Central Mining Institute, Katowice, Poland
Experimental Mine “Barbara”

Directional CBM Drillings Ahead of Mining - New Chance for Reduction of CMM Emissions in Poland

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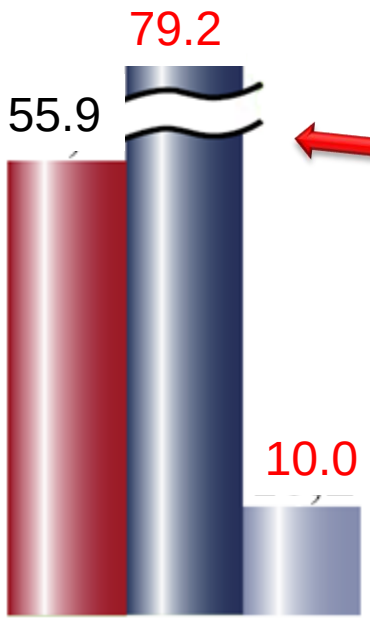
Vancouver, March 14th, 2013

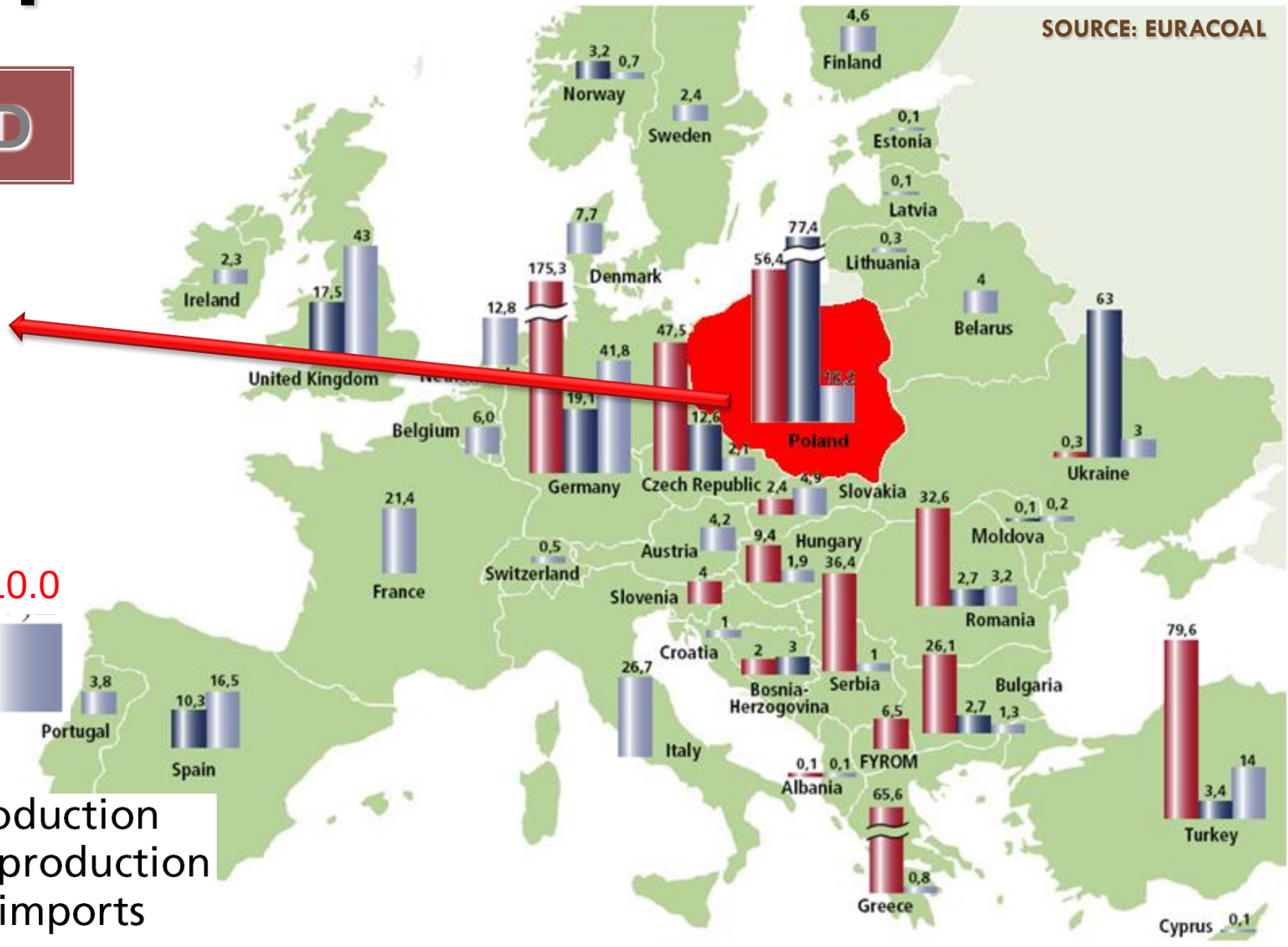
Coal production and imports in Mt in 2012

GIG

SOURCE: EURACOAL

POLAND





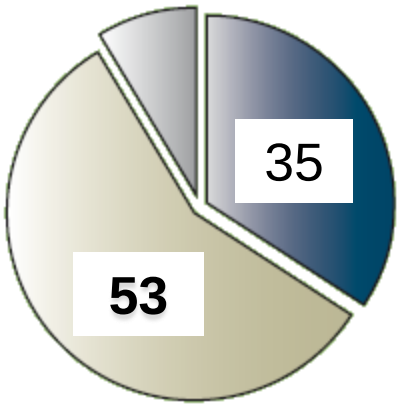
- Lignite production
- Hard coal production
- Hard coal imports

The role of coal in power generation in Poland

GIG

SOURCE: EURACOAL

POLAND



Coal's share 88%

EU 27 Coal's share 29 %

Location of major Polish hard coal basins

* completion of mining activities in 2000

2011 DATA

- **RESOURCES:**
  67 900 Mt
- **BALANCED RESOURCES:**
  43 201 Mt
- **COMERCIAL RESOURCES:**
  6,09 Mt

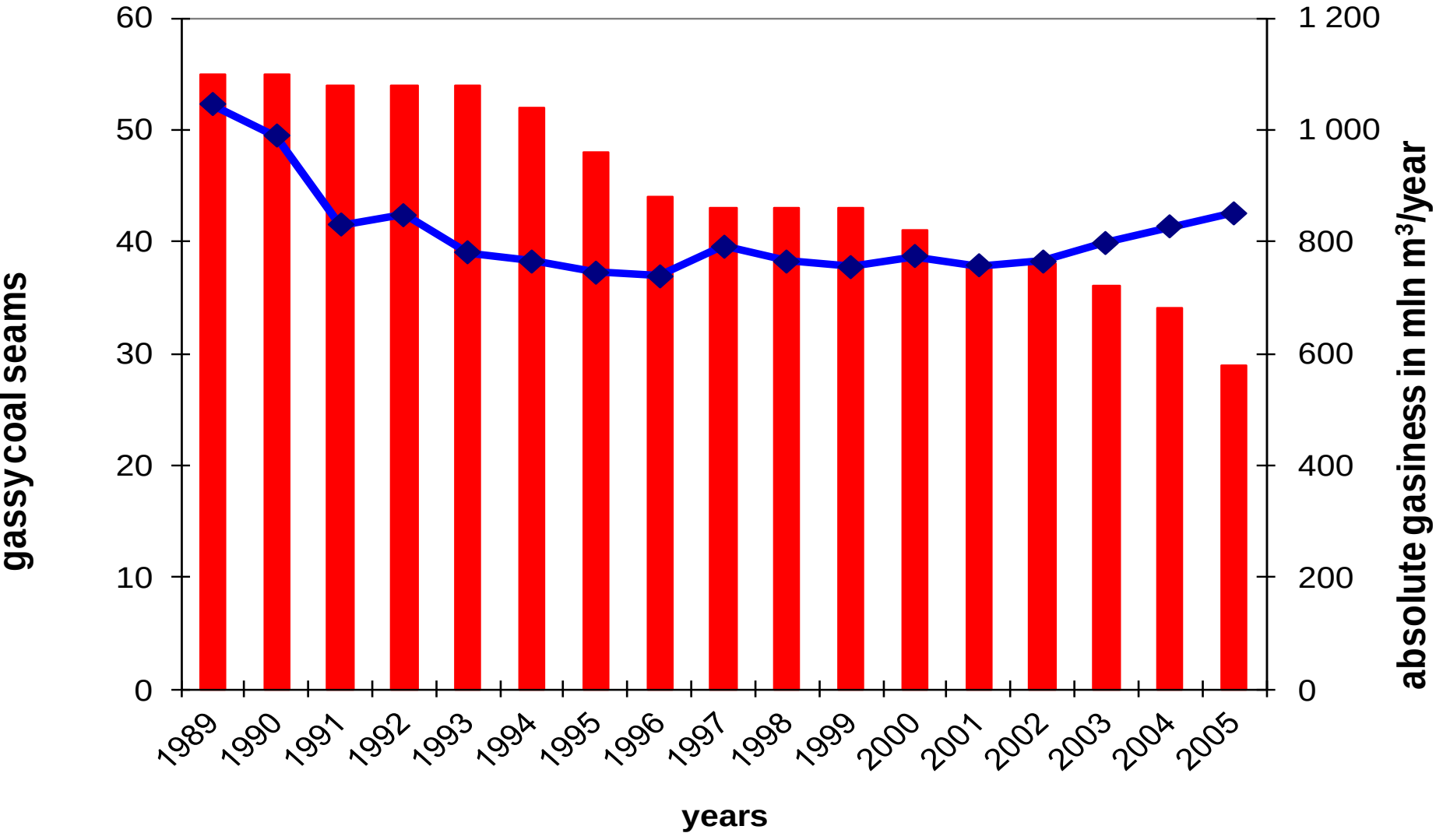
- **EMPLOYMENT**
  113 256
- **NUMBER OF MINES**
  30
- **HARD COAL COMPANIES**
  - KOMPANIA WĘGLOWA
  - KATOWICKI HOLDING WĘGLOWY
  - JASTRZĘBSKA SPÓŁKA WĘGLOWA
  - POŁUDNIOWY KONCERN WĘGLOWY
  - LUBELSKI WĘGIEL BOGDANKA
- **OUTPUT**
  79.2 mln tones

