Improving Quality and Efficiency of the Technology of Phase II CMM Utilisation Plant
Power Branch Company, Huajin Coking Coal

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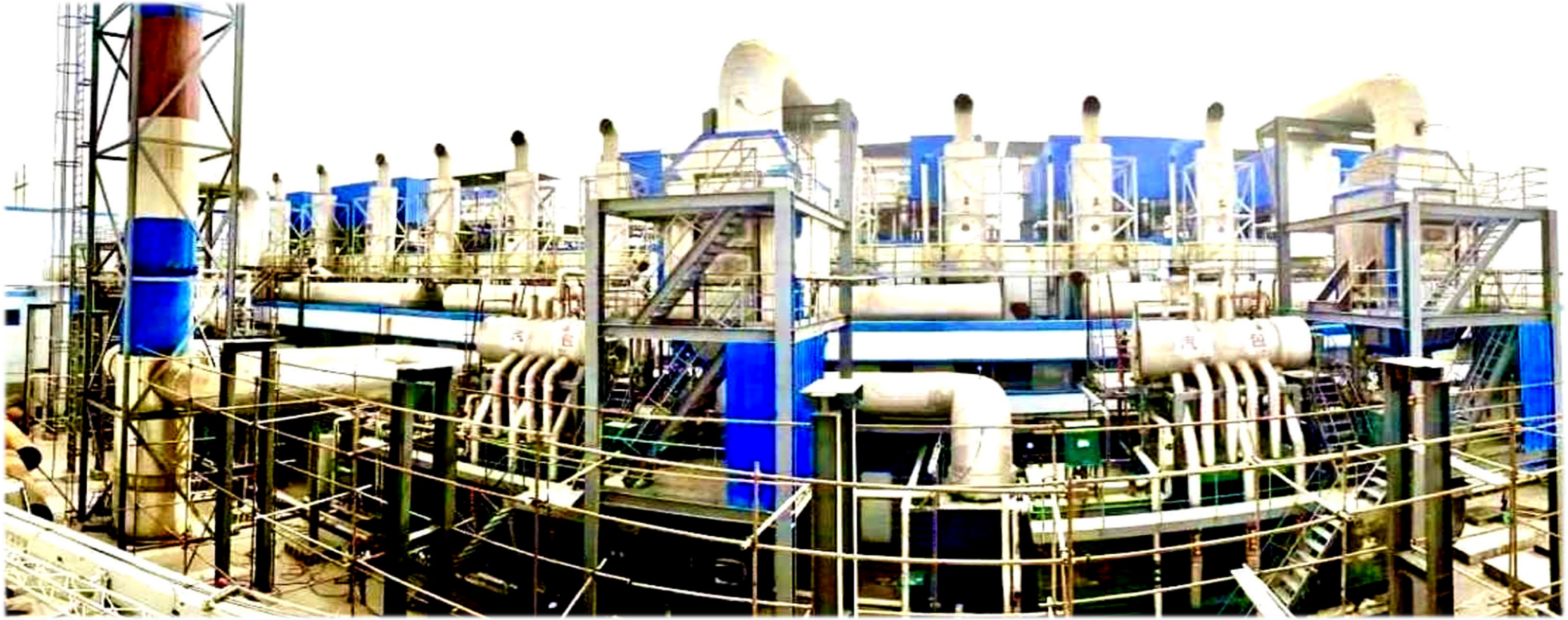
Part I: Project Introduction



