LONG REACH DIRECTIONAL DRILLING TECHNOLOGY –

an effective way of gas drainage and mitigation of GHG emission: case study of *Murcki-Staszic Hard Coal Mine*

DD-MET

GiG

Energy, Fuels, Environment 2020

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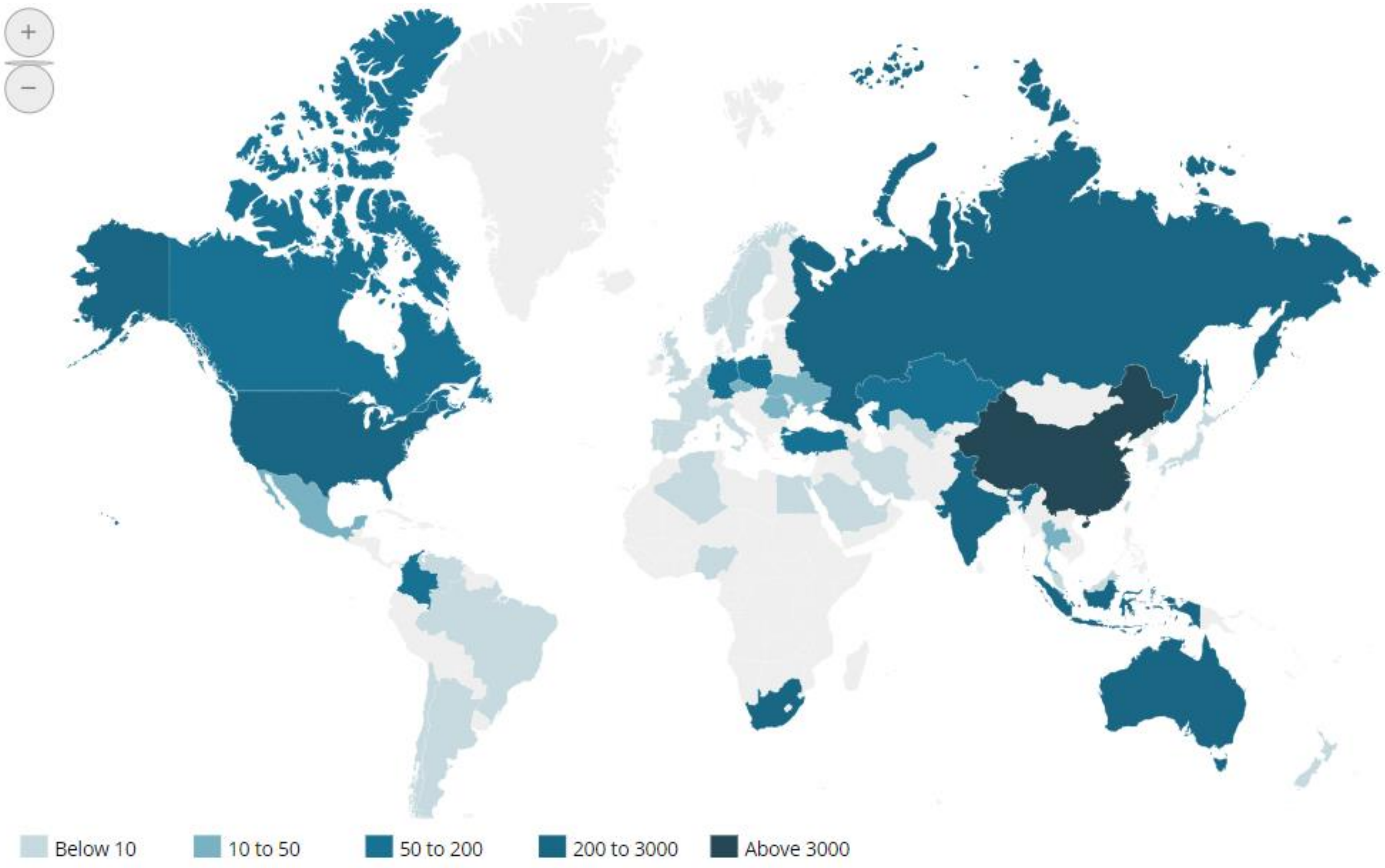
COAL PRODUCTION in selected countries

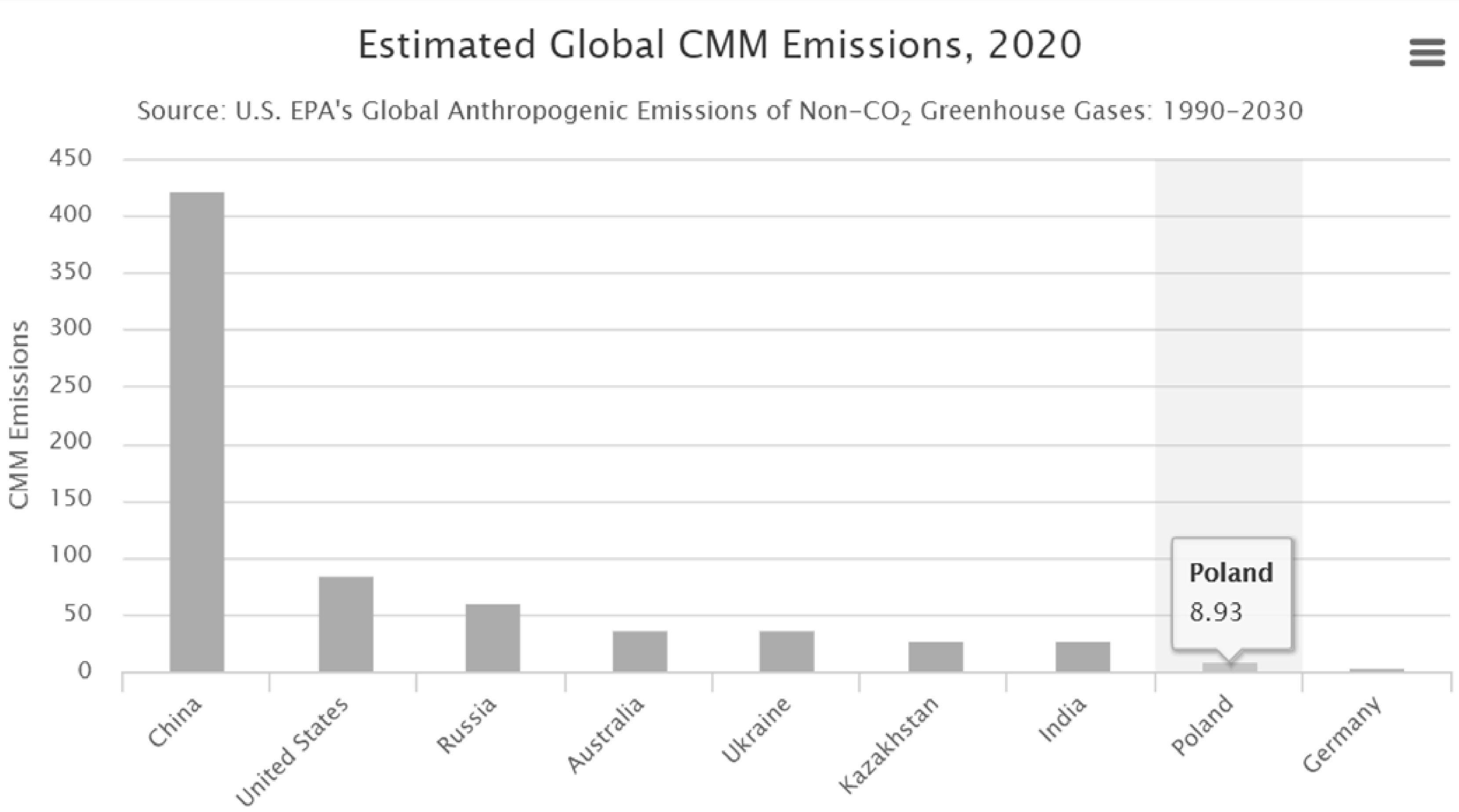


Unit: Mt | Highest

China	3,692
India	745
United States	640
Indonesia	585
Australia	500
Russia	425
South Africa	264
Germany	132
Kazakhstan	117
Poland	112
Turkey	84
Colombia	83

