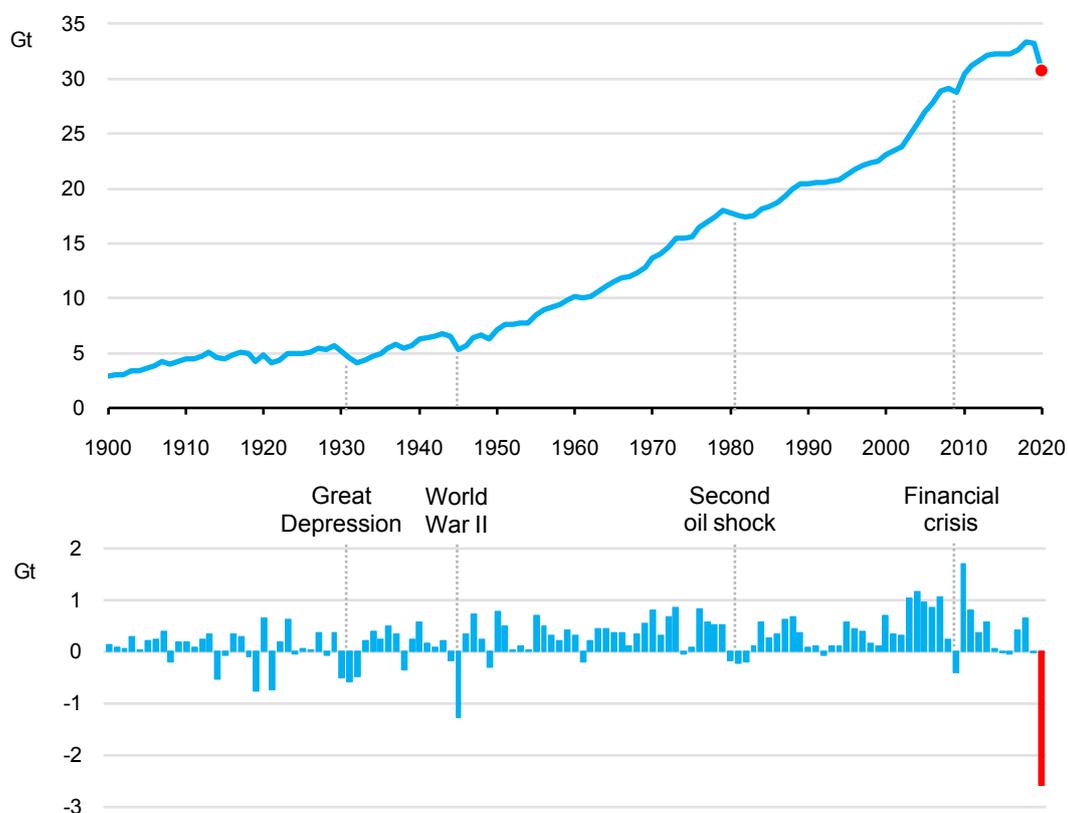
CO₂ emissions declined the most in the regions that suffered the earliest and largest impacts of Covid-19; China (-8%), the European Union (-8%) and the United States (-9%), with milder weather conditions also making an important contribution to the emissions decline in the United States.

Full-year projections

Global CO₂ emissions are expected to decline even more rapidly across the remaining nine months of the year, to reach 30.6 Gt for the 2020, almost 8% lower than in 2019. This would be the lowest level since 2010. Such a reduction would be the largest ever, six times larger than the previous record reduction of 0.4 Gt in 2009 due to the financial crisis and twice as large as the combined total of all previous reductions since the end of World War II.

Of the almost 2.6 Gt reduction in CO₂ emissions, reduced coal use would contribute over 1.1 Gt, followed by oil (1 Gt) and gas (0.4 Gt). The United States would undergo the largest absolute declines at around 600 Mt, with China and the European Union not far behind.

Global energy-related CO₂ emissions and annual change, 1900-2020



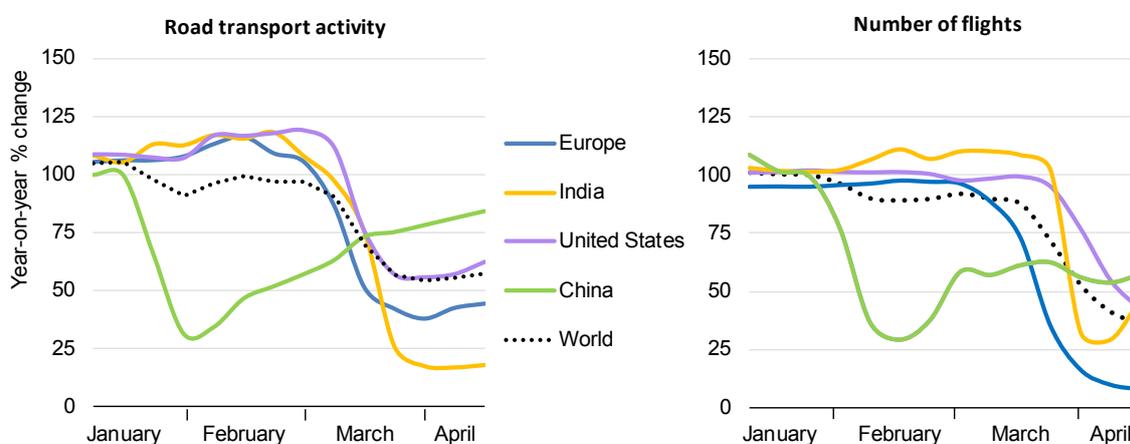
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Oil

First quarter of 2020 (compared with first quarter of 2019)

As a consequence of global lockdown measures, mobility – 57% of global oil demand – has declined at an unprecedented scale. Road transport in regions with lockdowns in place has dropped between 50% and 75%, with global average road transport activity almost falling to 50% of the 2019 level by the end of March 2020. Air travel in certain regions has almost come to a halt, with aviation activity in some European countries declining more than 90%. Aviation activity in China has rebounded slightly from the low at the end of February, as lockdown measures have eased slightly. Nonetheless, as lockdowns spread, global aviation activity declined a staggering 60% by the end of Q1 2020. As a result of declines in mobility, in March alone world oil demand plummeted by a record 10.8 mb/d year-on-year.

Evolution of road transport and aviation activity in 2020 relative to 2019



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Source: IEA analysis based on Apple Mobility, Rystad Energy and OAG data.

In China, the country first affected by the Covid-19 outbreak, lockdowns began to curb mobility from the end of January, resulting in an estimated decline of more than 13% in quarterly oil demand compared with Q1 2019. China's National Bureau of Statistics and Chinese Customs data on refinery production and trade indicate a decline in total oil demand in February of over 2.5 mb/d, or 20%, relative to February 2019. The drop was largely due to a decline in gasoline demand of 1.1 mb/d, or 33%, while demand for jet kerosene dropped by 28% as aviation activity

plummeted in February. In March, activity increased as certain provinces eased restrictions. Nonetheless, we estimate that oil demand levels in China were 22% lower in March 2020 than in March 2019.

The damage done by Covid-19 to oil demand beyond China became clearer during March, as the outbreak moved to Europe and the United States and a growing number of countries imposed strict containment measures. Oil demand in March declined by more than 10 mb/d relative to March 2019, pushing Q1 2020 demand in advanced economies down by 2.3 mb/d relative to March 2019. In the rest of the world, demand dropped by 3.3 mb/d across Q1 2020. Chinese oil demand is believed to have accounted for 1.7 mb/d of the non-OECD drop. In OECD countries, Europe's oil demand is estimated to have dropped by 0.9 mb/d, America's by 0.8 mb/d and Asia's by 0.6 mb/d. Total oil demand is estimated to have declined by 5.6 mb/d in Q1 2020.

As global aviation activity collapsed, jet fuel was the oil product with the largest decline in demand relative to 2019. We estimate that combined jet fuel and kerosene deliveries fell in January by 310 kb/d, or 4%, and in February by 1.1 mb/d, or 14%, relative to 2019. Demand is likely to have fallen by 2.1 mb/d, or 27%, in March after travel bans were implemented widely and a large proportion of the world's aircraft fleet was grounded from around the middle of the month. In Q1 2020, world jet kerosene demand is estimated to have fallen 1.2 mb/d from Q1 2019 levels.

