



JSW and GIG's report on the use of methane from the coal mines in Poland

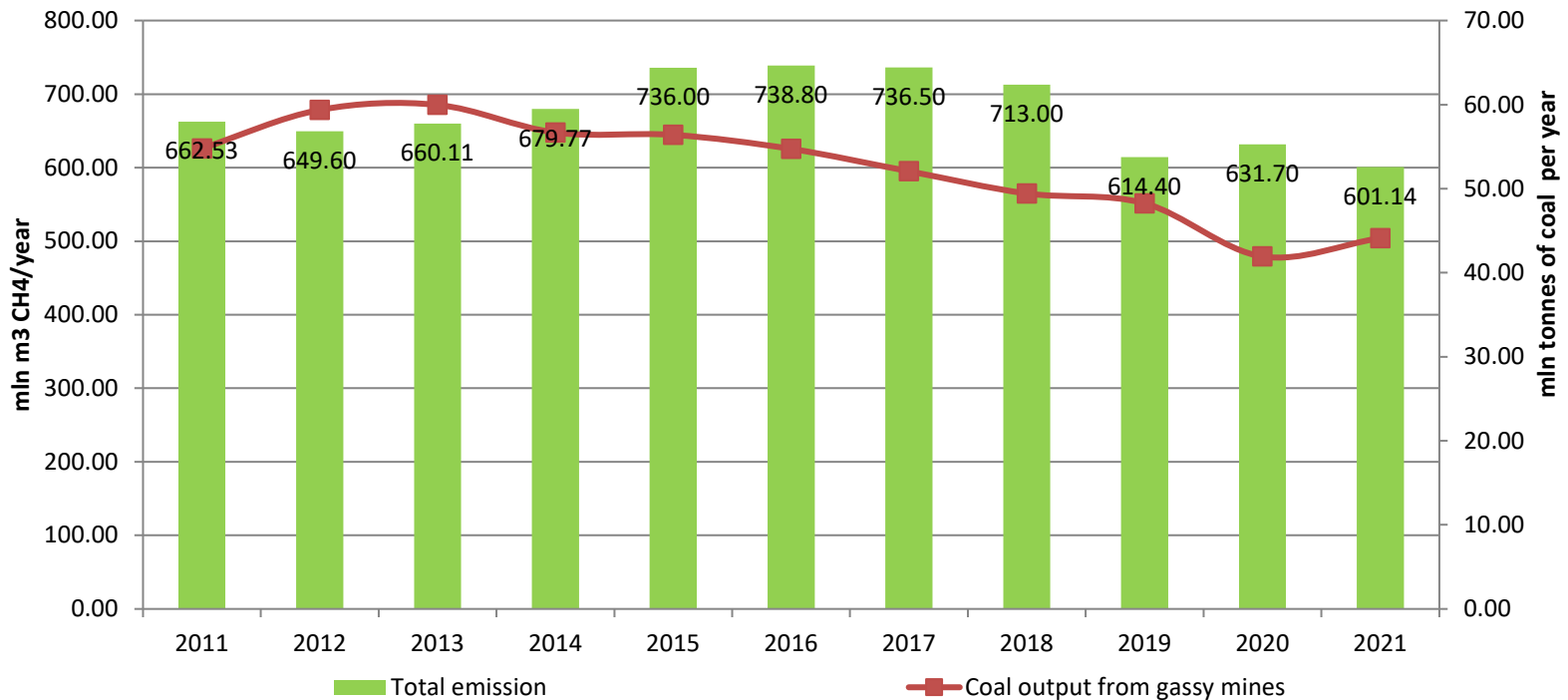
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Acknowledgments

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Geneva , March 20th, 2023

Evolution of methane emissions from underground hard coal mines in Polish mines in the years 2011 - 2021 in relation to total methane emissions and extraction