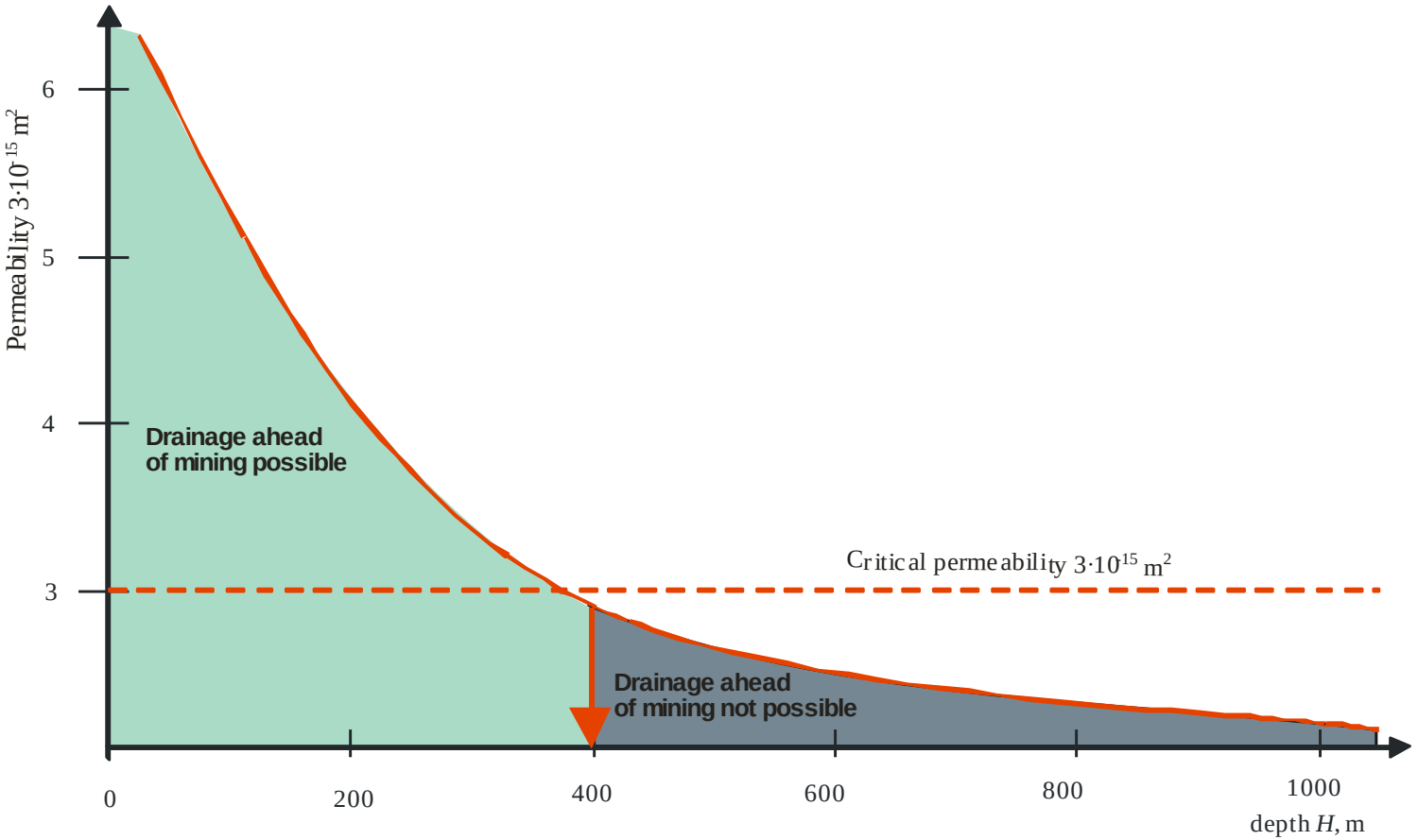



Methods of methane drainage in Poland:

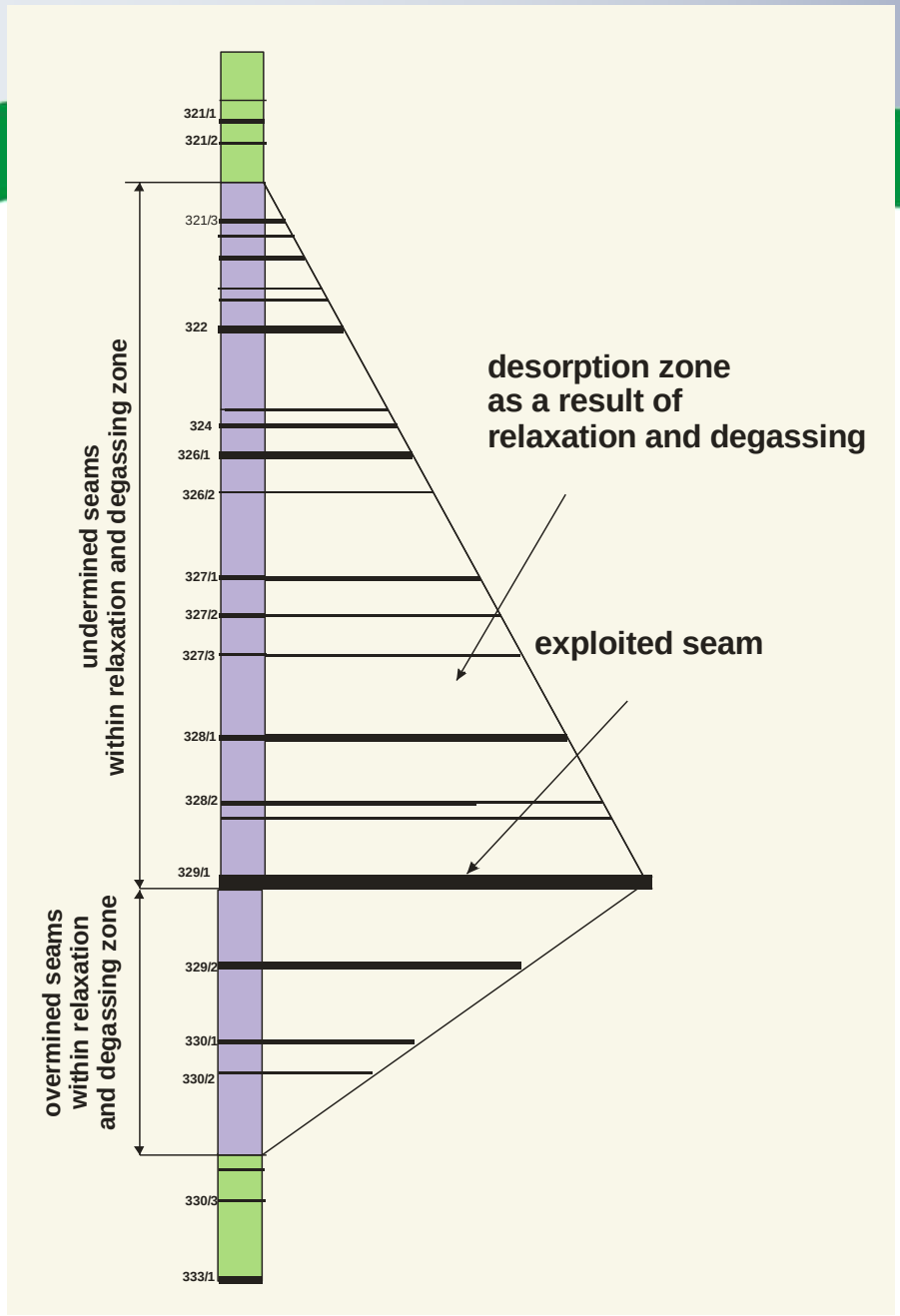
- drainage of the coal seams ahead of mining (before exploitation),
- drainage during coal exploitation,
- drainage of goaves

Changes of absolute gasiness versus decrease of active gassy coalmines' number





Changes of coal seams' permeability with the depth

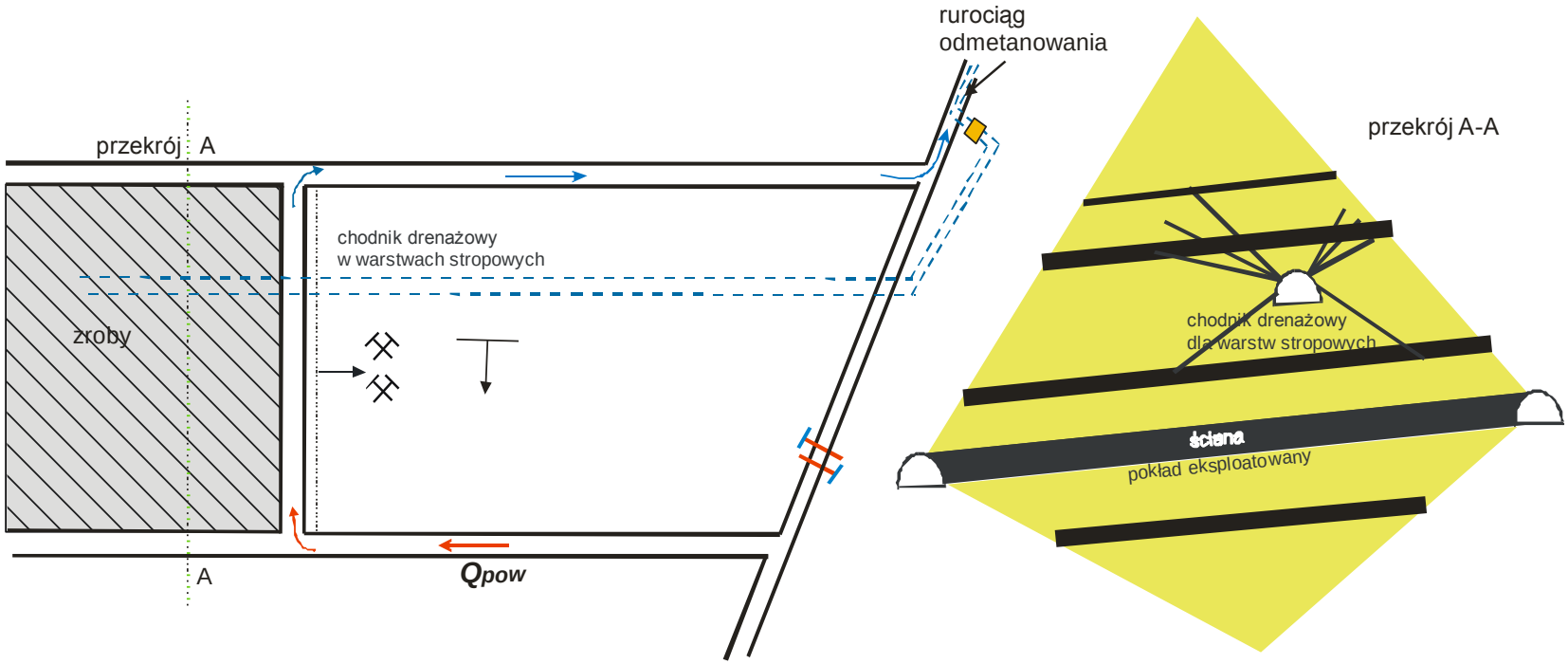


Share of methane from the exploited seams constitutes about 20-40% of total released methane

Zone of relaxation and degassing of coal seams undermined and overmined by minig exploitation



Degassing of the longwall by the mean of drainage gallery located in the roof layers






Consequences

- Increased gas hazard
- Drasitcally growing statistics of stopping coal exploitation

In more and more cases it is not coal mine management

but… **methane**

which is the critical factor determining coal output !