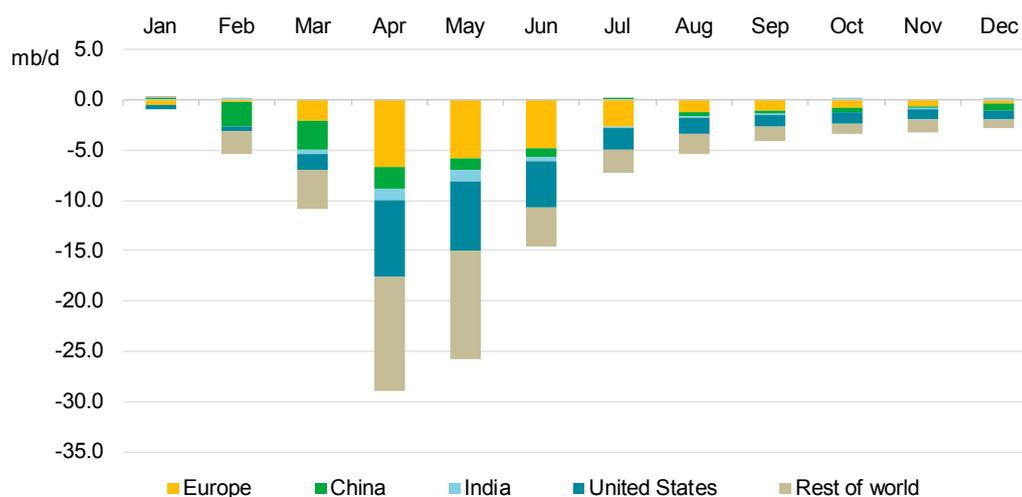
Gasoline was the fuel with the largest absolute decline in demand related to Covid-19 containment measures. In the days after the world's largest cities implemented lockdowns or other restrictions, road traffic fell sharply. Peak congestion in mid-March was down by 50% to 60% in cities as varied as Istanbul, Los Angeles, Mexico City, Mumbai, New York, Paris, Sao Paulo, Rio de Janeiro and Toronto, according to data supplied by the navigation device maker TomTom. Anecdotal evidence suggests that gasoline demand is down by 70% in both France and the United Kingdom during the confinement period. Reduced mobility is estimated to have lowered world gasoline demand by 1.7 mb/d in Q1 2020 compared with Q1 2019. Diesel demand fell by 1.5 mb/d because of lower economic activity and restrictions to rail and bus transport.

Full-year 2020 projections

Global oil demand is expected to be a record 9.3 mb/d lower in 2020 than in 2019. The impact of containment measures in 187 countries and territories has almost

brought global mobility to a halt. Demand in April is estimated to be 29 mb/d lower than a year ago, falling to a level last seen in 1995. For Q2 2020, demand is expected to be 23.1 mb/d below 2019 levels. The recovery in the second half of 2020 is projected to be gradual, as economies come out of containment and activity levels rise. Nonetheless, demand is not expected to reach pre-crisis levels before the end of the year, with December demand projected to be down 2.7 mb/d from December 2019 levels.

Change in monthly oil demand in 2020 relative to 2019



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Source: IEA Oil Market Report – April 2020.

Lockdowns in Q1 2020 and a slide in consumer confidence reduced not only transport activity but also global car sales, with important implications for oil demand across the rest of the year. Car sales in China declined 82% in February relative to 2019, before recovering to 48% below 2019 levels in March. Across the European Union, March car sales fell 55% from 2019 levels. Electric vehicle (EV) sales maintained their momentum in the European Union, however, reaching record shares in sales in many countries, with 2020 CO₂ standards playing an important role in boosting sales. The picture for EVs in Europe contrasts with China where EV sales in Q1 2020 declined even further than total car sales. Car sales in the United States also experienced major declines, down 38% in March, while sales in India in the same month fell 50%. Lower car sales will impact gasoline demand through the remainder of 2020. The drop in car sales slows improvements in energy efficiency where there are fuel economy targets in place. This can reduce declines in gasoline and diesel demand in markets with limited expansion in total fleet size, such as the European Union and the United States. In expanding markets, however, slower sales can put a brake on demand growth, compounding the impacts of Covid-19.

We expect gasoline demand to remain under pressure in the second half of 2020, falling by 590 kb/d on average, because of the postponement of large events such as the Tokyo Olympics and because some containment measures are bound to stay in place in some countries. For 2020 as a whole, we forecast gasoline consumption to decline by 2.9 mb/d, or 11%.

The same factors are likely to weigh on diesel fuel consumption, but not to the same extent. A substantial share of diesel demand globally is used in trucks and ships to transport goods, or in the manufacturing sector, rather than in passenger cars. While demand has no doubt been affected by containment, owing to the closure of shops in many countries, several basic activities and industries have remained open, thus providing a demand floor. The International Maritime Organization's sulphur regulations on bunker fuel, which took effect at the start of the year, offset part of the drop by boosting diesel demand in the shipping sector. By contrast, the warm temperatures across the northern hemisphere led to lower diesel demand for heating than in 2019. Overall, for 2020, diesel consumption is expected to fall by 2 mb/d (7%).

The International Air Transport Association expects flight capacity utilisation to average 65% below 2019 levels in Q2 2020, 40% in Q3 2020 and 10% in Q4 2020. Data show that global flight numbers were down 70% at the start of April from a year earlier. Looking ahead to the rest of 2020, we expect demand for jet fuel and kerosene to decrease 20% in the second half of the year relative to 2019. For 2020 as a whole, demand is expected to fall by 2.1 mb/d on average, or 26%.

Covid-19 containment measures will also reduce demand for other oil products, such as LPG, ethane, naphtha and residual fuel, but the impact is likely to be less acute than for gasoline, diesel and jet fuel. Demand is increasing for certain petrochemical products because of greater consumer demand for packaging and demand for personal protective equipment, with a notable potential for increased PET demand.

The oil outlook crucially depends on the duration of the Covid-19 outbreak and the strength of the subsequent restart of economic activity. A reduced lockdown period and a strong rebound of the economy in the second half of 2020 could reduce the annual decline in oil demand to 6.5 mb/d. Gasoline demand, in particular, could be supported by unwillingness to use public transport as recent trends show in China. Declines in oil demand could be even greater, on the other hand, if a second wave of Covid-19 occurs in the second half of 2020, constraining activity and oil demand across most of 2020.

Electricity

Lockdown measures have significantly reduced electricity demand, affecting in turn the power mix. Increases in residential demand were far outweighed by reductions in commercial and industrial operations. Daily data collected for more than 30 countries, representing over one-third of global electricity demand, show that the extent of demand declines depends on the duration and stringency of lockdowns. On average we find that every month of full lockdown reduced demand by 20% on average, or over 1.5% on an annual basis.

Demand reductions have lifted the share of renewables in electricity supply, as their output is largely unaffected by demand. Demand fell for all other sources of electricity, including coal, gas and nuclear power. In our projection for 2020, global electricity demand would fall 5%, with 10% reductions in some regions. Low-carbon energy sources would far outstrip coal-fired generation globally, extending the lead established in 2019. A faster, V-shaped economic recovery would cut the impact on electricity demand by half, leading to smaller year-on-year falls for coal, gas and nuclear power. But longer lockdowns, slower economic recovery, and wide diffusion of Covid-19 in developing countries could cut demand even further.

Electricity demand

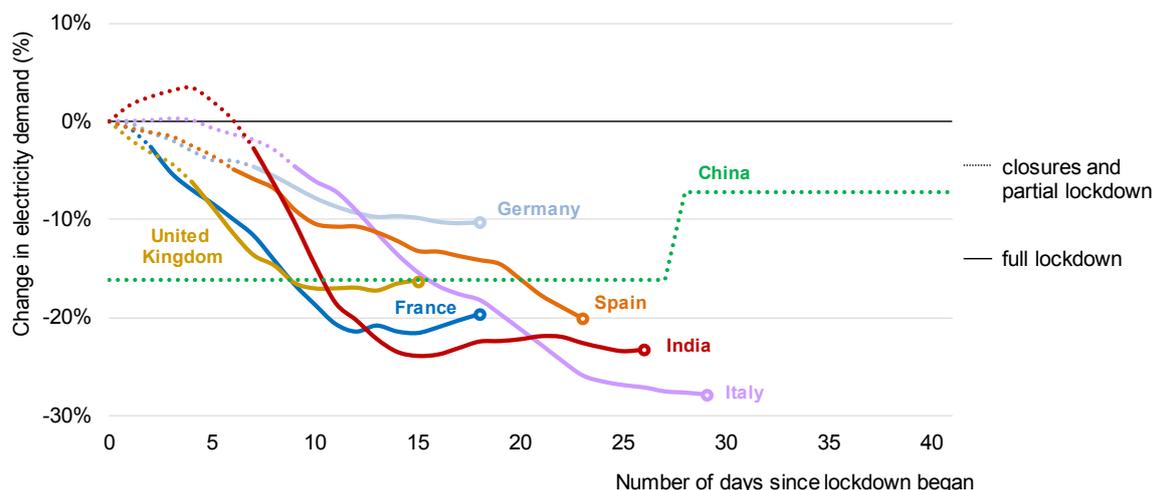
First quarter of 2020 (compared with first quarter of 2019)

Global electricity demand decreased by 2.5% in Q1 2020, though lockdown measures were in place for less than a month in most countries. China was the first to implement containment measures, in mid-January, and experienced the world's largest demand reduction in Q1 2020, of 6.5%. Impacts were more limited in other parts of the world, where restrictions began in March and were introduced progressively. Electricity demand fell by 2.5% to 4.5% in Europe, Japan, Korea and the United States in Q1 2020 relative to Q1 2019, not only because of Covid-19 but also because weather in January and February was milder than in 2019.

