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China Coal Action Plan Offers Roadmap for Coal Phase-Out

By Helen Jia, Runjin Yang, Benjamin McCarron

The Chinese government has issued the first carbon-reduction plan for coal-fired power emissions. Operators and investors should consider what this means for current and proposed plants.

China Coal Action Plan Offers Roadmap for Coal Phase-Out

- The new plan sets out carbon emissions-reduction targets for new and retrofitted coal power plants, using biomass, ammonia, and carbon capture.
- Analysis shows the new targets drive the cost of most low-carbon coal-fired power above the price of renewables with grid-scale storage.
- The plan signals policy turning away from unabated coal power, increasing risks to new or recent investments.
- There is now a stronger case for power utilities to safeguard capital expenditure plans through issuing no-new coal-fired power commitments.

In July, the Chinese government issued an Action Plan guiding the country's coal-fired power industry along the first steps on a path to decarbonisation. The plan establishes two milestones for the transformation of existing power plants, and the construction of new lower-carbon facilities.

"By 2025, the first batch of low-carbon coal-fired power transformation projects will all be started," the document states. Carbon emissions per kilowatt hour (KWh) of these projects will be about 20% lower than those from the equivalent units in 2023. By 2027, the emissions per KWh will be reduced by about 50%, "approaching the carbon emission level of natural-gas power generation."

The plan proposes three approaches. The first two involve co-firing in new or retrofitted plants; reducing emissions by blending coal with biomass or with "green ammonia." The third is to deploy carbon capture, utilisation and storage (CCUS) technologies.

According to the official document, power plants will have to blend coal with a minimum 10% biomass from agricultural and forestry waste, or the equivalent percentage of ammonia synthesised by "utilising surplus electricity from renewable energy sources such as wind power or solar generation."

In addition, plants will deploy "chemical, absorption, membrane, and other technologies to separate and capture carbon dioxide from flue gas."

Figure 1: Retrofitting Plants

Category	Criteria
Biomass Co-Firing	Utilising biomass resources such as agricultural and forestry waste, desert plants, and energy crops. The process considers biomass supply, operational safety, flexibility, efficiency, and economic feasibility to couple biomass with coal-fired power generation. After retrofit, coal power units should be capable of co-firing more than 10% biomass fuel, significantly reducing coal consumption and CO_2 emissions.
Green Ammonia Co-Firing	Using excess renewable energy (wind and solar) to produce green hydrogen through water electrolysis, which is then synthesised into green ammonia. This green ammonia is co-fired with coal in power generation. After retrofit, coal power units should be capable of co-firing more than 10% green ammonia, significantly reducing coal consumption and CO_2 emissions.
Carbon Capture, Utilisation, and Storage	Employing technologies such as chemical absorption, adsorption, and membrane separation to capture CO_2 from coal boiler flue gases, followed by regeneration and purification through pressure and temperature adjustments. CO_2 can be utilised in enhanced oil recovery or converted into chemicals like methanol or stored geologically. After retrofit, site-specific CO_2 geological storage should be implemented, significantly reducing CO_2 emissions.

For China, this is a step forward. While it has established a dominant global position in renewables and EVs, its reliance on coal power remains a major obstacle to achieving its emissions targets. For a country that accounted for about 95% of the world's new coal-power construction activity in 2023,[1] the Action Plan can be seen as an important initial statement of intent.

At the time of writing, aspects of the plan remain unclear, however. It does not state which, or how many, coal plants will be targeted for retrofitting, or whether retrofitting will be confined to a limited number of demonstration projects. It is also unclear whether the emissions targets for new coal plants will be mandatory.

So, at this stage, we don't know whether China's coal policy will echo that of Japan — by introducing co-firing and subsidising demonstration projects designed to reduce

1 Global Energy Monitor, Carbon Brief

emissions but delay the retirement of coal[2]—or of the US and UK, where prohibitively expensive new build and retrofitting standards have driven a phase out of coal.

So, what could China's plan mean for the industry, and for investors? Does it allow operators to extend retirement plans for coal-fired power, or encourage no-new-coal commitments from an industry that has, to date, been reluctant to make the first move in the absence of clear policy guidance?

