Coal Mine Methane Potential in Indian Coalfields

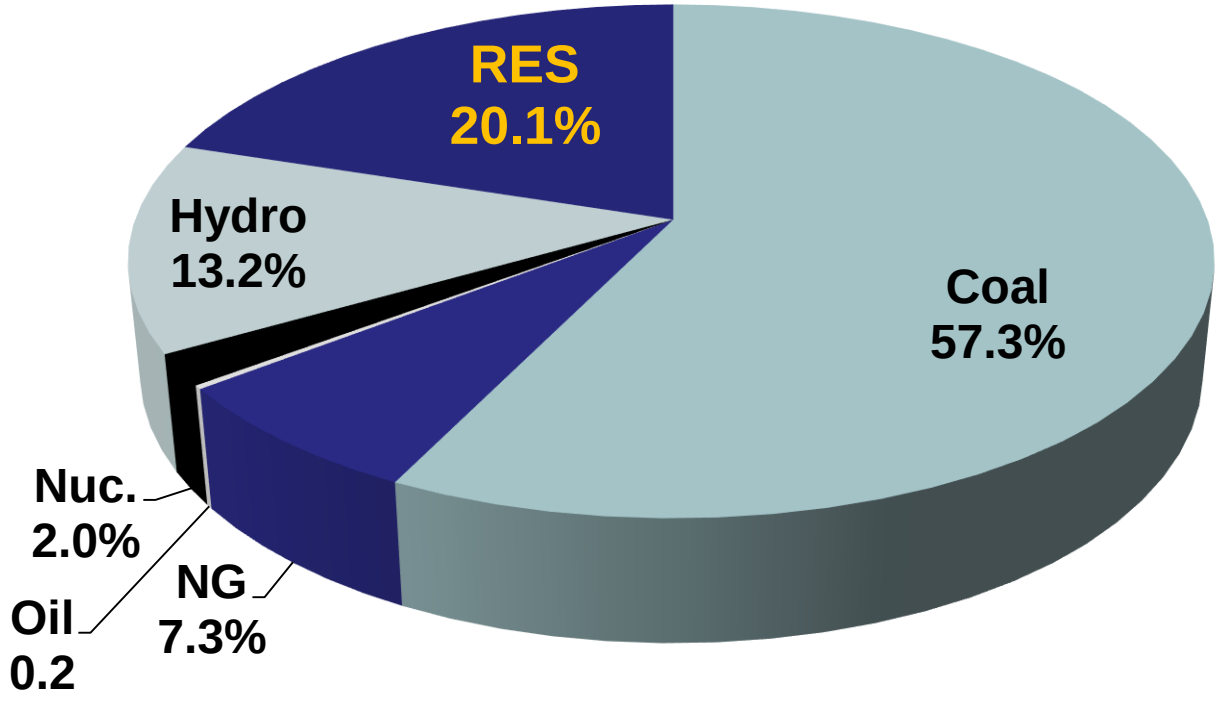
Ajay Kumar Singh
ajay.cimfr@gmail.com

Int. workshop on Optimum Utilization of CMM/CBM in India
Ranchi
24th April 2019

India's Energy Scenario: Role of Coal

India has 344 gigawatts of installed electricity capacity.

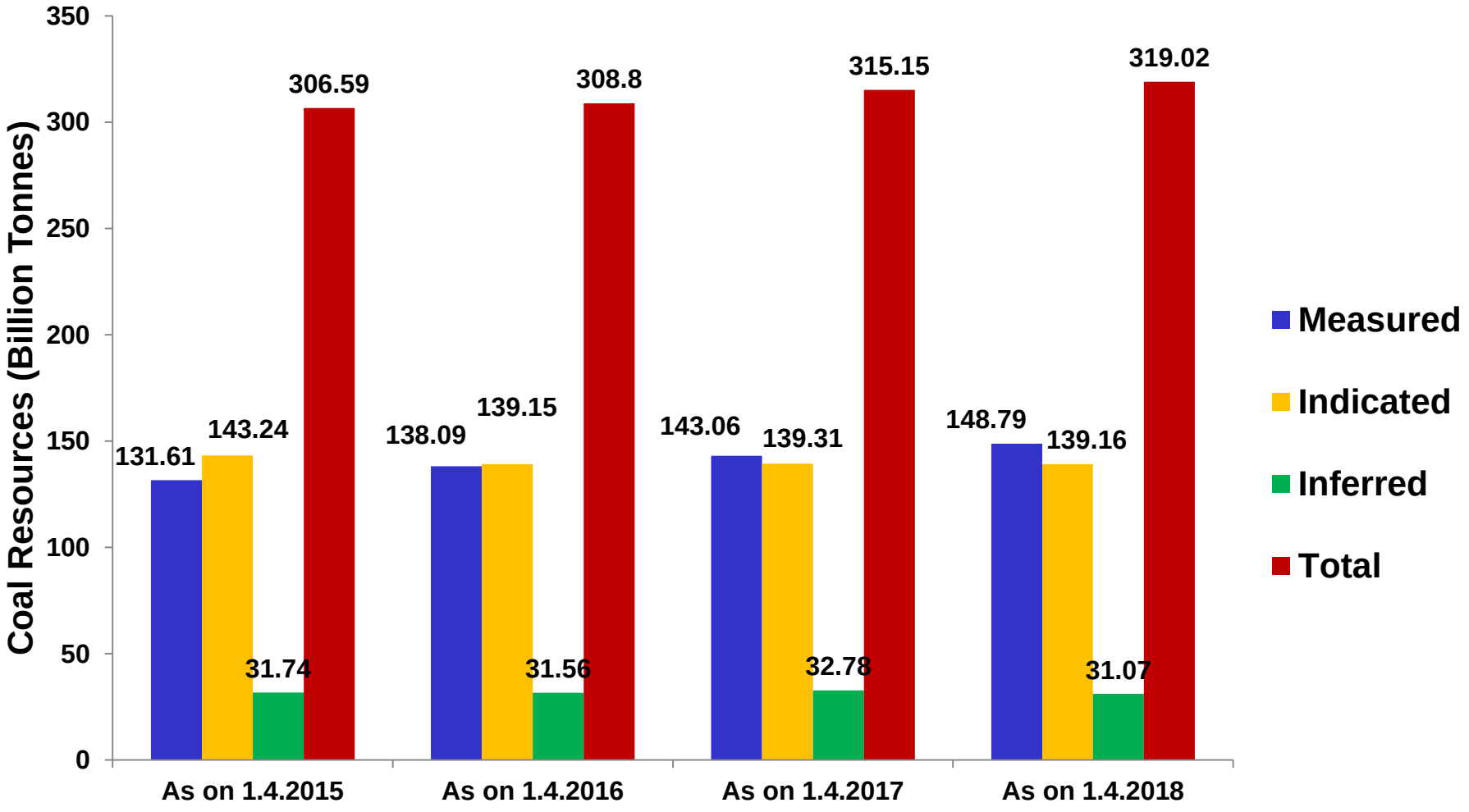
All India Installed Capacity (%) of Power Station (As on 31.03.2018)



Source: CEA

http://www.cea.nic.in/reports/monthly/installedcapacity/2018/installed_capacity-03.pdf

