19th International Mining Congress of China

First Workshop of the International Centre of Excellence on Coal Mine Methane (ICE-CMM) in China

Tianjin 24 September 2017

CMM: Best practice benefits and challenges for China

Dr D P Creedy – UNECE Group of Experts; Managing Director CMM&VAM, Sindicatum Sustainable Resources

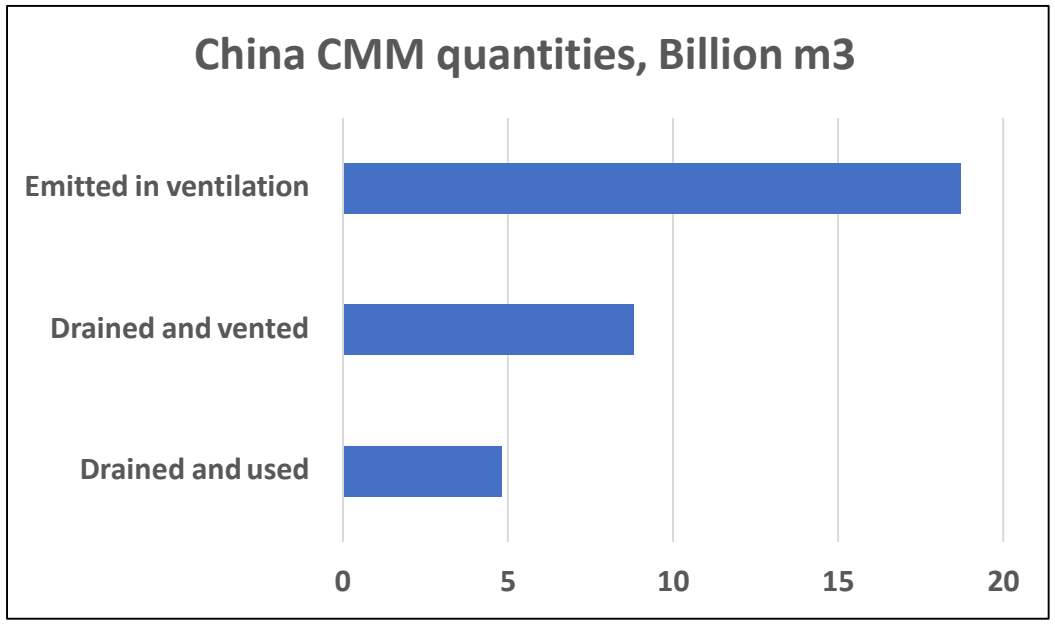
Mr Jia Baoqiang – General Manager, Sindicatum Sustainable Resources, China

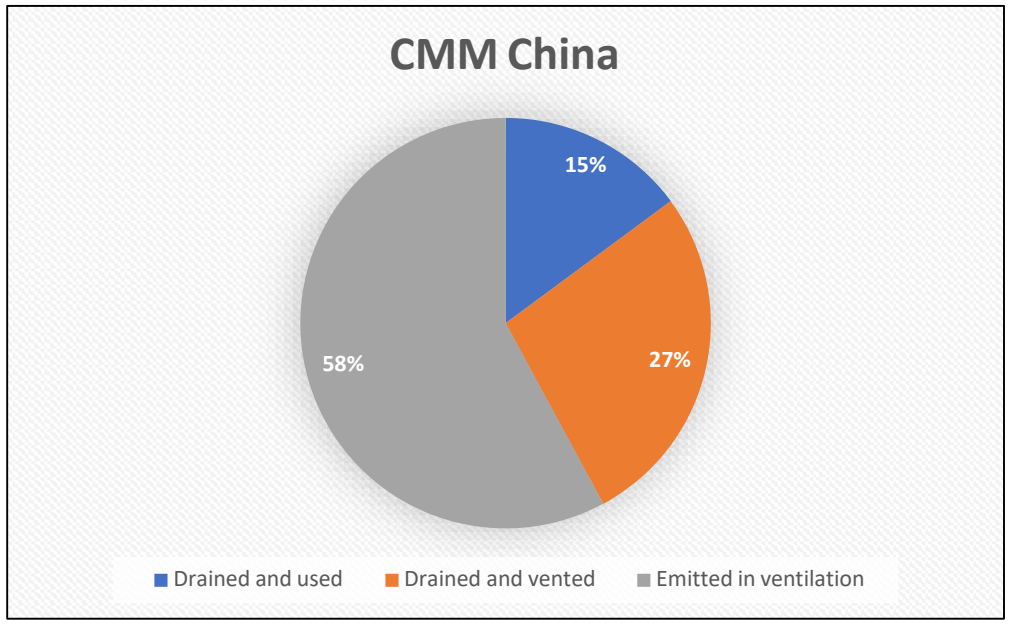
Scale of CMM resource and emissions in China

