How mining industry help reduce greenhouse gas emissions

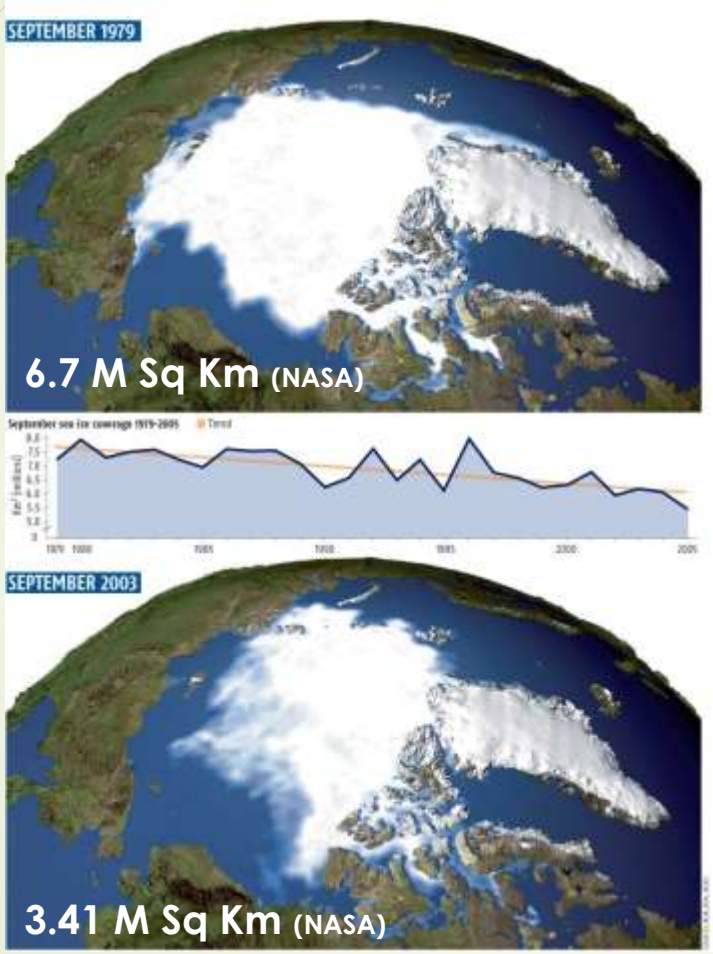
By Tapan Goswami

Blast Outcome Services

Presentation content

- Mine energy & GHG emissions
- Maximising recovery (share experience)
- Equipment productivity (share experience)
- How GHG can be compensated (example)
- Conclusions