*Source: https://yearbook.enerdata.net/coal-lignite/coal-production-data.html

GLOBAL CMM EMISSIONS

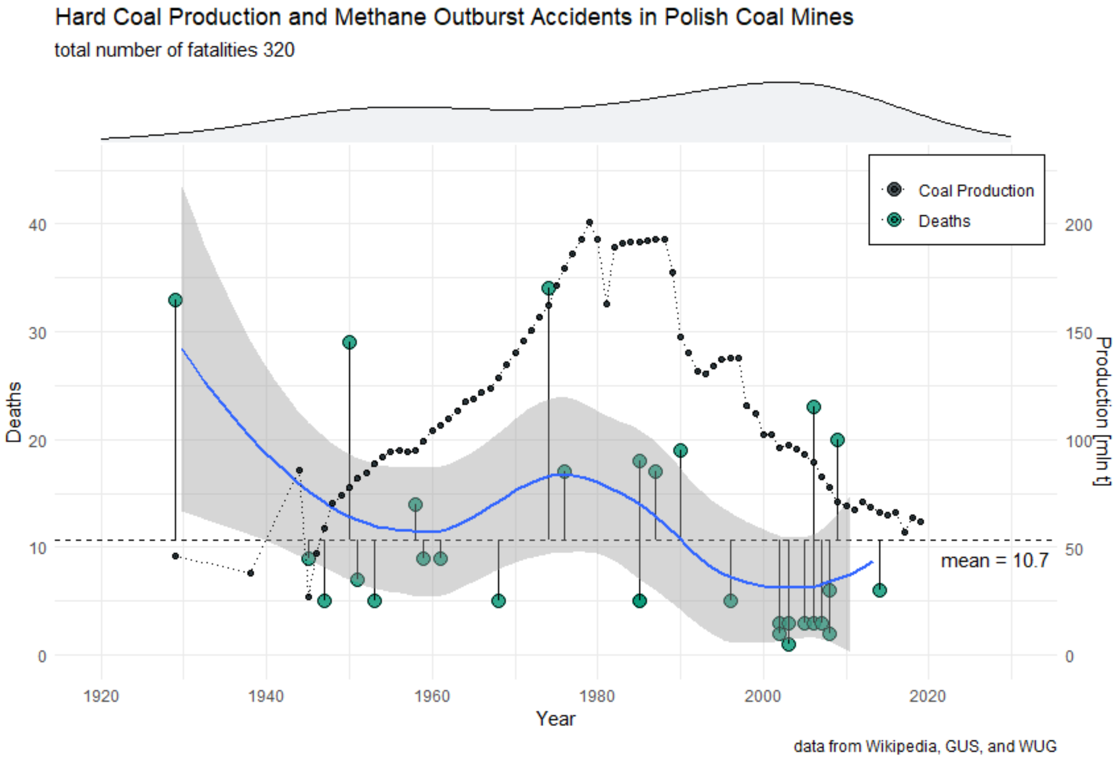


Source: https://www.epa.gov/cmop/frequent-questions

MOTIVATION

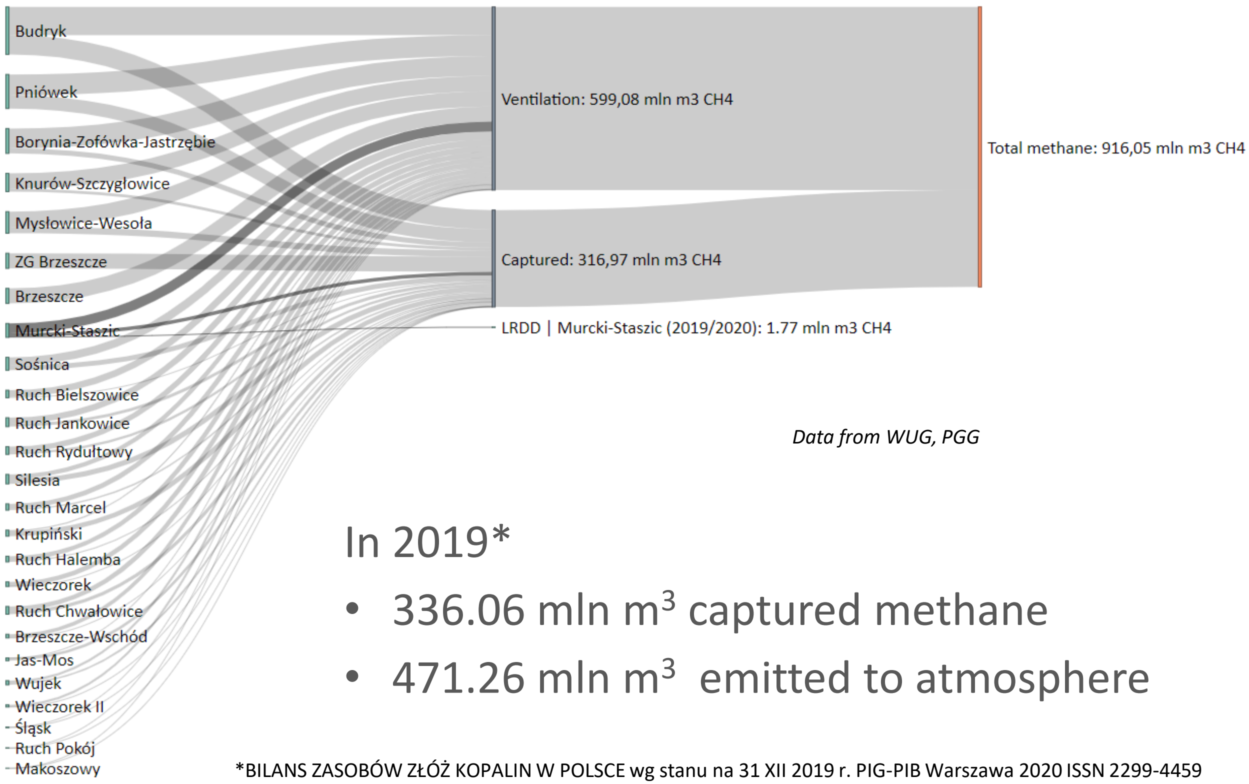
Reduce GHG emissions

Improve safety and productivity



CMM released and captured during mining operations in 2018

Methane drainage efiiciency 34.6%



Data from WUG, PGG

In 2019*

- 336.06 mln m^3 captured methane
- 471.26 mln m^3 emitted to atmosphere

*BILANS ZASOBÓW ZŁÓŻ KOPALIN W POLSCE wg stanu na 31 XII 2019 r. PIG-PIB Warszawa 2020 ISSN 2299-4459