Full lockdown measures pushed down electricity demand by 20% or more, with smaller effects for partial lockdowns. After correcting for weather effects, full lockdowns have reduced daily electricity demand by at least 15% in France, India, Italy, Spain, the United Kingdom and the northwestern region of the United States. The largest impacts have been felt in economies that implemented strict measures and those where services make up a larger part of the economy. Both of these criteria

apply to Italy, where electricity demand fell by over 25%. Periods of partial lockdown measures had lesser impacts on electricity demand, up to 10% at most, during initial containment phases in Europe and the United States and ongoing measures in Japan.

Reductions of electricity demand after implementing lockdown measures in selected regions, weather corrected



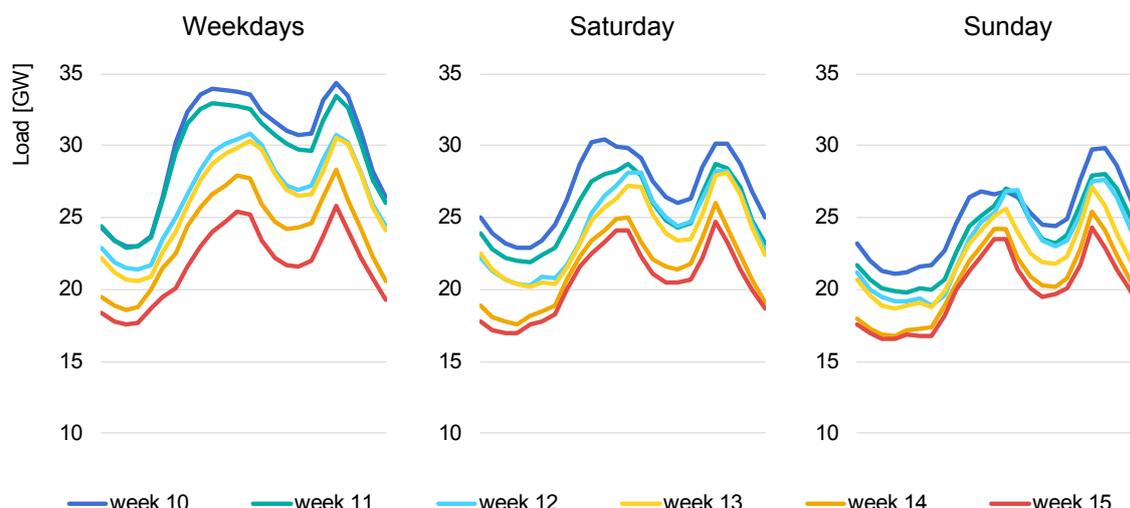
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Sources: IEA based on RTE (France), Terna (Italy), Red Eléctrica (Spain), ELEXON (UK) – all four accessed via the ENTSO-E Transparency Platform; Bundesnetzagentur | SMARD.de (Germany), POSOCO (India), China Statistical Information Network www.stats.gov.cn (China).

Changes to how and when electricity is used during lockdowns have transformed the shape of electricity demand over the course of the day in some regions, with the pattern on weekdays now resembling the pattern usually seen only on Sundays. Hourly electricity demand data for Spain demonstrate these marked changes in weekday patterns, reflecting stringent lockdown measures that have sharply reduced commercial and industrial activities. Weekend patterns are relatively consistent, driven mainly by residential demand.

The services sector has been hit hardest by lockdown measures, as retail, office, hospitality, education and tourism activities were almost completely shut down in many major economies. Across the most affected economies of the European Union, average weekday electricity demand for services declined considerably as March progressed. In Italy, the hardest-hit country in Europe, declines reached 75% relative to the same period in 2019.

Impact of Covid 19 on hourly profile of electricity demand in Spain in 2020



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Source: IEA based on Red Eléctrica (Spain), accessed via the ENTSO-E Transparency Platform.

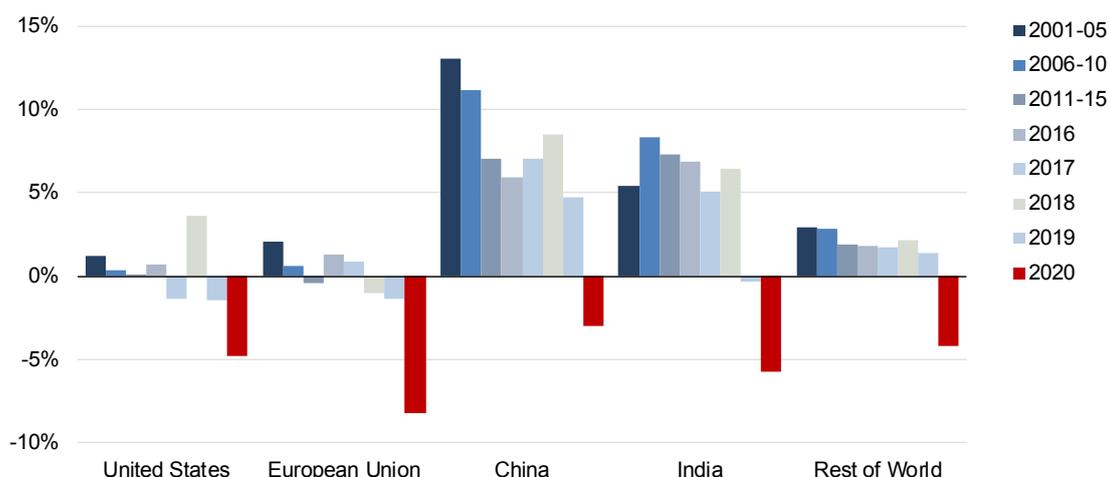
The impact on demand was less significant for the industry sector on average. Many factories have been able to continue operations by applying precautionary measures to protect workers. In China the industry sector demand dropped the most. Demand in the construction and manufacturing industry (which made up 68% of total demand in 2019) decreased by 12%.

Residential electricity demand has increased in most economies as a result of lockdown measures. Most people are spending more time at home and undertaking additional activities at home, such as teleworking. In the last week of March and first week of April, residential demand during the week was up to 40% higher across certain European economies than in the same weeks in 2019.

Full year projections for 2020

We expect global electricity demand to fall by 5% in 2020. This would be the largest decline since the Great Depression and would be eight times the reduction in 2009 due to the global financial crisis. In 2009, continued growth in China and India was able to largely offset reductions elsewhere. However, China and India are not in a similar position in 2020. Their electricity demand growth was already slowing and they are both suffering significantly from the Covid-19 crisis. A faster recovery would reduce electricity demand by 2% in 2020, as all areas of economic activity resume. But wider spread of Covid-19 in Africa, Latin America and other areas of the developing world, and a second wave in autumn in advanced economies, could lead to a decline of greater than 5%.

Annual average growth rates of electricity demand in selected regions, 2001-20



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In economies that rely more heavily on industry, lockdown measures have less effect on electricity demand. In China, industry accounted for more than 60% of electricity consumption in 2019, compared with 10% for services, part of the reason that it would experience a smaller impact on overall electricity demand. In the United States, industry only accounts for 20% of electricity demand, while the services sector accounts for almost 40%, leading to more pronounced impacts on total electricity demand as non-essential services have been hit the hardest by lockdown measures. Europe is set to feel the largest impact as hard hit services sectors play a central role in its economy.

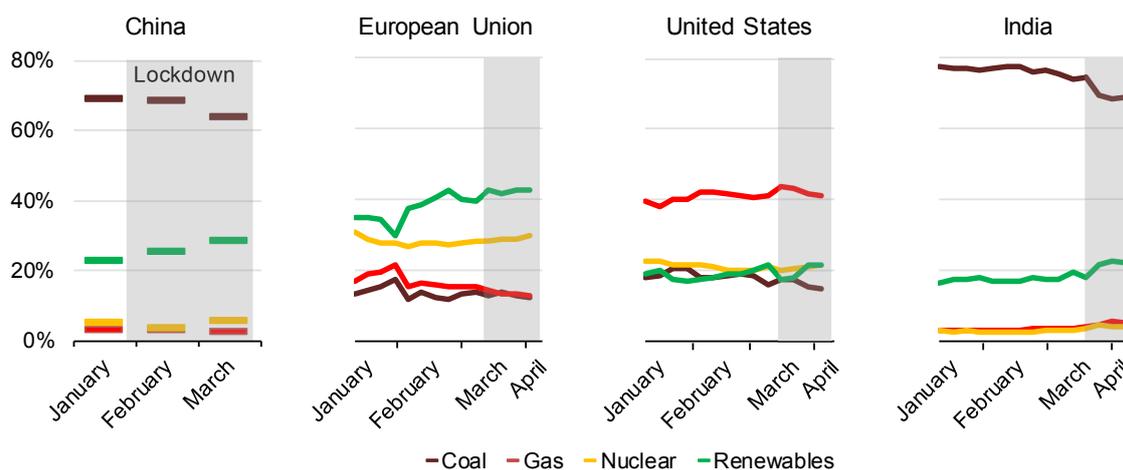
Electricity supply

Renewables have claimed a greater share of electricity generation as a result of lockdown measures and depressed electricity demand. Global electricity generation was 2.6% lower in Q1 2020 than in Q1 2019. Renewables-based generation increased by 3%, mainly because of a double-digit percentage increase for wind power and a jump in solar photovoltaic (PV) output from new projects over the past year. The share of renewables in electricity supply neared 28% in Q1 2020, up from 26% in Q1 2019.

