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HOW FAST IS KAZAKHSTAN LEAVING COAL? THE COAL SHARE OF
ELECTRICITY IN KAZAKHSTAN COMPARED WITH CHINA, RUSSIA,
UZBEKISTAN AND KYRGYZSTAN, 2000-2025

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Abstract: Coal still produces most of Kazakhstan's electricity. This study asks how fast the coal share of electricity has been falling in Kazakhstan compared with Uzbekistan, Kyrgyzstan, Russia and China, and from what moment Kazakhstan began to lag behind. Yearly data for 2000-2025 from the Ember electricity dataset were used, and the Kazakh figures were compared with the national statistics committee, the system operator KEGOC and the Ministry of Energy. Only China had a coal share as high as Kazakhstan's and reduced it steadily; in Russia, Uzbekistan and Kyrgyzstan coal was a small and not declining share. Over 2011-2025 as a whole, Kazakhstan's coal share fell about as fast as China's in the Ember data (1.6 and 1.5 percentage points per year), and slightly slower (1.3-1.4) with data only to 2022 or with the Ministry of Energy's figure for 2025. The main visible difference is in the middle of the period: from 2015 to 2019 Kazakhstan's coal share did not fall (70.6% in 2015, 70.4% in 2019), while China's fell by 1.2 points per year, and from 2017 to 2022 Kazakhstan's share was above China's. With five years of data this pause is descriptive, not statistically certain, and the year in which the lag "began" depends on how lag is defined. The clearer gap is in clean electricity: the non-fossil share of Kazakhstan's electricity fell to 8-10% in 2008-2014 and returned to 14.9% in 2025, about where it was in 2000, while China's rose from 17.9% to 41.6%. How far coal has fallen since 2022 depends on the source: Ember gives 54.3% for 2025, a 2026 Ministry of Energy statement gives 62.1%.

Keywords: coal, electricity generation, energy transition, Kazakhstan, China, Central Asia, Ember, renewable energy

Introduction

The author lives in an industrial region of Kazakhstan. In winter he regularly sees thick smog over the city and black soot on the snow. At the same time, he knows that coal power still keeps electricity affordable for homes and keeps local industry running. He wanted to understand where the line lies between cheap baseload energy and an ecological future, and whether Kazakhstan can make the energy transition without damaging its own economy. This paper approaches that question through one measurable part of it: how fast coal is leaving Kazakhstan's electricity.

Coal is the main source of electricity in Kazakhstan. In 2019, according to the national statistics committee, 70% of the country's 106 TWh of electricity was produced from coal, 20% from natural gas and 10% from renewable sources including large hydropower [2]. National plans set targets for renewable electricity of 3% of production by 2020, 6% by 2025, 10% by 2030, and 50% for alternative and renewable sources together by 2050 [3]. A 2025 study based on expert interviews and an expert survey named five main barriers to renewable energy in Kazakhstan: low

tariffs for electricity from fossil fuels, underdeveloped local production, outdated infrastructure, limited experience in localization and a lack of public interest in energy-efficient technologies [5].

International comparisons of electricity mixes are regularly published by Ember and the International Energy Agency, but they usually cover the world or large regions. This paper asks a narrower question about Kazakhstan and its neighbours: how fast has the coal share of electricity been falling in Kazakhstan compared with Uzbekistan, Kyrgyzstan, Russia and China, and from what moment did Kazakhstan begin to lag behind?

The author's expectations. On 12 October 2026, before the calculation, the author wrote down what he expected. He expected China to leave coal fastest, because it is building huge wind and solar parks and developing nuclear power, and has the money, technology and strict state policy to do so. He set Kyrgyzstan aside, because its electricity has always come mainly from hydropower. He expected Kazakhstan to have started lagging noticeably around 2017-2018, when much of the world was investing in green energy, because domestic coal is cheap, the old plants already exist, and building something fundamentally new is expensive and difficult. These expectations are tested below.

Materials and Methods

Data. The main source is the yearly electricity dataset of Ember, an energy think tank, which gives electricity generation by source, electricity demand, net imports and installed capacity for each country [1]. The full release was downloaded on 27 October 2026 (released under a CC BY 4.0 licence); it covers 2000-2025 for all five countries. Ember compiles the data from international and national statistics, so the figures may be revised in later releases, and the most recent year is the least final.