Current Situation of CMM Utilization in Huajin

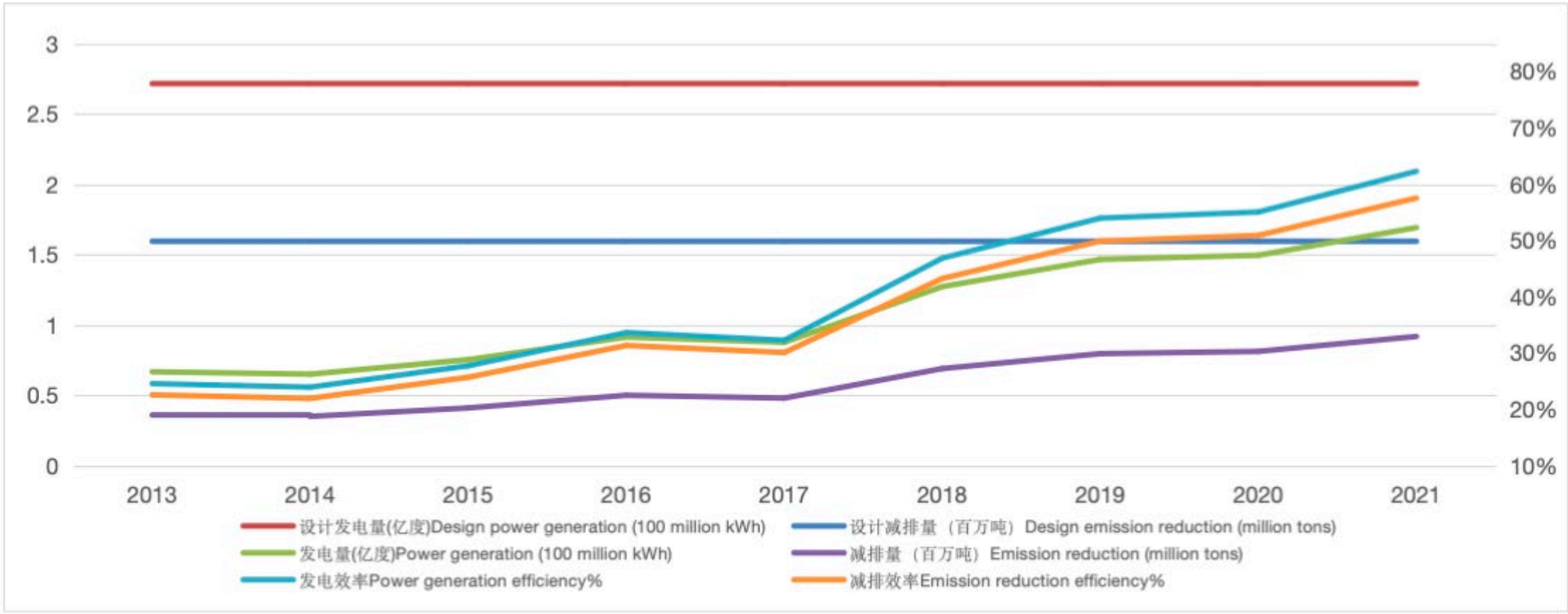
- Established a specialized gas utilization company - Electric Power Branch.
- The Branch mainly engages in gas power generation, high-voltage power supply, gas boiler heating, and unit exhaust heat utilization business.
- It is currently the largest comprehensive utilization base for CMM in Shanxi Coking Coal and Lvliang City region.
- Phase 1 power priority to the coal mine
- Phase 2 power priority to the Grid

Methane Utilisation History

- ◆ Some drained gas supplied to Liulin Towngas Company2006/2007 CDM financed project development initiated
- ◆ Original Phase 1
- 14MW CMM power project installed.
- 20 x Jinan diesel nominal 700kW generators
- Phase 1: Poorly performing equipment was removed in 2023
- Will be replaced by high efficiency 4x 3.3mw Jenbacher engines. Expected to become operational this year. Note: Jenbacher engines can achieve in excess of 40% efficiency.
- The new Phase I is being constructed by Tianjin DI.
- ◆ Original Phase 2
- The original CDM project design was for:
- 62 MW of gas engines
- Waste heat recovery boilers
- 2 steam turbine generators each with a capacity of 3MW.
- Flare(s) for the destruction of unused CMM
- CMM-fired boilers for space heating as a back-up.
- Phase II as constructed (2012) had an installed capacity of 31MW
- There are 14 * 2MW high concentration gas power generation units produced by Caterpillar,
- 1 *3MW steam turbine.

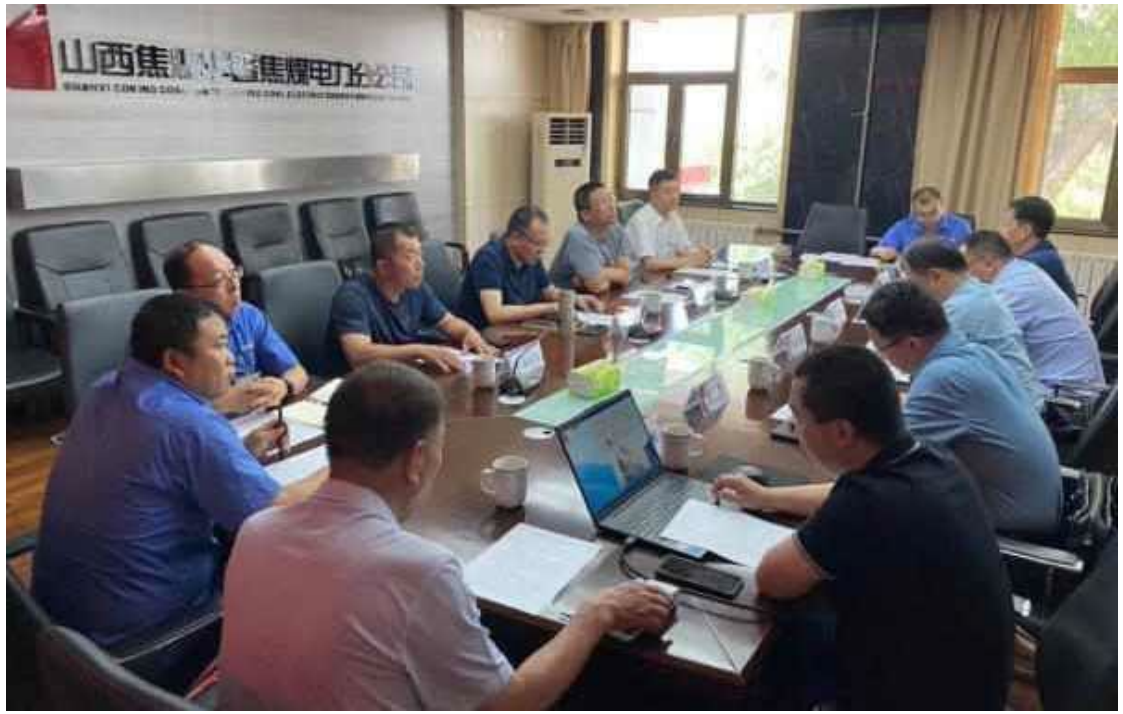
- ◆ The phase 2 is the topic of this talk.