Aside from renewables, which are largely unaffected by electricity demand, most other sources of electricity declined in the first quarter of 2020. Nuclear power generation fell by 3% in response to lower demand and because fewer reactors were operational in some regions. Low-carbon generation increased in total, however, reducing the need for electricity produced from fossil fuels by close to 3%. Gas-fired

generation increased by 4%, buoyed by low prices for natural gas in markets around the world. In some markets, coal-to-gas switching opportunities based on fuel costs arose for the first time. Coal-fired power generation was squeezed from all sides, and output fell by 8% in Q1 2020 relative to Q1 2019.

Electricity mix by region in 2020

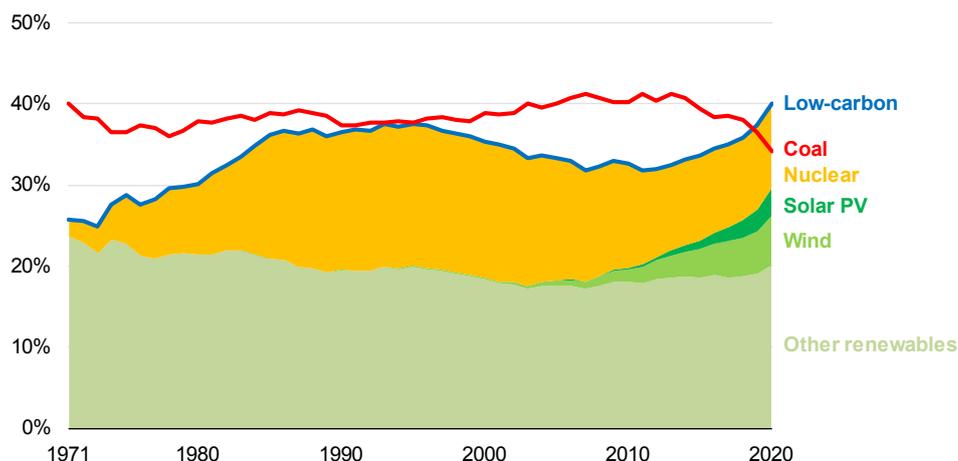


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Sources: IEA based on China Statistical Information Network www.stats.gov.cn (China), POSOCO (India), and EIA (US).

In all regions that implemented lockdown measures, the electricity supply underwent a notable shift towards low-carbon energy sources in Q1 2020. China had the largest reduction for coal-fired power generation, about 100 TWh, driving the global decline as China is by far the largest producer of electricity from coal. Reductions were pronounced in both February and March in China, where significant lockdowns spanned both months. In the European Union, the share of renewables in electricity generation picked up in weeks following the onset of lockdown measures, in part due to lower demand, driving coal and gas out of the power mix. In the United States, the decline of coal-fired generation accelerated in the weeks after lockdown measures were initiated. Gas-fired generation fell slightly, while generation from renewables rose. Overall, US coal-fired generation in Q1 2020 was down by one-third on Q1 2019, squeezed by lower demand, cheap gas and 20% increases in wind and solar PV output. In India, which implemented nationwide measures with immediate effect, coal-fired generation and its share in the power mix fell sharply from Q1 2019 to Q1 2020, bringing the shares of renewables and coal in electricity generation as close as they have ever been.

Global generation shares from coal and low-carbon sources, 1971-2020



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A U-shaped recovery would push low-carbon sources of electricity well ahead of coal-fired generation globally in 2020. The low-carbon share of generation is expected to surge to 40% in 2020, the highest level on record, partly because total generation would fall by almost 5%. Low-carbon sources would be six percentage points ahead of coal, after having taken the lead in 2019. Renewables would reach the highest level in terms of output and share, with new projects more than compensating for lower nuclear power output. Wind and solar power are set to increase in any case because of new projects that have been built over the past year, lifting their share of generation to nearly 9% in 2020, twice as high as in 2015. Coal-fired generation would be squeezed the most over the year, falling 10% in 2020. Gas-fired generation would also be hit hard, sinking by about 7% for the year, the largest declines on record.

A faster recovery would boost electricity demand, raising demand for all sources of electricity. Coal- and gas-fired generation would still fall but by only about half as much, though low-carbon sources would still outpace coal-fired generation. Renewables would undergo additional growth, as more projects would be completed, particularly solar PV projects that can be constructed quickly. Nuclear power would rebound to nearly match 2019 output over the course of 2020.

A slower recovery, on the other hand, would put further downward pressure on coal, gas and nuclear power, leading a greater shift to renewable energy sources in the overall power mix as long as their output is fully integrated.

Natural gas

First quarter of 2020 (compared with first quarter of 2019)

Natural gas consumption was falling over the first months of 2020 in major markets even before the Covid-19 pandemic, mainly due to historically mild temperatures in the northern hemisphere. In Europe, milder weather pushed down natural gas demand by an estimated 2.6% during Q1 2020 relative to Q1 2019, according to data published by natural gas transmission system operators. Consumption by distribution customers (mainly residential and commercial) dropped by 3%, while gas-fired power generation declined by over 5%, squeezed by a combination of high wind generation and lower heating-related electricity consumption.

Similarly, US natural gas demand decreased by an estimated 4.5% in Q1 2020 compared with Q1 2019, dragged down by a sharp decline of 18% in residential and commercial demand. Mature Asian markets also experienced a contraction in natural gas consumption. LNG imports in Japan fell by 3% in Q1 2020 relative to Q1 2019, while in Korea domestic sales for January and February fell by 2.5%. Natural gas demand in China was essentially flat while in India it grew at almost 8% in January and February compared with a year earlier.

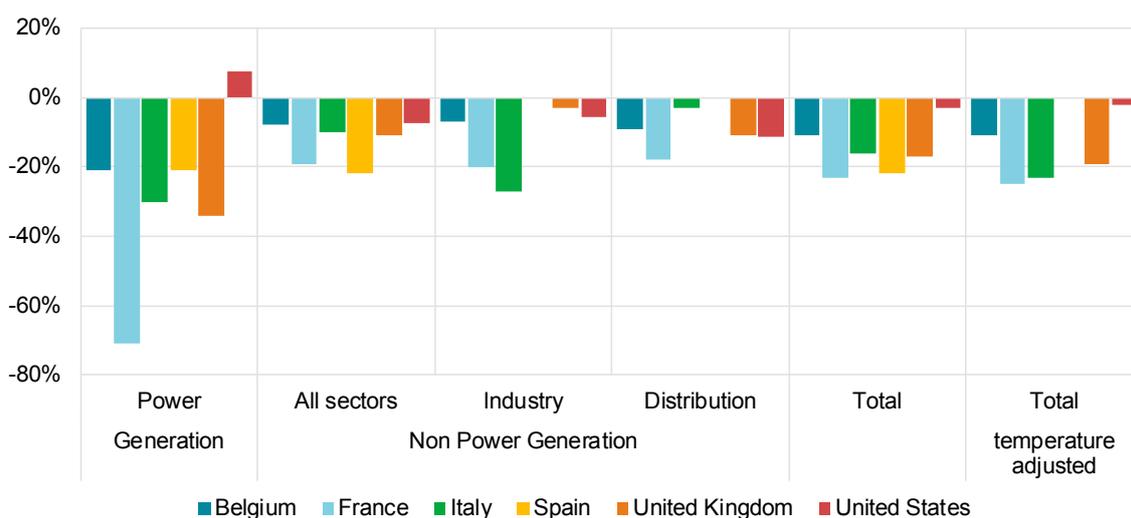
Data covering half of global demand suggest that gas consumption fell by more than 3% in the first quarter of 2020. This finding is based on a sample of key markets in Asia, North America and Europe. Perspectives from other regions are mixed. Demand in the Russian Federation (hereafter, "Russia") and other Eurasian markets is assumed to have been similarly pushed down by mild temperatures; Russia's electricity consumption, the main component of gas demand, declined by 1.9% in Q1 2020. But other regions, such as Southeast Asia or the Middle East, have almost no space heating needs and would have therefore experienced more typical consumption profiles.