Measures. For each country and year, the share of coal in total electricity generation (in percent) was used. To see what replaced coal, the shares of gas, hydropower, nuclear power and wind and solar were also used, together with the clean share (all non-fossil sources: hydropower, nuclear, wind, solar and bioenergy, as defined by Ember). For Kazakhstan, generation and demand in terawatt-hours (TWh) were also used.

Speed of change. The speed at which the coal share changed was measured in percentage points (p.p.) per year, in two ways: as the difference between the first and the last year of a period divided by its length, and as the slope of a straight line fitted by least squares to every year of the period, with a 95% confidence interval. Because there is no single accepted definition of when one country "falls behind" another, several definitions were compared: a higher coal share than China's in a given year, the same with three-year averages, a slower trend over a period, and the fall in the coal share counted from each country's own peak. The periods 2011-2015, 2015-2019 and 2019-2025 were read from the shape of the series, so the results for them are descriptive.

Where the extra electricity came from. In the Ember data, electricity demand equals generation plus net imports. So when coal generation changes between two years, the change can be split exactly into the change in demand, plus the change in net exports, minus the change in generation from all other sources. This is an accounting identity: it shows which sources covered a change in demand, not why demand changed.

Check against national sources. The Ember figures for Kazakhstan were compared with three national sources: the energy statistics booklet of the Committee on Statistics for 2019 [2], the 2023 annual report of KEGOC, the national electricity grid operator [3], and the Ministry of Energy figures published in June 2026 [4]. All calculations were done in Python; the scripts are kept with the data.

Results

Figure 1a shows the coal share of electricity in the five countries from 2000 to 2025, and Table 1 gives its values in the main years. The countries split into two groups. In China and Kazakhstan, coal produced 70-80% of electricity for most of the 2000s. In Russia, Uzbekistan and Kyrgyzstan, coal was a small source throughout: Russia relies mainly on gas, with nuclear and hydropower, Uzbekistan mainly on gas, and Kyrgyzstan on hydropower.