METHANE DRAINAGE CONSIDERATIONS

Geologic characterization

Reservoir characterization

Source of gas emissions

Mining technique

Operation time schedule/mining activity

Drainage approach/techniques

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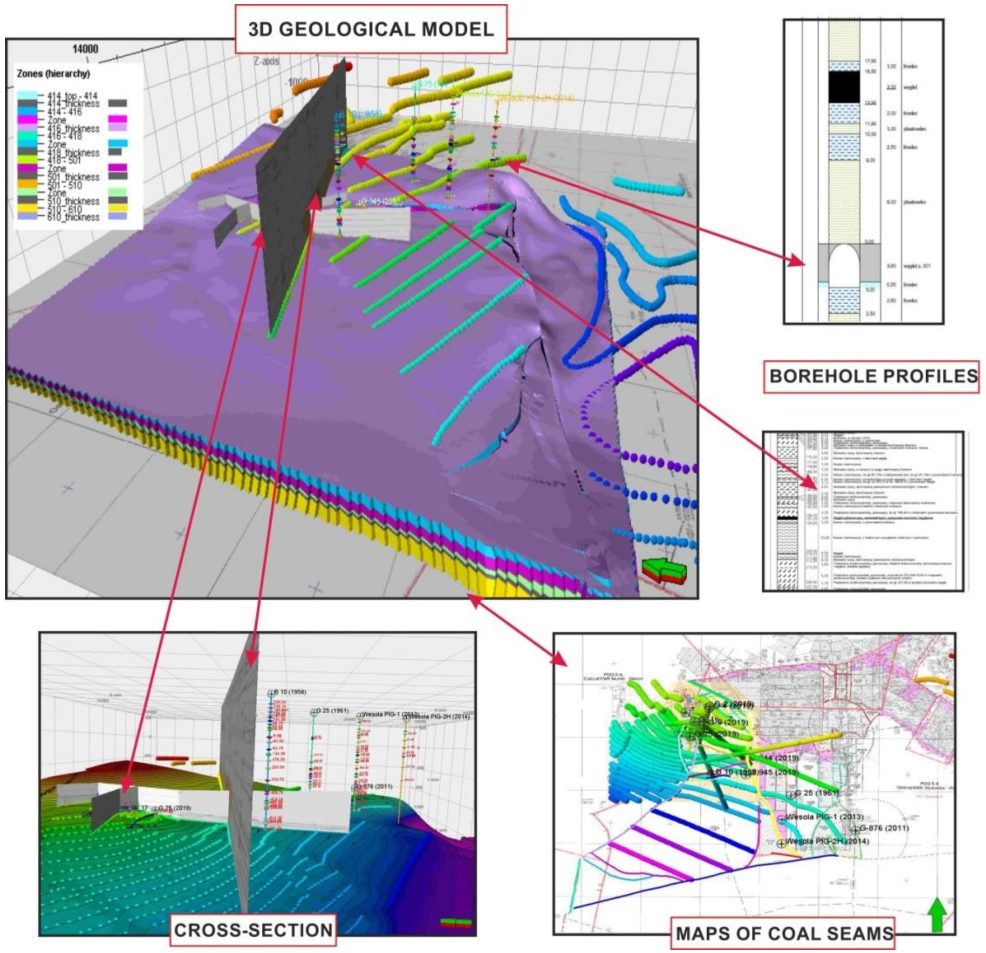


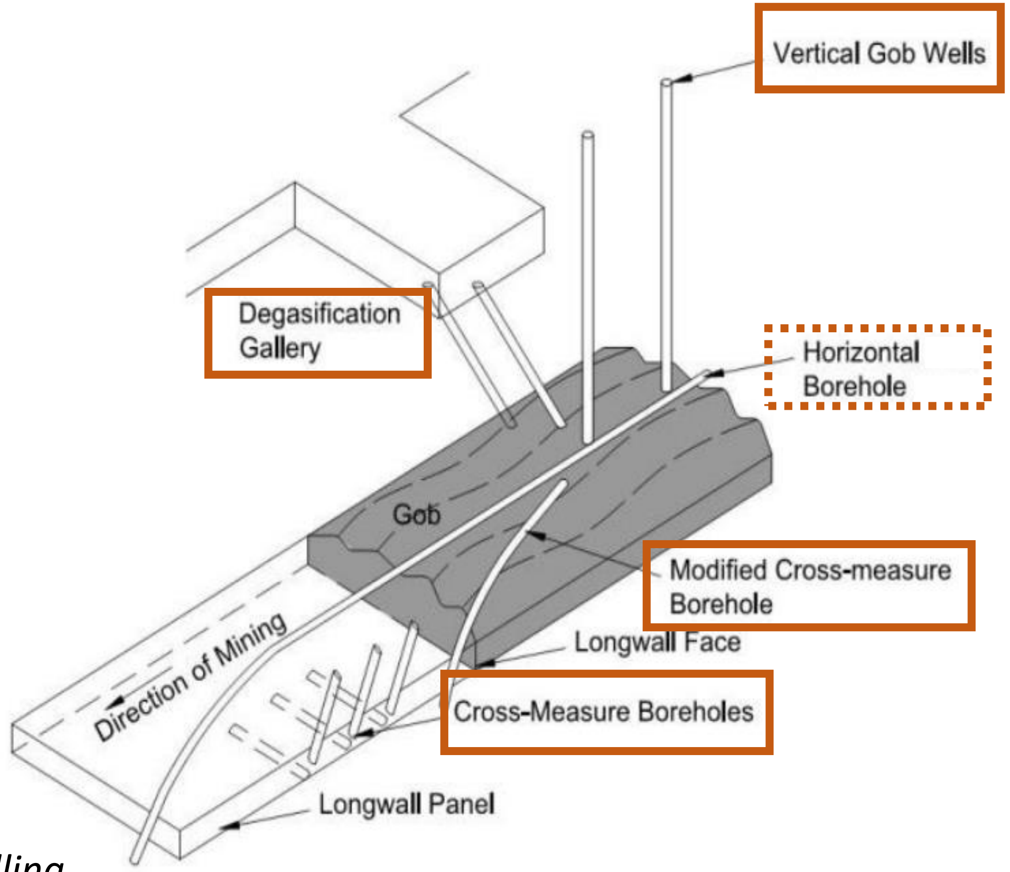
METHANE CONTROL STRATEGIES

- dilution to safe concentrations with the ventilation system
- capturing in boreholes gas drainage galleries
  - drainage before (pre-mining) and/or during coal exploitation

CONVENTIONAL

ALTERNATIVE (new)

The strategy for gas control varies among different mines. In some coal mines the methane release at the operating longwall can be effectively managed using a ventilation air system. In gasses coal mines, however usually a combination of drainage and ventilation must be used.



REI Drilling

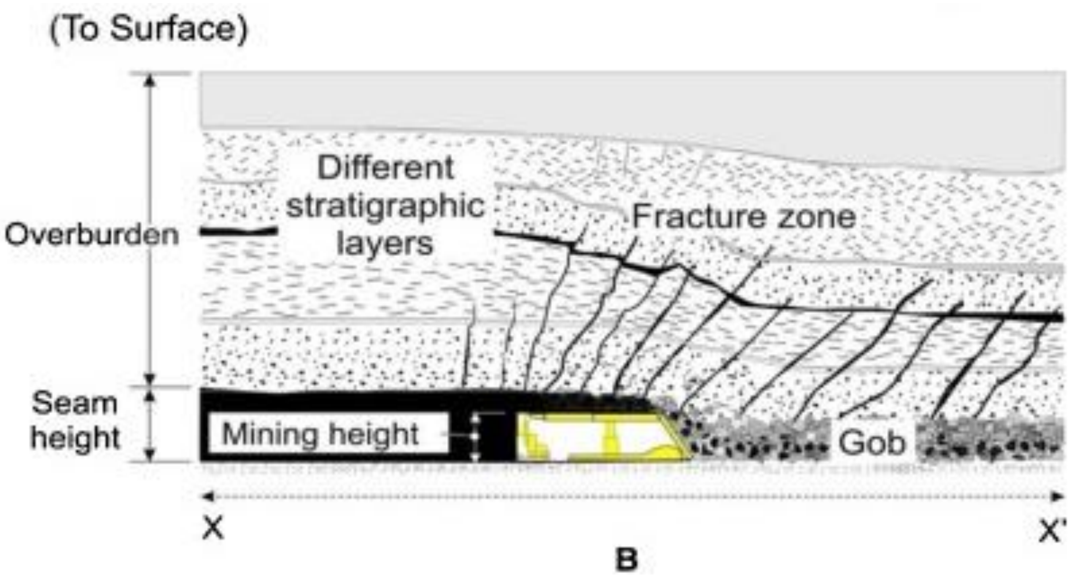
LONG REACH DIRECTIONAL DRILLING

LRDD can operate in-seam cross a seam
or be a combination of both

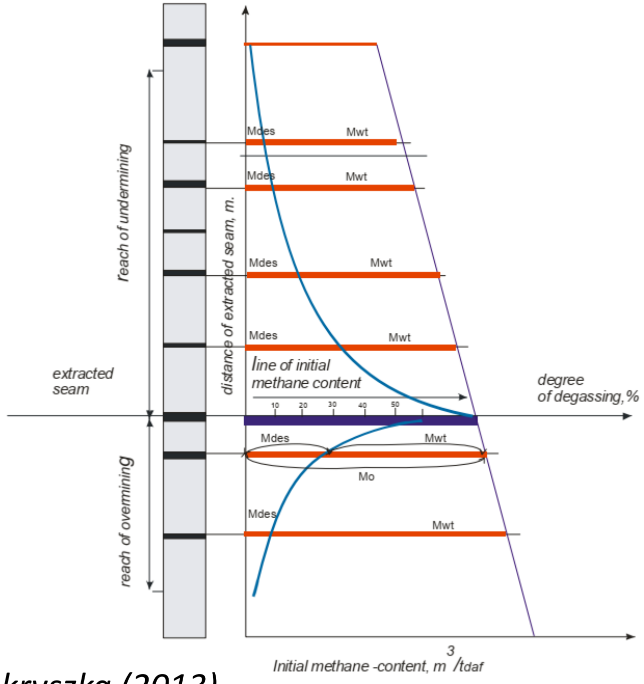
Drilled above the coal panel into the fractured zone (inside coal or sandstone) but above strata relaxation zone and gob zone