First feasibility study for cost effective methane degassing and capture ahead of mining operations to reduce methane emissions in Poland during mining

funded by US EPA grant



Subject feasibility study was possible

to be performed

thanks to acceptance and active cooperation of Jastrzebska Coal Company

– the owner of „Pawlowice 1” coal field

Technical feasibility	**T1**	**Identification of coal seams to be the target of mining operations**
	T2	**Methane predictions for the planned mining operations**
	T3	**Design of CBM production and degassing system using surface-bored wells which include:**
	T3.1	*data collection*
	T3.2	*determination of coal reservoir parameters*
	T3.3	*determination of coal seam continuity (depositional characteristics, structural features);*
	T3.4	*selection of appropriate drilling technology based on the US CBM experience;*
	T3.5	*preparation of CBM drilling, completion and production design;*
	T3.6	*determination of well locations and well spacing;*
	T3.7	*determination of production volumes using reservoir simulator*
	T3.8	*determination of methane drainage effectiveness using reservoir modeling techniques;*
	T3.9	*planning of produced water disposal*
Economic analysis	**T4**	**Estimation of methane emission reductions**
	T5	**Estimates of the CBM production implementation cost**
	T6	**Review of methane end-use strategies**
	T7	**Calculating of net revenues and estimating of the CBM production project lifetime**
	T8	**Development of an economic model and calculating NPV and IRR**
	T9	**Converting estimated methane emission reductions to carbon credits**
	T10	**Estimates of possible cost savings for the Pniowek coal**
	T11	**Final economic analysis**
	T12	**Conclusions and recommendations**

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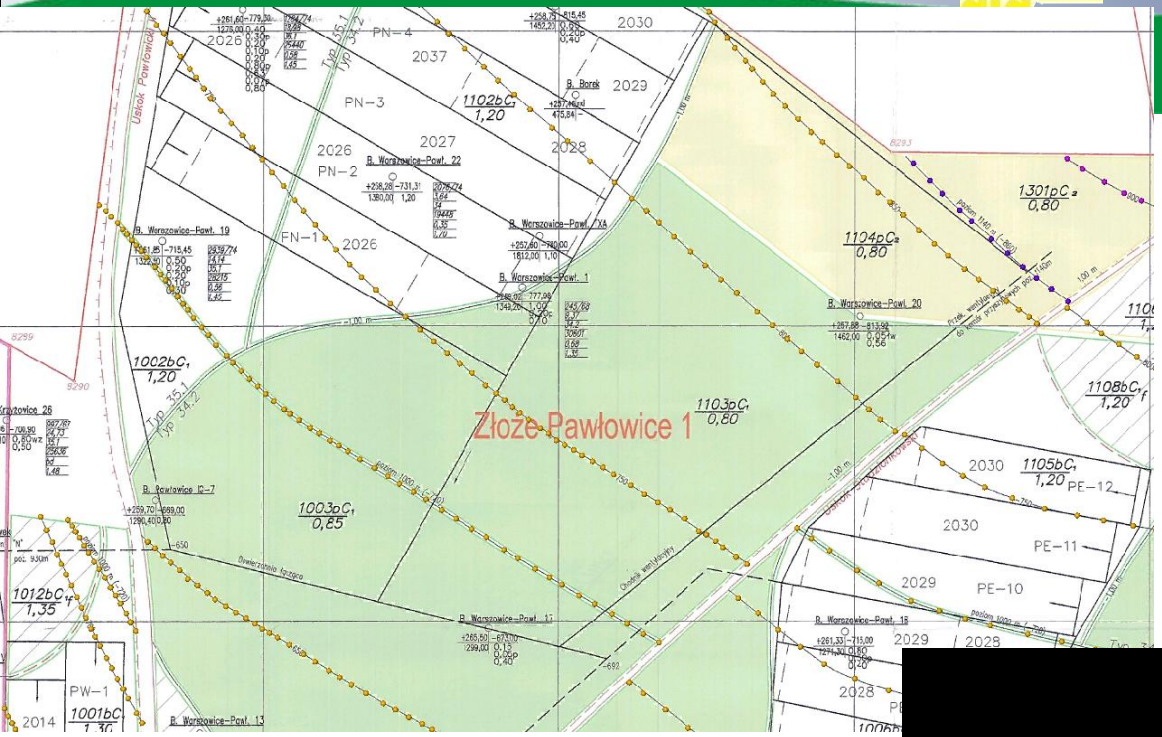