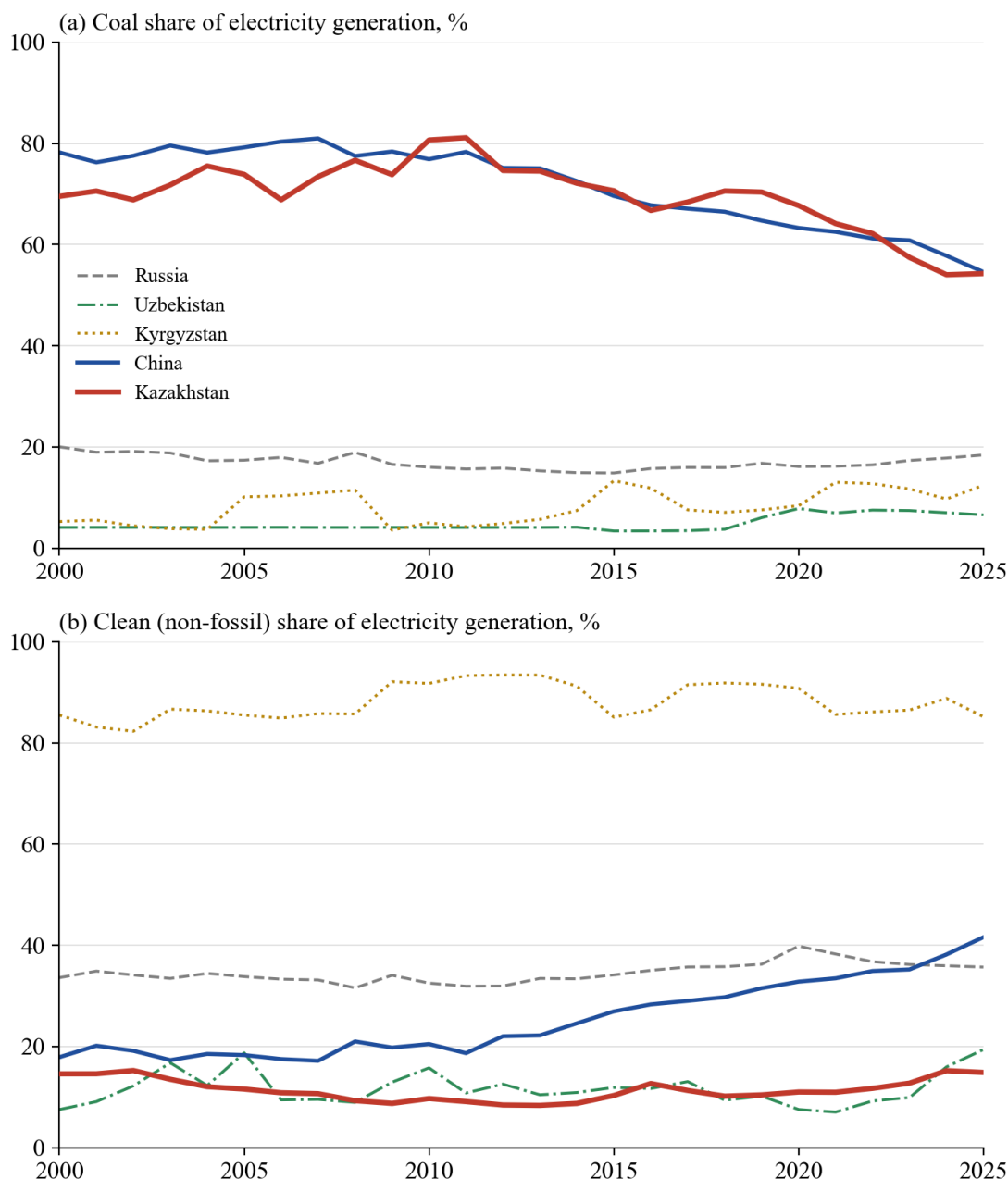


Figure 1 - Share of coal (a) and of clean, non-fossil sources (b) in electricity generation, %, 2000-2025. Data: Ember [1]

Table 1 - Coal share of electricity generation, %, and its average change (difference between end years divided by the number of years), percentage points per year. For Kazakhstan after 2022 see Table 4 and the comparison with the Ministry of Energy figures. Data: Ember [1]

Country	2000	2011	2015	2019	2025	Change per year, 2015-2019, p.p.	Change per year, 2019-2025, p.p.
Kazakhstan	69.5	81.1	70.6	70.4	54.3	-0.1	-2.7
China	78.2	78.3	69.6	64.7	54.6	-1.2	-1.7
Russia	20.0	15.6	14.9	16.8	18.4	+0.5	+0.3
Uzbekistan	4.1	4.1	3.4	6.0	6.6	+0.7	+0.1
Kyrgyzstan	5.2	4.2	13.3	7.6	12.4	-1.4	+0.8

China. China's coal share was highest in 2007 (81.0%) and has fallen every year since 2011, from 78.3% to 54.6% in 2025. Over 2000-2025 it fell by 23.6 percentage points, more than in any other country studied. Between 2019 and 2025 China's coal share fell by 10.1 points while the share



of wind and solar grew by 13.4 points (from 8.4% to 21.8%). Coal itself was not retired: China's coal capacity grew from 1,019 GW in 2019 to 1,243 GW in 2025, but its wind and solar capacity grew much faster, from 415 GW to 1,843 GW.

Russia, Uzbekistan and Kyrgyzstan. None of these three countries shows a sustained decline. Russia's coal share fell from 20.0% in 2000 to 14.9% in 2015 and has risen since, to 18.4% in 2025; in absolute terms, its coal generation grew from 158.6 TWh in 2015 to 219.5 TWh in 2025, by 38%. In Uzbekistan the coal share rose from 3-4% before 2018 to 6-8% from 2019. In Kyrgyzstan it moved between 3.6% and 13.3% from year to year, as the output of its hydropower plants changed. So among the four neighbours, only China can be compared with Kazakhstan in how it leaves coal.

Kazakhstan. Kazakhstan's coal share rose from 69.5% in 2000 to its highest value, 81.1%, in 2011, and then fell together with China's: in 2012-2014 the two shares differed by less than 0.6 points. From 2015 to 2019 Kazakhstan's coal share did not fall: it was 70.6% in 2015 and 70.4% in 2019, with a dip to 66.7% in 2016. China's fell steadily over the same years. Kazakhstan's coal share was higher than China's every year from 2017 to 2022 (and also in 2010, 2011 and 2015); the gap was largest in 2019, 5.7 points. After 2019 Kazakhstan's coal share in the Ember data fell quickly, by 2.7 points per year on average, and was below China's in 2023-2025 (54.3% against 54.6% in 2025).

