

2. The wider context

The low-carbon energy transition requires the reduction of greenhouse gases from the production and consumption of fossil fuels. Whilst the deployment of carbon capture storage and use may be widespread by the middle of this century, before then it is essential to reduce the consumption of fossil fuels. The most harmful of the fuels is coal. Although the global consumption of coal appears to have peaked in 2014, it declined only by 2.7 per cent between 2014 and 2019. A sharper decline in 2020 was probably temporary due to the COVID-19 pandemic.³ The Asia Pacific region accounts for about 80 per cent of global coal consumption, with coal accounting for about 48 per cent of the region's primary energy mix (Table 1).

China dominates both the global and regional consumption of coal and this is one of the reasons why its greenhouse gas emissions are the highest. Coal combustion has also been the main source of air pollution. For these reasons, China has been taking increasingly vigorous steps to reduce its dependence on coal through electrification, enhancing energy efficiency, and deploying renewable and nuclear power. As a result, the trend of annual coal consumption is broadly flat. In contrast, demand for coal in industrializing countries such as India, Indonesia, the Philippines, and Vietnam is likely to keep rising through the 2020s or even beyond. Nevertheless, the governments of these and other countries around the world that have sizeable domestic coal industries will need to start constraining, and then reducing, their national consumption.

Table 1: Coal consumption in Asia Pacific countries for 2020 where coal accounted for more than 30% of the primary energy mix.⁴

Country/region	Coal consumption 2020 (Exajoules)	Coal share of primary energy mix (2020)	Share of global coal consumption (2020)
Australia	1.69	30.3%	1.1%
China	82.3	56.6%	54.3%
India	17.5	54.8%	11.6%
Indonesia	3.3	42.6%	2.2%
Philippines	0.73	39.9%	0.5%
Taiwan	1.6	33.9%	1.1%
Vietnam	2.1	51.4%	1.4%
<i>Asia Pacific</i>	<i>121.0</i>	<i>47.8%</i>	<i>79.9%</i>

Many countries, including those in the Asia Pacific region, have announced pledges to variously peak greenhouse gas emissions or achieve net zero emissions in the coming decades. Based on these pledges and an assumption of increasing mechanization of mining, the International Energy Agency has estimated that approximately two million jobs will be lost along the global coal supply chain between 2019 and 2030. Most of these jobs will be in the Asia Pacific region and many will involve low-skilled workers who cannot easily be transferred to the clean energy sector.⁵ These individuals will need to be compensated in some way – through other forms of employment or by direct financial means. With the world's largest coal mining industry, China can't afford to avoid, and indeed has not avoided, addressing this challenge. In 2014, the estimated number of workers involved in coal mining and dressing⁶ is

³ BP, BP Statistical Review of World Energy 2021, London, BP, 2021.

⁴ BP, BP Statistical Review of World Energy 2021, London, BP, 2021.

⁵ International Energy Agency, World Energy Outlook 2021, Paris, IEA, 2021.

⁶ The term "dressing" refers to a number of processes for sorting the coal and removing waste materials, including the washing process. The government statistics are for "coal mining and dressing"

estimated as having been around 5.3 million.⁷ By December 2021, the number was about half the previous figure, at 2.6 million,⁸ not as a result of the modest production decline, but rather due to industry restructuring and mechanization.

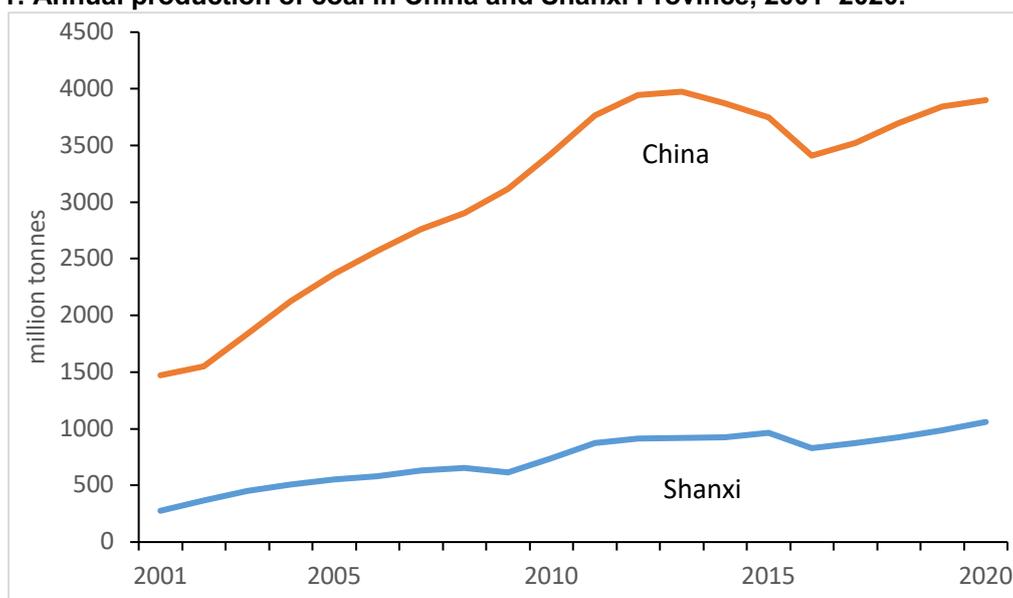
3. Managing the job losses in coal mining