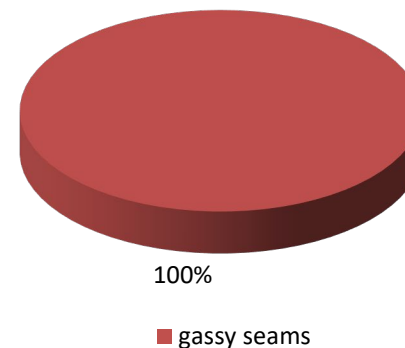
Entities engaged in hard coal mining in Poland:

- Polska Grupa Górnicza S.A.
- Jastrzębska Spółka Węglowa S.A.
- Tauron Wydobycie S.A.
- Kopalnia Lubelski Węgiel Bogdanka S.A.
- Przedsiębiorstwo Górnicze "SILESIA" sp. z o.o.
- Węglokoks Kraj S.A.
- Z.G. EKO-PLUS Sp. z o.o.
- Zakład Górniczy SILTECH Spółka z o.o.

Division of coal extraction from gassy and non-gassy seams in Polish mines (in tonnes)

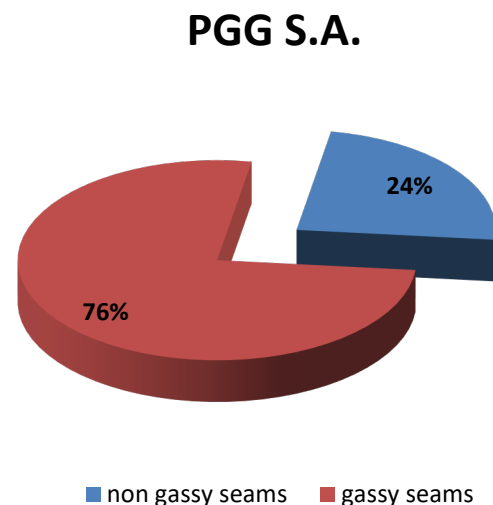
JSW S.A.

Coal mine	Non-gassy coal seams	Gassy coal seams	All coal seams
Borynia-Zofiówka	-	3 434 501	3 434 501
Jastrzębie-Bzie	-	94 720	94 720
Pniówek	-	3 350 909	3 350 909
Budryk	-	2 292 185	2 292 185
Knurów-Szczygłowice	-	4 581 985	4 581 985
Sumarycznie	-	13 754 300	13 754 300



Division of coal extraction from gassy and non-gassy seams in Polish mines (in tonnes)

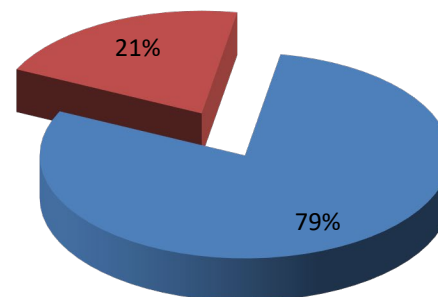
Coal mine	Non-gassy coal seams	Gassy coal seams	All coal seams
Ruda Ruch Bielszowice i Ruch Pokój	-	1 582 740	1 582 740
Ruda Ruch Halemba	-	1 197 500	1 197 500
ROW Ruch Jankowice	-	1 870 800	1 870 800
ROW Ruch Chwałowice	-	2 236 000	2 236 000
ROW Ruch Marcel	-	2 416 100	2 416 100
ROW Ruch Rydułtowy	-	1 572 400	1 572 400
Piast-Ziemowit Ruch Piast	1 975 000	-	1 975 000
Piast-Ziemowit Ruch Ziemowit	2 950 000	-	2 950 000
Bolesław Śmiały	566 075	890 925	1 457 000
Sośnica	-	1 332 000	1 332 000
Mysłowice-Wesoła	-	2 128 100	2 128 100
Staszic-Wujek	-	2 361 100	2 361 100
Sumarycznie	5 491 075	17 587 665	23 078 740



Division of coal extraction from gassy and non-gassy seams in Polish mines (in tonnes)

TAURON Wydobycie S.A.

