COP 26 — The Coal Countdown

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End of Coal in Sight?

According to a 2020 study conducted in EU 28 countries on lifecycle CO_2emission per kWh generated by different electricity sources, pulverised hard coal has 70 to 170 times more global-warming potential when compared with offshore wind and conventional LWR. Even when compared with the natural gas combined cycle (NGCC, most commonly CCGT), coal emits about 2.5 times of greenhouse gas.[1]

Despite the (late and rather reluctant) full adoption of flue-gas desulfurization systems (FGD, used to reduce $SO_2$from exhaust flue gases) across UK's coal-fired plants since 2015. It's inevitable that during energy production, coal-fired power plants still directly emit particulate matter (PM, colloquially "soot") as well as gases that undergo chemical reactions to form fine particles in the atmosphere, such as SO_2 and NO_x. These emissions cause significant degradation in air quality and low pH precipitation (acid rain) over large areas downwind of the plants which have been consistently linked with increased mortality from cardiopulmonary diseases and numerous other respiratory illnesses.[2][3]

Based on the aforementioned risks coal power poses on the environment and human health. "A rapid phase-out of coal" was set as one of the major priorities of the COP 26 conference, during the conference countries had pledged to phase out coal power by 2040 at the latest, and major banks had committed to halting international public financing of new unabated coal by 2022.[4]

Till 2020, power stations remain the largest coal consumer in the UK accounting for about 33% of total coal usage. And since the 2015 shutdown of the last British deep coal mines, most UK coal consumption comes from imports, (with Russia being the largest provider of UK's steam coal accounts for 53% of 2021's total import, and another 15% import from Venezuela[5]) while the remaining 36% come from domestic surface mining. [6]

UK government and National Grid have committed to completely phasing out coal power by October 2024.[7] By this date, all 3 last remaining active core-fired power stations in the UK (which has a total capacity of 4.52GW, accounts for 6% of the UK's installed capacity (2020)[8]) are scheduled for decommissioning.

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[1] "Life Cycle Assessment of Electricity Generation Options | UNECE" unece.org. Retrieved 11 March 2022.

[2] "Estimating the Health Impacts of Coal-Fired Power Plants Receiving International Financing" environmental defence fund. Retrieved 20 March 2022.

[3] "The politics of FGD deployment in the UK" UK Energy Research Centre. Retrieved 24 March 2022.

[4] "End of Coal in Sight at COP 26" United Nations external press release 04-11-2021. Retrieved 20 March 2022.

[5] "Coal Import – GOV.UK" assets publishing service gov.uk. Retrieved 22 March 2022.

[6] "UK Energy in Brief 2021" Department for Business Energy & Industrial Strategy. Retrieved 11 March 2022.

[7] "End to coal power brought forward to October 2024" GOV.UK. Retrieved 11 March 2022.

[8] "Digest of UK Energy Statistics (DUKES): electricity" GOV.UK. Retrieved 14 March 2022.

UK Government Stance on Coal Emission Regulations

During the negotiations of the EU Emission Trading System (EU ETS), the European directive on Large Combustion plants (LCPD), UK had been seen as "a key force for delay and lower ambitions."

UK coal-fired plants had lobbied for extra carbon allowance in exchange for FGD adoption under the EU ETS scheme. During the aforementioned EU negotiations, with government supports UK utilities most of the time had opposed emission limitations and the introduction of FGD. There were even separate negotiations between the UK coal plant operators and UK regulators about the use of cheaper fuels with higher sulphur content.[9]

A Recent UK-EU Court Case on Coal

Volatile matter (VM) refers to the amounts of unstable components in coal that readily produce CO_2, SO_2, NO_x during combustion. VM value is therefore used by ISO as an emission potential indicator to classify coal rankings; as the rank of coal increases, the VM value decreases.[10]

The European Parliament and European Council (EC) have introduced a directive on industrial (large combustion plants) emissions in 2010 which regulates solid fuel (coal) used in thermal plants must have VM values less than 10%. [11]

Neither UK regulator nor coal plant operators in the UK regularly provide precise data on plants' annual average volatility. A 2012 EC inquiry discovered Aberthaw power station (South Wales, closed in 2020) may have emitted Nitrogen Oxides 2.6 times the regulatory limit during 2009 to 2011, and the coal used in Aberthaw PS only had average VM values of less than 10% in few brief occasions during the same period.