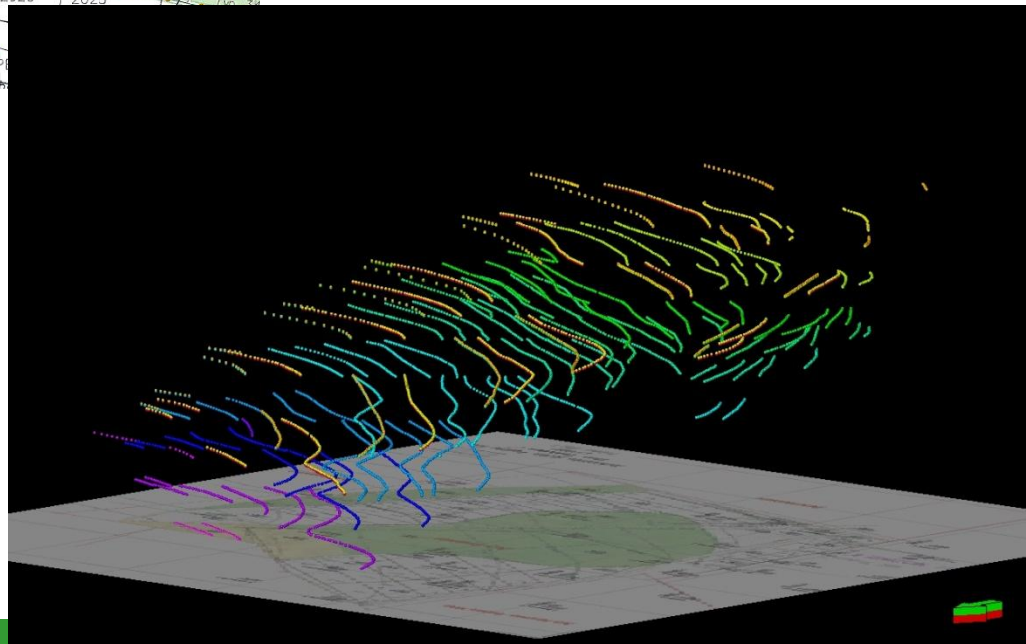

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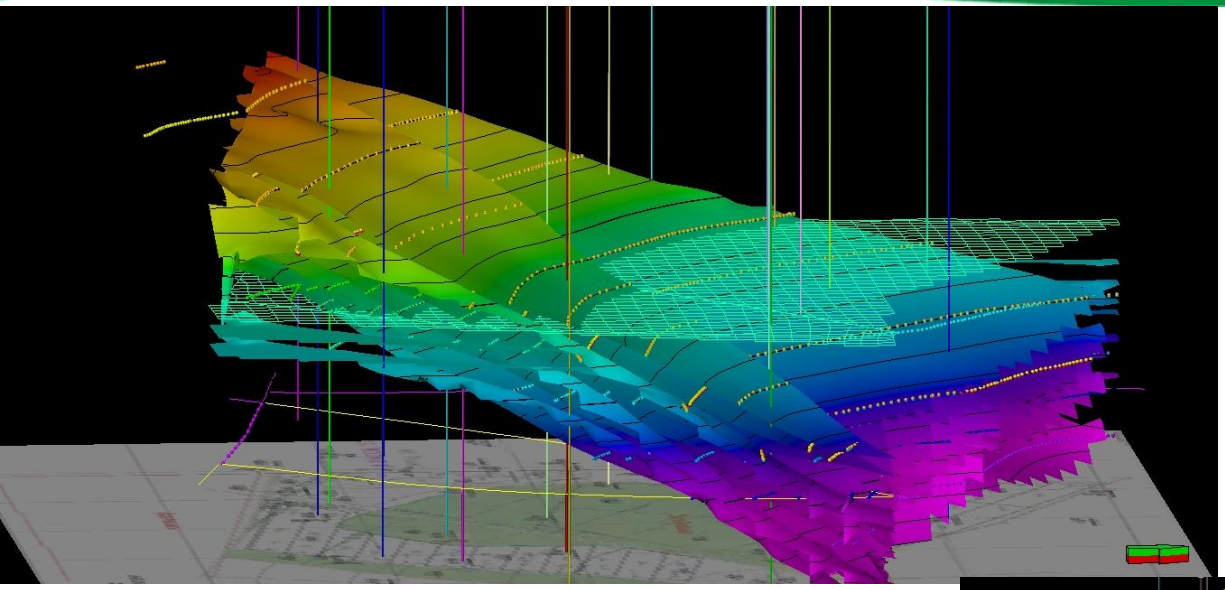
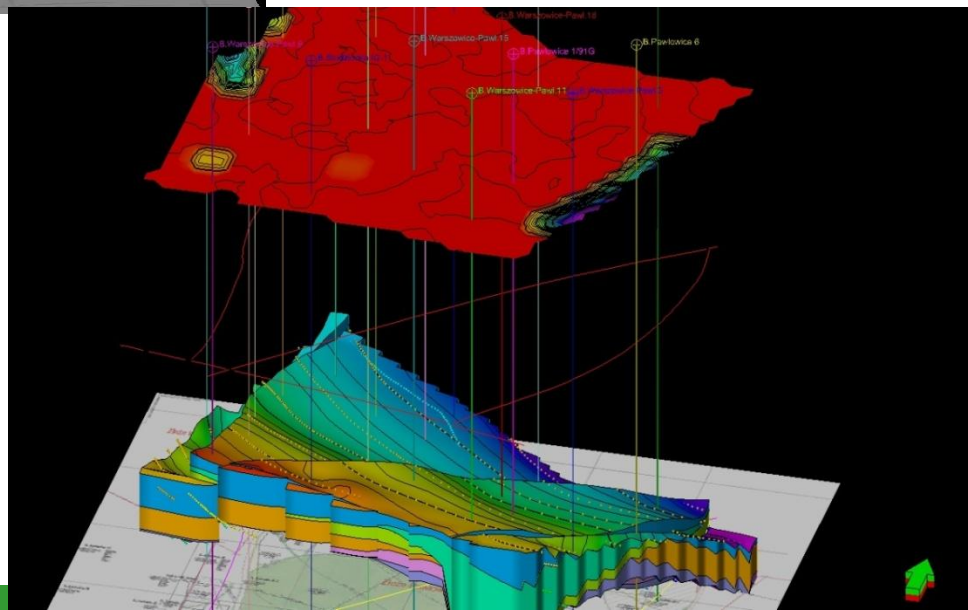
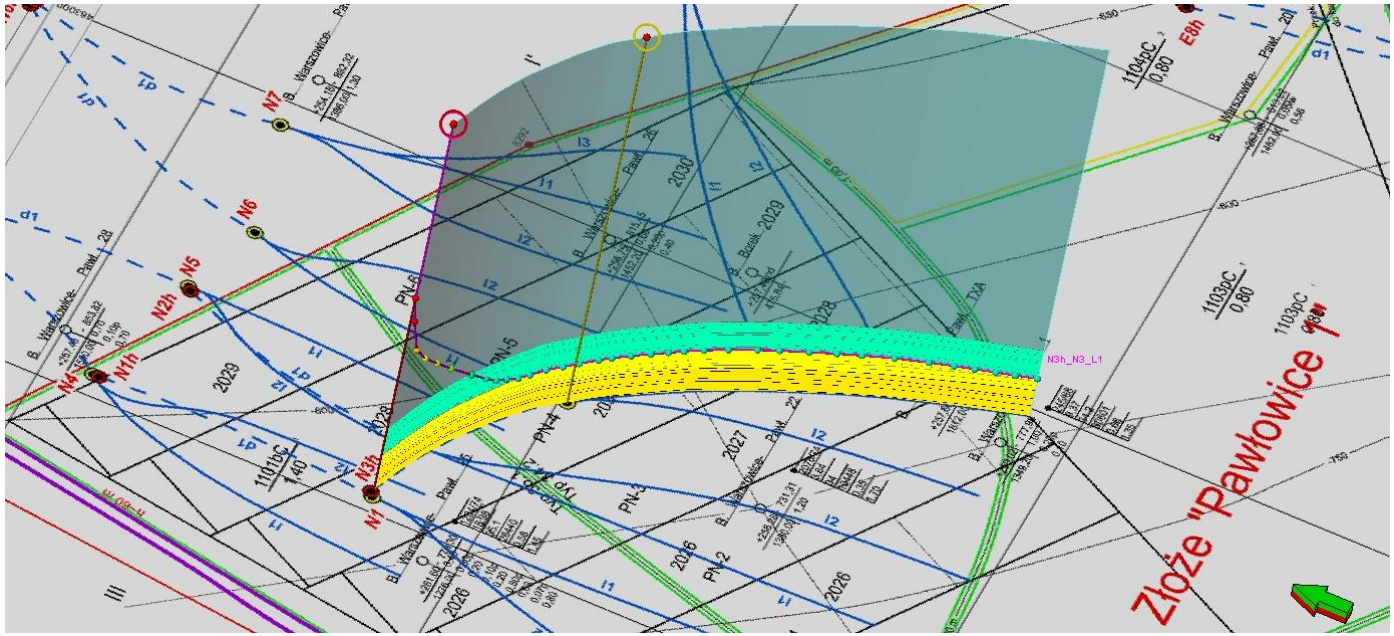
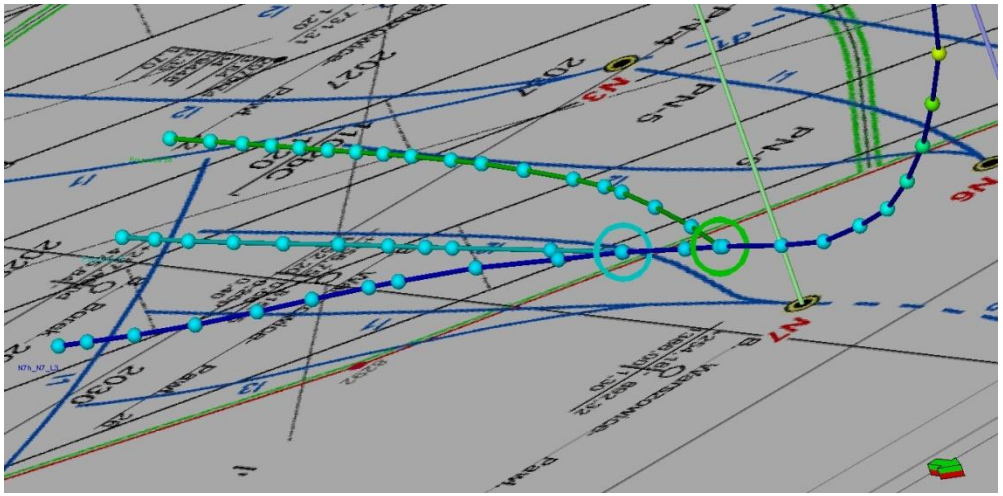





Złoże "Pawłowice"
N3h_N3_L1



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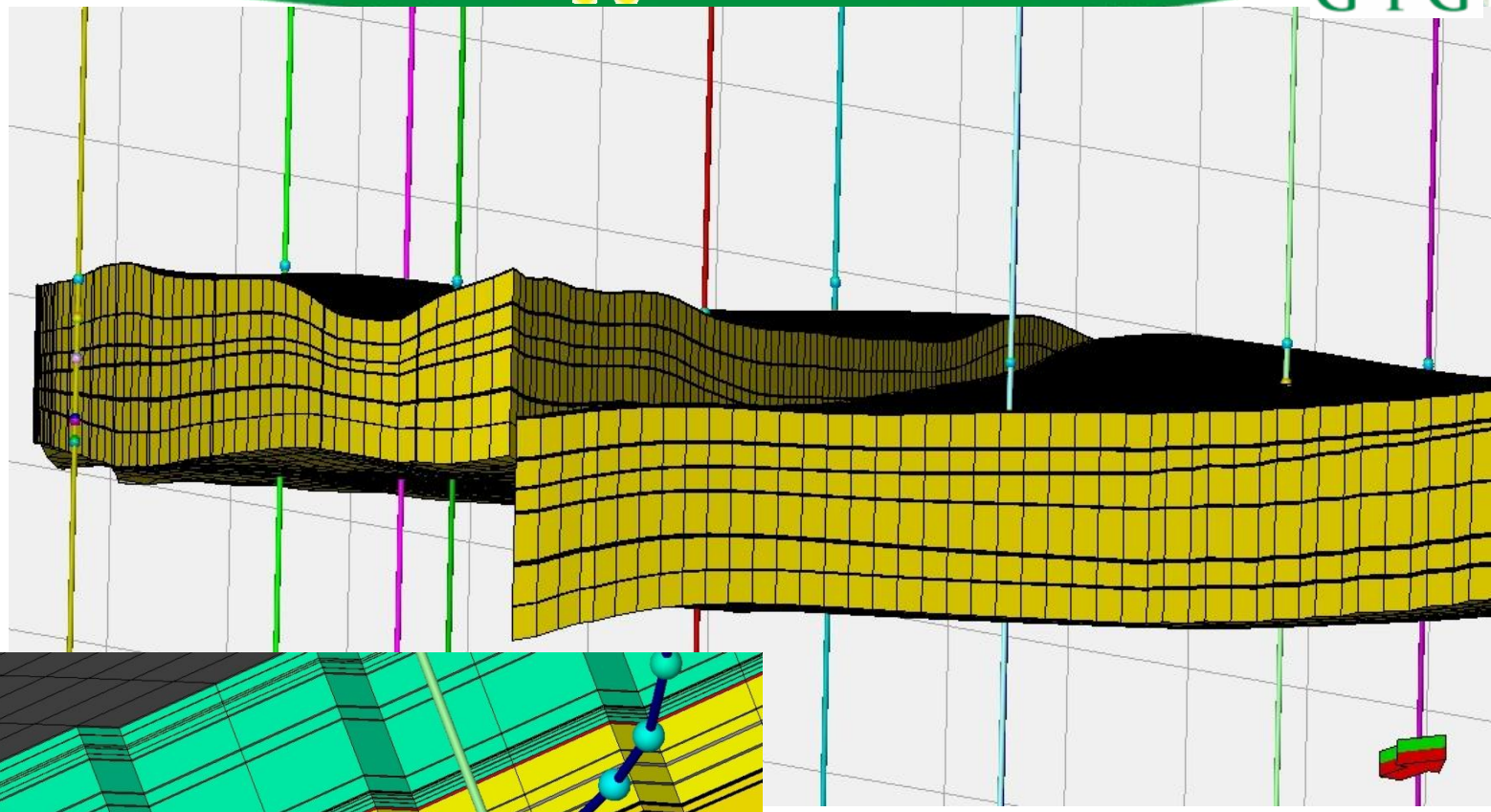

