

## TURKEY ELECTRICITY REVIEW 2022

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### Coal generation fell for third consecutive year, but Turkey's electricity still dirty

Unlike many European countries, Turkey's coal power generation dropped again in 2021, for the third year in a row. On the other hand, gas generation increased to compensate for the drought-induced decline in hydropower generation. Hence Turkey's emissions per kWh power generation remain unchanged. In fact there has been no significant improvement in Turkey's carbon intensity of power in at least 30 years.

#### Key findings

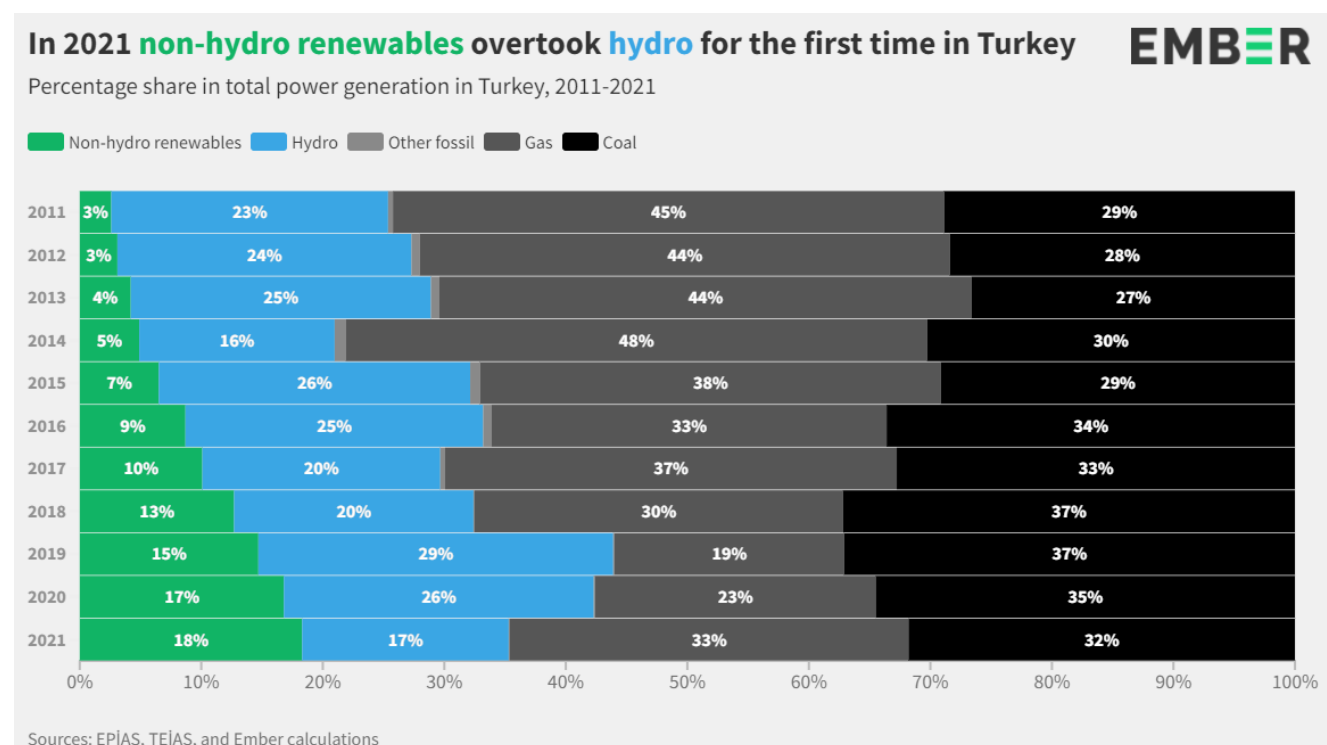
- Non-hydro renewable generation (wind, solar, geothermal & bioenergy) doubled since 2017 and overtook hydropower for the first time. Drought also played a role in the shift between hydro and non-hydro renewables.
- Decline in hydropower has been compensated by gas power in Turkey. While hydro share decreased from 26% to 17%, gas increased from 23% to 33% year over year in 2021 and pushed the share of fossil fuels to 65% in 2021.
- Wind and solar generation set a new record by reaching 44.6 TWh, a 25% rise in a year. In 2021 wind & solar reached 13.6% share in total power generation, up from 11.7% in 2020.
- Coal generation fell in 2021, for the third year in a row, as a result of extremely high costs of importing hard coal. Turkey's coal generation has declined by 8% from 2018 to 2021. Coal generation fell even in comparison to 2020, when five lignite plants were shut down for six months due to their non-compliance with new air pollution limits. But it is still at the highest level of the pre-2018 period.
- Total renewable generation doubled in the last ten years; however, the rise in renewables (+58 TWh) since 2011 was far from meeting the power demand increase in the same period (+95 TWh). The gap was filled by mostly imported coal (+32 TWh).
- In 2004 Turkey's carbon intensity of power was better than many European countries. However, while Turkey saw a 3% increase in carbon intensity from 2004 to 2021, these European countries have seen significant reductions and outranked Turkey: Denmark (-60%), Greece (-50%), UK (-50%), Romania (-45%), Italy (-45%), Netherlands (-32%), Germany (-28%) and Bulgaria (-13%).