Power Generation and Methane Mitigation Performance Before Reconstruction



Problems with the Original Utilisation Schemesin for Phase II

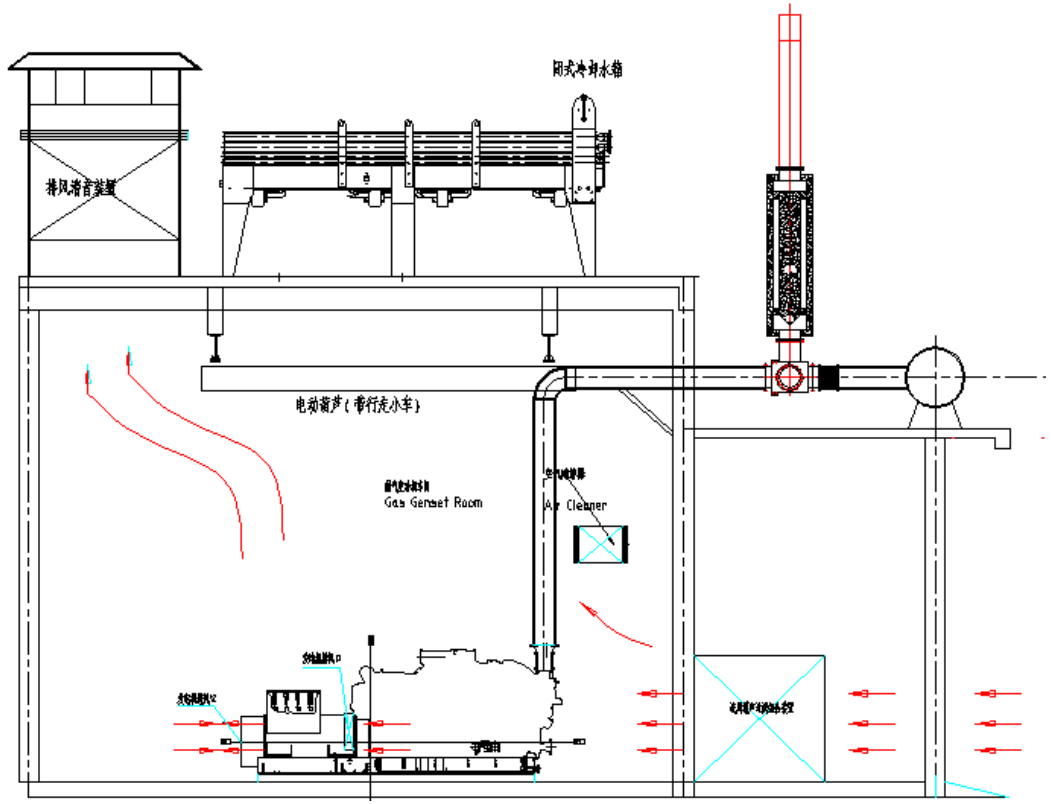
- Badly designed and never satisfactorily completed or operated. Much of the equipment that had been installed fell into disrepair.
- Suffered from low power output, engine overheating, frequent equipment failures, high operating costs, defects in the original design, and inability to put the waste heat power generation system into operation.
- Phase 2 reconstruction and improvement of CMM combined cycle power generation started in 2021



Main Problems

Poor ventilation design in the main workshop

The main building is inadequately ventilated due to the poor design implemented. In summer, the internal temperature can reach 55-60 Degree C, which reduces generation efficiency and is an unacceptable work environment.



System design has defects

Imperfect design of pre-treatment: low filtering accuracy, insufficient capacity of chiller, high outlet temperature and relative humidity. The gas pipeline contains water causing engine malfunction.

