

G L O B A L
E L E C T R I C I T Y
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G L O B A L
T R E N D S

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**About Ember's
Global Electricity
Review**

This annual report analyses electricity data from every country in the world to give the first accurate view of the global electricity transition in 2020. It aggregates generation data by fuel by country from 2000. 68 countries comprising 90% of world electricity generation have full-year data to 2020 and have formed the basis of an estimate for changes in worldwide generation. All remaining countries have full data as far as 2019. G20 countries, which comprise 84% of world electricity generation, each have a separate in-depth country analysis. All the data can be viewed and downloaded freely from Ember's website.

www.ember-climate.org/global-electricity-review-2021

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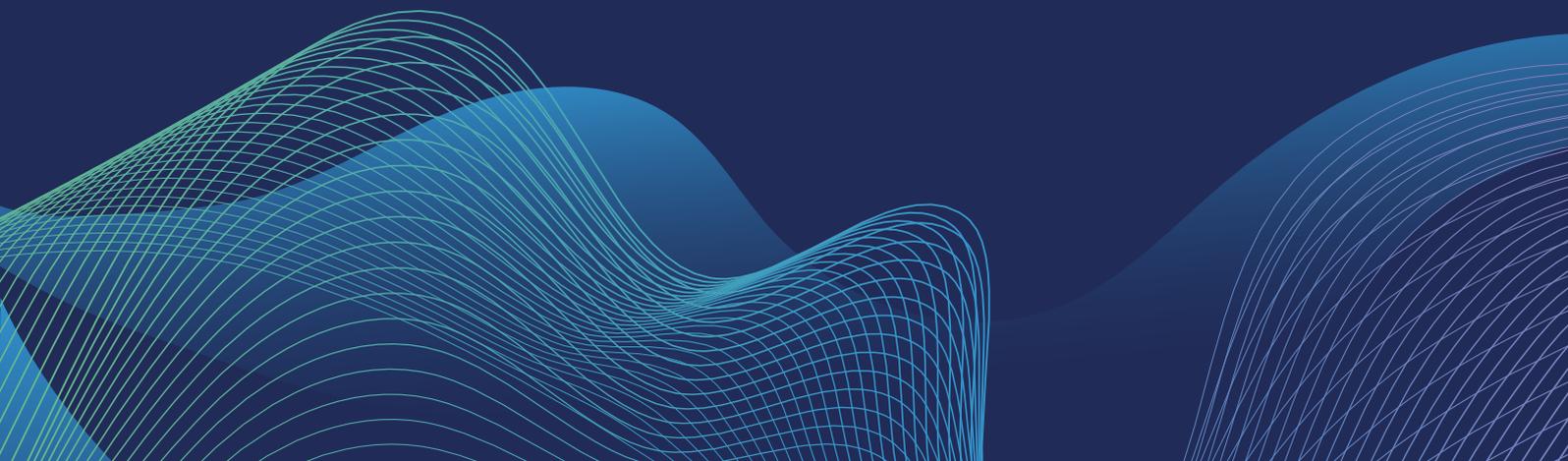
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Wind and solar drive a record fall in coal in 2020

**But only because
the pandemic
paused rising
electricity demand**



**Pandemic
paused
demand
growth**

-0.1%

**Wind
and solar
helped
push coal
to a record
fall**

-4%

**Global
emissions
still higher
than 2015**

+2%

**Wind
and solar
showed
resilient
growth**

+15%

**China
alone in
G20 for
growing
coal**

+2%



Key findings

Wind and solar drive a record fall in coal in 2020 - but only because the pandemic paused rising electricity demand

1 Pandemic paused electricity demand growth.

Global electricity demand fell slightly (-0.1%) in 2020, the first fall since 2009. But this pause has already ended: by December 2020, electricity demand was already higher than in December 2019 (India +5%, EU +2%, Japan +3%, South Korea +2%, Turkey +3%, US +2%).

2 Wind and solar showed resilient growth, rising to supply almost a tenth of global electricity.

Wind and solar generation rose robustly in 2020 by 15% (+314 TWh). This meant that wind and solar produced almost a tenth (9.4%) of the world's electricity last year, doubling from 4.6% in 2015. Many G20 countries now get around a tenth of their electricity from wind and solar: India (9%), China (9.5%), Japan (10%), Brazil (11%), the US (12%) and Turkey (12%). Europe is leading the way, with Germany at 33% and the United Kingdom at 29%. Indonesia, Russia and Saudi Arabia still have near-zero.

3

Wind and solar helped push coal power to a record fall.

Coal fell a record 4% (-346 TWh). This was similar to the rise in wind and solar power of 314 TWh, more than the UK's entire electricity production. This dwarfed the aggregate changes across global electricity: demand fell 23 TWh, gas and oil fell 12 TWh. A rise in hydro of 94 TWh was mostly countered by a fall of 104 TWh of nuclear. In comparison, coal collapsed almost everywhere, with large falls in the US (-20%), EU (-20%) and even India (-5%).

4

China was the only G20 country with a large increase in coal generation.

China's coal generation rose by 2% in 2020. That was because electricity demand growth continued to outstrip new clean electricity. China's electricity demand was 33% higher in 2020 than in 2015, rising by more than all electricity demand in India in 2020. Across those five years, China's fossil-free generation met only 54% of the rise in electricity demand, so 46% was met from fossil generation. That pushed China's coal generation 19% higher in five years. China is now responsible for more than half (53%) of the world's coal-fired electricity, up from 44% in 2015.

5

Global power sector emissions were still higher than in 2015, when the Paris climate agreement was signed.

Electricity demand rose 11% (+2536 TWh) since 2015, but the increase in clean electricity generation (+2107 TWh) didn't keep up. That led to an increase in overall fossil generation: gas-fired electricity rose 11% (+562 TWh) and coal fell only 0.8% (-71 TWh). As a result, power sector CO₂ emissions were around 2% higher in 2020 than in 2015.

Fossil-free electricity met only 54% of the rise in electricity demand in China, 57% in India and 37% in Indonesia. Meanwhile in Europe, and especially the US, coal's fall was caused not only by a rise in clean electricity, but also a rise in gas generation. Of the 10% rise in global gas generation since 2015, half of that was in the United States.