Category-wise Resource of Indian coal

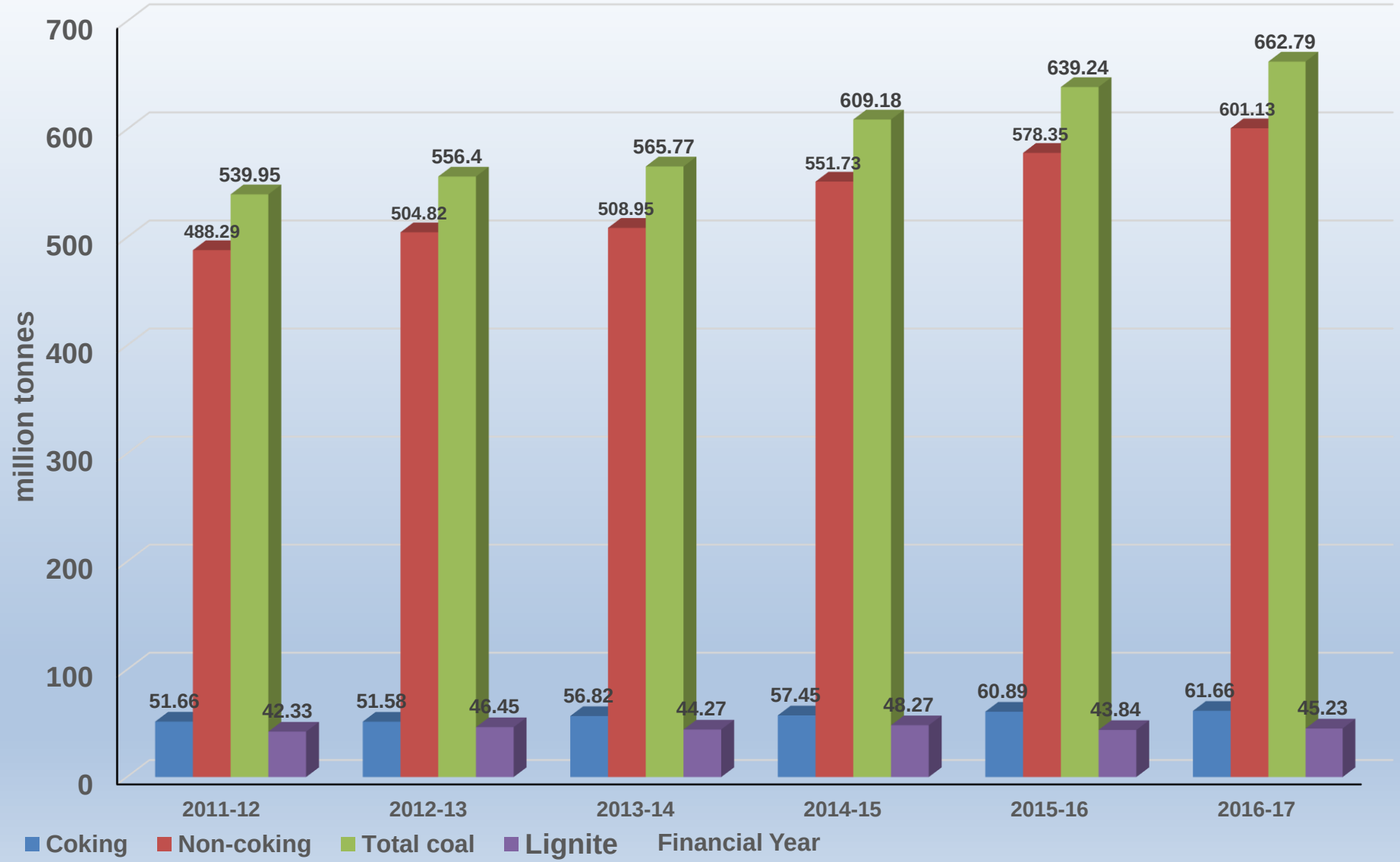


Source: GSI

Indian Coal and Lignite Resources 2018

Trend of Coal and Lignite Production

(in million tonnes)



Electricity Requirement 2031-32

		@GDP Growth Rate	
		8%	**9%**
Billion kWh	Total Energy Requirement	3880	4806
	Energy Required at Bus Bar	3628	4493
Projected Peak Demand (GW)		592	733
Installed Capacity Required (GW)		**778**	**960**

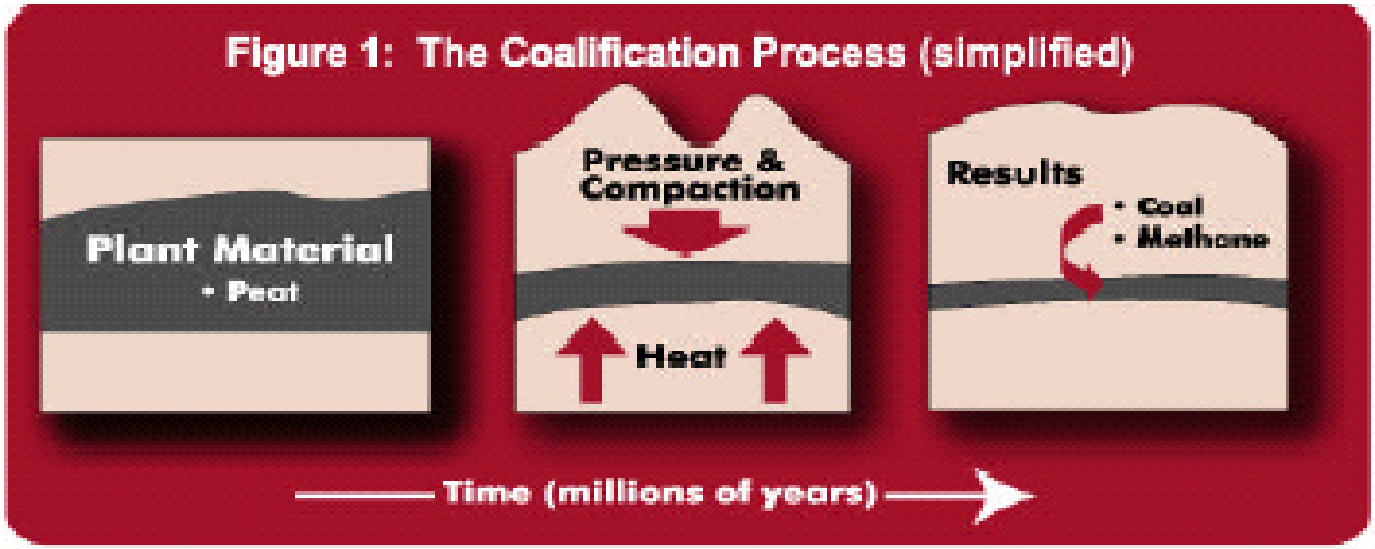
Source: Planning Commission
Integrated Energy Policy of India

Augmenting Resources for Energy Security

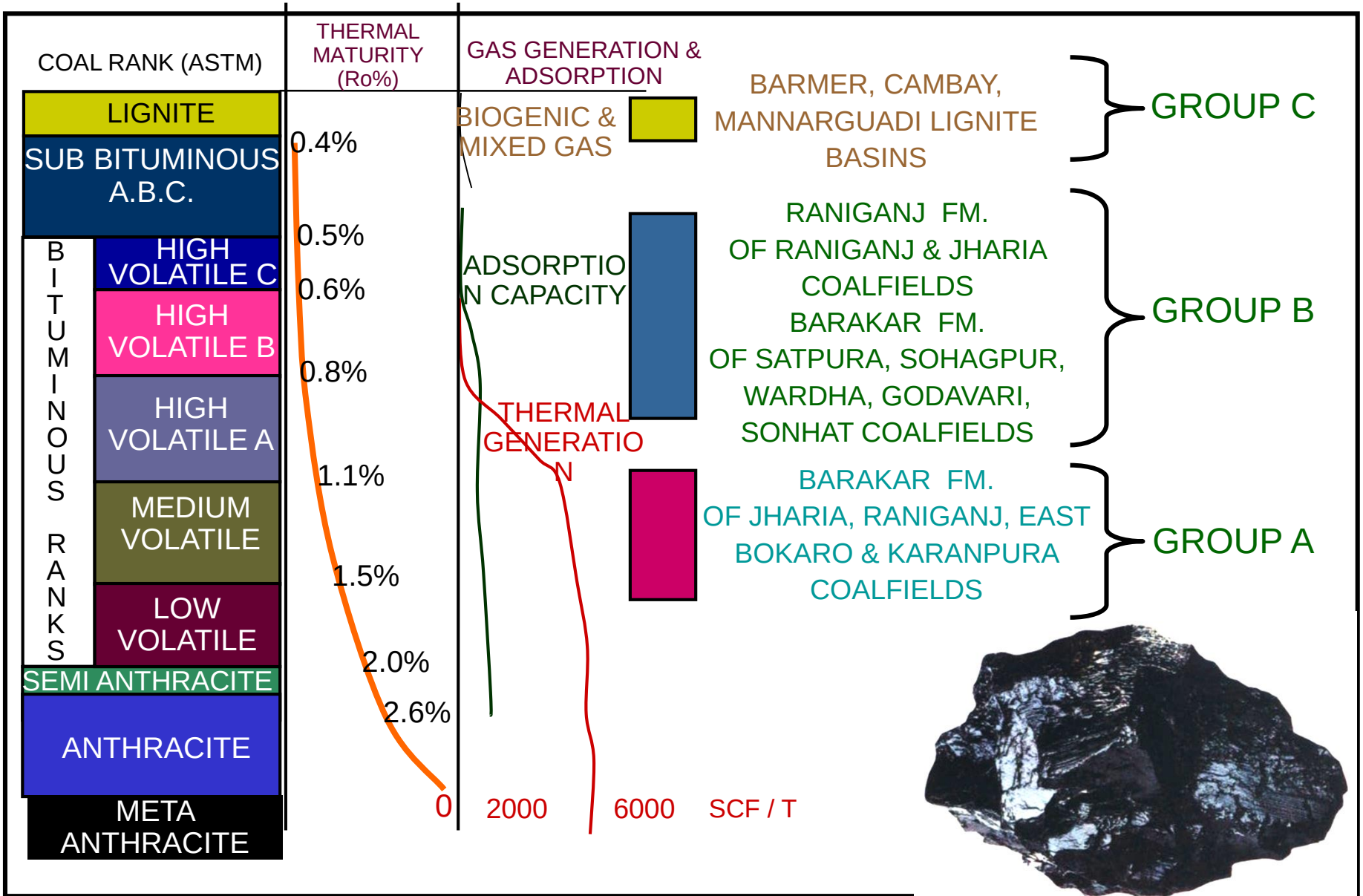
- **Accelerated exploration for coal, oil and gas**
- **Accelerating Nuclear**
- **Developing the thorium cycle for nuclear power**
- **Exploiting non-conventional energy sources**
- **In-situ coal gasification**
- **Enhanced recovery of oil and gas**
- **Clean coal technologies**

What is Coalbed/Coalmine Methane?

