SOCIO-ECONOMIC IMPACTS OF COAL TRANSITION IN CHINA:
A REGIONAL CHALLENGE

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Summary

- China has over 50 per cent of the world’s coal-fired power generation capacity, and its largest coal reserves. China plans to peak carbon emissions by 2030, with a decline in coal consumption expected in its 15th Five Year Plan (2026-2030). It has also committed to achieving carbon neutrality by 2060. In order to meet these objectives, it will need to phase out unabated coal-fired power generation by the 2050s.\(^1\)

- We use detailed data to reconstruct China’s coal production-consumption network and model the impact of the transition on jobs and tax revenues in the thermal coal sector from 2021 to 2060, under five progressively stricter phase-out scenarios.\(^2, 3, 4\)

- We find that continued improvements in the productivity of technology and labour will lead to declines in coal jobs regardless of energy transition policies. However, coal job losses in the near term could be significantly higher in fast transition scenarios. Even if job gains in the economy as a whole are higher in fast transition scenarios, as other research suggests,\(^5\) this implies an increasing need to support the most-affected regions through the transition.

- Similarly, reductions in coal-related tax revenues will be greater in the near term in fast transition scenarios. However, these may be partially or fully offset by reduced subsidies to the coal sector, and by expanded economic activity in emerging clean industries.

- China’s provinces will experience these impacts unevenly, depending on the extent of their structural reliance on the thermal coal sector. Central government agencies should consider targeted fiscal, social and investment support policies for affected provinces. Measures to prevent excessive expansion of the coal sector now could reduce the risks of provincial power or mining company losses, defaults or bankruptcies.

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\(^4\) The scope of this study is coal power plants and the mines that supply them (i.e. mines producing ‘thermally coal’), and the jobs and tax revenues associated with those power plants and mines. Thermal coal demand (i.e. excluding metallurgical coal and coal for heating) accounts for approximately 60 per cent of total coal mine output and associated data.

The socio-economic challenges of coal phase-out in China: jobs and taxes

China’s plan to peak carbon emissions by 2030 and to achieve carbon neutrality by 2060 implies a transition away from burning coal in power and industry. One side of this transition involves the creation of new energy infrastructure: the installation of renewable power generation, expansion of grids, electrification of industry and so on. Here we focus on the other side of the transition: understanding the socio-economic consequences of winding down and eventually phasing out the use of the most carbon-intensive fossil fuel: coal. We show how the decline in coal use is likely to affect jobs and tax revenues, and draw some tentative policy conclusions.

We use a micro-simulation approach to model changes in the magnitude and distribution of jobs and tax revenues generated by the thermal coal sector over time. This has two advantages for studying transitions, compared to conventional macro-economic models. First, the high level of detail used in our model allows it to represent changes – such as in levels of economic activity and interaction between economic factors over time – that are invisible in conventional models that use more aggregated data and high-level assumptions. Second, rather than predicting a single ‘optimal’ technology mix within the most likely transition pathway, our method focuses on how jobs and tax revenues change over time in a range of different scenarios, allowing for flexible policy planning and adjustments. We use three layers of data: first, location-specific data on individual coal-fired thermal power plants, linked to coal mining capacity in provinces, segmented by coal type. Second, we add a layer of coal transportation data accounting for the distances between mines and plants. Third, we overlay data on employment and tax revenues onto this network.

Our novel method allows us to simulate the effect of different phase-out scenarios on each component of China’s coal production-consumption network. We assume that the final demand for thermal coal is determined by China’s climate policies across four main scenarios of coal use based on current policies and accelerated policies, and we estimate the impact of these scenarios (see Table 1) from 2021-2060 on thermal coal jobs and tax revenues. To implement the scenarios, the only variables that are changed are the operating lifetime of each coal plant and whether or not plants under construction are brought online. The coal power plant fleet is phased out in the 2050s across all scenarios, with stricter scenarios resulting in a more rapid phase-out. Our model takes Carbon Capture and Storage (CCS) technologies into account; we find that even if CCS deployment continues on current trends, or even under optimistic CCS deployment scenarios, CCS is unlikely to arrest or reverse the outcomes observed. Further, our model does not account for the negative externalities associated with coal extraction and production.

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6 Load factors remain constant but in practice, load factors are likely to decline as renewable power begins to meet not only all incremental demand but a growing share of existing demand as well, although this is likely to vary widely across provinces. This is an area to be explored in further work.
Decline in coal industry jobs – uncertain in timing, uneven in location

Employment in the coal industry is already in decline, with the total number of jobs supported by mines supplying China’s coal plants halving between 2014 and 2020, from 5.3m to 2.6m. Coal industry labour productivity in that period increased on average by 8 per cent annually, suggesting that this decline was a result of policies promoting small mine closures, falling labour intensity, and improved technology.