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“Progress is nowhere near fast enough. Despite coal’s record drop during the pandemic, it still fell short of what is needed. Coal power needs to collapse by 80% by 2030 to avoid dangerous levels of warming above 1.5 degrees. We need to build enough clean electricity to simultaneously replace coal and electrify the global economy. World leaders have yet to wake up to the enormity of the challenge.”

Dave Jones

Global Programme Lead, Ember

“Despite some progress, China is still struggling to curb its coal generation growth. Fast-rising demand for electricity is driving up coal power and emissions. More sustainable demand growth will enable China to phase out its large coal fleet, especially the least efficient sub-critical coal units, and provide greater opportunity for the country to attain its climate aspirations.”

Muyi Yang

Senior Electricity Policy Analyst - Asia, Ember

“India has started its clean electricity transition. India now needs to ramp up wind and solar considerably in the next decade to both replace coal and meet rising electricity demand. India has the opportunity to ensure that coal generation doesn’t see a resurgence after the last two years of coal falling.”

Aditya Lolla

Senior Electricity Policy Analyst - Asia, Ember

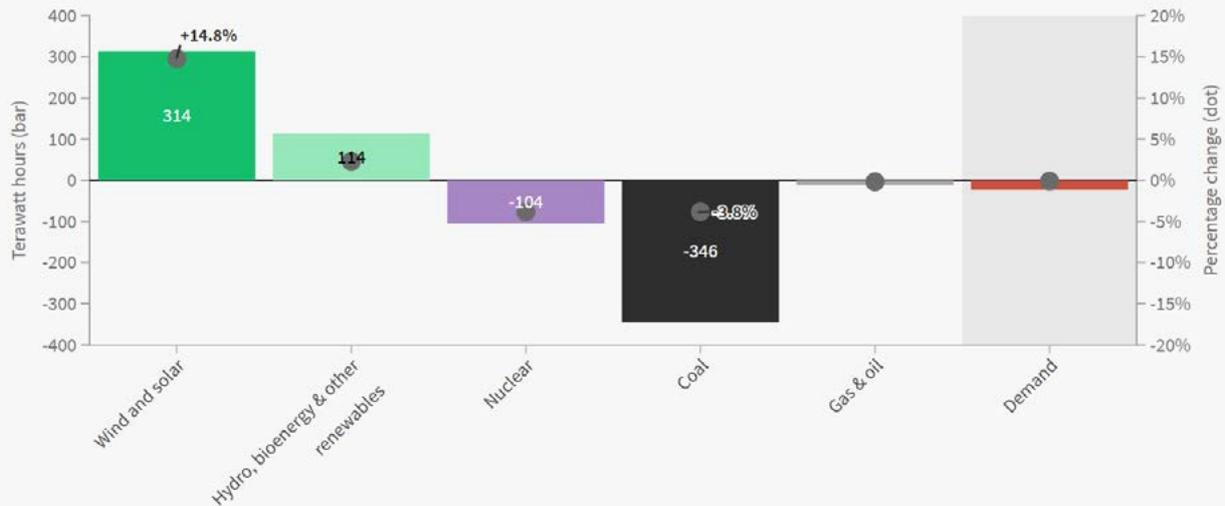
WHAT HAPPENED IN 2020?

Electricity generated by new wind and solar helped to force a record fall in global coal power in 2020. However, this was only possible because the pandemic paused the world's rising demand for electricity. Only China saw a large increase in coal in 2020.



Wind and solar cause record fall in coal as demand growth paused

Electricity generation change in 2020 versus 2019, by source



Ember's Global Electricity Review, March 2021.

Wind and solar generation rose by 15% (+315 TWh) in 2020, more than the UK's entire electricity production. That helped coal to fall a record 4% (-346 TWh).

This dwarfed all the other changes to electricity in 2020. Nuclear generation fell 4%, while hydro generation rose 3% due to rainy conditions in China, EU-27 and Russia. Gas and oil generation registered a very small fall of 0.2% (-0.9% for gas, +3.5% for other fossil). It was only the second year gas generation fell this century.

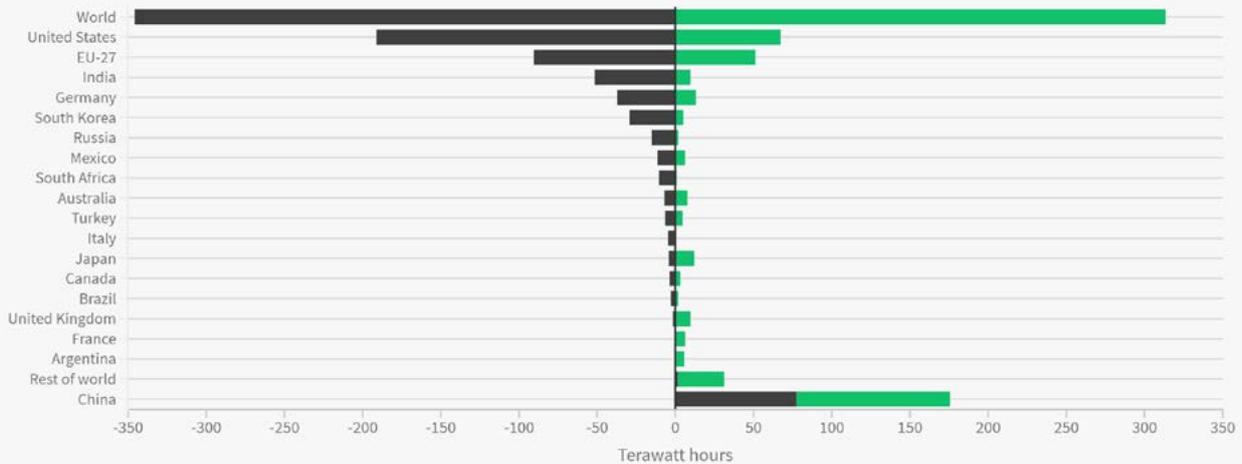
Electricity demand remained almost unchanged year-on-year, falling 0.1%. It was only the second time this century that electricity demand fell; it fell 0.3% in 2009 due to the global recession.

The increase in global wind and solar generation was the biggest ever in absolute terms, rising a record 315 TWh. However in relative terms it was the smallest on record, rising 15% year-on-year. So although wind and solar generation is steadily rising every year, it's not yet accelerating in a way needed to reach climate targets.

