14th International Student

Petroleum Congress

May 5th – 7th 2026

Kraków

EAST MEETS WEST

Congress Book

Content

Organizing Committee

Aleksandra Lasko
Wojciech Hoc
Artur Bystrai
Oskar Dunaszewski
Adrian Piekarczyk
Katarzyna Bobak
Maja Radtke
Igor Dankowski
Bartosz Kazior
Przemysław Ziemba
Krzysztof Woś
Filip Studziński

Support

Edyta Stopyra
Wojciech Panek
Jakub Ślęk
Piotr Kiebzak
Jan Kowalski

Scientific Advisors

Prof. Stanisław Nagy - Chair

Ph.D. Katarzyna Chruszcz - Lipska
Ph.D. Ewa Knapik
Ph.D. Iwona Kowalska - Kubsik
Ph.D. Łukasz Klimkowski
Ph.D. Szymon Kuczyński
Ph.D. Przemysław Toczek

Message from the S.C. President

Dear Participants and Guests,

Welcome to the 14th East Meets West Congress. We are pleased to have you with us and to continue building a space where students, researchers, and industry professionals can come together to share knowledge and ideas.

The previous, 13th edition of the Congress, held on April 2025 at the AGH University of Krakow and organized by the SPE AGH Student Chapter, marked an important step in the event's development. It brought together 94 participants from six countries: Poland, Ukraine, Italy, Peru, the United Kingdom, and the United States, making it the largest and most international edition since the pandemic.

This year, our theme "***Where Ideas Ignite Energy***" reflects the spirit of EMW 2026, a place where creativity, knowledge, and collaboration come together to spark new solutions for the energy sector. We hope it will inspire engaging discussions, innovative thinking, and the exchange of ideas across disciplines.

Building on this progress, we are especially excited to welcome back the **SPE Student Paper Contest (SPC)**, which was first introduced several years ago. After a period without the contest, SPC returns to EMW 2026 as a key highlight, giving students the opportunity to present their research, develop technical and communication skills, and receive feedback from industry professionals. Its return underlines the Congress's ongoing growth and international recognition.

We hope this year's edition will offer even more opportunities to learn, connect, and exchange perspectives. We encourage you to take full advantage of the program, engage in discussions, and make the most of your time here.

We wish you an inspiring and rewarding Congress!

Let's make this conference a success together!

Best regards,

East Meets West Organizing Committee

Agenda

05.05.2026 – Day 1			
Hours		**Activities**	
08:00 – 09:00	Poster Session	Registration + Morning coffee AGH University of Krakow, A4; room 3 (ground floor)	Career Opportunities Session AGH University of Krakow, A4; room 313 (ground floor)
09:00 – 10:10		**Opening ceremony & keynote speech**	
10:10 – 10:20		Group photo	
10:20 - 10:40		Coffee break	
10:40– 12:00		**Partner technical presentations**	
12:00 – 13:00		Lunch break	
13:00 – 14:00		**Panel Discussion** *„Where Ideas Ignite Energy: Building a Career in a Net-Zero World"*	
14:00 – 14:30		Coffee break	
15:00 – 18:00		**Energy Transition Game** AGH Student Construction Center, building D-12, Kawiory 42, 30-055 Kraków	
20:00 – 24:00		Icebreaker	

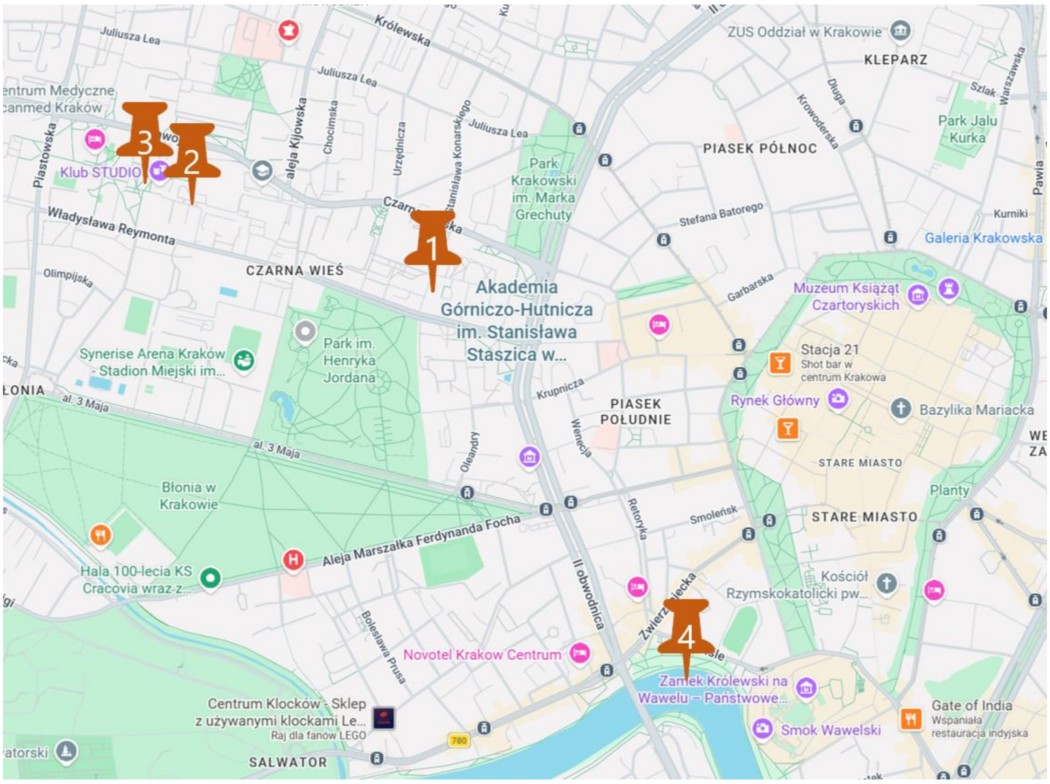
Agenda

06.05.2026 – Day 2		
Hours		**Activities**
08:00–08:30		Registration + Morning coffee AGH University of Krakow, A4; room 3 (ground floor)
08:30–10:00	Poster session	**Student Paper Contest (SPC) I** *Master Students*
10:00–10:15	Poster session	Coffee break
10:15–11:45	Poster session	**Student Paper Contest (SPC) II** *Master Students*
11:45–12:00	Poster session	Coffee break
12:00–13:30	Poster session	**Student Paper Contest (SPC) III** *Master Students / PhD candidates*
13:30 -14:15	Poster session	Lunch break
14:15–16:45	Poster session	**Student Paper Contest (SPC) IV** *PhD candidates*
16:45-17:15		Coffee break
17:15-18:00		**Award and Closing Ceremony**
20:00–24:00		Gala dinner

Career Opportunities Session
AGH University of Krakow, A4; room 313 (ground floor)

07.05.2026 – Day 3	
Hours	**Activities**
8:30–19:00	Field trip to ,,Museum of Oil and Gas Industry Ignacy Łukasiewicz” in Bóbrka (transport by bus) Return time might change!

Event Map



1. **EMW 2026 - AGH University of Krakow, building A4, room 3**
   Al. Adama Mickiewicza 30, 30-059 Kraków
2. **Energy Transition Game – AGH Student Construction Center, building D12**
   Kawiory 42, 30-055 Kraków
3. **Icebreaker Meeting - BGH Brewery**
   Witolda Budryka 4, 30-072 Kraków
4. **Gala Dinner – "Aquarius restaurant"**
   Bulwar Czerwieński 81, 31-069 Kraków
5. **Ignacy Łukasiewicz Museum in Bóbrka**
   ul. Kopalniana 35, 38 - 458 Chorkówka, Subcarpatian voivodeship, Poland

Contact

President of AGH University of Krakow SPE Student Chapter

Aleksandra Lasko

+48 535 230 578

Coordinator of the Organizing Committee

Artur Bystrai

+48 729 212 171

Vice President of AGH University of Krakow SPE Student Chapter

Wojciech Hoc

+48 669 764 899

Honorary Guest

Pierre Emmanuel d'Huart

SPE Regional Director for Europe

Pierre Emmanuel d'Huart, 40, is currently Head of Offshore Technological Development at Saipem. With over a decade of experience in various offshore projects across Europe, Egypt, Nigeria, Brazil, and the Middle East, he has made remarkable contributions that have had a significant impact on the industry.

He led a team to build the heaviest and deepest pipeline ever and contributed to establishing the first subsea drone operations contract. Additionally, Pierre Emmanuel was a visiting lecturer at IFP School for three years, where he shared his knowledge and experience with students.

He now leads the development of Saipem's offshore & subsea technology solutions, driven by his passion for learning and industry collaboration.

Pierre Emmanuel holds an MSc in Civil Engineering from ESTP in Paris and an MSc in Petroleum Engineering from IFP School. He is an accomplished author with several papers at OTC and articles about major industrial achievements in the field of Production & Facilities.

Beyond his work, Pierre Emmanuel is a proud father of 2. He has served the wider community as a reserve navy officer for the French Navy and is engaged on the Board of Directors of the Society of Petroleum Engineers as Regional Director for Europe.

Student Paper Contest

The SPE Student Paper Contest (SPC) is an international competition organized by the Society of Petroleum Engineers that gives students the opportunity to present their own research in the field of energy and petroleum engineering. It is designed to develop both technical knowledge and communication skills by challenging participants to prepare an original paper and defend their work in front of a professional jury (representing industry and academia).

The contest is structured in two main stages: the regional level and the international final. Students first compete within their SPE region, where the best papers and presentations are selected by a panel of experts. The winners of each region then advance to the International Student Paper Contest, held during a major SPE conference, where they represent their regions and compete on a global stage.

Taking part in SPC is a valuable experience, as it helps students build confidence, gain feedback from industry experts, and connect with professionals from around the world. It also creates a platform for sharing innovative ideas and encourages young engineers to actively contribute to the future of the energy sector.

ORLEN EMPOWERS
BALTIC EAGLE GAS HUB

ORLEN

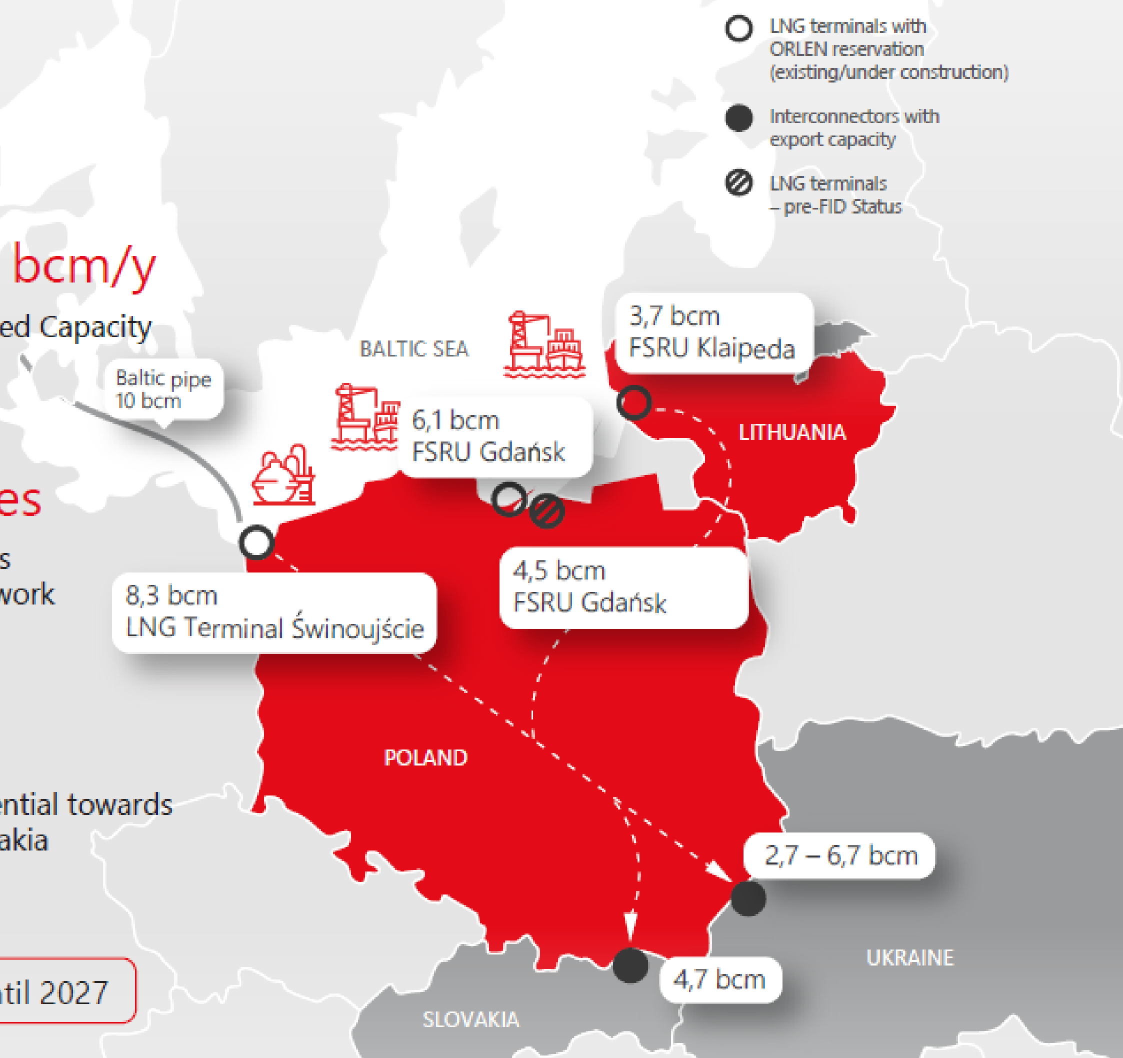
Baltic Eagle Gas Hub enables deliveries of non-russian gas to the whole Central and Eastern Europe