Capacity of 3MW Steam Turbine (T3505) Re-operation

It needs a complete overhaul including the steam turbine, generator, control and electrical systems, and the PLC unit.

Related Supporting Equipment is Outdated

3 sets of heat recovery boilers (evaporators, super-heater and economizer) have operated for more than 10 years. The water treatment system cannot meet the needs of the steam turbine.

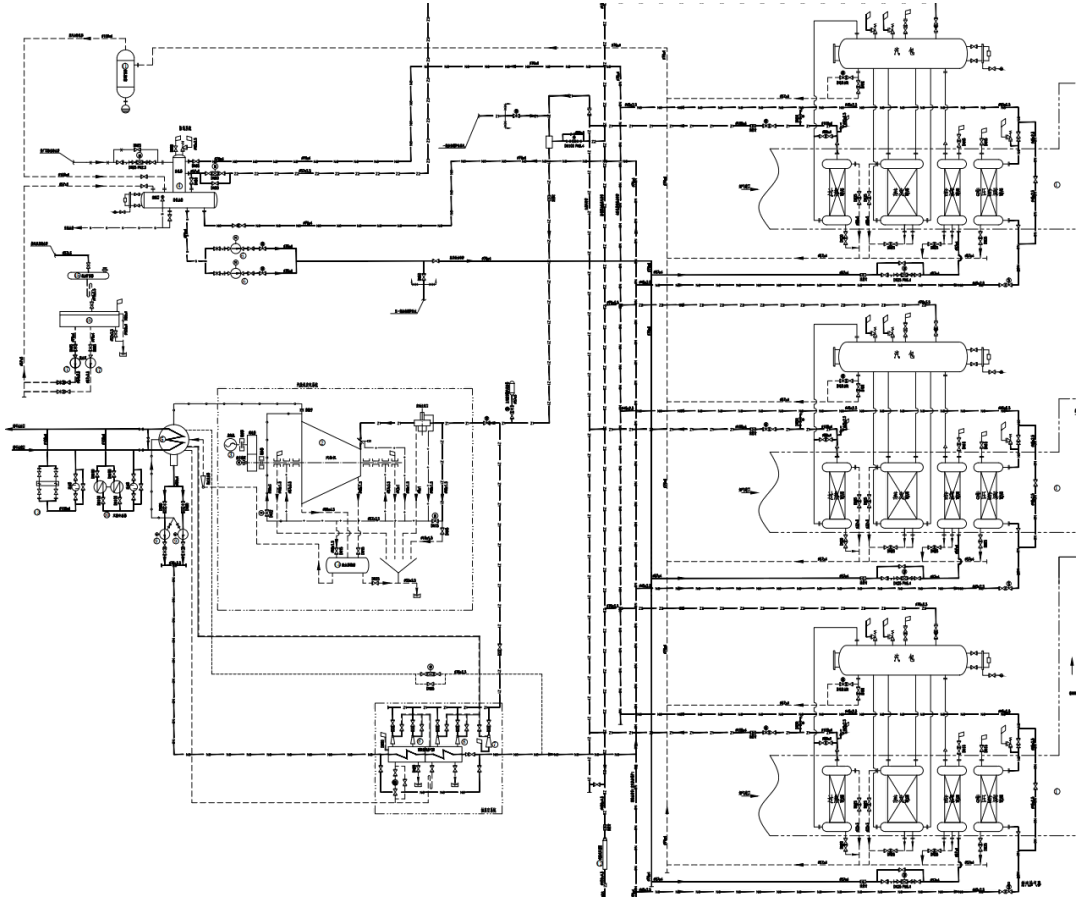
Part II：Improving Quality and Efficiency of the Technology

Cooperation of the Project Implementation

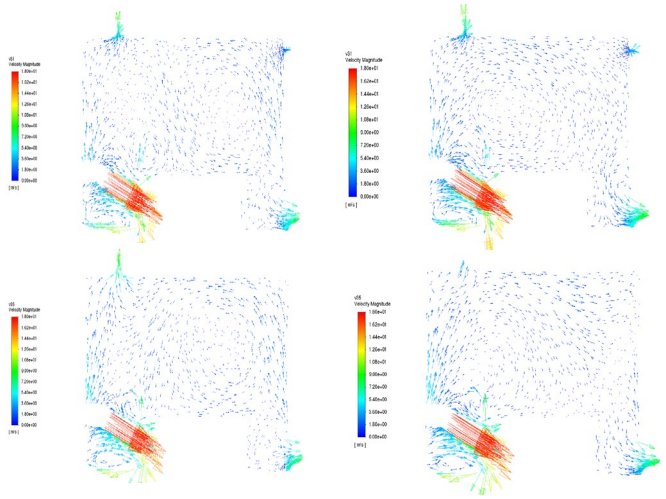
- Implementation Company: Coal Industry Taiyuan Design and Research Institute Group Co., Ltd.
- Joint implementation Company : Shanxi Guomeng Electric Power Technology Co., Ltd