China isolated as the world turns away from coal power in 2020

Electricity generation change in 2020 versus 2019, for G20 countries

■ Coal ■ Wind and solar



Indonesia and Saudi Arabia are not included as no 2020 data exists.
Ember's Global Electricity Review, March 2021.

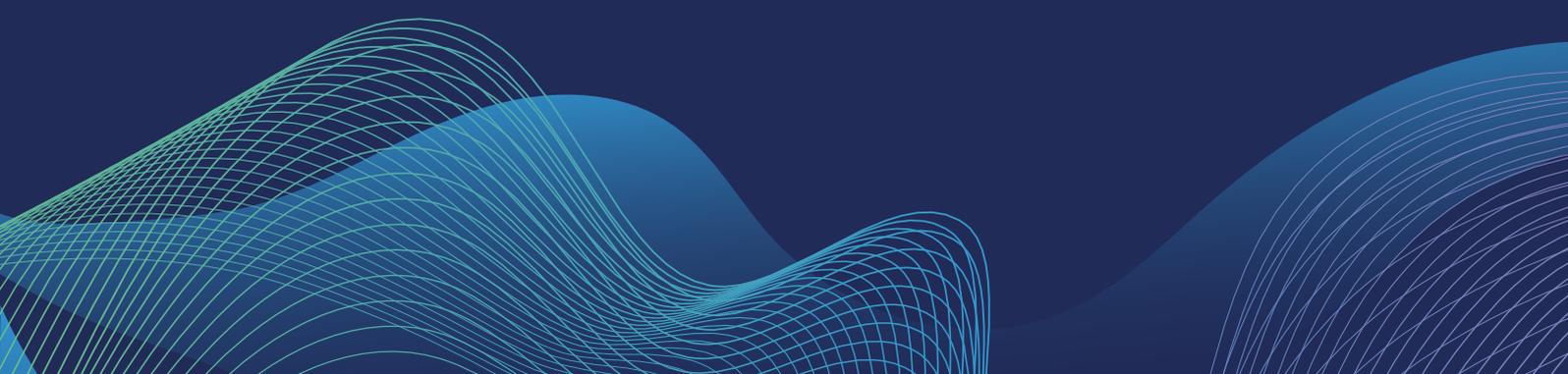
In 2020, almost every G20 country saw a rise in wind and solar generation and a fall in coal generation. This contributed to the record fall in global coal generation.

In many countries, wind and solar only partly contributed to the fall in coal. It was also caused by a fall in electricity demand. In the US, electricity demand fell 2.5%, the EU-27 fell 3.5%, India fell 2.3%. This—alongside increases in wind and solar generation—meant that coal generation saw particularly large falls in these countries. If electricity demand grows rapidly in 2021, it is possible that wind and solar growth will not be enough to ensure coal continues to fall.

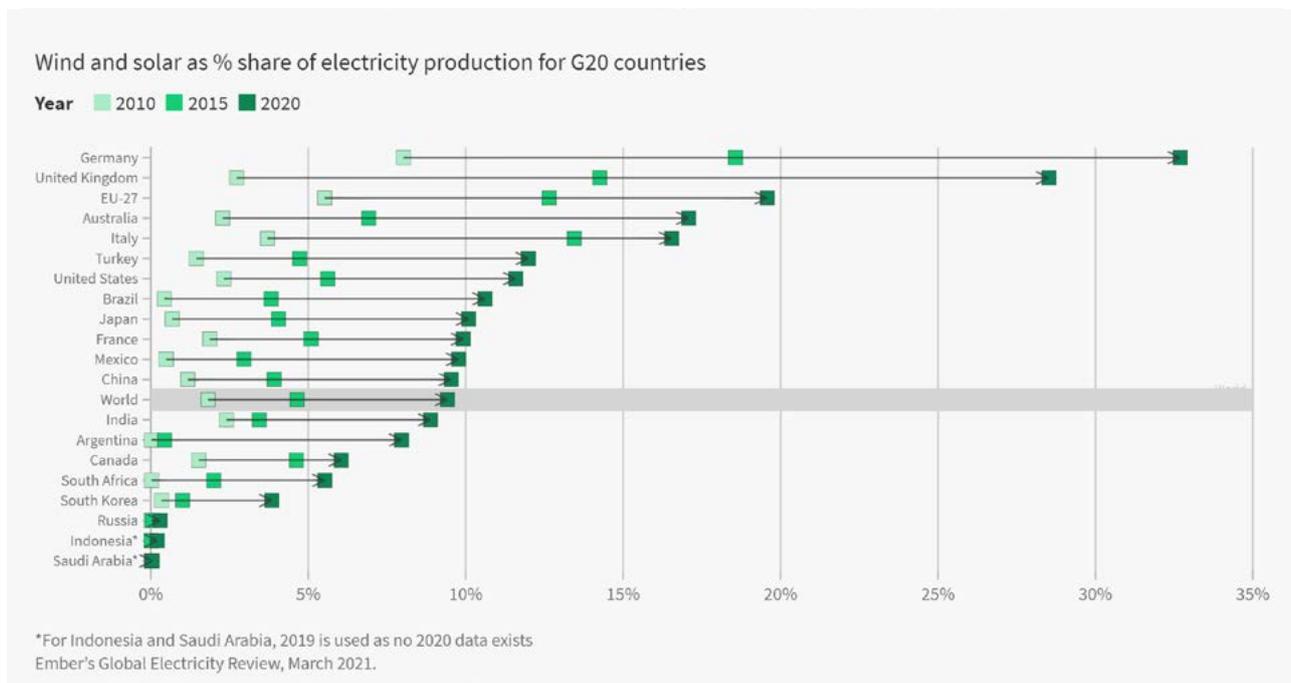
China was an exception, seeing a 4% increase in electricity demand, which meant it was the only G20 country to show a large increase in coal generation (+1.7%), and despite large growth in wind and solar, clean generation was unable to wholly meet increased demand. Only a third of China's increase in electricity demand was met from gains in wind and solar generation, and another third from increased hydro, nuclear and bioenergy, leaving the need for increased coal generation.