3
Regasification terminals

over 17 bcm/y
Installed & Secured Capacity

7 countries
Connected by gas transmission network

7 bcm/y
Total export potential towards Ukraine and Slovakia



Phase-out of Russian gas until 2027

- EU policy change aimed at full phase-out of imports from Russia changes supply routes in Central Europe.
- Poland is ahead of this schedule - currently no russian gas is delivered to its system.

LNG hub in Poland

- ORLEN has secured several contracts with US LNG suppliers, strengthening US-EU cooperation.
- Trade between Poland and US have significant impact on both economies and influences resilience in the whole region.

Gas Hub in Poland serving CEE region

- 15 bcm of regasification capacity is reserved by ORLEN. Excess capacity in terminals will support LNG exports to CEE countries.
- Poland is best placed to distribute large quantities of LNG in the region.

After 2022 LNG terminals and Baltic Pipe have become core sources of gas to the region

SPC Judges

Gisela Vanegas Cabas is the Head of Capability Excellence in OMV. She holds a Master's degree from Colorado School of Mines. She has a background in reservoir engineering and leadership, with more than 20 years of experience. During her 8 years in OMV she has been advancing new ways of working, stochastic modelling workflows and other new technologies.

Jacek Dudek, PhD, is an upstream energy professional specializing in the intersection of reservoir engineering, digital transformation, and value-driven operations. As a Senior Reservoir Engineer and Digital Project Manager at Upstream Polska Branch Complex of ORLEN S.A., he works on strategic initiatives that combine reservoir simulations, integrated engineering, Digital Twins, deployment of AI/ML, and production optimization to enable faster, smarter, and more scalable decision-making. His doctoral research at AGH University of Science and Technology focused on optimizing oil and gas field management through advanced recovery methods.

Andrew (Andrzej) Pasternacki is based in Krakow, Poland, and currently serves as Product Owner for one of Shell's Quantitative Interpretation tools that utilizes machine learning methods within the Seismic Imaging and Inversion team under the Data, Digital, and Innovation organization in Upstream. Over the previous seven years, he worked in Subsurface Technical Asset Support, where he supported, built, and later led distributed teams delivering subsurface data services. His contributions included strengthening data lifecycle practices, improving delivery reliability, and enhancing remote support models used across multiple regions. He holds a PhD in Geosciences from AGH University of Science and Technology, where his research focused on quantitative geophysical workflows integrating seismic and microseismic analyses. Before joining Shell, he contributed to academic geophysical research and several industry funded projects. His work involved seismic interpretation, geological modeling, quantitative interpretation, microseismic monitoring, and geohazard assessments, including participation in a seismological hazard study supporting the planning of a nuclear power plant in Poland. Early in his career, he worked with Schlumberger in well testing operations across Europe, gaining hands on experience in high pressure field environments. He also spent time at Halliburton supporting software and database solutions for subsurface data.

Piotr Szczurak holds a degree in Petroleum Engineering, graduating WWNiG AGH Cracow in 2006. He began his professional career with a national drilling contractor in Poland, where he spent more than four years before joining a leading oilfield service company (Halliburton), initially supervising cementing operations in the field across Europe before progressing into a managerial role over a period of more than seven years. For last eight years, he has been with a global commodity and specialty chemicals provider (Brenntag), where he was leading drilling fluids and cementing portfolio development as Product Manager, working closely with major oil and gas companies and global chemical producers. Since 2024 holds a role of Senior Business Manager, responsible for strategic growth and sustainable solutions for renewables sector of Energy across region of EMEA.

Ewa Knapik is an assistant professor at the Faculty of Drilling, Oil and Gas, AGH University of Krakow. She obtained an MSc degree in Chemical Technology and a PhD degree in Mining and Petroleum Geology. Her doctoral research concerned the removal of petroleum compounds from produced water using nanocomposites. The scientific activity of Dr Knapik focuses on the treatment and management of formation waters accompanying hydrocarbon extraction. Her most recent research project, CompLithium, focuses on the recovery of lithium from brine. In her research work, she conducts laboratory studies using advanced instrumental techniques (chromatographic and spectroscopic). She is the author/co-author of 40 publications and conference presentations. Between 2015 and 2025, she was involved as a researcher in 7 industry-funded R&D projects commissioned by major Polish oil and gas companies. She is a member of the Association of Polish Inventors and Rationalizers since 2019. She has experience in leading research projects and managing a research team (completed certified AgilePM Foundation and Prince2 trainings).

Łukasz Klimkowski holds the position of Assistant Professor at the Faculty of Drilling, Oil and Gas of AGH University of Krakow, Poland. He obtained his Ph.D. degree from the same university in 2016. In 2020, he held a postdoctoral research fellow position at the Ali I. Al-Naimi Petroleum Engineering Research Centre within King Abdullah University of Science and Technology, Kingdom of Saudi Arabia. His research involves mathematical (analytic and numerical) modelling of multiphase fluid flow in porous media, including conventional and unconventional gas reservoirs, as well as geological storage of CO_2. He is also interested in combining classical mathematical methods with the capabilities offered by artificial neural networks.

SPC abstracts - Master Students

Indonesia's Gas Price Cap (HGBT) Policy: Implications for Gas Project Viability and National Economic Outcomes — A Literature Review

Ferralda Talitha Amir

University of Dundee

United Kingdom

Over the past two decades, Indonesia's natural gas production has exceeded crude oil output and recent hydrocarbon discoveries have been predominantly gas-oriented. Consistent with this trend, Indonesia holds the fourth-largest proven natural gas reserves in the Asia-Pacific region at 44.2 TCF. These developments underscore the increasing role of natural gas in Indonesia's industrial energy mix, where under the National Energy General Plan (RUEN), gas is projected to remain the main industrial energy source through 2050, with the metal, fertilizer, and ceramics sectors accounting for around 83% of industrial gas demand. In line with these developments and to support national economic growth, the Indonesian government introduced the Determined Natural Gas Price policy (HGBT) through Presidential Regulation No. 40/2016, which caps natural gas prices at USD 6/MMBTU for selected industrial sectors. The policy has since been revised through subsequent regulations like Presidential Regulation No. 121/2020, expanding the range of eligible sectors and refining the price adjustment mechanisms over time. This paper reviews the economic impacts of Indonesia's Determined Natural Gas Price (HGBT) policy on offshore gas project viability and national economic outcomes. Based on literature covering project-level economic evaluations on three different fiscal regimes and development concepts. The study finds that while HGBT can support the viability of certain offshore gas developments, it remains challenging for new, capital-intensive deepwater projects. At the macroeconomic level, based on the publication that using computable general equilibrium (CGE) analysis on gas price reductions, it shows that the policy stimulates output, employment, and competitiveness in gas-intensive sectors, generating multiplier effects through the downstream linkages. However, when reductions in state revenue shock is incorporated, economy-wide gains are constrained and limiting the allocated budget for economic stimulation, resulting in negative impacts on GDP and household income.

Optimization of Cement Slurry Formulations for Squeeze Cementing Operations

Igor Dankowski

AGH University of Krakow

Poland

The presentation entitled ,,Optimization of Cement Slurry Formulations for Squeeze Cementing Operations" addresses issues related to squeeze cementing treatments, classified as remedial cementing operations, performed to restore the integrity and tightness of the cement sheath in wellbores. Loss of cement sheath integrity may result in gas migration, uncontrolled inter-annular flows, and environmental hazards; therefore, effective remedial actions are essential to ensure long-term operational safety of wells. The objective of the study was the laboratory optimization of cement slurry formulations intended for squeeze cementing operations, with particular emphasis on their ability to penetrate narrow fractures and microcracks. The work describes the causes of cement sheath integrity loss in wellbores. Emphasis was placed on determining the factors leading to the formation of discontinuities within the cement structure and the loss of its zonal isolation function. Potential pathways for fluid and gas migration within the cement sheath were identified, including flow along formed fractures and channels. The influence of pressure and temperature variations during well operation on cement barrier integrity was also analyzed. In addition, the technological requirements for slurries used in squeeze cementing operations were discussed, with particular attention to rheological parameters governing pumpability, fluid loss control, appropriately adjusted thickening time, and the ability to penetrate formations with very low permeability. Due to the fact that squeeze cementing operations require pumping cement slurry under pressure into systems of narrow fractures, their design is complex and requires precise formulation adjustment. The laboratory investigations focused on slurries based on microcement combined with Class G oil well cement. The effect of microcement content on the properties of both fresh and hardened slurry was analyzed. The experimental program included measurements of slurry density, determination of rheological parameters in accordance with the Bingham model, evaluation of fluid loss, thickening time, and spreadability. Additionally, compressive and flexural strength of samples were determined after different curing periods. As part of the study, a concept of a testing apparatus for evaluating the injectability of cement slurry through narrow slots was proposed, simulating real conditions encountered during the sealing of cement sheath fractures. This solution may constitute a direction for future research, enabling a more precise assessment of slurry performance in squeeze cementing applications. The obtained results confirm that microcement content significantly influences the technological properties of the slurry, affecting both its penetration capability and mechanical strength parameters. The findings indicate the necessity of comprehensive formulation optimization, including proper selection of the water-to-cement ratio and the dosage of plasticizing additives, in order to achieve a balance between pumpability, fluid loss control, and mechanical durability. The results of the study may provide a basis for designing more effective cement slurry formulations intended for specialized remedial well operations.

