



## Materials, Resources and Sustainability series

Reading time: ~20 minutes

### Coal – yesterday’s commodity, or still an important part of global development?



#### Introduction

This paper is part of a series on **materials and resources**. In this series we ask how we can use risk management approaches, techniques and tools to improve the way we source, develop, use and dispose of the materials, resources and products that power our modern economy, and to support everyone involved in their value chains. The series uses [the United Nations Sustainable Development Goals](#) (the SDGs) as a common thread to discuss diverse sustainability and risk aspects and elements to each subject.



## Coal – nature’s compressed energy binder...

When most of us think of coal, we probably think of a dirty rock, or perhaps images of coal miners, their faces blackened by a hard day’s work “at the coalface” (our use of this phrase in our workplaces literally comes from this industry).

Coal is a combustible sedimentary rock of either black or brownish-black colour, formed as rock strata called coal seams. It is defined as having more than 50 percent by weight, or 70 percent by volume, carbonaceous matter which is produced by the compaction and hardening of plant remains, in the form of peat. The majority of deposits of coal on our planet originate in former wetlands – called coal forests – that covered much of the Earth’s tropical land areas during the late Carboniferous and Permian times (some 250-300 million years ago – carboniferous means “coal-bearing”).

Coal is formed from two main components, as a result of heat and pressure from deep burial underground over millions of years:

1. Carbon-based matter – decayed remains of prehistoric vegetation, which is composed mostly of five elements: carbon, hydrogen, oxygen, nitrogen and sulphur, and
2. Mineral matter – which comes from the ground from which the coal is dug.

Different varieties of coal arise because of differences in the plant material composition (the *coal type*), the degree of coalification (the *coal rank*), and the range of impurities that are present (*coal grade*).<sup>1</sup>

Coal progresses from biomass (newly dead plant matter) through to charcoal (almost pure carbon). Over time, the oxygen and some hydrogen are gradually removed, leaving more and more carbon behind.

### **Brown to Black**

*Lignite*, often referred to as brown coal, is softer than black coal and brown in colour. It is considered the lowest rank of coal due to its relatively low heat content. Lignite / brown coal contains more oxygen and less carbon than black coal and slightly more hydrogen.

Bituminous coal, or black coal, is still relatively soft in comparison to anthracite, containing a tarlike substance called bitumen or asphalt. It is of higher quality than lignite coal (it contains more carbon) but of poorer quality than anthracite. Black coal is usually the result of high pressure being exerted on lignite.

Anthracite, often referred to as hard coal, is a hard compacted type of coal with a sub-metallic lustre to it. It is the highest ranking of coal types, as it has the highest carbon content (typically 92-98% of its composition), the fewest impurities, and the highest energy density.



Typical (approximate) coal composition for “coal types” is described below:

## Coal composition

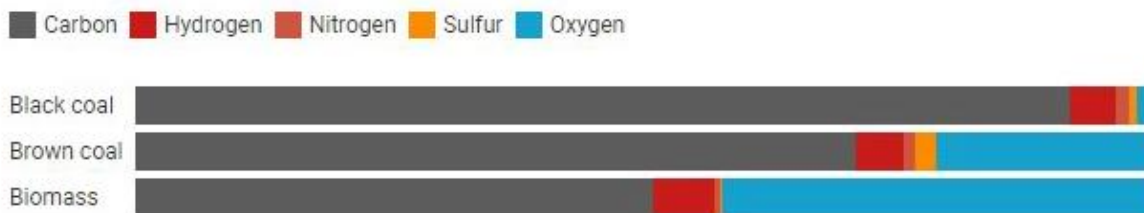


Image credit: [The Conversation](#)

Steam coal (coal that has a grade between bituminous coal and anthracite), also known as thermal coal, is mainly used in power generation. Coking coal (which on heating in absence of air leaves a solid residue), also known as metallurgical coal, is mainly used in steel production.

## Coal in the early ages of civilisation

References to early uses of coal are fairly sparse. Aristotle referred to “bodies which have more of earth than of smoke” and called them “coal-like substances.” (biblical references to coal are to charcoal rather than to the rock we call coal.)

In China, coal was being used commercially long before it was first used in Europe – perhaps as early as 1000 BC. <sup>1</sup>

Roman ruins in England have exposed coal cinders, which suggests that the Romans were familiar with coal before 400 AD. The first known recorded proof of coal being mined in Europe comes from the monk, Reinier of Liège, who wrote in circa 1200 AD of “black earth very similar to charcoal used by metalworkers”. <sup>1</sup>

## Coal comes of age in the Industrial Revolution

Fast forward many centuries, and coal played a pivotal role in the British Industrial Revolution, and the ensuing industrial activity that powered the world. It is thought that in 1700, over 80% of the world’s coal mining was carried out in Britain. As coke, it provided fuel for turning iron ore into iron – and iron was crucial to everything, <sup>3</sup> from The Iron Bridge across the River Severn at Coalbrookdale in 1779, to the industrial machinery that filled the factories that powered the industrial age (and with, it must be said, the widely documented challenges of labour rights and working conditions) and the ships that made the globalisation of the age possible.

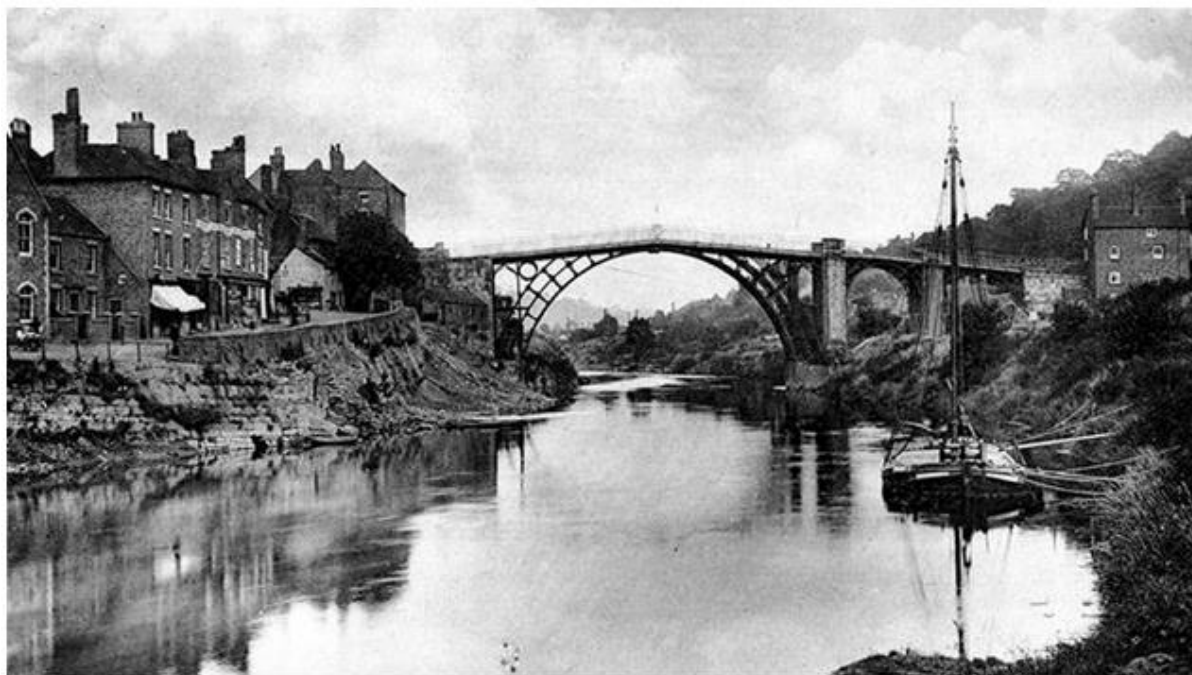


Image credit: [The Iron Bridge](#) of 1779

Coal powered the machinery and what the English poet William Blake described as the “dark satanic mills” that revolutionised the manufacture of cotton. It powered James Watt’s double-acting piston engine and famous locomotives such as The Flying Scotsman. The coal-powered railway locomotives and steamships that were built at this time reduced the time and cost of bringing coal into factories, and transported their products to British export markets across the globe.<sup>3</sup>



Image credit: [Flickr](#)

These new forms of transport also gave rise to exciting adventures for the British population, from which the tourism industry was born.

Coal also fuelled engines that drained water from deeper, less accessible coal mines to maintain the supply of coal. When steel superseded iron in the 19<sup>th</sup> century, coal remained a critical raw material (as indeed it has up to modern times).



Image credit: [Pinterest](#)



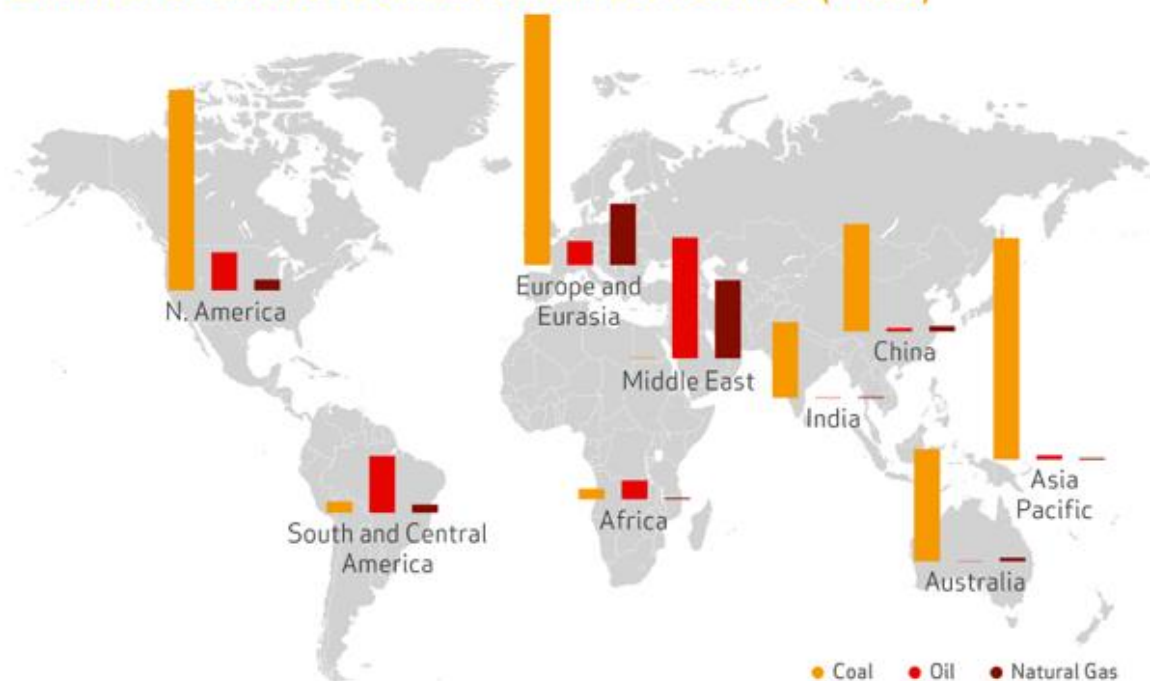
Image credit: [Pinterest](#)



