



# Case Study: Best Practice of CMM Development and Utilization in China



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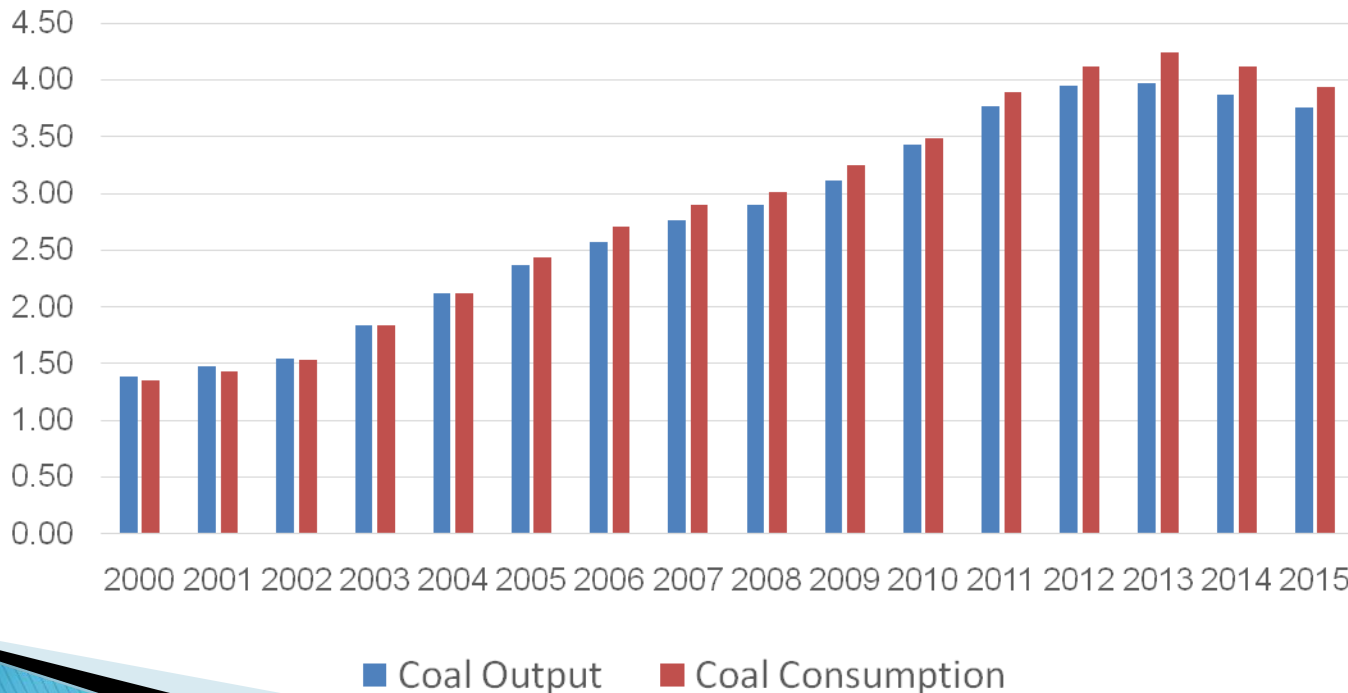
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# 1. Situations and challenges of CMM Recovery and Utilization in China

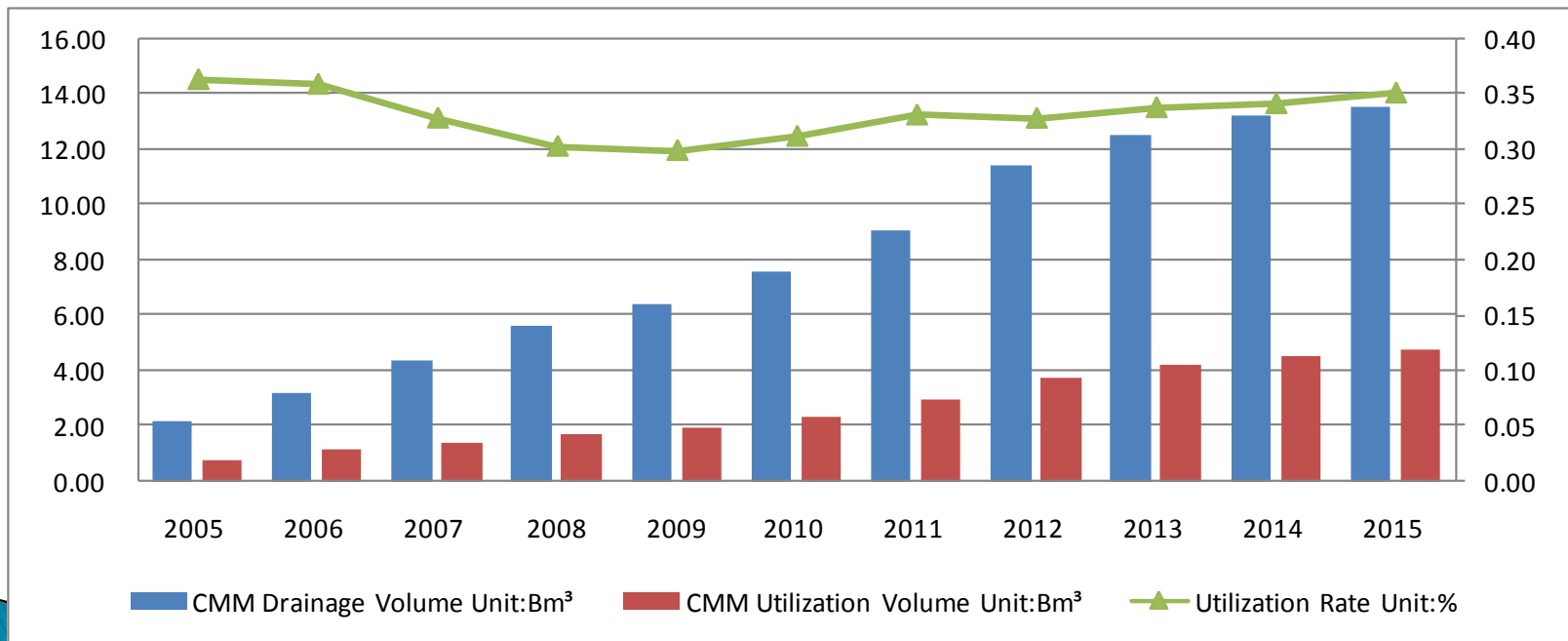
- ▶ China is the largest coal producer in the world. The coal output was 3.75 billion tons in 2015, decreased by 3.3% in comparison with that in 2014.
- ▶ Coal consumption totaled at 3.94 billion tons in 2015, decreased by 4.4% in comparison with that in 2014.