Harnessing Agricultural Feedstocks for Petroleum Transition: Insights from Indonesia for a Competitive Molasses-Based Bioethanol Policy Framework in Southeast Asia

Agung Firmana

University of Dundee

United Kingdom

Southeast Asia is home to agricultural products that offer huge potential as resources for biofuel development. One of these is molasses, a residue from sugarcane processing, which can be used as a feedstock for bioethanol production. Bioethanol can then be blended with gasoline for use as transportation fuel. However, most countries still depend on imported gasoline, reducing their energy resilience and contributing to higher global emissions annually. This is due to the lack of economic and policy instruments to bridge the cost gap, resulting in bioethanol being naturally uncompetitive. This study presents an economic and policy analysis using Indonesia as a case study for producing bioethanol from sugarcane molasses, showing its role in reshaping petroleum dependency and reducing GHG emissions through designed sustainable frameworks for the bioethanol. Indonesia produces a significant amount of molasses that provides strong potential as a bioethanol feedstock, as it delivers high yields and complies with most sustainability criteria, with an estimated GHG reduction of 69%. Using a net present value (NPV) model, this research simulates financial performance under different blending percentages (E5, E10, E20) and market prices to achieve attractive investment outcomes. This includes quantifying the bioethanol break-even price to make the project economically viable. It then quantifies the energy-adjusted cost difference needed to compete with gasoline and designs policies to close the cost gap using carbon pricing frameworks that generate revenue from carbon abatement. This provides a better alternative rather than relying on government subsidies, which could place a financial burden in the long term. The approach also incentivizes bioethanol production and forms a market-based solution rather than setting administrative interventions. The results show that if E5 can be implemented nationwide in Indonesia, it can reduce gasoline imports by 1.5 billion litres and reduce emissions by 3.6 $MtCO_2e$ annually, with greater effects at higher blending percentages.However, E5 projects will need additional financial support amounting to USD 213.6 million per year, equivalent to a carbon price of 59.73 USD/tCO_2. This price is within the global benchmark, such as the Renewable Transport Fuel Obligation (RTFO) in the UK, which produces Renewable Transport Fuel Certificates (RTFCs) accounting for approximately 26 p/litre, or equal to 152 USD/tCO_2 depending on supply and demand. This research provides valuable insights for policymakers to design well-established market-based frameworks and solutions for both emission reduction and energy resilience by benefiting the agricultural sector. Keywords: Bioethanol, Carbon Pricing, Energy Resilience, GHG Reduction.

Partially Liberalising Indonesia’s Electricity Market: Lessons from India for Procurement Transparency, Price Formation, and Renewable Energy Deployment

Rizky Duanita Hermilia

University of Dundee

United Kingdom

Indonesia’s electricity sector is characterised by a fully regulated, vertically integrated, single-buyer model in which Perusahaan Listrik Negara (PLN) controls generation procurement, transmission, and retail supply. Electricity tariffs are set by the government, and most new capacity is contracted through negotiated Power Purchase Agreements (PPA) with Independent Power Producers (IPP). While this model has historically supported electrification and affordability objectives, it has also resulted in limited transparency, non-competitive procurement, costly long-term coal contracts, and slow renewable energy deployment (Halimatussadiah et al., 2024). This paper examines whether partial electricity market liberalisation could address these challenges by drawing lessons from India’s experience, using a qualitative comparative approach, this study analyses the structural limitations of Indonesia’s current electricity market and evaluates the potential impacts of selective liberalisation. A PESTEL framework is applied to assess the political, economic, social, technological, environmental, and legal opportunities and risks associated with reform. The analysis focuses on procurement transparency, price formation, investment incentives, and renewable energy uptake.

The findings suggest that carefully sequenced reforms—such as competitive renewable auctions, transparent market-based pricing, open grid access, and stronger regulatory independence—could reduce system costs, improve investment certainty, and accelerate Indonesia’s energy transition. However, these benefits depend on managing distributional impacts, addressing coal-related lock-in, and maintaining affordability. Partial liberalisation is therefore best viewed not as deregulation, but as a strategic redesign of market institutions to support Indonesia’s long-term decarbonisation goals.

Decarbonising UKCS Offshore Oil and Gas Assets Through Integrated Green Hydrogen Power Systems: A Comprehensive Technical Framework

Prince Innocent

Robert Gordon University

United Kingdom

The United Kingdom faces urgent need to decarbonise offshore oil and gas operations to reduce offshore carbon emissions and meet statutory climate commitments. Within the United Kingdom Continental Shelf (UKCS), power generation represents 79% of offshore carbon emissions, creating a significant challenge for achieving the UK's targets of 50% emissions reduction by 2030, 90% by 2040, and Net Zero by 2050. Current offshore assets rely on fossil fuel-based power generation with limited adoption of alternative energy systems despite increasingly demanding regulatory requirements. This study evaluates integrated green hydrogen power systems as a technically viable pathway to decarbonise existing offshore assets while maintaining operational reliability. This research develops a Comprehensive Offshore Green Hydrogen Framework to evaluate decarbonisation pathways across the UKCS. The methodology applies a mixed-methods approach combining quantitative technical analysis with economic evaluation. A novel Factor-Based Matrix Model correlates platform size, age, and production volumes to establish energy consumption profiles across over 65 producing assets, accounting for the operational characteristics of aging infrastructure and declining production rates. Multi-Criteria Decision Analysis evaluates alternative electrolyser and fuel cell technologies across five weighted criteria: technical performance (41.6%), marine environment compatibility (26.2%), operational considerations (16.1%), installation requirements (9.9%), and economic factors (6.2%). The framework integrates North Sea wind resources, which demonstrate capacity factors of 60 to 70% at deep offshore sites, significantly exceeding onshore alternatives.The analysis identifies Proton Exchange Membrane (PEM) technology as optimal for both electrolysis (MCDA score 0.739) and power generation (MCDA score 0.713) in marine applications, driven by superior dynamic response capabilities essential for variable renewable integration. Nine strategic hydrogen production hubs are positioned to leverage existing offshore wind capacity, requiring 1,800MW total electrolyser capacity to produce 854,450 tonnes of hydrogen annually. Implementation follows a phased deployment strategy spanning immediate (0 to 5 years), medium-term (5 to 10 years), and long-term (over 10 years) timeframes, delivering 70 to 80% reduction in power generation emissions equivalent to 6.8 million tonnes of CO_2 annually. The research addresses critical knowledge gaps in offshore decarbonisation practice through three distinct contributions. It provides the comprehensive technical framework addressing hydrogen integration with existing UKCS infrastructure while accounting for North Sea environmental conditions. The Factor-Based Matrix Model offers a standardised methodology for energy assessment across diverse platform configurations, filling a gap in current evaluation approaches. Additionally, the phased implementation strategy provides industry operators with practical guidelines for equipment selection, hub positioning, and infrastructure development under operational offshore conditions.

The effect of heating rates on Wax Disappearance Temperature (WDT) measurements by the Cross-Polarization Translucency (CPT) method

Fidel Lopez Gomez

TU Clausthal

Germany

Maintaining flow during production and transportation of crude oil is essential in both onshore and offshore operations. Flow assurance requires an understanding of the complex interactions among fluid composition, flow regime, and thermal properties. Wax deposition occurs when the temperature of the fluid drops below the Cloud Point or Wax Appearance Temperature (WAT), which is defined as the temperature at which the first paraffin crystal forms. Multiple experimental methods exist for measuring WAT: Differential Scanning Calorimetry, Ultrasonic Methods, Cross-Polar Microscopy, and Cross-Polarization Translucency, to name a few. However, WAT measurements depend on the methodology and the sample cooling rate: the faster the cooling rate, the lower the measured WAT will be, due to supercooling effects and the time required for nucleation and crystal growth. Nevertheless, these wax deposits are reversible, and the temperature at which the last precipitated paraffin redissolves in the oil is known as the Wax Disappearance Temperature (WDT). WDT is regarded as a solid-liquid equilibrium point; an accurate measurement is vital to a deeper study of wax deposition. Currently, literature and experimental studies on WDT measurement are limited. The objective of this study is to close that gap by exploring the impact of the heating rate on WDT measurements. For this work, the WDT of multiple crude oils with different wax content was measured using Cross-Polarization Translucency (CPT). This method is based on the ability of hydrocarbon crystals to reorient the oscillation angle of the polarized light illuminating the sample; these changes are recorded as the WAT or the WDT, depending on whether the sample is being cooled or heated. The results of this investigation suggest that the WDT measurements are less dependent on the kinetics of crystal formation and less susceptible to superheating effects, which would represent an actual equilibrium state and the liquid-solid saturation temperature. Utilizing WDT measurements to develop and validate predictive thermodynamic models of wax deposition would provide a better approximation of real-world wax precipitation conditions.

Uncertainty assessment of microbial effects on underground hydrogen storage using tNavigator

Naswa Lunani

Technical University of Clausthal

Germany

Underground gas storage (UGS) modelling approaches were originally developed for natural gas systems, which are mainly methane-based. Consequently, many correlations describing thermodynamic behaviour, phase equilibrium, and flow properties were formulated and calibrated for methane-dominated systems. As underground storage sites are now being considered for hydrogen storage, the applicability of these correlations to hydrogen-rich systems must be reassessed. In addition to distinct thermophysical properties, hydrogen storage is further complicated by potential microbial activity, particularly methanogenesis, which converts hydrogen and carbon dioxide into methane and may alter gas composition over time. The benchmark study by Hogeweg et al. (2022) was developed to evaluate the capability of reservoir simulators to model underground hydrogen storage.

The study defined a common geological model, fluid system and operational schedule, and introduced four scenarios differing in hydrogen content and inclusion of microbial activity. While the research simulator DuMuX enabled full implementation of microbial kinetics using a double Monod formulation, the commercial simulator ECLIPSE was limited to purely physical cases, highlighting constraints in representing biochemical reactions within commercial tools. Using the commercial simulator tNavigator, this thesis implements the scenario of physical kinetics with 10% hydrogen in the injected gas stream coupled with microbial methanogenesis. Methanogenesis is represented through an Arrhenius-based reaction formulation, providing an alternative kinetic approach within a commercial modelling environment. The implementation is compared with the double Monod formulation applied in the research simulator DuMuX to determine whether Arrhenius kinetics offer a practical and robust representation of microbial effects in commercial simulators, where direct application of the double Monod approach is limited. In addition, a detailed sensitivity and uncertainty analysis is conducted to quantify the influence of key microbial kinetic parameters on hydrogen recovery and storage performance.

Hierarchical Phase-Adaptive Machine Learning Framework for Real-Time Non-Productive Time Prediction in Offshore Drilling

Julia Mbamarah

Robert Gordon University

United Kingdom

Non-productive time (NPT) prediction in offshore drilling operations faces a critical challenge where the relative importance of operational parameters varies significantly across drilling phases and geological formations, yet conventional machine learning models apply static feature weights throughout the well-bore. This study presents a novel hierarchical phase adaptive feature weighting framework that dynamically adjusts parameter importance based on real time drilling phase classification and formation type identification.

The methodology was developed using 2.38 million time series records from the Volve Field, offshore Norway, spanning 84 days of continuous drilling operations across 15 wells. The study developed 90 features incorporating rolling window statistics, rate of change metrics, and physics-based calculations including Mechanical Specific Energy (MSE). Statistical analysis revealed significant distributional shifts for 87% of engineered features ($p < 0.01$) when comparing normal operations versus the 30-minute warning period preceding NPT events. The phase adaptive framework integrates three hierarchical levels of real time classification including drilling phase identification from inclination measurements, formation type determination from gamma ray logs, and dynamic feature weight adjustment through phase specific multipliers. Phase specific analysis revealed distinct parameter priorities across drilling contexts, with depth-related features showing highest importance in vertical sections (0.062), directional control parameters dominating curved sections (0.071), and standpipe pressure emerging as the critical indicator in lateral drilling (0.084). Comparative evaluation demonstrates that the phase adaptive approach achieved 99% overall accuracy with significant improvements over static weight models, including 12% accuracy enhancement during phase transitions, 34% reduction in false positive alarms, and 18% improvement in early detection lead time. The framework maintained roboust performance during external validation on an independent well (F1 score of 0.95), with strong results in detecting equipment related NPT events 30 minutes in advance. Cost benefit analysis indicates potential savings of $375,000 per well through early intervention, with projected field wide annual savings exceeding $15 million. The hierarchical phase adaptive framework addresses a fundamental limitation of existing NPT prediction systems by accounting for the dynamic nature of drilling operations where parameter relationships vary across operational phases.

This methodology provides a replicable approach for adaptive machine learning in complex industrial time series applications where operational context fundamentally alters system dynamics, with direct applications to real time drilling optimisation, predictive maintenance, and automated parameter control across diverse geological environments.