3.1 Background to coal mining in China and Shanxi Province

Coal has long been the major source of primary energy supply in China. This is due to the large scale of its domestic resource, which allowed it to be the world's largest producer and consumer of coal from the mid-1980s. Since that time, the country's share of global coal production has risen from 20 per cent, to 50 per cent in 2020. During the period 2001 to 2020, annual output increased from 1.47 billion tonnes to 3.90 billion tonnes as the economy grew more than five times in real terms (Figure 1).

Shanxi Province has long been the major supplier of coal to the country, though its share of national production has steadily declined (Figure 1) as new mines have been opened in Inner Mongolia, Shaanxi, and Xinjiang. Nevertheless, output in 2020 exceeded one billion tonnes, equivalent to US coal production at its peak in 2008. Many of Shanxi's mines are old and many are underground and becoming less economical and more dangerous to operate. In addition, the province has a long history of small-scale coal mining that is unsafe and often illegal.

Figure 1: Annual production of coal in China and Shanxi Province, 2001–2020.⁹



The coal mining industry has been a major source of environmental damage to land, water, and air.¹⁰ As a result, the central government has been taking steps to improve the management of coal mines in Shanxi and other regions, by closing illegal or unsafe mines, consolidating mining operations, and deploying more advanced mining technologies and techniques. Government inspections also result in the suspension of operations in those mines that do not meet required standards of safety,

⁷ Feng Hao, 2017. '2.3 million Chinese coal miners will need new jobs by 2020', *China Dialogue*, 7 August, <https://chinadialogue.net/en/energy/9967-2-3-million-chinese-coal-miners-will-need-new-jobs-by-2-2/>.

⁸ CEIC, 'China number of employee: coal mining & dressing', <https://www.ceicdata.com/en/china/no-of-employee-by-industry-monthly/no-of-employee-coal-mining--dressing>.

⁹ BP, *BP Statistical Review of World Energy 2021*, London: BP, 2021;

National Bureau of Statistics, 2000–2021. China Energy Statistical Yearbook, item 3-2 Raw Coal Production by Region. Retrieved from: <https://data.cnki.net/Trade/yearbook/single/N2021050066?zcode=Z024> (in Chinese).

¹⁰ Elizabeth Economy, *The River Runs Black*, Ithaca: Cornell University Press, 2004.

environmental protection, or financial integrity. Finally, the country has a substantial excess of coal mine capacity that the government has been trying to reduce. Shanxi Province has been a particular target for these various measures, despite its importance to the national supply of energy.¹¹

3.2 Policies and trends for reduction of coal mining capacity and employment

As part of the 13th Five-Year Plan, the central government set out a strategy to overhaul the national coal mining industry. The key elements of the strategy for the period 2016–2020 were to:¹²

- Reduce mine capacity by 500 million tonnes per year;
- Reorganize another 500 million tonnes of capacity;
- Control the opening of new mine capacity;
- Close mines that fail to meet required standards;
- Close mines that are below a certain scale (for example, 600,000 tonnes per year in major coal mining provinces such as Shanxi);
- Reform coal mining enterprises and improve their operating and technological standards;
- Provide compensation for the resettlement of excess employees.