**Output and Consumption of Coal from 2000 to 2014 in China**

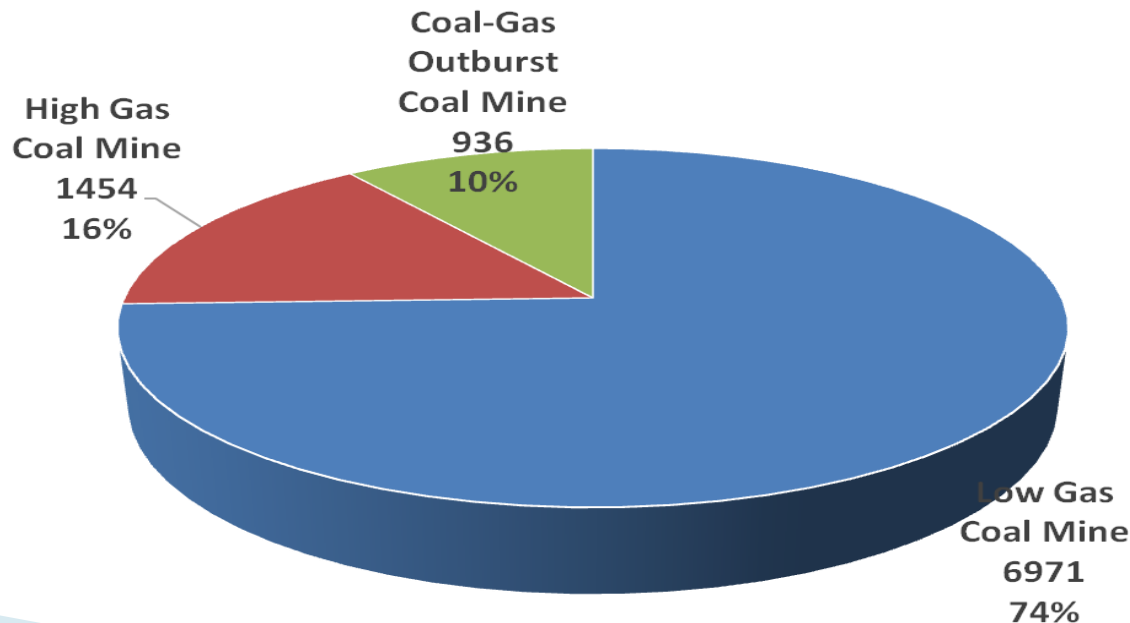
# 1. Situations and challenges of CMM Recovery and Utilization in China

- ▶ CMM drainage increased from 2.2 billion in 2005 to 13.6 billion m<sup>3</sup> in 2015.
- ▶ Volume of CMM utilization are 4.77 billion m<sup>3</sup> in 2015, and utilization rate is 35.1%. About 8.8 billion m<sup>3</sup> of gas are available for more gas utilization projects.



**CMM Drainage and Utilization from 2005 to 2015 in China**

- ▶ With a large amount of gassy and outburst-prone coal mines, China is confronted with great challenges in mine safety and improvement of the efficiency of CMM recovery and utilization. Coal mining companies in China have been making great efforts to use innovative technologies in CMM recovery and utilization.
- ▶ Main difficulties: low permeability, soft coal, small gas flow from a single underground borehole or vertical well, low methane concentration, etc.



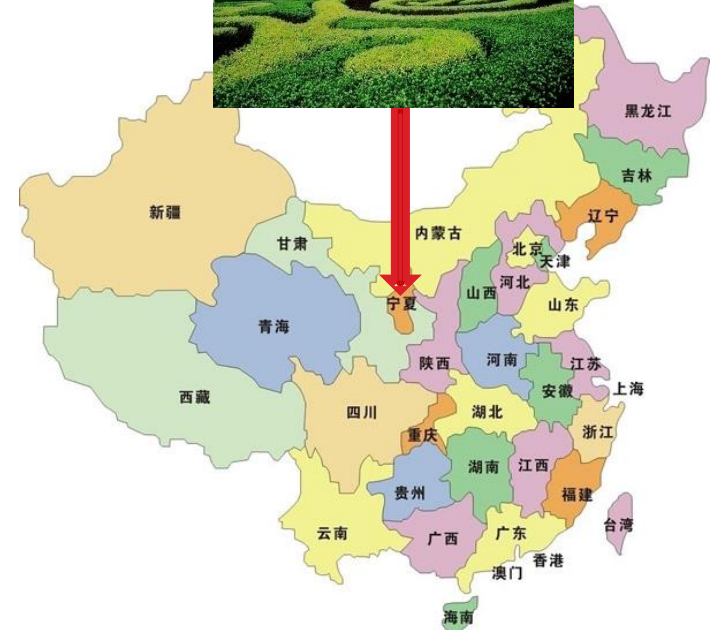
**Classification of coal mines with gas contents in China 2015**