A Data-Driven Framework for Predicting Mud and Filtrate Alkalinity in Drilling Fluids

Ahmet Önder

Istanbul Technical University

Turkey

Modern drilling operations rely heavily on the continuous monitoring of drilling fluid properties to maintain well control, ensure borehole stability, and optimize cuttings transport. Among these properties, alkalinity is essential for preserving the chemical balance and buffering capacity of drilling fluids. However, key alkalinity measurements phenolphthalein end point of the mud (Pm), phenolphthalein alkalinity of the mud filtrate (Pf), and methyl orange alkalinity end point of the mud filtrate (Mf) are still determined through manual titration in routine operations. These conventional methods are time-consuming, prone to human error, and limit real-time decision-making.

This study introduces a data-driven approach to transform alkalinity measurement by enabling rapid, reliable, and automated estimation using machine learning. A comprehensive dataset consisting of 1,600 mud reports and laboratory measurements collected under diverse drilling conditions was used to develop predictive models. The dataset includes rheological properties, fluid loss parameters, and chemical composition variables that are readily available during drilling operations. More than ten machine learning algorithms were evaluated to predict Pm, Pf, and Mf values. Model performance was assessed not only with statistical metrics but also against laboratory repeatability limits, ensuring practical reliability. Extreme Gradient Boosting achieved the highest accuracy for predicting Mf, while a two-stage learning strategy—using predicted Mf as an intermediate variable—enabled improved estimation of Pf and Pm. This approach reduced model complexity while maintaining high predictive performance.

The results demonstrate that machine learning can deliver alkalinity estimates with accuracy comparable to laboratory measurements while significantly improving speed and consistency. By reducing reliance on manual testing and enabling near real-time monitoring, this framework supports safer drilling operations and advances the digital transformation of the oil and gas industry.

Design of geothermal boreholes for a geothermal power plant in the Podkarpackie Province

Wojciech Piotr Ornat

AGH University of Krakow

Poland

The main goal of this project is to come up with the designs for geothermal wells that have different trajectories. Within the scope of the project, comprehensive work strength and heat loss calculations to the rock formations, plus a thorough financial analysis. Based on geological field studies at the regional scale, the location of a geothermal power plant has literally been chosen. The plant is intended to be the energy source for the town of Brzozów, which will supply energy to the glassworks and various commercial buildings in the town.

After a literature survey and geological data, the research paper has adopted very specific well casing designs and borehole trajectories. In this paper the heat loss to the surrounding rock formation is calculated, and the solution to minimize it is also presented. The two variants are presented with cost analysis. On the exhaust, this project should be considered as a delivery to the local authorities in terms of the potential placement of a geothermal power plant in the future, a strategic plan for the modernization of the energy infrastructure of the region.

Gas flaring mitigation strategy through on-site CO2 capture and storage in nearby depleted reservoirs: The case study of Prinos field

Alexandros Psalidas

Democritus University of Thrace

Greece

Gas flaring remains a common operational practice in oil fields for managing associated gas that cannot be immediately commercialized or exported. Although this approach ensures safe disposal and operational continuity, it results in significant CO_2 emissions and increasing environmental and regulatory pressure. At the same time, Carbon Capture and Storage (CCS) technologies are being actively developed worldwide, with depleted oil reservoirs recognized as technically suitable formations for long-term CO_2 storage. This study investigates an integrated strategy that connects these two techniques: the mitigation of gas flaring emissions and the utilization of nearby depleted reservoirs for geological CO_2 storage. The proposed concept applies to oil fields where a productive well producing associated gas operates in proximity to an exhausted reservoir suitable for storage. In the examined configuration, associated gas is first utilized for onsite power generation to ensure platform energy autonomy. Any remaining gas is flared in accordance with operational practice. In both cases, the CO_2 generated from combustion is captured and transported for permanent storage in the adjacent depleted reservoir. The feasibility of this approach is evaluated through a case study based on the Prinos oil field in the North Aegean Sea, Greece. The Prinos complex presents a unique configuration, combining an active offshore production facility and a nearby depleted reservoir currently considered for CO_2 storage development. Using real field-based data and engineering calculations, the study assesses the technical viability of integrating post-combustion CO_2 capture, conditioning, and compression within existing offshore operational constraints. Three operational configurations are examined to determine the most beneficial implementation pathway, focusing on emission reduction potential, energy implications, and system compatibility with storage requirements.

The analysis emphasizes mass and energy balances, capture feasibility, and operational integration. The results demonstrate that coupling offshore production facilities with adjacent depleted reservoirs can provide a technically grounded pathway for substantial emission reduction without compromising operational continuity. The proposed framework illustrates how mature oil provinces can transition toward lower-carbon operation by leveraging existing infrastructure and geological assets, offering a replicable model for similar offshore fields worldwide.

Experimental Quantification and Geochemical Model Validation of Barite Scaling under Static and Dynamic Flow Conditions

Alia Saddik

University of Leoben

Austria

This research focuses on the need to predict barium sulfate scaling in flow systems, where geochemical models are commonly used without validation in changing conditions. The aim is to conduct controlled experiments to check the predictions of geochemical models and to predict, quantify and characterize barite scaling. Static tests assess how precipitation behaves thermodynamically, while dynamic flow loop evaluations measure deposition rate and the governing scaling mechanisms. The influence of temperature 25,85°C, supersaturation, and transport processes is analyzed to distinguish between equilibrium controlled and reaction transport controlled scaling.

IOR in Unconventional Oil Reservoir through synergistic effect of Ketone

Matteo Scarano, Luis E. Zerpa

Politecnico di Torino

Italiy

Objectives/Scope: Unconventional oil reservoirs are characterized by low permeability, low porosity, and significant heterogeneity, all of which negatively affect primary oil recovery. This study focuses on modifying key reservoir parameters, namely wettability and interfacial tension (IFT), to enhance production and facilitate oil expulsion from the tight matrix. In this paper, we assess the effectiveness of the synergism between a mutual solvent and a surfactant in promoting incremental recovery compared to their individual injection. The wettability modifier, a ketone (mutual solvent), aims to alter the rock surface from oil-wet to water-wet to promote imbibition. Simultaneously, the surfactant decreases IFT, promoting oil flow through the fractures. The scope includes evaluating interfacial properties of fluid-fluid and rock-fluid interactions at reservoir conditions and performing core-scale experiments to quantify the incremental oil recovery achieved by this novel formulation.

Methods, Procedures, Process: The experimental program began by selecting Colton Sandstone core samples, which are representative of unconventional tight reservoir properties (permeability 0.1–2 mD; porosity 7–10%). Core plugs were characterized for porosity, permeability, and pore volume, and then aged in crude oil at a reservoir-relevant temperature (75°C). To evaluate interaction properties, various chemical formulations were prepared in synthetic brine using a nonionic surfactant and a ketone (3-Pentanone), including single-component and synergistic mixed formulations. A high-pressure/high-temperature tensiometer was used to measure IFT and contact angle. Additionally, a custom-made core-flooding apparatus was utilized to evaluate incremental oil recovery against individual components and primary brine floods. The core floods were conducted under controlled conditions using a huff-n-puff procedure. Results, Observations, Conclusions: Analysis of the chemical actions confirms the distinct roles of the ketone and surfactant. The ketone (3-Pentanone) demonstrates a strong effect on altering wettability toward more water-wet conditions, while showing a weaker response in altering IFT. Conversely, the surfactant provides low IFT values, indicating strong oil mobilization potential. By exploiting the dual benefits of both substances, simultaneous IFT reduction and favorable wettability alteration are achieved. Core flooding results are expected to reveal that the combined mixture provides superior oil recovery compared to individual surfactant or ketone injections.

Optimization of Gas-Condensate Field Development Strategy Using Integrated Production Modeling (Prosper & MBAL)

Yurii Typusiak
Ivano-Frankivsk National Technical University of Oil and Gas
Ukraine

The object of this study is a deep-seated gas-condensate field (depth > 4500m) characterized by complex tectonic structure and currently operating at a mature stage of depletion. The primary challenge is to identify an optimal development strategy to maximize hydrocarbon recovery under conditions of declining reservoir pressure and retrograde condensation risks. This study utilizes the IPM software suite (Petroleum Experts) to perform an integrated analysis of the reservoir performance. First, well models were built and matched in PROSPER to generate precise Vertical Lift Performance (VLP) curves. Second, a material balance model was developed in MBAL, incorporating PVT analysis and history matching of production data to simulate reservoir behavior without referencing specific geographical coordinates. Three development scenarios were simulated for a 10-year forecast: 1. Base Case: Natural depletion with existing well stock. 2. Optimization Scenario: Reduction of the operating (wellhead) pressure to minimize backpressure on the reservoir. 3. Investment Scenario: Drilling of new infill wells to target undrained sectors. The simulation results indicate that the Base Case yields a baseline cumulative gas recovery. Reducing the operating pressure provides a moderate increase in recovery (+19% compared to base), primarily by extending the well life cycle. However, the Investment Scenario (drilling new wells) proved to be the most effective, increasing cumulative recovery by approximately 74%. The study concludes that while lowering operating pressure isa cost-effective operational measure, substantial recovery growth requires drilling new wells to access unswept reservoir volumes.

Numerical Assessment of Geothermal Energy Integration in Mature Natural Gas Reservoirs

Marcela Vargić

Clausthal University of Technology

Norway

Understanding how geothermal energy can be integrated with conventional natural gas production is increasingly important as subsurface energy systems are adapted to support the transition toward a lower-carbon energy supply. Mature gas reservoirs offer the potential to produce geothermal energy while extending hydrocarbon recovery by reusing existing infrastructure. In particular, the use of geothermal heat offers significant potential to meet local and regional heat demand in villages and towns near mature gas production fields, thereby improving overall energy efficiency. This study investigates the integration of geothermal energy extraction and natural gas production in mature sandstone reservoirs, with a focus on the Middle Buntsandstein Formation in Northwest Germany. The modeling framework evaluates geothermal-assisted gas production over 30 years, examining the influence of well configuration and reservoir geometry on thermal and water breakthroughs. Different structural and stratigraphic settings, including horizontal, anticlinal, and inclined reservoirs, are analyzed to assess the optimal well placement in geothermal– natural gas systems.

The research indicates that integrating geothermal production can enhance cumulative gas recovery compared with conventional production scenarios. This improvement is primarily attributed to delayed water breakthrough. The use of industry-standard reservoir modeling and simulation tools supports the applicability of the results to real-world subsurface energy assessments. While the study demonstrates the theoretical potential of geothermal–natural gas co-production, uncertainties remain regarding practical implementation and operational constraints. This work contributes to ongoing research on the sustainable utilization of mature gas reservoirs and their role in the evolving energy transition.

Keywords: Geothermal–natural gas co-production, Mature gas reservoirs, Subsurface energy systems, Reservoir modeling and simulation, Energy transition, Well configuration optimization.

SPC abstracts - PhD Candidates

Rate-Controlled Intermittent Connectivity and Dynamics During Drainage in a Natural Caprock Fracture

Sahyuo Buo Achuo Dze

Heriot-Watt University

United Kingdom

Caprock integrity controls long-term containment in fluid storage and other subsurface injection operations, yet fractures and reactivated faults can provide focused leakage pathways even when the surrounding seal rock has extremely low matrix permeability. Leakage risk therefore depends not only on how much non-wetting fluid enters a fracture, but on whether it forms a persistent inlet-connected pathway or remains fragmented into disconnected clusters that intermittently reconnect. We use three-dimensional Volume-of-Fluid direct numerical simulations (DNS) of immiscible decane–brine drainage in a natural rough-walled fracture hosted in a low-permeability caprock. Injection rate is varied over two orders of magnitude (10^-3 – 10^-5), thus capillary number, from results are compared as a function of pore volumes injected. Connectivity is quantified using inlet-connected non-wetting volume fraction, disconnected cluster counts, and cluster-size distributions. These topology metrics are linked to local capillary pressure statistics and to aperture-conditioned occupancy to determine where connected and disconnected structures reside within the aperture field. As capillary number decreases, invasion commonly advances while remaining disconnected from the inlet for extended intervals. Snap-off followed by reconnection produces intermittent, pulsed connectivity rather than monotonic growth of a connected backbone. Across the studied rates, the peak disconnected non-wetting volume fraction increases thirty-four-fold as capillary forces become dominant. Disconnected clusters frequently lead the inlet-connected front, indicating that distal invasion can precede hydraulic connectivity to the inlet.