At national level, the goal for reducing coal mine capacity was exceeded, reaching more than one billion tonnes per year against the target of 500 million tonnes. This involved closing about 5,500 mines.¹³ The central government set Shanxi Province the goal of reducing excess capacity by 113.8 million tonnes during the Five-Year Plan period. In January 2021, the provincial government claimed that the excess capacity had been reduced by 156.8 million tonnes, far in excess of the target. However, due to the opening of new capacity, the total mine capacity in the province had declined by only 110 million tonnes per year, from 1.46 billion tonnes to 1.35 billion tonnes. The number of coal mines had declined from 1,078 to less than 900. The average capacity of mines had risen from 1.35 million tonnes per year to more than 1.50 million tonnes per year and all mines with a capacity of less than 600,000 tonnes per year had been closed. Finally, the proportion of what is termed ‘advanced production capacity’, notably mechanization,¹⁴ had increased from less than 30 per cent to 68 per cent.¹⁵

These policies, together with previous measures, resulted in a significant reduction in the number of employees in coal mining and washing, especially at national level. From a peak of 4.47 million in 2013, the national total declined to 3.75 million in 2015 and then to 2.31 million by the end of 2020. A total reduction of 2.16 million or 48 per cent, of which 1.43 million was during the 13th Five-Year Plan period (Figure 2) was achieved. One estimate suggested that employment in coal mining could decline by a

¹¹ Bridle, R., Kitson, L., Duan, H., Sanchez, L., & Merrill, T., 2017. *At the crossroads: balancing the financial and social costs of coal transition in China*, Winnipeg, MB, Canada: International Institute for Sustainable Development (IISD), pp. 4–11.

<https://www.iisd.org/system/files/publications/crossroads-balancing-financial-social-costs-coal-transition-china.pdf>; People’s Daily, 2022. ‘Continuing to make new breakthroughs in high-quality development (following the footsteps of the General Secretary in Shanxi Province)’. 26 May. <http://politics.people.com.cn/n1/2022/0526/c1001-32430502.html> (in Chinese); The State Council Information Office, 2020. ‘The transformation of Shanxi, a major energy province: creating a Chinese-style “Ruhr”’, 18 November. <http://www.scio.gov.cn/xwfbh/xwfbh/wqfbh/42311/44521/xgbd44528/Document/1694999/1694999.htm> (in Chinese).

¹² The State Council, 2016. ‘Opinions of the State Council on Resolving Excessive Capacity in the Coal Industry’, 5 February. http://www.gov.cn/zhengce/content/2016-02/05/content_5039686.htm (in Chinese).

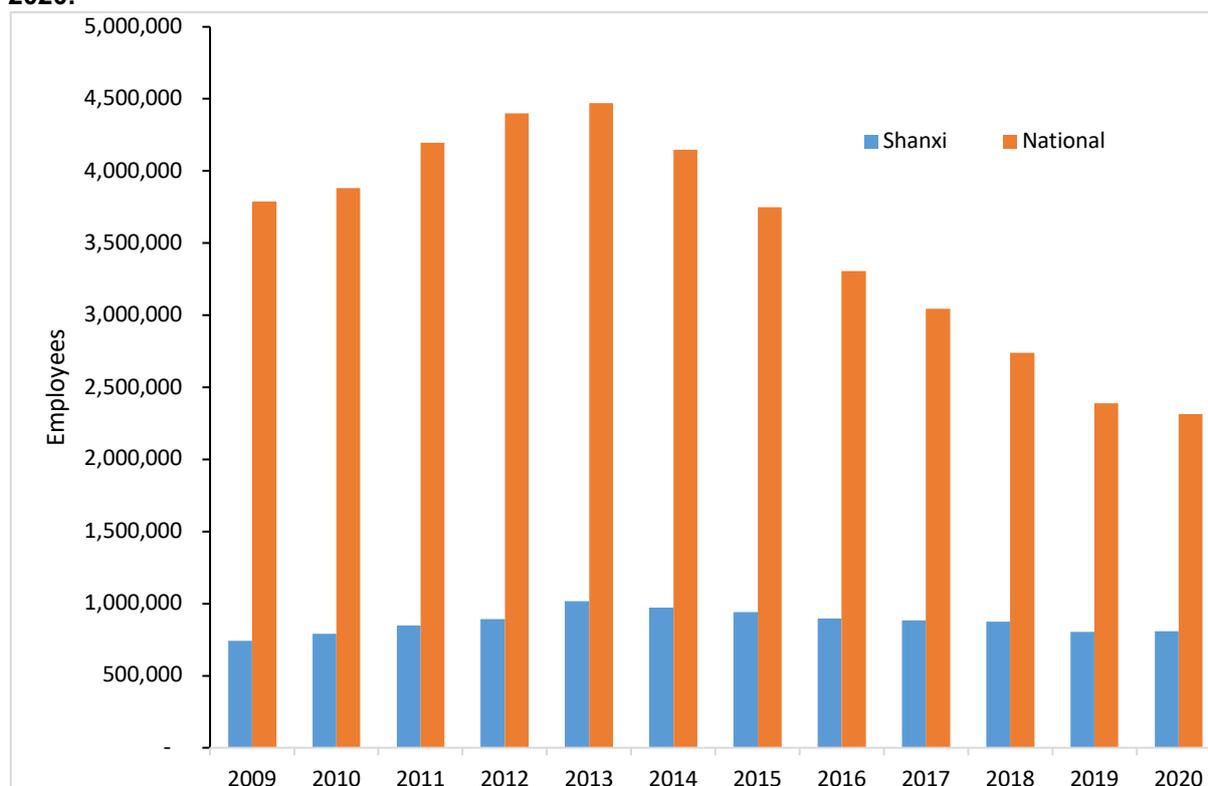
¹³ Xinhua news, 2021. ‘At the end of the ‘14th Five-Year Plan’, China’s annual coal output will be controlled at 4.1 billion tons’, 3 March. http://www.gov.cn/xinwen/2021-03/03/content_5590004.htm (in Chinese).