PROGRESS SINCE PARIS

Wind and solar doubled in five years to generate almost a tenth of global electricity in 2020. Although coal's market share is falling, absolute coal generation is only 0.8% lower than five years ago. Coal is collapsing in OECD countries. But coal still rose in Asia; the clean electricity boom still isn't keeping up with fast-rising electricity demand. In fact, the world generated more electricity from fossil fuels in 2020 than in 2015 when the Paris Agreement was signed.



Wind and solar produced almost a tenth of the world's electricity, doubling in just five years



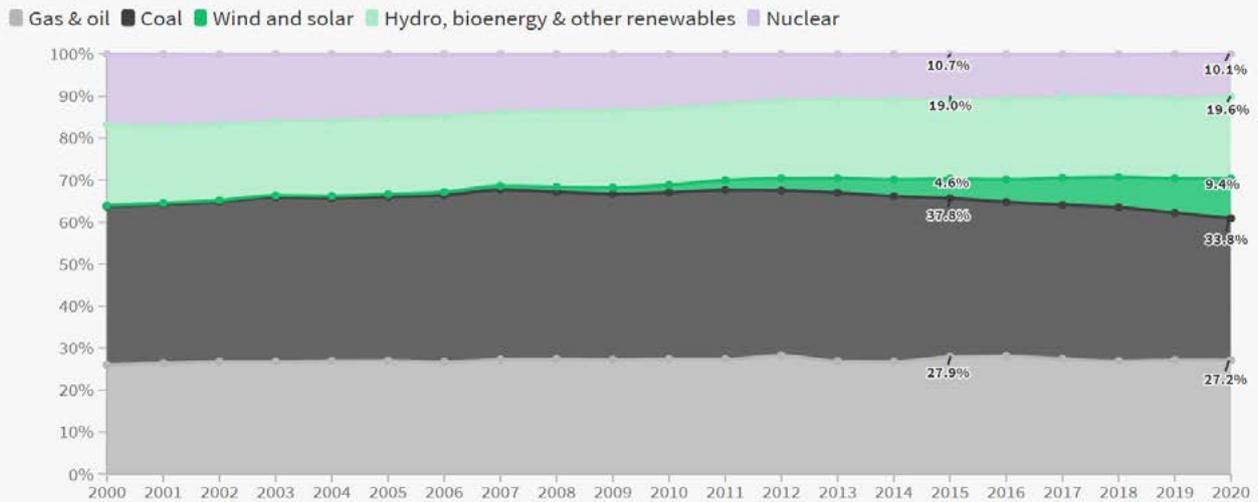
Wind and solar produced 9.4% of the world's electricity in 2020. Its share has more than doubled from 4.6% in 2015, the year when the Paris Climate Agreement was signed.

A surprising number of G20 countries now produce around a tenth of their electricity from wind and solar: India (8.9%), China (9.5%), Japan (10.1%), Brazil (10.6%), the US (11.6%) and Turkey (12.0%).

Germany and the UK are leading the way, with 33% and 28% respectively. They have become a hotbed of innovation, showing how to successfully integrate huge amounts of intermittent wind and solar into the broader electricity system.

Wind and solar are taking market share from coal

Global electricity mix by year



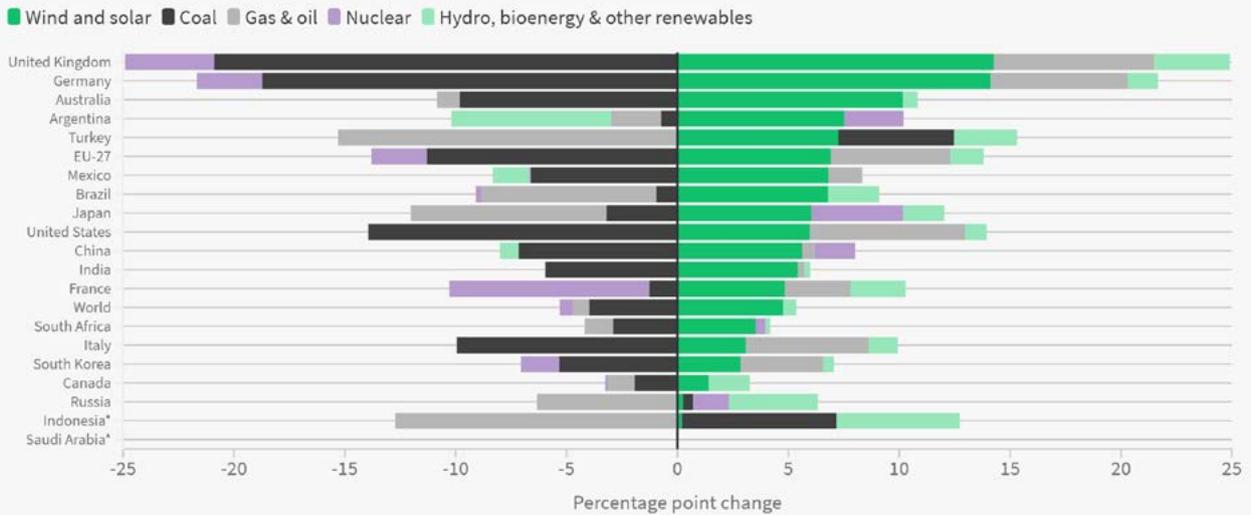
Ember's Global Electricity Review, March 2021.

Across the last five years, wind and solar power's combined market share increased by 4.8 percentage points (from 4.6% to 9.4%) and coal's market share fell by 3.9 percentage points (from 37.8% to 33.8%).

The global market share of most other fuel types has not changed significantly. Coal remains the world's single largest power source, generating 33.8% of global electricity in 2020.

Most G20 countries see wind and solar replacing coal

Change in electricity market share between 2015 and 2020, for G20 countries



*For Indonesia and Saudi Arabia, 2019 is used as no 2020 data exists. Saudi Arabia's electricity mix is made up of entirely gas and oil, so shows no change. Ember's Global Electricity Review, March 2021.

