The Problem of AMM: Fugitive emissions, composition, accumulation, migration and potential hazards

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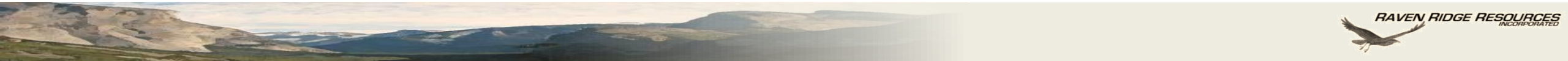
Post-Mining Perspectives:
Capture and Use of AMM and Mine Reclamation and Revitalization of Post Mining Areas
Cracow, Poland 25 February 2020



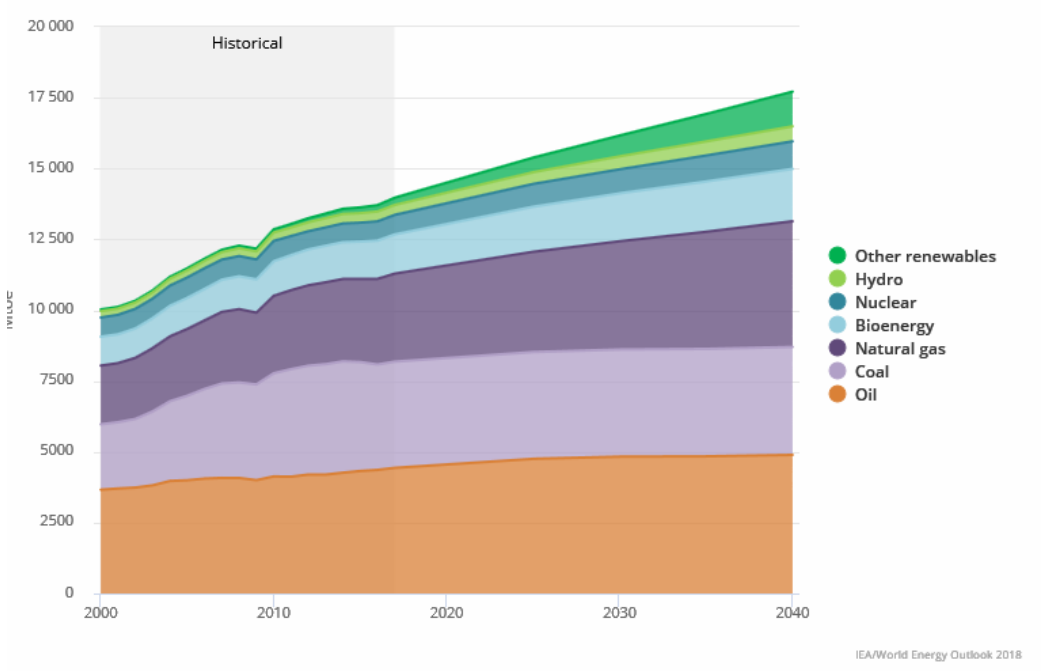
Introduction and outline

- Future use of coal
- Coal mining life cycle, hazards and gas composition
- Abandoned mine emission modeling and IPCC inventory guidelines
- Conclusions