Our findings (Figures 1a and 2a) suggest that this trend is likely to continue even in the absence of new energy transition policies. The decline varies with the pace of the transition. For instance, starting from roughly 2.7m jobs in 2021, coal industry employment declines in our modelling by 31 per cent for a Baseline (current policies) scenario, 41 per cent for a Renewable (accelerated diffusion) scenario, and a much higher 72 per cent and 93 per cent for the C50 and C80 (faster transition) scenarios, respectively.

Even in a most unlikely scenario of ‘no transition’, coal jobs would still be lost (declining by 17 per cent by 2030), along with all the economic benefits that a transition would have brought. This is not just due to global transition from coal to clean energy technologies, but also a projected continuation of efficiency and productivity improvements (for example, consolidation and automation) in China’s coal sector.

China may choose to pursue a faster transition for reasons of cost. Another study has found that the cost of electricity from solar with energy storage could be roughly half that of electricity from coal in China by 2030. Modelling suggests that a faster transition could lead to greater net-positive outcomes for jobs and GDP than a slower transition, because of the economy-wide benefits of cheaper energy and the effects of increased investment in new infrastructure. Further benefits may arise from the creation of jobs associated with renewable energy and related technologies. However, new jobs are unlikely to replace coal jobs on a like-for-like basis.

Provinces that have smaller, more efficient workforces will experience smaller absolute impacts on jobs compared with large and highly labour-intensive ones. The coal-producing provinces of Inner Mongolia, Shanxi, Shaanxi, and Xinjiang – which supply 75 per cent of the nearly 2.5bn tonnes of annual total coal production, will face particular challenges in managing the localised effects of job losses and redirecting workers to other productive sectors.

Impact on coal-related tax revenues – net-positive for public finances, with distributional challenges

Fiscal revenues from the thermal coal industry accrue to national and provincial authorities. The former receive income taxes, prospecting and exploration fees, 20 per cent of mining royalties and 75 per cent of VAT, while provincial authorities receive taxes on environmental pollution, resources, education and construction surcharges, 80 per cent of mining royalties and 25 per cent of VAT. We find that tax revenues associated with the coal power industry decline across all scenarios, with annual rates of revenue loss of just 1 per cent through the 2020s, rising rapidly to over 10 per cent by the 2040s in the Baseline scenario, and much faster in the C80 (rapid transition) scenario. Revenues peak at CNY 338bn (£41bn) (2023) in the Baseline (current policies) scenario (Figures 1b and 2b).

However, thermal coal industry subsidies are likely higher than ‘peak’ tax revenues – we estimate around CNY 480bn (£58bn) annually at present, based on a detailed survey of the available literature on direct and indirect subsidies across the value chain modelled in the study. This is without fully accounting for negative impacts of the coal sector on health, the environment and climate change. Therefore, the effect of tax revenue and subsidy declines could well be net-positive for public finances.

The policy challenge will be to manage distributional impacts of the decline in revenues for provincial governments – especially coal-producing ones such as Inner Mongolia – that depend on them to meet public expenditure and financial obligations. These revenues will need to be replaced so that spending obligations can be met without relying on excessive borrowing.

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2 Measured in terms of coal industry jobs supported by coal power plants located in each province.
Policy options to ensure a sustainable and equitable coal phase-out

China already has some transition management measures in place to manage coal job losses. In 2016, its finance ministry set up a CNY 100bn (£12bn) Industrial Special Fund based on projections of 1.5m coal sector job losses by 2020 (driven mostly by capacity reduction and consolidation). Provinces can draw from this fund to support worker relocation, retraining, early retirement, public sector job creation and welfare payments.

Our findings suggest that up to 2.5m coal jobs could be lost between 2020 and 2030, implying an increasing need for this kind of transition support. Given the high concentration of coal jobs in certain regions, we suggest these measures should be geographically focused and aligned with strategic planning for development, including by national-level authorities. This may require closer coordination and cooperation between national and regional (i) authorities and (ii) state-owned enterprises. Funding for worker relocation and retraining could be supplemented by strategic investments in scaling up China’s world-leading capabilities in the manufacture of complex low-carbon products (solar panels, EVs and third generation nuclear reactors); these industries could make use of the human capital and expertise developed in the coal industry. There may be advantages to putting coal-intensive regions, and the state-owned enterprises with a major presence in those regions, on a new development pathway sooner rather than later, to take early advantage of remaining flexibilities in the labour market once accounting for workers that have already been relocated, and to reduce any long-term transition risks (such as the long-term deindustrialisation seen in past coal transitions in parts of the UK, for example).