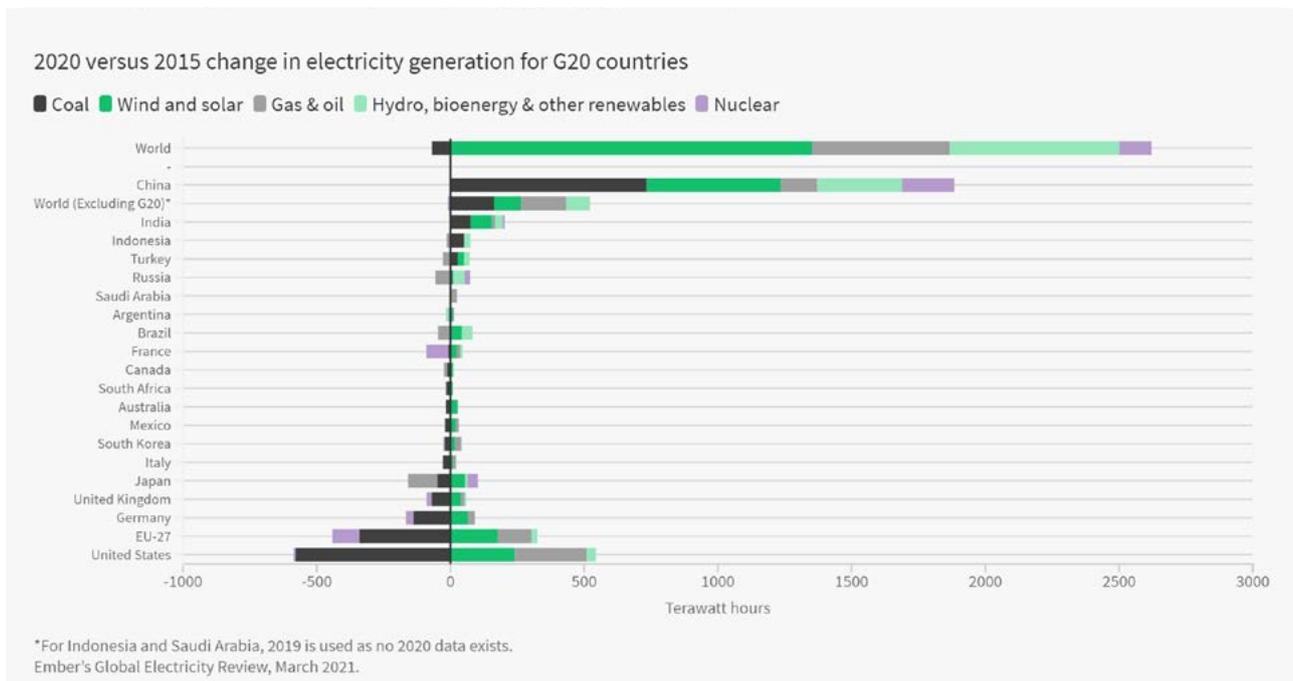
Almost every G20 country saw a similar pattern—from the US and EU to China and India.

Coal's global share actually fell faster than the rise in wind and solar because gas also replaced coal to some extent in the US and Europe. This meant that while coal fell significantly in those regions, the overall fall in fossil fuel generation is much less impressive.

There were only three G20 countries where coal's share didn't fall; Turkey, which replaced gas with coal, and Russia and Indonesia, which built near-zero amounts of wind and solar. Saudi Arabia didn't even register changes, as its electricity mix was unchanged at 100% gas and oil generation.

The minor fall in coal's market share in France, Argentina and Brazil reflects coal's small role in the electricity mix in those countries.

The world generated more electricity from fossil fuels in 2020 than five years ago



Electricity demand rose 11% (+2536 TWh) since 2015, but the increase in clean electricity generation (+2107 TWh) didn't keep up. That led to an increase in overall fossil generation: gas-fired electricity rose 11% (562 TWh) and coal fell only 0.8% (71 TWh). So although global coal generation fell in relative share, it barely fell in absolute terms. As a result, power sector CO₂ emissions were around 2% higher in 2020 than in 2015.

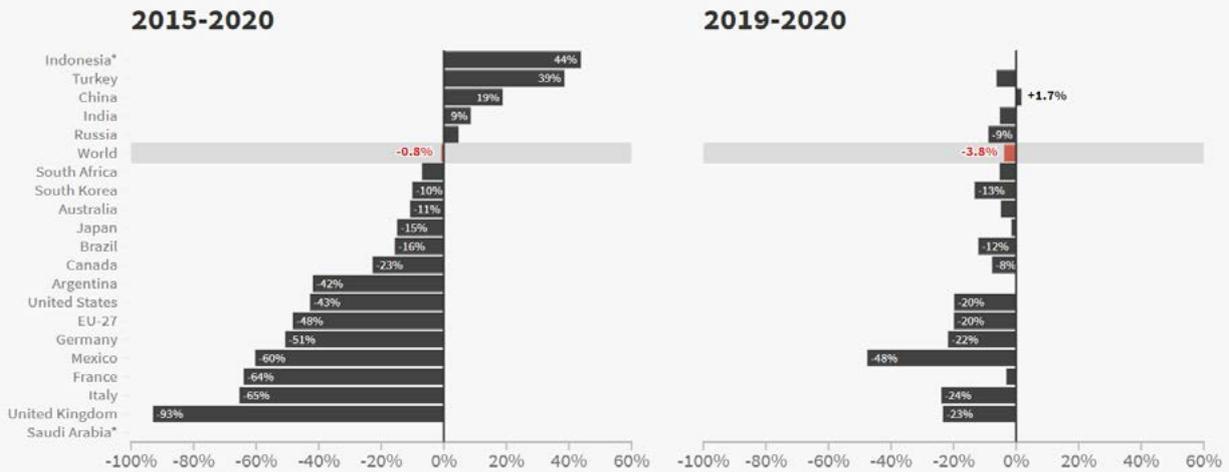
The rise in fossil-free generation was led by wind and solar. Wind grew 92% (+762 TWh), solar 232% (+589 TWh), hydro 13% (+490 TWh), nuclear only 5% (+120 TWh) and bioenergy by 28% (+127 TWh).

Electricity demand across Asia rose rapidly, and fossil-free electricity met only 54% of the rise in electricity demand in China, 57% in India, 37% in Indonesia. Hence the overall rise in fossil generation in those regions. China's electricity demand rose by 1880 TWh (+33%) from 2015 to 2020, which is more than India's entire electricity demand in 2020.

