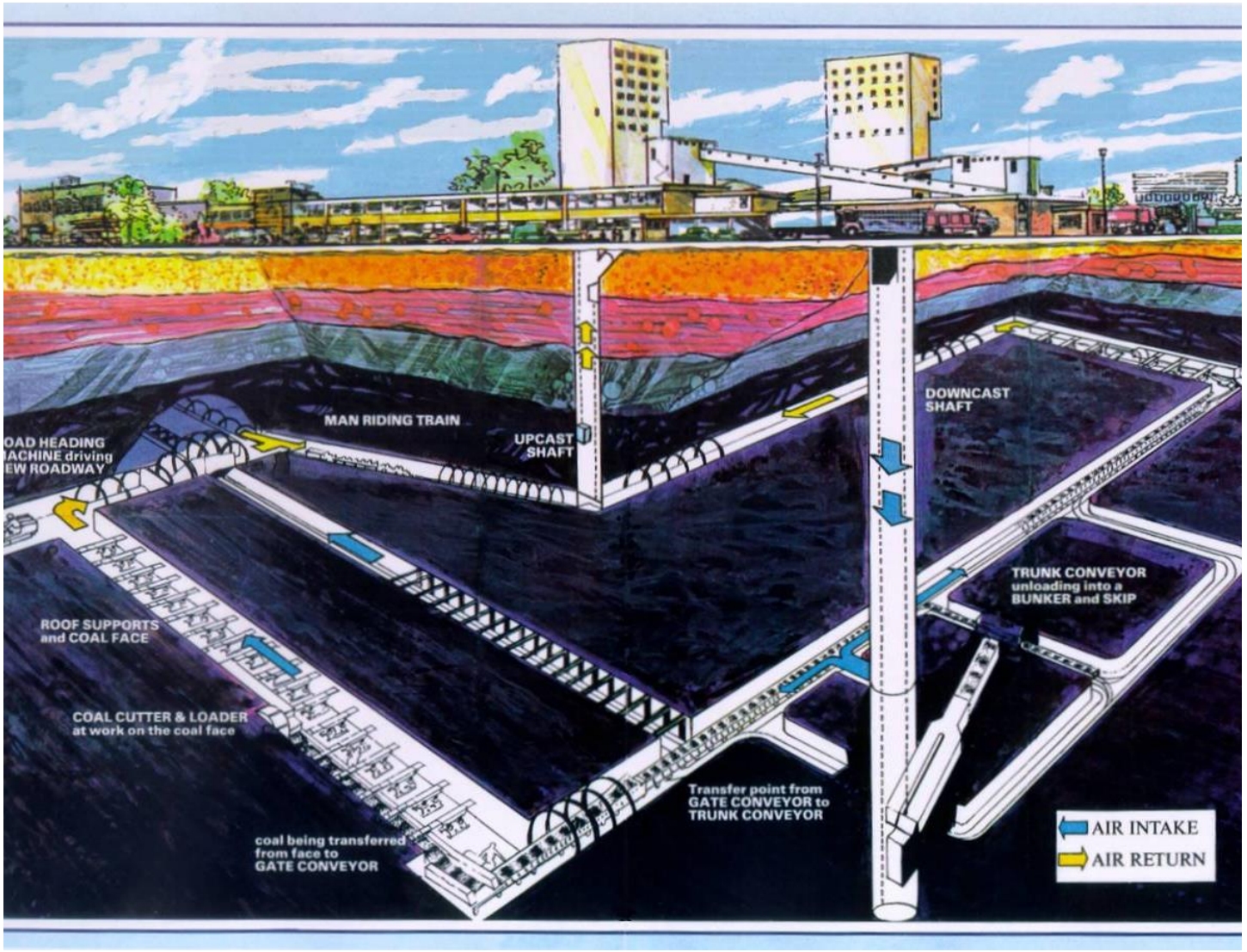


Global Methane Forum, Washington DC
March 2016

CMM Drainage Methods and their Implication on Optimization of Safety, Economic Benefit from Coal Production and Beneficial Use of Methane, with Complimentary Reduction of Greenhouse Gas

HEL-East Ltd™

Why do we drain methane?