Addressing the changes in tax revenues due to the transition away from coal may require the national government to play a redistributive role. Net fiscal savings from phasing out coal in less-exposed provinces could be used to temporarily replace losses in more-exposed provinces, easing their path through the transition. It may also be advisable for national agencies and supervisory and enforcement bodies (e.g. the National Energy Administration, Central Environment Inspection Team, and China Banking and Insurance Regulatory Commission) to strategically coordinate to minimise financial risks for the central and provincial governments that may arise from the coal phase-out. For example, as provincial governments and state-owned enterprises have relative fiscal independence and can issue their own debt, there may be a risk that they borrow excessively to finance coal expansion that faces low or no demand as a result of energy transition policy. Making national support for regional development conditional on having a clear plan for the transition might weaken future incentives for economically unnecessary coal expansion.

In the longer term, as revenues from coal decline, taxes could potentially shift to other forms of energy use, provided that vulnerable low-income households are supported. The electrification of transport, heating and industry, as well as overall economic growth, is likely to increase electricity demand – for instance from 8,539 TWh in 2021 by an estimated 30 per cent by 2030, and 90 per cent by 2050 according to the IEA’s World Energy Outlook. A shift in taxes towards energy consumption, together with efficiency regulations, could increase energy efficiency and limit the growth in demand for electricity, reducing the amount of new grid infrastructure that needs to be built.

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Just six years ago, we aimed to deploy 20 GW of offshore wind in the UK by 2030. With the announcement last year of the Prime Minister's Ten Point Plan for a Green Industrial Revolution, we doubled that target to 40 GW by 2030 – enough to power every home in the country. Meanwhile, the number of high-quality jobs supported by the industry and its supply chains continues to grow.

It is not only in the UK that progress in clean technologies has been faster than expected. The amount of solar power deployed globally in 2020 was over ten times higher than experts had forecast only fifteen years before. Similarly, analysts’ predictions of the share of electric vehicles in global car sales continue to be revised radically upward. As we aim to keep the goals of the Paris Agreement within reach, and to maximise the benefits of the transition to net zero emissions, it is crucial that we learn the lessons of these successes.

Last year, the UK Government issued new guidance on policy appraisal in contexts of transformational change. This recognised that when the future is uncertain, the aim of analysis is less to predict outcomes precisely, and more to find the points of leverage – places where a small intervention can have a large effect. I am delighted that researchers from the UK, China, India and Brazil are working together to deepen our understanding of where such leverage points for transformational change can be found, and to apply this to addressing climate change and ecosystem degradation, our greatest shared challenge.

The International Energy Agency has estimated that without international collaboration, the transition to net zero global emissions could be delayed by decades. On the other hand, if we work together, we can innovate faster, realise larger economies of scale, and create stronger incentives for investment. As countries of the world come together at COP26, we must be guided by this positive vision. With determined action and sustained collaboration, we can create new economic opportunities while securing a safe climate for the future.
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### Table 1: Overview of coal phase-out scenarios modelled

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Plant Operating Lifetime (years)</th>
<th>2030 Capacity (Gigawatts)</th>
<th>2030 Generation (Terawatt-hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Baseline; reflects existing policy of carbon neutrality by 2060</td>
<td>30 if plant age &lt; 30; 35 if plant age &gt; 30; 40 if plant age &gt; 35; Age + 1 if plant age &gt; 40</td>
<td>114</td>
<td>4,827</td>
</tr>
<tr>
<td>R</td>
<td>Accelerated Diffusion of Renewables</td>
<td>25</td>
<td>984</td>
<td>4,270</td>
</tr>
<tr>
<td>C50</td>
<td>50% decline in emissions from Coal power by 2030 relative to 2015</td>
<td>20; cancellation of plants under construction</td>
<td>486</td>
<td>2,125</td>
</tr>
<tr>
<td>C80</td>
<td>80% decline in emissions from Coal power by 2030 relative to 2015</td>
<td>15; cancellation of plants under construction</td>
<td>195</td>
<td>867</td>
</tr>
</tbody>
</table>

Note: For purposes of comparison we estimated a ‘no transition’ scenario in which no climate policies are implemented – which we believe to be highly unlikely.

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Note: The year 2015 falls within a growth plateau period from 2014-2019.
Economics of Energy Innovation and System Transition

The Economics of Energy Innovation and System Transition (EEIST) project develops cutting-edge energy innovation analysis to support government decision making around low-carbon innovation and technological change. By engaging with policymakers and stakeholders in Brazil, China, India, the UK and the EU, the project aims to contribute to the economic development of emerging nations and support sustainable development globally.

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