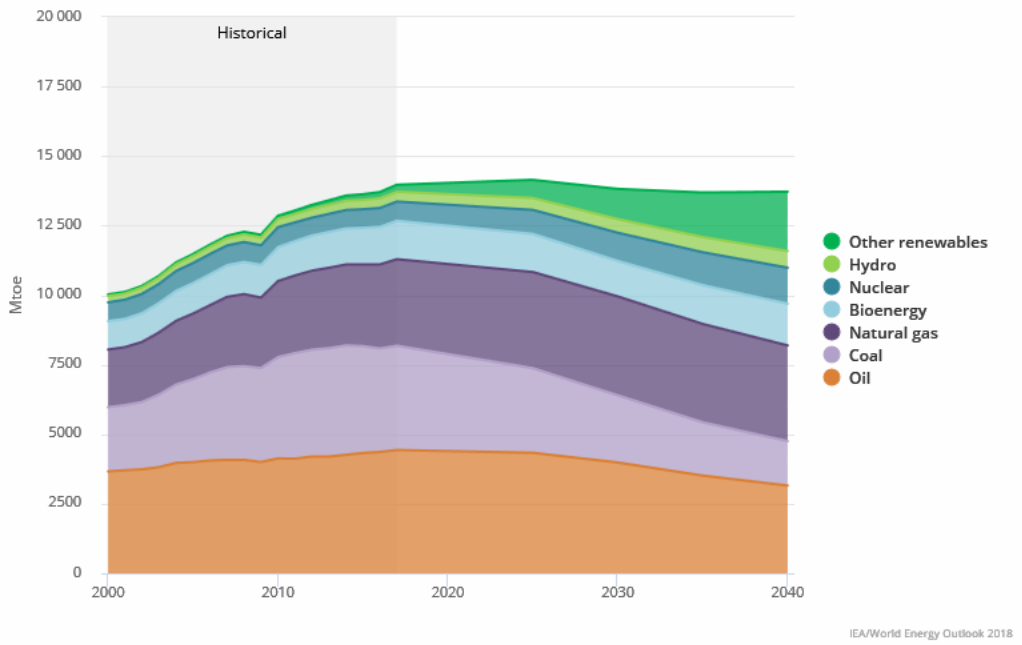
Future coal use

World energy demand under differing policy scenarios

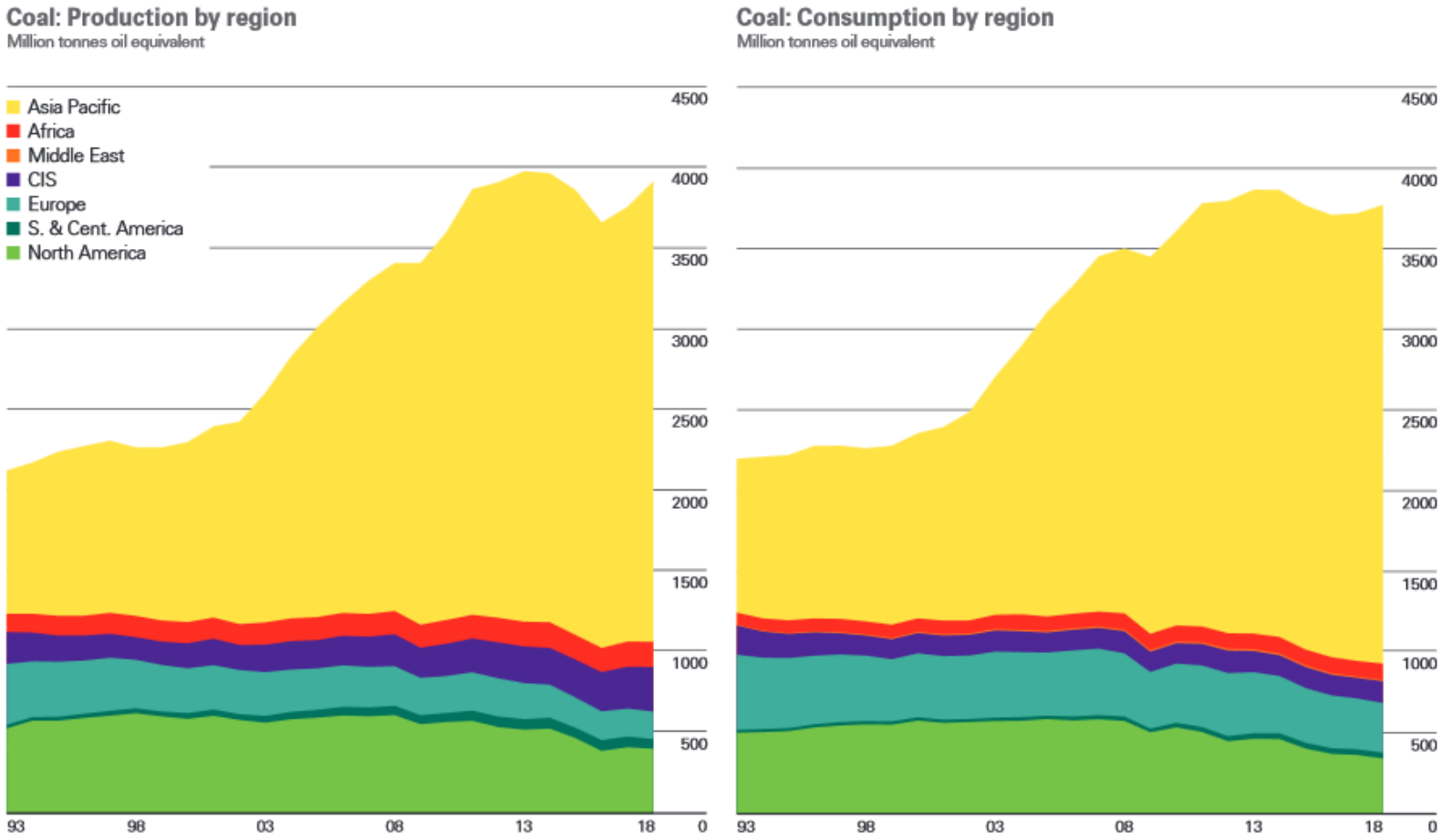