## 2. Case Studies

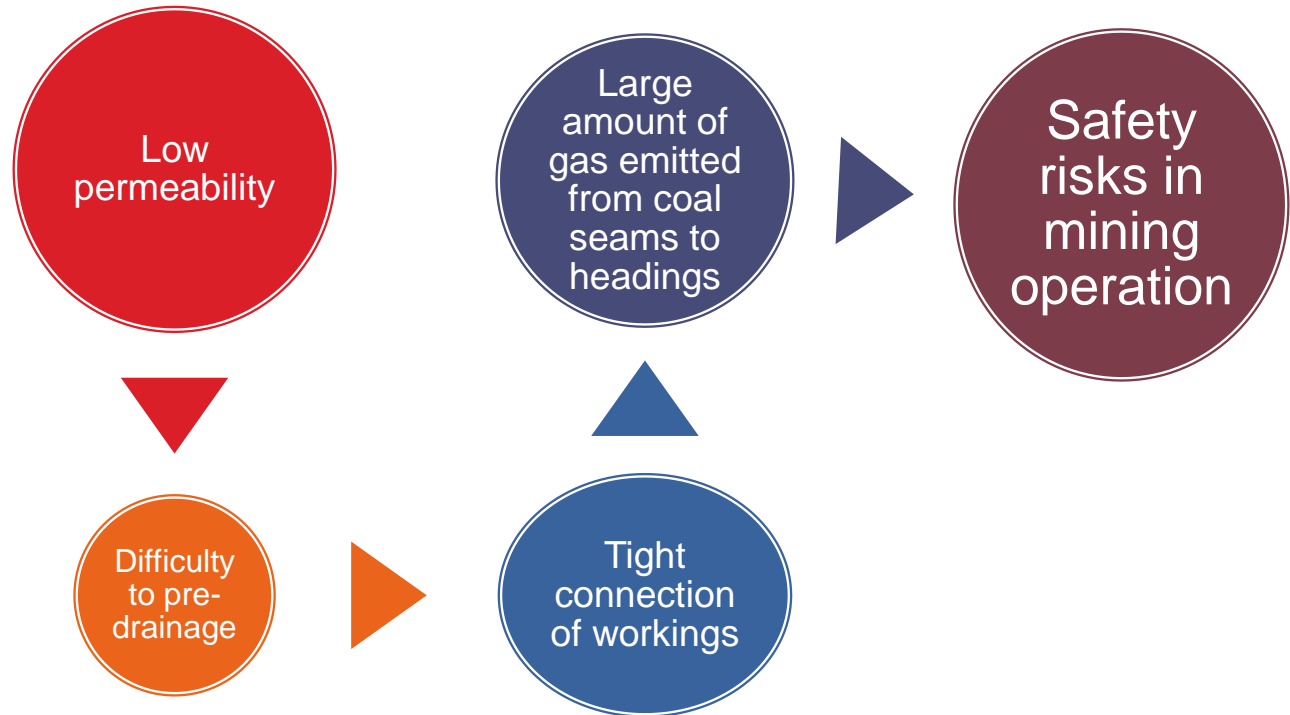
### ▶ Case Study1: Pre-drainage of CMM using Multi-literal Horizontal Wells

▶ Site: a coal mining panel at Shaqu Coal Mine of Huajin Coking Coal Co., Ltd, Shanxi Province.

- Length of the panel: 1500m,
- Width of the panel: 220m
- Strength of the coal seam to be mine:  
soft coal,  $f=0.5$
- Gas content:  $11.5\text{m}^3/\text{t}$
- Permeability:  $1.78\text{-}3.78\text{m}^2/\text{MPa}^2\cdot\text{d}$