Coal mine	Non-gassy coal seams	Gassy coal seams	All coal seams
ZG Sobieski	2 217 338	-	2 217 338
ZG Janina	1 863 593	-	1 863 593
ZG Brzeszcze	-	1 065 921	1 065 921
Sumarycznie	4 080 931	1 065 921	5 146 852

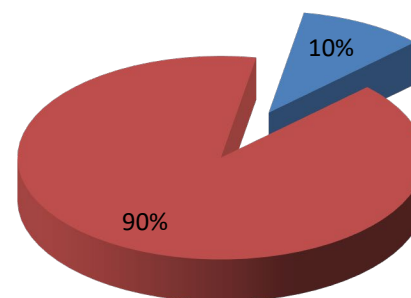


■ non gassy seams ■ gassy seams

Division of coal extraction from gassy and non-gassy seams in Polish mines (in tonnes)

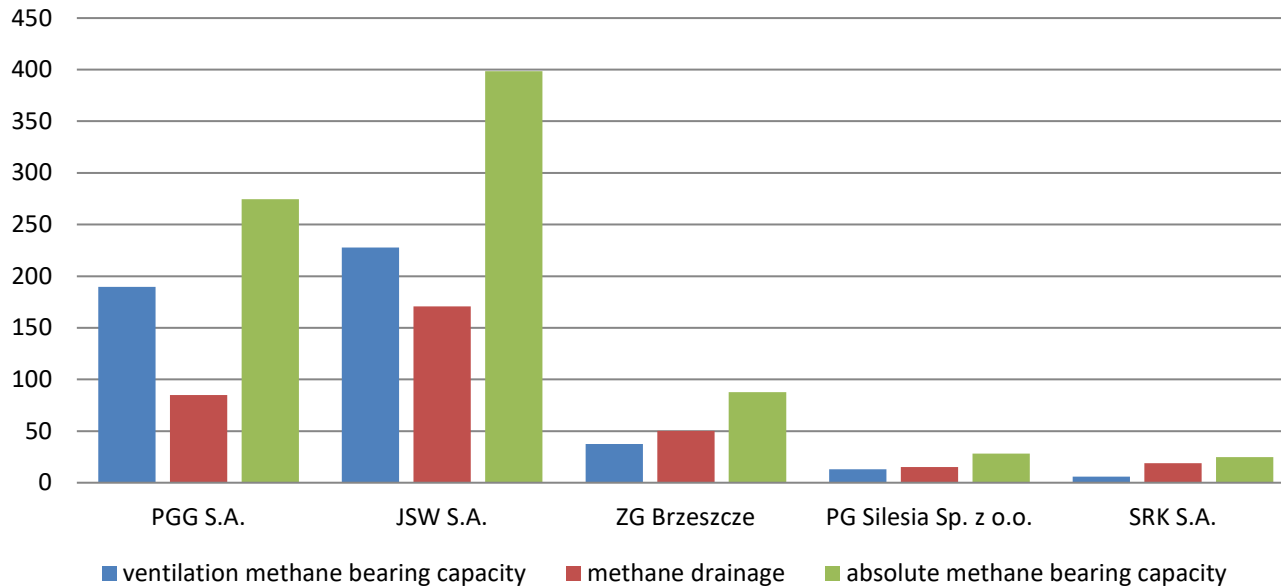
Coal mine	Non-gassy coal seams	Gassy coal seams	All coal seams
LW Bogdanka SA	-	9 934 867	9 934 867
PG Silesia Sp. z o.o.	-	1 290 522	1 290 522
EKO-PLUS Sp. z o.o.	-	141 496	141 496
Bobrek-Piekary	1 303 600	356 000	1 659 600
ZG Siltech Sp. z o.o.	b.d	b.d.	b.d
Sumarycznie	1 303 600	11 722 885	13 026 485

Other coal mining plants



■ non gassy seams ■ gassy seams

Absolute methane bearing capacity, methane drainage and ventilation methane bearing capacity in Polish hard coal mines in the year 2021