China emits 43% of global CMM

In 2016:

- 4.8Bm^3 of CMM was drained and utilised
- 27.5Bm^3 of CMM was vented to the atmosphere (492Mt CO2 equivalent)

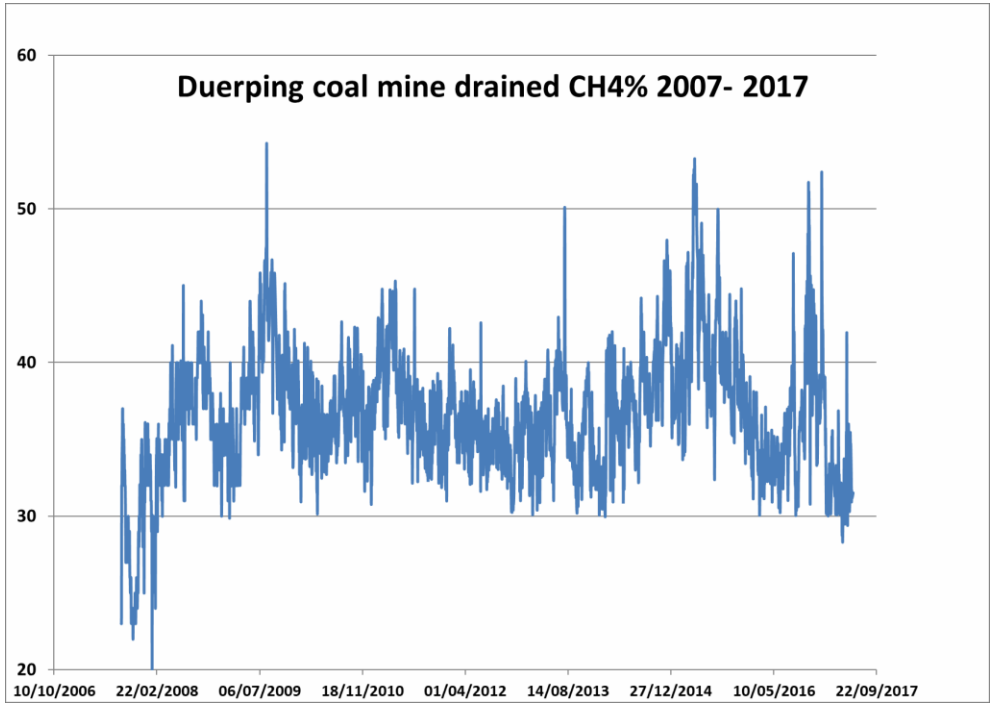




CMM safety issues

The current situation in China's coal mines

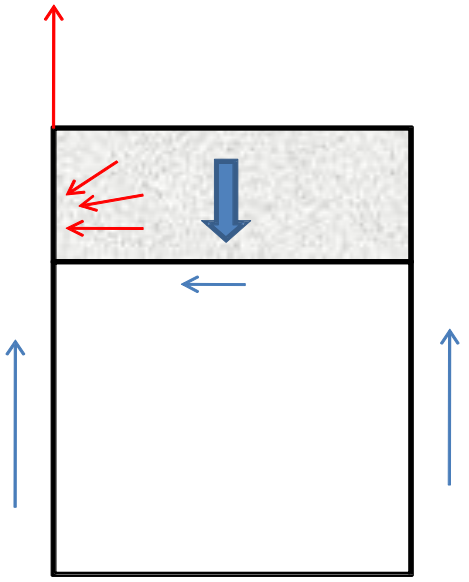
- Despite significant reductions in coal mine accidents, too many fatal gas accidents still occur.
- Poor safety behaviour by miners, inadequate equipment, insufficient training and poor management standards in many small mines
- Too much gas is drained at hazardous low concentrations – subsidies and regulations (mining and environmental) encourage inefficient capture, dangerous pipeline transport and use of low quality CMM
- Large State-owned mines have made real improvements in gas management



CMM safety issues

What is needed to improve gas control

- More interactive training on risk management for gas control and explosion prevention - UNECE GoE are developing tools to help this process
- Introduce ventilation systems to dilute and remove CMM flows from the goaf to replace inefficient and hazardous low concentration drainage at the return ends of longwall faces, eg., Y-ventilation or bleeder roads
- Safety regulation on CMM transport in pipelines (>25% CH4) to reduce explosion risk and increase drainage efficiency.