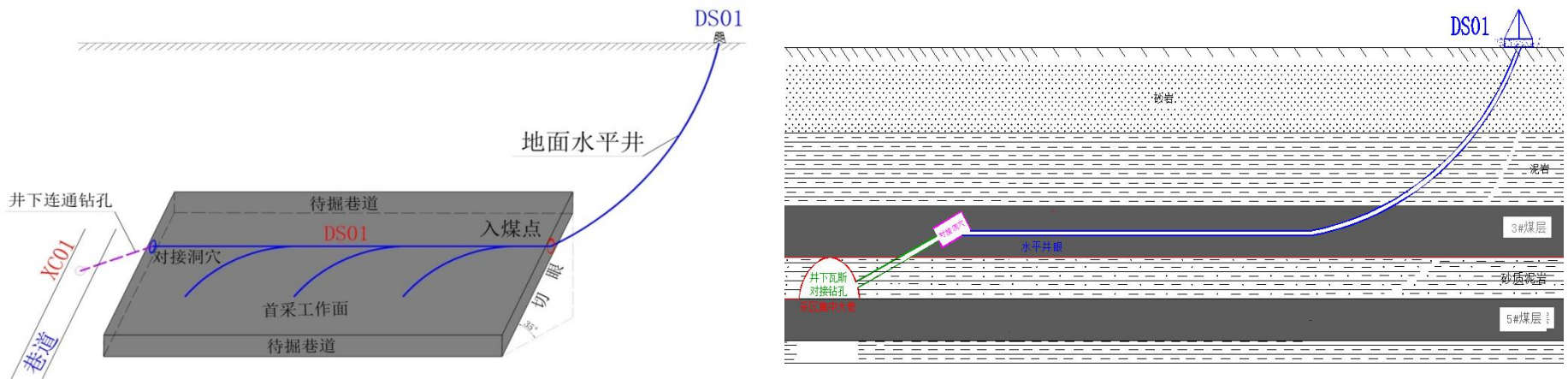
# Difficulties





# Solution: Pre drainage of CMM using multi-literal horizontal wells

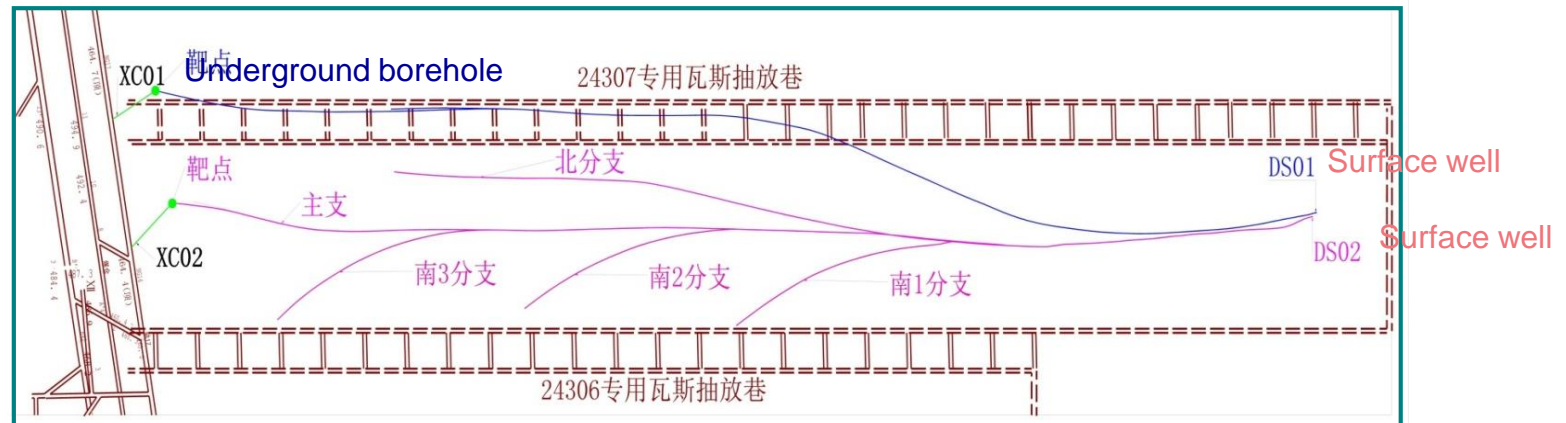
## Design of horizontal wells



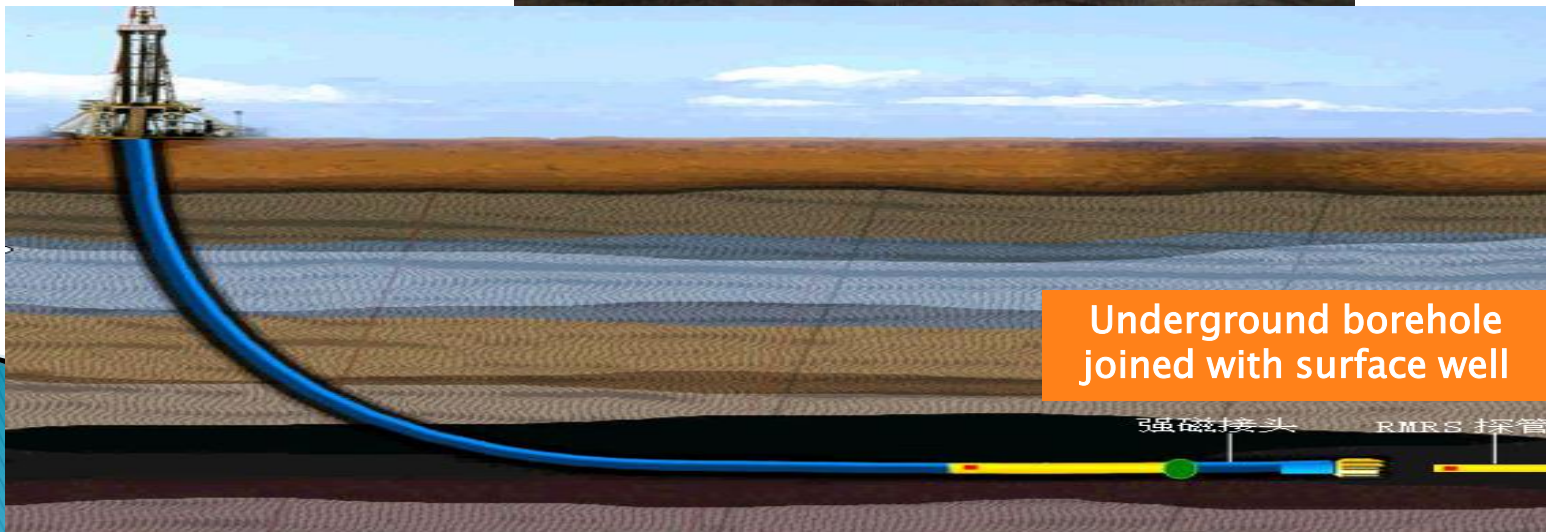
- ▶ The multi-literal horizontal wells reached to all places of the panel
- ▶ The horizontal wells were drilled within the coal seam