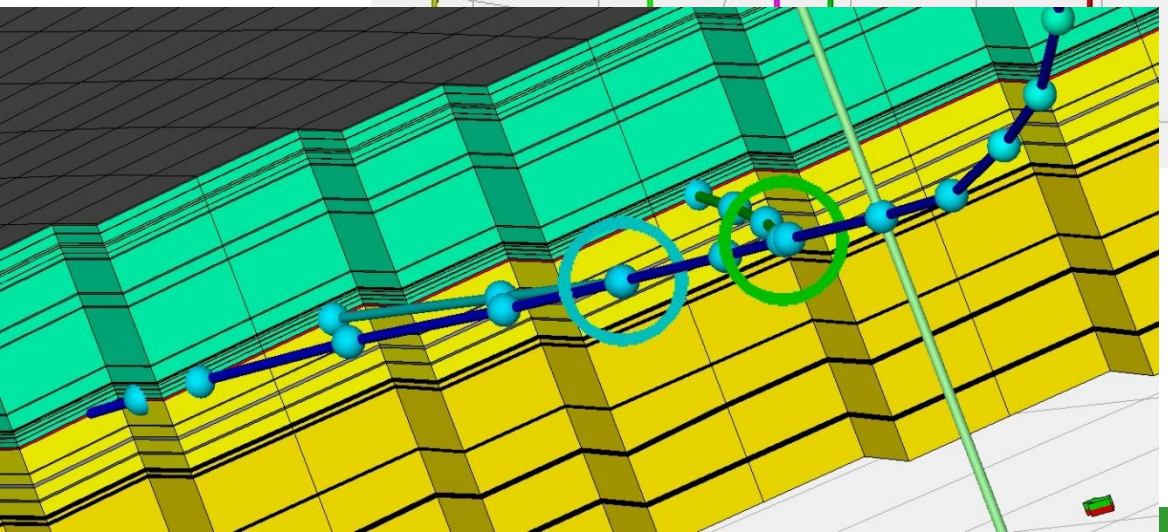

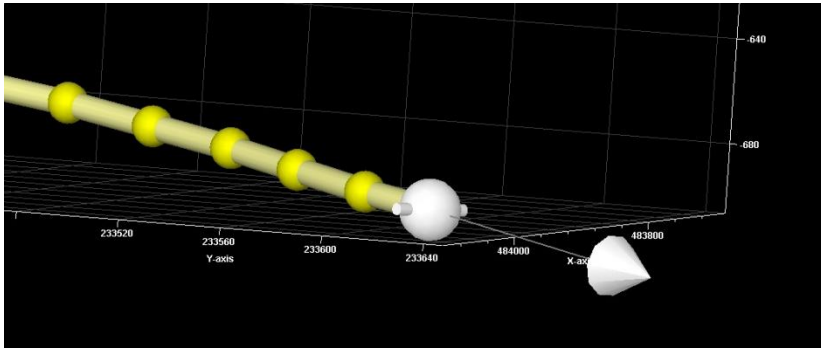
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233600
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484000
483800
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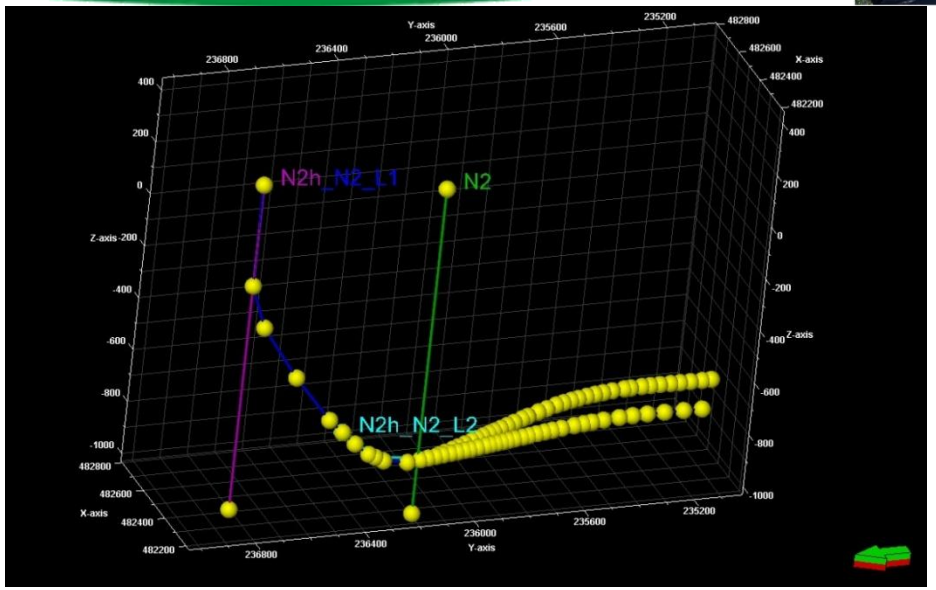
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X-axis
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482600
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482200
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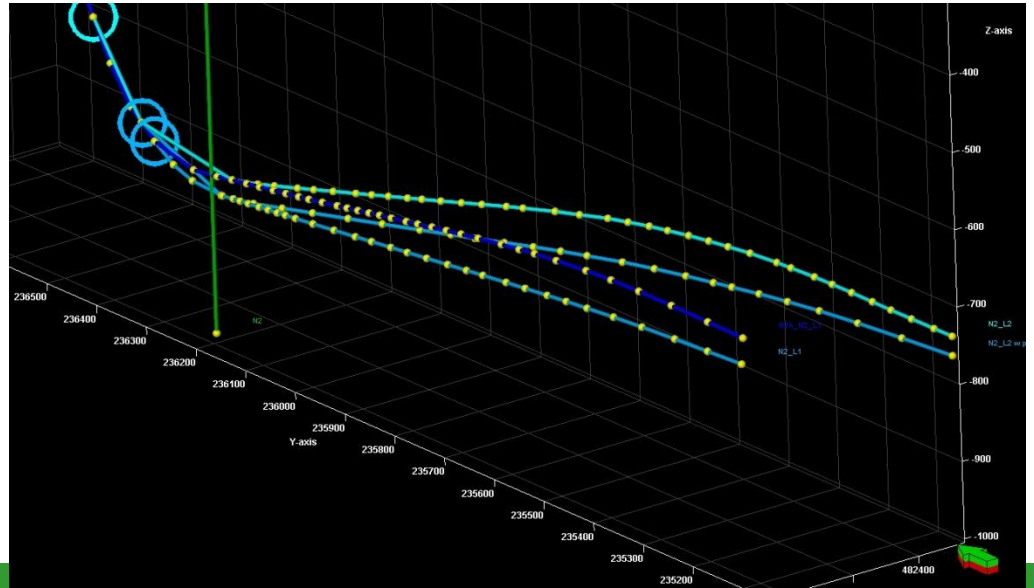
0
-200
-400
-600
-800
-1000
N2h_N2_L1
N2
N2h_N2_L2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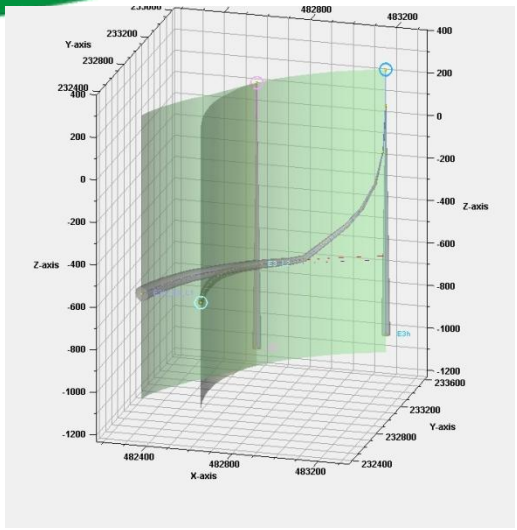
Y-axis
482400
N2
N2_L1
N2_L2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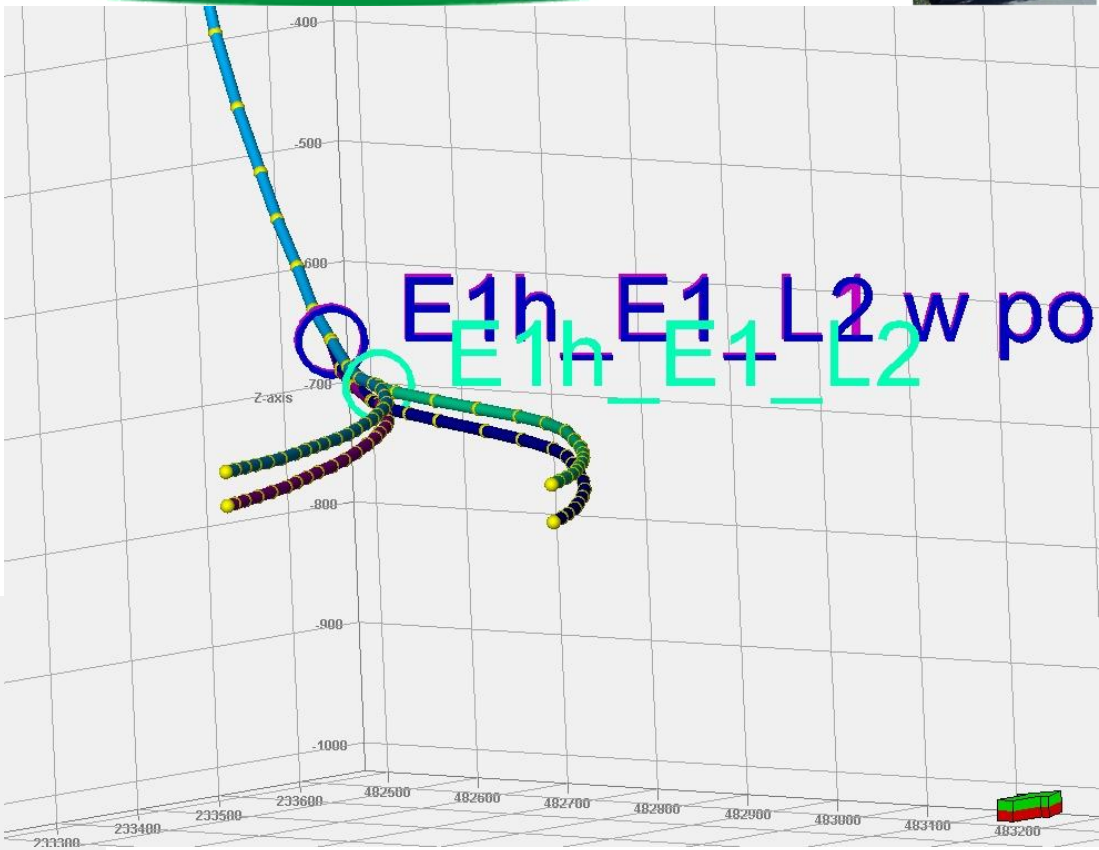
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E1h_E1_L2
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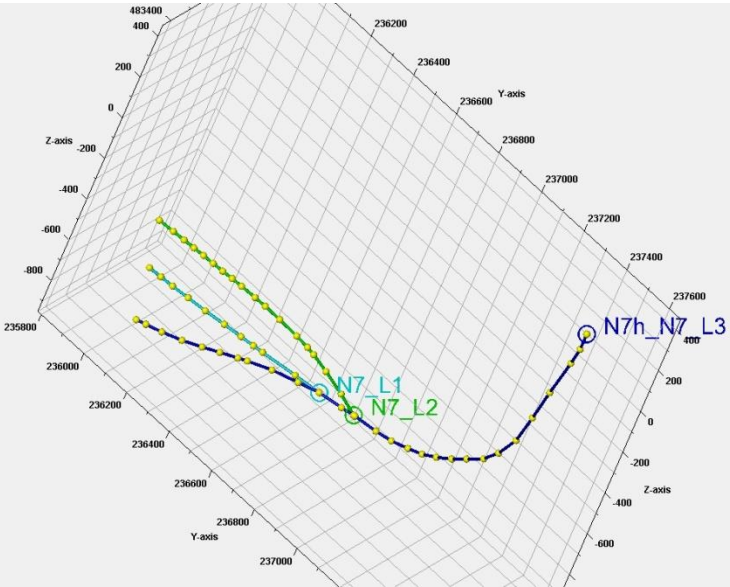
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N7_L1
N7_L2
Y-axis
Z-axis
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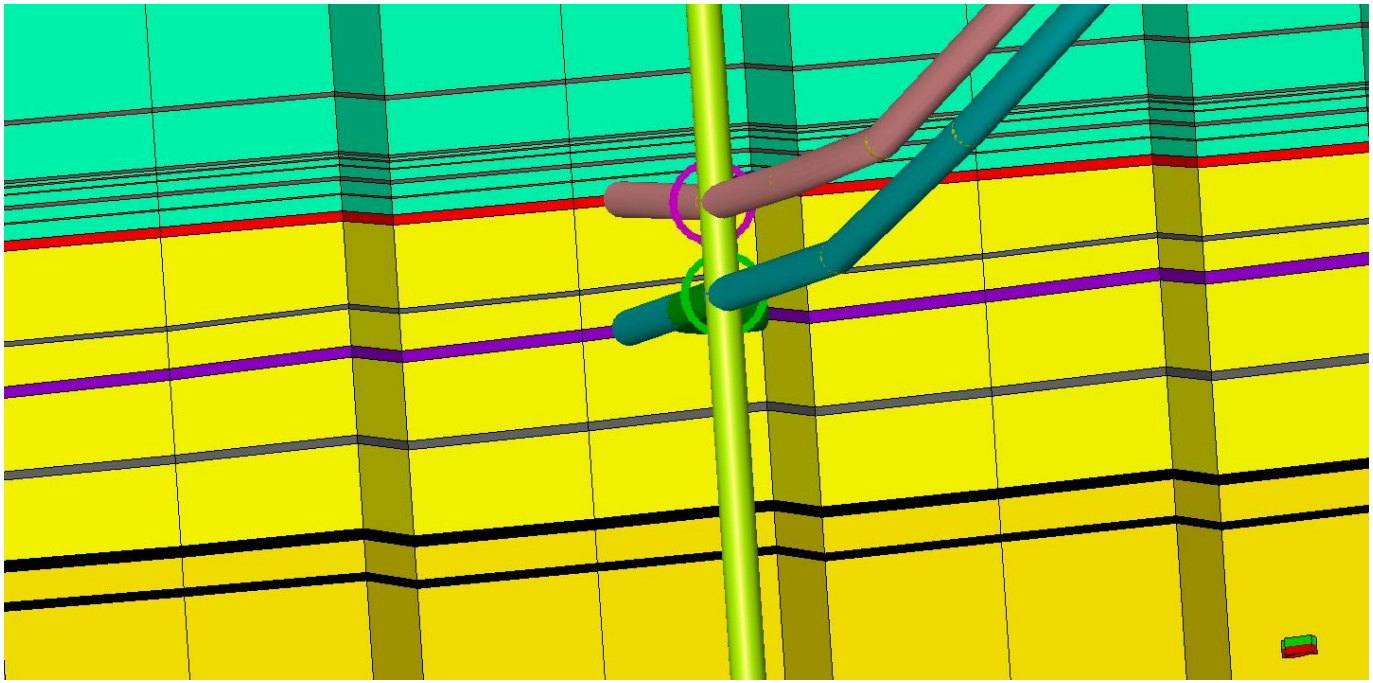