The incompliance incident on the EC directive has resulted in 2015 the UK government being taken to the EU Court of Justice by the EU commission over excess emissions from Aberthaw PS[12][13]

During the 2015 infraction proceedings, EC accused the UK government's response to Aberthaw PS's nitrogen oxide over-emission and its breach on VM limit "littered with inconsistent or missing data".[14]

Some reports suggested the UK government's insistence for Aberthaw PS's continued operation till 2 years ago despite the European court case was because 2/3 of Aberthaw PS 5000 – 6000 tons of daily coal consumption came from South Wales Coalfield and the support that provides to the sizable local coal mining industry; despite in fact, Welsh coal is better suited for long-outdated steam engines, difficult to ignite and requires chemical catalysts to initiate ignition.[15]

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[9] "The politics of FGD deployment in the UK. 2.3 key actor and their roles" UK Energy Research Centre. Retrieved 24 March 2022.

[10] "Volatile Matter (Part of Proximate Analysis)" Kentucky Geological Survey. Retrieved 19 March 2022.

[11] "EU Parliament Directive 2010/75/EU" Official Journal of the European Union. Retrieved 19 March 2022.

[12] "Court of Justice of the European Union, Report of Cases". EUR-Lex. 21-09-2016. Retrieved 20 March 2022.

[13] "UK government taken to court over Aberthaw Power Station emissions" BBC News 26-03-2015. Retrieved 20 March 2022.

[14] "UK lobbying to keep open one of Europe's dirtiest coal power plant" the Guardian 19-08-2014. Retrieved 20 March 2022.

[15] "Aberthaw power stations •Operations" Wikipedia. Retrieved 22 March 2022.

The Economy of Coal and A Counterproductive Capacity Market

Already in 2020 coal contributed only 1.8% of the UK's electricity mix which was down from 25% five years ago. And there are increasing periods of coal-free electricity generation.

Contrary to the common belief that coal is used as baseload generation that constantly operates around the clock, coal-fired plants actually have load factors below 10% since 2019[16]. (Plant Load Factor PLF is the ratio between the actual energy generated to the maximum possible energy that plant can generate at rated power for an entire year; UK CCGTs have PLF above 40%; UK nuclear fleet has PLF around 65% to 80%.)

Continued operation and economic viability of the remaining coal-fired power stations entirely depend on securing contracts from the capacity market (previously the National Grid Supplemental Balance Reserve (SBR))[17]. However, it is worth mentioning that in the past coal plants had defaulted on their capacity market contracts or opted to retire due to the high costs for upgrade/refurbishment obligated by such contract. (e.g., Fiddlers Ferry broke 2018/9 capacity contracts incurring a £33m penalty[18], early closure of Drax unit 5-6)

The largely moderate and volatile capacity market (CM) pricing doesn't attract investors building new dedicated CCGT plants which in part keeps coal fire plant competing contracts in the CM market. (CM T-4 auctions were cleared around £20/kW from 2018/19 to 2020/21 and dropped to about £7 for year 2021 to 2023; CM T-1 auctions were cleared low at <£7/kW from 2017/18 to 2020/21, till a sudden rise to £45/kW in 2021/22.[19])
National Grid asserts that new gas plants could be built with money from the Capacity Market if the auctions clear at £49/kW (i.e., Cost of New Entry, CONE)[20], as shown above, all the T-4 auctions since the introduction of CM in 2017/18 have cleared well below such value.
(Bulk of the capacity for each delivery year is forecast and secured 4 years in advance through T-4 auctions, T-1 auctions act as near term "top-up" supplements T-4; therefore, the average yearly Capacity cost is largely set by T-4 price rather than T-1).

On a side note, in 2019 220MW (not a lot, about 14% of Aberthaw PS capacity) of diesel generation has successfully won the T-1 Capacity Market bid. All diesel generator sets providing the aforementioned capacity are small units that are not restricted by the current carbon pricing scheme also with less strict emission limits. Funding those highly polluting diesel generators in the electricity system is seen by some as a setback to the decarbonisation process. [21]

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[16] "PLF of coal fired stations in the UK from 2010 to 2020" Statista. Retrieved 14 March 2022.
[17] "Supplemental Balancing Reserve from forecasting to despatch" National Grid ESO. Retrieved 12 March 2022.
[18] "SSE set to shut down ¾ of Fiddlers Ferry" Utility Week. Retrieved 14 March 2022.
[19] "Capacity at What Cost" Inspired Energy. Retrieved 14 March 2022.
[20] "Electricity Market Reform – Capacity Market" GOV.UK. 04-09-2014.Retrieved 14 March 2022.
[21] "How new diesel generators are securing excess returns at taxpayers' expense" IPPR Think Tank. Retrieved 22 March 2022.