## Coal today

It is estimated that over 90% of the world's total proven coal reserves are located in just ten countries. The US takes top spot with its reserves, with more than 20% of the proven total. In terms of production and consumption of coal, China currently ranks first. <sup>2</sup>

### Location of the world's main fossil fuel reserves (Mtoe)



Source: BP Statistical Review of World Energy 2018 (WCA Analysis)

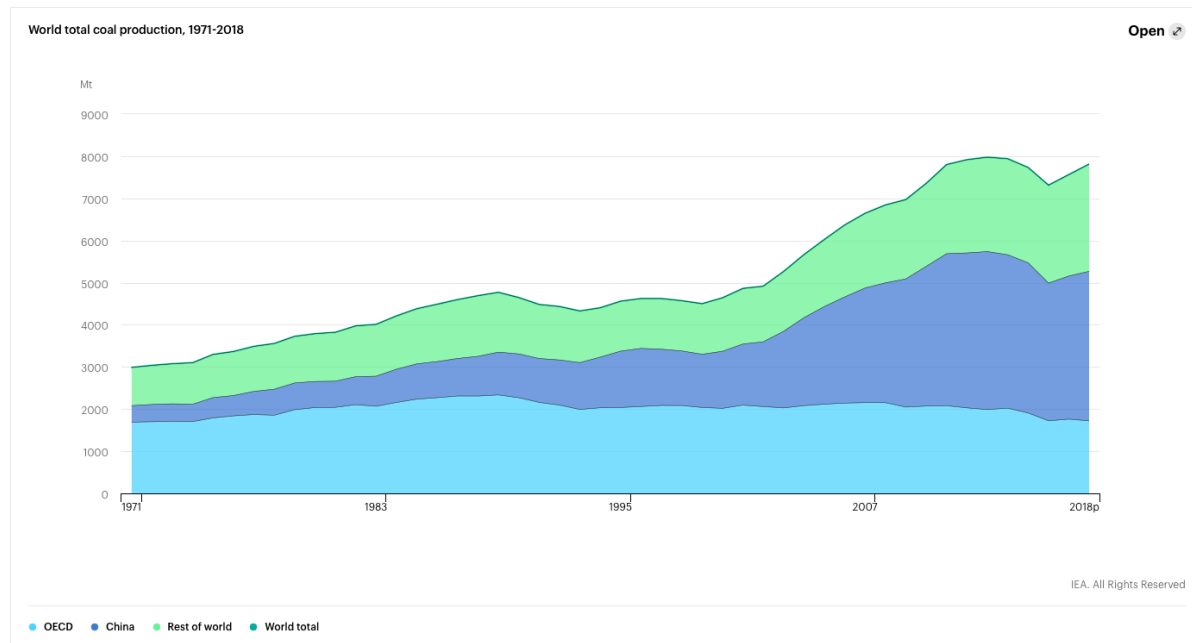
Summary of recorded / stated coal reserves as of December 2018 (Bt = billion tonnes, Mt = million tonnes): <sup>2</sup>

Country & Rank	Proven reserves	% of global reserves	Summary
United States of America	250.2 Bt	Approx. 24%	Montana, Wyoming, Illinois, West Virginia, Kentucky, and Pennsylvania hosting more than three-fourth of the total reserves. World's third-biggest producer (9.3% - 685 Mt) and consumer (8.4%) of coal. 27% of electricity generation.
Russia	160.3 Bt	Approx. 15.2%	Major deposits include the Donetskii reserves in Moscow, the Pechora basins in Western Russia, and the Kuznetski, Kansk-Achinsk, Irkutsk, and South Yakutsk basins in Eastern Russia. Mostly hard coal. World's sixth-biggest producer (420 Mt) and consumer (88 Mt) of coal. Exported 210 Mt in 2018.
Australia	147.3 Bt	Approx. 14%	Black coal mostly in New South Wales & Queensland (95% of output). Brown coal in Victoria.

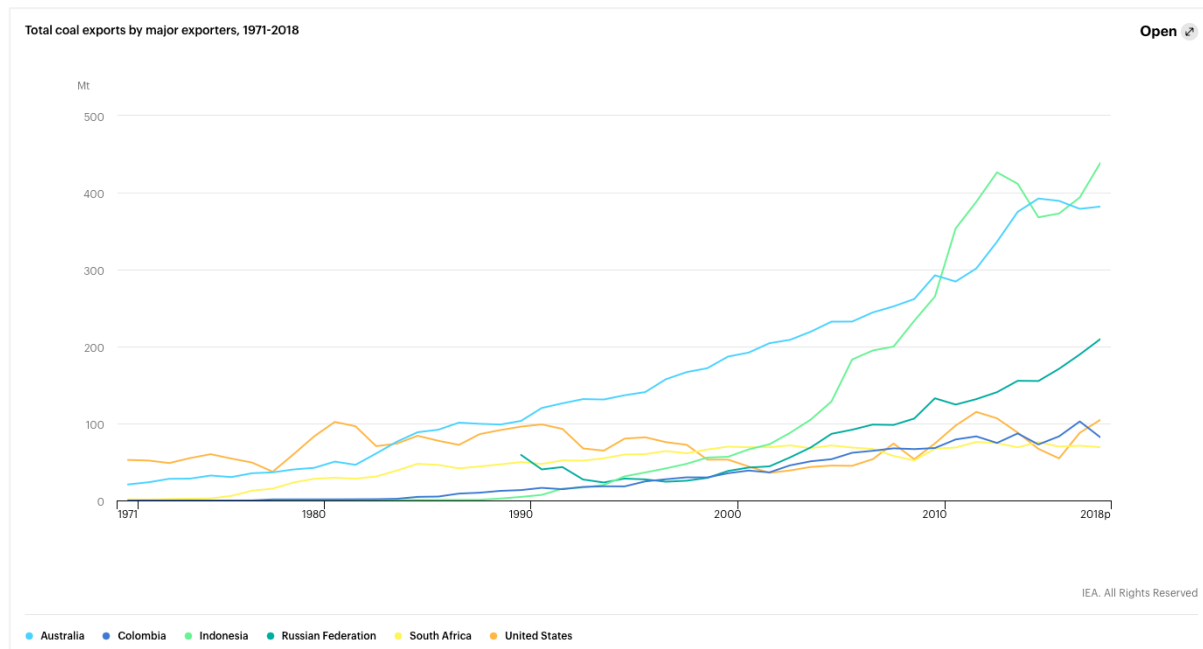
Country & Rank	Proven reserves	% of global reserves	Summary
			World's fifth-biggest producer (483 Mt, 7.7%). Most is exported – 79%, 382 Mt in 2018.
China	138.8 Bt	Approx. 13%	Most in the North and North-west regions (Shanxi and Inner Mongolia). World's biggest producer (3.55 Bt, 46.7% of total) and 50% of global consumption. 70% electricity generation. Imported 295 Mt in 2018, to become the biggest importer.
India	101.3 Bt	Approx. 9%	Eastern states of Jharkhand, Chhattisgarh, Orissa, and West Bengal account for more than 70% of the country's coal reserves. Tamil Nadu in the south hosts most of lignite deposits. World's second-biggest producer (771 Mt, 7.9% of total) and 12% of global consumption. More than 70% electricity generation. Imported 240 Mt in 2018, to become the second-biggest importer.
Indonesia	37 Bt	Approx. 3.5%	Mostly in South Sumatra, East Kalimantan, and South Kalimantan. World's fourth-biggest producer (549 Mt). World's biggest exporter in 2018 (439 Mt). A major supplier to Asian markets.
Germany	36.1 Bt	Approx. 3.4%	Biggest reserves in Europe. Ruhr Coal Basin in the North Rhine-Westphalia state and the Saar Basin in the south-west Germany are more than 75% of hard coal production. Rhineland region hosts the country's largest lignite deposits. Produced 169 Mt in 2018 (1.2% global production). 2.1% of global consumption. 43% of electricity generation in 2018.
Ukraine	34.37 Bt	Approx. 3.3%	Most in in Donets Basin in Eastern Ukraine. Produced 33.29 Mt (0.4%) in 2018.
Poland	26.4 Bt	Approx. 2.5%	Most hard coal in Upper Silesia and in the Lublin basin, eastern Poland, most lignite in the Belchatow basin in central Poland. Produced 122 Mt in 2018 (1.2% global). Europe's second-largest producer, world's ninth-largest. 80% of electricity generation in 2018.
Kazakhstan	25.6 Bt	Approx. 2.4%	Mostly concentrated in three provinces including Karaganda Oblast in Central Kazakhstan and the Pavlodar and Kostanay Oblasts in North Kazakhstan. Produced 114 Mt in 2018 (1.3% global), tenth-largest in world. 1.1% of global consumption in 2018.