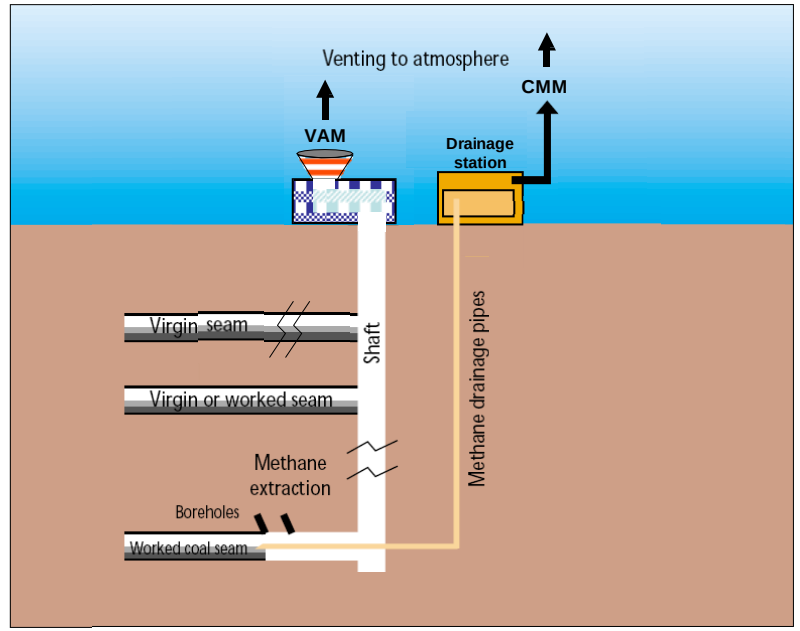


Y-type ventilation system

Environmental and energy regulation and policy

Current situation - too much CMM is vented to atmosphere.

- Subsidies provide incentives to capture and use CMM for power generation
- An environmental regulation requires use of CMM at or greater than 30% methane purity
- A current CCER methodology allows CMM projects to generate emission reduction credits provided they can be proved additional (ie., projects are only financially viable with carbon credits, and utilisation is not mandated).
- Due to a maximum permitted CH4 in travelling returns of 1%, many mines dilute the Ventilation Air Methane (VAM) to 0.8% to avoid penalties. VAM concentrations are therefore low making utilisation or emissions mitigation very costly



Environmental and energy regulation and policy

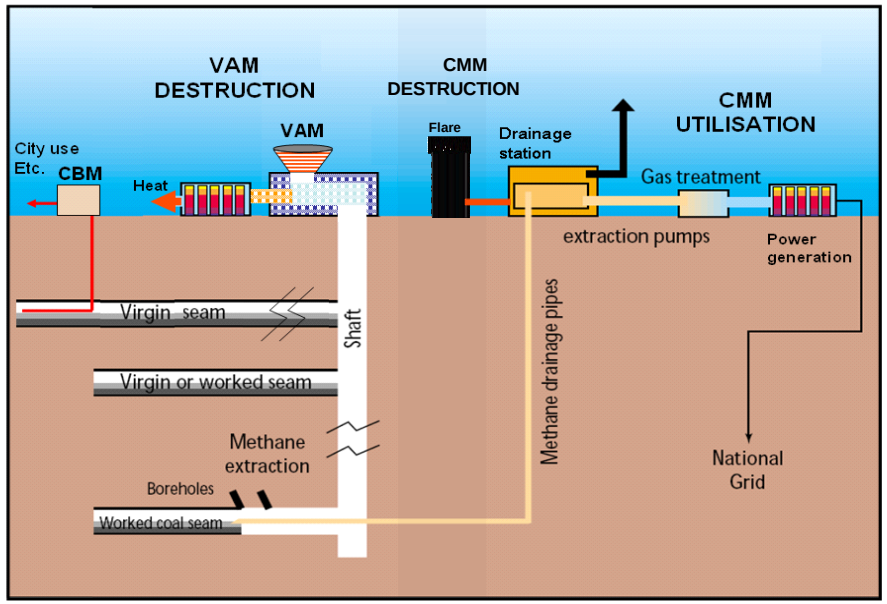
How to accelerate CMM clean energy project development and CMM emissions reductions:

- Encourage third party investment in CMM utilisation through easy access to power grids, strong carbon prices and predictable market conditions
- Introduce a standardised CCER methodology for CMM use and destruction (as in California) to remove complex and uncertain additionality tests and reduce project development risk.
- China National Emissions Trading Scheme should allow offsets (CCERs) from qualified CMM projects for compliance use.
- Introduce policy and incentives to encourage destruction of drained CMM that cannot be utilised - to mitigate GHG emissions.
- Examine safety risk implications of allowing higher VAM concentrations (1.5%?) in travelling returns to allow for more efficient use and mitigation of VAM emissions.