Natural gas supply did not adjust to this drop in consumption, resulting in a considerable build-up of gas in storage. US dry gas production grew by 7% in Q1 2020 relative to Q1 2019, while global LNG trade increased by an estimated 13%. Europe accounted for about 60% of the increase in LNG imports over this period. While pipeline imports decreased in both markets, underground storage inventories

experienced a strong build-up. In the United States they rose by 77% compared with 2019, 17% above the five-year average as of the end of March. In Europe they rose 40%, to reach 80% above the five-year average. These increases were supported by exceptionally low spot prices, with the US Henry Hub price at its lowest Q1 average since 1999, and the European TTF price at its lowest Q1 average since its establishment in 2003.

Lockdowns in China and elsewhere piled additional pressure on natural gas demand. In China, where the Covid-19 outbreak reached its peak in February, gas consumption growth was close to zero: according to the National Development and Reform Commission, apparent gas consumption grew by 1% in January and February from a year earlier. In Europe, the implementation of nationwide lockdowns in several countries from mid-March sharply reduced natural gas consumption in the industry and power generation sectors. Distribution network consumption was less affected, as residential consumption was stable under confinement and benefited from colder temperatures at the end of March. Natural gas demand fell less in the European countries that imposed restrictions without implementing full lockdowns: between mid-March and mid-April, demand fell by 3% in Germany and 7% in the Netherlands, relative to 2019.

Year-on-year impact of lockdowns (from first day to April 15) on natural gas consumption per sector for a selection of European countries and the United States



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Notes: Temperature adjustment is based on heating degree days and applies to demand from distribution network. Daily data for Spain provides consumption data for power generation, conventional and trucks; daily breakdowns for industry and distribution are not available.

Sources: Data compiled from national transmission system operators for European countries and the Energy Information Administration (EIA) for the United States (national data starting from the implementation of the first state-level lockdowns).

Natural gas consumption appears to have been more resilient in the United States since the implementation of state-wide lockdowns. Demand from the industry sector fell by 6% between mid-March and mid-April, relative to 2019, but gas-fired power generation increased by 8%. In India, the infrastructure operator GAIL reported in mid-April a fall in sales of about 30% since the imposition of a national lockdown, yet anticipated a recovery in the near term as consumption recovers in the fertiliser industry – the largest consumer of natural gas – in preparation for the sowing season.

Full year projections for 2020

Global natural gas demand could decrease by 5% in 2020, based on our broad assumptions for the year. This decline is less than the anticipated fall in oil demand, reflecting the fact that natural gas is less exposed to the collapse in demand for transportation fuels. But it nonetheless represents a huge shock to a gas industry that is used to robust growth in consumption. This drop would be the first in annual consumption since 2009, when consumption fell by 2%, and the largest recorded year-on-year drop in consumption since natural gas demand developed at scale during the second half of the 20th century. During the Great Depression in the early 1930s, gas demand in the United States fell by 13% in 1931 and by 7% in 1932. At that time, however, the United States was the only major producer and consumer of natural gas in the world; now gas is a global commodity accounting for well over 20% of global primary demand. Natural gas consumption is expected to fall in every sector and region in 2020 compared with 2019, but most of the declines are in power generation.

- Gas consumption in **power generation** would drop by around 7%, accounting for almost 60% of the decrease in global demand. The decline would be especially sharp in Europe, where the dominant role of natural gas in thermal generation would be squeezed by the decrease in electricity consumption from industry and commercial sectors, while non-fossil fuel generation remains more resilient. Very low natural gas prices mean that the impact on gas-fired generation is expected to be less severe in North America. Prolonged lockdowns in regions such as the Middle East or North Africa, where natural gas is the main source of power generation, would further hit global gas-fired output.
- The **industry sector** accounts for about 25% of the global decrease, dropping by about 5%. On top of the direct impact of reduced activity during lockdowns, natural gas demand from industry is further dampened by the slowdown in consumer spending for manufactured goods, which affects gas use in export-driven economies, especially in Asia.

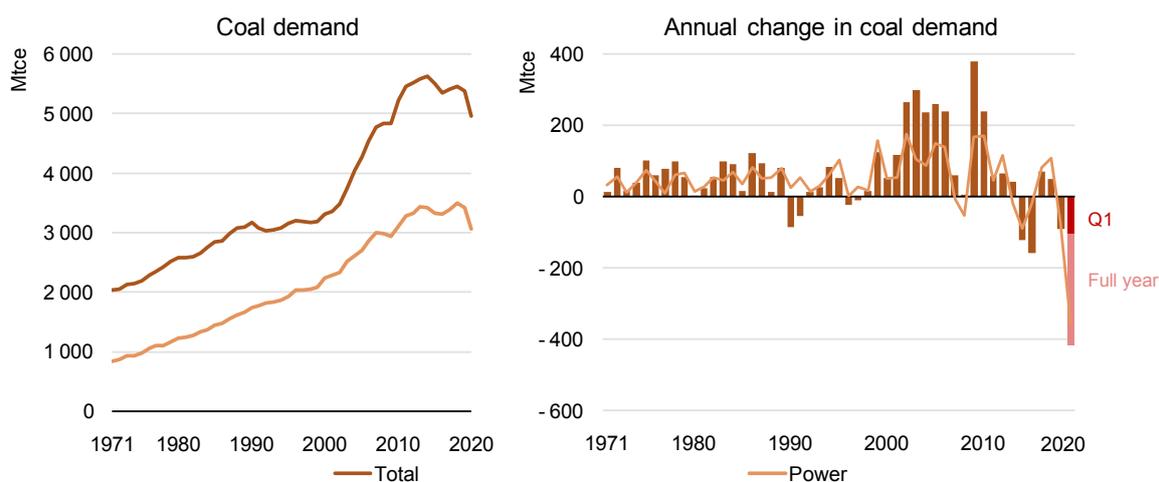
- The **energy sector** itself would account for around 10% of the fall in global gas demand, dropping by 4%. This reflects the overall fall in global supply that reduces gas needs for upstream operations, as well as for energy transformation (refining) and transportation (pipeline gas compression).
- Most of the impact on gas demand in the **residential and commercial sectors** is expected to come from the already observed drop in Q1 2020 caused by mild temperatures – with some additional loss in the commercial sector for non-heating uses during the lockdown periods.

Faster post-lockdown recovery in Europe and North America and shorter lockdowns in other regions would reduce the negative impacts on Asian manufacturing economies and gas exporting regions, leading natural gas consumption to decrease by about 2.7% instead of 5%.

Coal

The response to the Covid-19 outbreak has curtailed electricity use and industrial production in most countries, pushing down global coal consumption. The size of the economic impact and the speed of recovery from it in the main coal-consuming jurisdictions will determine the ultimate size of the decline in global coal use in 2020.

Global total coal demand, and coal demand for power generation



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First quarter of 2020 (compared with first quarter of 2019)

We expect global coal demand to fall by 8% in Q1 2020 relative to Q1 2019. This significant drop was driven by lower demand in the electricity sector, where two-thirds of coal is consumed: coal power generation fell by around 10%. Industrial use of coal also declined during the period, although reported increases in coal use for steel production in China mitigated the decline.

In **China**, where more than half of the world's coal is consumed, the Covid-19 outbreak triggered a marked decline in coal demand because coal supplies 60% of primary energy and an even higher share of electricity. Coal consumption fell by 8% in Q1 2020 compared with 2019 as the economy contracted by 6.8% and coal power generation fell by close to 9%. Industrial production fell sharply; in January and February, automobile production declined by almost 50% and cement production by 30%, with a slight recovery afterwards.

In **India**, the economy had not yet fully recovered from last year's slowdown when the government mandated the lockdown of the whole country on March 24. Electricity demand and industrial production declined significantly in late March, likely leading to a new decline in India's coal use in Q1 2020, after the drop in 2019.

In the **United States**, a mild winter and the abundance of natural gas pushed gas prices down. Along with expanding renewables, this further squeezed coal out of the market. The decline in electricity use after the first states started lockdowns pushed coal use down even further, by around 30% in Q1 2020, with coal's share in the power mix falling below 20% for the first time since the widespread development of coal-fired electricity generation in the 21st century.

In the **European Union**, coal demand fell by more than 20% in Q1 2020. The Covid-19 outbreak and shrinking electricity demand during lockdowns added pressure on coal use, which was already falling because of low gas prices, a mild winter and increasing renewable output, which was also supported by favourable weather conditions. The fall in CO₂ allowances did not improve coal's competitiveness with gas in the power sector and therefore was not much relief for coal, which declined 20% in Q1.