## How has our use of coal around the world changed over time?

Whilst in the past few decades coal use has been falling in the West, in the East it has been growing, and it continues to grow. <sup>14</sup>



Source: [the IEA](#)

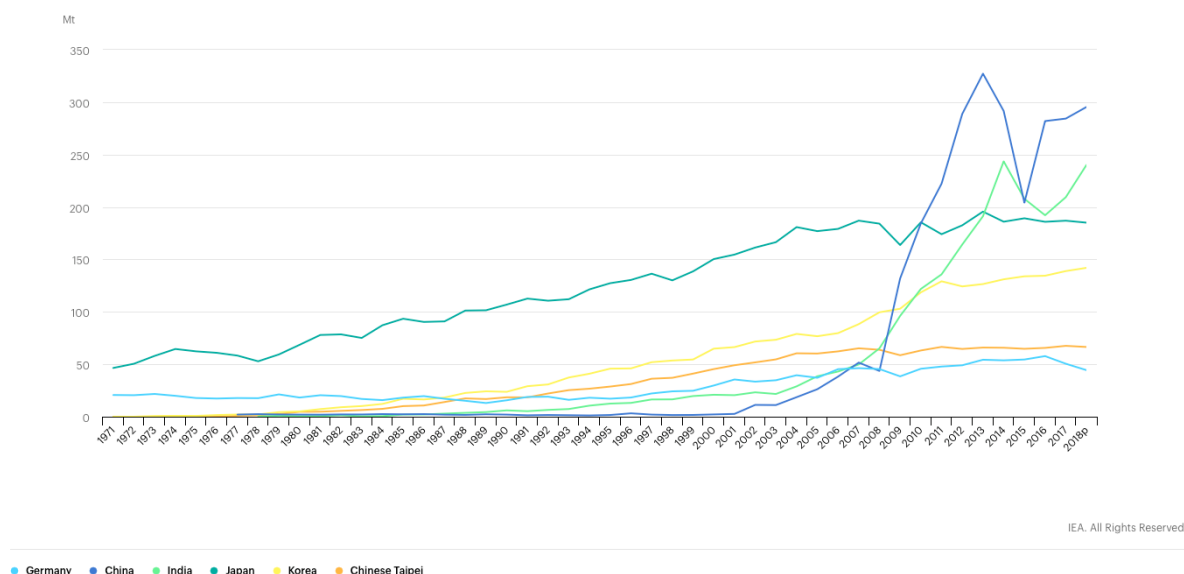


Source: [the IEA](#)



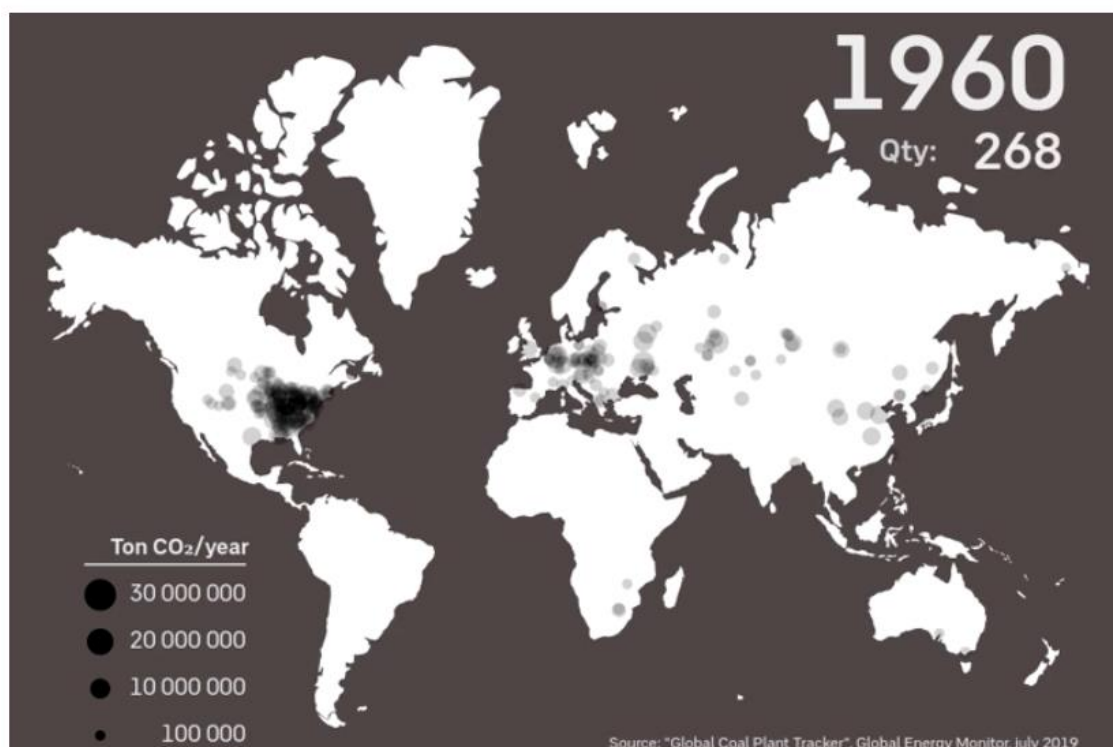
Total coal imports by major importers, 1971-2018

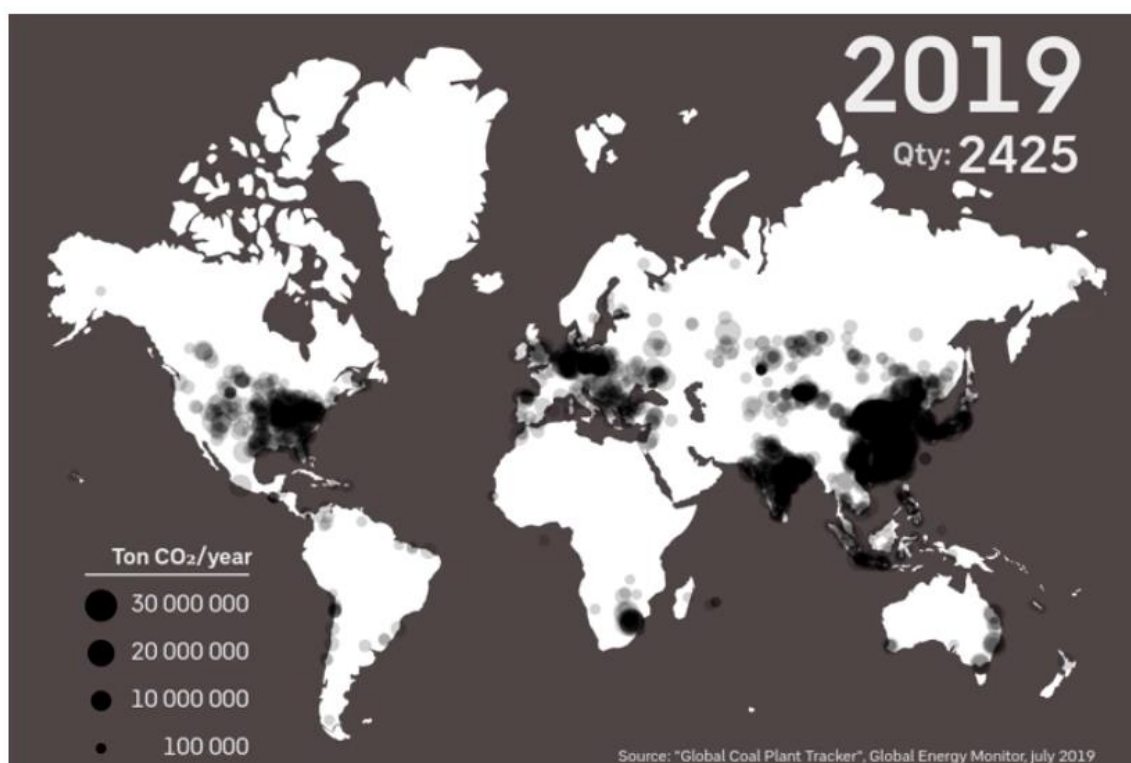
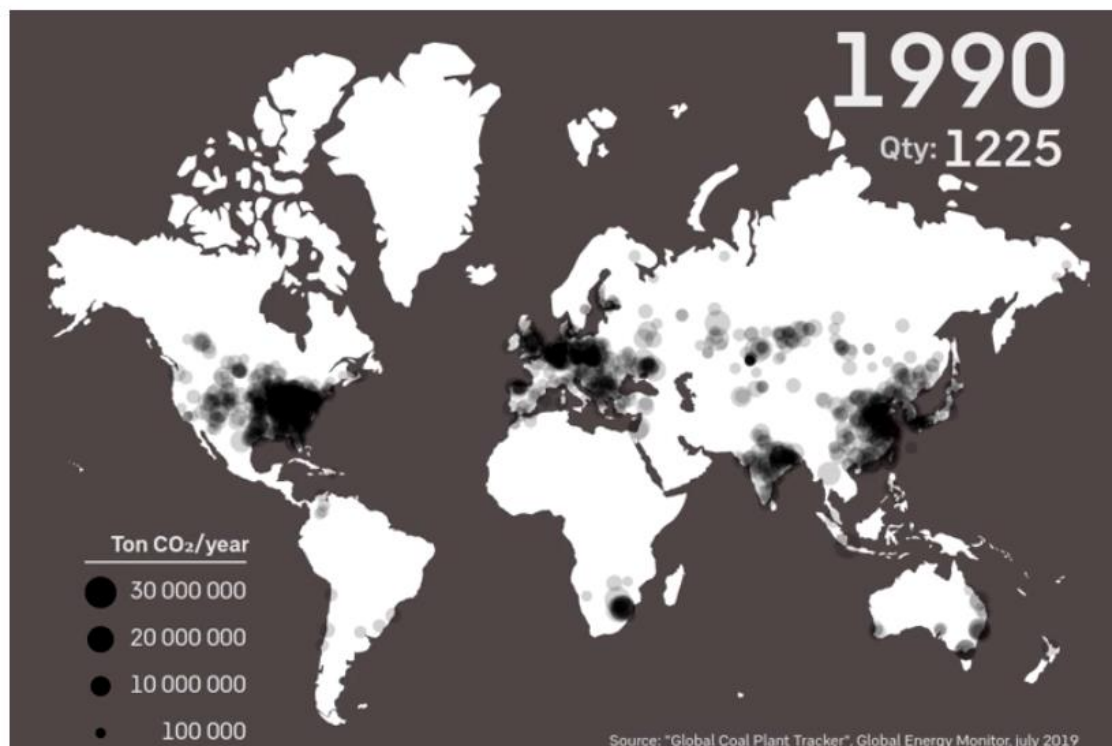
Open 



Source: [the IEA](#)