¹⁴ The definition of ‘advanced capacity’ includes standards for degree of mechanization, rates of recovery, operational safety, energy consumption, and environmental practice, see for example: ‘Notice on the opinions on giving play to the role of advanced production capacity in resolving excess capacity and promoting the transformation and upgrading of the coal industry’, 22 July 2016, http://drc.jiangxi.gov.cn/art/2016/7/22/art_14590_607259.html (in Chinese).

¹⁵ Shanxi Daily, 2021. ‘Shanxi completed the “13th Five-Year Plan” coal production capacity reduction task’, 11 January. http://www.gov.cn/xinwen/2021-01/11/content_5578864.htm (in Chinese).

further 1.1 million by 2035.¹⁶ The decline in employment in Shanxi was less dramatic than at the national level. The province saw an overall decline of about 200,000 employees, from 1.01 million in 2013 to 810,000 at the end of 2020, a reduction of just 20 per cent. Of this, 129,000 took place during the Five-Year Plan period. The contrasting declines of employment between that seen at national level and that within Shanxi Province can be attributed at least in part to the different amounts of capacity reduction. This in turn arises from Shanxi's continued role as a key source of coal supply for the nation. This decline in employment in the coal industry took place during a period when overall employment in Shanxi was rising, notably in sectors such as construction, wholesale and retail, information technology, and business services.¹⁷

Figure 2: Total number of employees in coal mining and washing in China and Shanxi, 2009–2020.¹⁸



3.3 Mechanisms to address the job losses

Both central and provincial governments provided financial mechanisms to support the process of restructuring, capacity reduction, and workforce adjustment (Table 2). In 2016, the Ministry of Finance established a new set of funds, 'Special Incentive and Subsidy Funds for Industrial Enterprise Structural Adjustment' or 'Special Funds' that was aimed explicitly at the coal and steel industries.¹⁹ These funds

¹⁶ A. Clark and W. Zhang, 'Estimating the employment and fiscal consequences of thermal coal phase out in China', *Energies* 2022, 15, 800.

¹⁷ Shanxi Provincial Bureau of Statistics, 2011–2021. Shanxi Statistical Yearbook, item 2-6 to item 2-11, number of employees and wages. Retrieved from <https://data.cnki.net/area/yearbook/single/N2021110006?dcode=D04> (in Chinese).

¹⁸ National Bureau of Statistics of China, 2011–2021. China Statistical Yearbook. Item 4-6, number of employees by sectors. Retrieved from <https://data.cnki.net/trade/Yearbook/Single/N2005120319?zcode=Z033> (in Chinese); Ministry of human resources and social security, 2011–2021. China Labour Statistical Yearbook. 3-2 Number of employees by sector and region. Retrieved from <https://data.cnki.net/Trade/yearbook/single/N2022020102?zcode=Z001> (in Chinese).

