Australian National University

Effects of China's decarbonization and energy security plans on Australian coal exports

Results from an installation-level linear optimization model developed by the Centre for Climate and Energy Policy, ANU

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Summary

China's decarbonization plans will reduce its consumption of coal for power generation and steel making. China further aims for improved energy security, with expanded domestic coal production and transport infrastructure. We have analysed effects of both these pressures on Australian exports of thermal and coking coal to China, with an installation-level model of China's coal sector.

We find that Australian exports of thermal coal to China are likely to fall from 49.4 Mt in 2019 to between 30.6 and 39.1 Mt, depending on the ambition of Chinese decarbonization and energy security plans, by 2025. Exports of coking coal are likely to fall from 28.7 Mt in 2019 to between 20.5 and 22.0 Mt, because of expanded supply of cheap and high quality coking coal from neighbouring Mongolia.

China's share of Australian coal exports

China is the second largest destination of thermal coal, after Japan, and the second largest destination for coking (or metallurgical) coal, after India. Exports to China were worth A$ 13.5 billion, or 23.3 % of the value of all Australian coal exports in 2019 (Fig. 1). Over 2020, trade restrictions led to a 30% reduction in volumes of thermal coal exported to China, and a 9% reduction for coking coal. Total export value fell more strongly, due to a price slump in global thermal and coking coal markets resulting from the covid pandemic. Coal prices have sharply rebounded over 2021, to the highest levels for the past decade, and total export value for 2021 should be expected to well exceed 2019 levels.

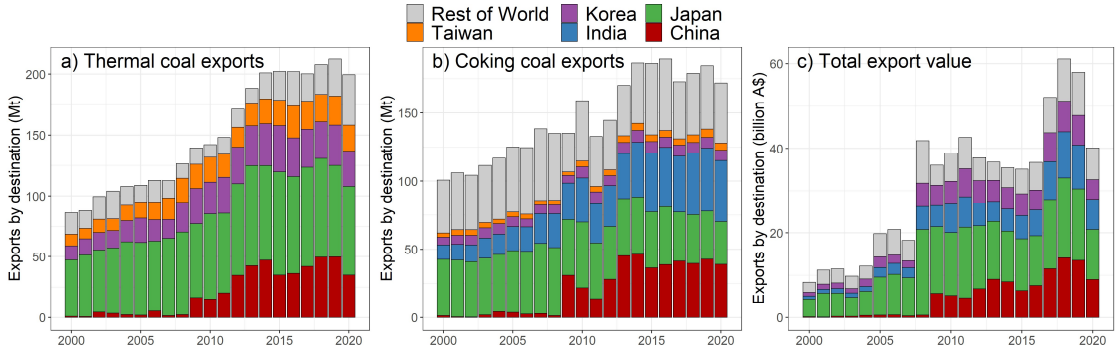

Fig. 1. Australian exports of coal by destination. Data sources: DISER (REQ Q4 '21) for exports in Mt, UN Comtrade for export value. Coking coal exports as sum of 'high quality' and 'other' metallurgical coal as reported in the REQ.

The China coal model developed by CCEP ANU

Analyses of international coal markets have typically used so-called multi-regional models, or node-and-link type models to represent transport infrastructure. It's important to accurately account for transport in such analyses, given the large share of transport in the total cost of coal to consumers, and because of the restrictions imposed by technical transport capacities in railways, ports, and other infrastructure. However, previous work for such analyses has used highly simplified networks, typically with a few dozen nodes representing continents in global analysis, or provinces in China-focused analyses. These nodes conflate provincial-level production and demand into single points, and interprovincial transport infrastructure into single links.