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## Non-hydro renewables overtook hydropower for the first time

Hydropower has a very long history in Turkey, the [first power plant](#) in its history was a hydropower plant constructed in Southern Turkey in the early 1900s during the Ottoman Empire era. Especially after 1958, hydropower share in power generation exceeded 20% and reached as much as 60% in 1988. Until then hydropower was one of the two leading sources of power generation together with coal. After 1988, gas entered into the picture; and since then coal, hydro and gas shared the top three positions in power generation without any exception until 2021.



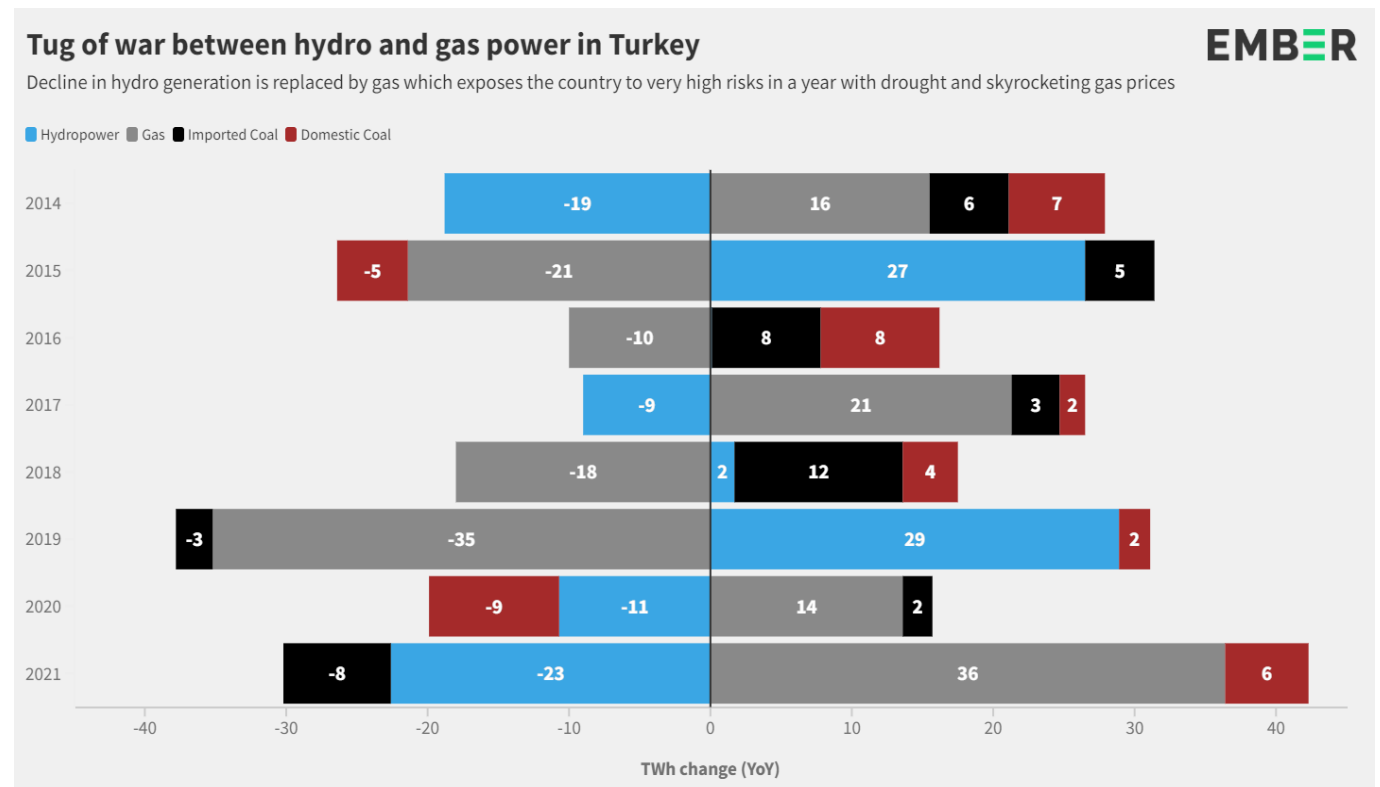
Non-hydro renewables doubled their power generation since 2017 and overtook drought-induced hydropower. Wind & solar owned the lion's share in this result by reaching 13.6% share in total power generation in 2021, up from 11.7% in 2020; while biomass & geothermal reached 4.9% share. Wind and solar generation set a new record by reaching 44.6 TWh, a 25% rise in a year.