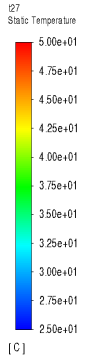
Phase 2 Improved, High Efficiency Utilisation Scheme

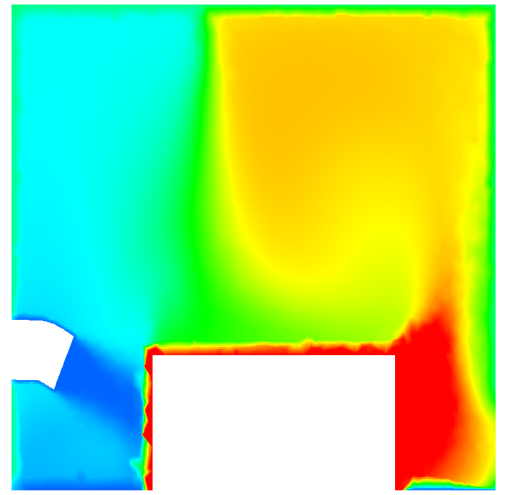
- The aim is to upgrade, raise efficiency and enhance the power generation performance of the system.
- Reuse existing equipment which can be refurbished,
- Replace unsatisfactory equipment with new modern equipment
- Improve the ventilation standard of buildings used to house existing engines to prevent overheating
- Pretreatment for the existing CMM gas-engines is being upgraded with replacement filters and chillers,
- The steam turbine is being refurbished.



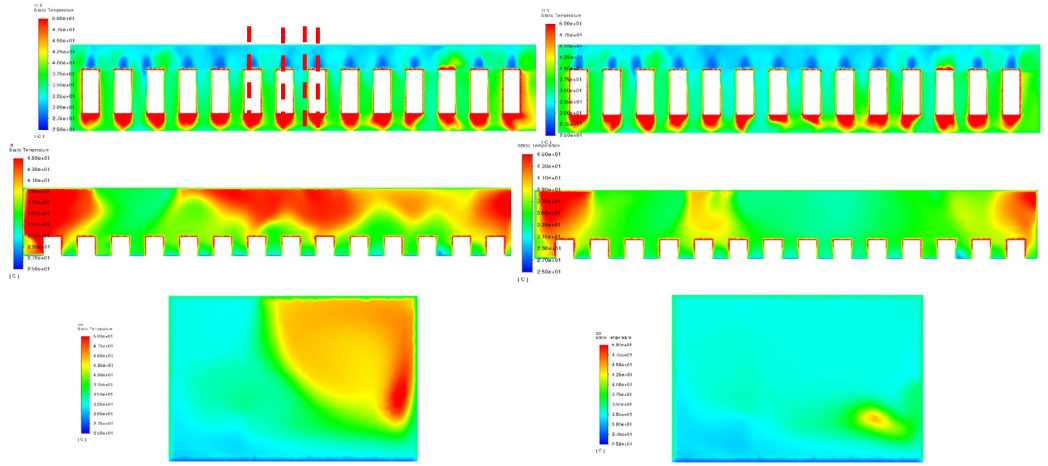
Improve the Design and Optimize the Ventilation System