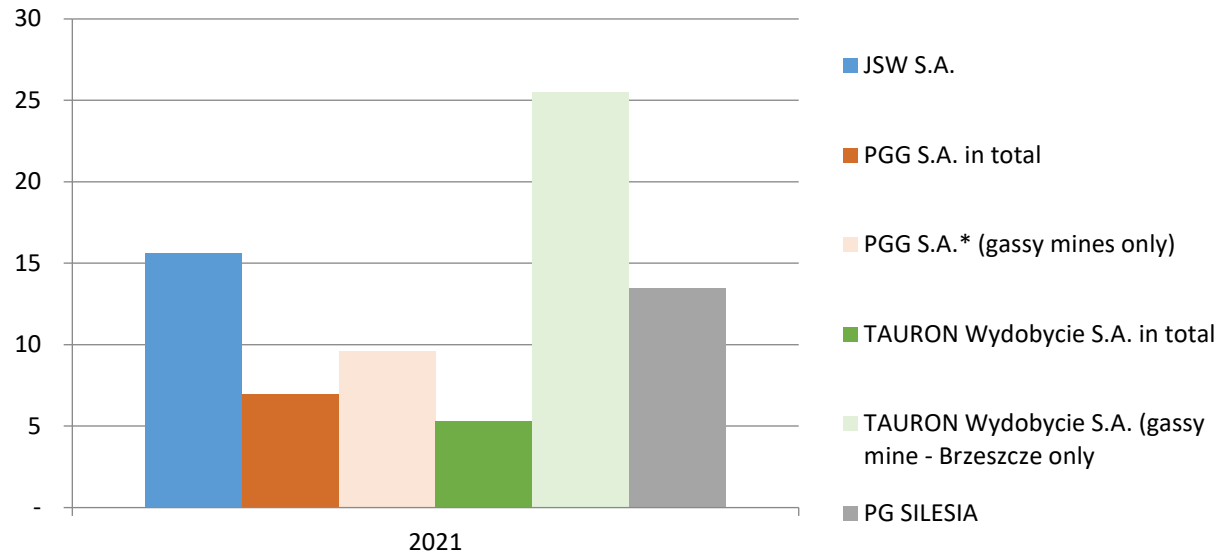
Management of captured methane efficiency in Polish coal mines (in %)



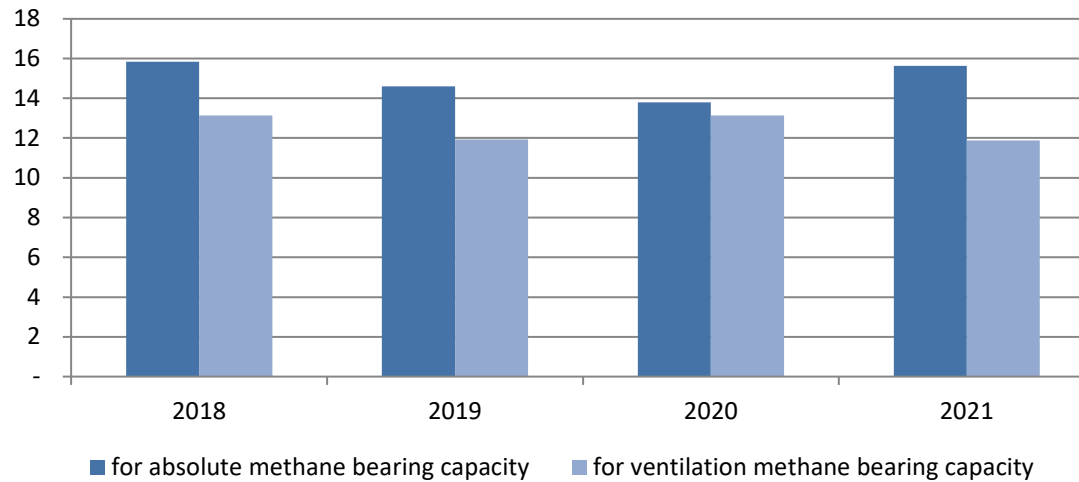
In Polish hard coal mines,
methane captured by methane drainage stations is managed:

- in cogeneration units producing electricity in combination with heat (and cooling),
- in gas boilers producing heat,
- in boilers co-firing methane with coal for heat production,
- in gas engines for the production of compressed air,
- by selling it to the third parties.