- *Coal bed methane is natural gas.*
- *It is formed during coalification, the process in which plant material forms coal.*
- *Contained within the coal seams and surrounding rock strata, coal bed methane generally does not escape into the atmosphere unless exposed by coalmining activity.*
- *Released into the mines, the gas becomes Coal Mine Methane, which must be removed from a coal mine for safety reasons.*



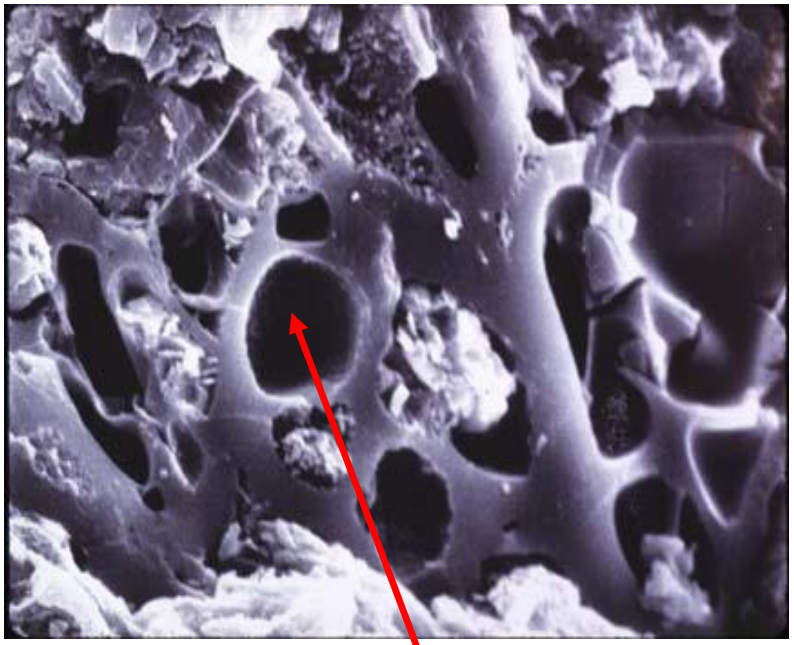
Coal Rank, Gas Generation and adsorption



Volumes of Gases Generated During Coalification

Methane	2,000 to 5000+ scf/ton (63 to 157 + m^3/t)
Carbon dioxide	177 scf/ton to 6,000+ scf/ton (6 to 188+ m^3/t)
Wet gases	100 to 1,000+ scf/ton (3 to 31 + m^3/t)
Nitrogen	250 to 500 scf/ton (8 to 16 m^3/t)

Dual Porosity of Coal

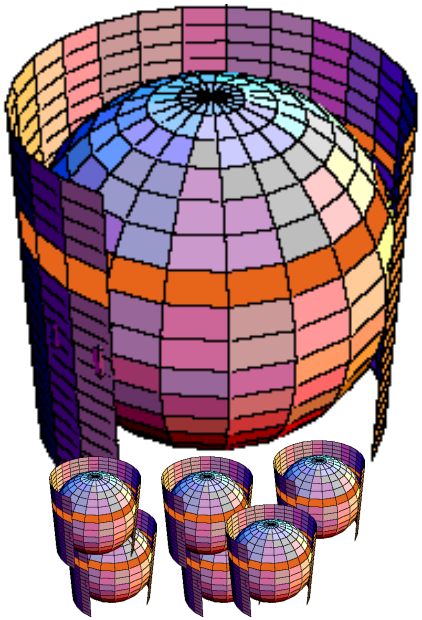


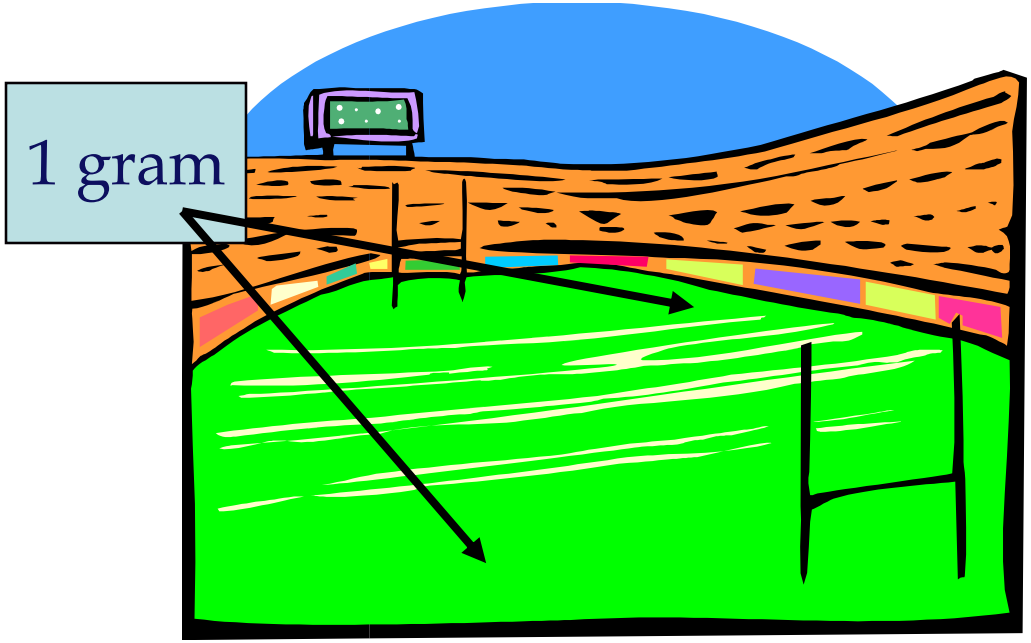
Microscopic view of the Micropores structure of coal

Fracture system, cleats in coal

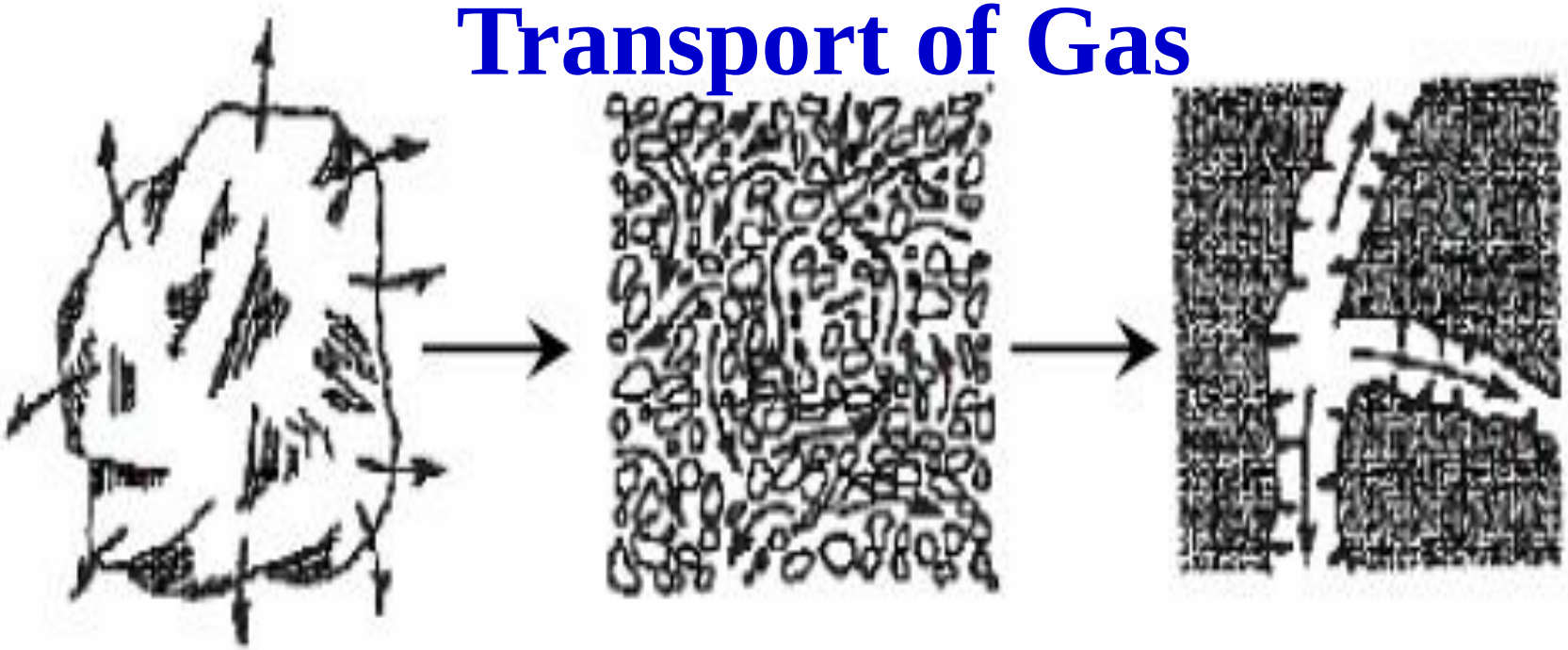
What Makes CBM Special?