Coal Mined per Face/Annum	1,000,000	tonnes
Low Market Price per Tonne	40	$
Low Turnover of Face	40,000,000	$/annum
High Market Price per Tonne	70	$
High Turnover of Face	70,000,000	$/annum
Drainage	30	m3/min
Power Generation Capacity	7,000	kW
Hours	6,570	Hrs/annum
Low Market Price of Electricity	0.05	$/kWhr
Low Revenue from Electricity	2,299,500	$
% of Low Market Face Turnover	6	%
% of High Market Face Turnover	3	%
High Market Price of Electricity	0.20	$/kWhr
High Revenue from Electricity	9,198,000	$
% of Low Market Face Turnover	23	%
% of High Market Face Turnover	13	%

Cost of safe drainage

Opportunity cost of not utilizing gas for heat or power

Cost of loss of production

($1 million dollars per week?)

Cost of loss of life

(human cost + reputational loss + cost for each life)

Gas explosions often cause dust explosions

Barbara Experimental Mine, Poland

Drainage Techniques – geology/depth dependent

- Mine Ventilation – Use of suction or pressure mine air fan
- Surface vertical or guided horizontal in seam pre-drainage
- Surface guided horizontal fracked in seam pre-drainage
- Underground in seam pre-drainage
- Surface gob well post-drainage
- Underground roadway post-drainage
- Underground cross measures post drainage

How do we optimize gas drainage?

1

Do what you do already, but do it better!

Improve physical installation of pipework (find leaks and fix them)

Improve sealing at points of connection

Measure suction and concentration at each point of drainage and reduce suction where drainage is effective*

Review mine management

2

Your engineers know their mine's geology and their drainage technique better than anyone – widen their breadth of experience!

Take your internal expertise and allow them to travel and see how other mines using similar techniques control their gas

Take experience from other parts of the world, with incremental improvements to your existing arrangements

3

Systematic fundamental review of gas drainage

New Project

Internal Review team

Change Management

National Academia

Government Regulation

International Experience

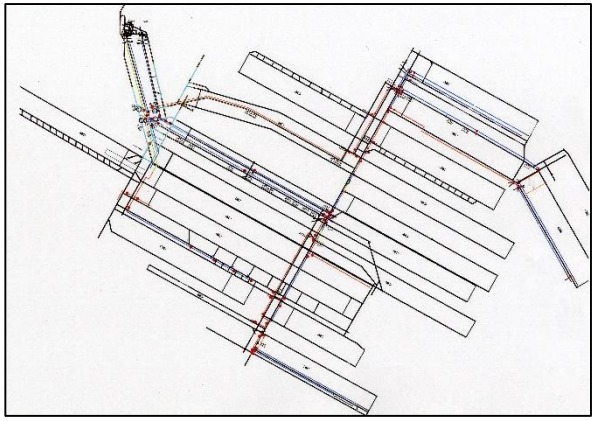
Manufacturers/Drillers

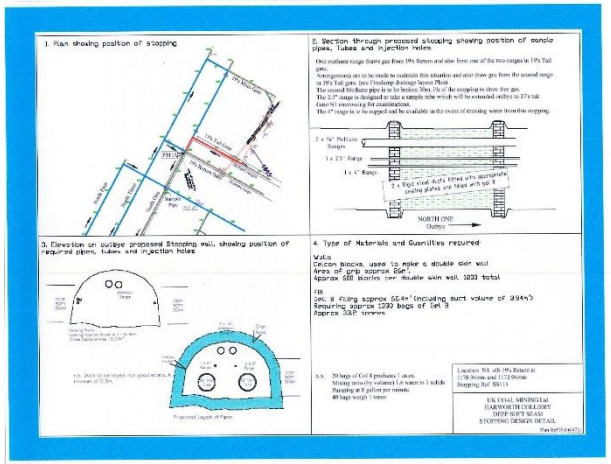
How to Fund?

