



Coal Mine Closure Practices in China: An Overview







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Outline



Development of Coal Industry and Resource-Based Cities in China



1

Types of Mine Closure in China







2022 China Mineral Resources Reserve

Province/Region	Coal (100 million tons	Petroleum (10,000 tons)	Natural Gas (billion cubic meters)
China	2070.12	380629.30	65690.12
shanxi	483.10		1210.59
Inner Mongolia	411.22	12290.09	10115.95
Xinjiang	341.86	66956.82	11482.11
Shaanxi	291.0	35120.11	11770.37
Guizhou	137.30		6.10
Yunnan	67.13	10.15	0.47
Anhui	57.25		0.24
Ningxia	54.18	5679.91	931.94
Henan	44.43	2876.78	61.39
Gansu	40.38	48233.81	729.76
Heilongjiang	36.68	31696.32	1343.88
Shandong	32.85	26244.26	347.25
Hebei	24.22	24159.41	336.49
Sichuan	10.78	641.21	16546.46
Liaoning	10.72	14182.94	152.52
Qinghai	9.88	8565.05	1034.42
Jilin	4.88	16633.44	804.53
Jiangsu	3.09	2048.07	21.9
Hunan	2.57		
Fujian	1.92		
Jiangxi	1.84		
Guangxi	1.51	142.13	1.36
Beijing	0.97	17.07 0.04	
Zhejiang	0.2	133.93	
Hubei	0.13	988.78	44.18
Tibet	0.11		
Tianjing	Tianjing 0.00		294.50
Shanghai	0.00		
Guangdong	0.00	15.49	0.97
Hainan	Hainan 0.00		19.35
Chongqing	0.00	220.08	2562.83

(Data Source : Ministry of Natural Resources of China)



(Data Source : Coal 2023 Analysis and forecast to 2026)

(Data Source : Energy Institute, Statistical Review of World Energy)

China's Energy Production Structure, 2013-2022 (%)

(Data Source : China Energy Big Data Report (2023))



Changes in China's Raw Coal Production and Growth Rate, 2013-2022

(Data Source : National Bureau of Statistics of China)



Primary Energy Structure Scenario Based on Scientific Production Capacity & Energy Consumption

(Unit: 100 million tons of standard coal)

(Data Source : Research on China's Medium to Long-term Energy Development Strategy for 2030 and 2050)

Year	Total Amount of Energy	Coal	Oil & Gas (Coalbed methane, etc.)	Nuclear Power	Non-hydro Renewable Energy	Hydro Power
2020	40 ~ 42	22 ~ 24	11.5	1.7	2	3
2030	45 ~ 46	20 ~ 21	13	4.5	4	4
2050	55 ~ 56	18 ~ 19	15	9	8	5

Energy consumption structure of China in 2018 and the

prediction for 2025 (XIE Heping, WU Lixin & ZHENG Dezhi. 2019)



Resource Based Cities Classified by Resource Type



Research group, Academy of Macroeconomics, National Planning Commission. The definition and classification of resource-based cities in China [J]. Macroeconomic Research,2002(11):37-39+59.







Resource-based Cities are cities with mining and processing of natural resources such as minerals and timbers as their leading industries. —— National Sustainable Development Plan for Resource

Based Cities (2013-2020)



According to the difference of resource supply ability and sustainable development ability, resource-based cities are divided into four types: Growing, Mature, Declining and Regenerating.

——National Sustainable Development Plan for Resource Based Cities (2013-2020)



Table 2 National GDP, Population and Proportion of Secondar Industry of China

	GDP	Proportion of the	
	(billion	Secondary Industry to	Population
Year	RMB)	GDP(%)	(100million)
2019	9865	38.6	14.10
2004	16184	45.9	13.00



Fig 3 GDP(a), Proportion of Secondary Industry(b) and Population of resource-based city











Types of Mine Closure in China





2. Types of Mine Closure in China



- □ The permanent shutdown of mining enterprises caused by resource depletion, complex geological conditions, macro-policy, market influence, operating conditions, etc.
 (Source : HU Zhenqi, BAO Yan, SUN Qingxian. 2005)
- Resolving Excess Capacity in the Coal Industry to Achieve Development Out of the Dilemma. The State Council, Document (2016) No. 7.