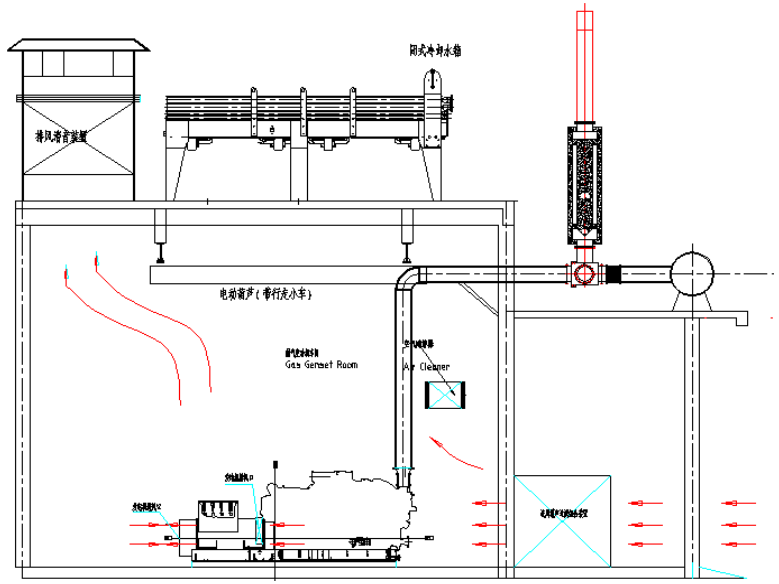


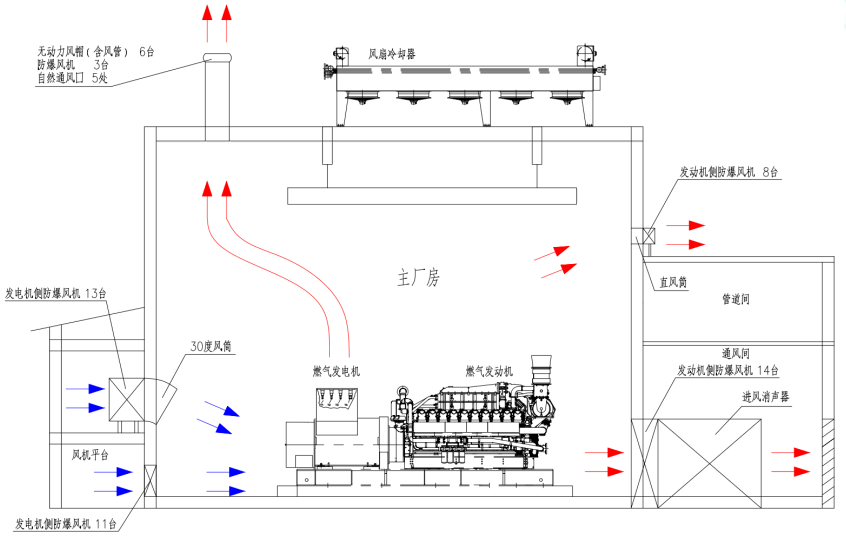


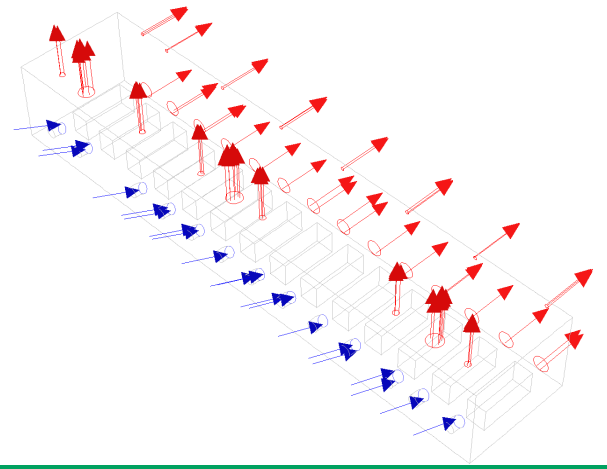
Establish a ventilation and heat transfer model, reveal the mechanism of thermal environment formation inside the building, optimize ventilation system design, and determine renovation plans



Ventilation System Upgrade







Including

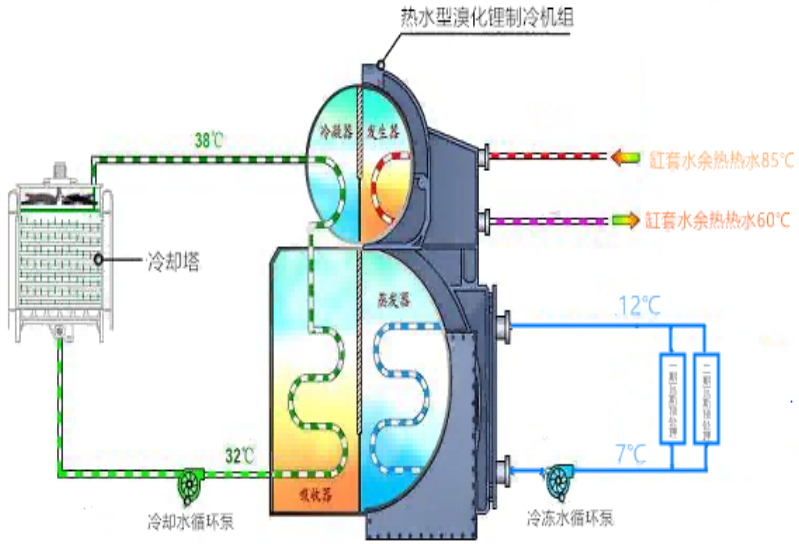
- Intake from Generator side, Return from engine side, auxiliary return from top
- Removed the top 14 fans, install 13+11+14+8+3=49 fans and 6 unpowered fan ventilators

Upgrade Pre-treatment System for the Engines

Install 30m3 water tank in the main pipeline to remove liquid water; replace large primary filters to improve filtration accuracy, heat exchange efficiency, and dehydration capacity; utilize lithium bromide refrigeration workshop to provide gas cooling.