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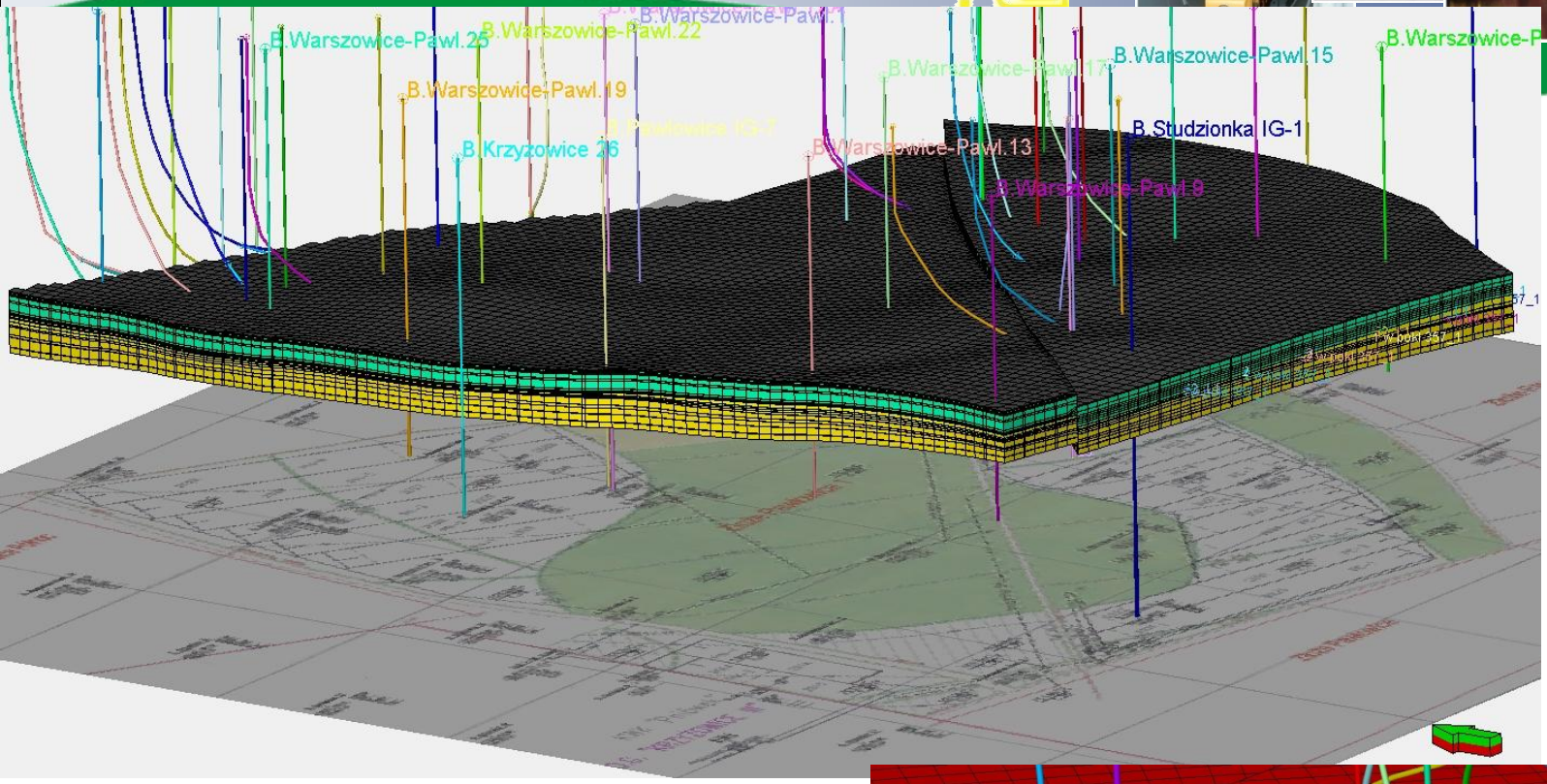
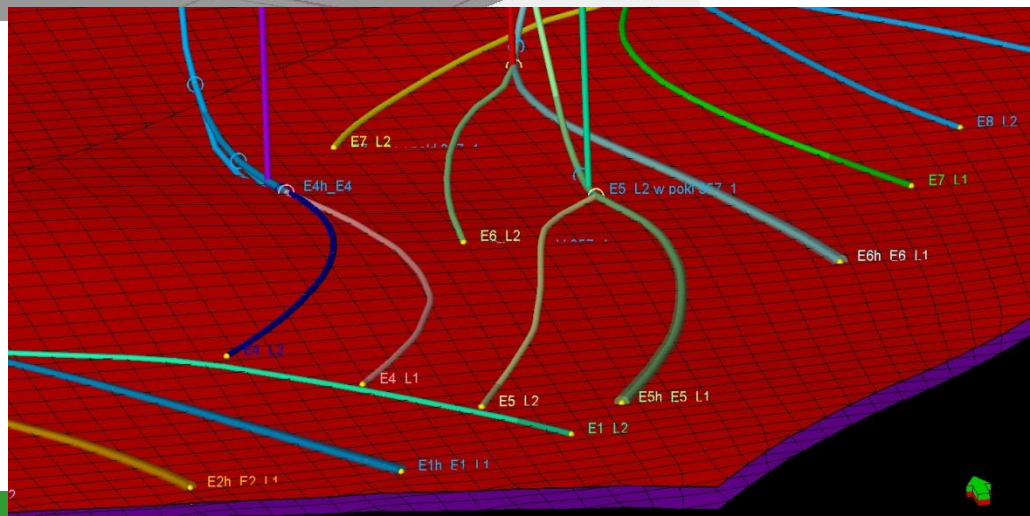
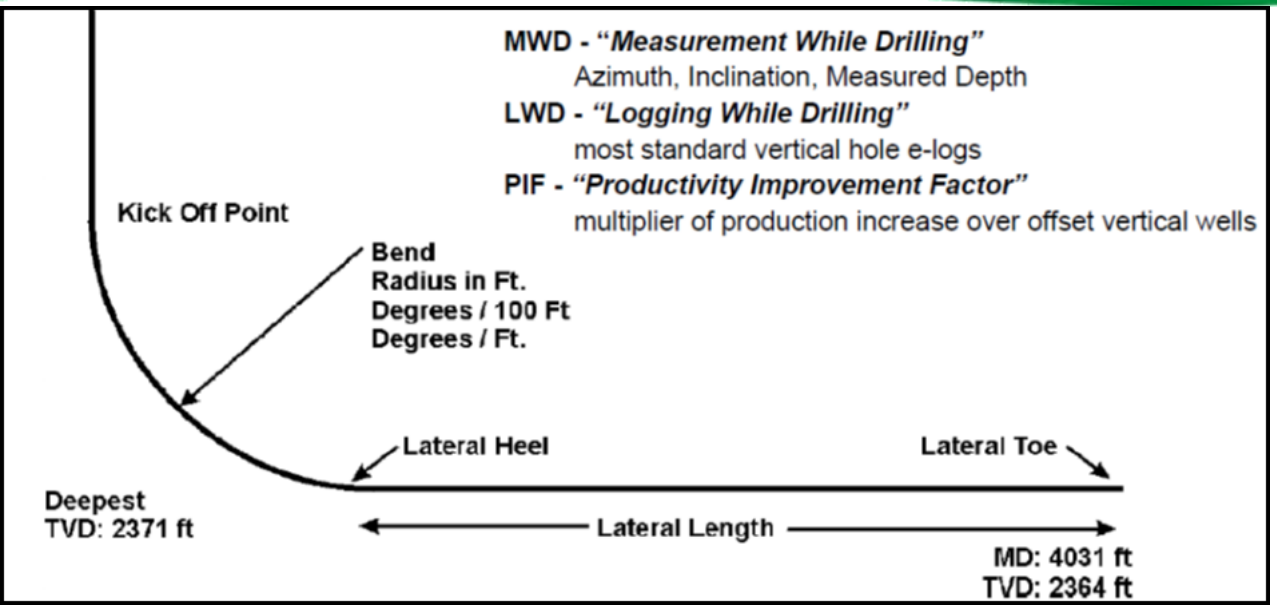
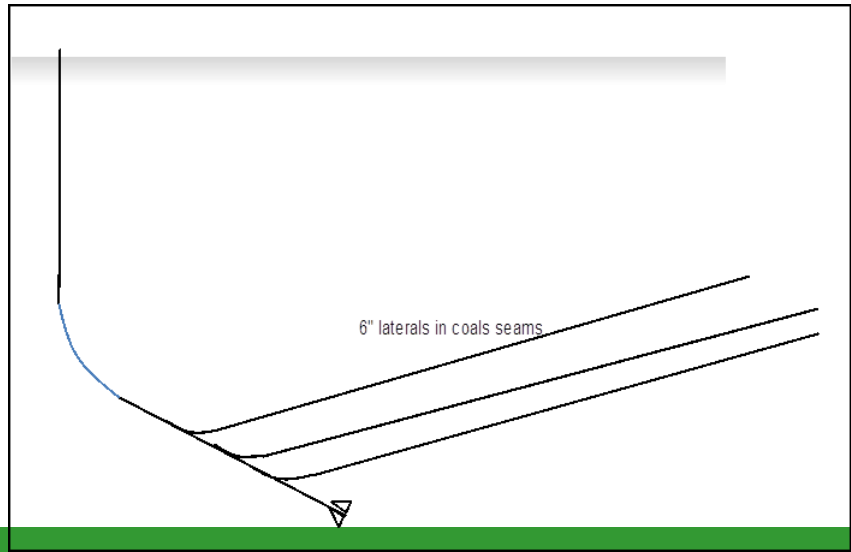