## Hydropower varies in a high range

Drought also played a role in the shift between hydro and non-hydro renewables. In 2021 hydropower production and its share in total generation were the lowest since 2014. Gas replaced the reduction in hydropower, increasing the fossil share in generation to almost 65% from 56-58% levels in 2019-2020. Lack of hydropower pushed [gas consumption into as much as 61.6 bcm](#), another annual record of all time.

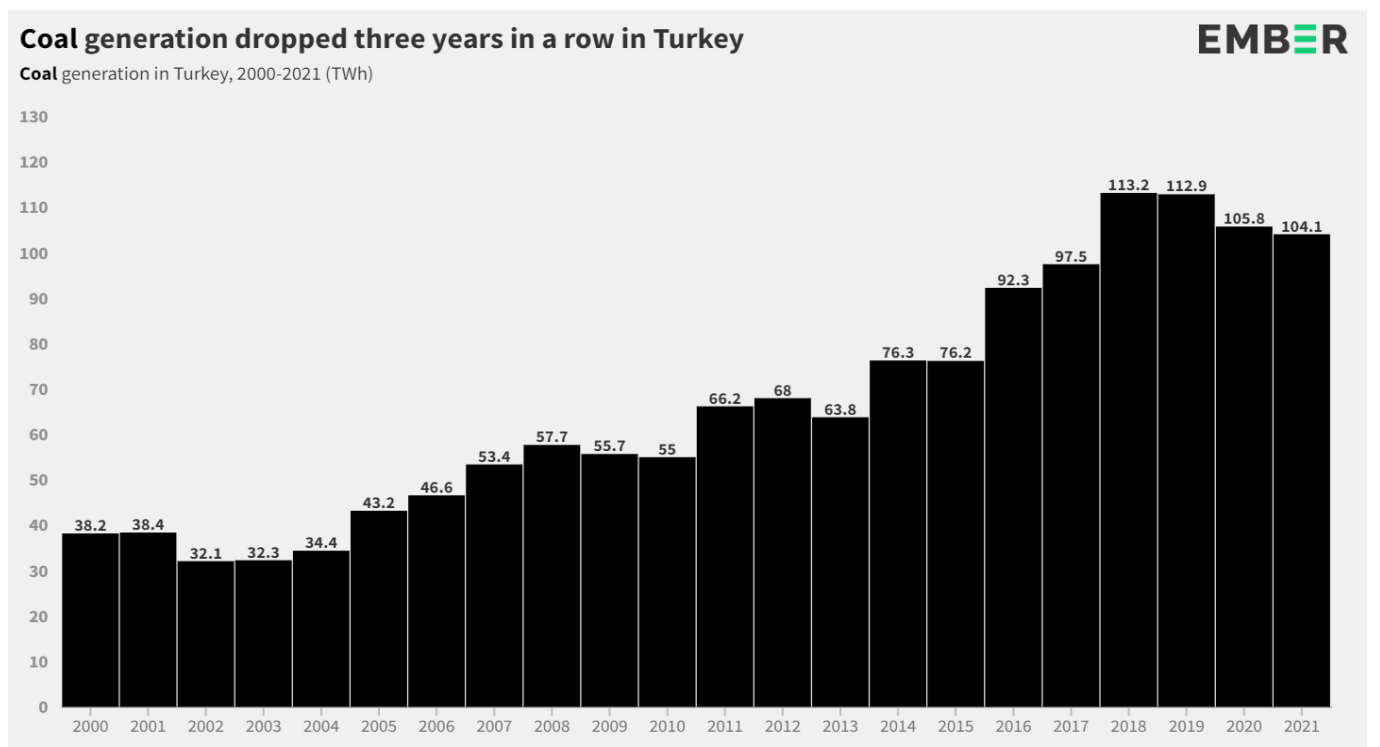
Turkey is highly dependent on hydropower but hydropower production in Turkey exhibits great volatility, such that year-over-year hydro generation may differ as much as 30 TWh which equals around 10% of countrywide power demand. The share of hydro in total power generation likewise varies between 20-30% every year. Lack of hydropower is currently met with imported fossil fuel sources. Hence the country is exposed to very high risks in a year with drought and skyrocketing fossil