*including sealed waste areas

Control Suction on all Suction Points

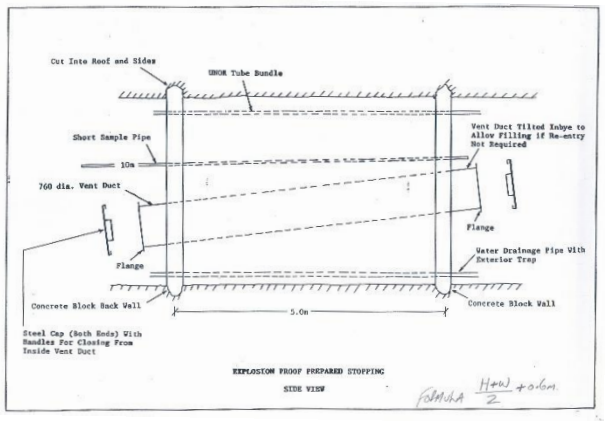
- All connections should be tightly sealed, but in practice this is not always possible
- Where gas extraction points connect to the mine, if they are poorly sealed, they will draw air into the pipework system
- Typical 60m3/min extraction pump will cost $80,000 in electricity to run, at 25% CH4, you will be spending $60,000 per year on air leaks
- Reducing suction on poorly connected holes increases suction/flow available to good holes





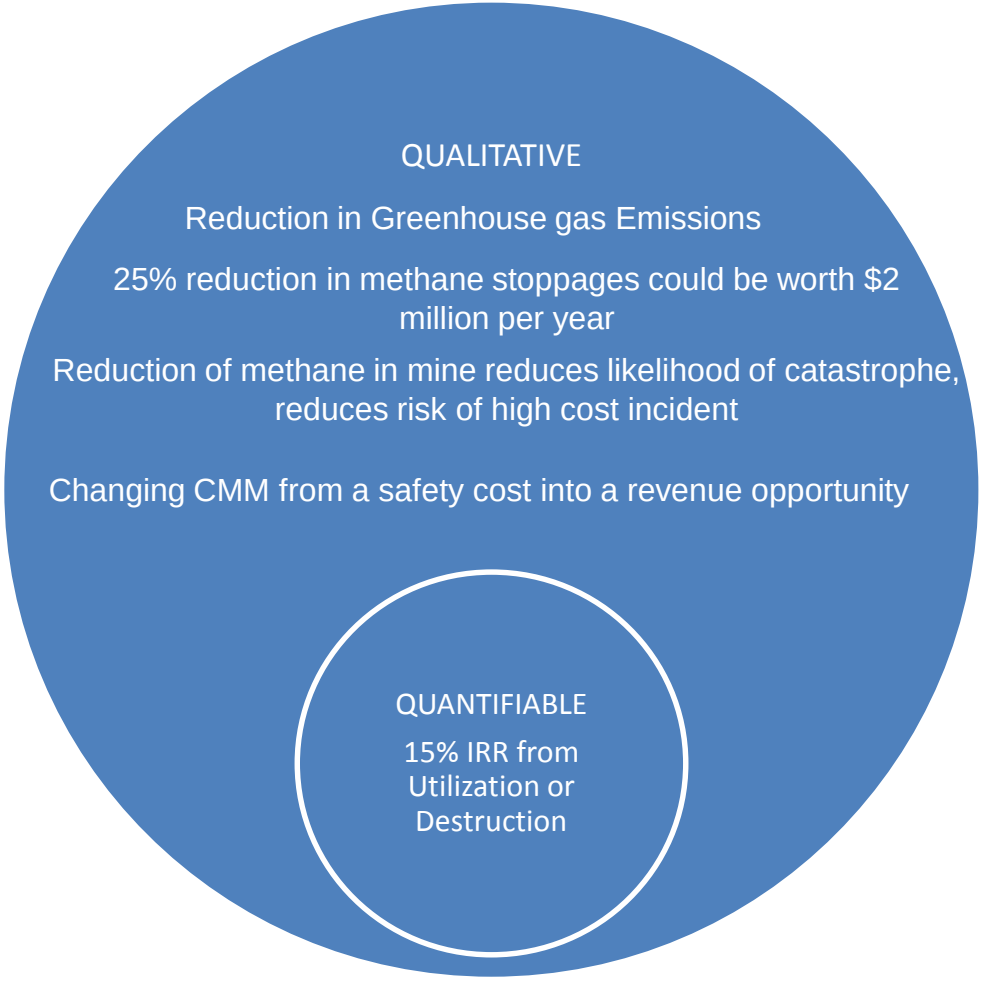
Sealed Areas as a Gas Reservoir Source

- Gas not being drained from a sealed area enters the mine roadways and makes the mine less safe
- Gas being drained from a sealed area is kept out of the mine roadways, makes the mine safer, and raises the concentration of CH4, making transportation safer
- Can be done either from underground or from the surface
- Automatic control is straightforward – CH4 concentration can be used to control an air actuated control valve