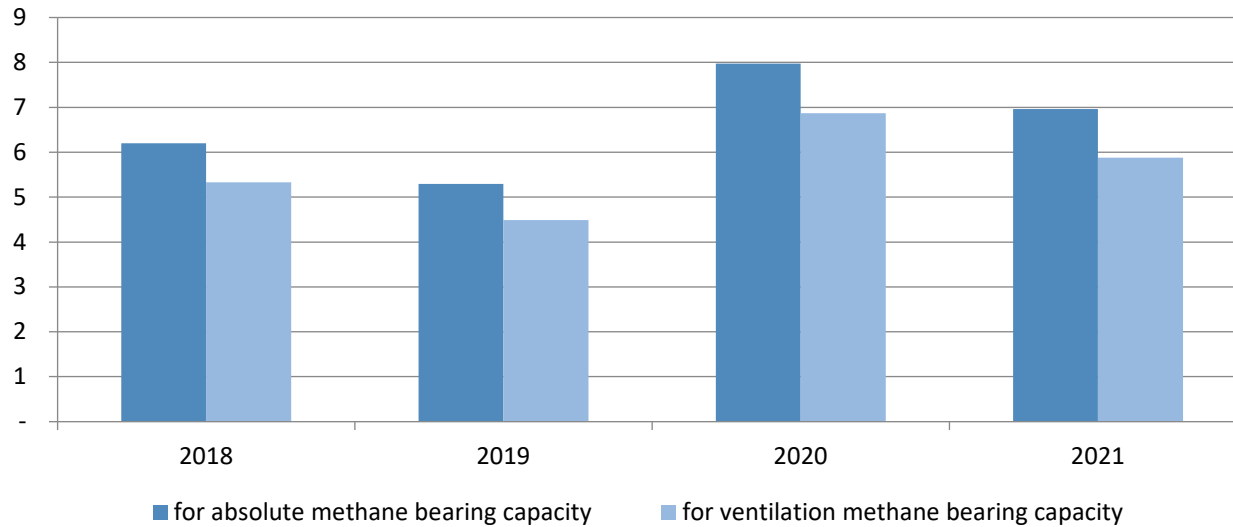
**Methane emission ratios in JSW S.A. and PGG S.A.,
 tonnes of methane/1000 t of coal extraction**



Methane emission ratios in JSW S.A.
tonnes of methane/1000 t of coal extraction



Methane emission ratios in PGG S.A.
tonnes of methane/1000 t of coal extraction



The existing technologies allowing economic use of methane from ventilation shafts as the threshold for economic and energy profitability indicate the concentration of this gas in the air at a level of 1.0-1.2 percent.

However, according to the regulations being in force in Poland, the concentration of methane in ventilation shafts must not exceed 0.75 percent.

Presently methane concentrations in Polish coal mines' shafts differ from 0.06-0.45 %, depending on the geological conditions (methane content in the seams) and applied methane hazard prevention to avoid exceeding safety level in the event of sudden pressure changes.

Methane Emission Reduction Program

JSW Group has been taking environmental and climate measures for years, including the reduction of greenhouse gases, and the current strategy is a continuation and development of the direction adopted so far.

Considerable pressure in line with market, social and regulatory expectations in the strategy is located in the area of emission reduction.

The target of reducing greenhouse gas emissions (carbon footprint) by 30% by 2030 (compared to 2018 - i.e. at 2.5% per year in line with the "well below 2°C" policy) was adopted and a commitment was made to act towards achieving climate neutrality by 2050.

Methane Emission Reduction Program

Due to the fact that 74% of the JSW Group carbon footprint is methane, in this area, the Methane Drainage and Management Office has developed a schedule for the methane emission reduction program until 2025 (REM), taking into account the current program of economic use of methane and new conceptual activities necessary to achieve the assumed level of methane emission reduction.

Among others, improving the efficiency of methane drainage, building a pipeline connecting northern mines, and installing additional cogeneration engines.