New policies scenario



Sustainable development scenario



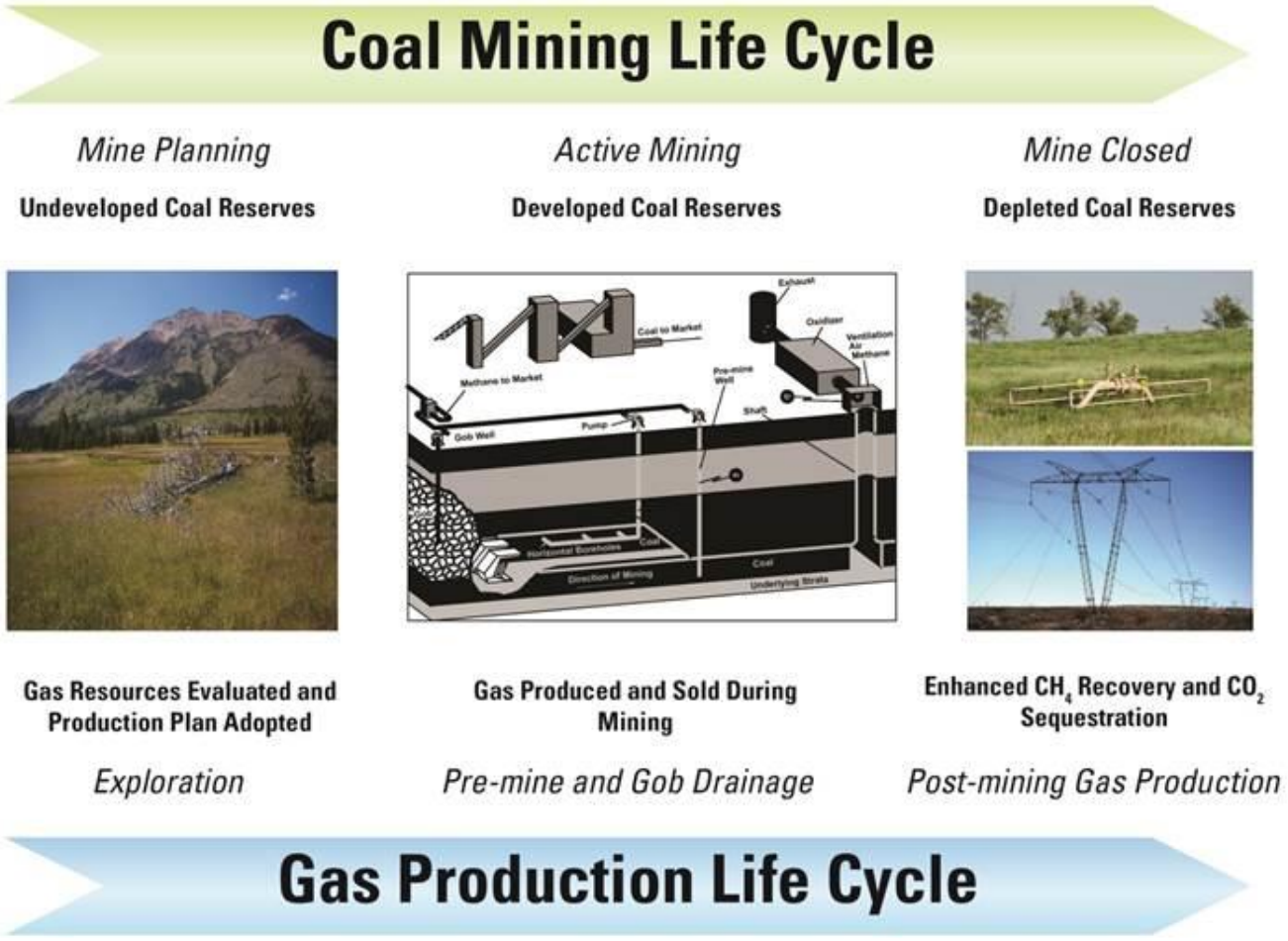
Coal production and consumption by region 1993-2018