When did Kazakhstan fall behind? Table 2 compares the definitions. They do not give one date. By level, Kazakhstan was above China in several separate years from 2010 and continuously from 2017 to 2022. By trend, the difference is concentrated in 2015-2019: the fitted slope of Kazakhstan's coal share was +0.3 p.p. per year and China's -1.1, but with five years of data the slope of the gap between them (+1.4 p.p. per year) has a 95% interval from -0.2 to +3.0, which includes zero. Over 2011-2025 as a whole, Kazakhstan's coal share fell about as fast as China's in the Ember data, and slightly slower with data only to 2022 (-1.3 against -1.5 p.p. per year); counted from each country's own peak, Kazakhstan's fell further in the same number of years, also before 2023.

Table 2 - Kazakhstan compared with China under different definitions of "falling behind". Data: Ember [1]

Definition of lag	Kazakhstan	China	What it shows
Coal share higher than China's in a year	2010, 2011, 2015, 2017-2022	-	above China continuously in 2017-2022 (with the Ministry's figure, also in 2025)
Same, three-year averages	2010-2012, 2014, 2016-2021	-	above China mostly in 2016-2021
Fitted trend 2015-2019, p.p. per year (95% interval)	+0.3 (-1.6 to +2.2)	-1.1 (-1.5 to -0.7)	gap trend +1.4 (-0.2 to +3.0): not certain
Fitted trend 2011-2025, p.p. per year (95% interval)	-1.6 (-2.0 to -1.3)	-1.5 (-1.6 to -1.4)	similar speed
Fitted trend 2011-2022, before the suspected break, p.p. per year (95% interval)	-1.3 (-1.7 to -0.8)	-1.5 (-1.7 to -1.3)	Kazakhstan slightly slower
Fall from own peak after 11 years, p.p.	18.9 (2011-2022)	14.5 (2007-2018)	Kazakhstan fell further
Clean share, gap with China, p.p.	-	-	3.3 (2000), 9.6 (2011), 16.6 (2015), 21.1 (2019), 26.7 (2025)

Where the extra electricity came from. In 2016 Kazakhstan's coal share dropped to 66.7%, and by 2018 it had risen again to 70.6%, while China's continued to fall. The author's explanation (14 October 2026) was that after the shock of the 2015 devaluation the economy recovered, large industrial companies increased production and electricity use, and since renewable energy was only beginning, all of the extra load was covered by the old coal plants. Table 3 shows the part of this that the data can describe. Between 2016 and 2018, demand grew by 10.4 TWh



(11.2%) and net exports by 2.2 TWh, so generation rose by 12.6 TWh; coal supplied 12.6 TWh of it (99%), and all other sources together 0.1 TWh. Gas rose by 2.4 TWh, but hydropower and other fossil fuels each fell by 1.2 TWh; 2016 had the highest hydropower output of the whole period (11.6 TWh). Between 2019 and 2025 the situation in the Ember data was different: demand grew by 22.7 TWh (21.9%), other sources added 25.0 TWh (gas 16.5 TWh, wind and solar 6.8 TWh), the country turned from a net exporter into a net importer of electricity, and coal generation fell by 7.8 TWh.

Table 3 - Where the change in Kazakhstan's coal generation came from (rows are rounded, so sums may differ by 0.1). Data: Ember [1]

Change, TWh	2016-2018	2019-2025
Electricity demand	+10.4	+22.7
Net exports	+2.2	-5.5
Generation from all sources other than coal	+0.1	+25.0
of which gas	+2.4	+16.5
of which wind and solar	+0.2	+6.8
of which hydropower	-1.2	+0.5
of which other fossil fuels	-1.2	+1.2
Coal generation (= demand + net exports - other sources)	+12.6	-7.8

What replaced coal. Figure 1b shows the clean share of electricity. Kazakhstan's clean share was 14.6% in 2000, fell to 8-10% in 2008-2014, and returned to 14.9% in 2025; in TWh, clean generation grew from 7.5 to 18.4. In the same period China's clean share rose from 17.9% to 41.6%, and in 2024 and 2025 Uzbekistan's was again above Kazakhstan's (19.4% against 14.9% in 2025), as wind and solar reached 12.1% of Uzbek generation in 2025 against 6.4% in Kazakhstan. In the Ember data, of the 16.1-point fall in Kazakhstan's coal share between 2019 and 2025, gas took 10.8 points and wind and solar 5.3 points. Kazakhstan's coal capacity hardly changed over ten years (13.1-13.5 GW in 2015-2025).