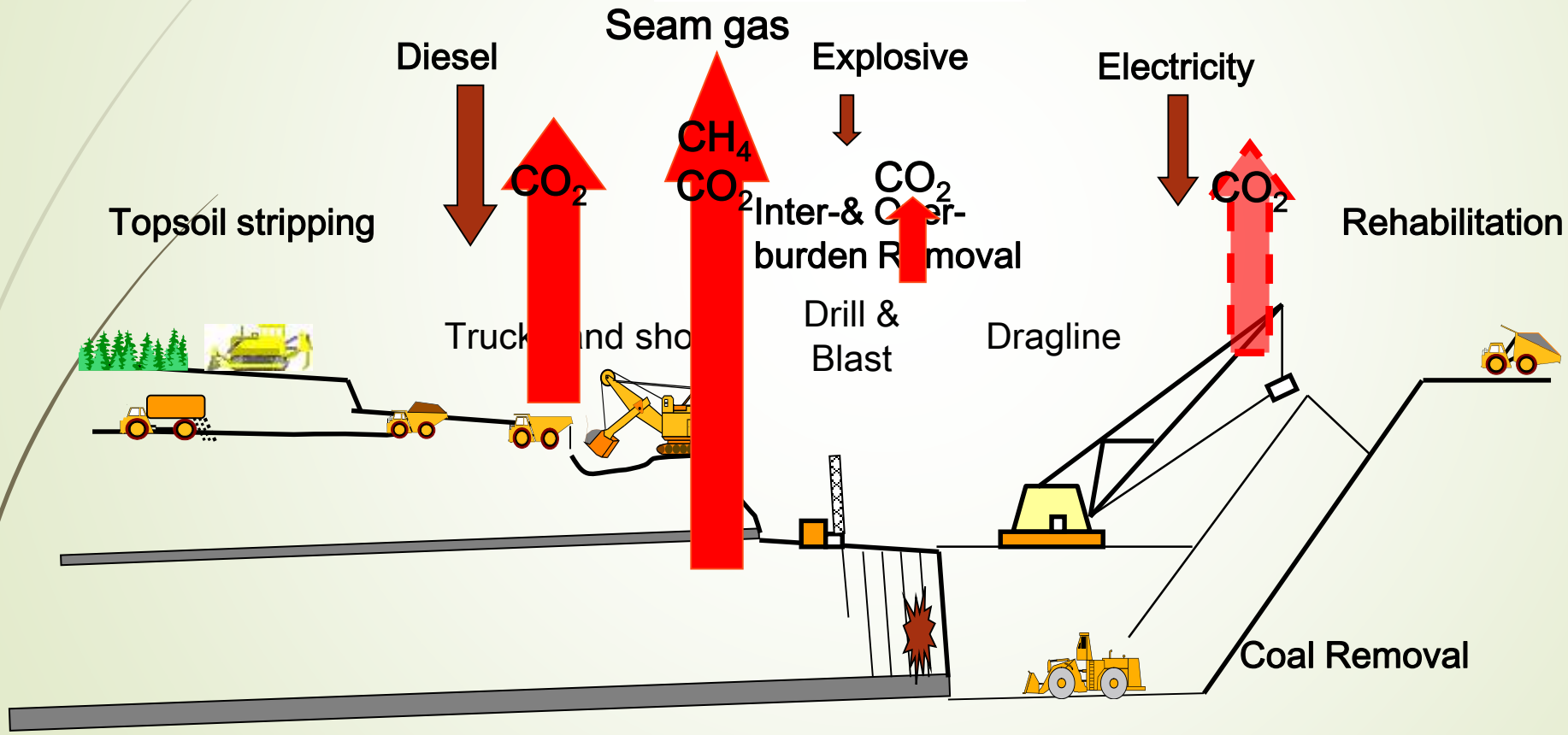
Major source of emission from mining



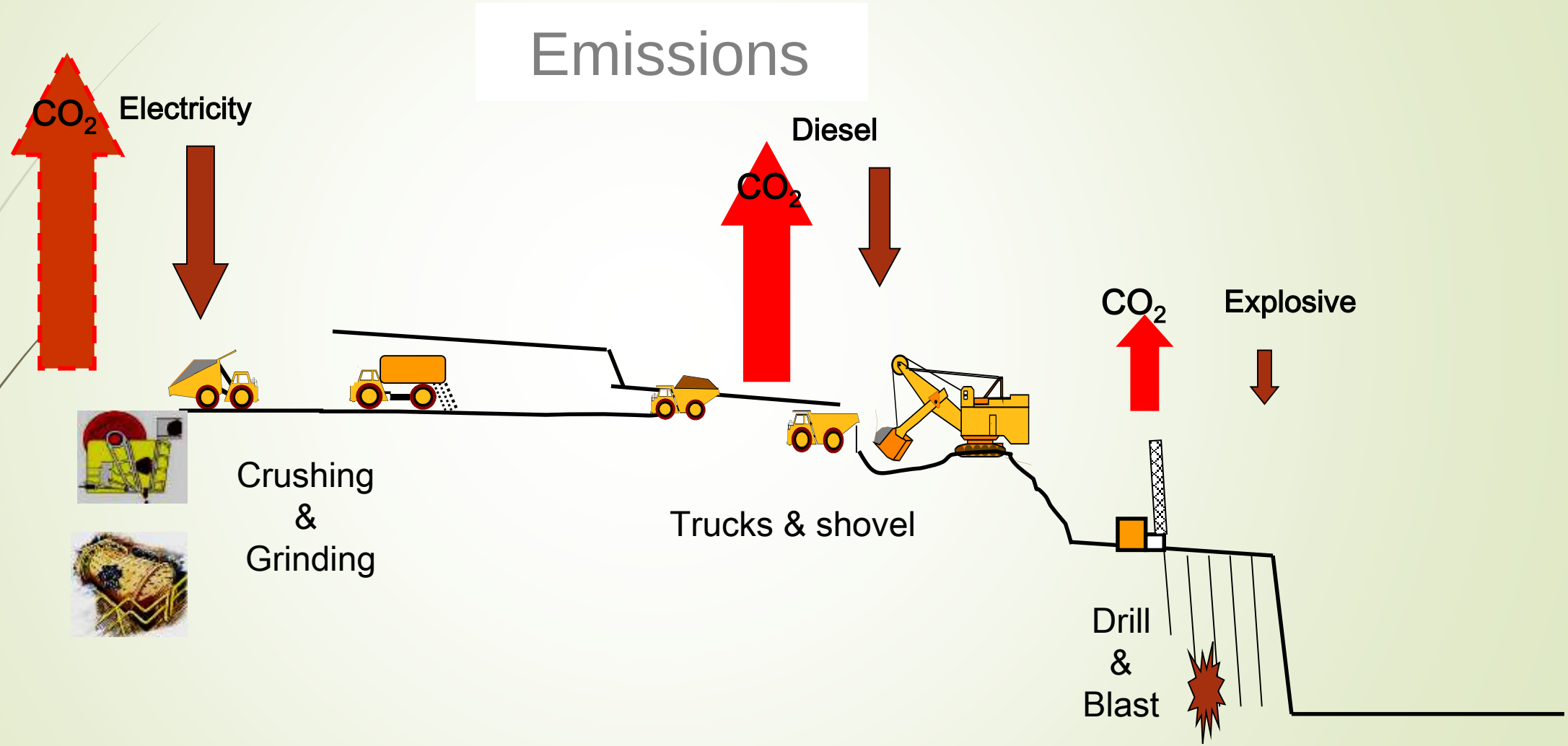
- Stats - lies, damned lies and statistics
- Mines use three major source of energy:
  - Diesel - emit CO_2 when used
  - Electricity - emit CO_2 when generated
  - Chemical energy - emit CO_2
- All coal mines emit seam gas (CH_4/ CO_2)
- Metalliferous mines emit negligible amount of seam gas