BP Statistical Review of World Energy, 2019

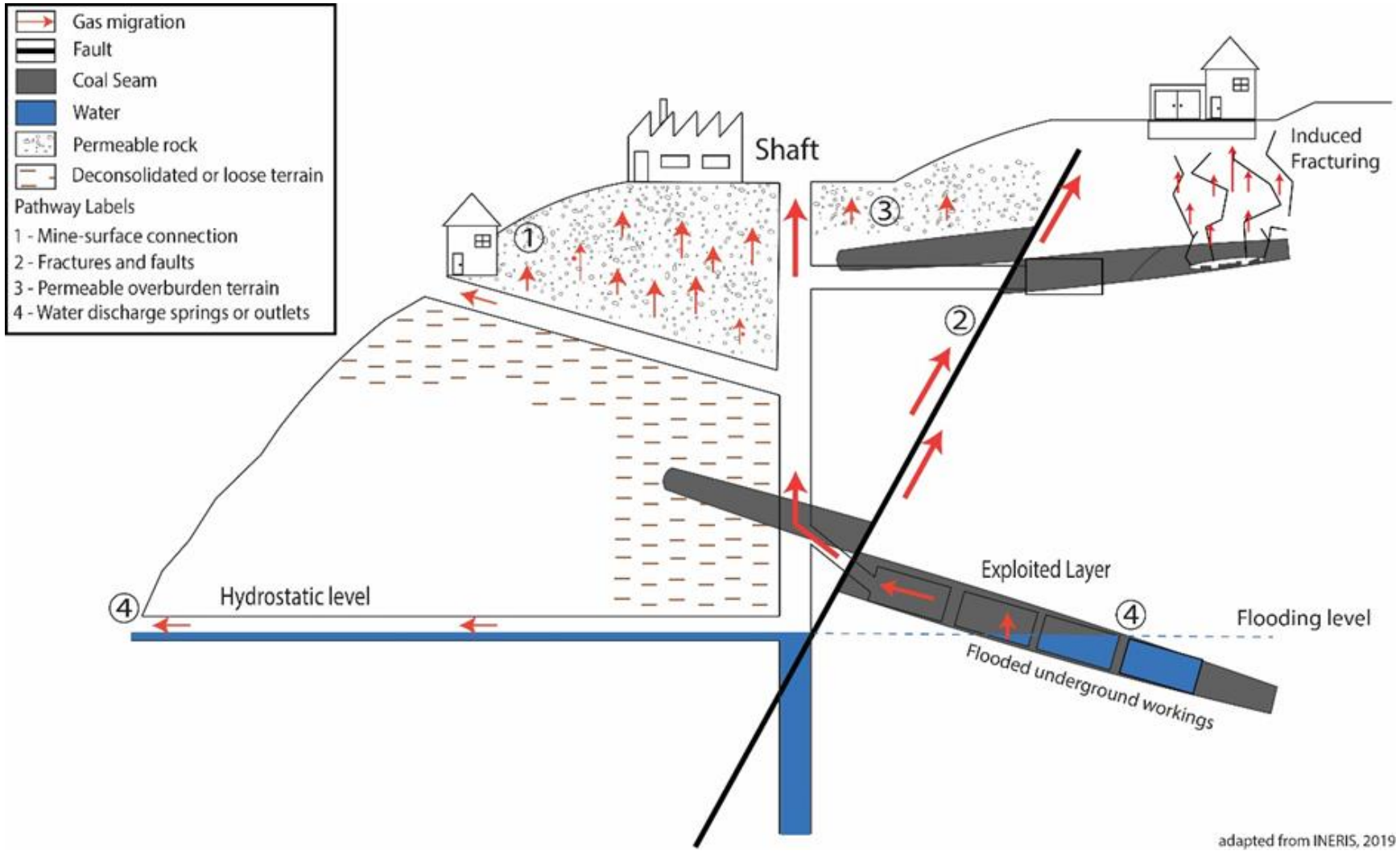
Coal mining life cycle, hazards and gas composition

Opportunities for methane emission mitigation and lowering coal-fired power generation carbon footprint