Methane Emission Reduction Program

Implementation of the entire program for the reduction of methane emissions (REM) with an estimated value at the level of approx. PLN 300 million by 2025 (including PLN 122 million included in the current business model), will allow to reduce greenhouse gas emissions per carbon footprint by approx. 24% by 2026.

This is a decrease in direct methane emissions as well as emissions resulting from external energy purchases.

The Methane Emission Reduction Program assumes an increase in the methane drainage efficiency to 50% and the use of captured methane to 95%.

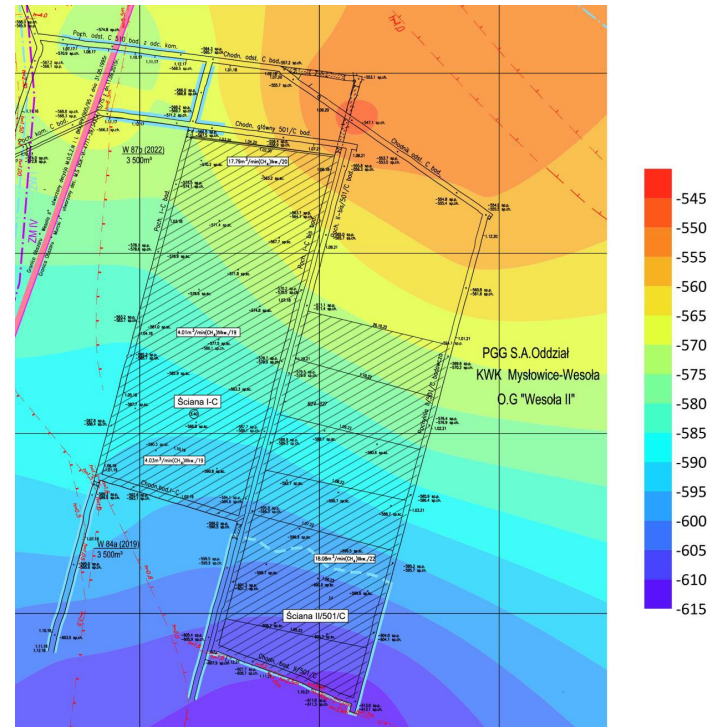
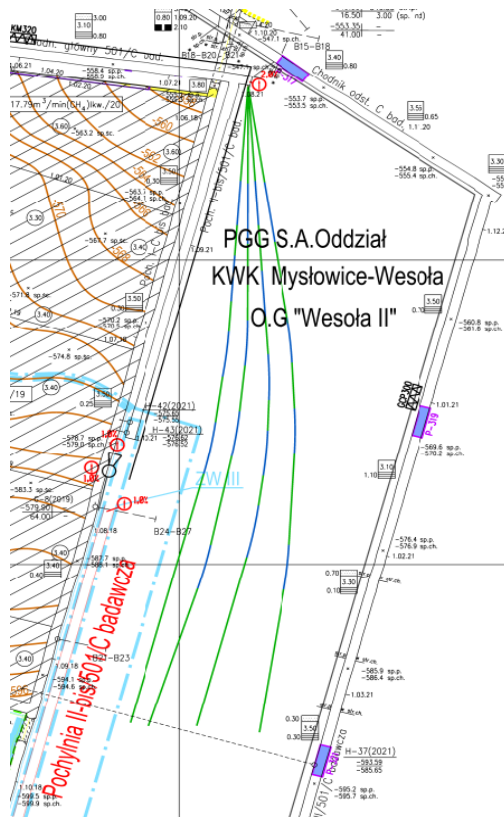
Methane Emission Reduction Program

Design works are currently underway by the Central Mining Institute and the AGH University of Science and Technology under the supervision of the Methane Drainage and Management Office. Achieving the assumed reduction of methane emissions requires many underground works, modernization of the methane drainage network and investment in surface infrastructure.