fuel prices. However, Turkey can hedge itself against drought by covering its [huge hydro reservoirs](#) with floating solar which would complement the lack of hydro in the summertimes.



### Coal generation fell three years in a row

Coal generation is in a modest downward trend in Turkey. In 2018 coal generation peaked at 113.2 TWh which was followed by a 0.3 TWh decrease in 2019. Coal produced 7.1 TWh less power in 2020 when five lignite plants were forced to cease their operation for six months due to their



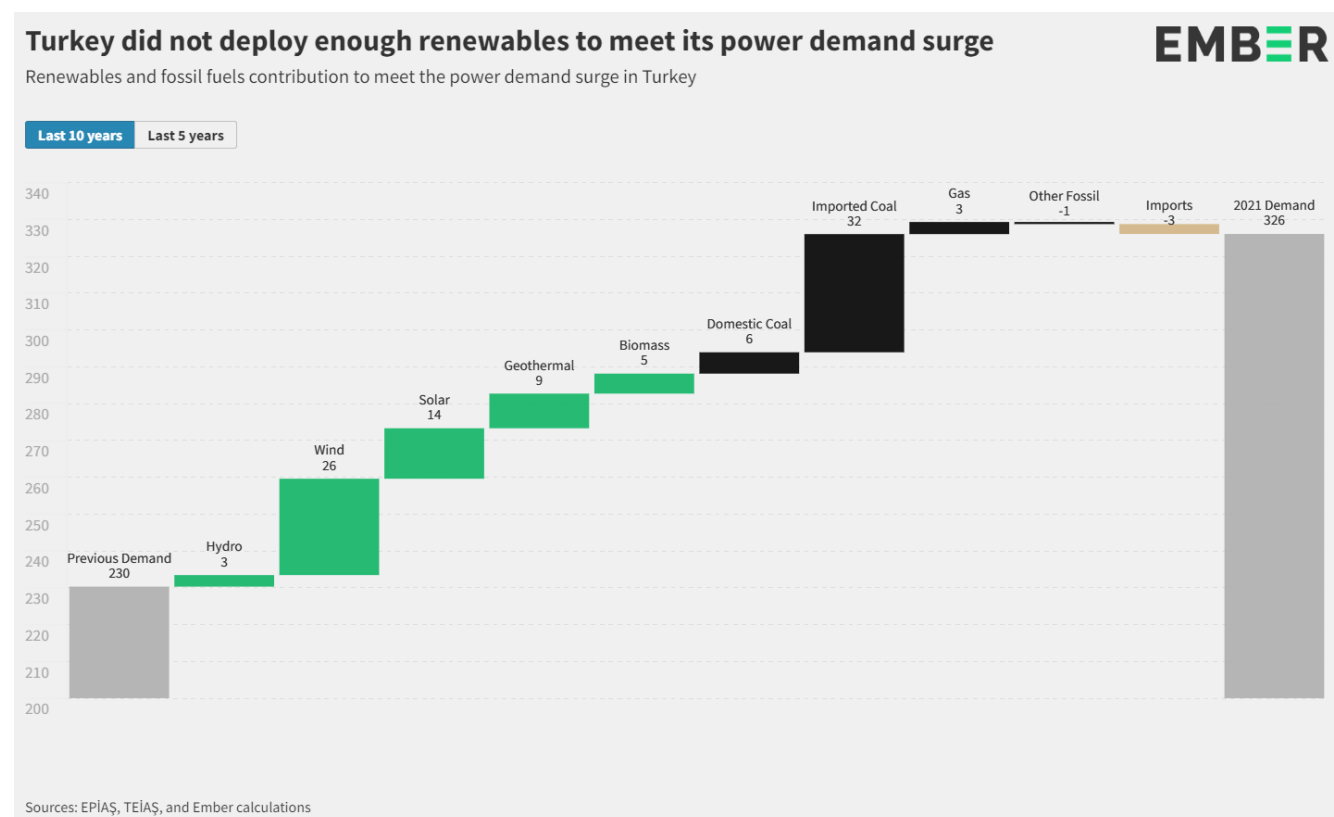
non-compliance with the new air pollution limits. In 2021, Turkey saw another 1.7 TWh drop in coal generation because of skyrocketing hard coal prices. As a result, coal power fell three years in a row, which translates into an 8% drop from 2018 to 2021.