Closed and abandoned coal mines are thought of as hazards—not resources

CMM and AMM flow toward the lowest pressure environment



Example of gas composition from Illinois Basin, USA

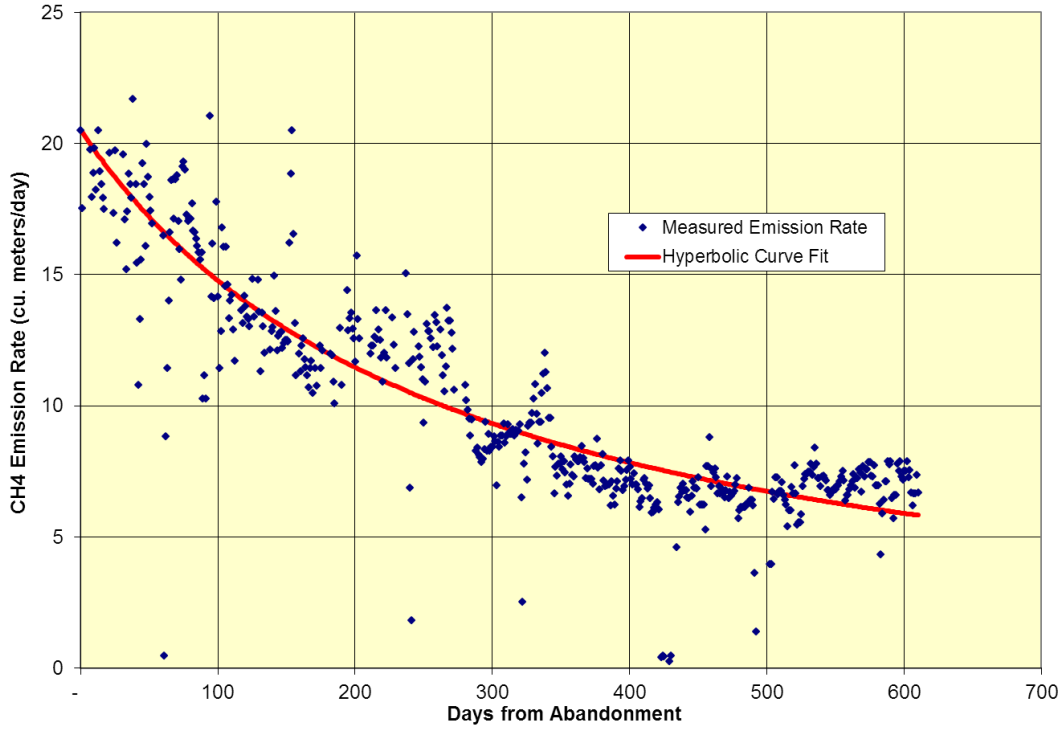
	Depth (m)	Gas Composition in percent of sample						Heating Value MJ//m^3
		CO_2	O_2	N_2	CH_4	C_2H_6	C_3H_8	
Range	33-167	nd-16	nd-14.4	nd-79	nd-90	nd-9.5	nd-0.1	none-35.7

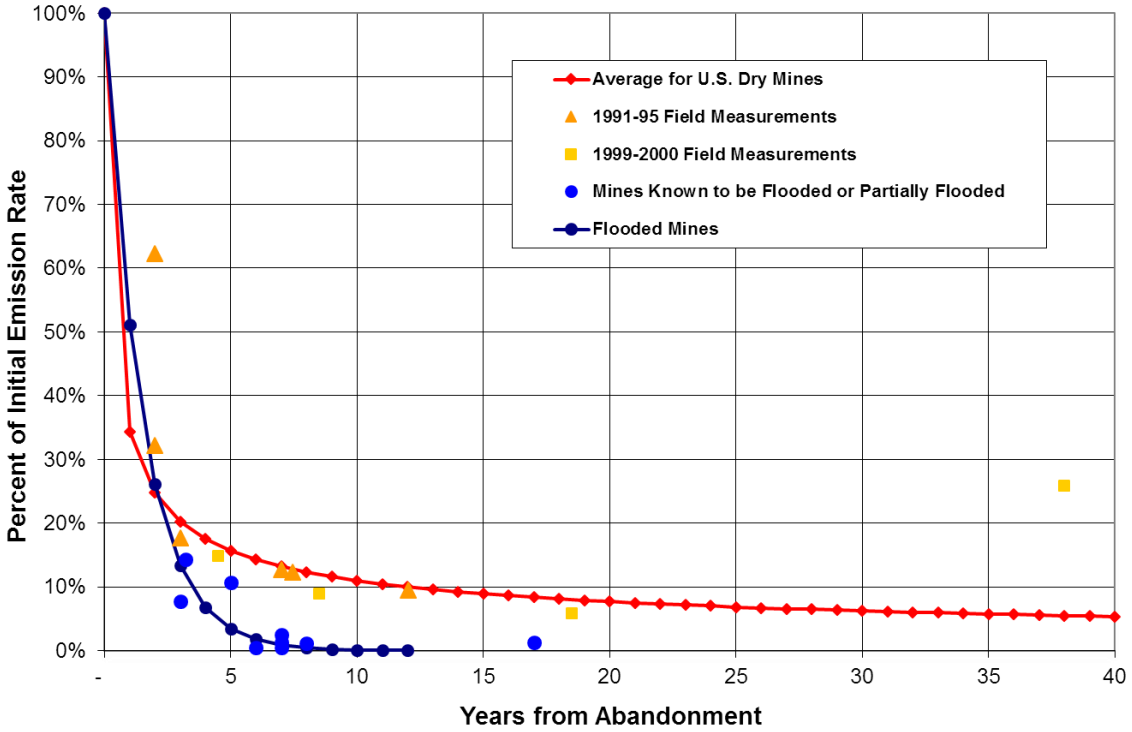
Abandoned mine emission modeling and IPCC inventory guidelines