Using data from the International Energy Agency (IEA) and other sources, ARE has examined the various possibilities presented by the plan to gauge how it might impact the decisions of investors and power companies. We believe it can potentially encourage operators to commit to no new coal and dissuade future investment in coal plants.

Crucially, this is the first time the government has issued a quantitative carbon-reduction plan for coal-fired power emissions, with a specific timeline. As such, the Action Plan has opened a path forward.

Why The Plan Can Discourage New Coal

Cost & Feasibility

We expect that though co-firing and CCUS technologies do theoretically offer the potential to delay the coal phase-out, the costs of retrofitting and other factors are likely to prove too prohibitive compared with renewables-plus-storage, and the benefits too limited, to encourage widespread implementation.

The renovation and construction requirements for coal power plants under the plan are straightforward enough; the document stipulates that projects seeking to co-fire biomass should be sited near "long-term and stable access to agricultural and forestry waste," while the first plants to use green ammonia should be close to "large-scale wind power and photovoltaic bases in deserts, Gobi, and wasteland areas."

But construction and retrofitting of power plants is, of course, a lengthy and expensive process. The costs of renovation and the compressed timeline—with all projects to begin by 2025—suggest that retrofitting may initially be confined to demonstration projects.

These projects are likely to be subsidised at first. The document says capital will be available through the newly issued ultra-long-term special government bonds "and other funding channels." But even if initial capital investment costs are subsidised, ongoing fuel and operating costs are likely to be a deterrent factor.

2 Bloomberg New Energy Finance (BNEF)

For operators, co-firing looks expensive and impractical. Green ammonia is significantly more costly than coal, ranging from USD720 to USD1,400 per tonne.[3] Moreover, ammonia's lower energy density (about 18.6 MJ/kg compared with coal's 24-35 MJ/kg) means that a larger volume of ammonia is needed to produce the same amount of energy, further increasing costs. And while biomass co-firing is cheap, especially when directly mixed, availability of resources and transportation radius of raw material are major obstacles in China.

If operators pursue the targets, for power plants to achieve a minimum 50% reduction in carbon emissions the proportion of green ammonia co-firing would need to exceed 50%,[4] well above the mandated minimum of 10%. There are newly retrofitted ammonia co-firing test projects in Japan with blending rates of 20%. However, there is no certainty that co-firing at 50% is feasible. There is still the question of how to bring the carbon emission rates down to zero, which could only be achieved by switching to 100% green ammonia or adding CCUS.

According to a Bloomberg New Energy Finance study of Japan's co-firing policy, "retrofits with 50% and 100% ammonia blending are set to be far more expensive than 20% ammonia blending and therefore uncompetitive against other low-emission technologies."[5] By 2030, the study estimates, even the most expensive renewables like offshore wind will be cheaper than 50% ammonia + coal retrofits.

The economics for adding CCUS on top of co-firing seem completely prohibitive. CCUS has very high up front capital requirements, which must be amortised over the remaining years of competitive life before renewables paired with grid-scale storage become cheaper. Each passing year gives less time to earn back the costs of a CCUS retrofit.

These higher operating costs will ultimately lead to more expensive power. As the table (Figure 2) below shows, based on IEA data the Levelised Cost of Electricity (LCOE)[6] for coal power with CCUS is still currently higher than that for renewable energy paired with utility-scale storage, and is estimated to remain so through 2027 and beyond.

Only unabated[7] coal can achieve a lower LCOE than renewables, and if China is to meet its emissions targets, unabated coal is not a long-term viable option.

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3 Oxford Institute for Energy Studies, Can Hydrogen and Carbon Capture and Storage (CCUS) help Decarbonize the coal power plants in Asia?, 2024

4 BNEF

5 BNEF

6 Value of the net present cost of produced electricity, accounting for costs over the full life cycle of the generator.

7 The term "unabated" has various definitions:

— OECD: Pollution abatement refers to technology applied or measures taken to reduce pollution and/or its impacts on the environment.

— IEA: Use of fossil fuels in facilities without CCUS is classified as "unabated."