Full year projections for 2020

We expect global coal demand to fall by about 8% in 2020, the largest drop since World War II, with coal use declining in virtually every sector of every region in the world.

In **China**, coal demand will decline in 2020 by around 5%, despite the gradual recovery since February lockdown. Coal-fired power generation will be hit especially hard, because the power system is crowded by low variable cost hydro, wind, solar and nuclear power. If a more favourable dispatch for coal power plants is established, this could offer some relief for coal power producers.

An even greater decline in coal demand is expected in **India**, where economic growth and power production are slowing significantly. Despite the recovery expected later in the year, a decline in coal power generation will push coal use down for the second year in a row.

In the rest of the world, coal demand will decline steeply in 2020. Even in **Southeast Asia**, the region with fastest growth in the recent years, where coal power generation is curtailed by lower electricity demand, especially in Malaysia and Thailand. We also

expect significant declines in coal demand in advanced economies: by 25% in **the United States**, around 20% in the **European Union**, and 5% to 10% in **Korea and Japan**.

In the current situation, the uncertainty about the outlook for coal is the highest among all fuels. In large part, this is because its use is concentrated in the power sector, and is strongly dependent on the level of electricity demand. In particular, coal is dominant in China and India, the largest and the third-largest electricity users in the world. In addition, the use of coal in power generation is squeezed by low-carbon generation, including hydro, wind, solar and nuclear power, which have been less affected by the Covid-19 crisis. Hence, differences in economic activity and the associated electricity demand have an outsized effect on coal-fired electricity generation and overall coal consumption.

For example, global coal use could decline only half as much if China and other large consumers of coal recover more quickly from the crisis. Even so, many trends would remain unchanged, such as double-digit percentage drops in the European Union and the United States, single-digit declines in Japan and Korea, and a drop in India. In some markets, coal demand may even grow if recoveries are faster, such as in Southeast Asia, driven by Indonesia and Viet Nam.

Projections of 2020 coal trends need a final caveat regarding China, as the Chinese government has pledged to implement a fiscal and monetary stimulus to its economy. The magnitude and design of that stimulus – in addition to how energy-, electricity- and coal-intensive it is – might change coal use trends significantly in China and therefore in the world.

Renewables

Renewable energy has so far been the energy source most resilient to Covid-19 lockdown measures. Renewable electricity has been largely unaffected while demand has fallen for other uses of renewable energy. In Q1 2020, global use of renewable energy in all sectors increased by about 1.5% relative to Q1 2019. Renewable electricity generation increased by almost 3%, mainly because of new wind and solar PV projects completed over the past year and because renewables are generally dispatched before other sources of electricity. Along with depressed electricity demand, power grids have managed heightened shares of wind and solar PV. The use of renewable energy in the form of biofuels declined in Q1 2020 as consumption of blended fuels for road transport fell.

We estimate that total global use of renewable energy will rise by about 1% in 2020. Despite supply chain disruptions that have paused or delayed activity in several key regions, the expansion of solar, wind and hydro power is expected to help renewable electricity generation to rise by nearly 5% in 2020. This growth is smaller than anticipated before the Covid-19 crisis, however. A faster recovery would have a minimal impact on renewable energy production, though it would enable more new renewables-based projects to be completed. If recovery is slower, renewable energy would still increase, making renewables the energy source the most resilient to the Covid-19 current crisis.

First quarter of 2020 (compared with first quarter of 2019)

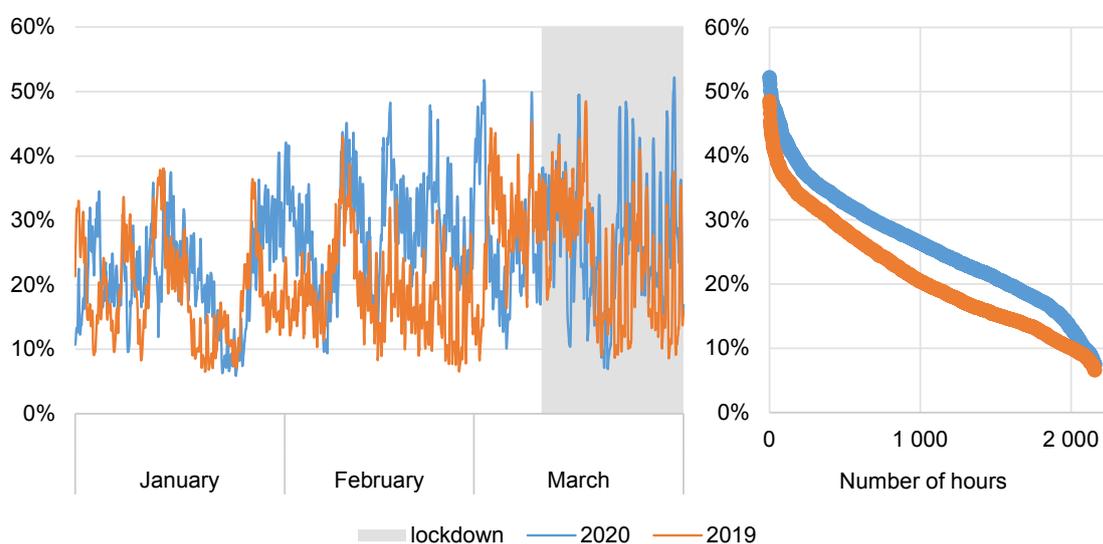
In Q1 2020, the global use of renewable energy was 1.5% higher than in Q1 2019. The increase was driven by a rise of about 3% in renewable electricity generation after more than 100 GW of solar PV and about 60 GW of wind power projects were completed in 2019. In addition, wind availability was high in Europe and the United States in Q1 2020. Renewables are also resilient to lower electricity demand because they are generally dispatched before other electricity sources due to their low operating costs or regulations that give them priority.

The share of renewables in global electricity generation jumped to nearly 28% in Q1 2020 from 26% in Q1 2019. The increase in renewables came mainly at the cost of coal and gas, though those two sources still represent close to 60% of global

electricity supply. In Q1 2020 variable renewables – in the form of solar PV and wind power – reached 9% of generation, up from 8% in Q1 2019.

On an hourly basis, variable renewables met a higher share of electricity demand throughout most of Q1 2020. Before lockdown measures were implemented, shares of variable renewables were similar or higher due to favourable weather conditions, projects completed in 2019 and limited electricity demand growth. Once lockdown measures were put in place, electricity demand fell while levels of wind and solar PV held steady. This led to a noticeable step up in variable renewables’ share of demand. Multiple regions have seen record-high hourly shares of variable renewables in electricity demand during lockdowns, including Belgium, Italy, Germany, Hungary and eastern parts of the United States. Since strict social distancing measures began in Germany on March 22, the share of variable renewables has been consistently higher than in the same period in 2019. Overall, electricity systems have been able to deal with increasing shares of variable renewables over the past few months because most markets have already experienced higher levels in summer months when solar PV penetration increases significantly.

Wind and solar share of hourly electricity demand in selected countries, chronological and ordered in Q1 2020



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Sources: IEA based on RTE (France), Terna (Italy), Red Eléctrica (Spain), ELEXON (UK) – all four accessed via the ENTSO-E Transparency Platform; [Bundesnetzagentur | SMARD.de (Germany)].

In Q1 2020, [the renewable industry faced supply chain disruptions](#) and a slowdown in installation activity due to lockdown measures. Having paused or reduced production because of lockdowns in several key provinces, China – which accounts for over 70% of global PV module manufacturing – is ramping up production again.

The wind energy supply chain, on the other hand, is much more globally interconnected. Some production facilities in Europe, India and in various US states were closed or reduced activity in March. These disruptions, especially in February and March, have sent ripples across manufacturing hubs such as Europe, China and the United States as wind turbines require multiple parts are shipped from across the globe. However, several countries are easing lockdown measures for industries to revive the economy.

Liquid biofuels are directly affected by declining road transport fuel demand as they are blended with gasoline or diesel under existing blending mandates. Ethanol and biodiesel production facilities in Brazil, the European Union and the United States have reduced their outputs as a result of sluggish local and international demand. US ethanol production was down by nearly 50% between the end of February and early April, as numerous plants idled or reduced output. Brazil's ethanol sector is under dual pressure from constrained demand and low gasoline prices that undercut the competitiveness of ethanol consumption. As demand has fallen, biofuel stocks have grown in many markets, depressing biofuel prices and compromising the profitability of production. Ethanol plants in many countries have ventured into production of much-needed hand sanitizer.