Modeling provided type curves for emissions decline

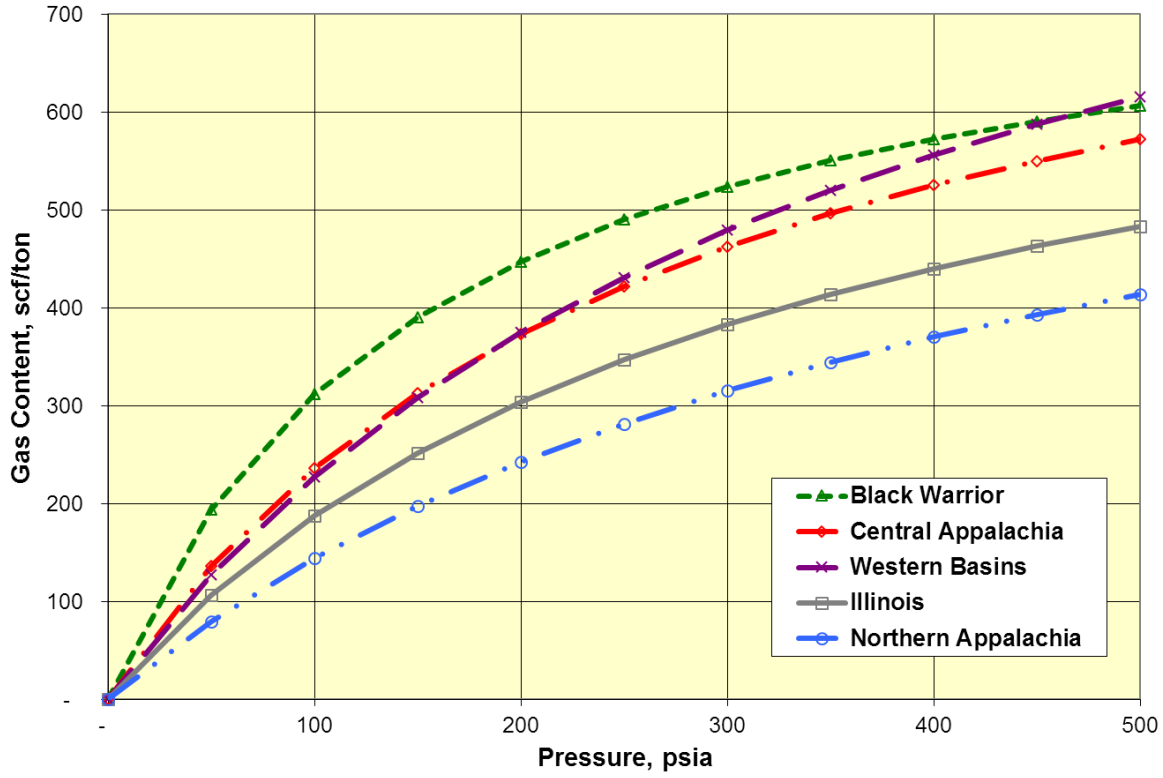
- Reservoir models were developed to investigate the most important attributes in coals seams that are extracted in major American coal basins
- Inputs for models were gathered from literature, private sector data sets and field measurements
- We recognized that the natural decline for coal associated gas deposits are hyperbolic
- The curve varies by an exponent that reflects, coal rank, permeability and formation pressure.