¹⁹ Ministry of Finance, 2016. 'Regulations of Special Incentive and Subsidy Funds for Industrial Enterprise Structural Adjustment', 14 June. http://www.gov.cn/xinwen/2016-06/14/content_5082051.htm (in Chinese).

were set up to run during the 13th Five-Year Plan period, ending in 2020.²⁰ In the early stage, the Ministry of Finance levied fees from electricity grid companies to support 'Special Funds',²¹ but terminated the fee levying one year later.²²

The main objective of the funds was to support coal and steel companies in reducing their workforces through placement in other jobs (either within the company or elsewhere), early retirement, and contract termination. For this task one part of the fund, which amounted to RMB100 billion, provided RMB55,000 per employee.²³ This money could also be used by the companies to cover arrears in wages and social insurance payments, as well as other debts. The amount of funding declined as the time taken by an enterprise to reduce capacity increased. Other types of fund were explicitly directed at companies in Shanxi Province, on account of the major role of coal and steel industries in the province's economy. The quantity of funds received by a provincial government would depend on two factors: the scale of mine capacity reduction achieved against the provincial target, and the timing of the capacity reduction – early reduction being rewarded more generously.

The Shanxi Provincial government devoted at least three different funds to assisting coal and steel companies and their employees in the restructuring process (Table 2). The Unemployment Insurance Fund is a nationwide system for assisting unemployed workers, and it was first introduced in 1986. The first scheme channelled the funds through the specific state-owned enterprise that was laying off workers. In 1999, the scheme was amended so that all urban employers and employees were obliged to contribute. At the same time, the administration of the scheme was assigned to provincial and lower levels of government, although it is overseen by the Ministry of Human Resources and Social Security. Likewise, the size of the monthly payment varied between locations depending on the cost of living and the state of local government finances. Other forms of support were also provided, including help to find new employment.²⁴

The original scheme required contributions of 2 per cent of total payroll from employers and 1 per cent of the earnings from individual employees. Since 2015, a gradual reduction resulted in a combined 1 per cent in 2017.²⁵ In Shanxi, the allocation was 0.7 per cent from employers and 0.3 per cent from employees.²⁶ To benefit from the fund, contributions should have been received for a minimum of 12 months. The period over which benefits can be drawn depends on the duration of the contributions, but the maximum is two years of benefits. The amount received by the individual varies but should not exceed the local minimum wage. The recommended level is 90 per cent of the local minimum wage. This local minimum wage should be 40–60 per cent of the local average wage. The Unemployment

²⁰ Ministry of Finance, 2018. 'Updated Regulations of Special Incentive and Subsidy Funds for Industrial Enterprise Structural Adjustment', 30 August. http://czt.gd.gov.cn/tzgg/content/post_181945.html (in Chinese);

Yang Weidong, 2017. 'Theoretical Inspiration and Policy Suggestions on the Issue of Employee Placement in Enterprises to Reduce Overcapacity: Taking Shanxi Province Coal Enterprises as an Example', *Coal Economic Research*, 37(5), 5. (In Chinese).

²¹ Ministry of Finance, 2016. 'Notice on the collection of funds for structural adjustment of industrial enterprises', 22 January. http://www.gov.cn/xinwen/2016-01/22/content_5035331.htm (in Chinese).

²² Ministry of Finance, 2017. 'Notice on the cancellation of funds for structural adjustment of industrial enterprises', 16 June. http://www.gov.cn/xinwen/2017-06/16/content_5203177.htm (in Chinese).

²³ The Ministry of Finance allocated RMB100 billion on the coal and steel industries. http://www.gov.cn/xinwen/2016-05/19/content_5074583.htm (in Chinese).

According to statistics from the Ministry of Human Resources and Social Security in 2016, the reduction of overcapacity in the coal industry involved about 1.3 million people, and the steel industry involved 500,000 people, for a total of 1.8 million people. http://www.gov.cn/xinwen/2016-02/29/content_5047432.htm (in Chinese). The average is RMB55,000/person.

²⁴ Duckett, J., & Hussain, A., 2008. 'Tackling unemployment in China: state capacity and governance issues', *The Pacific Review*, 21(2), 211–29; Vodopivec, M. & Tong, M. H., 2008. *China: Improving Unemployment Insurance*, World Bank, Social Protection & Labor.