During mining or after mining VS after ecological restoration







2. Types of Mine Closure in China



2-1: Mine closure for resource exhaustion

Pilot city for the transformation of resource-exhausted cities



The Haizhou open-pit coal mine was closed in June 2005 due to resource depletion. From 2004 to 2017, **Fuxin City** carried out a series of renovation projects on the Haizhou open-pit mine, achieving some good results and becoming one of the first national mining parks in the country.

2. Types of Mine Closure in China



2-2: Mine closure for low production capacity

- 13 categories of small coal mines are given
- coal mines with production less than 300,000 tons/year, or with previous record of major serious safety accident
- coal mines with production less than 150,000 tons/year, and previous record of accidents
- four provinces, Shanxi, Neimeng, Shanxi and Ningxia, with production less than 600,000 tons/year
- 11 provinces, Hebei, Liaoning, Jilin, Heilongjiang, Jiangsu, Anhui, Shandong ,Henan,Gansu,Qinghai and Xinjiang, with production less than 300,000 tons/year
- In other areas with production less than 90,000 tons/year



2-3: Mine Closure for Environmental Protection

Mines that can not be reclaimed to meet the requirements of ecological restoration

"Lucid waters and lush mountains are invaluable assets"

In 2018, for the first time, ecological civilization will be written into the Constitution, and the construction of green mines will be upgraded to a one part of national strategy.

Coal mines with overlapping mining areas such as nature reserves, scenic spots and drinking water source protection areas are encouraged/compulsory to exit those areas.



eastern mining areas

2-3: Mine Closure for Environmental Protection

The product quality does not meet the requirements of the Coal Quality Management Law. Those coal mines within overlapping area with nature reserve, ecological red line core area were required to exit.



mining on the surface

2. Types of Mine Closure



2-4: Mine closure for failling to reach the third level of safety and quality standardization

- Coal mines with severe hazards such as coal and gas outbursts, extremely complex hydrogeological conditions, and rockburst, which are difficult to effectively prevent and control under existing technological conditions.
- Coal mines that fail to reach the third level of safety and quality standardization will be closed.







2-5: Mine closure for outdated mining technology and other reasons

- Coal mines that adopt mining methods and techniques prohibited by the state and cannot carry out technical transformation; coal mines that are not mechanized
- Coal mines without carrying out social responsibility, long-term tax arrears and social security costs
- Other voluntary withdrawal mines.













Types of Mine Closure in China



4 The Risks of Mine Closure



3. Geographical Distribution of Closed Mines

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The number of coal mines in China

3. Geographical Distribution of Closed Mines





Number of closed mines in China		
2013	1256	
2015	1258	

The number of coal mines in China has decreased, and the number of closed mines in southeastern China is significantly higher than the national closure level.









Types of Mine Closure in China









4-1: Land destroy and reuse—— Subsided and excavated land

Land subsidence, soil erosion, collapsed water, ground fissures, bench, collapse hit,

15

10

-10

2016-10-01

2017-04-01

形变/mm

2018-01-03

2017-10-01

2018-04-01

2018-10-0

← JU6 --- JU7 --- JU8

2019-10-01

2019-04-01



Mine ClosureTime: 2015.12. Time Series Deformation of 12 Selected Points After A Mine Closure

(Source : DENG Kazhong, Zheng Meinan, ZHANG Hongzhen, et al. 2022)





4-2: Environmental Pollution —— Water

Groundwater pollution, surface water pollution, surface marshes, toxic substances permeating from coal mine waste heap,





Yiyang, Hunan) (Yiyang, Hunan)



4-2: Environmental Pollution — Atmosphere

Spontaneous combustion of coal gangue, leakage of toxic gases in underground mined-out areas, coal dust pollution,









4-3: Transformation of the Coal Mine Area After the Closure

Above-ground : Mine Park, Geopark, Mine Museum, Mine Industrial Relics,

Jinhuagong Mine National Mine Park, Shanxi, Datong





Transformation Direction?