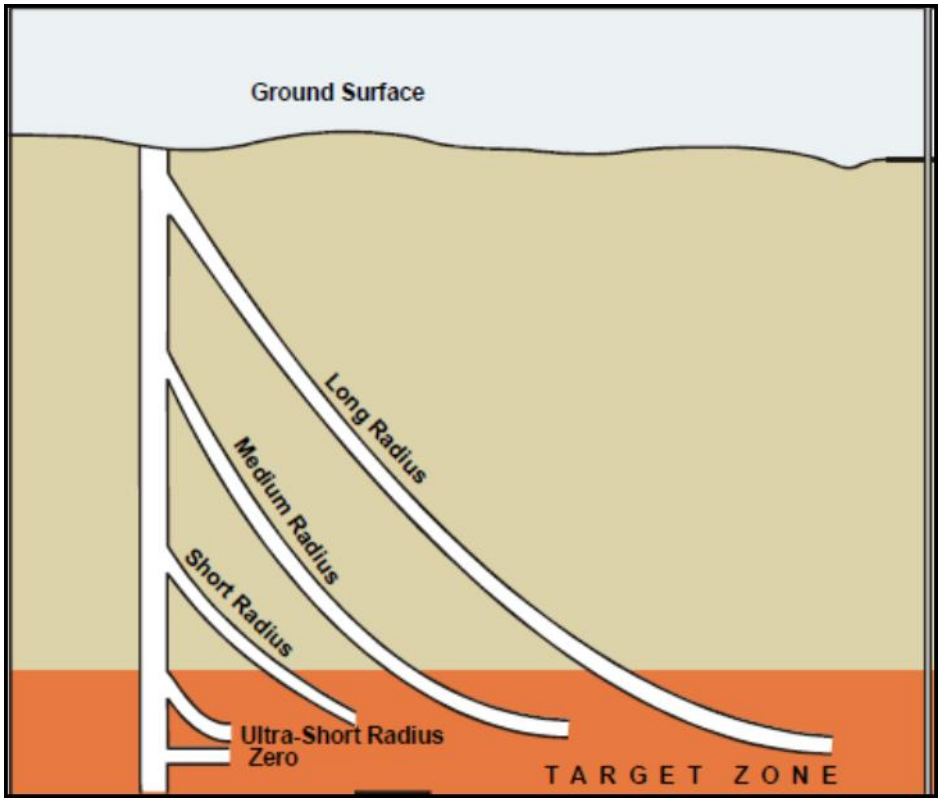




Horizontal well path



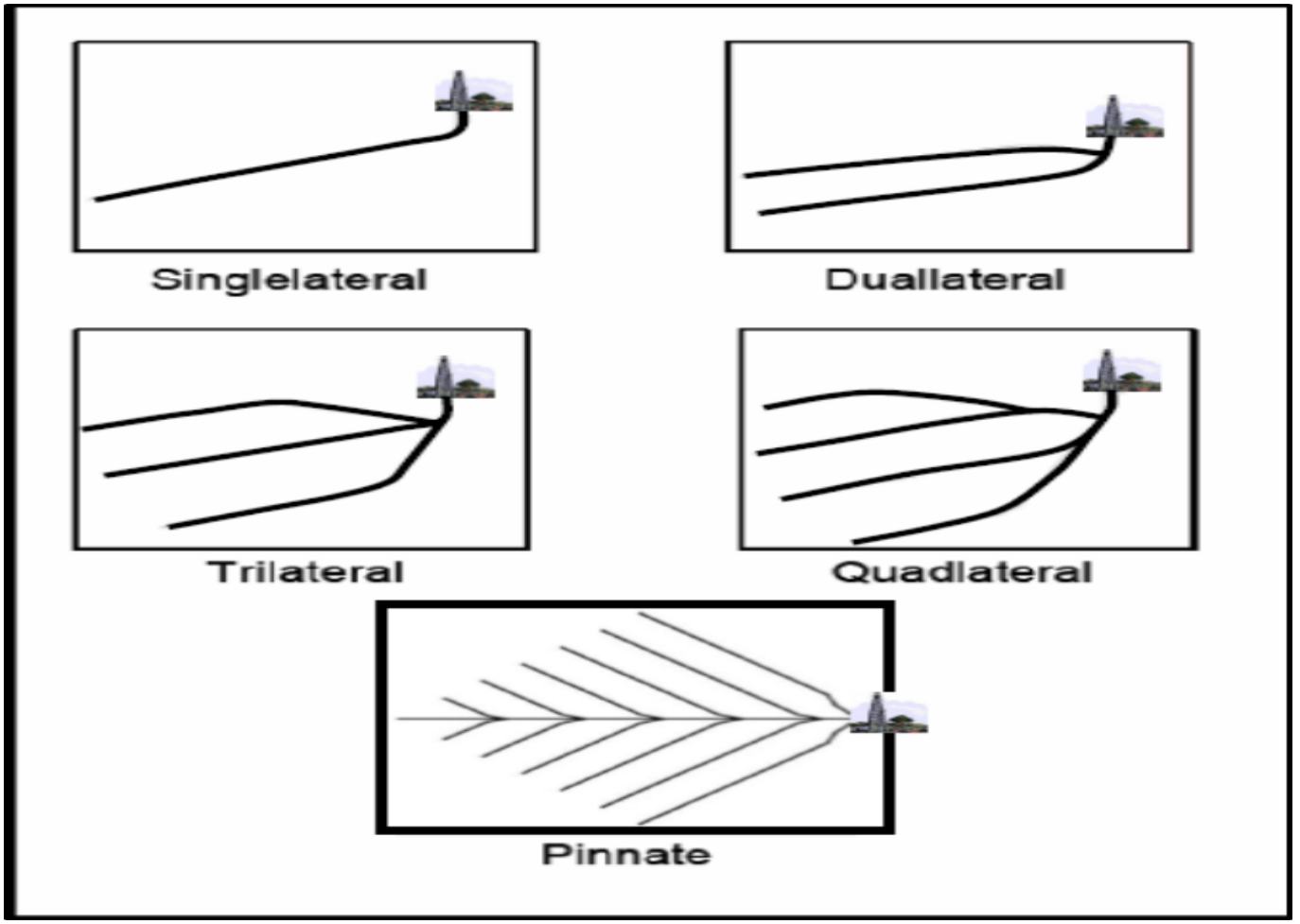
Types of directional drilling techniques