The rate of methane release in disturbed strata depends on:

- gas content
- thickness of disturbed coal seams
- strength of coal-bearing strata
- coal seam permeability
- rate of coal production
- the geometry of mine workings
- and mine design
- geology



Karacan (2008)



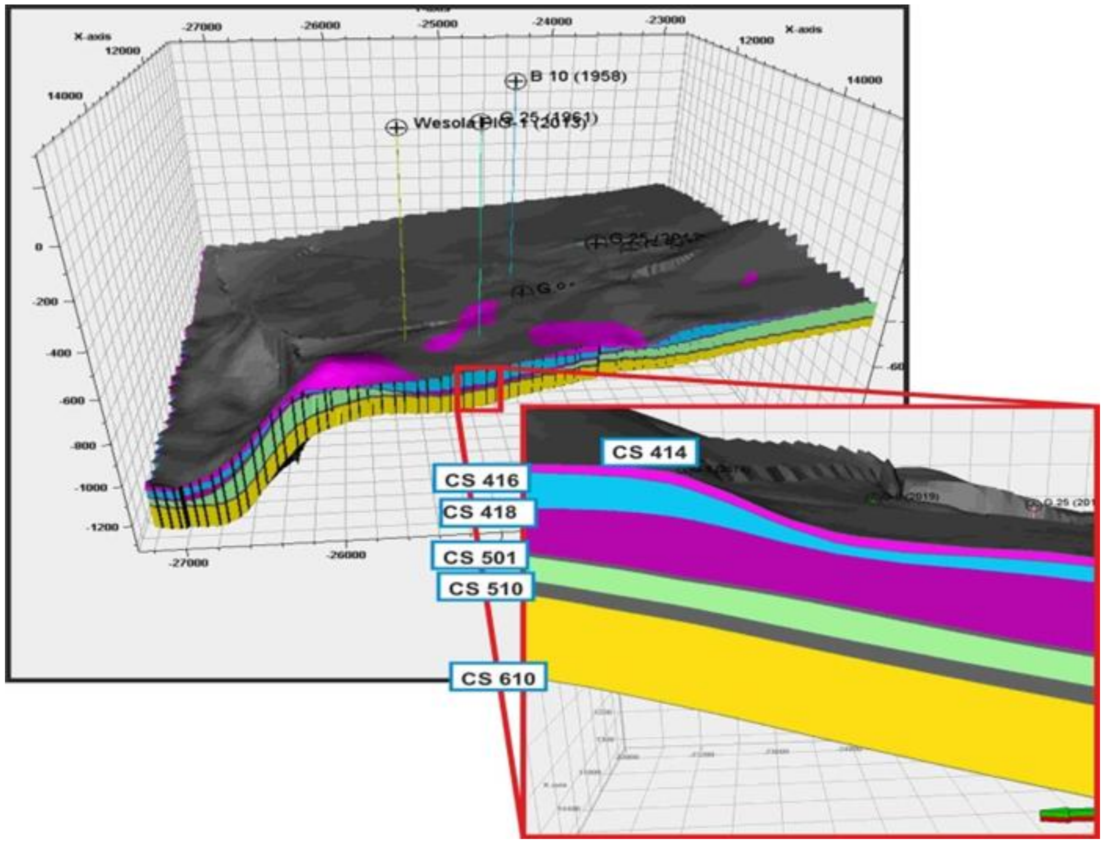
Krause and Pokryszka (2013)