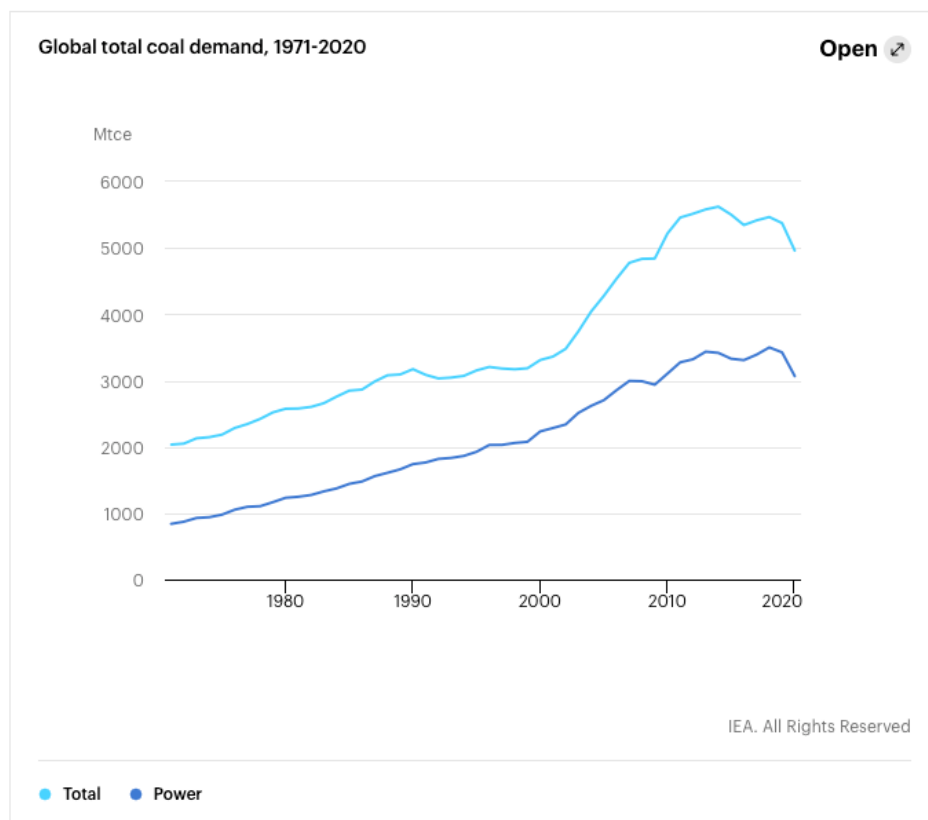
The number, and concentration, of coal power plants around the world has changed markedly over the past 60 years: <sup>4</sup>



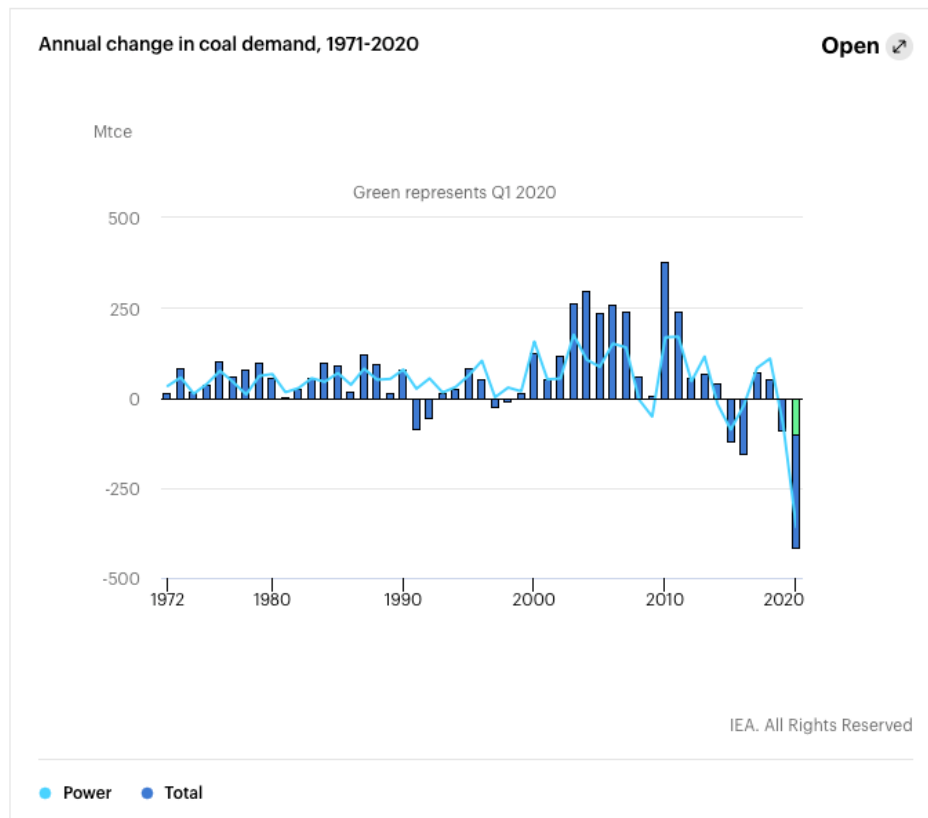


Images credit: [Visual Capitalist](#)

The rise of coal plants in Asia over the past few decades is clear to see. The International Energy Agency (IEA) thinks that global coal demand may fall by about 8% in 2020, which would represent the largest drop since World War II. <sup>5</sup>



Source: [the IEA](#)



Source: [the IEA](#)



The IEA believes that, out of all fuel types, coal faces the greatest uncertainty in the energy outlook. The primary reason for this uncertainty is that its use is concentrated in the power sector, and in particular electricity demand – and cost-effective, greener energy sources for electricity are changing the landscape of options available to us.

Across the world, including in China and India – two countries where coal is still dominant – the use of coal for power generation is being challenged by cost-competitive low-carbon options.

Renewable energy sources of hydro, wind, solar, plus also nuclear power, have been less impacted by the COVID-19 global crisis than coal. Changes in economic activity and electricity demand are proving to have an outsized effect on coal-fired electricity generation and overall coal consumption – and this has major implications for the future of power generation. <sup>5</sup> Nonetheless, coal-fired power stations are still active, and more are planned in certain parts of the world, particularly in Asia.

Here is a brief recap from around the world.

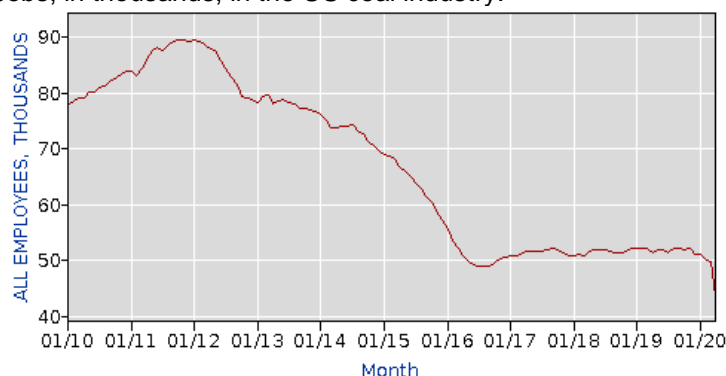
### The United States

In the US, the government believes that in 2020 more electricity will be generated this year from renewable power than from coal, for the first time on record. <sup>9, 10</sup> Whilst the demand for coal was already falling, the situation caused by COVID-19 has accelerated it. Even if coal demand surprises and beats the analysts' expectations to rebound in demand, experts say that the shift in the nation's electricity system away from coal is unlikely to change track.

In mid-2020 it was reported that jobs in the US coal industry are being lost at the fastest rate in decades, as the use of coal is increasingly crowded out of an electricity market that, in the first half of 2020, shrank because of the COVID-19 pandemic. <sup>6</sup> Many analysts think that COVID-19 will accelerate the decline of the coal industry in the country. <sup>6</sup>

In specific numbers, the number of coal mining jobs in the US fell by 12 per cent to 43,800 in April 2020, as reported by the US labour department. <sup>6</sup> The situation is being felt across all the major coal districts of Kentucky, West Virginia and Wyoming.

Jobs, in thousands, in the US coal industry:



Source: [US Bureau of Statistics](https://www.bls.gov/news.release/archives/mining_031920.pdf)

## Europe

Across Europe, a reduction in coal use has been underway for some time.

It was in 1882 that the world's first coal-fired public-use power station opened in London at 57 Holborn Viaduct. Move forward to the 1960s, and the coal industry employed more than 600,000 people in the UK. Then 135 years later, on 20 April 2017 the UK had its first coal-free day of power.<sup>8</sup> In 2019, it went a fortnight without using coal power for the first time.<sup>11</sup> In April, May and June 2020, new records for clean energy have been set as the combination of sun and wind, and low electricity demand, has led to a new level of use of renewable power in the UK.<sup>7</sup> This is in the midst of setting a new record for the longest period the national electricity grid has ever operated without coal. For two months and counting as of 10 June 2020, the last coal generator in Britain came off the system at midnight on 9 April – no coal has been burnt for electricity in the two months that followed.<sup>36</sup>

Legislation in the UK to encourage energy sources other than coal has played its part. For example, no new coal plants can be constructed without expensive carbon capture and storage technology being included.<sup>11</sup>

Some countries in Europe still use a large amount of coal. Poland burns the most hard coal in the EU, and is second to Germany in burning lignite (the most polluting grade of coal). Almost 80 per cent of Polish electricity is still generated from coal. The “hard black fuel” has powered Poland’s industrialisation and, for decades, the miners who dug it up were lionised as the vanguard of economic progress.<sup>12</sup>

However, Poland’s coal reserves are falling, and today Polish people worry more about dirty air and a polluted countryside. Questions are being raised over a fuel that is seen as an environmental curse and, in recent years, an economic burden.<sup>12</sup> The sector has been caught up in the COVID-19 pandemic, too. In June, twelve coal mines were closed as infections at these sites hampered the country’s attempts to limit the spread of COVID-19.<sup>37</sup>

Germany is an interesting case. The country shut down its last black coal mine in 2018. Black coal mines that date back to the 1870’s once fired the furnaces that made Germany the economic powerhouse of Europe.

But the times are changing. Some coal mines have been, and others are also being converted to museums and heritage sites, with the involvement of former miners to show tourists how life once was in Germany’s western industrial heartland.

In contrast to other developed economies such as Australia, which are expanding coal exports and building new mines, Europe’s biggest economy is phasing out its entire coal industry for good.

Having stopped its use of black coal, Germany is also phasing out brown coal – the cheaper, dirtier fossil fuel that has even higher carbon emissions.

The government in Berlin has announced a timetable to close by 2038 not only every remaining brown coal mine but also all the carbon-emitting power plants that burn coal to make electricity.

In a landmark deal, trade unions, energy companies, green groups and government have all agreed that the coal industry must go. The Government is investing in the country's coal regions to create new jobs and industries. Miners in Germany have been offered new jobs or early retirement as a centuries-old way of life came to a sudden end in the country.

Today, renewables in Germany are much more prevalent. For example, in February 2020 renewable production overtook non-renewable production for the first time providing 56.2% of the total electricity production, or 28.1 TWh (wind was the primary electricity source).