One gram of coal has the surface area of ½ a football field





Transport of Gas



Desorption from Internal Coal Surfaces

(a)

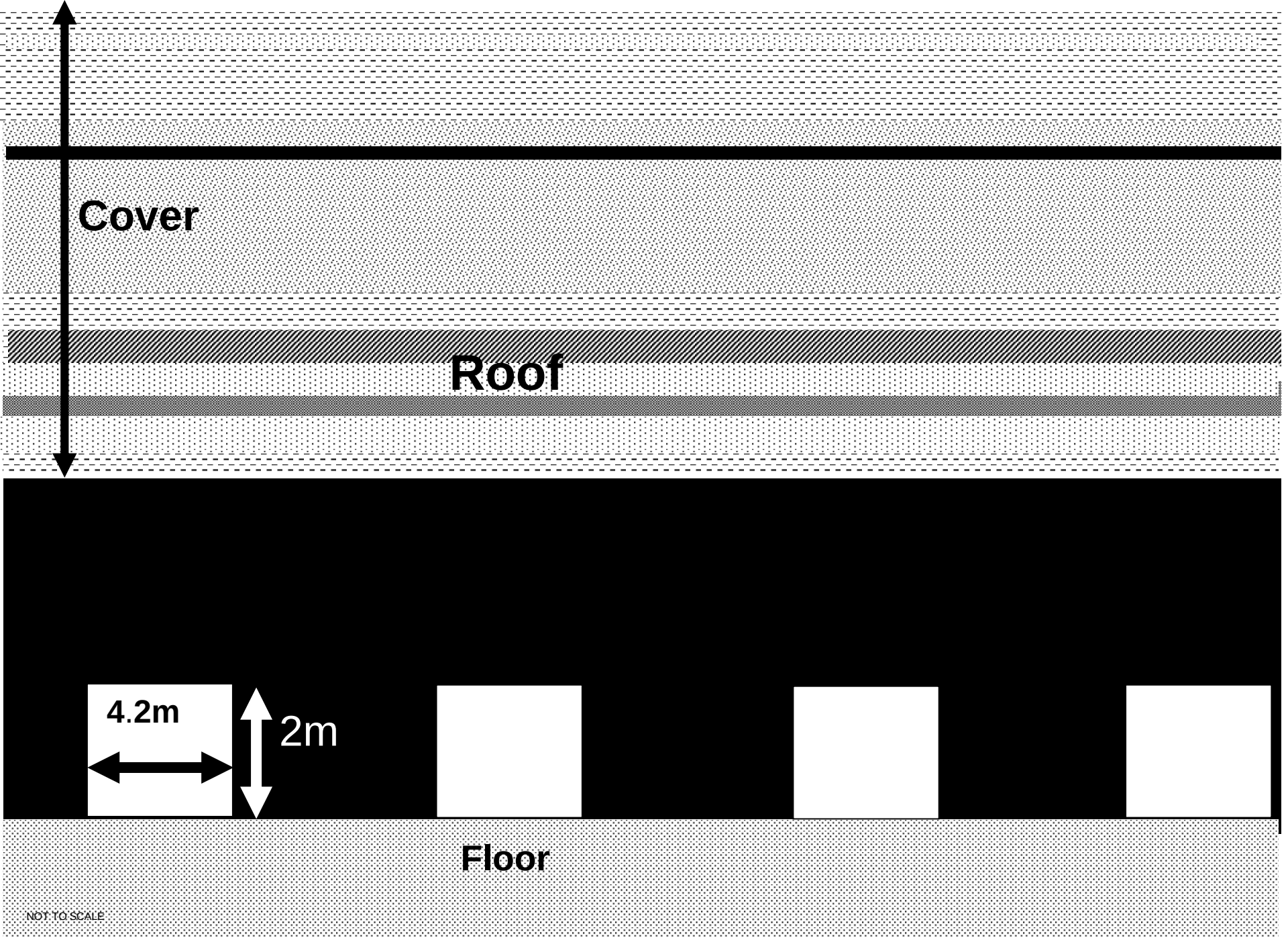
Diffusion Through the Matrix and Micropores

(b)

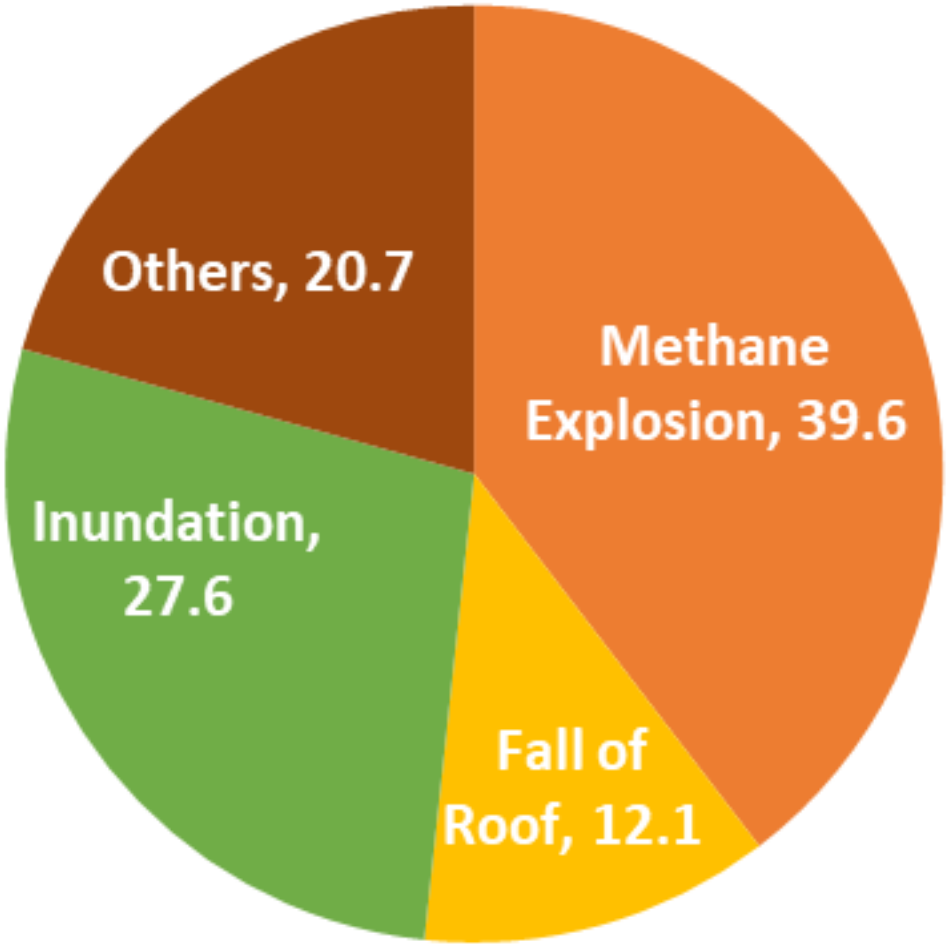
Fluid Flow in the Natural Fracture Network

(c)