The China coal model developed by CCEP ANU drastically improves on this state of the art, with an installation-level model of China, that is, a model that represents every coal mine, power and steel plant, all ports, all railways with all stops, and an intercity road network. Our model has 12,000 nodes and 40,000 links with accurate technical and geo-spatial detail for individual installations. This is important detail when assessing imports by a country such as China, as competitiveness between domestic and foreign coal suppliers is strongly driven by transport costs and capacities, and because this level of detail helps accurately represent the relative cost of transport to coastal versus inland power and steel plants. Model calibration versus real data for 2015-2019 shows its very high accuracy, giving confidence about its predictions for future years.

Expected effects of China's decarbonization and energy security plans on Australian coal exports

We used our model to predict market shares of different domestic and foreign suppliers of coal, under a number of different levels of Chinese coal demand in the years 2025 and 2030 (summary in Fig. 2).

For thermal coal, our baseline scenario sees Australian imports to fall from 49.4 Mt in 2019 to between 30.6 and 39.1 Mt, depending on Chinese demand levels, by 2025. This is due in part to expected power plant efficiency improvements, which will reduce overall coal demand. Demand for Australian and other seaborne imports further suffers from expanded transport infrastructure that lower the cost of delivery of domestic coal, a relative shift of thermal coal consumption away from coastal and towards inland provinces, and expected development of Chinese mining capacity. Different scenarios, in chich Australian mining capacity would be expanded in accordance with the REQ's major project list, would lead to only marginally smaller reductions. There is virtually no difference in demand for Australian thermal coal whether all of China's provinces decarbonize their power generation at equal rates, or when richer (coastal) provinces decarbonize more rapidly than poorer (inland) provinces. Different individual components of China's infrastructure investments, in rail, ports, or UHV networks, are expected to have had relatively small effects on Australian imports. The combined effect is noticeable however; if China would have made none of these infrastructure investments, demand for Australian coal by 2025 would be roughly at 2019 levels, in the high demand scenario. By 2030, exports to China are expected to fall further, to between 22.8 and 35.1 Mt, depending on Chinese demand levels.

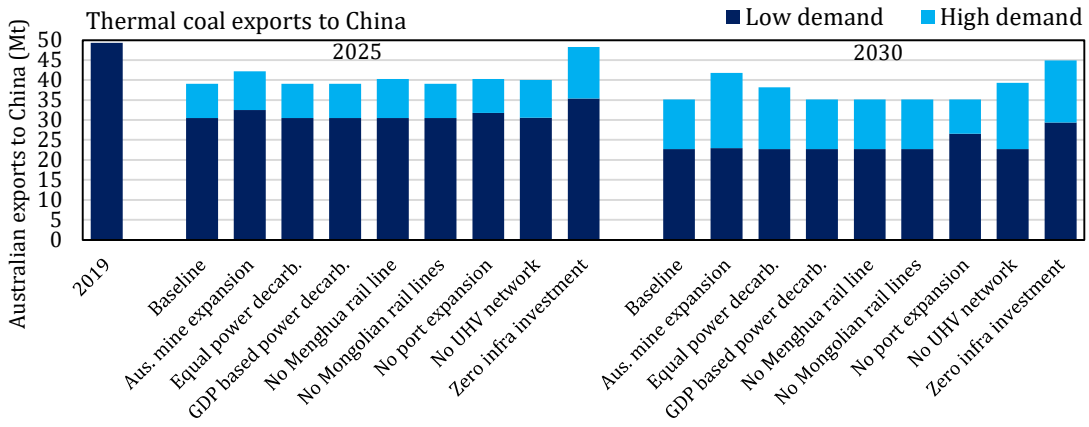

Fig. 2. Australian exports of thermal coal to China. Results for different scenarios for 2025 and 2030 of the China coal model developed by CCEP ANU. The low and high demand levels correspond to the IEA's 'Stated Policies' and 'Sustainable Development' scenarios, respectively.