Open Cut Coal Mine

Emissions



Metalliferous Mine



Emission from a small scale coal mine

- 5 Mt pa Coal & 35 Mbcm pa overburden:
  - Diesel - 25 M litres = 70 kt CO_2e
  - Electricity - 100 GWh =115 kt CO_2e
  - Explosives - 10 kt = 2kt CO_2e
  - Seam gas emitted during mining:
    - 85 kt CO_2e (QLD)
    - 230 kt CO_2e(NSW)
- Total emission - <u>300 to 450 kt CO_2e pa</u>
- **Potential CO_2 liability : > $10 M pa**
- <u>HOW CAN WE LESSEN LIABILITY</u>

Mining industry is here to stay

- Lifeline - 28% of total employment (world Bank 2010)
- Many more live indirectly on mining industry
- Survival of the industry is vital
- Science behind
- Political controversies
  - Our livelihood threatened

NEWS

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Global warming: World sweats over July breaking warmest month record, 2015 hottest year so far

Updated about 3 hours ago

Australians may be surprised to hear July was the warmest month ever on record worldwide and 2015 has been so far the hottest year.

The US National Oceanic and Atmospheric Administration (NOAA) announced the record just over three months before world leaders seek to reach a climate agreement in Paris.

In its monthly global climate report released online, NOAA said many countries and the world's oceans experienced heatwaves, with the Earth's oceans temperature also hitting record highs last month.

This July saw a monthly combined average temperature over global land and ocean surfaces

PHOTO: NOAA said many countries and the world's oceans experienced heatwaves in July. (ABC News)

MAP: Australia

How can each one of us help

- Minimise wastage and maximise mineral recovery
  - Recycling vs throw away economies
- Minimise spontaneous heating of coal
- Maximise use of cheaper source of energy e.g. chemical energy
- Control dilution thereby increase product yield
- Minimise use of other resources e.g. water, chemical etc.
- Use of green energy in mining sector


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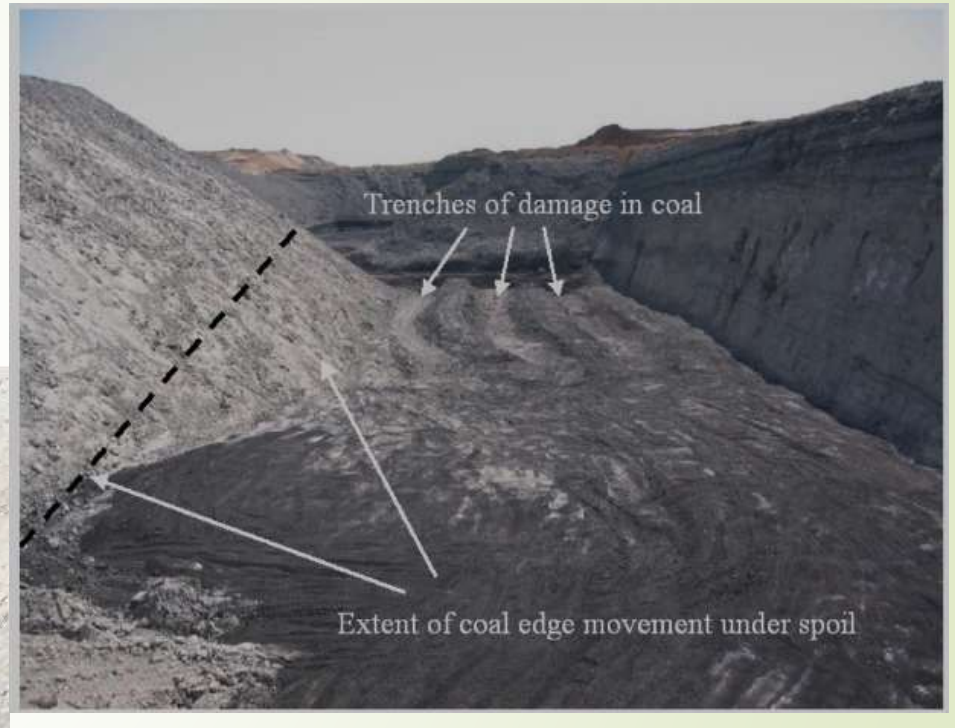
Minimise coal loss

- Coal edge loss
  - Front row hole location
  - Stand-off distances
  - Multiple points of initiation