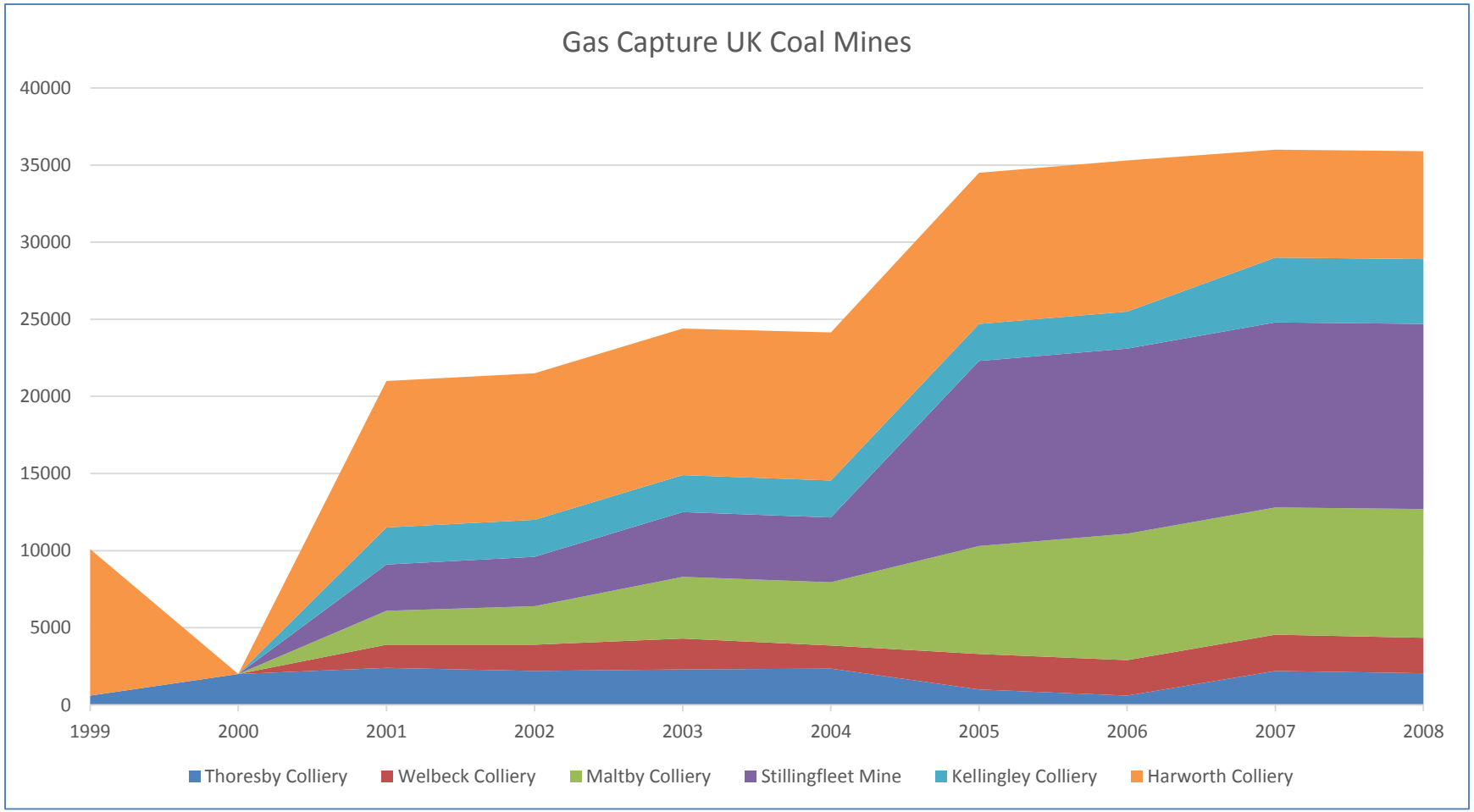


How do we make a better business case for CMM development?

- It is clear that turning CMM drainage from a cost centre to a revenue centre increases mine focus on drainage
- Increased attention to capture improves the safety of the mine
- Revenue generation enables investment in new safety/drainage infrastructure
- Need for more quantitative methods of coal mining business improvement analysis



Gas Optimization Results – Linear Improvement in Gas Safety, Financial Performance and Reduction in Greenhouse Gases



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