## Drilling wells boreholes

- ▶ Drilled 2 main horizontal wells (DS01- well, DS02 – well) with 4 side branches
  - The length of DS01- well: 1027m.
  - The length of DS02 - well: 1056m
  - The length of the 4 side branches of DS02 – well: 272m, 272m, 273m, 797m
- ▶ Drilled 2 underground boreholes
  - XC01- borehole (53m long), CX02 – borehole (54m long)
  - Be connected with the directional branches of the horizontal well

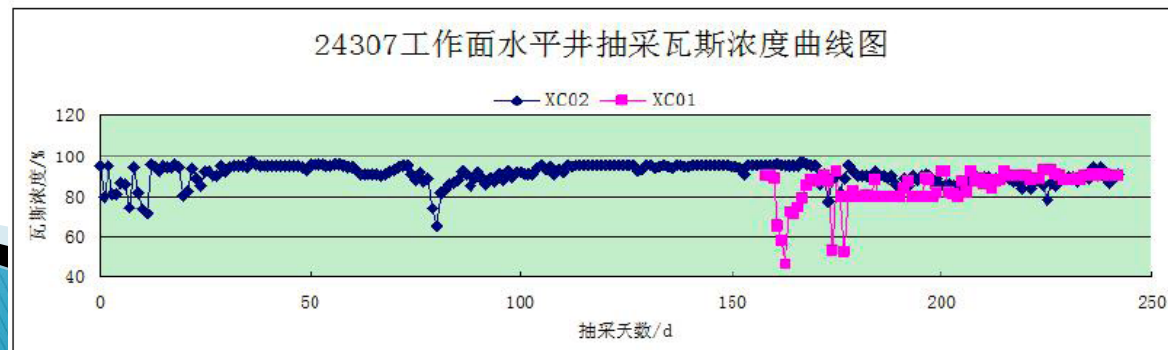
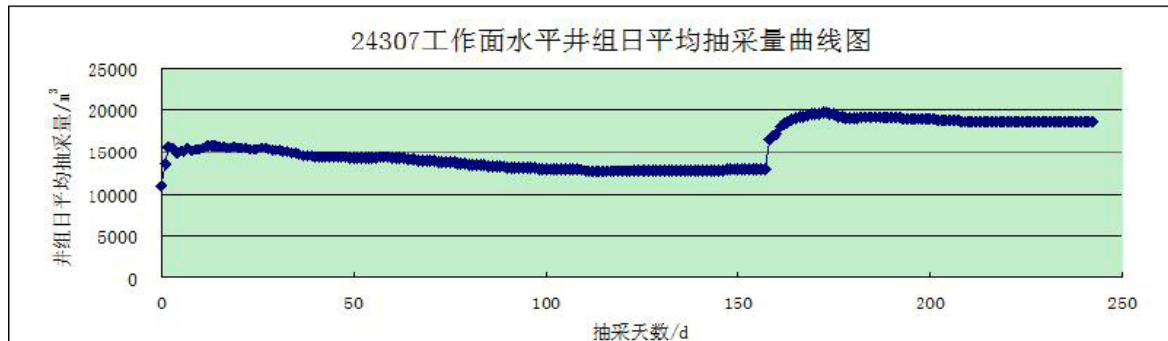






# Achievements

- ▶ Period of CMM recovery: 672 days,
- ▶ Total volume of CMM recovered: 10,130,000 m<sup>3</sup>
- ▶ Averaged CMM flow: 15069 m<sup>3</sup> per day
- ▶ Methane concentration : > 90%. The CMM was used as fuels for the Power Plant at Shaqu Coal Mine.