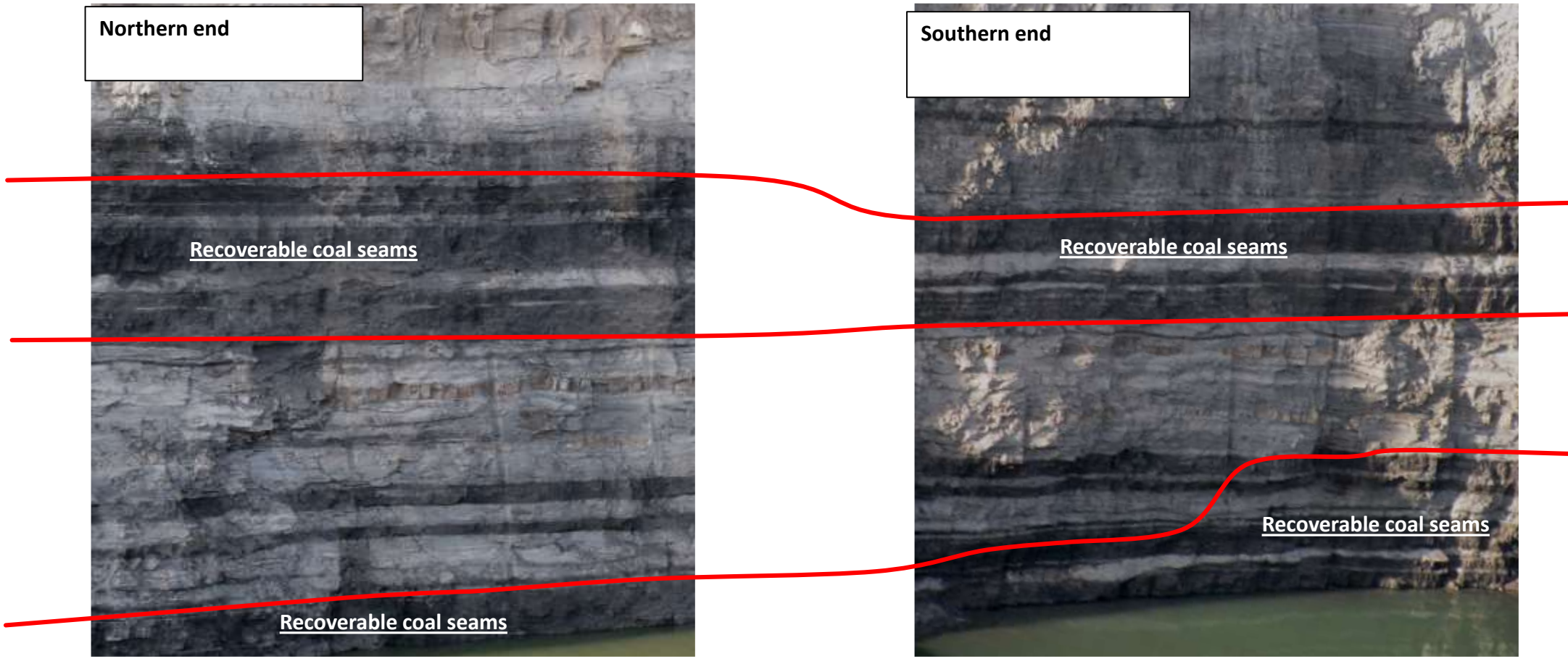
- Throw?
- Buffer
- Baby deck
- Stand-off distances
- Timing