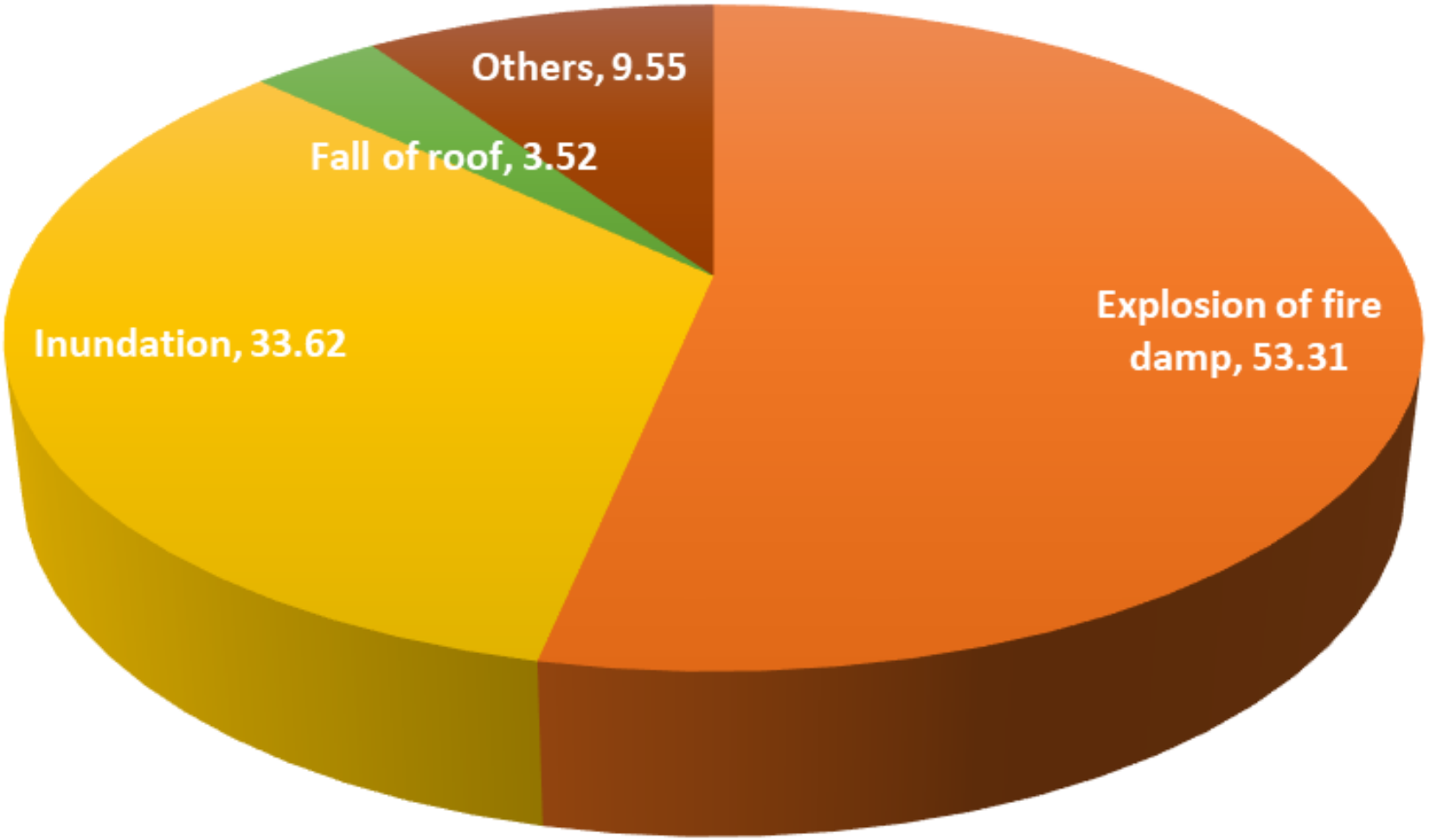
Increasing Size ⟶


Cover
Roof
4.2m
2m
Floor
NOT TO SCALE

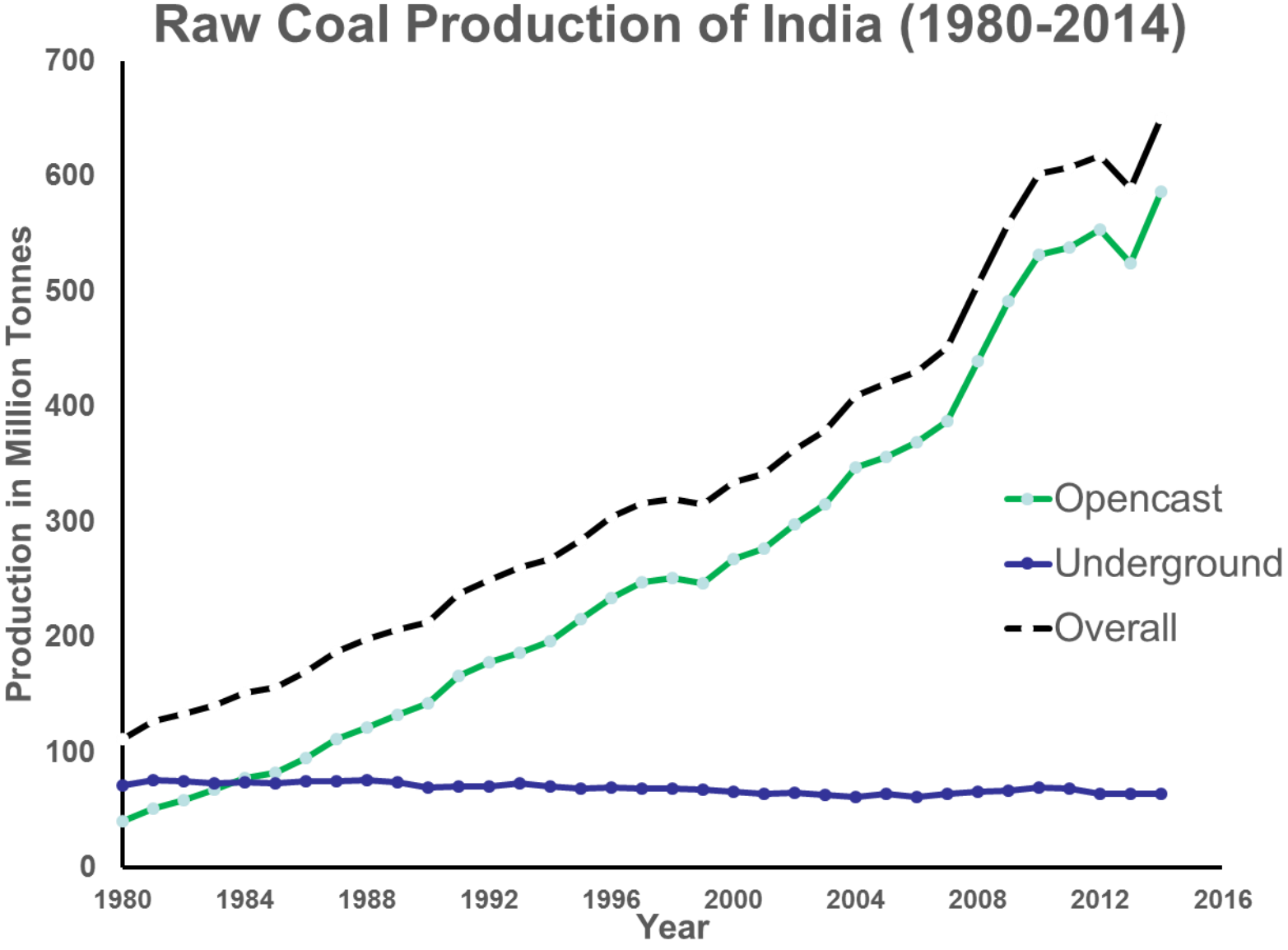
Cause-wise Indian coal mine disasters (%)