Meanwhile in Europe, and especially the US, coal's fall was caused not only by a rise in clean electricity, but also by a rise in gas generation. Of the 10% rise in global gas generation since 2015, half of that was in the United States.

Coal is collapsing in the OECD, but has not yet finished growing in Asia

Change in coal generation, for G20 countries



*For Indonesia and Saudi Arabia, 2019 is used as no 2020 data exists.
Ember's Global Electricity Review, March 2021.

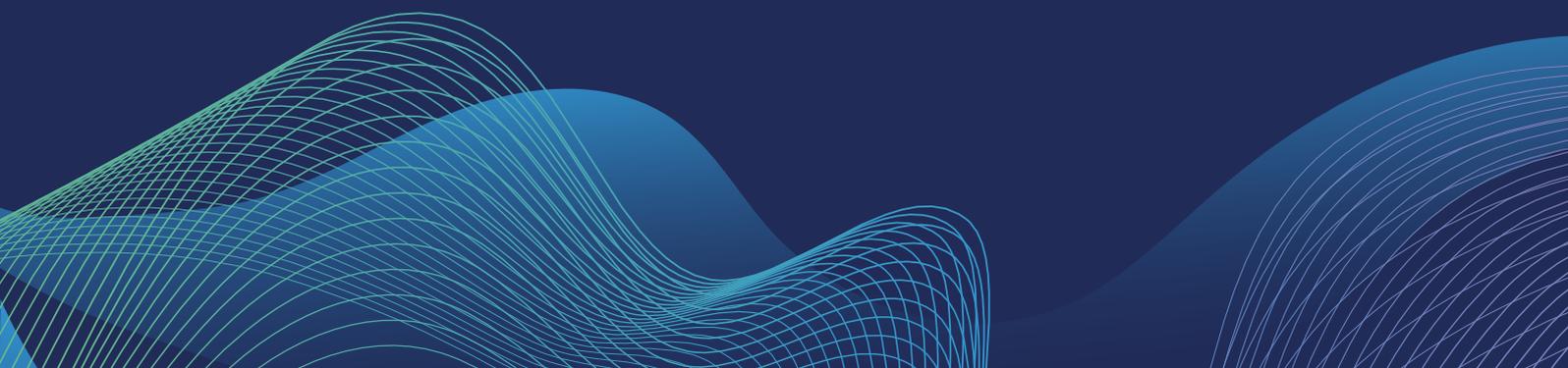
Many OECD countries are seeing coal collapse. EU-27 coal generation has almost halved since 2015 (-48%), and the US saw a similar fall (-43%). Smaller, more recent falls have happened in Japan, South Korea, Australia, Canada and Mexico.

However, these falls over the last half-decade were almost entirely offset by rises in Indonesia, Turkey, China and India. That meant, even including 2020's record 4% fall, global coal generation was only 0.8% lower in 2020 than in 2015.

OECD countries saw a combined 23 GW reduction in coal capacity in 2020. This trend means that across [the OECD and EU-28](#), 56% of coal capacity has either been retired since 2010, or is scheduled to retire by 2030. The story in China is very different, where in 2020 alone 9 GW of coal plant retirements were offset by the opening of 39 GW of new coal capacity.

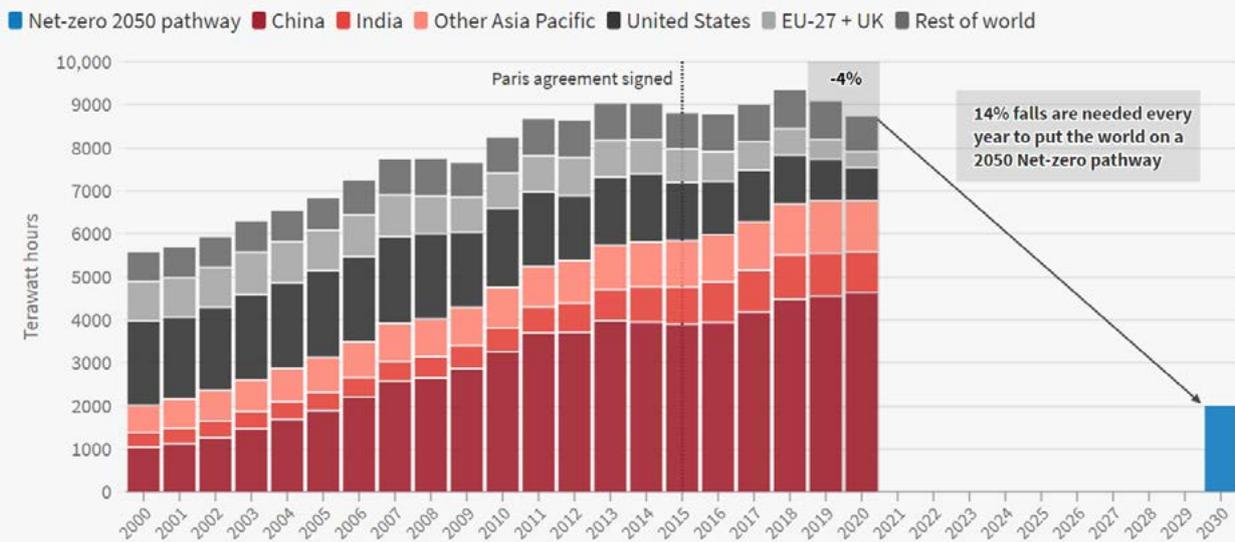
ARE WE ON TRACK FOR 1.5°C?

The world's transition out of coal power is happening far too slowly to avoid the climate crisis. Coal generation fell a record 4% in the pandemic year of 2020, but that's still insufficient to meet climate targets. With 77% of the world's coal electricity in Asia, all eyes are on how quickly it can reduce coal generation. Meanwhile fossil gas dominates elsewhere in the world. In 2020, 61% of the world's electricity still came from fossil fuels.



Coal generation fell a record 4% in 2020, but that's still insufficient to meet climate targets

Global electricity generation from coal, split by region



Net-zero pathway is from the IEA's first net-zero modelling in their 2020 World Energy Outlook, and for 2030 coal, is quite consistent with majority of the IPCC's 1.5 degree scenarios.