Coal generation reduced in 2021 mainly because of the skyrocketing hard coal prices in the world. In 2021, the cost of power generation with imported coal exceeded 70 \$/MWh in Turkey so that [wind and solar power costs became much cheaper than running the existing imported coal power plants](#). Gas prices, on the other hand, were mostly fixed by oil-indexed long-term contracts with a quarterly price update. In addition, Turkey imposes a lira-denominated fixed tariff price on gas used for electricity generation which varied between 20-30 €/MWh in 2021. While gas-fired plants enjoyed their low fixed costs paid in lira, coal imports for power generation almost came to a halt. However, it is unsure whether 2018 would be the year of peak coal in Turkey, as the country still [has plans to expand its coal generation](#).

### Turkey did not deploy enough renewables to meet its surging power consumption

Renewable power production in 2021 was twice as much as it was ten years ago; however, the 57 TWh increase in renewables between 2011-2021 met barely half of the surge in power demand (+95 TWh).

The trend has continued in the last five years. Renewable energy added another 24 TWh production during 2016-2021, while power demand surged by 46 TWh.

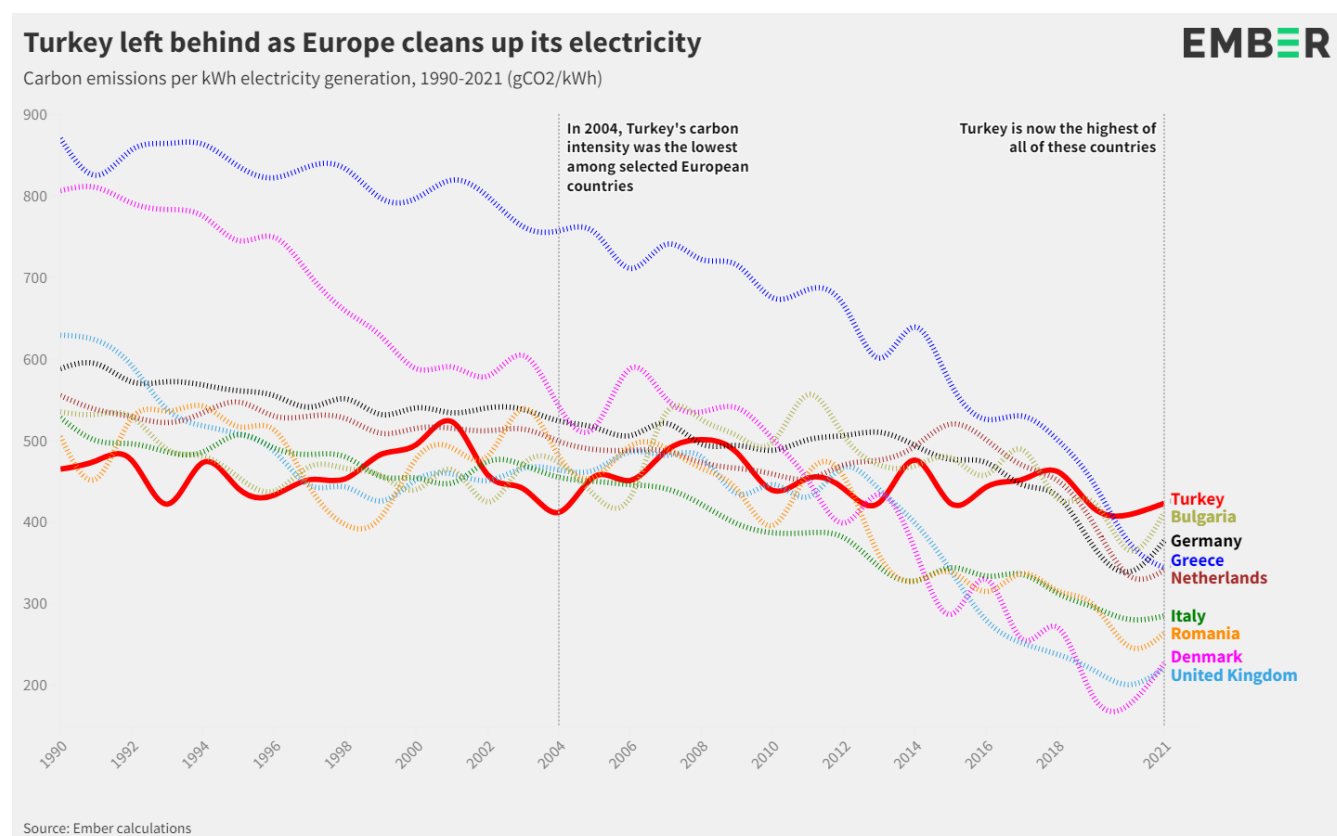


The gap between renewables and demand was mostly met by imported coal, meaning that Turkey's economic growth led to higher energy imports while increasing carbon emissions. Turkey needs to at least double its renewable deployment rate and curb its thirst for power consumption in order to

decarbonize its electricity sector and lower its import bills. Otherwise, an upward trend in demand together with hydropower volatility may even pose an energy security risk.

### Carbon intensity in electricity production did not show any improvement since 1990

In 1990, Turkey outperformed many countries in Europe in terms of carbon intensity per kWh electricity production. Although there were some ups and downs due to the volatility in hydropower generation, in 2004 Turkey's carbon intensity of power (412 g/kWh) was still better than Germany (524 g/kWh), United Kingdom (464 g/kWh), Denmark (542 g/kWh), Netherlands (499 g/kWh), Greece (757 g/kWh), Romania (481 g/kWh) and Bulgaria (473 g/kWh). However, this has turned upside down over the course of 17 years.