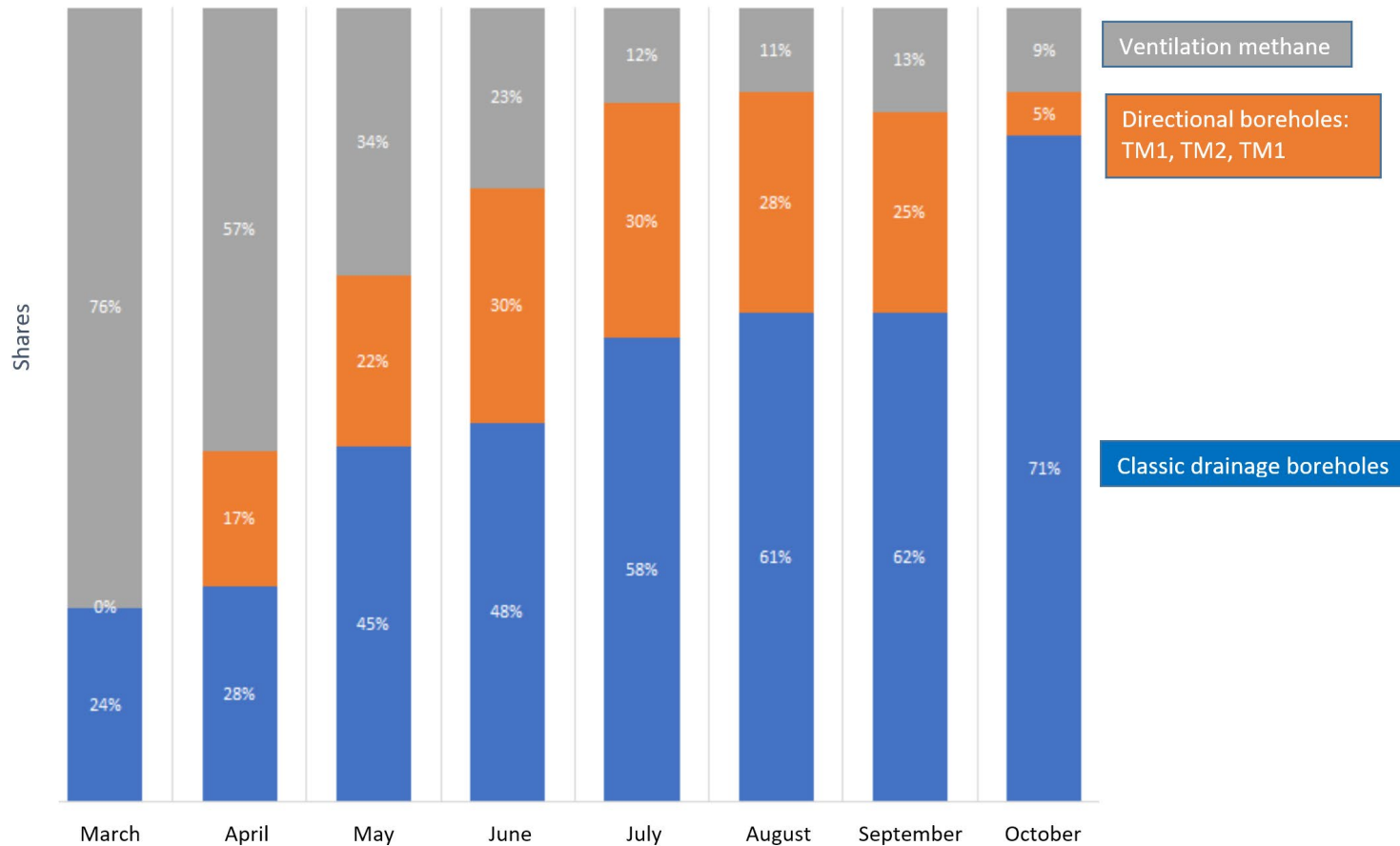
The reduction of methane emissions to the ventilation air, and thus to the atmosphere through ventilation shafts, will be implemented through actions directly in the mining excavations, mainly increasing the methane intake by means of the methane drainage system.

It was assumed that the methane drainage efficiency of JSW mines would be > 50%. Currently, the methane drainage efficiency ranges from 30% to 40% at JSW, where the world's average is 20%.