Aperture-conditioned analysis shows that disconnected clusters preferentially occupy larger apertures and occur at lower capillary pressures than the connected phase, while narrow constrictions govern pathway continuity and trigger snap-off. The key contribution of this work is the use of DNS to provide time-resolved, quantitative characterization of connectivity intermittency in a natural caprock fracture, directly linking invasion topology, capillary pressure and aperture structure. The results demonstrate that saturation alone is insufficient to describe hydraulic state in caprock fractures under capillary-dominated conditions, and they provide pore-scale metrics that can be used in subsequent work to estimate effective transport properties and improve leakage assessment and monitoring models.

Evaluation of the first Successfully Implemented Fishbone Jetting Stimulation in The Iraqi Tight Carbonate reservoir

Asaad Hashim Kadban Al-Saedi

Heriot-Watt University

United Kingdom

While the hydraulic fracturing with different number of stages has been used to enhance oil recovery in tight carbonate reservoirs, however this technique poses significant risks in the X formation in southern Iraq. The primary concern is the reservoir thin oil layers, the vertical propagation of uncontrol the hydraulic fracturing often breaks into water-bearing zones, causing excusive water production and rendering the wells uneconomical. To avoid this fear of water breakthrough and the high cost of the multi-stage hydraulic fracturing, this paper investigates the successful application of fishbone jetting stimulation technology superior alternative for completing this tight formation. Unlike uncontrolled fracturing, fishbone technology utilises liners subs equipped with four needles to penetrate the formation by acid injection.

A key aspect of this study is the optimisation of the fishbone design to match the reservoir thinness to ensure success in the X formation. The needles length was tailed to 7 meters, rather than the standard approximately 12 meters, to ensure the simulation remains strictly within the thin oil-bearing zone and avoids underlying water. The feasibility of this design was assessed using a special simulation designed to model a single well of fishbone. Real field data was used to model the fishbone with 16 subs. Additionally, laboratory tests on core samples using 15% hydrochloric acid (HCl) at a 1450 psi differential pressure confirmed that the formation is soluble and penetrable. The pilot test demonstrated that fishbone stimulation significantly increased oil production and production rate, with an estimated daily output of 3,435 bbl/day, exceeding the design allocation of 2,000 bbl/day and becoming the production well with the highest production in this formation. This technology offers a promising method for increasing oil rate and productivity index in the X formation while effectively mitigating the risk of water coing associated with traditional stimulation methods. Keywords, fishbone stimulation technology, multi-stage hydraulic fracturing, tight formations, water coing.

Digital Twin-Based System for Carbon Dioxide Dispersion Forecasting in Pipeline Failure Scenarios

Paweł Bielka

AGH University of Krakow

Poland

The safe operation of carbon dioxide (CO2) pipeline infrastructure is a critical challenge for the large-scale deployment of carbon capture and storage (CCS) systems. In pipeline failure scenarios, released CO2 may form a hazardous dispersion cloud whose extent and evolution depend on release conditions and rapidly changing meteorological parameters, making early-stage hazard assessment difficult under operational time constraints. Existing analyses are often based on predefined offline scenarios and do not fully support real-time situational awareness during actual incidents. Therefore, there is a strong need for integrated digital tools capable of combining pipeline monitoring data, environmental inputs, and predictive modeling to support faster and more reliable emergency response decisions. To address this need, a Hybrid Gaussian Digital Twin (HyG-CO2DT) was developed as a digital twin-based system for carbon dioxide dispersion forecasting in pipeline failure scenarios. The proposed framework combines a Gaussian dispersion model with the SLAB model, which accounts for momentum and energy losses, as well as additional heat losses (convection to ambient). An experimental test rig was built, consisting of a controlled dispersion source and fast-response NDIR sensors. More than 500,000 time series representing CO2 plume contour evolution were collected and used to tune the developed theoretical model. A physics-informed Long Short-Term Memory (LSTM) model was employed to process the time-series data and support near-real-time forecasting of dispersion behavior. In the present study, the dispersion modeling and forecasting workflow was developed and evaluated for pure CO2. Model validation was performed using an additional synthetic test dataset generated in DNV Phast software, including variable wind speed, wind direction, and ambient conditions. Validation at selected timestamps showed a mean relative error below 5%, indicating high reliability and operational effectiveness for the considered scenarios. In addition to forecasting accuracy, the system enables near-real-time generation of CO2 dispersion contour maps for user-defined concentration thresholds, supporting flexible hazard assessment, hazard-zone visualization, and operational decision-making. The system also incorporates a pressure-based leak localization module using data from multiple virtual monitoring points to simulate pressure-drop dynamics at different locations along the pipeline. A random forest algorithm was used to estimate the most probable leak source zone based on temporal pressure-change patterns, including pressure-drop magnitude, rate of change, and anomaly arrival sequence. For a representative 10 km pipeline model with three virtual monitoring points located at 0, 5, and 10 km, the leak source prediction error was below 50 m. The estimated source location is then used as an adaptive input to the dispersion forecasting module, enabling more relevant and operationally useful predictions of hazard evolution during the early phase of an incident. The proposed system advances digital twin applications for carbon dioxide transport infrastructure by coupling pressure-based leak source estimation with near-real-time dispersion forecasting in one integrated framework. This integration can improve situational awareness, reduce the time between anomaly detection and hazard assessment, and support faster, better-informed operational decisions in CCS-related pipeline safety management. Future work will extend the framework to account for CO2 streams containing impurities and additional components, enabling more realistic modeling of non-ideal transported mixtures and their influence on leak behavior and dispersion dynamics.

Closing the Loop: Fully Autonomous Reservoir Optimization and History Matching

Muhammad Iffan Hannanu

Norwegian University of Science and Technology

Norway

Reservoir management is a decision-making problem that involves two parts: the history matching (HM) and reservoir optimization (RO). The parts are typically performed separately, using different tools and executed by different people in the asset teams. This procedure thus becomes time-consuming and will lead to suboptimal decisions. Some of the difficulties in coupling the two parts are: 1) the RO is typically seen as a luxury, unlike the HM process that is mostly required by the authority, 2) the lack of efficient optimization methods used to find optimal decisions, especially when ensembles of reservoir models are used, 3) the simulation architecture typically relies on file-based I/O and software behind a paywall which requires non-intrusive methods, and 4) it requires collaboration of the entire chain of the subsurface team to work; from geology to operation for the coupling to work as intended. Our aim is to address the dual objectives in the reservoir management problem: maximizing the economic measures while minimizing the mismatch between the reservoir model and the true reservoir. To do so, we propose a closed-loop framework adapted from Stochastic Model Predictive Control (SMPC) to couple both processes autonomously. One of the main advantages of using the SMPC framework is that it perfectly aligns with the ensemble-based approach that is now often used to address the uncertainty of the reservoir. We use the efficient derivative-free trust-region (DFTR) method to solve the non-linear optimization problem and the state-of-the-art ensemble smoother with multiple data assimilation (ESMDA) to solve the HM problem. We tested our framework on the ensemble of Egg benchmark reservoir models. The prior ensemble consists of 16 prior members selected from the original dataset, while another member is chosen to represent the true model. The reservoir parameters to match are the directional permeabilities and the production data to match is the bottom-hole pressure of the injector wells and the fluid rate of the producer wells. The decision variables are the rate of the water injection.

The results suggest that the framework gives significant improvement than the traditional silo approach. In general, it allows for both the model update and optimal decision making in a systematic and autonomous fashion. Specifically, we can automatically reduce the model mismatch relative to the true model, producing a posterior ensemble with better accuracy (lower variance and bias) for predicting the optimal NPV.

Coupling Thermodynamics and Kinetics for Predictive Design of Phosphonate Precipitation Squeezes

Mozhdeh Igder

Heriot-Watt University

United Kingdom

Scale deposition remains one of the most persistent flow-assurance challenges in oil and gas production, particularly in carbonate reservoirs where phosphonate scale-inhibitor precipitation squeezes are widely deployed. While precipitation squeezes can significantly extend treatment life, the prediction of inhibitor return concentration and squeeze longevity remains highly uncertain. In practice, many designs rely on empirical field trends and equilibrium solubility assumptions, with limited quantification of rate-controlled dissolution under dynamic near-wellbore flow. Improving the predictability of these processes is not only an efficiency and integrity objective, but also a sustainability lever: longer-lasting and better-forecast squeeze treatments reduce the frequency of well interventions, offshore vessel mobilisation, and associated logistics, while lowering total chemical volumes manufactured, transported, and injected. More reliable squeeze design, therefore, contributes to both operational optimisation and emissions reduction across the production lifecycle. Published studies have highlighted the importance of coupling thermodynamic solubility limits with mass-transfer kinetics and residence-time effects, yet experimentally derived, model-ready kinetic parameters that directly link laboratory measurements to simulator implementation remain limited. This study presents a structured, physics-based laboratory workflow to quantify both the thermodynamic solubility limit (Cs) and the dynamic dissolution rate constant (r) of phosphonate–Ca precipitates under field-representative pack-flood conditions. The objective is to generate directly implementable inputs for precipitation–dissolution and reactive-transport models used in squeeze design and lifetime forecasting.

Homogeneous phosphonate–Ca solids were synthesised ex situ using a controlled precipitation protocol to eliminate unbound inhibitor and ensure reproducible solid-phase chemistry. Thermodynamic solubility was measured in brine systems containing 2,000 ppm Ca across 21–95°C, providing temperature-dependent Cs values consistent with the chemistry used in subsequent dynamic testing. Pack-flood experiments were conducted in a silica sand pack (100–315 μm) under controlled flow rates incorporating step changes and extended 72-hour shut-ins to reproduce near-wellbore residence times and operational interruptions. Effluent inhibitor concentration, calcium, and pH were continuously monitored, enabling full mass-balance reconciliation and isolation of non-equilibrium dissolution mechanisms. Dynamic return profiles reproduced characteristic field behaviour, including an early concentration peak followed by a prolonged low-level tail. Controlled flow-rate variations enabled the extraction of a kinetically meaningful first-order mass-transfer coefficient linking dissolution rate to thermodynamic driving force through: $dC/dt = r \times (Cs - C)$ Sequential pack-flood sets conducted under identical hydraulic conditions demonstrated that precipitate inventory evolution and surface history significantly influence effective dissolution behaviour, effects not captured by purely equilibrium-based design approaches. These findings clarify the interplay between solubility limits, residence time, and rate-controlled release in governing inhibitor return and squeeze performance. The proposed workflow provides a coherent methodology linking controlled solid preparation, brine-matched solubility measurement, and dynamic dissolution testing to produce model-ready Cs and r parameters. Integration of these parameters into reactive-transport and squeeze-lifetime simulators reduces uncertainty in forecasting inhibitor return concentration and treatment duration. The results provide quantitative guidance for brine selection, shut-in scheduling, and treatment optimisation, supporting more reliable, cost-effective, and lower-emission scale management in production systems.

Reservoir and Geochemical Simulation of Stimulated Geologic Hydrogen via Serpentinization

Axel Perwira Indro

Heriot-Watt University

United Kingdom

Serpentinization is a geochemical process in which water reacts with ultramafic rocks to produce hydrogen and serpentinite. This reaction occurs naturally in subsurface formations, with geochemical literature and laboratory studies indicate that the process typically occurs at temperatures below 300°C, peaking at approximately 250°C (McCollom and Bach 2009). Recently, multiple studies have suggested that engineered serpentinization by introducing water into subsurface ultramafic formations could be a viable method for large scale hydrogen production (Menke et al. 2025, Sekar and Okoroafor 2025, Egert et al. 2026). However, ultramafic rocks typically have very low porosity and permeability This means water injection requires permeability enhancement through stimulation. This constraint directly influences the achievable hydrogen generation rate and thus the overall production performance of such projects. Current research into stimulated geologic hydrogen production remains limited. A reservoir simulation study (Sekar and Okoroafor 2025) utilized a reservoir simulator to estimate production performance, assuming an initial gas saturation of 0.8 within a stimulated formation. Similarly, another study (Egert et al. 2026) modelled permeability enhancement in a thick ultramafic formation, using an initial hydrogen generation estimate of 1x10-4 gH2/grock. While these studies focus on production output, the underlying geochemical reactions that generate hydrogen and secondary minerals are not thoroughly discussed. These may lead to secondary minerals precipitation and changes in fluid saturation and available pore volume.