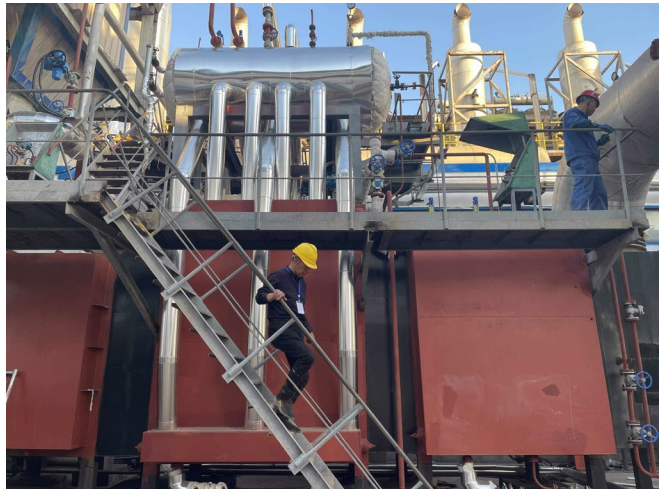
Recovery of Waste Heat from Jacket-water to Improve Heat Utilization Efficiency

The jacket water from engine 1# to 7# is used as a heat source for preparing mine bathing water, 8# to 14# is provided to the lithium bromide refrigeration unit. The measures also can improve the cooling effect of cylinder liner water.