Some technology challenges and opportunities

DURING ACTIVE COAL MINING

- Improve CMM drainage efficiency and gas quality – better borehole sealing, borehole management, suction control, dewatering pipelines
- Pre drain higher gas flows from low permeability coal seams
- Surface extraction of CMM from large, sealed areas of working mines – better gas recovery while working compared with after closure
- Achieve near-zero CMM emissions mining - all drained methane used or flared, all VAM oxidised
- Use more waste heat from CMM engines – seek all-year round use rather than seasonal



Some technology challenges and opportunities

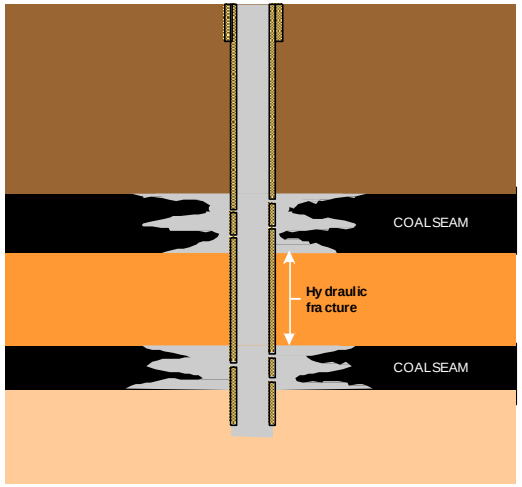
EXTRACTING CMM BEFORE COAL MINING

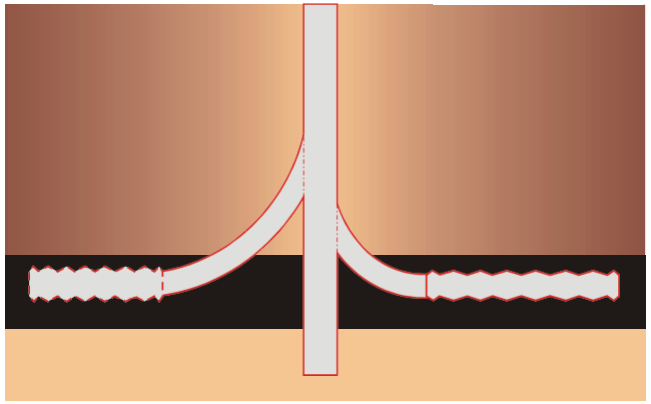
Extract gas from a Mining Area before mine construction: obtain clean energy first and remove serious gas hazards before mining

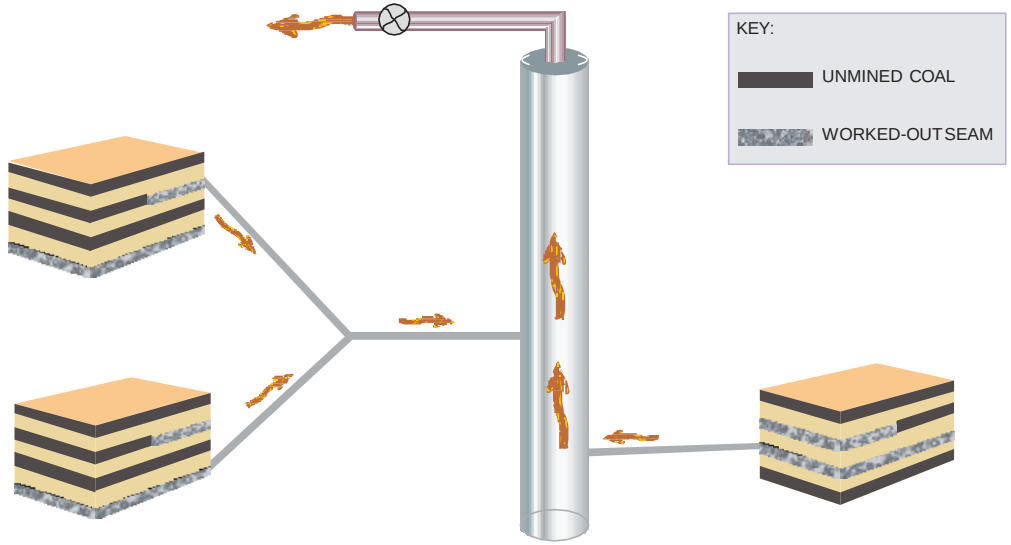
(after a concept by Ray Pilcher)

EXTRACTING CMM AFTER COAL MINING

Extract gas from abandoned coal mines where practicable.







Wishing great success to China's UNECE ICE-CMM and congratulations to Shanxi Jiaomei on its inauguration

China's International Centre of Excellence on CMM

Promoting UNECE best practice principles for:

- Safer coal mines
- Capturing more CMM
- Utilising more CMM
- Reducing GHG emissions