Check against national sources. Table 4 compares Ember with the national figures. They agree on total generation, the fossil share and the clean share; they disagree on the split between coal and gas. Total generation in 2019-2023 differs from KEGOC's by less than 1%. For 2019, Ember and the statistics committee agree on the coal share (70.4% and 70%), and the share of renewable sources including large hydropower in 2015-2019 is the same in both to one decimal place (which suggests that Ember uses these national figures, so this is not an independent check). In 2023 KEGOC gives 87.2% of generation from thermal and gas turbine plants together, and Ember gives 87.3% from fossil fuels. The Ministry of Energy figures published in June 2026 give coal 62.1% and gas 23.4% without stating the year [4], while Ember gives 54.3% and 29.4% for 2025; the clean share agrees (14.5% and 14.9%). Apart from the Ministry's undated 2026 figure, no national source available for this study divides thermal generation by fuel for 2015-2018 or after 2019.

Table 4 - Ember data for Kazakhstan compared with national sources [1-4]

Indicator	National source	Ember
Total generation 2019 / 2021 / 2023, TWh	106.0 / 114.5 / 112.8 (KEGOC)	106.5 / 115.1 / 113.6
Coal share 2019, %	70 (Committee on Statistics)	70.4
Renewables including large hydropower 2015 / 2016 / 2017 / 2018 / 2019, %	10.3 / 12.7 / 11.3 / 10.2 / 10.4 (Committee on Statistics)	10.3 / 12.7 / 11.3 / 10.2 / 10.4
Thermal and gas turbine plants 2023, %	87.2 (KEGOC)	87.3 (all fossil)
Coal share, latest, %	62.1 (Ministry of Energy, June 2026, year not stated)	54.3 (2025)
Gas share, latest, %	23.4 (Ministry of Energy)	29.4 (2025)
Clean share, latest, %	14.5 (large hydropower 7.5 and renewables 7.0, Ministry of Energy)	14.9 (2025)

If the Ministry's coal share of 62.1% is taken for 2025, five Ember-based results change: Kazakhstan's coal share would have fallen by 1.4 points per year after 2019, slower than China's



1.7; it would still be 7.5 points above China's; coal generation would be about 76.8 TWh, 1.9 TWh more than in 2019, not less; the fall in coal's share since 2019 would have gone about equally to gas (+4.8 points) and to clean sources (+4.1 points); and over 2011-2025 the fitted trend would be -1.4 p.p. per year, slightly slower than China's -1.5.

Discussion

The author's first expectation was right in the main: China left coal fastest of the four neighbours, and it did so mainly through wind and solar, as he expected. Its nuclear share, however, stayed below 5%, so nuclear power played a small part. He was also right to set Kyrgyzstan apart. What his expectation did not include is that Russia and Uzbekistan are not leaving coal: their coal shares are small, but they have grown slightly since 2015, and Russia's coal generation grew by more than a third.

His second expectation, that Kazakhstan began to lag around 2017-2018, matches the simplest definition: Kazakhstan's coal share was above China's every year from 2017 to 2022. But Table 2 shows that the answer to "from what moment" depends on the definition. Over 2011-2025 as a whole, Kazakhstan's coal share fell about as fast as China's in the Ember data, or slightly slower with data only to 2022 or with the Ministry's figure; the visible difference is a pause of about five years in 2015-2019, when Kazakhstan's share stayed near 70% while China's kept falling. That pause was not unique to Kazakhstan: in the same Ember data, the coal shares of South Africa and India also fell by only about 0.5 p.p. per year in 2015-2019, while Poland and Australia fell by about 1.8-1.9 p.p. per year. The measure on which Kazakhstan has clearly fallen behind China is clean electricity: the gap grew from 3.3 points in 2000 to 26.7 points in 2025, and it grew faster after 2011 than before.