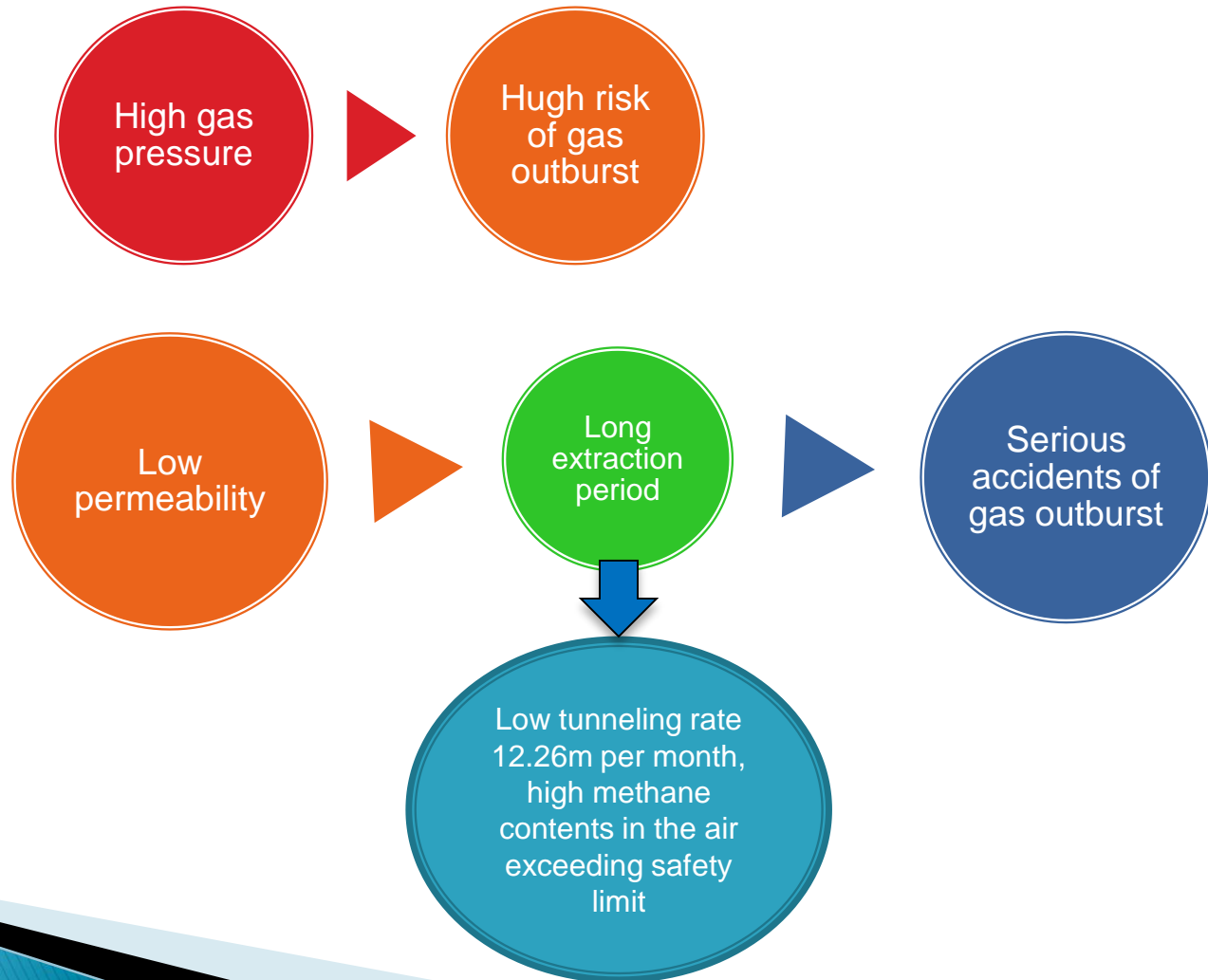
## Case Study 2: Underground hydraulic fracturing technology for improvement of permeability

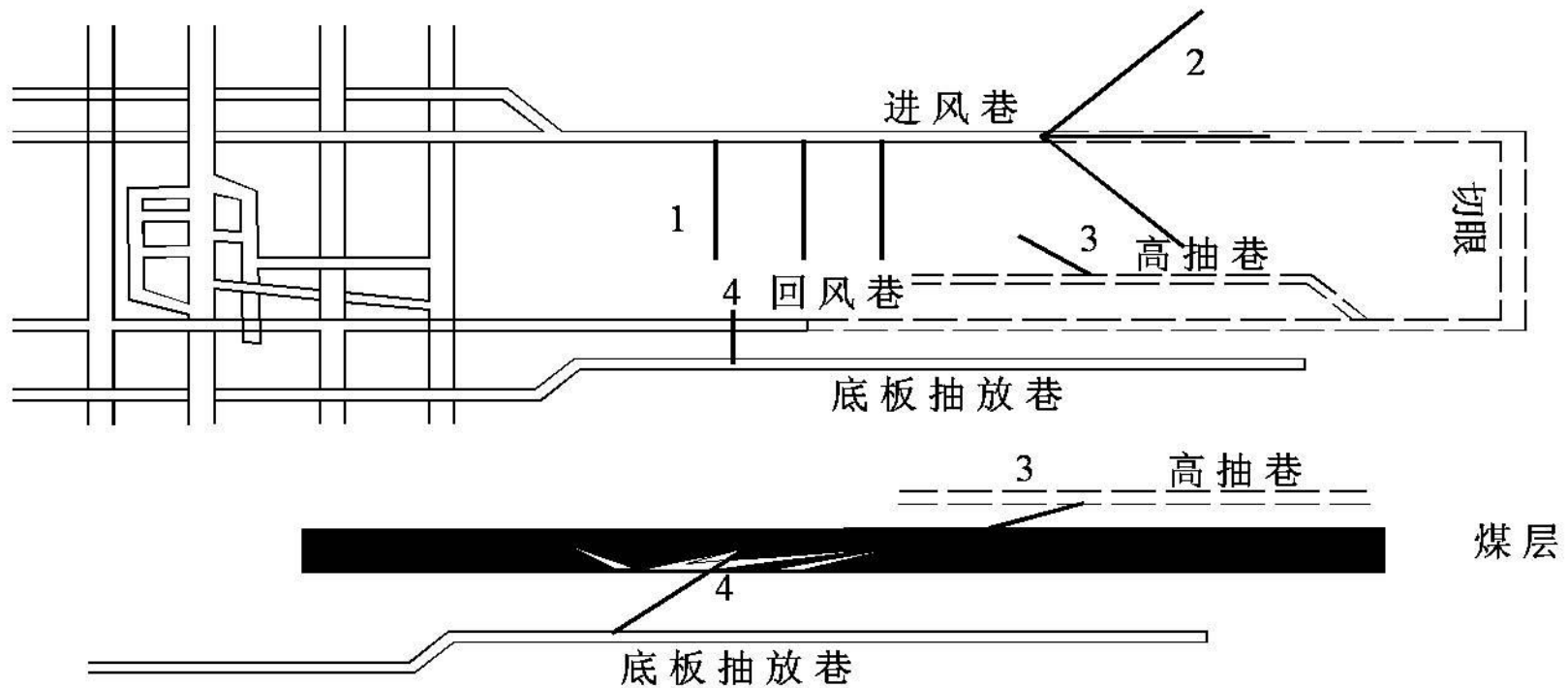


- ▶ Site: No.6 Coal Mine, Hebi Coal Company of Henan Energy and Chemical Industry Group, Henan Province
  - High methane content, risk of coal and gas outburst
  - Coal seam to be mined: soft coal,  $f=1$
  - Thickness of the coal seam: 4.72 ~ 13.51m
  - Gas emission: 25.07m<sup>3</sup> per tone of coal output