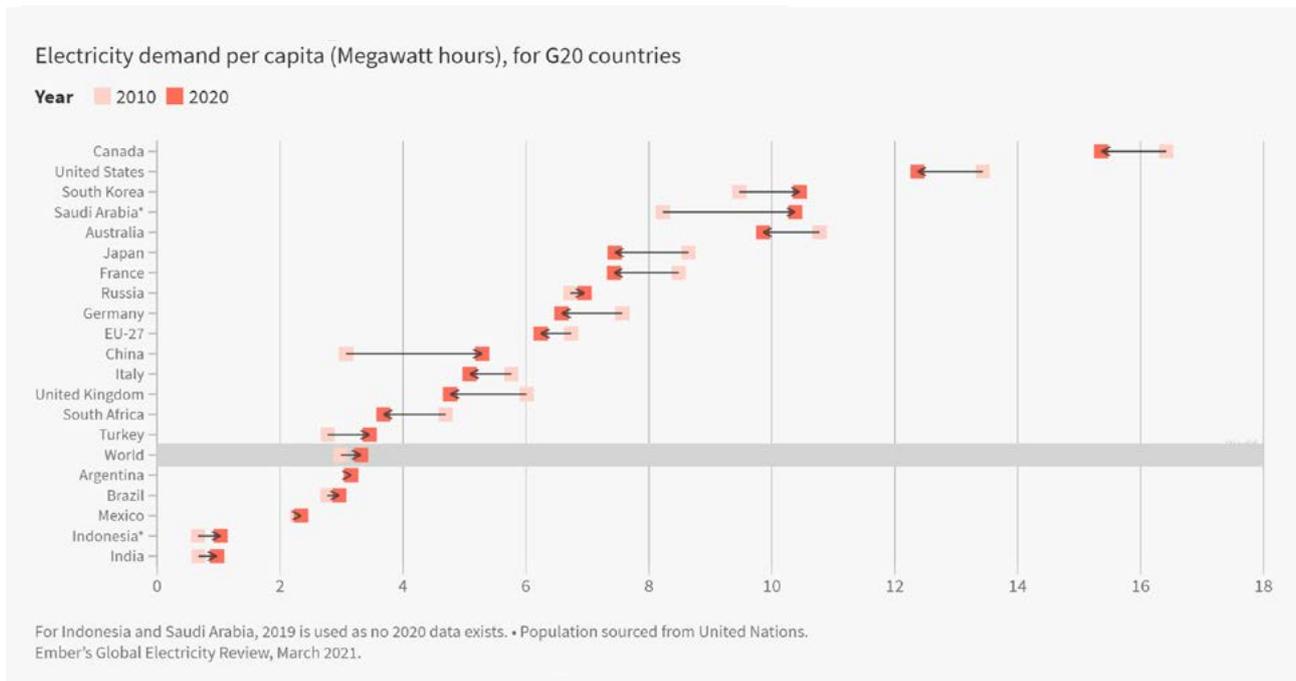
Climate Analytics' [analysis](#) of IPCC 1.5 degree scenarios show that OECD nations should end coal use entirely by 2030, and all coal-fired power stations must be shut by 2040 at the latest. Those dates were also [reiterated](#) by the UN Secretary General in March 2021.

The IEA's 'Net-Zero 2050 pathway' scenario from their 2020 [World Energy Outlook](#) is also fairly aligned with the IPCC 1.5 degree scenarios. It shows global unabated coal generation must collapse by around 80% from 2020 to 2030.

That implies falls of around 14% per year, compared to just a 4% fall in the pandemic year of 2020. This is particularly important because coal-fired electricity generation alone currently contributes around 30% of global CO₂ emissions, [according to the IEA](#). Although coal is collapsing in the OECD, it's not yet collapsing in Asia. The share of the world's coal generation in China increased from 44% in 2015 to 53% in 2020. For Asia as a whole, it has now risen to 77%.

The world's transition out of coal power is happening far too slowly to avoid the climate crisis. What's more, the IEA even anticipates coal generation [will rebound in 2021](#) as electricity demand picks up again.

Asia's future electricity demand growth has huge implications for coal in the next 10 years



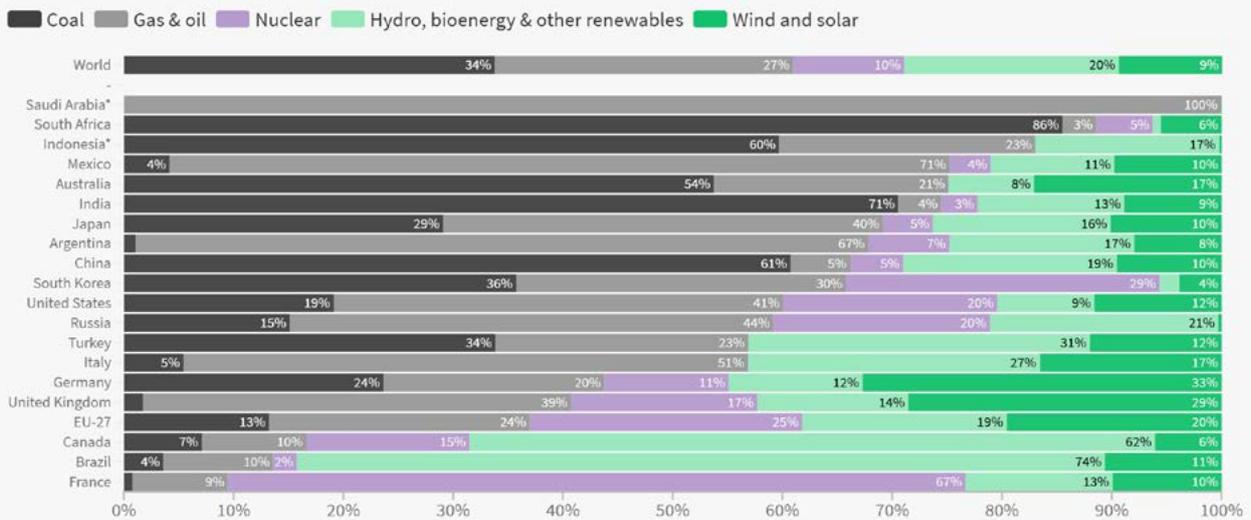
China's rise in electricity demand is unparalleled, rising by 71% over a decade. China's per capita electricity demand is now higher than the UK and Italy. Although demand in India and Indonesia has risen substantially, it is still only a third of the global per capita rate. South Korea has one of the highest per capita rates in the world, twice that of China's and ten times India and Indonesia's per capita levels.