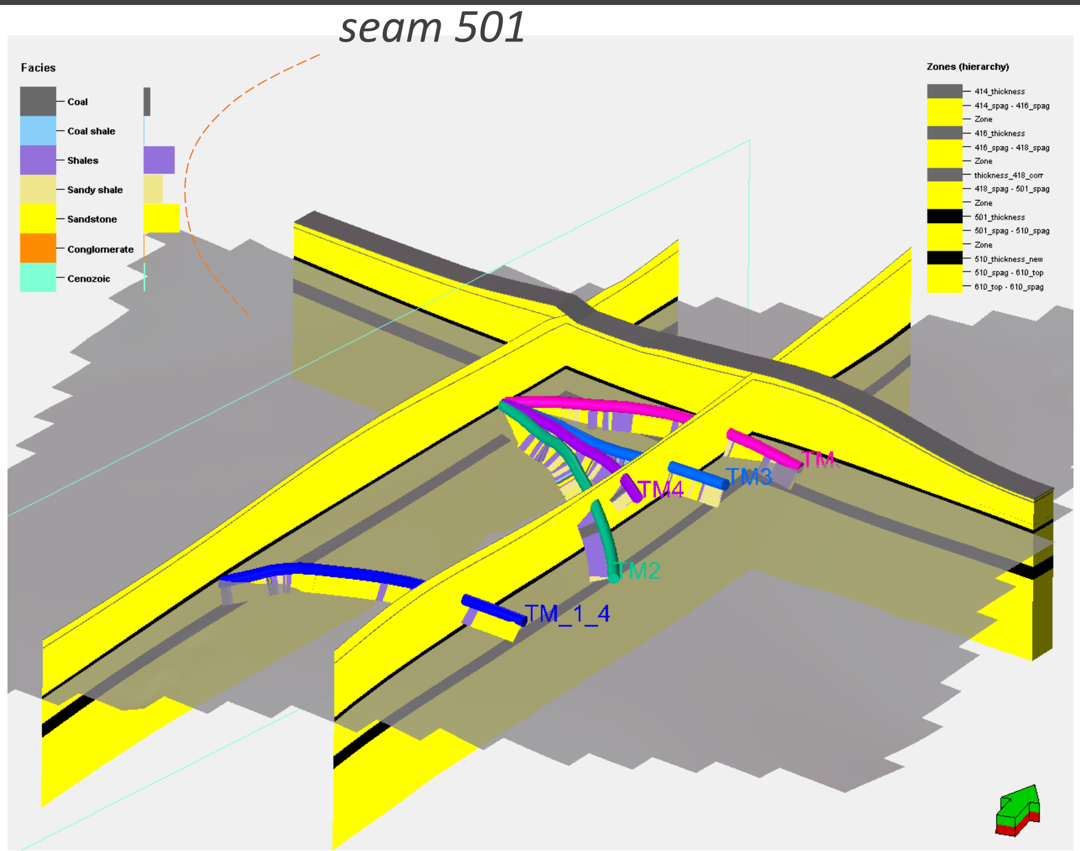
AREA OF STUDY

with location of five LRDD wells

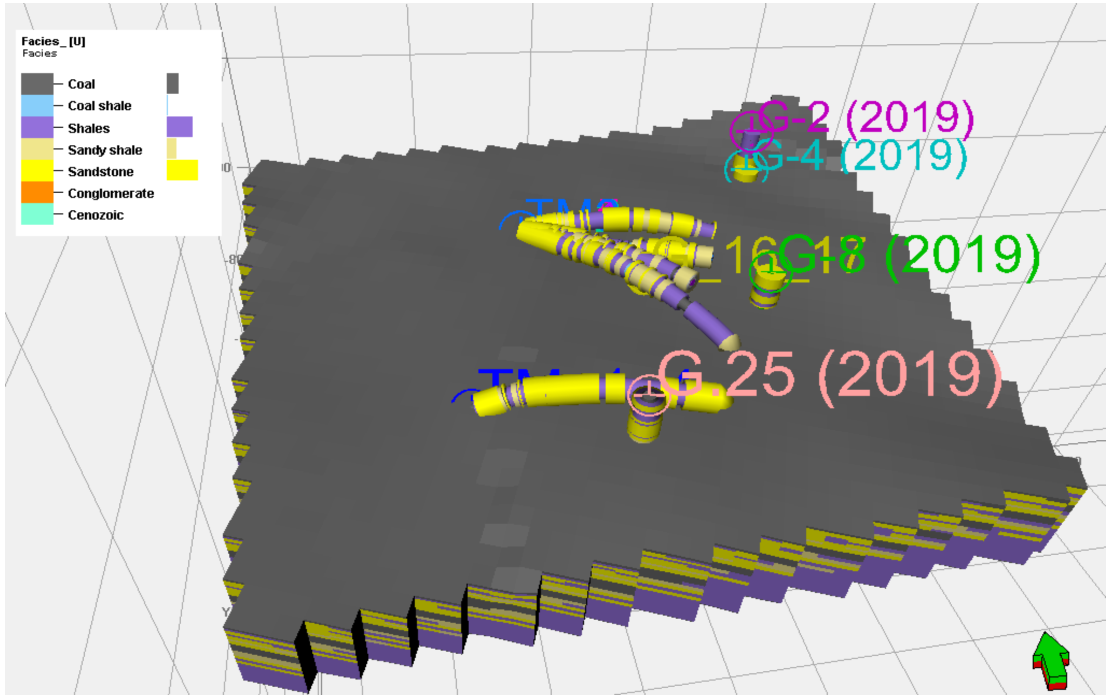
Reservoir properties	Pittsburgh	Pocahontas No.3	Lower Hartshorne	Blue Creek	USCB
Depth (m)	250-300	180-390	320-610	427-640	936
Permeability (mD)	10-15	10-27	1.2-1.6	12-20	0.5-1.0
Thickness (m)	2	2.1-2.4	1.4-4.3	1.5-1.9	1.2-8.8
Gas content (m3/t dmaf)	2-7	8-12.9	15.9-16.4	12.2-16.1	5-10

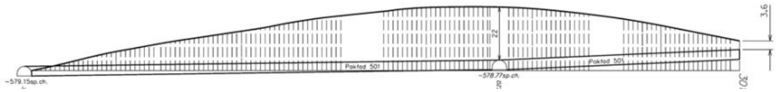
Murcki-Staszic Hard Coal Mine



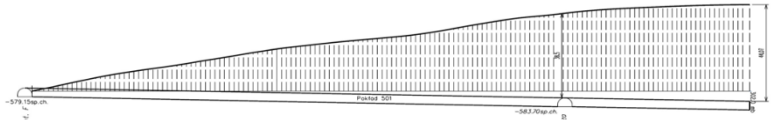


LOCATION OF LRDD WELLS

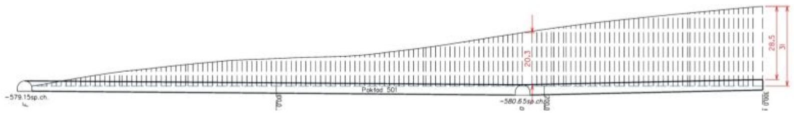




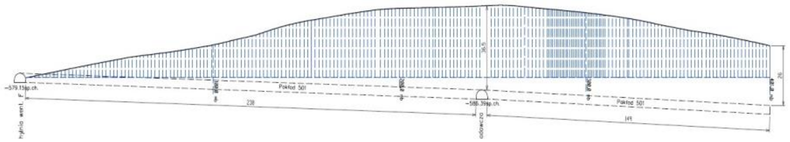
Bore hole nº TM 5. length: 302 m



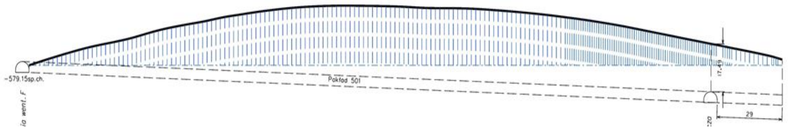
Bore hole nº TM 4. length: 301 m



Bore hole nº TM 3. length: 300 m



Bore hole nº TM 2. length: 401 m



Bore hole nº TM 1a. length: 402 m

Initial technical parameters of the wells

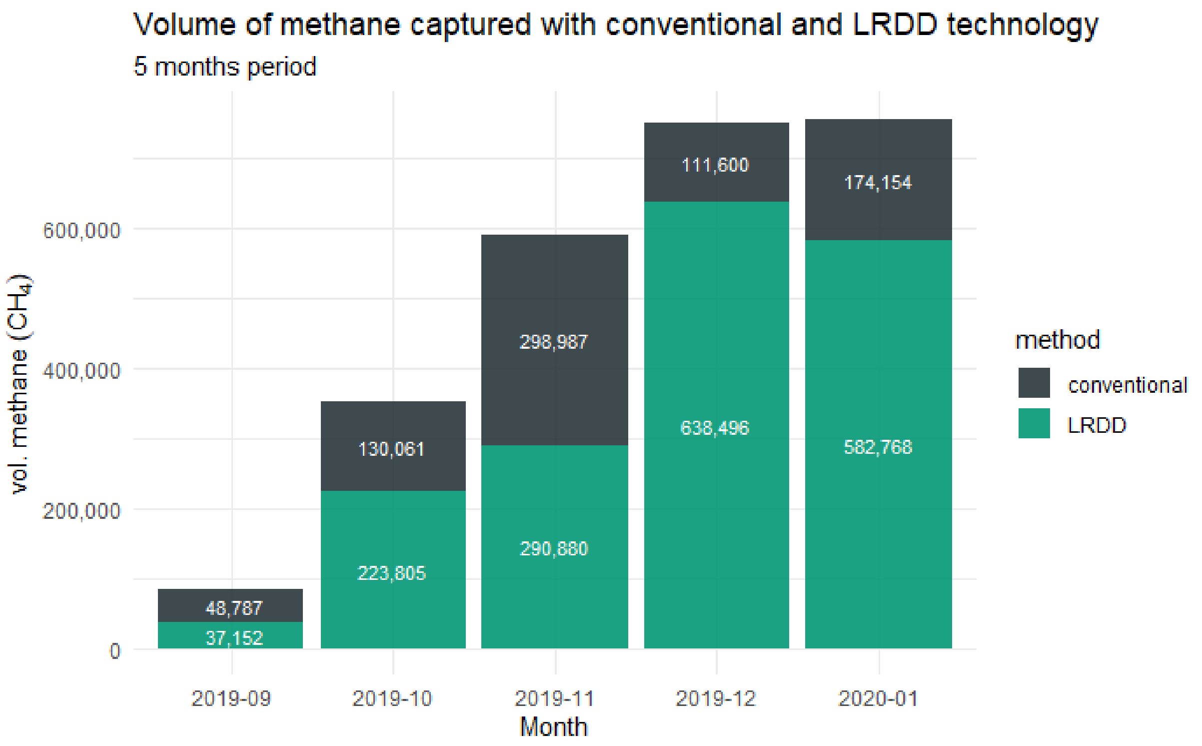
well	**TM-2**	**TM-3**	**TM-4**	**TM-5**
Initial vertical angle:	+ 8°	+ 6°	+ 16°	+ 16°
Initial horizontal angle:	30°S ⊥	16°S ⊥	22°N ⊥	15°N ⊥
Planned lengths of the horizontal wells:	401.0m	300.0m	302.0 m	301.0 m