Coal damage and loss

- Usually edge loss is associated with formation of trenches

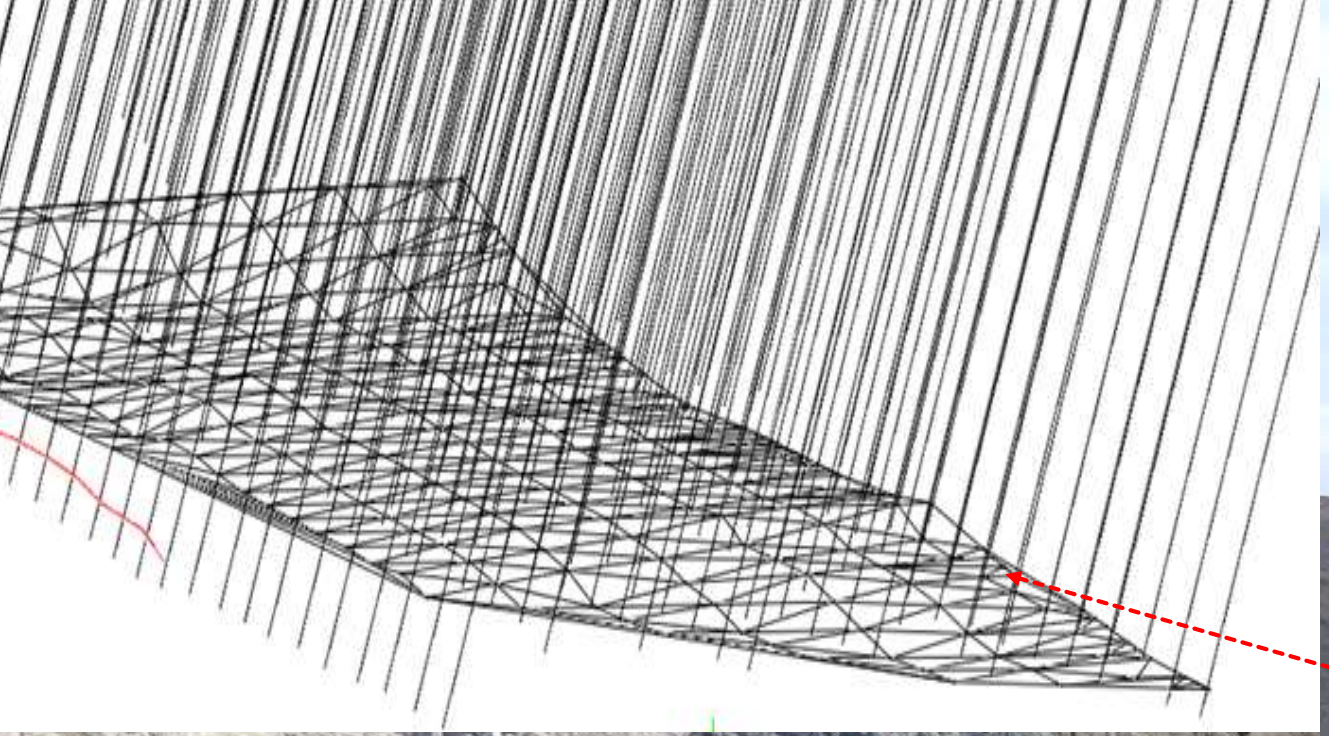
Controlling coal damage and loss

- Important to locate coal in the blast block
- Assess rock property in the roof and floor of coal
- Identify existence of weaker layer landing on the coal - if identified consider multiple point of initiation
- Wet & saturated coal seam require adjustment extra stand-off
- Create a surface using variable stand-off distances
- Apply multi layer blast


Northern end
Recoverable coal seams
Recoverable coal seams
Southern end
Recoverable coal seams
Recoverable coal seams

Outcome

- 2.2 M bcm blasted involving three major seams
- No environmental exceedances e.g. vibration, overpressure, fume
- As many as 7 blast events were avoided
- Overall 94% coal recovery from all layer
- High grade 240 mm was recovered (22% average recovery)
- +88% wash plant yield
- Multi pass dragline operation without leaving pit
- Overall rehandle 22%
- Coal was protected under a thin rock layer to minimise exposure to atmosphere and prevent from spontaneous heating