Elsewhere in Europe, in April 2020 Sweden closed its last coal-fired power plant, KVV6 in Hjorthagen, eastern Stockholm, two years earlier than planned, partly because the last mild winter meant it was not used (even before COVID-19 struck). Austria has gone ahead with the shutdown of its only remaining coal plant at Mellach. The Netherlands has stated that it would reduce the capacity of its thermal coal plants by 75% to comply with a court order to reduce climate risks.<sup>17</sup>

## Australia

In Australia change can often take time to occur. The coal industry is an example of this. As covered earlier, Australia is a major producer of coal, and in 2018 it was the second-largest exporter, particularly to China and India. Its exports of high quality coking coal, which is used to make steel, are particularly high when compared to the coal exports of other countries.<sup>22</sup>

Whilst many developed economies are phasing out their mining and use of coal, Australia is pressing ahead with new coal mines and exporting its coal abroad, especially the coking coal variety.

Major projects such as the Adani coal mine and the Valeria coal mine, both in Queensland, continue to progress. Whilst they face various challenges<sup>38, 39</sup>, they are still proceeding (job creation being cited by those backing them).<sup>45</sup>

Whilst Australia is a land rich in renewable energy potential, for which the federal government has launched a new initiative, the exporting of coal continues, and coal seam gas projects continue as well.<sup>40</sup>

However, changes in the geopolitical landscape could lead to a shift in Australia's coal exports. China, for example, may start to restrict imports from overseas as it tries to use more local energy sources (including renewables).<sup>13</sup>



## Asia

Asia is a major driver behind the use of coal today, and it will be a key influencer on its use in future.

Between 2008 and 2016, Japan, China and South Korea exported more than 130 gigawatts of thermal coal power capacity – which is the equivalent of the entire generation capacity of France. They have continued to export high-polluting coal technology to fast-growing economies in south-east Asia.<sup>15</sup> However, things are changing.

In Japan, the big three commercial lenders in the country and the governor of the Japan Bank of International Cooperation have recently said they will no longer accept proposals for coal generation.<sup>17</sup>

In South Korea, the party of president Moon Jae-in was re-elected in 2020 partly on a pledge to phase out domestic coal use, and many in the ruling coalition are pushing to end financing of overseas projects.<sup>17</sup> However, it is not a simple matter: the government is pursuing a US\$2 billion bailout of the country's biggest coal plant manufacturer, Doosan Heavy Industries & Construction, despite its promises to end coal financing.<sup>41</sup>

What about China? A big question people want to know the answer to is: will China continue to use coal in vast quantities, and continue to both operate and build new coal power plants?

As of mid-2020 more than half of the world's coal is consumed in China. The COVID-19 outbreak triggered a 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.<sup>5</sup>

In April 2020, it was thought by the IEA that China's coal demand could decline in 2020 by approx. 5%, despite a gradual recovery from March onwards. Coal-fired power generation has been forecast to decline, because of the availability of low variable cost hydro, wind, solar and nuclear power. If a more favourable dispatch for coal power plants is established, this might offer some relief for coal power producers.<sup>5</sup>

However, it has been reported in June 2020 that China's approvals for new coal power plant capacity expanded at the fastest rate since 2015, perhaps in a sign that to stimulate their economy as the country deals with COVID-19, the State feels that it is a necessary action to take.<sup>46</sup>

According to Carbon Brief, a UK-based group that monitors developments in climate science, climate policy and energy policy, China's 14<sup>th</sup> five-year plan (FYP), setting out the national goals for 2021-2025, will arguably be one of the world's most important documents for global efforts to tackle climate change.<sup>15</sup>

The overarching 14<sup>th</sup> five-year plan for economic and social development in China is to be finalised and approved in early 2021, followed by more detailed sectoral targets over the next year. A power sector plan can be expected in late 2021 – early 2022. <sup>15</sup>

It is thought that China is starting to change its approach to the financing of coal projects, including how “green bond financing” is used for so-called “clean coal projects”, but there is still more to be done before green bond financing in China has the same approach to that taken in western democracies.

India is the other “big player” in the Asia region, and currently the world’s second-biggest consumer of coal. Electricity demand and industrial production in the country declined significantly in late March 2020, which may lead to a further decline in India’s coal use in Q1 2020, following the reduction already seen in 2019. <sup>5</sup>

The Indian government has recently started to prioritise solar energy, which has fallen in price, in response to the drop in electricity demand in 2020. This has led to the first year-on-year fall in carbon emissions in India in four decades, improved air quality, and a growing public clamour for more renewables to be used. <sup>17, 44</sup>

Elsewhere in Asia, the picture is mixed. Indonesia, as described earlier, was in 2018 the world’s largest exporter of coal. A few years ago, Indonesia, along with Vietnam and the Philippines, were anticipated to be the industry’s biggest growth areas. However, as a result of the COVID-19 pandemic, the drop in renewable energy prices and a growing divestment campaign, several major coal projects have been put on hold (you can see details of coal-fired generating units in the Global Coal Plant Tracker, details of which are provided at the end of this paper).

## South America

In South America, Brazil, Chile and Colombia are the main consumers of coal. It is not a part of the world that is a major producer or consumer, due to other energy sources that it has available (chiefly, oil – another source of carbon emissions).

## South Africa

Coal in South Africa is at a crossroads. The government’s Integrated Resource Plan has helped to clarify the future of the country’s energy sector, but uncertainties remain over the coal industry. These include the financial difficulties of the electricity utility Eskom, changes in coal mine ownership, and the move from Mpumalanga, the country’s coal-mining heartland, to other areas. The IEA believes that South Africa’s demand, production and exports will remain stable through to 2024, but the factors mentioned above could change this projection. <sup>22</sup>

## Coal and the impact of COVID-19

This paper has already mentioned the impact that COVID-19 is having on the global energy market.

The International Energy Agency has said that the outbreak of COVID-19 would have a drastic impact on fossil fuels by prompting a collapse in energy demand seven times greater than the slump caused by the global financial crisis. <sup>42</sup> In April 2020, Fatih Birol, the IEA's executive director, said: "The plunge in demand for nearly all major fuels is staggering, especially for coal, oil and gas. Only renewables are holding up during the previously unheard of slump in electricity use." <sup>42</sup>

Renewable energy may grow by 5% in 2020, to constitute almost 30% of the world's demand for electricity (which has shrunk in 2020 due to the economic effects of the pandemic). The growth of renewables despite the global crisis could lead to fossil fuel companies moving more quickly towards their goals to generate more clean energy. Such moves will need to be linked to the way that governments make clean energy central to their economic stimulus packages, to ensure a "green recovery". <sup>42</sup>

## Looking at coal with the SDGs

Our production and use of coal can be examined through the lenses of the SDGs. The SDGs help to provide a balanced view of our use of coal, and how to ensure a measured approach to energy policy can be taken.





## 1. No Poverty

It has to be recognised that coal is still a major employer in developing parts of the world. The previous section showed how coal is still a major component of the energy sector across Asia in particular. It still plays a key part in industries such as cement production and steelmaking, and it is still a major employer in many developing countries, directly and indirectly.

## 3. Good Health & Wellbeing

Coal is a polluting substance when burned, and contributes towards poor health and therefore wellbeing. It is hard to argue that coal is good for our health and wellbeing.

## 7. Affordable and Clean Energy

Whilst coal is currently affordable as an energy source, it is not a clean energy. Cleaner energy alternatives exist, and they are increasingly price-competitive with forms of energy such as coal.

## 8. Decent Work & Economic Growth

Whilst the coal industry continues to provide work in many parts of the world, whether it is “decent work” in various parts of the world is questionable. Its value to economic growth is increasingly under question, as cleaner alternatives that are cost-effective are proving to be better options.

Coal currently “powers” two important industries that in turn power other industries, our cities and infrastructure – the steel industry and the cement industry. Whilst there are moves afoot to find cost-effective alternatives to coal, it is still the incumbent fuel source behind them both.

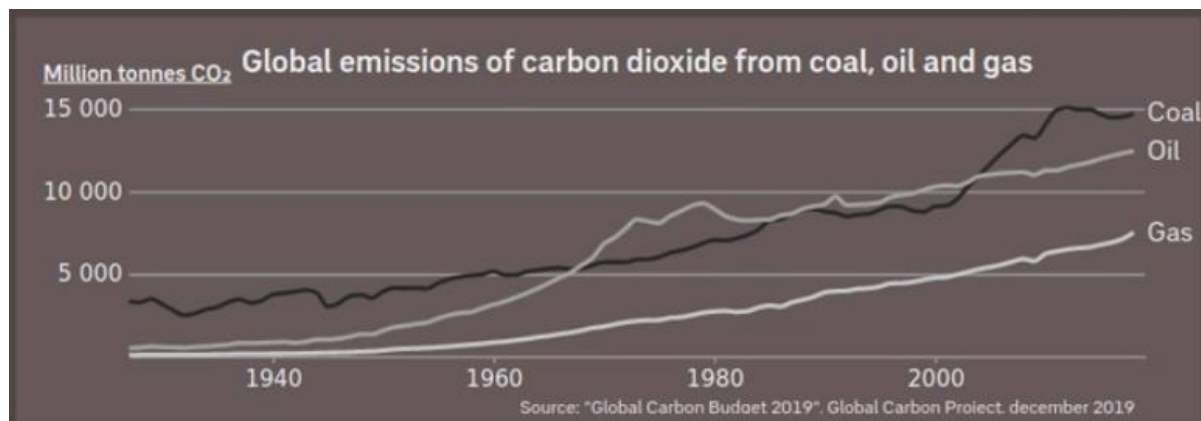
## 9. Industry Innovation & Infrastructure

Innovation and development in the coal industry is low in comparison to other forms of energy. The industry has been in existence for a long time, and much of the infrastructure is ageing.

However, it should be noted that some governments and businesses around the world are looking at innovation towards lowering emissions of coal mining, and use.