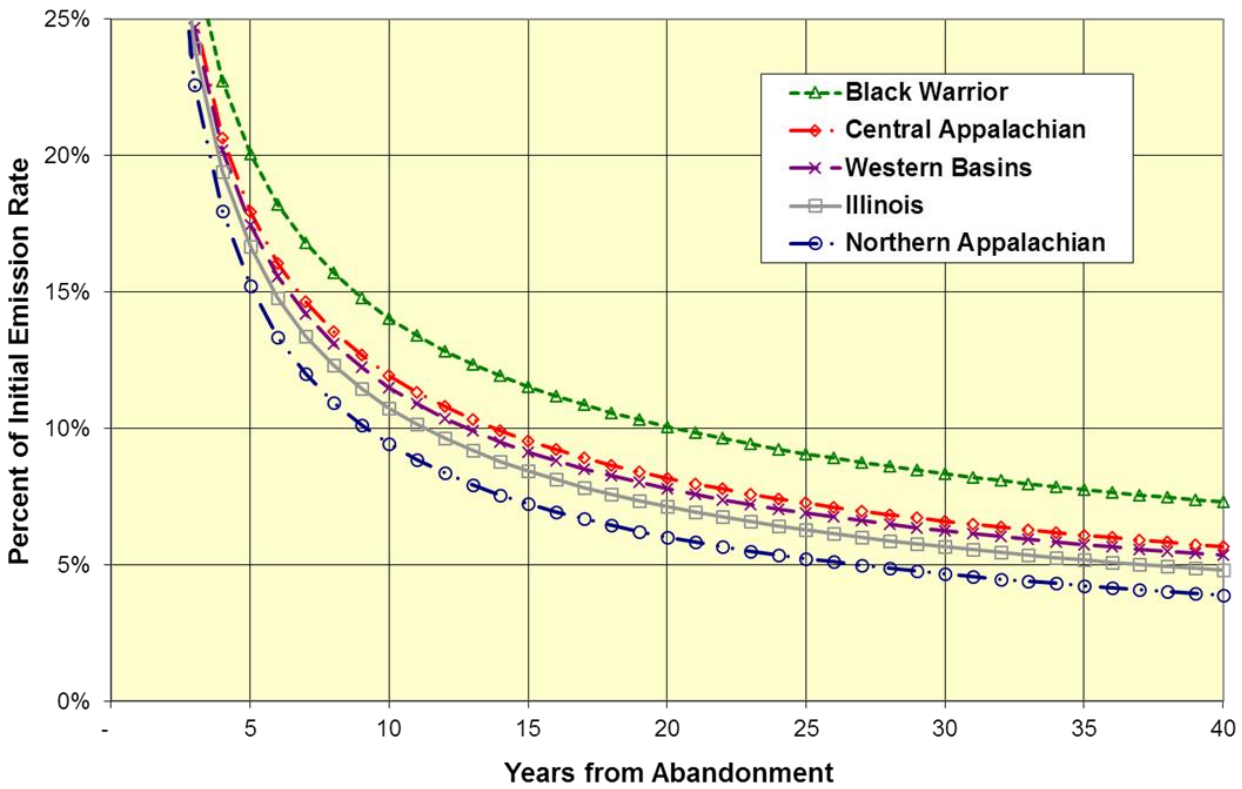
Abandoned mine methane production, or emissions follow a hyperbolic decline—unless the mine is flooding