Difficulty in Restoration?



Inner Mongolia Zalainoor National Mine Museum







4-3: Transformation of the Coal Mine Area After the Closure

Under-ground : Storage sites, Laboratories, Breeding farm,

Reservoirs in Shendong Coal Mine Area



Underground Power Generation System

Coal Gasification Laboratory, Xvzhou

Agricultural Planting Area



Social Needs?











4-4: Preservation and Inheritance of Coal Mine Culture

■ It is difficult to <u>dispose of the original fixed assets</u>.



■ It is difficult to preserve the original history and culture.



4-5:Other Risks (workers re-employment, Scarcity of specialists,)









Types of Mine Closure in China

4	The Risks of Mine Closure
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Multi-disciplinary fields

- Management
- Mining & Surveying & Environmental Engineering/Science and Technology

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The whole space in mining area

- Surface
- Underground space
- Lower tropospheric atmosphere

•••••

Existing during the whole mining life

- Pre-mining
- During-mining
- After-mining



Mining

development

0

——The entire lifecycle of a mine

A complete theoretical framework and technical system for mine closure rehabilitation, including core elements such as mine closure plan, stakeholder participation, financial security, pit closure methods and standards, post-mining monitoring and maintenance, and responsibility handover, and the concept of mine closure runs through the whole life cycle of mining projects.



Fig 6.1 Schematic diagram of the whole life cycle of mines







《Mineral Resources Law of the People's Republic of China》 (Effective October 1, 1986, Revised draft to be submitted in December 2023) 《Rules for the Implementation of the Mineral Resources Law of the People's Republic of China》 (State Council Issued on March 26, 1994)



Mine closure process



——Ministry of Land and Resources. *Regulations on the protection of geological environment in mines*, 2009.













Haizhou Open Pit Coal Mine, Fuxin, Liaoning Province









Pan'an Lake, Coal Mining Subsidence Area, Xuzhou, Jiangsu Province



(Source : ZHAO Huishun, HU Zhenqi, ,YUAN Dongzhu et al. 2019)

Nanhu-Kailuan Scenic Aera, Tangshan, Hebei Province

On-site water management: Cut off site sewage, Physical and chemical methods to purify water, Planting of water purification plants, Restoration of circulation and flow in the water system

Utilization of industrial and mining heritage: Retaining buildings and structures representing Tangshan's industrial civilization for renovation to showcase the city's industrial history.

深坑奇境 上海佘山世茂洲际酒店 INTERCONTINENTAL SHANGHAI WONDERLAN

≥ US\$283 per night

设计 〔英国〕 Martin Jochman

Alias: Deep Pit Hotel

Location: at the foot of Sheshan Mountain in Songjiang National Scenic Area, ShangHai

Discription:

an

abandoned pit with a depth of 80 meters. It was originally a quarry, and after decades of quarries, a deep pit with a circumference of kilometers and a depth of 100 meters was formed.

The "Deep Pit Hotel" is the world's first five-star hotel built in the pit.

Investor: Shanghai Shimao Group.

Equiption: underwater scene suites, sky garden, spectacular waterfall, steel structure resistant to 9 earthquake buildings.

Officially started: In March, 2013. On October 21, 2013, the wall and bottom rocks of the pit were blasted for the first time

Open date: November 15, 2018, the "Deep Pit Hotel", one architectural wonder of the world, was officially opened.

- □ Abandoned Mined Land and Coal Resource Based City keep sustainability is very important both during mining activity and after mine closure.
- □ "Mining for closure" should be one thinking way or working principle for each stakeholder and practitioner for mining.
- □Planning for Rehabilitation of Geological Environment and Land Reclamation for mining permit application is not enough. Mine closure planning is much more necessary for both comprehensive and its long-term vision combined with concrete actions.
- ■Both the government officials, scholars and miners should focus on accurate mines/closed mines' data collection and application, appropriate evaluation, suitable planning and good planning implementation.

Thanks for your attention

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