## 12. Responsible Consumption & Production

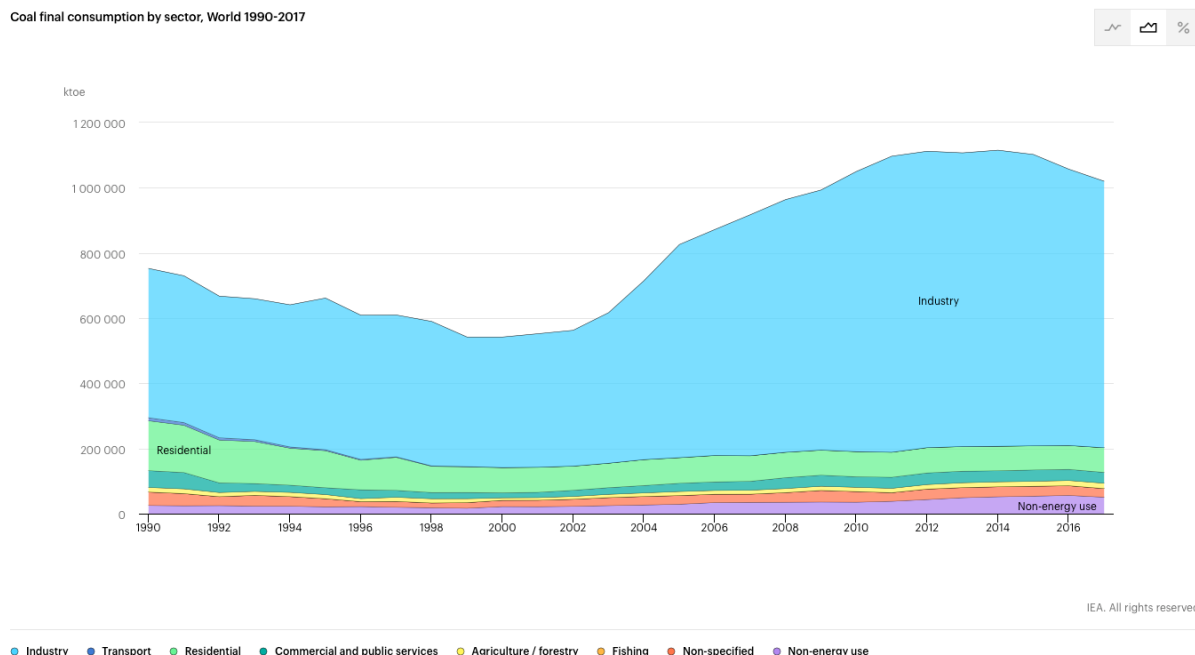
Our global use of coal, and the CO<sub>2</sub> emissions it has been responsible for, has continued to increase until very recently.



Images credit: [Visual Capitalist](#)

As this graph from the IEA shows, industry is the primary user of coal today (across different sectors):

Coal final consumption by sector, World 1990-2017



Source: [the IEA](#)

### 13. Climate Action

It is common knowledge that coal has a major impact on the climate. The environmental impact of the industry continues to impact land use, waste management and water and air pollution. In addition to atmospheric pollution, coal burning produces hundreds of millions of tons of solid waste products annually, including fly ash, bottom ash, and flue-gas de-sulfurisation sludge, that contain mercury, uranium, thorium, arsenic, and other heavy metals. Coal is the largest contributor to the human-made increase of CO<sub>2</sub> in the atmosphere today.

## **What are the positions of different groups towards coal?**

### **The general public**

Many people around the world recognise that coal is a polluting energy source and that it is responsible for much of the carbon emissions that have contributed towards global warming.

Our collective appreciation of the possibilities of renewable energy and the need for sustainable energy solutions that help us to put a stop to climate change continues to drive change.

That said, it has to be recognised that it still provides employment in various parts of the world.

### **Governments and international public policy**

As mentioned earlier in the paper, governments around the world are increasingly proactive in pursuing strategies and policies to phase out the use of coal. Governments need to focus on ensuring an overall regulatory framework is sensible, which includes agreeing a sensible price for carbon.

### **NGOs, Environmental campaigners and Not for Profit Foundations**

There is no doubt that many climate change activists around the world are targeting coal as an example of an industry that needs to be brought to a halt. Campaigners such as End Coal and Greenpeace are very vocal in their campaigns to bring an end to coal use.

### **Academic Research and Scientists**

The global scientific community has played a major role in showing the impact of carbon emissions to global warming, and the contribution towards these emissions by coal. Equally, they are driving lots of developments towards cost-competitive renewable energy solutions.

### **Financiers and Investors**

From an investor standpoint, more and more investors want to see evidence of well-thought-out plans to reduce carbon emissions. There have been some major announcements, about global investors that are selling out of businesses involved in coal.

As an example of investment fund strategic change, Norway's US\$1 trillion Norges Bank Investment Management, the world's largest sovereign wealth fund, has introduced criteria to stop investment in companies that extract more than 20m tonnes of thermal coal or use more than 10,000 MW of power from coal.

As a result, the fund has sold out of some of the biggest names in commodities and utilities after they decided they breached its guidelines on the use of coal. <sup>18</sup>

Blackrock, the world's largest funds manager with \$US1.8 trillion in assets it actively manages, announced in early 2020 that it will no longer invest in companies that generate more than 25 per cent of their revenue from thermal coal production. <sup>25</sup> BlackRock's alternative investments business will make no new direct investments in companies that fall under the same criteria (this generally excludes most large mining firms).

The major French bank BNP Paribas announced in February 2020 that it has expanded its target to end the use of coal by its electricity-producing customers by the end of 2030 to all OECD countries. BNP Paribas has confirmed a strengthening of its coal divestment strategy, setting forward the target date for ending the use of coal power by its electricity generating customers in multiple countries.

The bank is known as a leader in sustainable investment, and has focused on funding criteria for coal-related activities since 2011, particularly the generation of electricity using coal. It has not financed a single new coal-fired power-plant project anywhere in the world since 2017, and does not advise on the purchase or sale of such assets. <sup>28</sup>

Insurers are looking hard at whether to support coal projects, as they face pressure to support sustainable energy resources and to ensure their Taskforce for Climate-related Financial Disclosures (TCFD) are seen by their stakeholders as being acceptable. <sup>38</sup>

## Coal industry associations and producers

The World Coal Association (WCA) states that coal plays a vital role in meeting global energy needs and is critical to infrastructure development – it states that 38% of the world's electricity and 71% of the world's steel is produced using coal. <sup>19</sup>

WCA held its first event focusing on coal and the SDGs in London on 31 October 2017. They brought together a range of stakeholders for a one-day event to discuss the role of coal in four of the SDGs – affordable and clean energy (7), decent work and economic growth (8), industry innovation and infrastructure (9) and climate change (13). They state that a key aim was to challenge the industry about the future it can map for itself in a new global context. <sup>20</sup>

WCA has reported that it also held a series of roundtables in 2018 to build up its understanding of the issues and opportunities around coal and the SDGs. <sup>20</sup>



## Heavy industry

Businesses in heavy industry are responsible for the majority of coal use today.

The mining industry of course digs up the types of coal described at the start of this paper. Different mining companies have different footprints in terms of their mining operations for coal.

The following sub-section focuses on three large industry consumers of coal today – the energy sector, the cement industry and the steelmaking industry.

### The energy industry

Energy companies are facing challenging times as they respond to the changing demand for energy, and changes in government policies as the world adjusts its energy priorities following the COVID-19 pandemic. As this paper has highlighted earlier, the use of coal in the energy sector is changing in the face of renewable energy sources that are increasingly cost competitive.

There are moves by some energy companies that still use coal to make better, if not perfect, use of it. For example, some coal power stations in Australia are looking to use coal gasification to create “blue hydrogen” (classified as blue because of using a Carbon Capture System, or CCS), to become a supplier of hydrogen to Japan, as that country seeks to use hydrogen as a key energy carrier. As the associated Risk Insight Consulting Paper on hydrogen explains, whilst this is not the green hydrogen that we all want to move towards, any hydrogen-making facility that uses coal in Australia will be required to be equipped with a Carbon Capture System, so that no carbon emissions make their way into the atmosphere.<sup>29, 30</sup>

### The cement industry

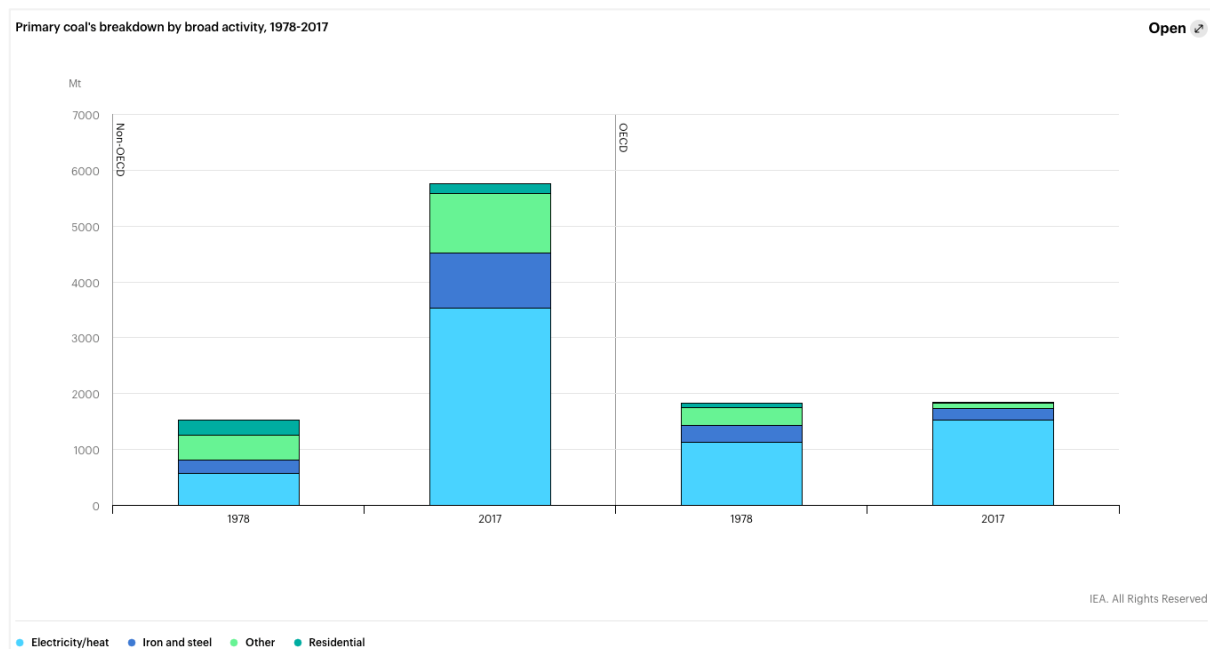
Coal fuels today’s cement production. Large amounts of energy are required to produce cement (which is described in a separate Risk Insight Consulting paper, on concrete). Approximately 200-450 kg of coal is required to produce one tonne of cement (for context, about 300-400 kg of cement is typically used to produce one cubic metre of concrete).<sup>21</sup>

Coal combustion products (CCPs) such as Fly Ash play an important role in cement manufacture and other materials in the construction industry.<sup>23</sup> Whilst there are replacement fuel sources instead of coal for cement production, they are not large in numbers at the moment.<sup>26</sup>

Traditionally, coal has been used in the production of cement due to its high heating value, good composition, favourable radiative heat transfer characteristics, and relatively low cost. Although some cement plants have started to use less carbon intensive fuels, such as waste streams and biomass, coal is still the most dominant fuel used in cement production.<sup>27</sup>