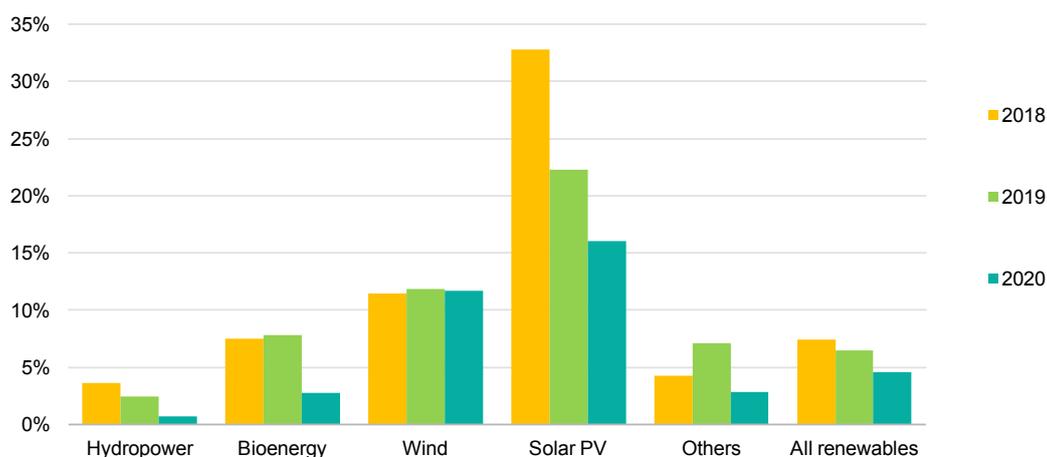
Full year estimates for 2020

In our estimate for 2020, renewable energy demand increases by about 1% from 2019 levels, in contrast to all other energy sources. Renewable electricity generation grows by nearly 5% despite the supply chain and construction delays caused by the Covid-19 crisis. In doing so, renewables almost reach 30% of electricity supply globally, halving the gap with coal (from 10 percentage points in 2019). Overall, renewables growth is more sluggish than last year but in line with the general slowing trend since 2016. The output of hydropower remains the largest uncertainty in 2020, as it accounts for almost 60% of all renewable generation globally and is dependent on rainfall and temperature patterns.

The pace of renewable power capacity additions could decline in 2020 as supply chain disruptions and labour restrictions delay construction. The duration and extent of lockdowns and social distancing measures in different countries will influence the total for the year, along with the scope and timing of economic stimulus packages in response to the economic downturn.

Solar PV is set to increase the fastest of all renewable energy sources in 2020. However, uncertainty remains over capacity growth in 2020, especially for distributed solar PV applications. Last year, one-fifth of all renewable capacity deployed globally consisted of individuals and small-to-medium-sized enterprises installing solar PV panels on their roofs or business sites. Currently, the installation of distributed solar PV has stopped or dramatically slowed in many countries as lockdown measures prevent access to the buildings.

Annual growth for renewable electricity generation by source, 2018-20



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Wind power is expected to increase the most in absolute generation terms among all renewables. A windy start of the year from January to March in many regions and strong capacity additions last year are expected to give a boost to wind generation in 2020. Some important policy deadlines require developers to commission projects by the end of 2020. In China, all wind projects need to be commissioned by the end of 2020 to qualify for feed-in tariff subsidies. In the United States, wind developers are in a similar situation, as they are required to ensure projects are operational by the end of 2020 to receive production tax credits. Despite such policy deadlines, however, uncertainty remains over capacity growth this year because of possible delays.

Electricity generation for bioenergy is expected to slow down as supply chain interruptions and logistical challenges are expected for the delivery of solid biofuels to large-scale power plants. For instance, large bioenergy power plants in Europe use as fuel wood pellets that mostly come from North America.

Pressure on biofuel consumption levels will continue because transport activity is expected to contract still further in the second quarter of 2020 in the United States,

European countries and many other countries. If the pandemic is under control by late in the northern summer, transport demand could rebound in the second half of the year, allowing a partial recovery of biofuel production. Full-year biofuel consumption is nonetheless likely to be substantially lower than in 2019. Planned increases to blending mandates have already been delayed in several Southeast Asian countries and the introduction of Brazil's flagship RenovaBio policy may be disrupted. Low oil and prices also limit appetites to increase biofuel blending levels. The impact on biofuel production across 2020 will depend on the share of sugar cane directed to sugar rather than ethanol, and the scope of financial support made available for producers as part of Covid-19 rescue and recovery packages.

A faster or slower recovery would have limited effects on renewable electricity production in 2020, with year-on-year growth expected under most conditions. However, the impacts on the renewable energy industry could be very large, as the regions most affected by the Covid-19 crisis could see a sharp reduction in construction. The production of renewable electricity largely depends on the availability of natural resources, as weather is the main determinant for hydropower, wind and solar PV, which together account for about 90% of all renewable electricity generation. The estimates for 2020 are based on past weather trends, and so deviations from these historical averages are a source of significant uncertainty. The total amount and timing of new capacity additions in 2020 also remain uncertain, but their impact on total renewable electricity generation is limited. The use of biofuels is more sensitive to the pace of the recovery, given its strong link to road oil demand, and could fall substantially if the recovery in 2020 is slow.

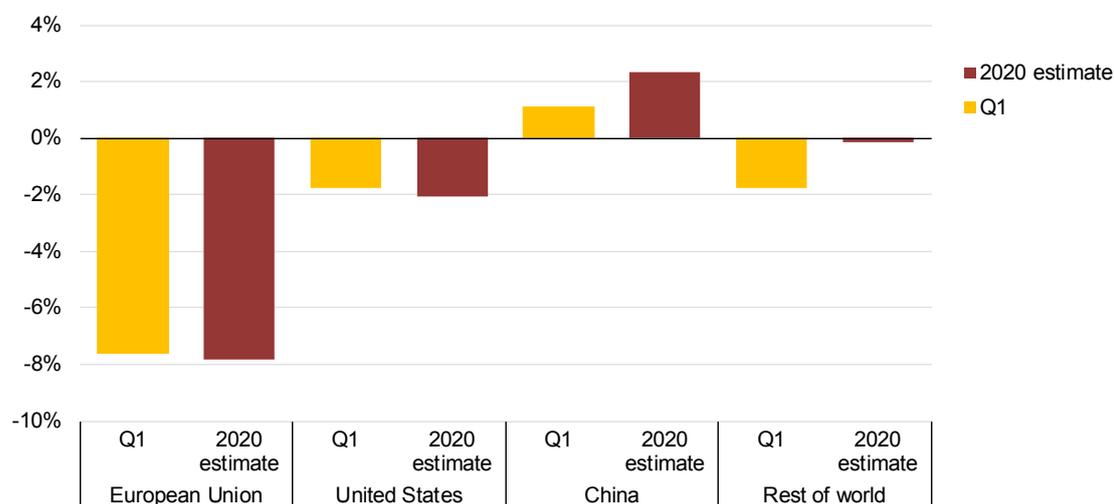
Nuclear

Nuclear power has not been immune to the impacts of the Covid-19 crisis, though in most cases reactors have continued to produce electricity. Global nuclear power generation fell by about 3% in Q1 2020 compared with Q1 2019, pulled down by electricity demand reductions. In our estimate for 2020, nuclear power declines by 2.5% from 2019 due to lower demand and delays for planned maintenance and construction of several projects. If the recovery from the crisis is faster, electricity demand would be higher and some new reactors would be completed in 2020, leading to a reduction in nuclear power in 2020 of just over 1%.

First quarter of 2020 (compared with first quarter of 2019)

In Q1 2020, most of the reductions in nuclear power were caused by lower electricity demand, alongside planned permanent closures of nuclear facilities. Since Q1 2019, six new reactors have come online globally, with a total power capacity of 5.5 GW, but this was only equivalent to half of the nuclear capacity that was permanently shut down over the same period.

Nuclear power output change year-on-year in leading markets



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The European Union had the largest reduction in Q1 2020. Lower demand led to nuclear output reductions in several countries, most notably France, where nuclear power generation was down by 11 TWh (10%) in Q1 2020. Beyond adjustments to planned maintenance, several additional reactors were taken offline as demand fell.

Closures of nuclear power plants also led to reductions. Nuclear power has also been an important source of power system flexibility in Europe, helping to maintain electricity security by operating in a load-following mode in several countries including France, Germany, Belgium, the Slovak Republic and Sweden. In Germany output fell by 3 TWh, or 17%, as steps are taken towards a complete nuclear power phase out by the end of 2022. In the United States, nuclear output in Q1 2020 was down 4 TWh, or 2%, due in part to lower electricity demand linked to mild weather.

China was one of the few regions with nuclear power growth, with a 1% increase in output between Q1 2019 and Q1 2020. A pair of large nuclear reactors came online in China in June 2019. Operations at these additional facilities more than compensated for the impact of depressed electricity demand.