Fault


Roll
Coal edge

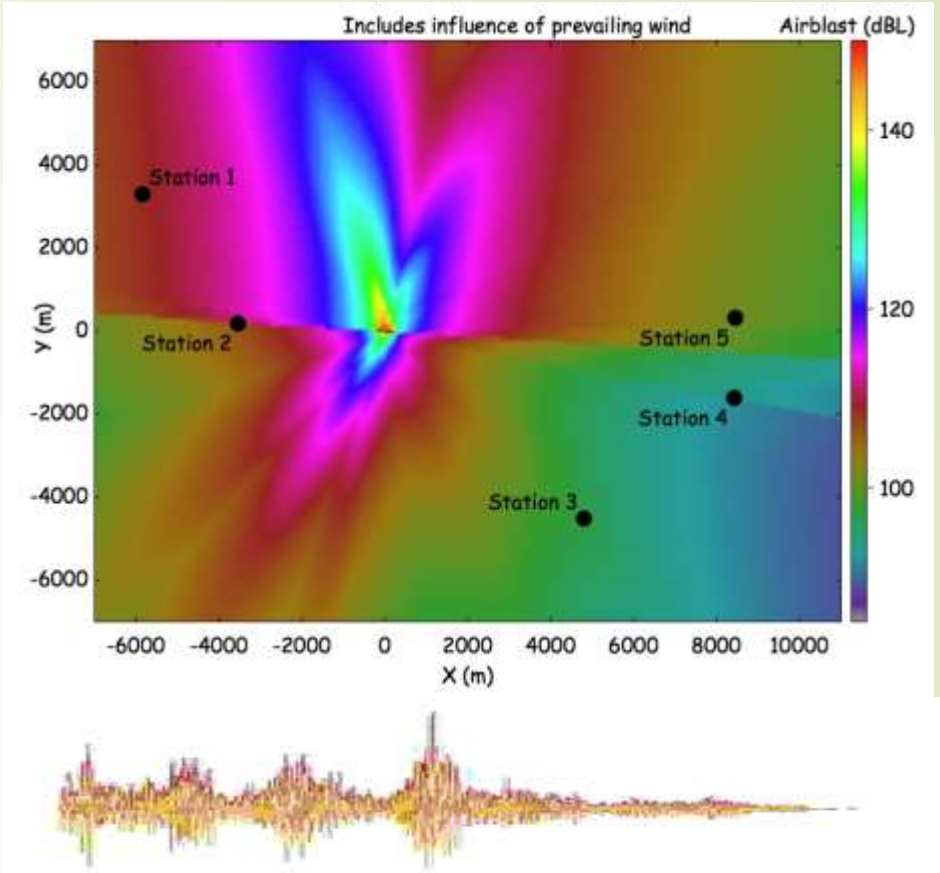
Mine in Queensland

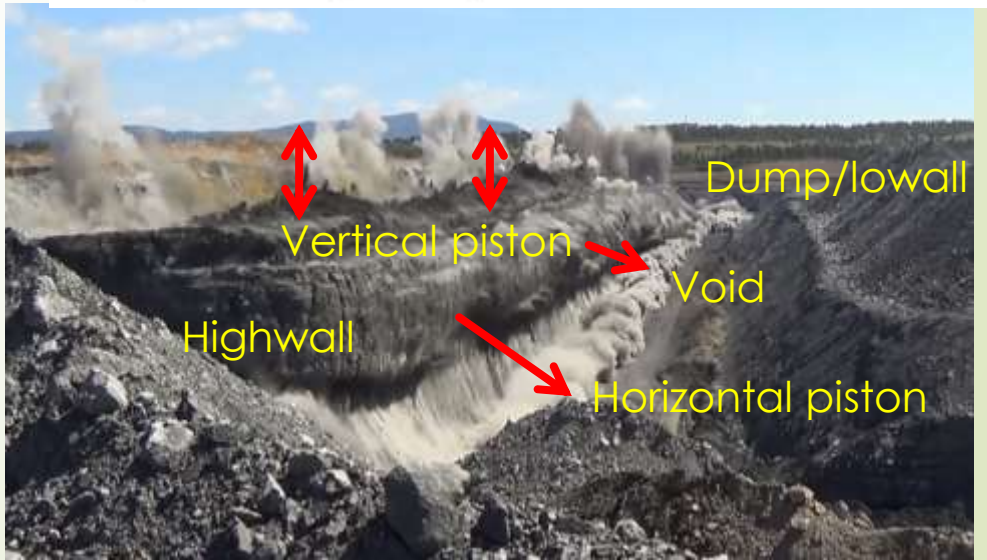
Mine in NSW:

Throw & stand-up blasts combined
- 11 points of initiation
- Throw & 2 stand-up blasts
- Up to 9 decks
- 1.6 km Strike
- 2.2 M BCM
- NO COAL Loss

Environmental control

- Vibration control
  - Compliance - standard site law, simple Fourier or by extracting frequency content
  - Sensitive structures
    - Monte Carlo superposition modelling,
    - Time frequency analysis,
    - 'EMD'- empirical mode decomposition (how structure shakes in various modes)
  - Piston model for airblast
- Multi point initiation - steer exceedances away from points of interest
- Mid-split tends to give better result
- Create damage zone/s (low powder factor)and blast into it
- Optimise timing design to avoid a peak