The resulting changes may affect hydrogen generation efficiency and recovery performance. In light of the knowledge gap outlined above, this study aims to (1) model the geochemical reactions and their impact on hydrogen and secondary mineral yields, (2) develop a representative reservoir-scale model integrated with geochemical kinetics, and (3) conduct sensitivity analyses based on the resulting models. This study utilized a widely used geochemical simulator (PHREEQC) with a commercial reservoir simulator (CMG-GEM) to model serpentinization kinetics, pore volume evolution, potential gas souring, and fluid transport (Parkhurst and Appelo 2013, CMG 2025). The simulations are based on a synthetic, permeability-enhanced reservoir model (105m x 210m x 100m) at a depth of 4,500 m, featuring a single production well. Our results indicate that hydrogen generation ranges from 0.416 x 10-4 gH2/gRock to 1.261 x 10-4 gH2/gRock depending on the reaction extent. The precipitation of less-dense minerals can result in rock volume expansion and reduce available pore volume by up to 40% of the initial value. This reduction in pore space, combined with gas generation, can increase system pressure by up to 50 bar in the configured system. With a single production well capped at 6,000 m^3/day and a 60-bar (BHP) limit, the system can maintain a constant production plateau for up to 7 years, dependent on the modelled geochemical effects and reaction progress.

Comparative Studies of the Potency of Two Hydrate Inhibitors for a Hydrocarbon Field Using Aspen Hysys

Onyekperem Chigozirim Cyprian

ENS Paris-Saclay

France

Hydrate formation in multiphase hydrocarbon production has been a major challenge, especially at offshore environment. They result into plugs that block flowlines, plaques downstream equipment and flowlines' appurtenances such as Valves, Tees, Elbows, therefore posing a challenge in the Energy transition and blue hydrogen gas generation where natural gas is a vital commodity. The high cost of hydrate inhibition using thermodynamic hydrate inhibitors which require large quantities or its electrolytes (> or =50 wt%) to disfavor hydrate formation thermodynamically, forced Energy industry to develop and utilize low dosage hydrate inhibitors. However, both the thermodynamic and the low dosage hydrate inhibitors used by the industry, though quite effective, are very unfriendly to the ecosystem. This study investigated the performances and effectiveness of Poly Vinyl pyrrolidone (PVP), a commercially used hydrate inhibitor and Starch derived from Manihot Esculenta, using the hydrate formation utility tool package of Aspen Hysys V11.0 The performances of the considered hydrate inhibitors in a modeled flowline system with diameter 355.6 mm, length of 12.095km in deep water hydrocarbon field within the Gulf of Guinea, were analyzed based on actual condition and production data. The simulation results at 40% and 80% water cuts were plotted for both steady state and dynamic state using Matlab. Pressure and temperature variations along the flowline length for the different inhibitors' concentrations (0.05, 0.10, 0.15, 0.20 mole fractions, respectively) were generated for steady state simulations. The result of the steady state simulations made it evident that there was no risk of hydrate formation for the field considered and that the hydrate inhibitors had no effect on both the temperature and pressure changes of the flowline's throughput.

However, for dynamic state simulations at 40% and 80% water cuts respectively, it was observed that when no inhibitor was added, the flowline's throughput pressure declined from 61bar to 40.52bar and 32.43bar respectively, for 240 minutes. Likewise, the temperature of the flowline's throughput sharply declined and suddenly rose again, indicating hydrate formations at both water cuts. The injection of the considered hydrate inhibitors into the hydrocarbon at same concentrations as in the steady state simulations, curtailed the pressure declines and temperature fluctuations of the systems. It was observed from both water cuts that Starch performed favorably as PVP at 0.2 mole fraction concentration. It was also observed that the performances of the considered hydrate inhibitors increased as their concentrations were increased. Starch was therefore recommended for field pilot-test and further developed, utilized as an ecofriendly hydrate inhibitor.

Unveiling the Power of Oscillation: Comparative Analysis of Straight and Oscillating Jet Nozzles for Enhanced Wellbore Descaling and Cleaning

Mubaraq Adewale Razaq

Robert Gordon University

United Kingdom

Scale deposition within wellbore tubulars increases flow resistance, reduces injectivity, well integrity and can lead to costly well interventions. Conventional mechanical descaling which relies predominantly on straight jet nozzles (SJNs), which deliver highly concentrated high-pressure jets that offers limited coverage, reduced cleaning force in deviated or irregular geometries and extended descaling times(1). Oscillating jet Nozzles (OJNs) have emerged as a superior alternative, as their self-excited jet motions periodically sweeps across the wellbore wall, resulting in a larger effective coverage area and enhanced cleaning efficiency(2,3). This study presents a comparative and developmental investigation of straight and oscillating jet descaling technologies to identify performance advantages relevant to restoring and improving well injectivity and maintaining well integrity. A validated Computational Fluid Dynamics (CFD) model of the straight jet nozzle was first developed and benchmarked against controlled experimental result to establish baseline accuracy in predicting jet behaviour, stagnation pressure and cleaning force. A corresponding transient CFD simulation of the oscillating jet nozzle was subsequently developed using the straight jet nozzle design parameters, incorporating its internal feedback channels responsible for Coanda-driven jet deflection, attachment, detachment and the generation of oscillatory motion. The simulation captured the development of internal recirculation zones and the release of fully formed oscillating jets into the wellbore, consistent with previously documented behaviour. Results show that while both nozzle types exhibit increased cleaning and descaling force (6-44) N with water flow rates (25-58) L/min, the oscillating jet nozzle consistently produces broader impact footprint, a more uniform and high wall shear stress distribution and more effective circumferential coverage under same flow conditions.

Distinct oscillation regimes, from weakly deflection to fully sweeping jets were observed, confirming that optimised oscillation significantly enhances descaling performance compared with straight jets. Overall, the findings confirm the superiority of oscillating jet nozzle for improving wellbore descaling, accelerating descaling operations, reducing water and energy consumption, and ultimately enhancing injectivity. This work provides a robust scientific framework for the development of next generation oscillating descaling tools that support safer, more sustainable and more efficient well interventions.

Revitalizing Deep Heavy Oil Reservoirs in Dnieper-Donets Basin: Integrated Asset Modeling Approach

Iryna Vashchenko

Dnipro University of Technology

Ukraine

As the global energy industry makes a switch from frontier exploration to brownfield optimization, the Dnieper-Donets Basin must confront one central problem: recovering deep, heavy oil from thermodynamically depleted reservoirs. This study shows that traditional natural flow is thermodynamically inefficient, recovering less than 1% of OOIP due to high viscosity and hydrostatic barriers.

The main goal was to determine the actual thermodynamic limit of these assets and to utilize Integrated Asset Modeling (IAM) to monetize the potential energy loss. A multifaceted approach comprising EOS-based PVT analysis, VLP/IPR nodal modeling, and Material Balance simulation (0D-modeling) was employed to analyze reservoir energy dynamics over a 20-year lifecycle. This study quantified the effects of aquifer support uncertainty and artificial lift intervention. Findings show that, in stark contrast, the "Do Nothing" approach results in premature well death in less than 12 months and negligible recovery (0.31 MMSTB). Conversely, employing a scientifically calibrated ESP (Electrical Submersible Pump) system unlocks the potential of the reservoir with cumulative production reaching 11.1 MMSTB.

Sensitivity analysis indicates that the project withstands geological uncertainties and remains viable even in the face of the most pessimistic aquifer conditions. This engineering intervention turns a distressed asset into a high-margin venture, generating a Net Profit of $641 Million with a payback period of less than one month. This study demonstrates that thermodynamic optimization of existing deep wells is not only a technical necessity but also a powerful business strategy for sustainable energy supply.

Integrated Multi-Criteria Evaluation of Nigeria's Low Enthalpy Geothermal Potential for Sustainable Energy Transition

Ovye Musah Yohanna

Heriot-Watt University

United Kingdom

Nigeria faces two challenges: a scarcity of energy for its more than 200 million people and the need to achieve a net-zero emissions target. Fossil fuels dominate the energy mix, the national grid regularly collapses, and about 40% of households lack access to electricity. The Nigerian government aims to achieve net-zero emissions by 2060 through policies and plans such as the National Renewable Energy and Energy Efficiency Policy (NREEEP), the Renewable Energy Master Plan (RERM), and the National Energy Transition Plan (ETP). These policies encourage investment in clean energy options, including geothermal resources. Despite the presence of warm springs, with elevated heat-flow zones and favourable hydrogeological conditions indicative of low-enthalpy geothermal systems, existing studies are still at an infant stage, and these opportunities remain largely unexplored. Existing investigations are fragmented, site-specific, and insufficient to provide a coherent national-scale assessment of their potential contribution to Nigeria's energy transition. We adopt a multi-criteria approach informed by technical and non-technical factors, and our research presents Nigeria's major, extensive assessment of shallow geothermal potential throughout all 36 states and the Federal Capital Territory for development, employing a hybrid Multi-Criteria Decision Analysis that integrates the Fuzzy Analytic Hierarchy Process (FAHP) and the Technique for Order of Preference by Similarity to the Ideal Solution (TOPSIS). Four criteria were delineated: (1) thermal regime, determined by heat flow and Curie point depth; (2) hydrogeology, categorised by aquifer kinds; (3) surface manifestations, assessed through warm spring density; and (4) energy demand, derived from electricity shortages and heating requirements.

Scores were normalised, and FAHP-derived criterion weights were assigned as thermal regime (50%), energy demand (25%), surface manifestations (16%), and hydrogeology (9%), highlighting the significance of subsurface heat, followed by socio-economic factors. TOPSIS evaluated and categorised states according to their proximity to ideal conditions, using performance index (Pi) values from 0.6432 (highest) to 0.0321 (lowest). The leading states, Nasarawa, Bauchi, Benue, Cross River, and Borno, exhibit significant thermal and hydrogeological potential, particularly Nasarawa, which possesses a surface score of 0.839. Lower-ranked states, such as Lagos and Gombe, exhibit significant energy demand but subpar geothermal performance, with Pi values below 0.10. This research can serve as a guide to exploration, resource distribution, and policy formulation to advance geothermal energy, bolster resilience, reduce emissions, and facilitate sustainable heating. It highlights low-enthalpy geothermal energy as a practical pathway for Nigeria to support direct-use applications such as water heating, agriculture, aquaculture, and recreation.

Student Poster Session

Similarly to the SPC session, the 14th EMW Student Poster Session is also focused on exploring the results of the contestants' research projects.

This competition, however, takes on a different approach to the form of presentation. Students are required to prepare a poster, containing the essentials of their work in a concise form that is both easy to comprehend and eye-friendly. And even if you find anything that is not quite clear, there is no need to worry – the authors themselves will spend some time right next to their posters, ready to discuss and answer in detail any questions you might have.

Make sure to use this great opportunity to learn something new!

Student Poster Session Jury

Iwona Kowalska-Kubsik obtained a Master of Science in Engineering in Civil Engineering, with a specialization in building and engineering structures, from Lodz University of Technology. She also earned a Master's degree in Computer Science from De Montfort University in Leicester, United Kingdom.Until 2013, she was employed at the Faculty of Civil Engineering at Lodz University of Technology, in the Department of Mechanics of Materials. Since 2013, she has been affiliated with the Department of Drilling and Geoengineering at the Faculty of Drilling, Oil and Gas, AGH University of Science and Technology in Kraków.Her research interests include geoengineering, geotechnics, and computational numerical methods, particularly their application to the simulation of natural phenomena occurring in soils, such as landslides and sinkholes, as well as the behavior of pipelines installed in challenging ground conditions.

Katarzyna Chruszcz-Lipska obtained her MSc and PhD degrees in Chemistry from the Faculty of Chemistry at the Jagiellonian University in Kraków. Since 2013, she has been employed at the Department of Petroleum Engineering, Faculty of Drilling, Oil and Gas, AGH University of Kraków, Poland. Her research interests encompass a broad range of topics related to the composition and physicochemical properties of reservoir waters, crude oil, and reservoir rocks. She is also involved in research on environmental protection in the petroleum industry, with a particular focus on the removal of petroleum-derived substances from water.