# Difficulties





Drilling boreholes for fracturing

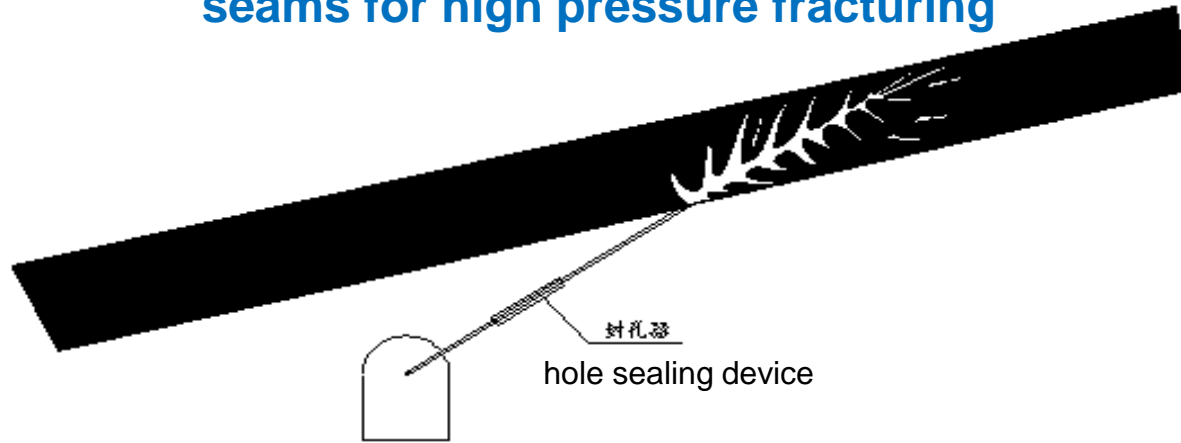
1. Borehole within the coal seam

2. Borehole within the coal seam in the entrance roadway and ventilation roadway

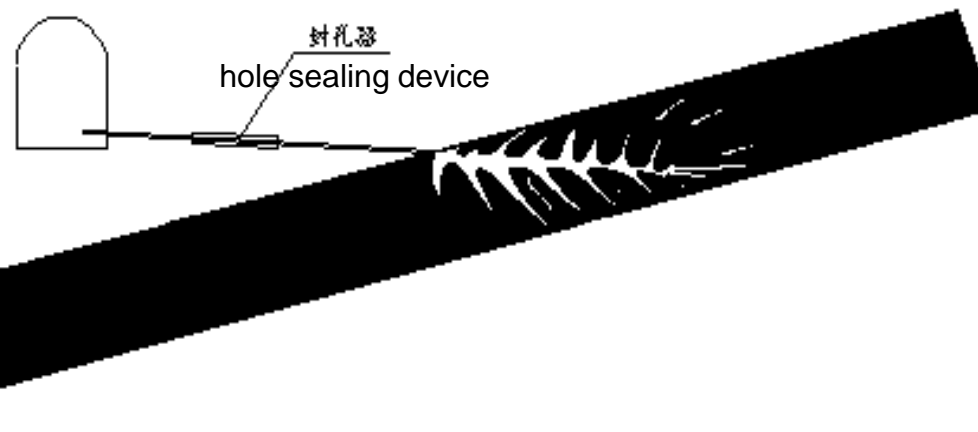
3. Borehole in gas drainage roadway over the coal seam

4. Borehole in gas drainage roadway under the coal seam

## Long boreholes in roadways under and above the coal seams for high pressure fracturing

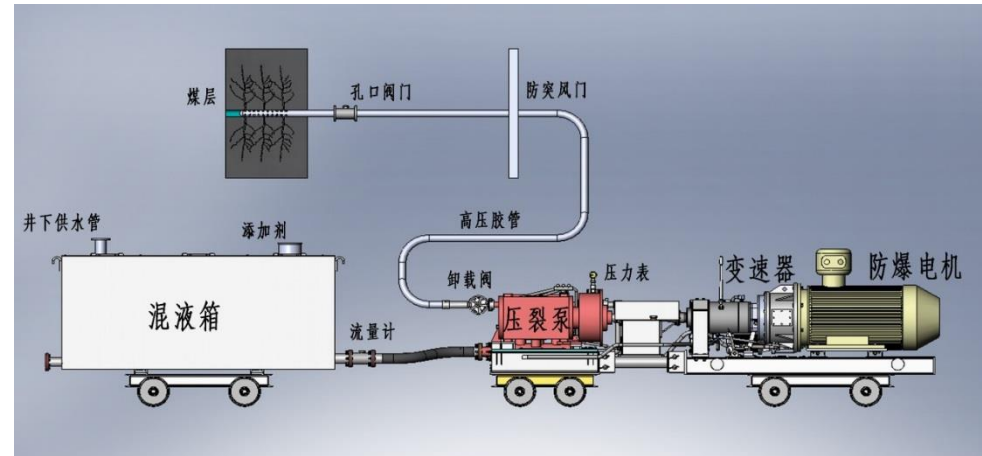


## Long borehole in the drainage roadway over the coal seam for high pressure fracturing





- ▶ Undertook 6 successful trials of hydraulic fracturing
- ▶ Drilled 114 boreholes with 7810 m in total
- ▶ Recovered 720,000m<sup>3</sup> of CMM
- ▶ Length of gas drainage roadway: 400m