— IPCC: "Unabated fossil fuels" refers to fossil fuels produced and used without interventions that substantially reduce the amount of GHG emitted throughout the life-cycle; for example, capturing 90% or more from power plants, or 50-80% of fugitive methane emissions from energy supply.

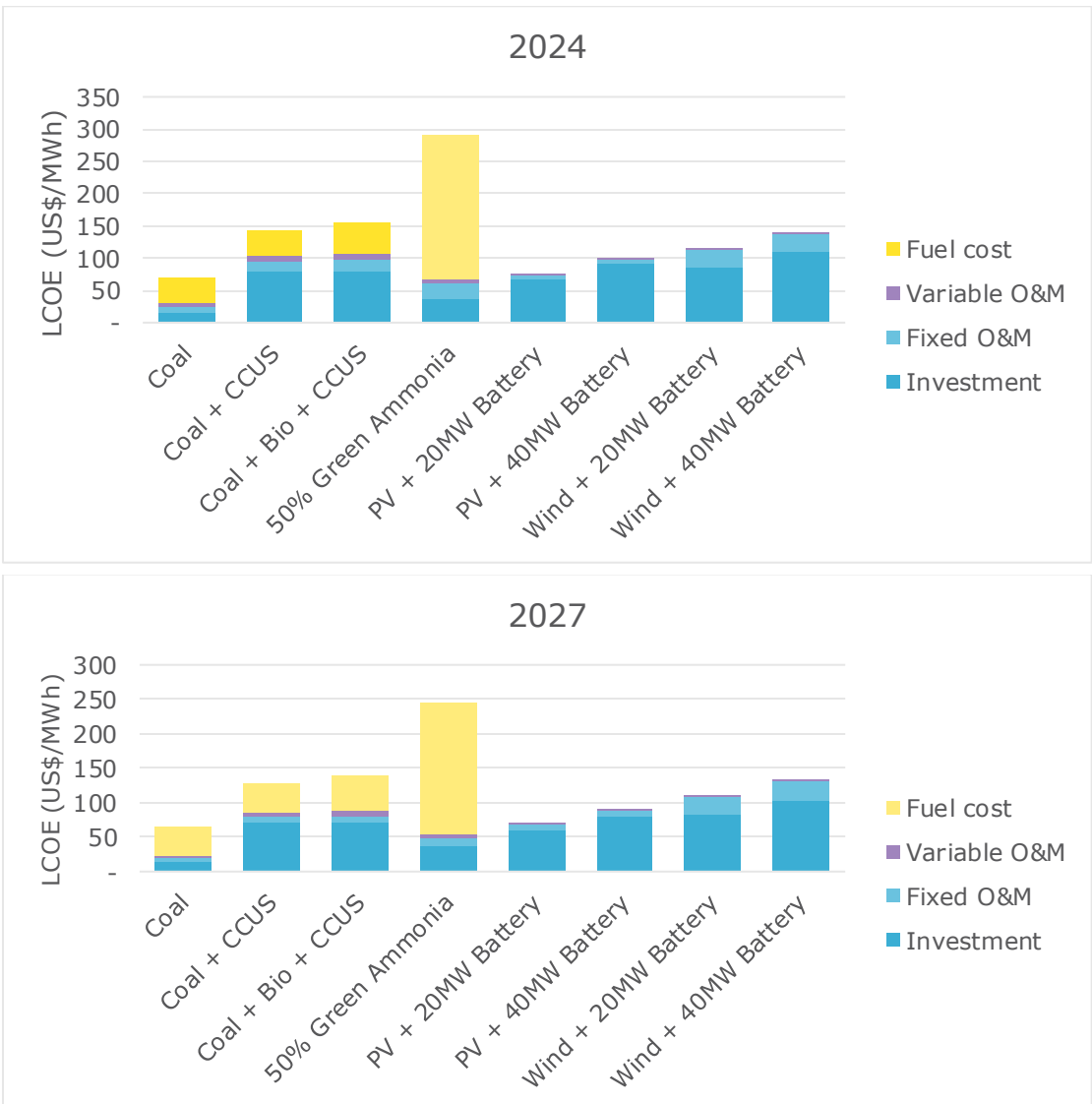
As renewable energy sources paired with grid-scale storage solutions become increasingly cost-effective, and storage technology steadily improves, new coal plants or those with expensive retrofits will look increasingly unviable.