Antony Martin holds a degree in Geology, graduating Anglia Ruskin University in 1995. He began his career in the Oil & Gas industry in 1996 as a mud logger. Working around the globe he progressed through MWD Engineer to Directional Driller. In 2012 he transitioned to an office role, coordinating Halliburton Sperry Drilling activities in Austria and Hungary before becoming Directional Drilling Manager for Continental Europe. He moved to the Austrian operator RAG in 2014, spending 5 years as a senior Drilling Engineer. In 2018, Antony started working for OMV in roles such as Directional Drilling Specialist, Drilling Cockpit Supervisor, senior project manager and his current (and favourite) role, Global Skill Pool Manager for Well Engineering and HSSE.

Przemysław Toczek is an Adiunct at the Faculty of Drilling, Oil and Gas of the AGH University of Science and Technology in Kraków, Poland, where he has been affiliated since 2016. He graduated from a technical secondary school of electrical engineering in 2002, received his MSc degree in 2009, and completed his doctoral studies in 2014. He was awarded the PhD degree in 2023. His research activity focuses on drilling engineering, geoengineering, well design, and technologies for the oil, gas, and geothermal sectors. His scientific output includes publications indexed in the AGH BaDAP database, as well as patented research solutions. The assumptions and outcomes of his doctoral research were patented and classified as confidential information.He combines academic and research work with extensive industrial experience. He worked as a drilling rig manager on shale gas, crude oil, and geothermal drilling projects. He is also the author and co-author of industrial expert reports prepared for the drilling, petroleum, and geothermal industries. He holds qualifications as a Mine Operations Manager.In his teaching activity, he delivers courses in oil and geothermal well design, drilling equipment, and petroleum drilling engineering. His academic work integrates scientific research with engineering practice, with a particular focus on innovative and application-oriented solutions for modern drilling and geothermal engineering.

Digital Twin-Based System for Carbon Dioxide Dispersion Forecasting in Pipeline Failure Scenarios

Paweł Bielka

AGH University of Krakow

Poland

The safe operation of carbon dioxide (CO2) pipeline infrastructure is a critical challenge for the large-scale deployment of carbon capture and storage (CCS) systems. In pipeline failure scenarios, released CO2 may form a hazardous dispersion cloud whose evolution depends on release conditions and rapidly changing meteorological conditions, making early hazard assessment difficult under operational time constraints. Existing analyses are often based on predefined offline scenarios and provide limited support for real-time situational awareness during actual incidents.

To address this gap, a Hybrid Gaussian Digital Twin (HyG-CO2DT) was developed as a digital twin-based system for carbon dioxide dispersion forecasting in pipeline failure scenarios. The framework combines a Gaussian dispersion model with the SLAB model to account for momentum and energy losses and convective heat losses to ambient conditions. An experimental test rig with a controlled dispersion source and NDIR sensors was built. More than 500,000 time series representing CO2 plume contour evolution were collected to tune the theoretical model. A physics-informed Long Short-Term Memory (LSTM) model was used to process time-series data. In the present study, the modeling and forecasting workflow was developed and evaluated for pure CO2 (100% CO2).

Validation against an additional synthetic test dataset generated in DNV Phast (including wind speed, wind direction, and ambient conditions) showed a mean relative error below 5% at selected timestamps. The system also generates predicted CO2 dispersion contour maps for user-defined concentration thresholds. A pressure-based leak localization module using a random forest algorithm achieved leak source prediction error below 50 m for a representative 10 km pipeline model with virtual monitoring points at 0, 5, and 10 km.

The integrated framework improves early hazard assessment and supports faster operational decision-making. Future work will extend the system to CO2 streams containing impurities and additional components to better represent non-ideal transported mixtures.

Thermal Maturity of Organic Matter in the Northeastern Carpathian Foredeep

Dominika Bogdziewicz, Marek Solecki, Marta Waliczek

AGH University of Krakow

Poland

Thermal maturity of organic matter is a key factor controlling hydrocarbon generation in sedimentary basins. Vitrinite reflectance (R_o) is widely used as a reliable indicator of maximum burial temperature and the degree of organic matter transformation.

The northeastern part of the Polish Carpathian Foredeep is an important gas-bearing region, where Miocene clastic deposits overlie deeply buried Precambrian basement rocks. In the Cewków area, natural gas occurrences have been documented, particularly in the Cewków-2 well.

This study is based on vitrinite reflectance measurements performed on core samples from the Cewków-1 (1014–1562 m) and Cewków-2 (1090–1501 m) wells. The Miocene strata show low VR_o values (0.33–0.39%), indicating thermally immature organic matter with no potential for thermogenic hydrocarbon generation. In contrast, significantly higher values (1.37–1.48%) were obtained from the deepest Precambrian samples, corresponding to advanced thermal maturity and the gas generation window.

The results indicate a clear thermal contrast between the Miocene succession and the Precambrian basement. This suggests that thermogenic hydrocarbons may originate from deeper, more mature formations, while the Miocene interval remains thermally immature.

Study of the effectiveness of restoring the permeability of the near-borehole zones

Artur Bystrai

AGH University of Krakow

Poland

When drilling into a reservoir zone, the main goal is to reach it without damaging the pore space. Damage to the pores can happen because of the drilling mud. Drilling mud, especially when it has solid particles and clay, can block the pores near the wellbore — this is called formation damage. To avoid this, drilling fluids often contain bridging agents, usually finely ground carbonate rocks. These small particles move into the pore spaces of the reservoir zone. While drilling through the productive layer, they protect it from the further invasion of drilling mud and its filtrate. After drilling is finished, the area where the bridging agents entered the formation is cleaned with hydrochloric acid (HCl). The acid reacts with the carbonate ($CaCO_3$), dissolving the blocking material. This process restores the permeability of the reservoir zone and allows hydrocarbons to flow freely into the well.

The aim of this work is to explain the theoretical background of this topic and to perform laboratory tests that confirm the effectiveness of this process.

Origin of Hydrogen and Hydrocarbons Based on Hydrous Pyrolysis: Evidence from Lower Palaeozoic Strata, Baltic Basin

Weronika Cyran

AGH University of Krakow

Poland

Hydrous pyrolysis is a laboratory technique used to simulate the natural processes of thermal maturation of organic matter and the generation of gaseous and liquid hydrocarbons and other products under conditions approximating the geological environment (Lewan, 1985). This method involves the isothermal heating of rock samples in closed reactors while maintaining continuous contact with liquid water (Lewan, 1985).

The aim of this study was to determine the origin of hydrogen and hydrocarbons accumulated in the Lower Paleozoic deposits of the Baltic Basin based on the results of molecular and stable isotopic analyses of gases generated during hydrous pyrolysis experiments. Rock samples representing the Caradoc and Llandovery were analyzed. The experiments were conducted for 72 h at temperatures 330 and 400 °C.

The highest hydrogen concentrations were observed in gas generated from the sample representing Jantar Formation, while the highest hydrocarbon concentrations were occured in gas generated from the sample representing Sasino Formation. Elevated hydrogen concentrations are presumably associated with the radiolysis of water resulting from the presence of radioactive elements, indicating a significant role of radiogenic processes (Kosakowski et al., 2017). The generated gaseous hydrocarbons show geochemical isotopic similarity to thermogenic gases accumulated in the Baltic Basin (Kotarba and Lewan, 2013).

The results obtained indicate that hydrous pyrolysis is a useful tool for a better understanding of the mechanisms of hydrogen and hydrocarbon formation in the Baltic Basin.

The Potential Role of Nuclear Energy in Poland's Energy Transition

Izabela Herbin

AGH University of Krakow

Poland

Poland's energy transition is a complex and long-term process shaped by the need to reduce greenhouse gas emissions, increase the share of renewable energy sources, and improve energy security. Due to its historical reliance on fossil fuels—particularly coal and imported hydrocarbons—Poland faces significant challenges in achieving a sustainable, independent energy system.

Poland's nuclear energy strategy is part of its broader national energy policy, including documents such as the Energy Policy of Poland until 2040 (PEP2040) and the Polish Nuclear Power Program (PPEJ).

This study discusses the role of nuclear energy in Poland's evolving energy mix, particularly in the context of renewable energy development. While renewable energy sources such as wind and solar power play a crucial role in decarbonization, their variability creates challenges for maintaining system stability.

In this context, nuclear energy may serve as a complementary source, providing a stable, low-emission electricity supply. Its integration with renewable energy sources can support the development of a more balanced and resilient energy system while also reducing dependence on imported fossil fuels.

It is concluded that nuclear energy has the potential to play an important role in Poland's transition towards a low-carbon and more energy-independent future.

A Simplified Physical Twin of a hydrocarbon reservoir as a platform for the integration of renewable energy technologies and Carbon Capture and Storage

Karolina Kogut, Wiktor Humeniuk, Karol Łaba,
Kacper Łazor, Marcel Łącki, Giovanni Garwacki,
Dominika Bogdziewicz, Oskar Dunaszewski
AGH University of Krakow
Poland

In the context of the energy transition, subsurface technologies such as CO_2 sequestration (CCS), hydrogen storage, and geothermal energy are increasingly considered for deployment in depleted hydrocarbon reservoirs. Their effective implementation, however, requires a quantitative understanding of coupled fluid flow and heat transport in porous media, which remains difficult to obtain under in situ conditions.

This study presents the development of a Simplified Physical Twin (SFT), designed as a controlled experimental platform for investigating multiphase flow and thermal processes relevant to subsurface energy applications. The SFT reproduces key reservoir properties using analogue materials with controlled porosity and permeability.

A transparent structure, combined with optical and thermal imaging, enables real-time monitoring of fluid migration, saturation evolution, and temperature fields. The system is instrumented with pressure and temperature sensors integrated into a data acquisition framework.

The modular design allows systematic variation of well configurations, boundary conditions, and operational parameters, enabling simulation of scenarios such as gas injection, geothermal circulation, and energy storage. The experimental program focuses on flow dynamics, heat transfer, system stability, and well interference effects.

Field observations of natural hydrocarbon seepage are incorporated for model calibration and validation.

Key words: Simplified Physical Twin (SFT), Porous media flow, CO_2 sequestration (CCS), Geothermal energy, Reservoir modeling, Renewable energy technologies.

Acknowledgements: We would like to express our special thanks to the Fundacja ORLEN im. Ignacego Łukasiewicza for providing financial support under the TURBOgrant programme (DKN/00027/2025).

Prediction of CO2 distribution in a heterogeneous aquifer during the post-injection phase using an artificial neural network

Jan Kowalski

AGH University of Krakow

Poland

CO_2 injection into aquifers is one of the potential methods of carbon dioxide sequestration. During both the injection and post-injection phases, CO_2 migrates within the formation. The migration of the CO_2 plume is a key factor in assessing the safety of the entire storage process.

Such analyses are typically performed using reservoir simulators which solve complex systems of equations to calculate fluid saturations and pressures in each model block at every time step. Due to the complexity of these calculations and the size of the models, simulations can be time-consuming, which may significantly limit the efficiency of the analysis process.

To address these limitations, Grid-Based Surrogate Reservoir Models (SRMs), built with artificial neural networks (ANNs) can be used. The aim of a Grid-Based SRM is to predict reservoir parameters at the block level for subsequent time steps. The development process involves generating training data using a limited number of numerical simulator realizations. Due to the need to perform simulations and the time required to train the ANN itself, this process can also be time-consuming, but the computations of the trained ANN are practically instantaneous.

The purpose of the poster is to present the results of research on the creation of a Grid-Based ANN reservoir model to predict the CO_2 migration during the post-injection phase. CMG's GEM simulator was used to generate database for ANN training, validation and testing. The model represented an anticline structure. The model was heterogeneous: permeability varied from 2 mD to 1080 mD and porosity varied from 0,04 to 0,22. The developed SRM shows a good ability to simulate CO2 migration. The discrepancies with the numerical simulation results occur mainly in the plume boundary blocks.