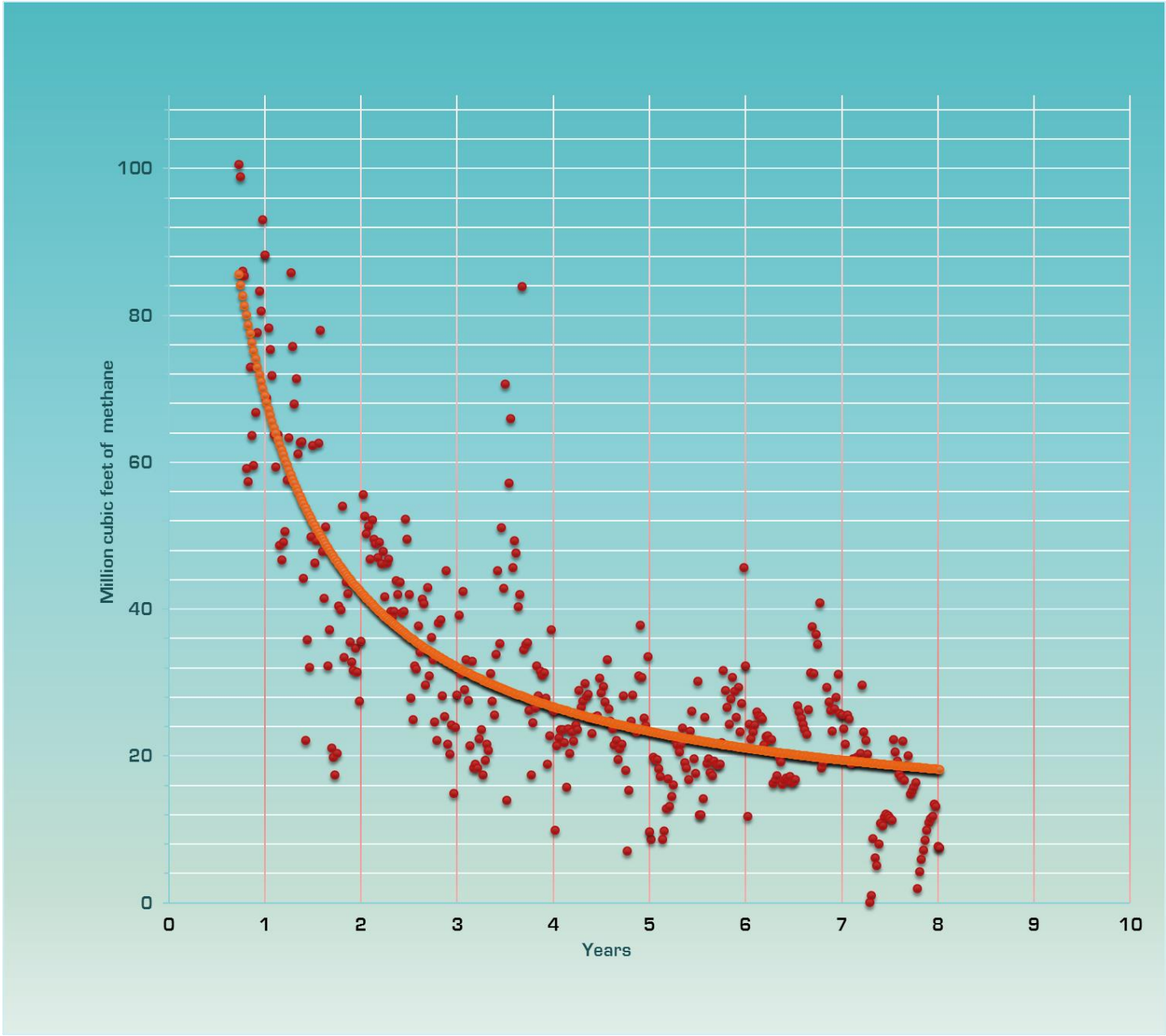
The basis of IPCC Guidance on estimating emissions





West Elk coal mine, Colorado, USA

- This mine has been open since 1978
- The mine has never used or destroyed methane that has been liberated from mining.
- In the years 2011-2018 44.2 million tons of coal was mined,
- 13.4 billion cubic feet of methane was liberated
- This represents 5.4 million tonnes of CO_2E using a GWP of 25, but 18.6 million tonnes using the more appropriate GWP value of 86.
- When this mine closes it could produce methane for another 20-30 years



Conclusions

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- Inventories of coal mining and abandoned mine emissions need to improve
  - Need more information relative to rank of coal, isotherms, and measured emissions and methane production for developing more robust models
  - Mapping of mines is critical, location and depth of underground workings is critical information—not just for present work, but investigations of future generations
  - Promote widespread use of satellite detection and other airborne methane detection
- Active coal mine and abandoned mine emissions are largely due to the consumption of the power sector, the entire value chain of emissions from mining related methane through carbon dioxide emitted from coal combustion, should be comprehensively studied and affordable solutions found to lower the carbon footprint
- Finance is critical, we need to change the way carbon credits are established and priced
- Our aim should be to recover more methane, repurpose the lands, and use the waste products for future benefit

Thank you!

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