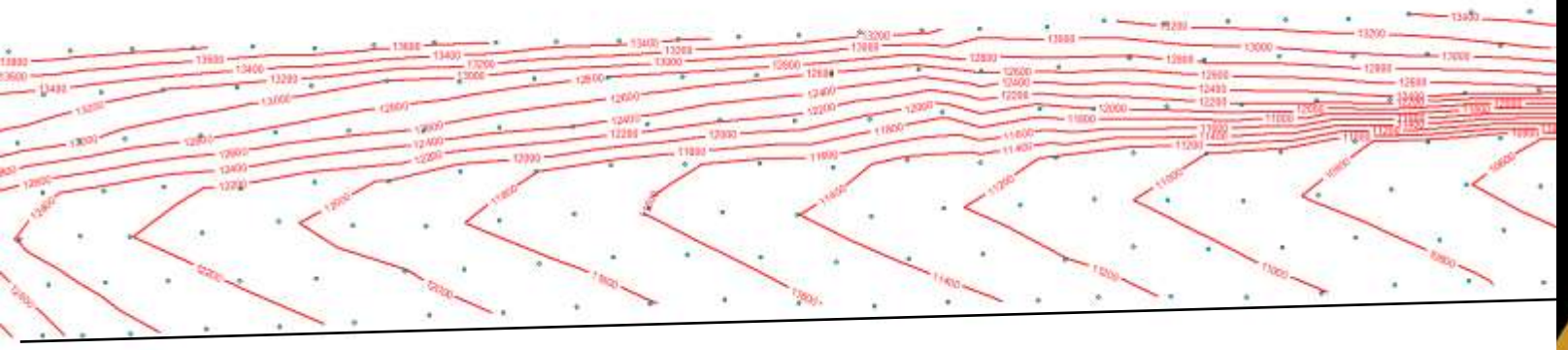


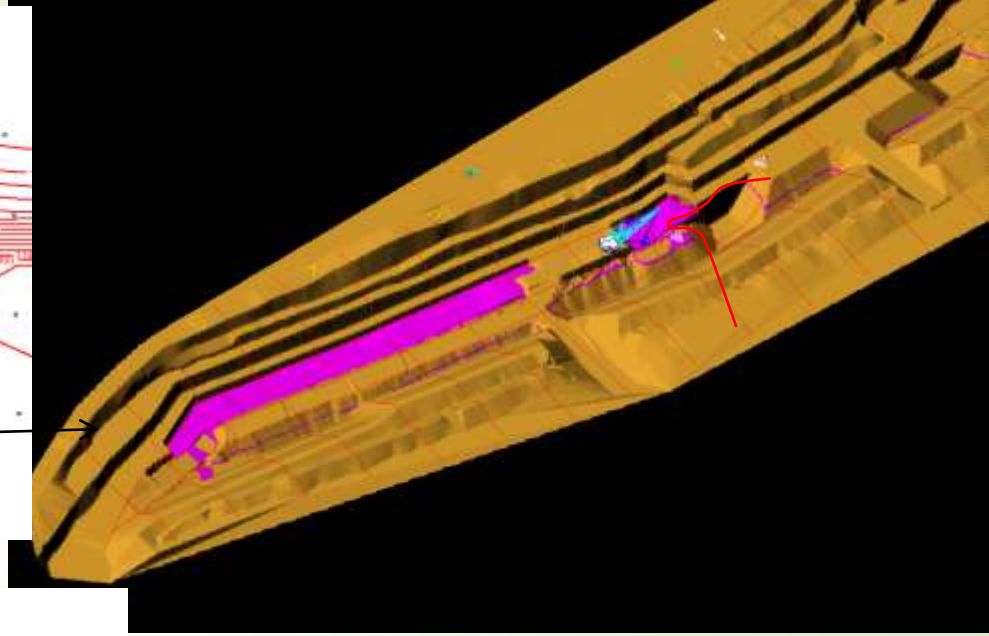


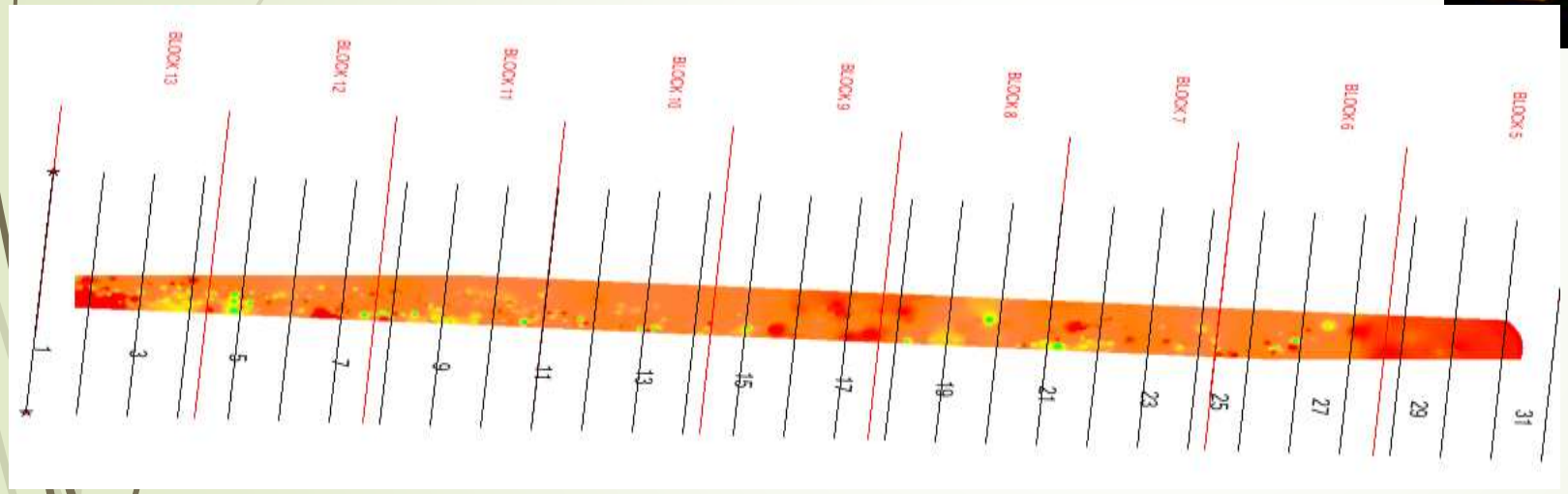
Equipment productivity

- Minimise relocation time
- Pre-decide bucket bite direction
  - Appeared to dig better if follows bite direction
  - Use row by row, ‘V’ or both to fire the blast
- Maximise productivity
- Form dynamic ramp for dragline
- Combine throw, stand-up and ramp blast within a blast
- Consider using explosives energy to create dragline bridge
- Minimise rehandle
- Maximise throw using explosives energy
- Dozer push

Free face






BLOCK 13
BLOCK 12
BLOCK 11
BLOCK 10
BLOCK 9
BLOCK 8
BLOCK 7
BLOCK 6
BLOCK 5
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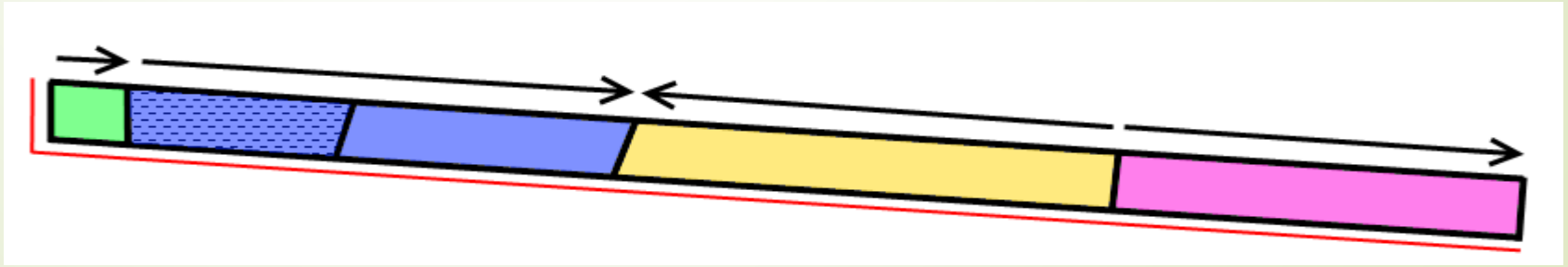