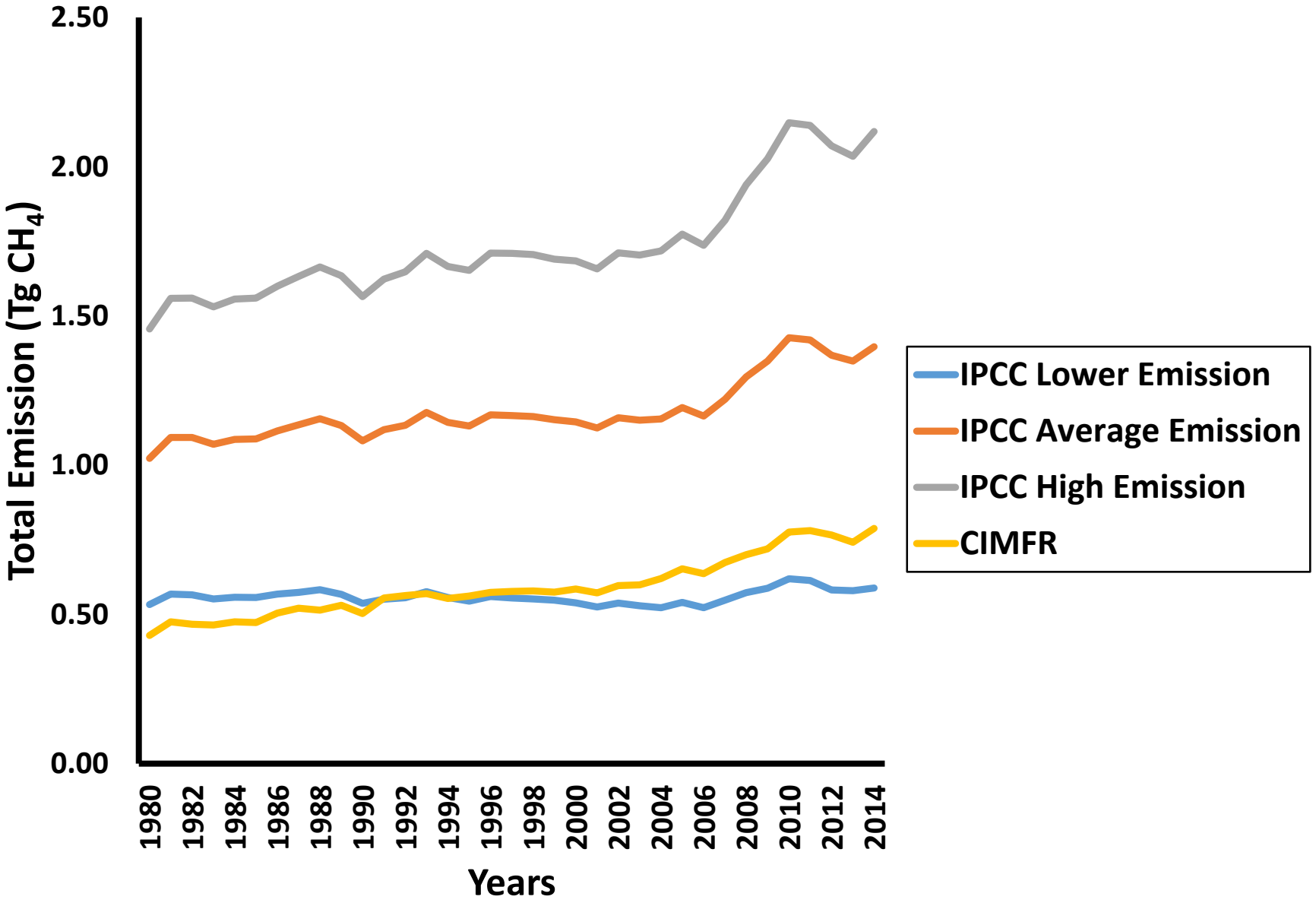
Casualties due to coal mine disasters in India (%)



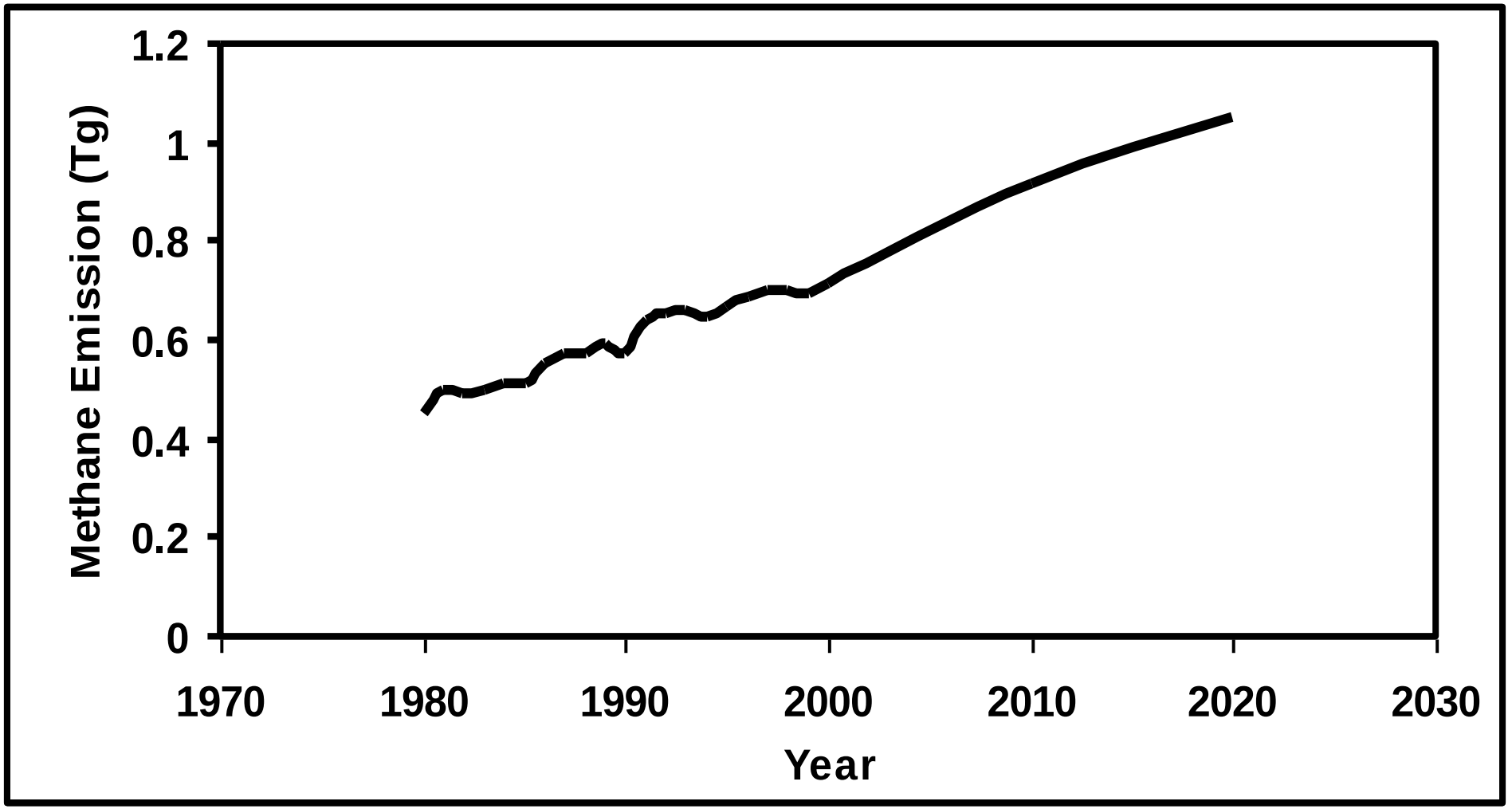
What about surface mines???


Raw Coal Production of India (1980-2014)
Production in Million Tonnes
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
Year
Opencast
Underground
Overall