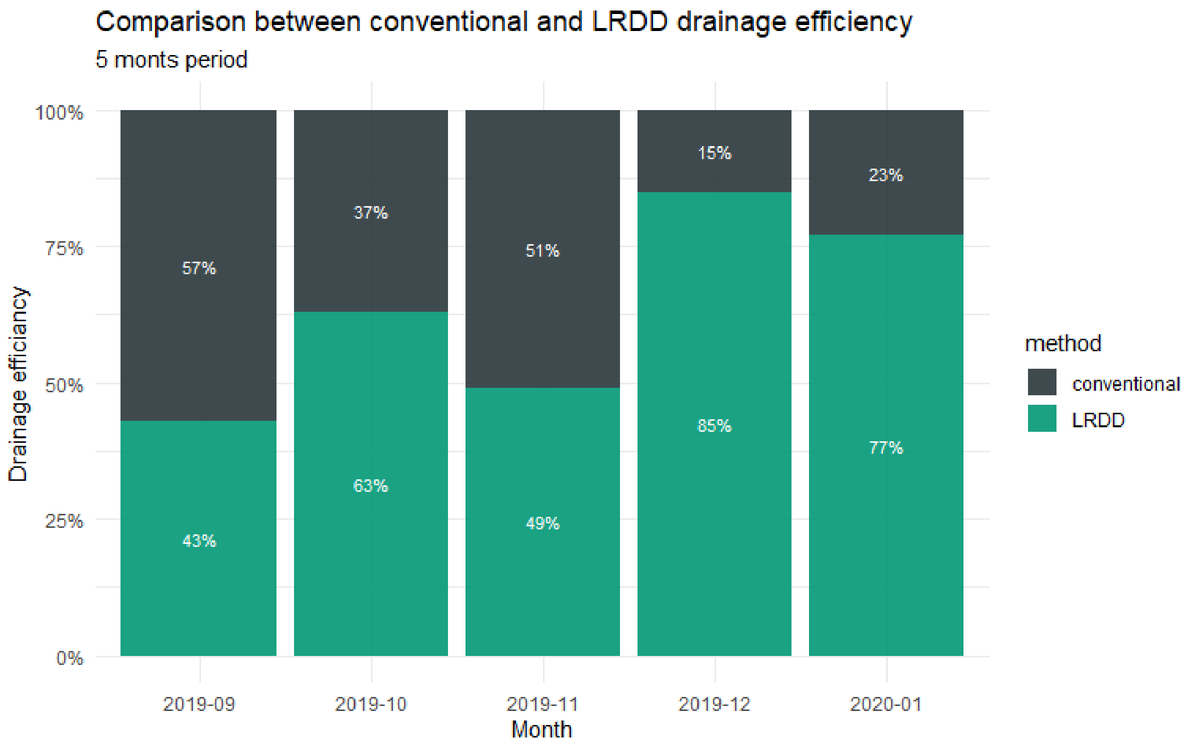
DRAINAGE EFFICIENCY

Conventional: 763 588.8 m^3 CH_4 **(30.1%)**

LRDD: 1 773 100.8 m^3 CH_4 **(69.9%)**

SUM: 2 536 689.6 m^3 CH_4

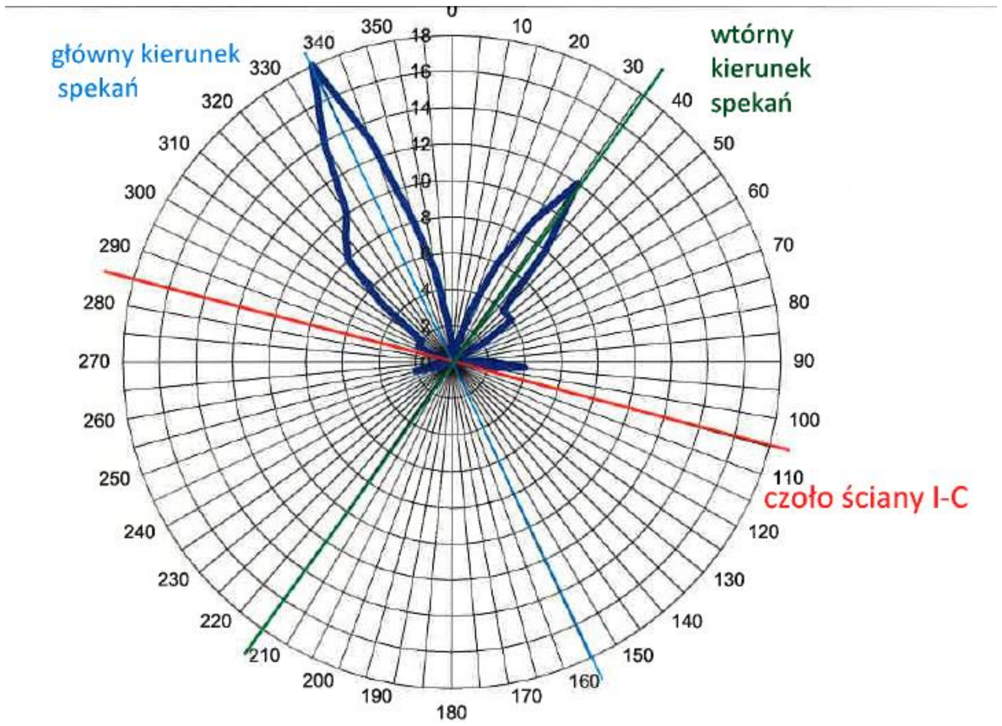


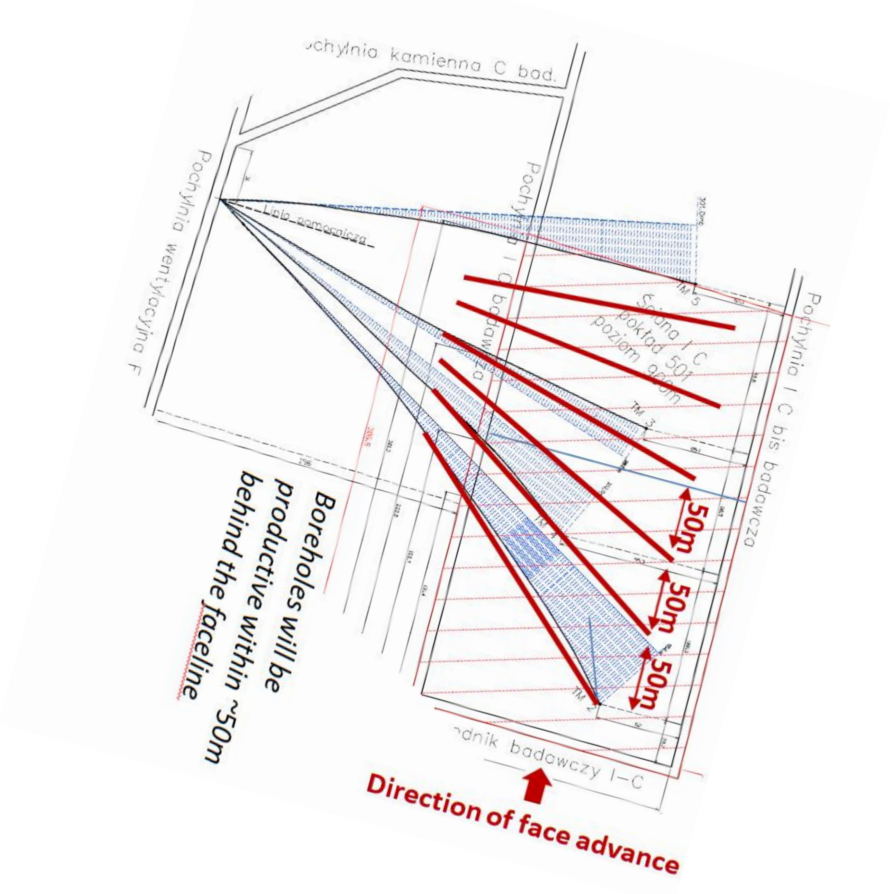


COAL PROPERTIES | GEOMECHANICS (selected samples)