Effect on revenue and emissions….

- A mine in the Hunter Valley, NSW:
  - was spoiling a thin seam of 240 mm (19")
- When recovered:
  - Annual extra coal = 120 000 t pa
  - Annual extra revenue = > $20 M pa
- More than twice the entire mine's CO_2 liability!
- Mine's emissions intensity per tonne of coal reduces
- No spontaneous combustion/oxidation of wasted coal

Change in emission intensity - an estimate

Blast Scenario	Impact of Blasting	% change in Overall Mine GHG intensity
Throw blasting	5-7% less material moved by dragline	1-2 % lower
Improved Fragmentation	10 % increase in mill throughput	5-6 % lower
Coal recovery	5-25% increase in coal recovery	5-25 % lower

Conclusions

- Mine energy efficiency gains can be made to reduce emissions by carefully mining
- Largest benefits are in coal/ore **recovery**
- **Any % increase in recovery generally decreases total mine intensity by similar %**

Acknowledgements

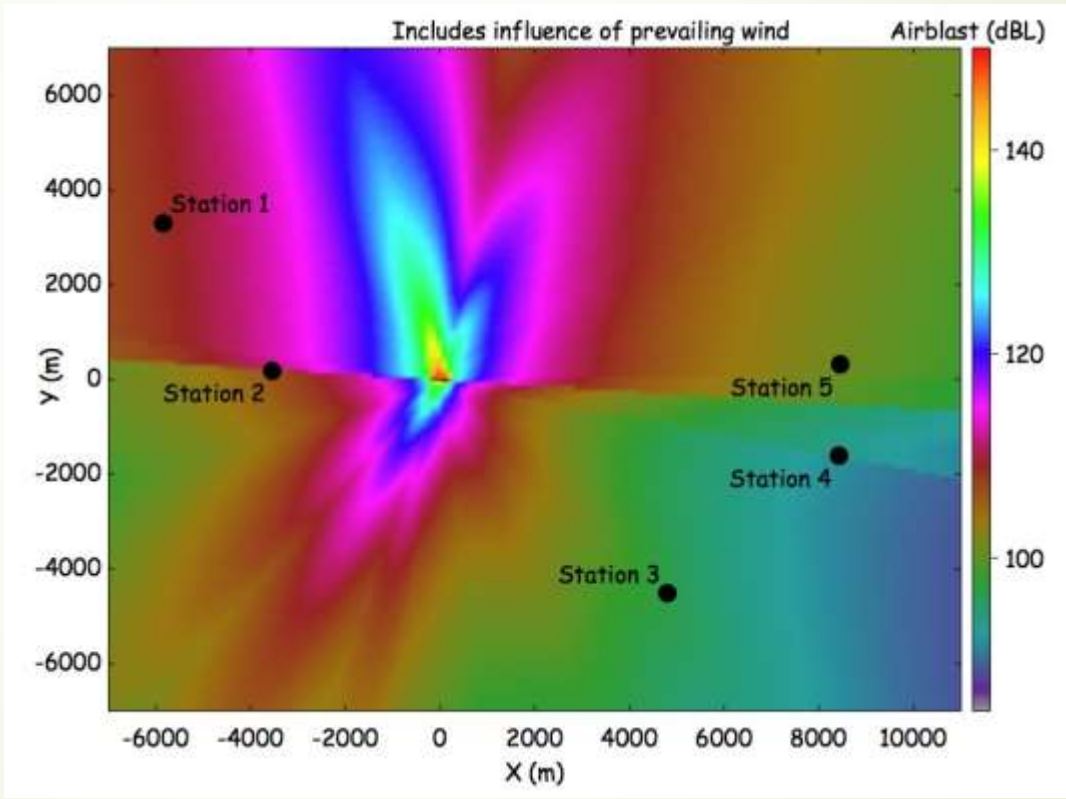
- ISEE, Fragblast, AusIMM
- My work colleagues and teams - special thanks to Dr Geoff Brent of Orica
- All sites where I have practised my trade
- My past employers

Thank you ……..

Second pass

First pass

Second pass


Includes influence of prevailing wind
Airblast (dBL)
140
120
100
Station 1
Station 2
Station 3
Station 4
Station 5
6000
4000
2000
0
-2000
-4000
-6000
Y (m)
-6000
-4000
-2000
0
2000
4000
6000
8000
10000
X (m)