Rate of Emission From Coal Mining



Trend of Methane Emission

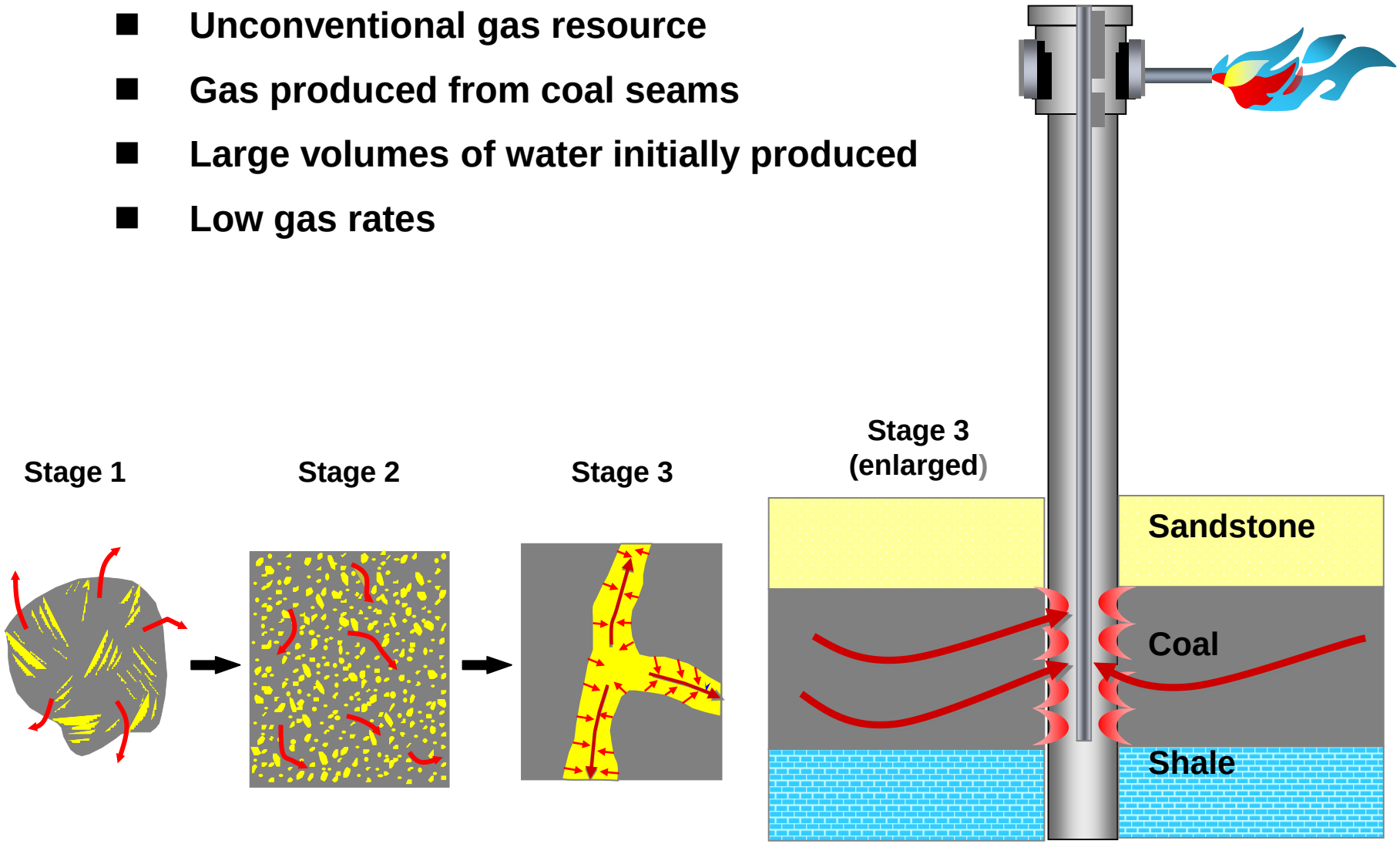


DIFFERENT CATEGORIES OF CBM

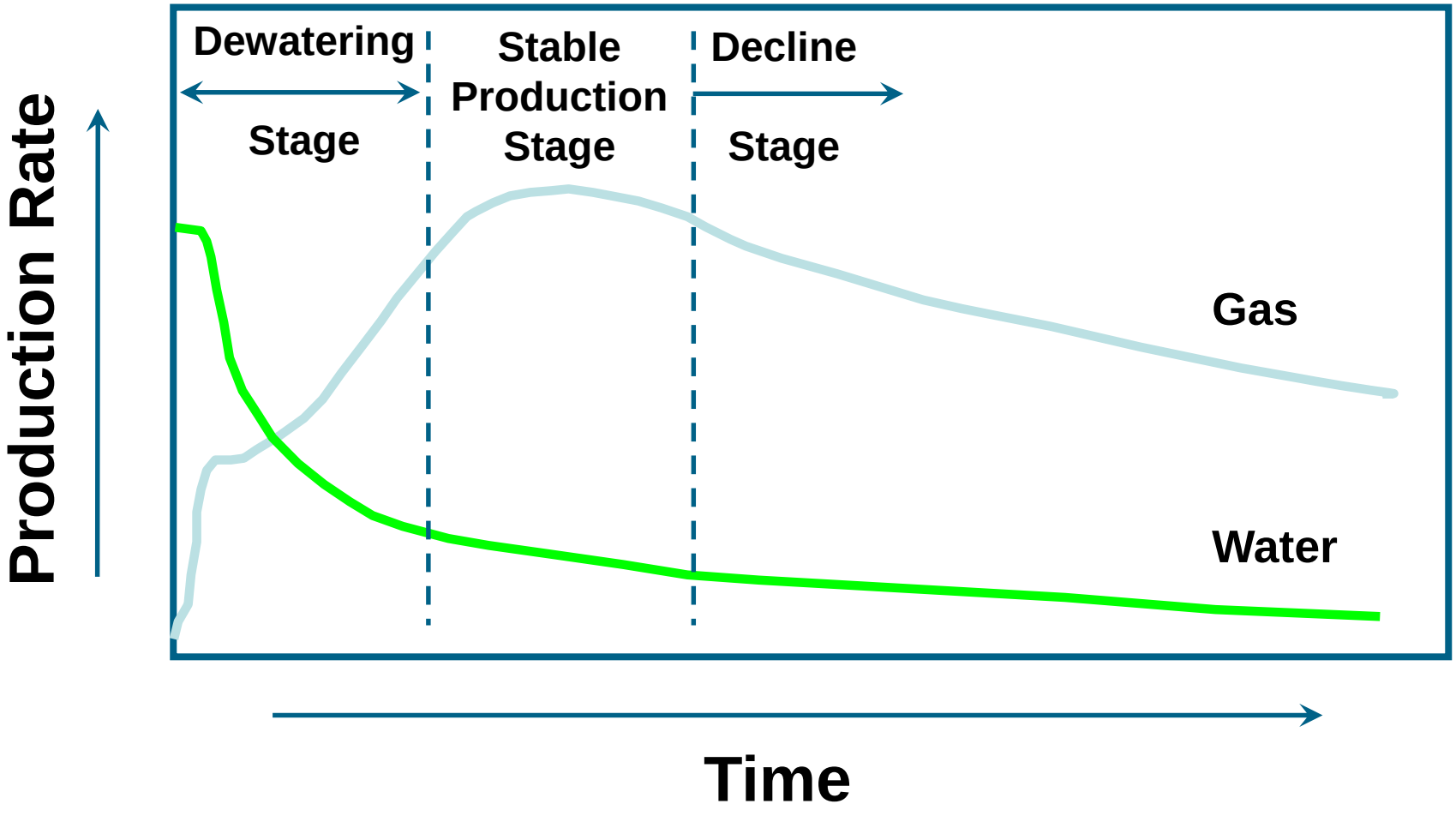
- **VCBM**
- **CMM**
- **AMM**
- **VAM**

What is VCBM?

- Unconventional gas resource
- Gas produced from coal seams
- Large volumes of water initially produced
- Low gas rates



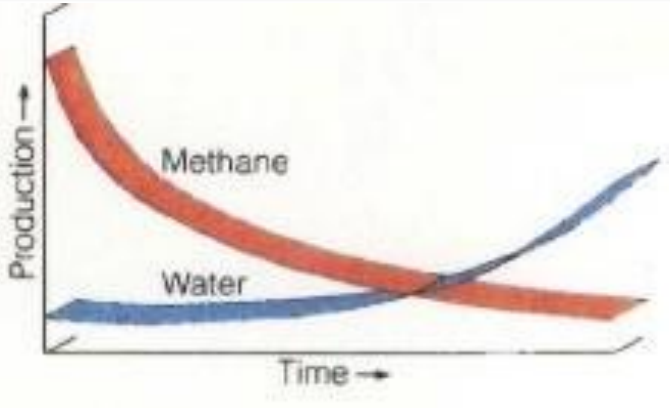
“Typical” CBM Well Production Profile

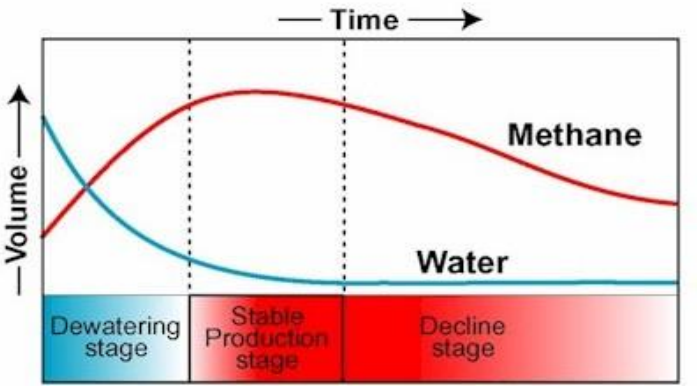


Conventional vs. CBM Reservoir

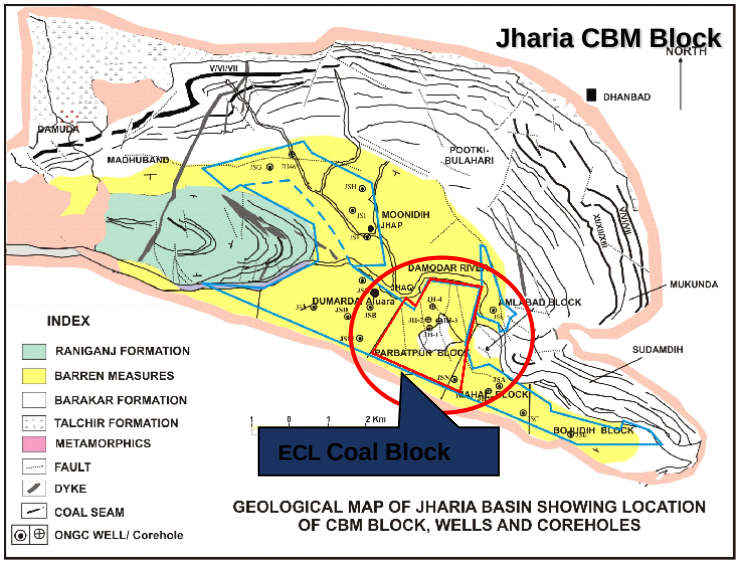
- Understanding of coal reservoir is necessary