Fossil-free electricity will meet some of the electricity demand growth, but the extent of this remains to be seen and the risk of falling back on fossil fuels looms large.

Asia's electricity demand growth is perhaps the biggest uncertainty of what will happen to global coal generation in the next 10 years.

The world still has a long way to go to stop burning fossil fuels for electricity

Electricity production mix in 2020, for G20 countries



*For Indonesia and Saudi Arabia, 2019 is used as no 2020 data exists. Ember's Global Electricity Review, March 2021.

61% of the world's electricity still came from fossil fuels in 2020. While the global focus needs to be on quickly phasing out coal generation, gas and oil generation also need to decline rapidly. In 2020, 23% of the world's electricity still came from gas. A further 4% was from other fossil fuels, such as oil.

Fossil use in the UK and EU-27 electricity has fallen, but fossil fuels still contribute 41% and 37% respectively. Even the historically cleaner electricity systems of France, Brazil and Canada still have some electricity from fossil fuels.

There are five G20 countries that had over three-quarters of their electricity supplied from fossil fuels in 2020: Saudi Arabia (100%), South Africa (89%), Indonesia (83%), Mexico (75%) and Australia (75%).

Conclusion

The global electricity transition is on a crash course with climate targets. Clean electricity is not yet being built quickly enough to keep pace with rising electricity demand. Wind and solar have provided the majority of the growth in clean electricity, with hydro and nuclear generation barely increasing. But even as wind and solar have risen to nearly a tenth of world electricity, their growth has slowed in recent years. This slow pace and lack of ambition is locking in reliance on fossil fuels.

2019 and 2020 bucked the trend as electricity demand temporarily slowed, which led to two record drops in coal generation. But even that wasn't enough to put the world on target. Electricity demand will undoubtedly pick up again soon, especially as the world looks to electrify all the sectors still relying on fossil fuels.

We can't let "mid-century net-zero targets" distract from the immediate need to focus on a quick transition out of burning coal for electricity.

Methodology

Summary

This annual report analyses electricity data from every country in the world to give the first accurate view of the global electricity transition in 2020. It aggregates generation data by fuel by country from 2000. 68 countries comprising 90% of world electricity generation have full-year data to 2020 and have formed the basis of an estimate for changes in worldwide generation. All remaining countries have full data as far as 2019. G20 countries, which comprise 84% of world electricity generation, each have a separate in-depth country analysis. All the data can be viewed and downloaded freely from Ember's website. [A detailed methodology can be accessed here.](#)

Disclaimer

The data used in this report is provided on an 'as is' basis, and was assembled using the best available data at the time of publication. We take no responsibility for errors. Please do contact us if you spot any errors or have suggestions at info@ember-climate.org

Methodology

Definitions

Generation data is mapped into nine generation types. [More information on mapping for different sources and countries can be accessed here](#). For the purpose of analysis these generation types are aggregated into different groupings as follows

Demand									
Production									
Renewables					Fossils				
Wind & Solar		Hydro, Bioenergy & Other Renewables				Gas & Oil			
Wind	Solar ¹	Hydro ²	Bio energy ³	Other Renewables ⁴	Coal	Gas	Other Fossils ⁵	Nuclear	Net Imports

¹ Solar includes both solar thermal and solar photovoltaic generation, and where possible distributed solar generation is included.

² Where possible, hydro generation excludes any contribution from pumped hydro generation.

³ Bioenergy generation includes generation from combustible renewables. For certain historical data sources all waste generation (renewable and non-renewable) is not disaggregated from other combustible renewables generation - this has all been mapped to bioenergy.

⁴ Other renewables generation includes geothermal, tidal and wave generation.

⁵ Other fossil generation includes generation from oil and petroleum products, as well as manufactured gases.

For the purposes of this report, renewables are classified in line with the IPCC and include bioenergy. However, the climate impact of bioenergy is highly dependent on the feedstock, how it was sourced and what would have happened had the feedstock not been burnt for energy. The current EU bioenergy sustainability criteria do not sufficiently regulate out high-risk feedstocks and therefore electricity generation from bioenergy cannot be automatically assumed to deliver similar climate benefits to other renewables sources (such as wind and solar) over timescales relevant to meeting the commitments of the Paris Agreement. For more information please see Ember's reports: *The Burning Issue* (June 2020) and *Playing with Fire* (December 2019).

Methodology

Historical data

Data from the United States Energy Information Administration's (EIA) international data browser forms the backbone of this report. With the exception of [China](#), [India](#), [EU-27](#) and the [United States](#), all data from 2000-2019 is taken from this source. For some generation types in non-OECD countries, 2019 data had not yet been published by the EIA. Where available, we used national data to estimate these values, otherwise, the average change for that generation type seen over 2015-2018 was added onto the 2018 generation value.

Thermal disaggregation

EIA international data does not disaggregate generation from fossil fuels. This was performed by Ember using two methods. If possible, the split between fossil fuels was estimated using the ratios of fossil generation types in [BP's statistical review of world energy](#). Fossil generation was disaggregated for any remaining countries by using the capacity split by fossil fuel type, taken from the [WRI's global power plant database](#).

2020 data

Data for 2020 is estimated using national sources. The year-on-year changes in generation for each fuel type from these sources are added onto the historical 2019 data to obtain a value for 2020. Data sources for Argentina, Canada, Ecuador, Kazakhstan and Russia provide no disaggregation of thermal generation - for these countries, estimates of the split between different generation types were made using the [IEA's monthly electricity generation statistics](#) and BP's statistical review of world energy.

World estimate

World data for 2000-2019 is the sum of all country data. World data for 2020 is estimated by summing generation for all countries where we have 2019 and 2020 data. Together this comprises 90% of global generation. The percentage changes in each fuel type from 2019 to 2020 are then applied to the world generation data for 2019, to create an estimate of global generation in 2020.

More information about the Global Electricity Review 2021

Global Electricity Review 2021

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