²⁵ Wong, C., & Qian, J., 2020. *COVID-19 Highlights Need to Strengthen China's Social Safety Net: The Unemployment Insurance Scheme*, East Asian Institute, National University of Singapore.

²⁶ Shanxi Provincial Department of Human Resources and Social Security, Department of Finance, 2017. Notice on Phased Reduction of Unemployment Insurance Rates. 6 April. http://rst.shanxi.gov.cn/zwyw/tzgg/201704/t20170413_2906866.html (in Chinese).

Insurance Fund is also used for other costs such as medical treatment, funerals, training, and job introduction. The fund is ring-fenced, so that expenditure on benefits relies on contributions.

In Shanxi, this fund is administered by the Human Resources and Social Security Department of Shanxi Provincial Financial Bureau. In October 2021, the proportion of unemployment insurance compensation in Shanxi Province was raised to 85% of the local minimum wage from a previously lower level. This amounts to RMB1,598 per month, far exceeding the standard of the subsistence level of RMB614.6 per month at that time.²⁷ The Unemployment Insurance Fund is also used to compensate companies for successfully placing employees in new jobs, as well as to provide general support to the companies (Table 2).

The other major scheme in Shanxi Province is the Shanxi Special Employment Fund. This fulfils several functions, all of which support the task of placing employees in new jobs (Table 2). These include compensating coal companies for arranging internal or external placements, and providing fees to public service agencies, career advice companies, human resource companies, and training institutes for meeting specified goals. In addition, workers who have to travel to their new places of employment receive a transport subsidy. Other support schemes include the Entrepreneurship Fund, which incentivizes workers to launch start-ups by covering the rent.

Table 2: Summary of key financial support mechanism at national and Shanxi provincial levels.²⁸

Name of fund/scheme	Aim/objective	Recipient	Amount per person (RMB)	Condition/note
Central Govt (MoF)				
Special Incentive and Subsidy Funds for Industrial Enterprise Structural Adjustment	Placement, retirement, medical insurance, compensation & other costs	Coal and steel companies	55,000	RMB100 bn ²⁹
Shanxi Govt				
Unemployment Insurance Fund	Unemployment benefit	Individual workers	85% of local minimum wage	Depends on level of contributions to fund

²⁷ Cao Xia, personal communication, October 2021.

²⁸ National level: State Council, 2016. '100 billion yuan of special financial funds to "Resolving excess capacity"'. 19 May. http://www.gov.cn/xinwen/2016-05/19/content_5074583.htm (in Chinese);

Provincial level:

Shanxi Provincial Government, 2016. Opinions on Resolving excess capacity in the Coal and Steel Industry Employee Replacement. 31 August. http://www.shanxi.gov.cn/zw/zfcbw/zfgb/2016nznzfgb/d18q_/sfbgtwj8/201608/t20160831_246519.shtml (in Chinese);

Shanxi Provincial Government, 2016. Opinions on Resolving excess capacity in the Coal and Steel Industry Employee Resettlement Work. 12 August. http://www.shanxi.gov.cn/yw/zcjd/201608/t20160812_237873.shtml (in Chinese).

²⁹ The coal and steel companies in Shanxi Province had received RMB1.213 billion from this fund up to 23 December, 2016. http://www.gov.cn/xinwen/2016-12/23/content_5151686.htm (in Chinese).

The six major coal companies had received RMB947.78 million by 25 August, 2016. http://www.shanxi.gov.cn/zw/tzqg/201608/t20160825_245771.shtml (in Chinese).

	Placement	Coal and steel companies	3,000	Unemployment insurance premiums paid for 5 years
	General support	Coal and steel companies	50–70% of previous year's premium	Depends on history of employment insurance premiums
Special Employment Fund	Placement (internal or transfer)	Coal and steel companies	1,000	Unemployment insurance premiums not paid for 5 years
	Placement	Public service agencies, career advice companies	Cost of career fare	Job fair attracting more than 100 affected workers
	Introduction fee	Human resource companies	300–800	Depending on location of new employment
	Vocational/ entrepreneurship training	Training institutes	1,200/1,800	Receipt of certificate
	Transport subsidy	Individual workers	500–800	Depending on location of new employment (for older workers only)
Entrepreneurship Fund	Entrepreneurship	Coal and steel companies	5,000–10,000	Per start-up within company, depending on context of start-up
		Individual workers	2,000/yr for 3 years	Per start-up, for individual entrepreneurs

3.4 How effective are these mechanisms?

Coal mining enterprises in Shanxi have taken a range of steps to manage the labour consequences of mine capacity reduction.³⁰ The preferred method has been to transfer employees within the enterprise, mostly to other coal mines, many of which are newly opened. Enterprises have also chosen to diversify their economic activities in order to absorb employees: for example into construction, finance, chemical industries, utilities, and logistics, as well as by creating labour service companies. Another option has been to set up a human resources company to help employees start their own businesses. Finally, some enterprises have relaxed their conditions for retirement.