Full year projections for 2020

In our estimate for 2020, lockdowns would reduce global nuclear power output by 3% from 2019 levels, less than the impact on total electricity demand. However, this decline would be the largest not associated with a natural disaster, and 40% as large as the reduction in 2011 following the accident at Fukushima Daiichi. Depressed electricity demand will continue throughout 2020, drawing less on nuclear power along with all other dispatchable sources of electricity. The Covid-19 lockdown measures have also slowed nuclear power construction activity. The completion of several projects is likely to be pushed by a few months to 2021, including two reactors in China and one in Finland, where a delay has already been announced. Other construction delays are likely for projects in France, the United Kingdom and the United States. Some refuelling outages have been postponed to 2021 as well, particularly in countries with large nuclear fleets such as France.

A faster recovery would help nuclear power output in 2020 to decline by just over 1% compared with the 2019 total, as reactors that are in service could operate at higher load factors to meet the rebound in electricity demand. A return to construction activities could bring reactors online in late 2020 in China. In any case, 2020 is likely to see a modest number of new reactors completed, falling well below the recent high water mark of 11 GW completed in 2018. At the same time, a slower recovery than envisioned would lead to lower electricity demand and further reduce nuclear power output (beyond a 2.5% decline) in 2020.

Implications

The Covid-19 crisis and measures taken to slow its spread have had a profound impact on energy demand, the likes of which have not been seen for 70 years. The full impact of the current situation, as yet unknown, will be determined by the duration of lockdown measures and the recovery paths taken around the world. This unprecedented situation and the stimulus packages that governments are putting in place will shape the energy sector for years to come, with significant consequences for the energy industry at large, energy security and clean energy transitions.

The energy industry is feeling the financial impact throughout value chains, with most energy companies losing substantial revenues. In effect, they are being hit twice, first by lower demand for their products – including oil, gas, coal and electricity – and again by lower prices for these products. Average oil prices fell sharply, with West Texas Intermediate hitting negative prices for the first time in history as excess storage became scarce. LNG prices have declined to all-time lows in European and Asian markets, which were abundantly supplied even before the Covid-19 crisis depressed demand. Natural gas prices have gone negative in parts of the United States, where storage is full. The smallest impact is on coal: as the supply chain is less affected by logistical constraints than oil and natural gas. A combination of cheap gas and weakening demand have also led to power prices declining by one-third to one-half in liberalised wholesale markets. Market prices for electricity have dipped below zero in the United States and a number of countries in Europe, including Belgium, Denmark, Finland, France, Germany, Sweden and Switzerland.

The energy sector that emerges from the Covid-19 crisis may look significantly different from what came before. Low prices and low demand in all subsectors will leave energy companies with weakened financial positions and often strained balance sheets. Business lines that are insulated to a degree from market signals, including those with renewable electricity projects, will emerge in the best financial position. Private firms that are the most exposed to market prices will experience the most severe financial impacts. Market concentration and consolidations are likely.

Across the energy sector, the Covid-19 crisis will have a significant impact on investment. This could raise concerns about energy security because investment is necessary even if global energy demand takes a long time to return to the pre-crisis trajectory. A considerable proportion of global energy investment is devoted to just sustaining existing levels of energy supply: maintaining oil and gas production at current levels, replacing ageing power generation capacity – often with a capital-

intensive combination of renewables and flexibility sources – and reinvesting in ageing electricity networks. Investment in these activities will have to remain robust even with a subdued recovery.

Energy security has been put to the test in new ways by the crisis, including in oil and gas markets. Simultaneous supply and demand shocks have sent oil markets into turmoil. Oil plays a central role in global macro finance, both as a share of international trade and as a critical source of government revenues for several major producers. Lockdown measures have caused unprecedented demand declines, whose speed and magnitude greatly exceed the normal market flexibility of supply. As a result, even with attempts at co-ordinated management, a disorderly production shutdown is likely in some places. The consequent macroeconomic and financial disruptions could undermine the industry's ability to ramp up production as the world economy and oil demand recover.

The supply of natural gas is critical to operations in all sectors, including industry, residential and services heating, and electricity supply. Due to large investments in recent years and the slump in demand because of Covid-19, global gas markets are abundantly supplied and storage levels are very high. At the same time, intense financial strain is hurting the industry, including companies who own and operate critical infrastructure facilities. Policy makers and regulators need to ensure that operational, maintenance and safety expenditures are prioritised and appropriately maintained. US LNG has played a major role in improving energy security and market efficiency in several regions, but the ongoing challenging market conditions risk significant shut-in of US LNG facilities.

Electricity security's place at the heart of modern economies has been underscored by the Covid-19 crisis. A robust, uninterrupted electricity supply is a key precondition of both the functioning of the health care system and the maintenance of social welfare and online economic activity. Robust power systems have enabled adaptations to the ongoing crisis, including a huge expansion of teleworking activities, particularly in advanced economies. In some parts of the world, however, a reliable supply cannot be taken for granted. In Africa, several thousand hospitals and health care facilities have no access to electricity. In both Africa and South Asia, electricity reliability problems limit social distancing.

Electricity security has remained robust as the Covid-19 crisis has accelerated the shift to renewable energy in the power mix. The share of renewables has jumped several years ahead of pre-pandemic expectations, including the shares of wind and

solar, curbing CO₂ emissions and air pollution. The rise of renewables has posed some problems for electricity security, however. In advanced economies, the main cause of blackouts is the inability of the system to manage sudden changes in power flows and various network problems. Lower electricity demand paired with continued growth of wind and solar PV has stepped up the share of variable renewables, calling for more flexibility to keep the lights on. At the same time, available flexibility has been limited by the shutdown of industrial facilities that provide demand response and because dispatchable power plants are idle because power prices are extremely low. As the energy industry's financial challenges grow, the cost of restarting dispatchable power capacity that had been mothballed could emerge as a significant energy security concern as economies and electricity demand recover. To date, electricity systems in major economies have maintained robust reliability, but continuous vigilance will be needed from system operators, regulators and governments.

The Covid-19 crisis is also influencing the path for **clean energy transitions**. Global CO₂ emissions are set for the largest year-to-year reduction on record, but a sustainable energy pathway calls for continuous efforts and commitment. The unprecedented decline in emissions in 2020 may only be temporary without structural changes. Recoveries from past crises have caused immediate rebounds in CO₂ emissions, including the highest year-on-year increase on record in 2010.

Governments will play a major role in shaping the energy sector's recovery from the Covid-19 crisis, just as they have long been in the driving seat in orienting energy investment. In particular, the design of economic stimulus packages presents a major opportunity for governments to link economic recovery efforts with clean energy transitions – and steer the energy system onto a more sustainable path. While the clean energy transitions and stimulus discussions are gathering momentum, a co-ordinated policy effort will be needed to harvest its opportunities and lead to a more modern, cleaner and more resilient energy sector for all.

Methodological note

This release is based on data for the first quarter of 2020 (Q1) from numerous sources, using data available as of mid-April 2020. Data is available for around two-third of global primary energy demand.

In general, the data collected includes the latest monthly IEA country data submissions through end-February and end-March when available; other statistical releases from national administrations around the world; and IEA estimates where official data is missing.

Oil demand data by country issues from the recent market data compiled for the latest monthly IEA Oil Market Report, published on 16 April 2020.

Gas demand data has been collected for around half of global gas demand. Data includes information from the EIA for the United States, transmission system operators in Europe, CQPGX for China, PPAC for India, KOGAS for Korea and LNG import data as a proxy for gas demand in several additional countries.

Coal demand data is derived principally from coal power generation information, with available data covering around two-third of global coal demand.

Data collected for renewable energy production in 2020 was combined with 2019 renewable energy capacity additions in over 120 countries.

Daily, weekly and monthly electricity demand and generation data was compiled from several sources, such as the United States EIA hourly data, ENTSO-E hourly data for Europe, latest monthly submission for OECD countries, National Load Dispatch Centre daily data for India, as well as China and Brazil. Collected electricity demand and generation data covers around three-quarters of global electricity demand.

As a result of possible differences in data collection methodologies and data definitions, real-time and daily data may not match the methodologies used for monthly, quarterly or annual data.

Assessment of the change in electricity demand by sector was based on a detailed load curve matching methodology that tracked changes to the profile of electricity use by sector in certain regions, and then adjusted the shares of electricity demand by sector to match the observed load curve during certain weeks of 2020. Total load curves were normalised to remove the weather effect from assessment of the impact by sector.

The impact of the pandemic on GDP due to the contraction of the sectoral outputs is based on a variety of sources. For countries available,⁵ sectoral and economy-wide impacts were derived from OECD analysis: "Evaluating the initial impact of Covid-19 containment measures on economic activity", 27 March 2020. Data for China, India, France, Germany, Italy and the United Kingdom were complemented by the following reports from: CEBR (2020); INSEE (2020); INSTAT (2020); Dorn et al. (2020); and ADB (2020).

The set of countries mentioned above account for a combined share of more than 80% of global GDP. To calculate the world average, the contraction on annual GDP growth for the rest of the world is assumed at 2% per month of containment measures.

⁵ Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Russia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

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