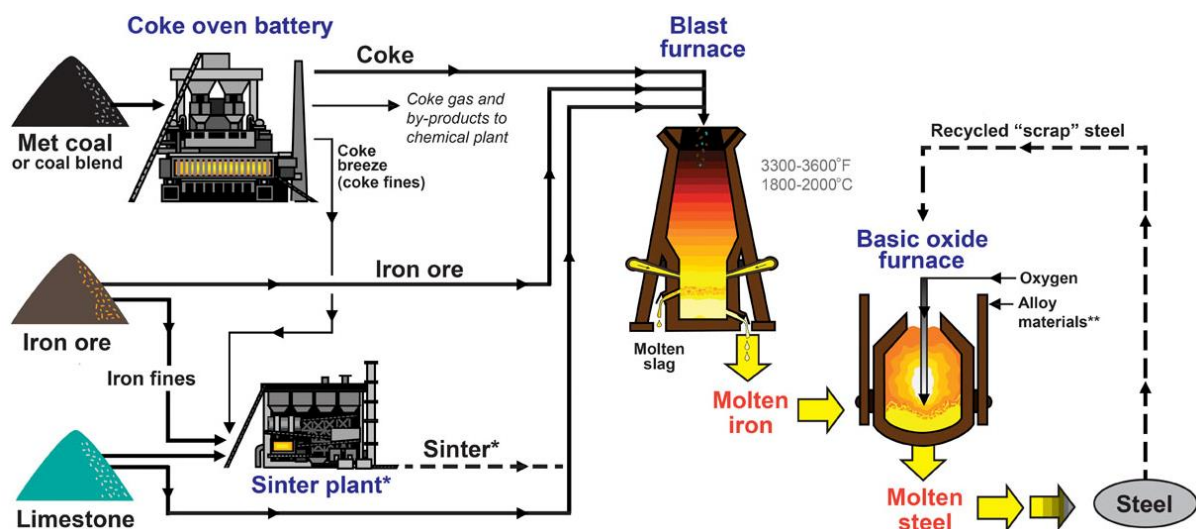
## Steel production – trials of new energy sources by ArcelorMittal, Thyssenkrupp, SSAB and Baowu

Steelmaking consumes a large proportion of industrial coal use. It is estimated to account for approximately 13% of coal consumption globally. <sup>24</sup>



Source: [the IEA](https://www.iea.org/)

Steel producers use metallurgical, or coking coal in steel production to make coke. Coke is produced by heating coking coals in a coke oven in a reducing atmosphere. As the temperature of the coal increases it becomes plastic, fusing together and then resolidifying into coke particles. This is known as the caking process. The quality of the resultant coke is determined by the qualities of the coking coals used, as well as the coke plant operating conditions.



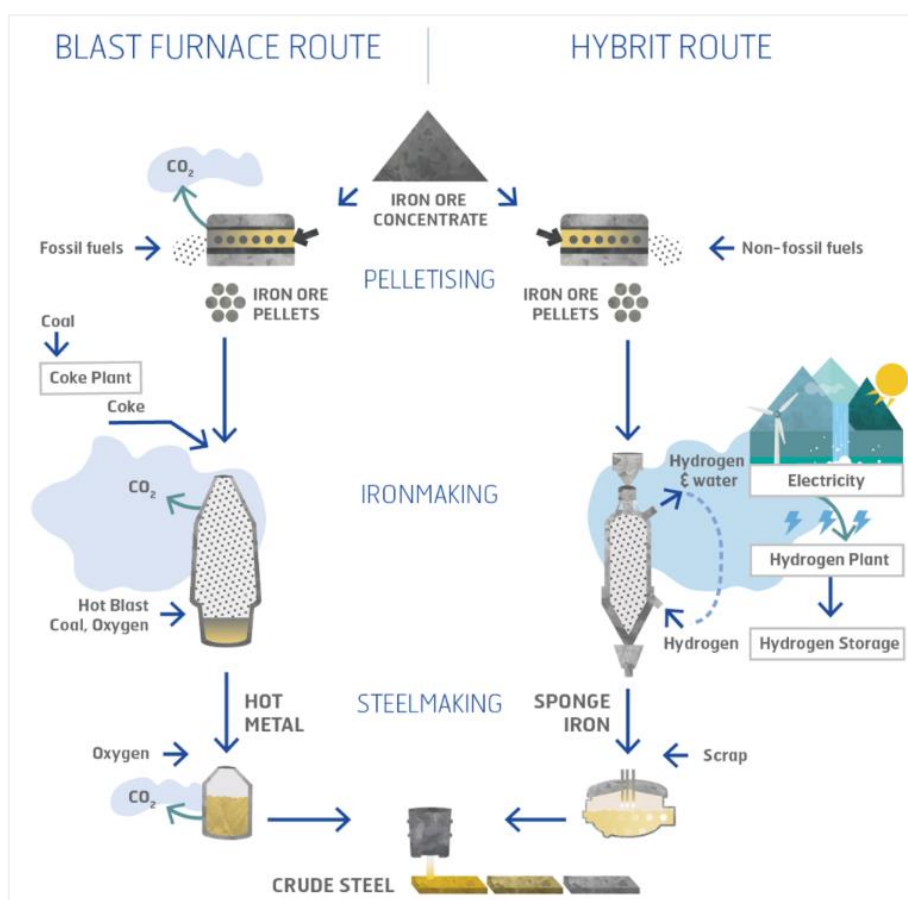
Source: [Kentucky Geological Survey](https://www.kgs.uky.edu/)

Steel producers require high quality coking coal to produce high quality coke in order to maximise the productivity of their blast furnace operations.

Iron is extracted from its ore in blast furnaces at temperatures of up to 1,200C using coke. One of the by-products of this process is carbon dioxide. The World Steel Association says that, as an average, for each tonne of steel produced 1.83 tonnes of CO<sub>2</sub> are produced using coke.<sup>31</sup>

Many steel producers are looking at ways to use greener sources of energy to replace coking coal – but it remains dominant in the process today, and facilities are set up to use it, which would require large-scale investment to change.

Various new methods are being trialled to change the steel production process to move away from using coal.<sup>34, 35</sup> As described in a separate Risk Insight Consulting paper on hydrogen, trials are being carried out to replace coking coal in the steel production process with hydrogen. Instead of heating iron ore and coking coal in blast furnaces, steel can be produced through a process called the Direct Reduced Iron (DRI) method, using hydrogen as a reductant. It is hoped that new production process using hydrogen could have a big impact in lowering the industry's carbon emissions. By replacing coke with hydrogen, the main by-product of steelmaking is water rather than CO<sub>2</sub>.



Source: [Hybrit](#)

The world's largest steel producer, ArcelorMittal, is working on a demonstration plant in Hamburg with Midrex Technologies for the large-scale production and use of Direct Reduced Iron (DRI) made with 100% hydrogen as the reductant, in place of coking coal. <sup>32</sup> In the coming years, it is expected that this demonstration plant will produce about 100,000 tons of direct reduced iron per year. Energy for hydrogen production to power the steelmaking could come from wind farms off the coast of Northern Germany. <sup>32</sup> The economics, however, may take some time to be realised.

Also in Germany, in November 2019 Thyssenkrupp completed a successful, first-of-its-kind demonstration of running a steel furnace completely on hydrogen. <sup>47</sup>

In another example, Svenskt Stål AB (Swedish Steel, or SSAB), which is headquartered in Sweden and partly owned by the government of Finland, announced in January 2020 that it would be making substantial investments to accelerate the transition of its steel furnaces to use emissions-free, renewable hydrogen. <sup>33</sup>

The Chinese steelmaker, Baowu, is also investigating the DRI process and is investing in research and development towards it. <sup>32</sup>



## What can Risk and Operations teams in various industries do?

Risk Managers and Risk Advisors in all organisations can play a valuable role in working out how they can achieve their sustainability objectives, and how to take and manage risks to do so. Sustainability is business-critical today – from investors that are demanding to see strategies are in place, to employees who want to work for a business that demonstrates purpose. Risk professionals can be trusted advisors who can help people to achieve objectives, using risk-informed decision-making and risk tools and techniques to work out which risks (opportunities) to take and which risks (threats) need to be managed.

With regard to any organisation's direct or indirect use of coal, Risk Managers and Risk teams can work with their colleagues in Sustainability and Operations to think through how, for their organisation's particular circumstances, they should approach their situation. Perhaps there are specific opportunities for an organisation to procure energy and products from organisations that are minimising their use of coal, and if they are using coal, that it is being used responsibly. Using good Risk tools and thinking carefully through your options can help you to work out what is most feasible and impactful to you, now and in future.

Consideration	Ideas and thoughts for consideration
1. What exactly do you do, and do you know what your energy sources are?	<ul style="list-style-type: none"> <li>• What do you design and / or produce, and how much energy do you use in your business processes?</li> <li>• Do you know how much of your energy is derived from coal?</li> <li>• Whether you produce physical assets or information-based assets, what can you do to ensure your consumption of energy uses cost-effective sustainable sources?</li> <li>• In your use of energy, are you asking your suppliers about their use of coal, and what their energy policies and strategies are?</li> <li>• For the products that you use and / or procure, do you know how much energy from coal is used to make them (such as the examples provided for steelmaking and cement)?</li> </ul>
2. Do you have the opportunity to be involved in any research?	<ul style="list-style-type: none"> <li>• If applicable, are there opportunities for you to be involved in industry-specific or cross-industry research into responsible energy?</li> </ul>
3. What does your supply chain look like?	<ul style="list-style-type: none"> <li>• In our modern world, we have spent many years honing our supply chains to be as real-time and efficient as possible. However, we do not always look at how our supply chain uses energy to produce what they supply us with.</li> </ul>

Consideration	Ideas and thoughts for consideration
	<ul style="list-style-type: none"> <li>Do you know if parts of your supply chain are using coal in their energy, and if so, how?</li> </ul>
4. Where do you operate in the world?	<ul style="list-style-type: none"> <li>If you operate in developed economies, many of them will already be investing in ways to reduce their reliance on coal.</li> <li>If you operate in fast-growing emerging economies (for example, Asia, Africa and India), how can you play a part in helping people and businesses to think through how to ensure sustainable energy sources as used, and reducing their reliance on coal?</li> </ul>
5. Do you know your investor expectations, for sustainability of businesses they invest in?	<ul style="list-style-type: none"> <li>Do your investors have expectations about your energy footprint?</li> <li>Are any of them talking about minimising the use of coal, and can you help them in demonstrating this?</li> <li>Are you engaging with them in how your green energy solutions could benefit their investment funds?</li> </ul>
6. Sustainability reporting	<ul style="list-style-type: none"> <li>Can your sustainability reporting and your sustainability commitments include a “position” on coal use?</li> </ul>

## Conclusion

This paper has discussed how the use of coal is changing across the world. Much of the world seems to be weaning itself off this polluting energy source – but Asia is a key region to watch. Other forms of energy to replace coal are demonstrating cost-competitiveness. Industries and businesses need to be clear and honest about their current use of coal, directly or indirectly, and what their path is moving forward. The finance sector can play a key influencing role in encouraging industries to use sustainable energy sources.