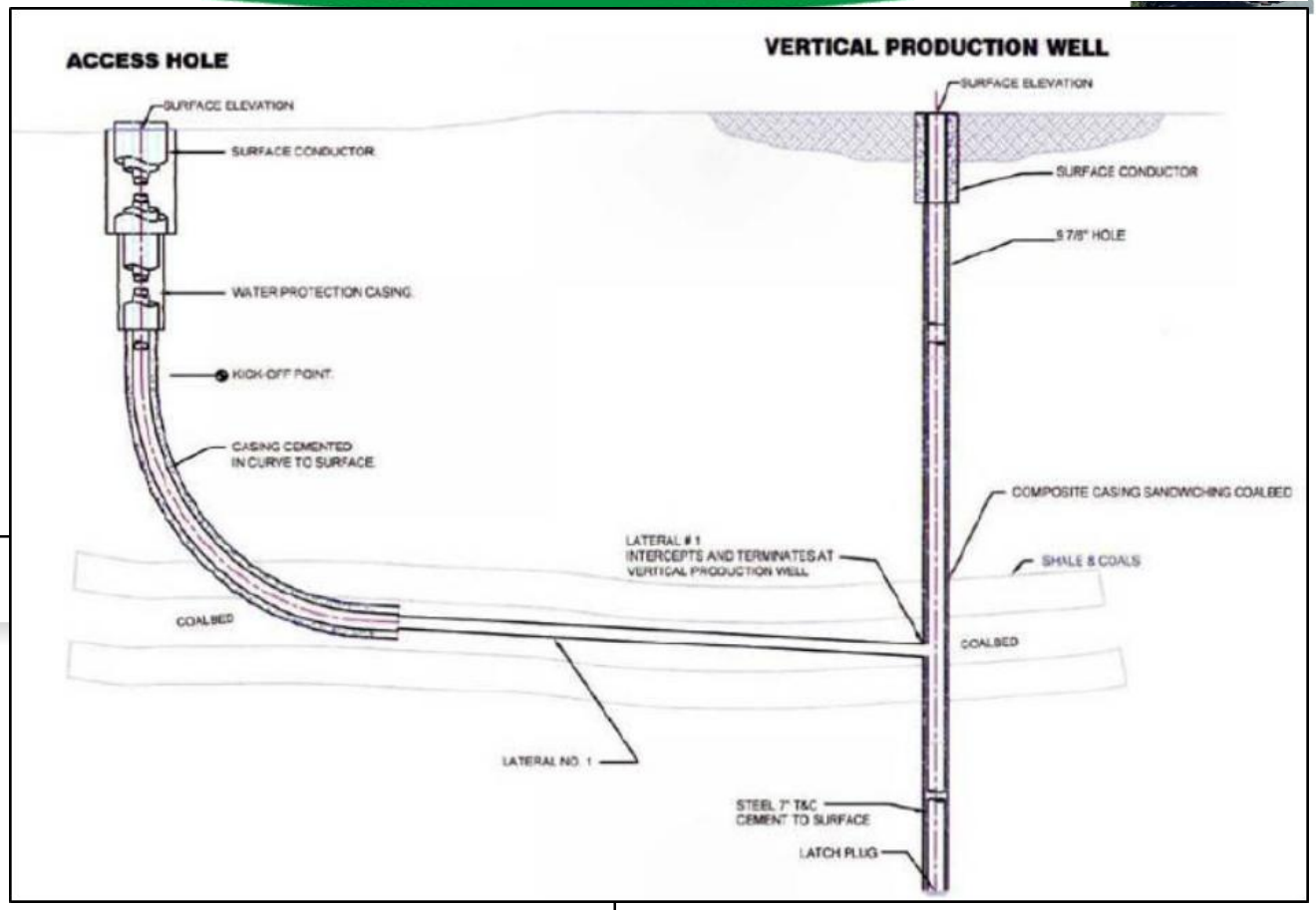
Tab. 2-1 Surface-drilled directional oil & gas well types defined by radius size

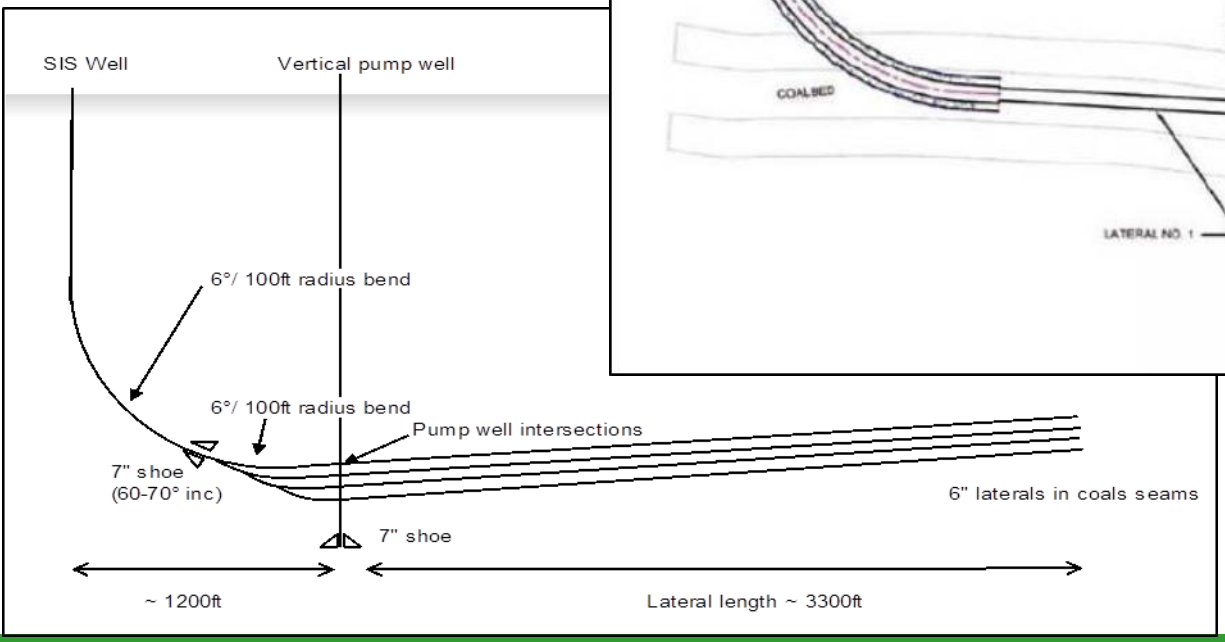
Radius Type	Radius (m/ft)	Curve build rates	Achievable Lateral Length (m/ft)	Drilling Method
Zero	0		3 / 10	Telescopic probe with hydraulic jet
Ultra-short	0.3-0.6 / 1-2	70 -150°/ 100’	60 / 200	Coiled tubing with hydraulic jet
Short	1-12 / 3-40	40 -70°/ 100’	460 / 1,500	Curved drilling guide with flexible drill pipe; entire drill string rotated from the surface
Medium	60-300 / 200-1000	6 -40°/ 100’	460-1,525+ / 1,500-5,000+	Steerable mud motor used with compressive drill pipe; conventional drilling technology can also be used
Long	300-850+ / 1000-2,500+	2 -6°/ 100’	600+ / 2,000+ (Record is over 12,000 m/ 40,000 ft)	Conventional directional drilling equipment used; very long curve length of 850-1,350 m (2,800-4,400 ft) needed to be drilled before achieving horizontal

Horiozontal well configurations commonly drilled in coal



Toe intersection





Tab. 3-6 Summary of gas content of coal seams

Total Number of Gas Tests - 340							
Coal Seam ID	356/1	357/1	358/1	359/1	359/3	360/1	361
Methane Content [m3/t daf]	2.2-10.1	2.3-11.2	4.1-14.4	3.4-9.5	4.7-12.8	5.6-9.6	3.8-12.7
Average Methane Content [m3/t daf]	7.2	7.6	7.9	7.4	6.7	7.7	6.7
Number of Gas Tests	8	7	12	10	6	7	13
Methane Hazard Category	I-IV	I & III-IV	II-IV	II-IV	III-IV	III-IV	II-IV

Apart from the questions to be answered by the feasibility study miners often ask:

Is there a real chance for degassing the coal seams in Upper Silesian Coal Basin by drainage ahead of mining ?

If it is feasible what will be the volumetric decrease of methane desorbing during coal expoitation to the environment of the longwall ?

What will be the impact of methane captured by drainage ahead of mining on minimizing gas hazard during coal expoitation when converting into reduced absolute gasiness of longwall environment ?



Is it possible to drill directional wells in the deposit characterized by the high faulting zones or/and high seismisity ?

What will be the situation in the zones with high seismisity after the quake ? Will the wells be cut off, what will happen with their patency and flow of drainage methane ?

Chances for the hard coal mines in Poland

1) Drainage of the rock mass by capturing methane from the relaxed zones over and under exploited longwall (conventional drainage, most efficient drainage galleries or directional wells in the future ?),

2) Capturing of methane desorbing to the isolated goaves – still does not solve the problem of gas hazard in the longwalls,

3) In case of elaborating new technology suitable for Polish mining conditions – capturing of methane from the coal pannel meant for the exploitation.



Thank you for your attention

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