Figure 2: Systems Used for Levelised Cost of Electricity (LCOE) Comparison

System	Capacity factor	Notes
Coal	50%	
Coal + CCUS	50%	Carbon capture rare of 90%, transportation and storage not included.
Coal + 20% Bio + CCUS	50%	Biomass based on straw, with 20% co-firing.
50% Green Ammonia	50%	Green ammonia cost assumed at 1000 US$/tonne
PV + 20MW Battery	21%	100 MW Solar PV Power Plant with 20MW/40MWh Battery Energy Storage System
PV + 40MW Battery	21%	100 MW Solar PV Power Plant with 40MW/160MWh Battery Energy Storage
Wind + 20MW Battery	21%	100 MW Onshore Wind Plant with 20MW/40MWh Battery Energy Storage
Wind + 40MW Battery	21%	100 MW Onshore Wind Plant with 40MW/160MWh Battery Energy Storage

Note 1: The 50% capacity factor or utilisation used for the coal plants is slightly below China's current average utilisation for coal power plants.
Note 2: The 21% capacity factor used for PV and onshore wind is in line with China's average.

Figure 3: Estimated Capacity-Weighted Levelised Cost of Electricity (LCOE) for Different Power Resources in 2024 and 2027.



Source: ARE analysis, based on inputs from IEA, Future Bridge, BloombergNEF

Emissions Targets

The other salient issue operators and investors must consider is: will retrofits extend the life of coal-fired energy in China, potentially delaying renewable build-out and resulting in higher cumulative emissions? Or will the economics of retrofitting and carbon reduction steer the industry and the country as a whole towards meeting the IEA's Net Zero 2050 (or the government's Net Zero 2060) target?

If existing retrofitted coal power plants meet the stipulated 50% carbon reduction by 2027, that would leave them with emissions of about 0.44kg of CO_2 per KWh (based on Climate Bonds data[8] that calculates the average emissions of a coal plant in China at 0.87kg). That would still be almost double the International Energy Agency's (IEA) 1.5°C power industry emissions target of 0.23kg of CO_2 per kWh.

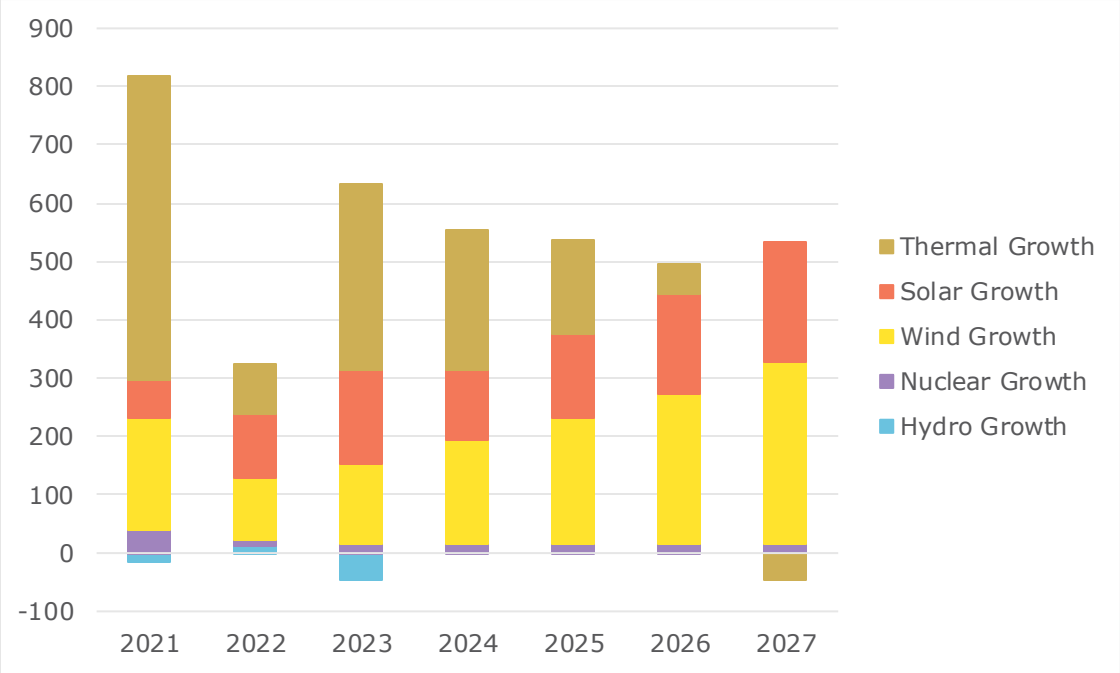
To achieve the IEA target, then, plants would need to blend in at least 50% green ammonia or biomass with CCUS, which is not economically feasible.