Governments around the world play an important role in the judicious use of policy-making to encourage positive change. Germany is a good example of how to wind down a coal industry in a sustainable way.

## Further suggested reading and watching

The International Energy Agency provides some excellent information about coal on its website.

- [Coal 2019 \(and forecasts to 2024\)](#)
- [Coal Information 2019](#)

For a global view of the circa 12,500 existing, proposed and retired coal-fired generating units, [visit the website of Global Energy Monitor](#).



Source: [Global Coal Plant Tracker](#)

## About the author

Gareth Byatt is Principal Consultant of [Risk Insight Consulting](#). He works around the world with clients in various industries and sectors, many of which require large amounts of energy to produce their outputs.

## References:

1. Encyclopaedia Britannica – coal  
<https://www.britannica.com/science/coal-fossil-fuel>
2. Mining Technology, 6 January 2020 – countries with the biggest coal reserves  
<https://www.mining-technology.com/features/feature-the-worlds-biggest-coal-reserves-by-country/>
3. The Conversation, 9 June 2016 – Coal was king of the Industrial Revolution, but not always the path to a modern economy  
<https://theconversation.com/coal-was-king-of-the-industrial-revolution-but-not-always-the-path-to-a-modern-economy-54107>
4. Visual Capitalist, 26 December 2019 – Every coal plant in the world (1927-2019)  
<https://www.visualcapitalist.com/every-coal-power-plant-1927-2019/>
5. The IEA, April 2020 – Global Energy Review 2020  
<https://www.iea.org/reports/global-energy-review-2020/coal#abstract>
6. Financial Times, 18 May 2020 – Trump campaign for US coal undermined by industry slump  
<https://www.ft.com/content/39909dd4-7c6c-425e-8f05-4f6e63b60c43?>
7. Financial Times, 14 May 2020 – UK renewables prove a shining success during pandemic  
<https://www.ft.com/content/78108d3a-d046-4916-858a-a5df090ce8c3>
8. Arstechnica, 24 April 2017 – UK has first coal-free power day since the Industrial Revolution  
<https://arstechnica.com/science/2017/04/uk-first-coal-free-power-day/>
9. New York Times, 13 May 2020 – In a First, Renewable Energy Is Poised to Eclipse Coal in U.S.  
<https://www.nytimes.com/2020/05/13/climate/coronavirus-coal-electricity-renewables.html?>
10. US Energy Information Administration (EIA), May 20 – Short-Term Energy Outlook  
<https://www.eia.gov/outlooks/steo/archives/May20.pdf>
11. FT, 1 October 2019 – How Britain ended its coal addiction  
<https://www.ft.com/content/a05d1dd4-dddd-11e9-9743-db5a370481bc>
12. FT, 3 May 2019 – Can Poland wean itself off coal?  
<https://www.ft.com/content/674ce754-6b9b-11e9-80c7-60ee53e6681d>
13. FT, 27 May 2020 – China expected to impose coal import restrictions  
<https://www.ft.com/content/6142f1b9-58cc-47e4-b2fb-8212ad792b2d>
14. The IEA, August 2019 – Coal information 2019  
<https://www.iea.org/reports/coal-information-2019>
15. FT, 19 June 2019 – Japan, China and South Korea must end support for coal  
<https://www.ft.com/content/2a3a41e2-8db3-11e9-a1c1-51bf8f989972>





16. Carbon Brief, 24 March 2020 – Analysis: Will China build hundreds of new coal plants in the 2020s?

<https://www.carbonbrief.org/analysis-will-china-build-hundreds-of-new-coal-plants-in-the-2020s>

17. The Guardian, 17 May 2020 – Coal industry will never recover after coronavirus pandemic, say experts

<https://www.theguardian.com/environment/2020/may/17/coal-industry-will-never-recover-after-coronavirus-pandemic-say-experts>

18. FT, 13 May 2020 – Norway's oil fund sells out of Glencore, Anglo American and RWE

<https://www.ft.com/content/ca33f62e-242a-4304-9895-f7cea36a497e>

19. World Coal Association

<https://www.worldcoal.org/coal>

20. World Coal Association – Coal & the Sustainable Development Goals

<https://www.worldcoal.org/sustainable-societies/coal-sustainable-development-goals>

21. Global Cement, 1 March 2016 – Coal for cement: Present and future trends

<https://www.globalcement.com/magazine/articles/974-coal-for-cement-present-and-future-trends>

22. The IEA, December 2019 – Coal 2019 (forecasts to 2024)

<https://www.iea.org/reports/coal-2019>

23. World Coal Association – Coal & cement

<https://www.worldcoal.org/coal/uses-coal/coal-cement>

24. The Reserve Bank of Australia, 19 Sept 2019 – The Changing Global Market for Australian Coal

<https://www.rba.gov.au/publications/bulletin/2019/sep/the-changing-global-market-for-australian-coal.html>

25. The ABC, 15 January 2020 – World's largest fund manager BlackRock cuts thermal coal exposure on climate concerns

<https://www.abc.net.au/news/2020-01-15/worlds-largest-fund-manager-to-cut-thermal-coal-exposure/11869300>

26. Cem Fuels, 28 January 2020 – Helvellyn Group launches coal replacement fuel for the cement industry

<https://www.cemfuels.com/news/itemlist/tag/Coal>

27. Science Direct, 15 January 2018 – Impact of fuel selection on the environmental performance of post-combustion calcium looping applied to a cement plant

<https://www.sciencedirect.com/science/article/pii/S0306261917315428>

28. Climate Action, 15 May 2020 – BNP Paribas accelerates exit from coal in all OECD countries by 2030

<http://www.climateaction.org/news/bnp-paribas-accelerates-exit-from-coal-in-all-oecd-countries-by-2030>

29. ABC, October 2019 – Why the coal sector is so excited about Australia's move to 'clean' hydrogen

<https://www.abc.net.au/news/2019-10-31/hydrogen-strategy-fossil-fuels-versus-renewables/11653336>

30. Intelligent Living, 16 March 2020 – Australia Is Transitioning To Hydrogen, And The Coal Sector Is Excited

<https://www.intelligentliving.co/australia-hydrogen-coal/>

31. World Steel Association – steel's contribution to a low carbon future

<https://www.worldsteel.org/publications/position-papers/steel-s-contribution-to-a-low-carbon-future.html>

32. ArcelorMittal, 16 Sept 2019 – ArcelorMittal commissions Midrex to design demonstration plant for hydrogen steel production in Hamburg

<https://corporate.arcelormittal.com/media/news-articles/2019-sep-16-arcelormittal-commissions-midrex-to-design-demonstration-plant>

33. Renew Economy, 30 Jan 2020 – Nordic steel giant to use renewable hydrogen to produce fossil-free steel by 2026

<https://reneweconomy.com.au/nordic-steel-giant-to-use-renewable-hydrogen-to-produce-fossil-free-steel-by-2026-2026/>

34. Let's talk about coal

<https://www.letstalkaboutcoal.co.nz/future-of-coal/making-steel-without-coal/>

35. Forbes, 15 May 2020 – Steel, Hydrogen And Renewables: Strange Bedfellows? Maybe Not...

<https://www.forbes.com/sites/thebakersinstitute/2020/05/15/steel-hydrogen-and-renewables-strange-bedfellows-maybe-not/#849599b188ed>

36. BBC, 9 June 2020 – Britain goes coal free as renewables edge out fossil fuels

<https://www.bbc.com/news/science-environment-52973089>

37. FT, 8 June 2020 – Poland to shut 12 coal mines in attempt to contain coronavirus

<https://www.ft.com/content/c7ce78b2-6c7d-4ef6-b226-fd01f55a550c?>

38. The Guardian, 12 June 2020 – Adani mine: three major insurers to have no further involvement in coal project

<https://www.theguardian.com/environment/2020/jun/12/adani-mine-three-major-insurers-to-have-no-further-involvement-in-coal-project>

39. The Guardian, 11 June 2020 – Australia cannot expect China to import and burn coal it no longer needs

<https://www.theguardian.com/commentisfree/2020/jun/11/australia-cannot-expect-china-to-import-and-burn-coal-it-no-longer-needs>

40. The Guardian, 12 June 2020 – Santos \$3.6bn Narrabri gas project formally backed by NSW government

<https://www.theguardian.com/australia-news/2020/jun/12/santos-narrabri-gas-project-formally-backed-by-nsw-government>



41. Climate Change News, 6 May 2020 – South Korean government backs \$2 billion bailout to coal company, despite green finance pledge  
<https://www.climatechangenews.com/2020/05/06/south-korean-government-backs-2-billion-bailout-coal-company-despite-green-finance-pledge/>
42. The Guardian, 30 April 2020 – Covid-19 crisis will wipe out demand for fossil fuels, says IEA  
<https://www.theguardian.com/business/2020/apr/30/covid-19-crisis-demand-fossil-fuels-iea-renewable-electricity>
43. The Guardian, 17 May 2020 – Coal industry will never recover after coronavirus pandemic, say experts  
<https://www.theguardian.com/environment/2020/may/17/coal-industry-will-never-recover-after-coronavirus-pandemic-say-experts>
44. Carbon Brief, 12 May 2020 – Analysis: India's CO2 emissions fall for first time in four decades amid coronavirus  
<https://www.carbonbrief.org/analysis-indias-co2-emissions-fall-for-first-time-in-four-decades-amid-coronavirus>
45. Mining.com, 14 June 2020 – Glencore's Valeria coal mine granted special status  
<https://www.mining.com/glencores-valeria-coal-mine-granted-special-status/>
46. FT, 25 June 2020 – China expands coal plant capacity to boost post-virus economy  
<https://www.ft.com/content/cdcd8a02-81b5-48f1-a4a5-60a93a6ffa1e?>
47. Renew Economy, 13 Nov 2019 – German steel furnace runs on renewable hydrogen in world first  
<https://reneweconomy.com.au/another-nail-in-coals-coffin-german-steel-furnace-runs-on-renewable-hydrogen-in-world-first-55906/>