His explanation of 2016-2018 agrees with Table 3 in its mechanical part: demand grew by 11.2% in two years, and almost all of the extra electricity came from coal, while other sources together added almost nothing. Three remarks are needed. The table is an accounting identity, so it shows which plants covered the extra demand, not why demand grew; the role of the 2015 devaluation and of industry would need data on electricity use by sector. About 2.2 of the 12.6 TWh went to higher net exports, not to domestic use. And the rise in 2016-2018 partly reflects how low 2016 was: in 2015 the coal share was already 70.6%, as high as in 2018, and 2016 was the best hydropower year of the period.

The reasons the author gave for the lag, cheap domestic coal, existing old plants and the high cost of new construction, agree with two of the barriers named by the experts in [5], low tariffs for fossil-fuel electricity and outdated infrastructure. In the data they are consistent with a coal capacity that has not changed in ten years and a clean share that stayed between 10% and 13% from 2015 to 2023; the data alone cannot show that these barriers caused the pause. Renewable sources did grow after 2019: according to KEGOC, they produced 6.0% of electricity in 2023, which already met the national target of 6% for 2025 [3]. Whether most of the coal that left the mix after 2019 was replaced by gas, as in Ember, or about equally by gas and clean sources, as the Ministry's figures would imply, cannot be decided from the available sources.

Limitations. The Ember split between coal and gas in Kazakhstan shows signs of breaks in the series. The gas share stays at 10.6-10.7% every year from 2000 to 2005, which looks like an estimate rather than a measurement, and Uzbekistan's coal share is 4.1% every year from 2000 to 2014. Kazakhstan's gas share jumps from 9.2% in 2011 to 16.1% in 2012, the year after the coal peak, and from 24.9% in 2022 to 29.3% in 2023, when total generation and installed gas capacity hardly changed (from 4.14 to 4.26 GW); this would mean gas plants running about 89% of the hours in 2023, an unusually high value. The 2011 peak and the post-2022 fall of coal should therefore be read with caution, while the total of fossil generation and the clean share, which national sources confirm, are more reliable. The latest year in Ember is the least final, and some 2025 values repeat the 2024 values (for example, Kazakhstan's net imports). Shares hide size: China generated about 85 times more electricity than Kazakhstan in 2025, and its coal generation in TWh was still growing until 2024. Finally, this is a description of yearly national data; it does not measure the effect of any policy.



Conclusion

Among Kazakhstan's neighbours, only China had a coal share of electricity as high as Kazakhstan's and reduced it steadily, from 78.3% in 2011 to 54.6% in 2025, mainly through wind and solar. Russia, Uzbekistan and Kyrgyzstan never depended much on coal and are not reducing it. Over 2011-2025 Kazakhstan's coal share fell about as fast as China's in the Ember data (slightly slower with the Ministry's figure), but not evenly: it fell with China's in 2011-2015, paused near 70% in 2015-2019 (in 2016-2018 growing demand was covered almost entirely by coal), was continuously above China's in 2017-2022, and then fell quickly. So the answer to "from what moment did Kazakhstan begin to lag" is: in coal share, during a pause in 2015-2019, visible as a continuously higher share than China's from 2017; in clean electricity, Kazakhstan has been behind China for the whole period, and the gap has widened, with small interruptions, since 2011. Whether Kazakhstan's coal share is now at China's level depends on the source (54.3% in Ember, 62.1% in the Ministry's figures). A next step would be to obtain the official split of thermal generation between coal and gas by year, and to check, with data by sector, which industries drove the growth in demand.

Data availability. The Ember yearly electricity data are publicly available at the address in reference [1]; the national figures are from the documents in references [2-4]. The extracted table and the analysis scripts are kept by the author's research mentor and are available on request.

Author contributions and use of AI tools. The author chose the research question (6 October 2026), wrote his expectations before the calculation (12 October 2026), found reference [5], and wrote the explanation of 2016-2018 tested in this paper (14 October 2026) and the account of smog and soot in the Introduction (17 October 2026). The data were downloaded and analysed, and the English text was drafted, by his mentors with the help of an AI assistant (Claude); the author read the final text and confirmed that it describes his part correctly.

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Conflict of interest. The author declares no conflict of interest.

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