PGG SA efforts to implement Underground Directional Drilling techniques to increase methane capture under DDMET project



PGG SA efforts to implement Underground Directional Drilling techniques to increase methane capture under DDMET project



**GIG and other Partners of ICE CMM
are actively supporting JSW SA and PGG SA
to more effectively capture and utilise methane from Polish mines.**

The latest projects...

- **Project REM:** Reduction of methane emissions from post mining goafs to minimise their inflow into VAM
- **Project ProVAM:** Reduction of Ventilation Air Methane Emissions in the Coal Mining Transformation Process

REM project abstract

Reduction of methane emissions (REM) from post mining goafs (Abandoned Mine Methane) to minimise their inflow into Ventilation Air Methane is a part of sustainable and intelligent mine Greenhouse Gases (GHG) management towards green deal economy, which is the key issue when minimizing costs of coal mines' liquidation process and mitigating Coal Mine Methane emissions to the atmosphere. **REM pilot and demonstration project is going to demonstrate intelligent management of low content AMM (less than 30% CH₄) cumulated in post mining goafs of presently operated „Pniówek” underground coking coal mine by: determination such goaf zones, sealing them, extracting Low Content AMM (LCAMM) using latest Long Reach Directional Drilling (LRDD) technology, transporting it using especially designed for LCAMM pipelines to the surface LCAMM compressor station and finally feeding it into especially designed gas engines adjusted for LCAMM to produce electricity and heat. Additionally VAM emissions to the atmosphere from coal mines' shafts will be monitored and verified with the application of the latest technology of optical gas indication (OGI) and with the use of unmobile aircraft systems (UAS). This completely innovative comprehensive management of the post-mining methane emission chain with the aim to substantially reduce VAM at Polish and Romanian gassy underground coal mines will significantly increase labour safety and reduce coal mines' carbon footprint. It will be realistic contribution of gassy coal mines towards Global Methane Pledge ambitious goals set for Energy sector.** Innovative techniques proposed in REM will be subject of international patents and can be subject of repeatability and re-scaling in gassy coal mines globally. REM project will be professionally handled by international consortium, including members (GIG, JSW, INiG, PIG) of the first International Center of Excellence on Coal Mine Methane (ICE CMM) established under UNECE Group of CMM experts.

ProVAM project abstract

Reduction of Ventilation Air Methane emissions in the Coal Mining Transformation Process of European underground coal mines can be effectively done if four major obstacles: dust load, humidity, variable air and methane flows, which create unfavorable conditions for efficient implementation of VAM utilisation technologies in underground coal mines are properly curbed. DURR – largest global VAM utilisation facilities’ producer, JSW SA largest EU coking coal producer and experienced Polish, Spanish and Romanian scientific units took on this task under R&D ProVAM project, which results will be verified in in-situ conditions of GIG’s Experimental Mine “Barbara” in Poland putting it in RTL6. Even partial destruction of VAM emissions will result in tremendous environmental effects making the objectives of Global Methane Pledge for mining sector realistic to achieve. **Preliminary economic assessment of ProVAM looks interesting enough to draw coal mines’ attention. ProVAM project results can be reskilled in 23 gassy EU coal mines (41 exhaust gassy shafts) and globally, which is the intention of project consortium.** Innovative techniques proposed in ProVAM will be subject of international patents and can be subject of industrial implementation in gassy coal mines globally. Many years’ engagement of ProVAM’s partners in activities of international platforms aiming at increasing global methane mitigation like: Global Methane Initiative, UNECE CMM Group of Experts, IMEO UNEP, World Mining Congress organisation and leadership in the first International Centre of Excellence on Coal Mine Methane established under UNECE Group of CMM experts by ProVAM’s project leader - GIG will facilitate the high level of ProVAM results dissemination. Lessons learned document and planned training and workshop will make its results easily accessible not only for the miners and practitioners but also will increase social awareness of VAM and make acceptance of coal mines’ phase out even smoother

Thank you for your attention....

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