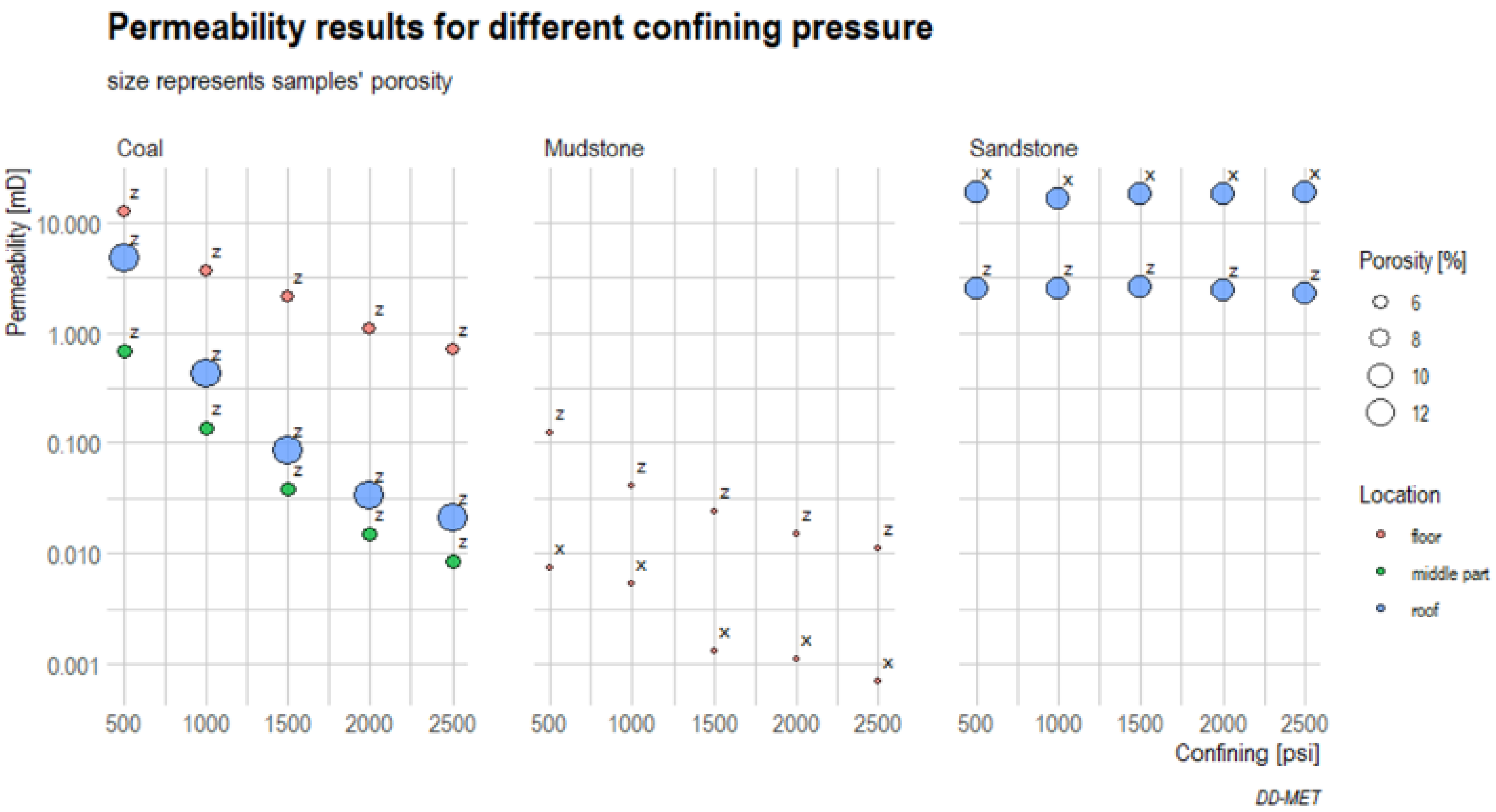
WELL TRAJECTORIES

with relation to primary and secondary fracture system



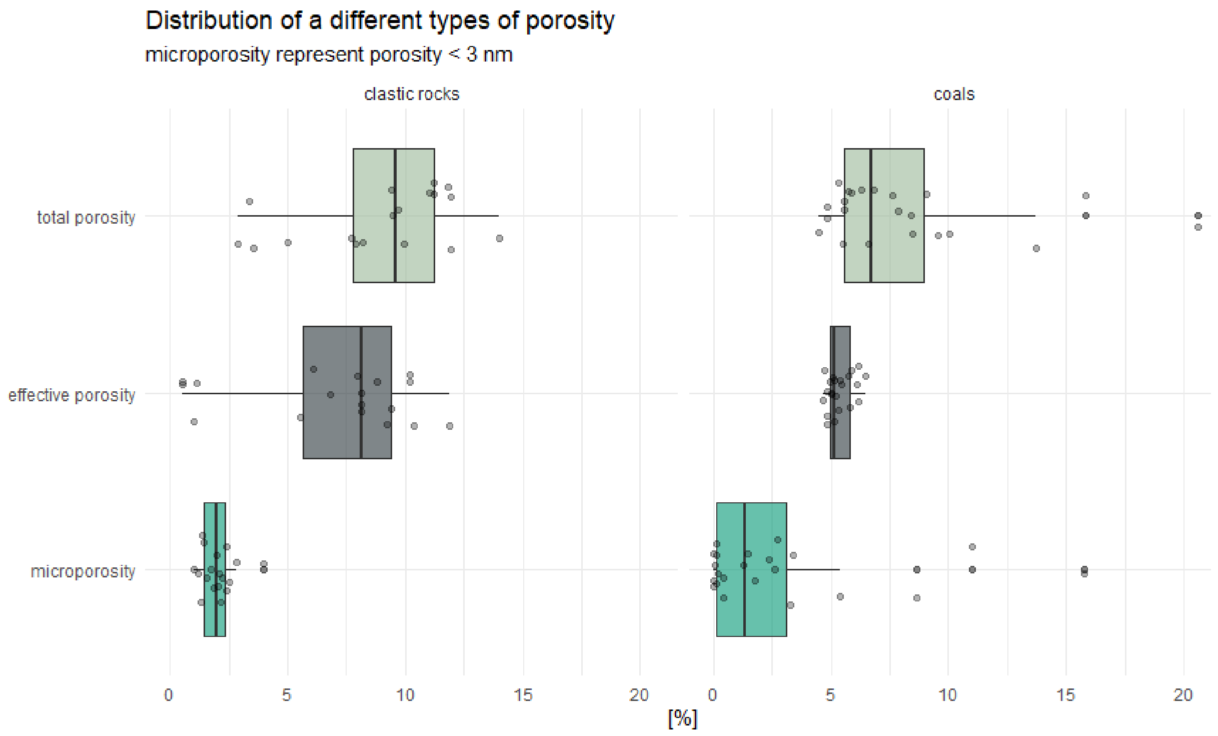


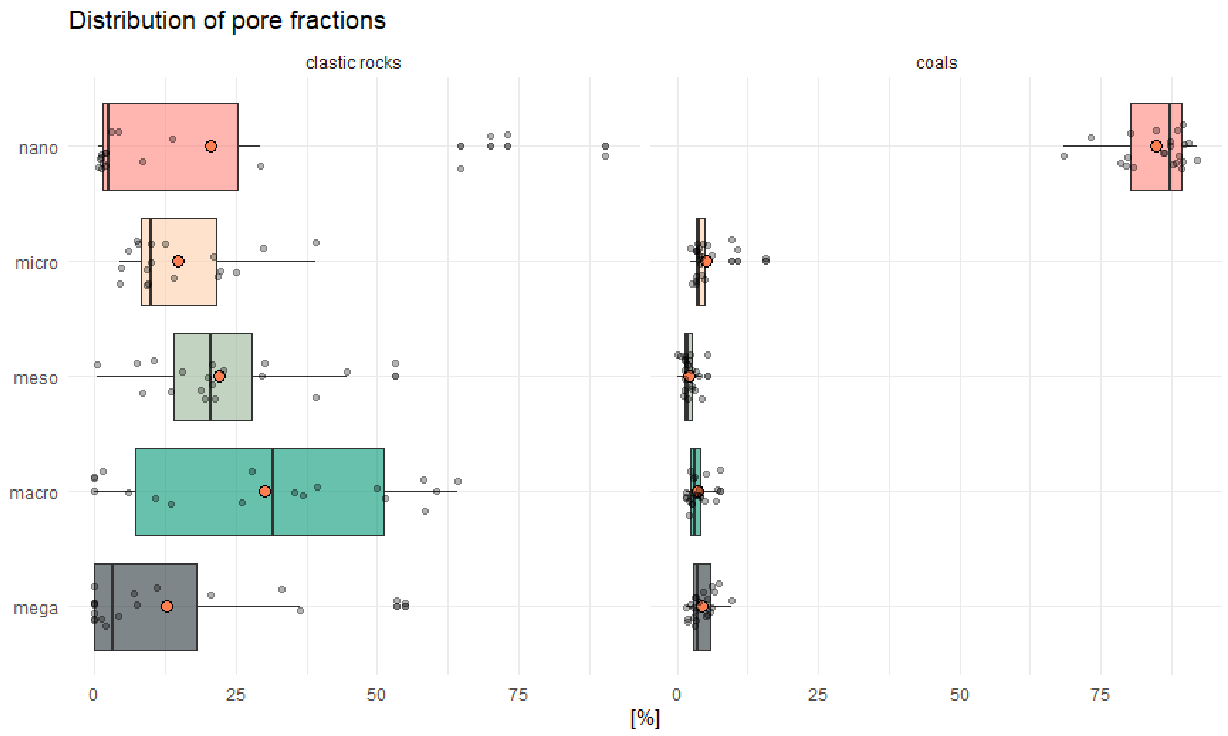
COAL and CLASTIC ROCK PROPERTIES | PERMEABILITY (selected samples)



COAL and CLASTIC ROCK PROPERTIES | POROSITY

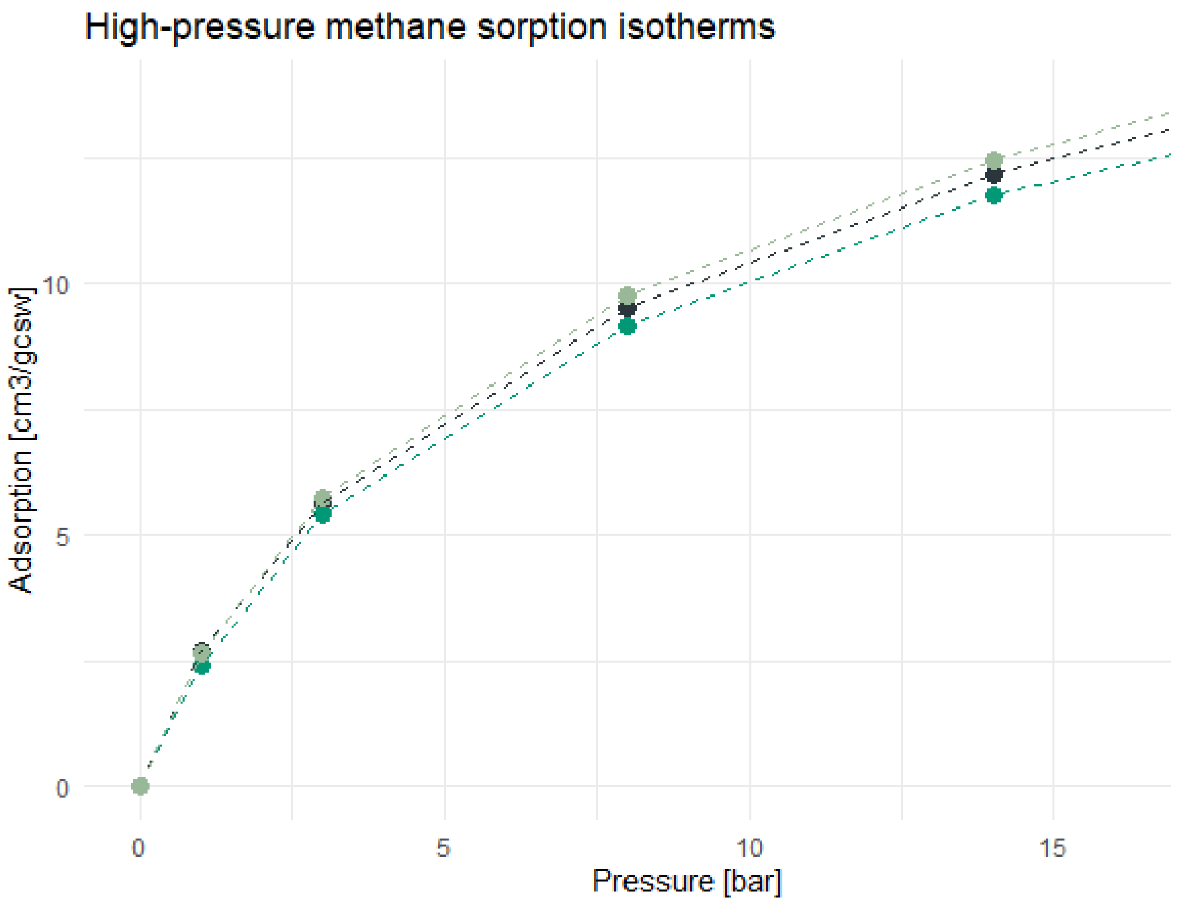
16 SANDSTONES
18 COALS
3 MUDSTONES



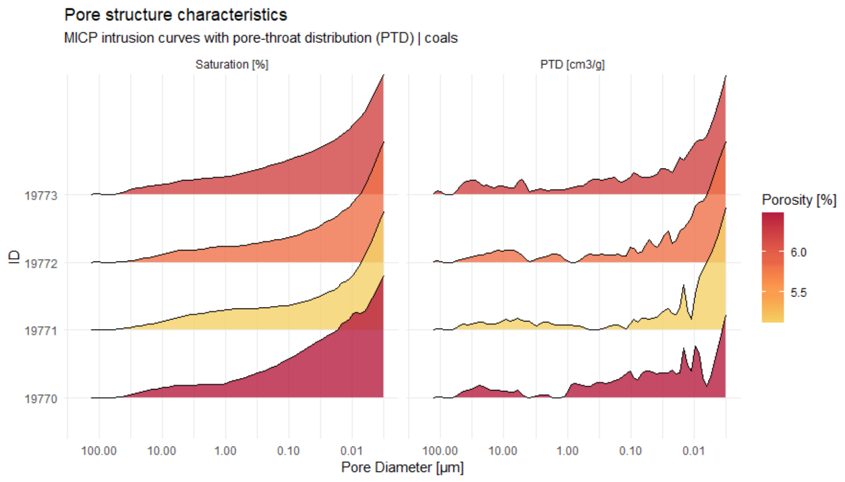


COAL PROPERTIES | SORPTION ISOTHERMS (selected samples)

The maximum methane content of seam 501, in the region of C lot can reach 9.15 m^3CH_4/t, which indicates the highest IV[th] methane hazard category



The sorption isotherms for the indicated pressures are similar, which proves the similar pore structure of the analyzed coal samples



CONCLUSIONS

The preliminary results of pilot wells proved that LRDD technology is an effective tool for improving safety and productivity during coal extraction and helps reducing GHG emissions in MS CM

The obtained high CH_4 drainage efficiency for LRDD wells could be a coincidence of high coal CH_4 content and good reservoir properties for barren rocks such as high permeability, moderate porosity, high uniaxial compressive strength – UCS (questions about internal friction angle - IFA ?, mineralogy ?, Young's module, Poisson's ratio?)

Also, the location of LRDD wells with the favorable regime of the primary and secondary fracture system seems to play an important role in drainage efficiency

This hypothesis is being verified using laboratory tests and geological modeling tools

THANK YOU FOR YOUR ATTENTION

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