Lingering Issues

Supporters of coal power may first point to the need to meet China's rising electricity use. In 2023, electricity demand grew 6.7% year-on-year, and more than half of that was supplied by thermal power plants, which predominantly use coal. However, without considering the highly variable increase in hydropower, with wind and solar on track to grow by about 20% according to our estimates, and electricity demand growth forecast to taper off to 4.5% by 2027, renewables will be able to meet future increases in usage.

8 Climate Bonds

Figure 5: Rapid Electricity Growth Scenario in China



Note: Wind and solar PV assumed to grow by around 20%; electricity demand growth: 2024: 6%, 2025: 5.5%, 2026: 4.8%, 2027: 4.5%; hydropower assumed to remain constant. The growth rate for nuclear power is assumed to be consistent each year.

Source: ARE analysis, based on inputs from National Bureau of Statistics

The IEA recently projected that, assuming normal weather conditions and a rebound in hydropower output, renewable energy and nuclear power are expected to meet almost all incremental electricity demand, starting this year.[9]

If companies were required to commit to only building new coal power plants with at least 50% fewer emissions by 2027, then renewable energy with battery storage would be the most cost-effective short-term solution to balancing the grid.

The other lingering issue is intermittency both intra-day and between seasons. Solar PV only produces for certain hours of the day, generally mismatched with the peaks in demand. Consequently, adding new solar does not reduce the need for generation capacity that can meet users' needs when solar is not generating. Short term storage solutions, including batteries or pumped hydro, can reduce the need for coal or gas fired power to plug the gap. But the capital costs are high to completely cover the intra-day shortfalls. So, there is a role for fossil-based peaker plants that can meet periods of high demand, and this will remain the case for some time.

The other challenge relevant for wind as well as solar is that of seasonal variability. Again, there need to be storage solutions.

9 IEA, Electricity 2024 - Analysis and forecast to 2026, 2024

In the long-term, storage technologies can replace backup generation. So, companies should carefully consider the purpose for any new coal or gas power plants, and differentiate between essential and non-essential projects, considering how the usage patterns and competitive positioning will evolve for such plants over their planned lifespan.

Overall, from a cost and operational perspective and bearing in mind the likely direction of regulation, the arguments in favour of building new coal plants as an essential tool for meeting power demand and providing cost-effective flexibility have weakened significantly.

Takeaways

To date, encouraging a halt on the construction of new unabated coal power plants in China has been challenging. In the absence of clear policy guidance, state-owned power companies have been reluctant to take the first step, not least because "abated" coal power—which under some definitions means reducing emissions by at least 90%—is a difficult and/or expensive task.

Now that there is a policy in place, power companies may be more likely to act. The plan offers them an opportunity to commit to less challenging initial targets, while simultaneously dissuading investment in new unabated coal plants.

Similarly, for investors and other stakeholders there is now an officially sanctioned policy that makes more concrete the likely direction of regulation, allowing further analysis of related costs. These factors support investors that seek clarity on coal-power related capital expenditure alignment with national and international decarbonisation pathways. Overall, the new plan strengthens the case against new coal power.

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- Protein Transition: Transition pathways working towards our investor-aligned 2030 vision.

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