The steady increase in non-hydro renewables in Turkey was only enough to keep its carbon intensity in electricity production at similar levels. While Turkey ended up with 3% higher carbon intensity in 2021 in comparison to 2004, in the same period Denmark reduced it by around 60%, Greece and the United Kingdom managed to reduce it by 50%, while Romania and Italy reduced it by 45%. Despite their lack of ambition in coal phase out, even the Netherlands, Germany and Bulgaria were able to decrease it by 32%, 28% and 13% respectively in the same period. As a result Turkey has been outranked by all of these eight countries over the course of 17 years.

#### What is the Carbon Intensity of Power?

Carbon intensity is a measure of CO<sub>2</sub> equivalent emissions caused for each unit of electricity (kWh) generated in a country. The lower it is, the cleaner the power generated in that country.

## Concluding Remarks

Turkey ratified the Paris Agreement in 2021 and set a net zero target. Despite its 2053 carbon neutrality target which implies coal exit sooner or later, there is no coal phase-out date or commitment not to build new coal in place yet. The growth in renewables (excluding hydro) is promising; however, it is still lagging behind the surge in power demand. The gap between the surging demand and the rise in renewables was filled by imported coal. However, [wind and solar power are cheaper than running coal power plants relying on imports](#). The rate of renewable deployment should be accelerated not only to replace coal, but to also meet the rise in power demand.

Taking into account the fluctuations in hydropower generation, overreliance on hydro comes with a cost. But Turkey can turn its overreliance on hydro into an advantage by covering its large reservoirs with floating solar. The complementing nature of hydro and solar production patterns will hedge the country against dry seasons and the spikes in international fossil fuel prices.

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## About Ember

Ember is an energy think tank that is focused on accelerating the global transition to fossil-free electricity.

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