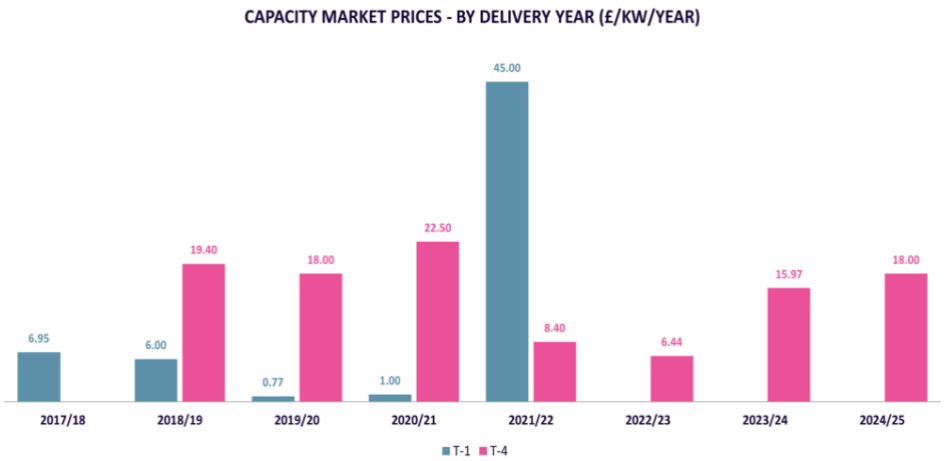

Figure 1. UK Capacity market T-1/T-4 auction prices — highly volatile and never enough to encourage less polluting gas plants/renewables to be built.

An Unexpected Resurrection?

In March 2022, multiple news outlets have reported that the government has contacted operators of the remaining coal power plants and were already in early stage talks in delaying shutdowns beyond the promised 2024 deadline.[22][23] With the soaring pipeline gas/LNG price triggered by the Russia-Ukraine conflict, the UK government has pledged to end Russian oil and gas import amid heightened concern about the use of Russian gas in the UK by the end of 2022.[24] Keeping the coal-fired plants online at least for the short term future seems to be a cost-effective way for the government to ease the current energy crisis.

Commentary:

- UK's coal-fired generation fleet is heavily reliant on imported coal (i.e., steam coal. coking coal import also facing similar situation), especially from countries that are now under increasing international sanctions. Fragile fuel accessibility raises questions on energy security. The government has not yet announced policies to address such dependency by means of increasing domestic coal production, exploring alternative foreign coal suppliers etc.
- *The current capacity mechanism doesn't motivate the modernisation and decarbonisation objectives of the UK electricity system.* One evidence of that is the capacity mechanism has failed to attract any new gas plant construction or interconnectors to the market. And coal plants continue to live on this scheme to stay open longer than they would have otherwise, despite the government's pledge to phase-out coal generation.
- The government's track record in lobbying for the continued operation of coal plants and seeking related legal exceptions before Brexit does *cast doubt on the UK government's sincerity behind its "complete phasing out on coal by 2024"*

[22] "UK may delay closure of coal power stations due to energy crisis" Independent. 14-03-2022. Retrieved 22 March 2022.
[23] "Plans to Keep Coal Plants Open" The Times. 14-03-2022. Retrieved 22 March 2022.
[24] "Press Release: UK to phase out Russian oil and gas imports" GOV.UK. 08-03-2022.Retrieved 23 March 2022.

commitment. *The recent history of the British government supporting UK coal-fired plant operators against the pressure for harder emission regulations from the EU does make one question the degree of goodwill behind the government's promise.*

- Given recent announcements from both the UK and EU authorities in cutting off the majority of Russian oil and gas imports by end of this year[25] and the strong public support rallied behind such policy; additionally with the UK government's failed attempt in securing alternative oil/gas suppliers[26]. Based on the current extremely low load/capacity factor of the 3 active coal-fired plants, there is a large potential generation capacity from those plants that *could be attractive for the government to use as a stopgap while Russian fossil fuel being phased out from the wider European grid.*

[25] "EU rolls out plan to cut Russia gas dependency this year" Reuters. 08-03-2022. Retrieved 24 March 2022.
[26] "Boris Johnson returns from trip to Saudi Arabia without commitment on oil" Financial Times. 16-03-2022. Retrieved 24 March 2022.