For coking coal, our baseline scenario sees Australian imports to fall from 28.7 Mt in 2019 to between 20.5 and 22.0 Mt, depending on Chinese demand levels, by 2025 (Fig. 3). Total Chinese demand for coking coal is expected to fall as steelmaking volumes will peak in 2021 in even the most bullish scenarios, and China is rapidly increasing the use of scrap, with policy targets for 330 Mt of scrap use by 2025 and 400 Mt by 2030, up from 214 Mt In 2019. Much more significant to Australian imports is the strong expansion of mining capacity at the Mongolian 'New Tavan Tolgoi' mine, a low-cost producer of high quality hard coking coal. A 10 Mt and a 30 Mt rail connection to China from this mine are expected to be put into operation over 2022. Different policy plans for the steel sector, with steelmaking moved to inland provinces or more production capacity moved to major ports, are expected to have limited impact on total demand for Australian coking coal. The combined effect of China's infrastructure investments, and the railway lines into Mongolia in particular, have added to this effect of Australian coking coal being replaced by Mongolian imports.

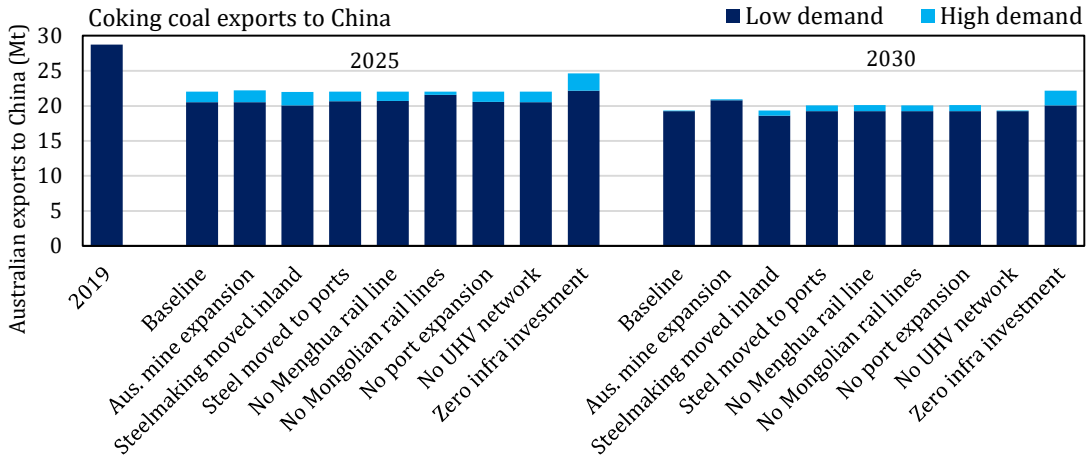

Fig. 3. Australian exports coking coal to China. Results for different scenarios for 2025 and 2030 of the China coal model developed by CCEP ANU. The low and high demand levels correspond to the IEA's 'Stated Policies' and 'Sustainable Development' scenarios, respectively.

Further model results

The model described here has been used to assess the sensitivity of imports from a number of key suppliers of thermal and coking coal to China, versus a wide range of possible future Chinese demand levels. The model has also been used to assess a broad set of scenarios for decarbonization and energy security policy, primarily with different assumptions on what provinces would bear the biggest responsibilities in decarbonizing power generation and steelmaking, and exclusions of recent and nearly completed transport infrastructure expansions. These results, as well as a full technical description of the model can be found in the working paper posted at:
https://arxiv.org/abs/2112.06357

Model development

The current model version includes only a simplified representation of the global market; more elaborate representation of demand from other countries and how this may respond to supply and price changes will be incorporated in future iterations. A further expansion to include iron ore is also planned.

We will be developing this model, for example to assess the future demand and price levels for existing or new mining capacity. Such analyses can be run at the level of individual mines, states or territories, or nationally. The model can also be used to provide strategic insight for policy makers, for example by assessing the societal cost of Chinese import restrictions under different future demand and infrastructure development scenarios.

To learn more, contact the model authors via jorrit.gosens@anu.edu.au.

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