Underlying the preference for internal transfer is the perceived inadequacy of the funds available to companies. Local governments and the enterprises themselves are meant to supplement the central government's Special Funds. However, throughout most of the period 2015–2020 neither party had sufficient funds available to support effective resettlement programmes.³¹

A further set of challenges to resettlement outside the employee's enterprise arises from the opportunities available, and also the characteristics of the miners themselves. Jobs in government are scarce and at a low rank. Vacancies in other industries are also limited and generally require specialized

³⁰ Yang Weidong, 2017. 'Theoretical Inspiration and Policy Suggestions on the Issue of Employee Placement in Enterprises to Reduce Overcapacity: Taking Shanxi Province Coal Enterprises as an Example', *Coal Economic Research*, 37(5), 5 (in Chinese).

³¹ Meng, Jin, 2019. 'The Practice and Thinking of the Diversion and Resettlement of Coal Enterprises in Anhui Province', *Chinese Workers/Zhongguo Gongren*, (7): 54–55 (in Chinese).

skills not possessed by miners. Moreover, many miners have been in the same state-owned enterprise for many years and are reluctant to abandon that job security. Finally, large numbers of miners are over 45 years old and have poor health as a result of their working conditions.³²

The option of terminating employment is costly to the enterprise³³ and normally requires the agreement of the employee.³⁴ Further, the Unemployment Insurance Fund suffers from a number of problems that have limited its ability to support the unemployed. The benefits are primarily for those with an urban residence permit who are formally registered as unemployed. Only about 45 per cent of China's urban workforce is covered by the scheme. Those not covered probably work in the informal sector or in private and micro enterprises. The low level of enrolment reflects, in part, the low level of benefits and the complexity of accessing the scheme. Migrant workers receive a lower level of benefit than urban workers. Moreover, this is administered by their rural local government after the funds have been transferred from the city government, which adds to administrative complexity.³⁵

Finally, the rules of the Fund decree that the level of benefit received depends on the level of contributions. The enterprise is responsible for making regular contributions to the Fund, having taken part payment from the employee. However, many enterprises make arrangements with their local government to withhold these payments for periods of time.³⁶ In such cases, the unemployed individual would receive less than their expected benefit, despite having made the payments themselves. The problem of enterprises withholding payments should now have been solved, following the establishment in Shanxi of a single electronic platform administered by the provincial tax authority.³⁷

One consequence of these deficiencies is that the proportion of those registered unemployed who claim unemployment insurance is low across China, averaging about 28 per cent. This falls to 11–15 per cent in Shanxi Province over the period 2013–2020, being just 11.5 per cent in 2020, when the number of registered unemployed reached a high of 277,000.³⁸ As a result, and despite the failure of some enterprises to make contributions, the Unemployment Insurance Fund steadily built up a substantial surplus as annual revenues continued to exceed annual expenditure.³⁹ Annual outlays only started to exceed revenues in 2019 at national level, and in 2020 in Shanxi.⁴⁰ Nevertheless, the balance of Shanxi's Unemployment Insurance Fund stood at RMB15.2 billion at the end of 2020.⁴¹

4. Conclusions and implications

China's leadership recognized clearly that the shift away from coal, as part of the nation's low-carbon energy transition, would have costs that would be borne by enterprises, local governments, households, and individuals. The central government, therefore, put in place various policies that included targets and financial support mechanisms which were complemented by local government measures and

³² Meng, Jin, 2019. 'The Practice and Thinking of the Diversion and Resettlement of Coal Enterprises in Anhui Province', *Chinese Workers/ Zhongguo Gongren*, (7): 54–55 (in Chinese).

³³ Liu, Yanbin & Meng, X., 2018. 'Research on Job Placement of Workers in Resolving Overcapacity', *China Labor/Zhongguo laodong*, (11), pp.20–28 (in Chinese).