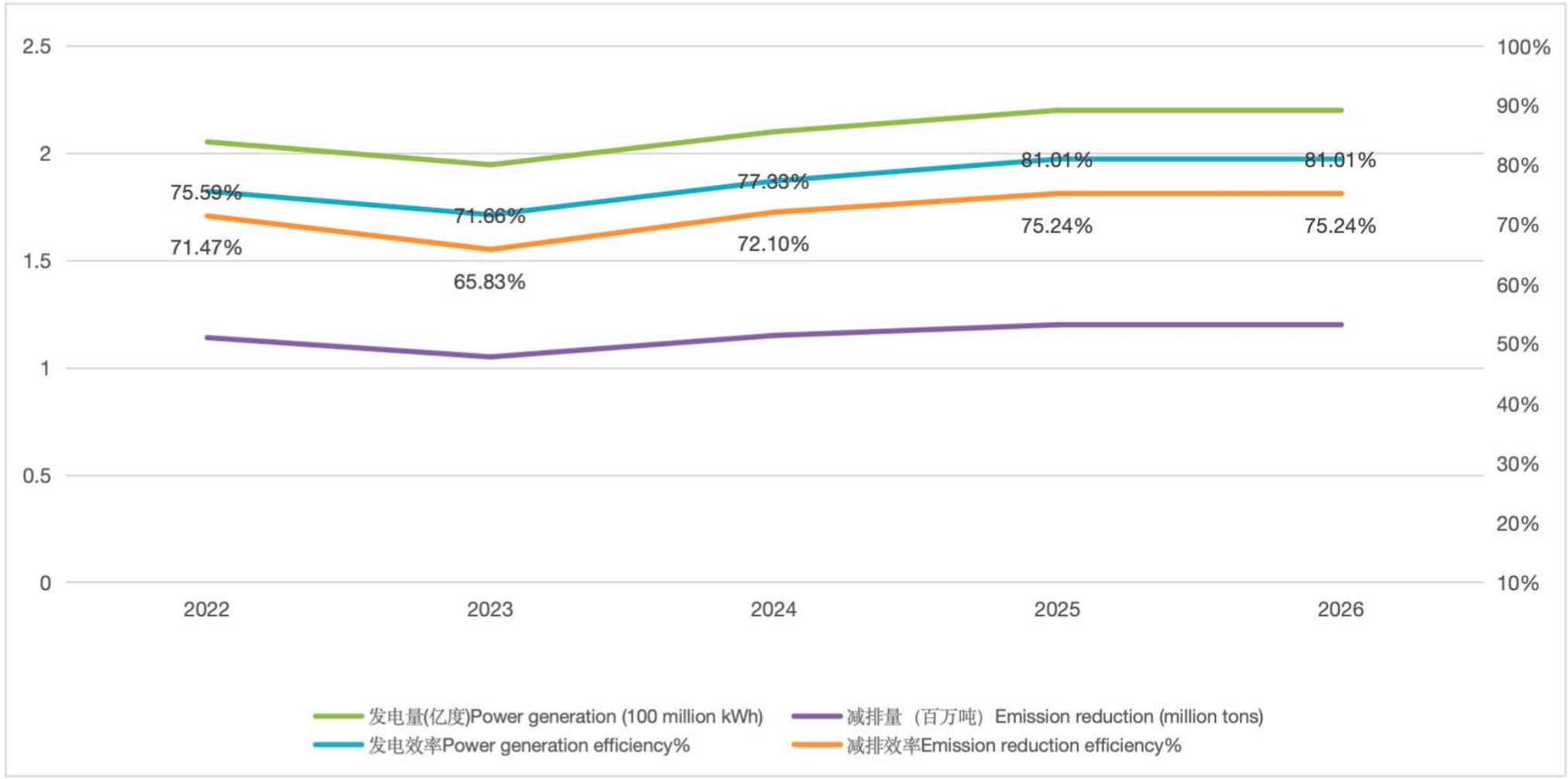
Upgrade of Supporting Equipment

Including boilers, water treatment, steam turbines, air cooled condensor

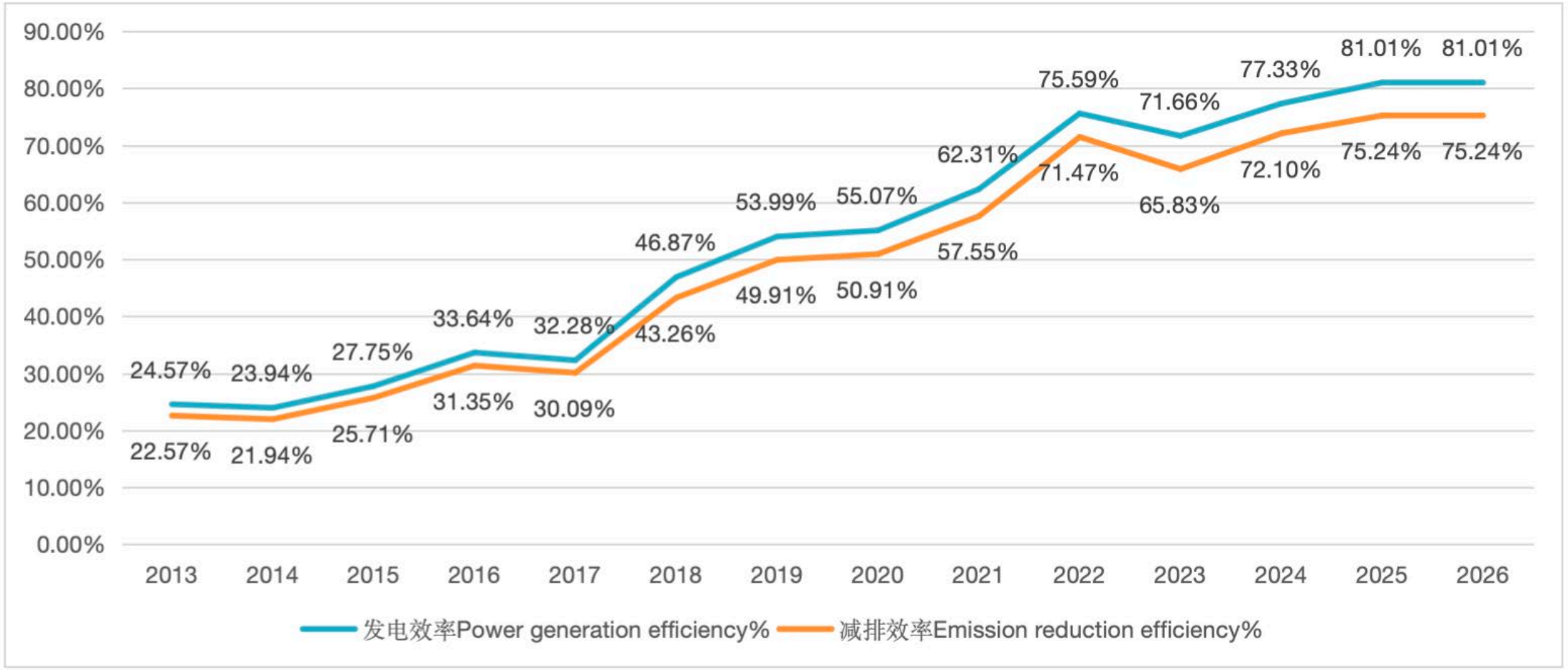


Part III: Project Achievement

Predicted Power Generation and Methane Mitigation Performance



Generation and Mitigation Performance Trend



Conclusion

Through project, the operational status and efficiency of the CMM project were studied and analyzed, we can get the following conclusions:

1. Since 2006, with the CDM mechanism, more CMM utilization and emission reduction projects have been promoted and developed; these projects have been in operation for over 15 years, providing clean energy and generating significant emissions reductions

2. Due to a lack of understanding of the project in the past, Suffered from defects in the original design, low power output, engine overheating, frequent equipment failures, high operating costs, through the upgrades and improvements, optimizing and improving the original design, upgrading and updating supporting equipment, improving remote control, and achieving maximum emission reduction effects

3. Meanwhile， by upgrading and renovating existing projects, higher requirements are put forward for the design principles, implementation standards, equipment matching, quality control, etc. of new projects, optimizing and improving the emission reduction effect of the projects

Therefore, upgrading and renovating traditional projects and improving the standardization of new construction projects are important means to improve emission reduction.