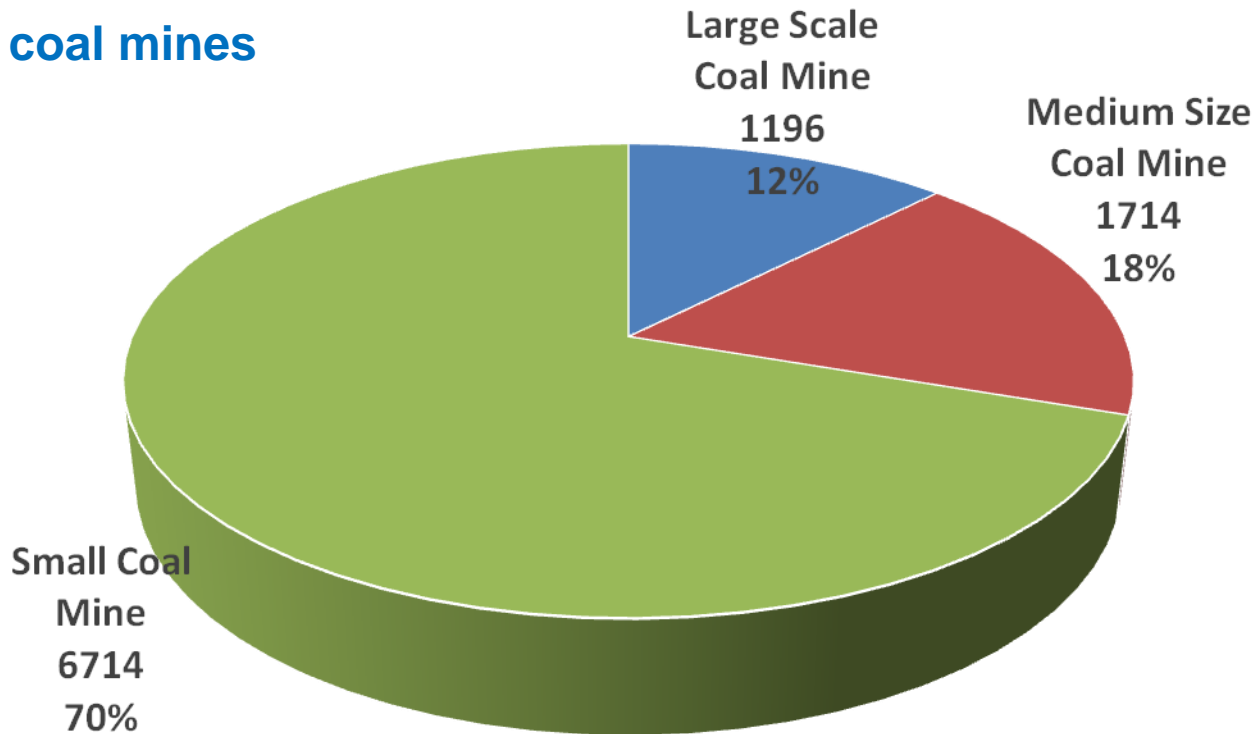


	Permeability t (md)	Gas flow decay coefficient (d <sup>-1</sup> )	Gas flow from single hole per 100m (m <sup>3</sup> /d.hm)	Tunneling rate per month (m)	Methane contents exceeding safety limit (%)
Before fracturing	0.03~0.045	0.3871	26.52	12.26	35
After fracturing	5.83	0.044	573.7	40	3.2
Increased by times	129~194	8.80	21.62	3.3	10.9

### 3. Great potential for AMM utilization

- ▶ Structure of coal mines in China.

**9624 coal mines**



**Classification of coal mines based on coal production capacity in China 2015**

- ▶ In consideration of the situations that coal supplies are much over demands and gassy coal mines are accident-prone, Chinese Central Government planed to close down about 4000 small coal mines and 300 large coal reserve- exhausted mines with total annual output capacity of 500 million tones of coal in coming 3 to 5 years, for which the Central Government will provide financial support of RMB 60 billion
- ▶ There exists a large amount of abandoned mine methane ( AMM ) in those coal mines to be closed.
- ▶ Using AMM as fuels for power generation will make great contributions to energy supply and emission reduction

## 4. Demonstration of CMM Utilization in different area

- ❑ Power generation
- ❑ Compressed CMM for vehicles fuel
- ❑ Liquefied CBM
- ❑ Household use





## 5. Conclusions

- ▶ Many coal mines are confronted with great challenges in mine safety and CMM recovery. Chinese government is encouraging coal mining companies to use best practices in improvement of CMM recovery and utilization with governmental funds and incentive policies.
- ▶ These challenges present potential opportunities for cooperation in CMM recovery and utilization between China and other countries. Innovative technologies demonstrated great accomplishments.
- ▶ The plans and actions in closing down a large number of gassy and exhausted coal mines offer more opportunities for AMM recovery and utilization. All these efforts will result in reduction of methane emissions from coal mines.



*Thank you for your attention*

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