³⁴ Meng, Jin, 2019. 'The Practice and Thinking of the Diversion and Resettlement of Coal Enterprises in Anhui Province', *Chinese Workers/ Zhongguo Gongren*, (7): 54–55 (in Chinese).

³⁵ Wong, C. & Qian, J., 2020. 'COVID-19 Highlights Need to Strengthen China's Social Safety Net: The Unemployment Insurance Scheme', East Asian Institute, National University of Singapore.

³⁶ Christine Wong, personal communication, October 2021.

³⁷ Cao Xia, personal communication, October 2021.

³⁸ Ministry of human resources and social security, 2021. *China Labour Statistical Yearbook*, item 9-15 unemployment insurance. Retrieved from <https://data.cnki.net/Trade/yearbook/single/N2022020102?zcode=Z001> (in Chinese).

³⁹ Wong, C. & Qian, J., 2020. 'COVID-19 Highlights Need to Strengthen China's Social Safety Net: The Unemployment Insurance Scheme', East Asian Institute, National University of Singapore.

⁴⁰ Shanxi Provincial Bureau of Statistics, 2021. *Shanxi Statistical Yearbook*, item 2-13 Basic statistics on social security. Retrieved from <https://data.cnki.net/area/yearbook/single/N2021110006?dcode=D04> (in Chinese);

Ministry of human resources and social security, 2021. *China Labour Statistical Yearbook*, item 9-2 Expenses of social security insurance funds. Retrieved from <https://data.cnki.net/Trade/yearbook/single/N2022020102?zcode=Z001> (in Chinese).

⁴¹ Ministry of human resources and social security, 2021. *China Labour Statistical Yearbook*, item 9-16 Unemployment insurance by region. Retrieved from <https://data.cnki.net/Trade/yearbook/single/N2022020102?zcode=Z001> (in Chinese).

finance. Despite the seemingly generous nature of financial support provided by the central government and the multiplicity of local government policies, the experience in Shanxi Province over the period 2016–2020 suggests that they encountered a range of challenges – financial, social, logistical, administrative, and planning.

The reduction of coal mine capacity, together with the continuing upgrading of this capacity, necessarily involved potential job losses or redeployment. Many mechanisms were put in place to assist the redeployment of redundant employees to other industries or to provide them with unemployment benefits. However, implementation failed to match aspirations. Most enterprises found it easier to transfer employees within the enterprise, often just to other coal mines, or to arrange early retirement. Reasons cited include a lack of funds to manage external transfers, the shortage of alternative job opportunities, and the employees' age, lack of relevant skills, and conservative attitudes. Making the worker unemployed was also unattractive. Not only would this require the agreement of the employee, but the longstanding administrative deficiencies of the Unemployment Insurance Fund rendered this option very unattractive to workers. Thus, whilst large-scale unemployment was avoided, the ambition of redeploying coal mine workers to other industries has not been realized. The cost is being borne by the coal mining enterprises.

The overarching lesson for other countries is that managing distributive justice during the low-carbon energy transition is both administratively difficult and financially costly, especially in a region with a coal-dependent economy. Although achieving significant success, China's programmes for coal mine worker assistance encountered significant obstacles to implementation. These challenges arose from a combination of the top-down campaign style of the programmes that led to poor policy coordination, together with the inadequate scale of available financial resources.

In more detail, the implications for managing distributive justice under the low-carbon transition in a coal-rich region include the following:

- A high degree of coordination between government agencies is needed, both horizontally and vertically, during policy design and implementation in order to ensure that the targets for support are correctly identified and that the support provided is both adequate in scale and duration, and appropriate in nature.
- Multiple policy instruments and/or technologies may need to be deployed to take into account the heterogeneity of socio-economic characteristics.
- The instruments for providing support should be transparent and easily understood and accessed by target populations.
- The agencies responsible for providing the support systems should be well resourced and managed, to ensure that the financial and other benefits are fully delivered, but without leakage through illegitimate claims, human error, or corrupt diversion.
- Care needs to be taken in estimating the scale and duration of the financial resources needed to support the programme(s), identifying the sources of the finance and ensuring their continued availability.
- A third-party consulting firm may be needed to estimate the financial cost in both the short and the long run, and to conduct a social impact assessment in advance.
- A robust grievance mechanism is essential for those affected to report any issues with implementation.