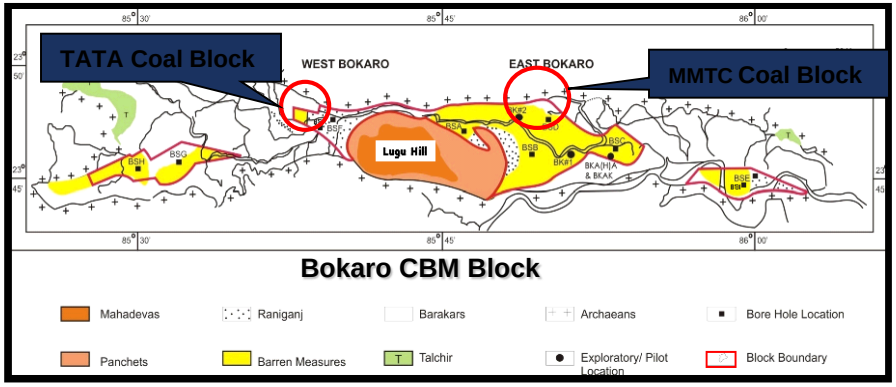
Conventional oil and gas	CBM reservoir
High Pressure Reservoir Transport of gas, a single stage process ✓ Darcy flow of gas to wellbore.	Low Pressure Reservoir Transport, a three stage process ✓ Desorption of gas from carbon surface ✓ Diffusion through micro pores by Fick's Law ✓ Darcy flow through fractures
Different Reservoir and source rocks	Reservoir and source rock same
Macropore size: 1µ to 1 mm	Micropore size: < 5A° to 50A°
Permeability not stress dependent.	Permeability is stress dependent
Conventional reservoir	Unconventional reservoir



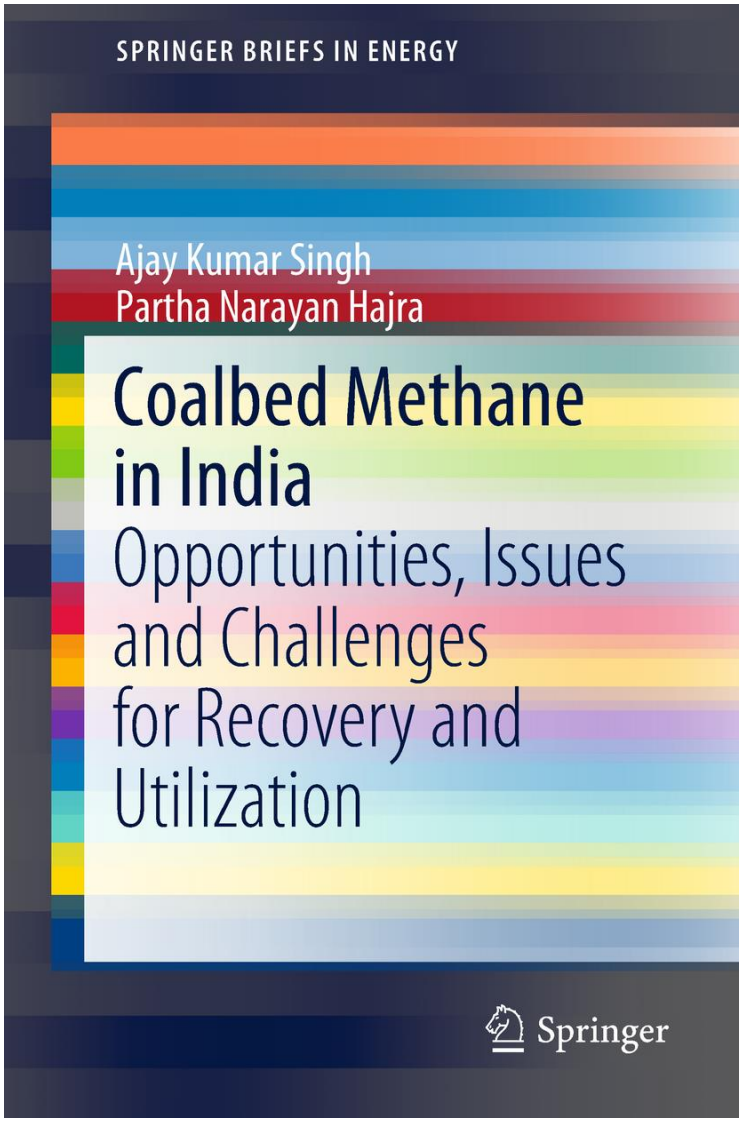


OUR STUDY AREA





Suggested reading



This book offers a first-of-its-kind, standalone review of coalbed methane (CBM) in India, covering all the major technical and policy aspects. As an authoritative text on CBM in India, it addresses the essential geological, engineering and policy issues. The Coalbed Methane industry is a rapidly developing sector in Indian energy supply. The book presents the characteristics of coal beds in India's Damodar and Son river valleys, which influence the commercial viability of CBM in the regions, as well as a study of the gas contents of the country's major coalfields.

The book begins with a brief review of methane emissions from Indian coal mines and the current coalbed methane situation in the country. Its unique features include a coalfield-by-coalfield technical assessment of CBM throughout India. Policy matters are addressed, including the National Exploration Licensing Policy (NELP) of the Indian Government Ministry of Petroleum and Natural Gas, which is vital to an overall understanding of CBM development in the country. The scope and depth of its book's coverage will benefit students, practicing engineers, researchers and policy-makers.

CMM Resource in Some Gassy Mines

Colliery	Coalfield/ Company	CMM Resource (BCM)
Kalidaspur Colliery Including Bakulia	Raniganj/ ECL	2.51
Ghusick and Adjoining SSI	Raniganj/ ECL	2.58
Murulidih and Bhatdih	Jharia/ BCCL	1.52
Amlabad and Sudamdih	Jharia/ BCCL	2.23
Jarangdih and Sawang	East Bokaro/ CCL	2.79

CMM Resource in Some Projectized Blocks

Block	Coalfield	CMM Resource (BCM)
Ichhapur	Raniganj	3.83
Kulti and Sitarampur	Raniganj	3.40
Central Parbatpur	Jharia	5.31
Kapuria	Jharia	1.51
Asnapani	Bokaro	6.64
Kathara	Bokaro	8.62

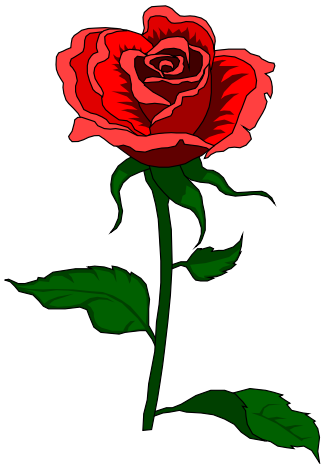
Major Achievements and Societal Benefits

- **Continuous R&D support for CBM recovery and utilization in Damodar River basin**
- **Established CMM potentiality in 6 proposed and 5 existing mines for commercial development of CMM**
- **Preparation of GHG Inventory on behalf of GoI for its communication to UNFCCC**
- **First carbon foot printing studies and CMM development studies in OCP areas**
- **Feasibility study for utilization of VAM/AMM for GHG stabilization**

Recommendations for Future

- **Pilot scale demonstration of CMM in a gassy mine**
- **Revamping efforts for R&D Projects on VAM**
- **Assessment of AMM resources**
- **Preparation of National Emission Factor for estimation of GHG**

THANK YOU



ajay.cimfr@gmail.com