AI-agent in Action - Data Extraction and Nodal Analysis for Geothermal Wells

Wojciech Panek
AGH University of Krakow
Poland

The study presents the development of an AI-based agent and software system designed to extract data from geothermal well reports and perform well nodal analysis.

The main goal of the project was to create a tool capable of processing unstructured documents—such as text, images, and tables—and converting them into structured data that can be used for optimizing the production of the geothermal wells. The system uses a Retrieval-Augmented Generation (RAG) approach combined with a vector database to efficiently search and retrieve relevant information from different types of data. It applies embedding techniques and image filtering to improve the quality of the extracted content. The AI agent identifies key parameters, such as well trajectory, casing details, and depth values, and transforms them into a structured format suitable for engineering calculations.

A dedicated nodal analysis module allows users to evaluate inflow and pressure conditions. The process is semi-automated, meaning that users can review and adjust the extracted data before running calculations, which helps ensure accuracy and reliability. The solution was developed during the SPE Europe Energy Geohackathon 2025, where it was awarded second place.

The results show that the system can effectively reduce manual work and support faster, more consistent analysis of geothermal wells, demonstrating the practical value of combining AI tools with engineering workflows.

Geothermal Energy in Peru: Potential, Challenges, and Development Opportunities

Juan Carlos Santivanez

SPE Poland YP

Poland

Peru possesses significant untapped geothermal resources due to its location along the Pacific Ring of Fire. Despite an estimated potential of approximately 3,000 MW, geothermal energy remains largely undeveloped, with no large-scale power plants currently in operation.

This work presents an overview of geothermal resource distribution in Peru, evaluates the main technical, economic, and regulatory barriers, and highlights the role of Organic Rankine Cycle (ORC) technology in enabling the utilization of low- to medium-enthalpy resources.

The study outlines key steps required to advance geothermal project development and identifies opportunities for integrating geothermal energy into Peru's energy matrix.

Geogenic Gases (H_2, He, CO_2) in Fault Zones of the Podhale Basin: Surface Geochemical Indicators of Natural Hydrogen Occurrence and Geothermal System Activity

Hanna Sojka

AGH University of Krakow

Poland

The growing demand for low-carbon energy highlights the importance of stable sources such as geothermal energy, widely used in the Podhale Basin since 1993. At the same time, natural hydrogen is increasingly considered a potential clean energy resource. This study investigates the spatial variability of geogenic gases and their relationship with the geological structure of the Podhale Basin.

Gas samples were collected along a 10 km cross-section using the free gas method at intervals of up to 100 m (137 samples, April–June 2025). Concentrations were measured using gas chromatography (FID and TCD), enabling analysis of hydrogen, helium, carbon dioxide, nitrogen, and hydrocarbons. Results were compared with geological structures, including fault zones, to identify gas migration pathways. Statistical analyses were performed using logarithmic transformation of trace gas data.

Elevated concentrations of helium, carbon dioxide, nitrogen, and total alkanes (C_2–C_5) indicate active upward gas migration. Maximum values reached 64.4 ppm (He), 5.944 vol.% (CO_2), 6,499 ppm (alkanes), and 88.88 vol.% (N_2). Five zones of increased hydrogen concentrations were identified. In two cases, hydrogen anomalies coincided with elevated helium (>10 ppm), suggesting a deep origin. No correlation between O_2–CO_2 ratios and H_2 or He was observed, indicating minimal influence of near-surface biological processes. Helium anomalies mark deep migration pathways, while hydrogen variability suggests multiple sources.

Further research in the Podhale Basin will focus on direct measurements of geogenic gas emissions. These studies will quantify emission fluxes, determine concentrations, and estimate the rate of gas migration from depth to the surface.

Caprock Wettability Under CO_2 Storage Conditions: From Risk Assessment to Active Sealing Enhancement

Ahsan Nabi Soomro

AGH University of Krakow

Poland

Caprock integrity is the primary containment risk in geological CO_2 storage, yet conventional assessment methods, mercury intrusion porosimetry and ambient-condition core floods are conducted under water-wet conditions that may not persist once supercritical CO_2 equilibrates with the caprock surface at depth. This study investigates the wettability behaviour of four mineralogically distinct caprock samples from Polish depleted gas fields under realistic storage conditions (50°C, 5–20 MPa), and evaluates two chemical strategies for restoring and enhancing capillary sealing capacity.

High-pressure contact angle measurements reveal a pronounced and mineralogy-dependent wettability transition at storage pressure. Quartz-rich caprocks (99–100 wt% quartz) become CO_2-wet at pressures above approximately 15 MPa, with receding contact angles reaching 82–105° at 20 MPa, driven by the instability of water films on silanol-dominated surfaces. With pure-quartz sample showing the most severe CO_2-wetting. In contrast, the mixed quartz–calcite–clay sample ($\theta \approx 78°$) and the dolomite–anhydrite caprock ($\theta \approx 65°$) maintain water-wet to intermediate-wet conditions across the full pressure range, owing to stable Ca^{2+} and Mg^{2+} hydration layers on carbonate and evaporitic surfaces.

Two chemical pre-conditioning strategies were tested. SDBS surfactant (0.5 wt%, 24 h immersion) reduced contact angles substantially across all lithologies, most critically converting the CO_2-wet pure quartz sample from $\theta \approx 105°$ to $\theta \approx 27°$, through hydrogen bonding of sulfonate headgroups to silanol sites and electrostatic adsorption on carbonate surfaces. P100 hydrophilic polymer coating achieved more robust and uniform wettability control, reducing all four samples to contact angles of 5–15° at 20 MPa regardless of mineralogy, by forming chemically bonded ultra-thin hydrophilic films that mask the underlying surface chemistry.

These results demonstrate that caprock wettability is a controllable rather than fixed property. Quartz-dominated caprocks that appear structurally adequate from permeability and thickness data alone can lose their capillary sealing function entirely at storage pressure, a failure mode invisible to conventional screening. Chemical pre-conditioning, particularly with P100 polymer coating, offers a practical pathway to actively engineer sealing capacity across heterogeneous caprock sequences in Polish CCS candidates.

Geohazard Assessment for Nuclear Power Plant Site Selection

Anna Szewczyk
AGH University of Krakow
Poland

The site selection process for a nuclear power plant (NPP) is a complex, multidisciplinary task that requires integrating technical, environmental, and regulatory considerations. A key component of this process is geohazard assessment, which ensures that natural hazards do not compromise the safety and long-term operation of nuclear facilities. In Poland, such assessments are not only a technical necessity but also a legal requirement, as defined in the 2012 siting regulation and in the 2025 preliminary siting regulation. These legal frameworks establish exclusion criteria, including the presence of capable faults, significant surface deformation, and other adverse geodynamic processes.

This study presents a comprehensive overview of geohazard-related criteria for NPP site selection, combining national regulatory requirements with international safety standards, particularly those developed by the International Atomic Energy Agency. The analysis identifies key geohazards relevant to site evaluation, including seismic hazards, tectonic activity, unfavorable geological and geotechnical conditions, hydrogeological processes, and geomorphological instability. Furthermore, the study outlines a structured approach to geohazard assessment that incorporates geological mapping, geophysical surveys, borehole investigations, in situ testing, seismic monitoring, and hydrogeological characterization.

The results emphasize that a systematic, transparent, and data-driven assessment of geohazards—aligned with both national regulations and international guidelines—is essential for ensuring regulatory compliance and the long-term safety of nuclear power plant.

Energy transition game

Energy Transition game is a fun and interactive game about the different roles and complexities associated with the process of energy transition. This event allows to see the perspective of Energy Providers, Industries, Governments, Consumers, and Non-Governmental Organizations during the simulation of the next 26 years. The game shows how each party can contribute to energy transition while staying profitable and increasing the standard of life.

Figure. Participants of the "Energy Transition Game" during the 12th EMW 2024.

Panel Discussion: "Where Ideas Ignite Energy: Building a Career in a Net-Zero World"

This panel discussion brings together a diverse group of 4–5 speakers representing industry, academia, and the student community, offering a comprehensive perspective on career development in the evolving energy sector. Moderated by Jakub Ślęk, the session will explore the challenges and opportunities associated with the global transition toward a net-zero future. Panelists will share their insights on emerging technologies, required skill sets, and pathways for young professionals entering the energy industry. The discussion aims to inspire students and early-career engineers to actively engage in shaping a sustainable energy landscape while navigating dynamic career trajectories.

EMW 2026 Congress Partners

ORLEN is an integrated, multi-utility corporation primarily active in Central Europe. We supply energy and fuel to over 100 million Europeans, and our advanced products are sold in more than 100 countries across six continents.

The company's activities span both upstream and downstream segments of the oil & gas industry, as well as power generation and distribution. A key element of ORLEN's mission is its commitment to leading the energy transition in the region.

Under its Strategy 2035, ORLEN aims, among others, to increase natural gas production, develop new carbon storage capabilities, deploy small modular nuclear reactors (SMRs) and develop offshore wind energy. By the end of 2035, the company plans to invest over USD 90 billion in strategic projects, with a significant share allocated to low-emission energy solutions.

It is our purpose to re-invent essentials for sustainable living. **OMV** is transitioning to become an integrated sustainable chemicals, fuels and energy company with a focus on circular economy solutions.

By gradually switching over to the low carbon business, OMV is striving to achieve net zero by 2050 at the latest. In 2024, the company generated revenues of 34 billion euros with a diverse and talented workforce of around 23,600 employees worldwide.

OMV shares are traded on the Vienna Stock Exchange (OMV) and in the US as American Depository Receipts (OMVKY).

For more information, please visit www.omv.com

GAZ-SYSTEM is a strategic company for the Polish economy. It is responsible for the transmission of natural gas, manages the most important gas pipelines in Poland and the Baltic Pipe offshore gas pipeline. It is the owner and operator of the LNG Terminal in Świnoujście, as well as the owner of Gas Storage Poland – a company acting as an operator of natural gas storage facilities.

GAZ-SYSTEM is currently implementing the construction of a floating gas terminal FSRU in the Gulf of Gdańsk, the aim of which is to ensure the diversification, stability and security of gas supplies. The company also wants to play an active role in the process of transformation and decarbonisation of the Polish economy, conducting projects concerning the possibility of transmitting biomethane and hydrogen.

For more than 150 years, **NOV** has been at the forefront of innovation in the energy industry, delivering the expertise, equipment, technologies, and operational support that help customers succeed in a complex and evolving world.

Across every region and every area of drilling and production, NOV has remained committed to advancing safety, efficiency, reliability, and performance for customers worldwide.

Today, NOV continues to build on that legacy by combining deep industry experience with forward-looking technologies and a global network of capabilities designed to help customers work smarter, faster, and safer.

With a strong focus on innovation, service, and long-term partnership, NOV is well positioned to shape the future of energy and deliver lasting value for years to come.

The Faculty of Drilling, Oil and Gas at AGH University of Krakow, with over 60 years of tradition, focuses on educating professionals for the broadly defined drilling, mining, and gas industries, as well as conducting scientific research, primarily of an applied nature.

Due to its fields of study, the Faculty of Drilling, Oil and Gas is unique in Poland. Currently, the Faculty educates students in Geoengineering and Borehole Mining, as well as Oil and Gas Engineering, within the discipline of Environmental Engineering, Mining and Energy. In addition, the Faculty offers a number of postgraduate programmes tailored to the current needs of industry and the economy, which have enjoyed sustained interest for many years.

The Faculty of Drilling, Oil and Gas has a broad research and technological portfolio in the areas of borehole mining, geoengineering, and oil and gas engineering. Its academic staff are the authors of numerous patent applications, utility models, patents, and implemented innovations.

Social Events

Welcome Evening – Icebreaking Meeting

The Icebreaking Party is a cherished tradition and the perfect way to kick-off EMW2026 in a relaxed and welcoming atmosphere. This year, we invite you to the **Browar Górniczo-Hutniczy (BGH)**, a unique spot on the map of Kraków that combines academic heritage with a modern, industrial vibe.

Located in the heart of the AGH University campus, BGH offers the perfect setting to connect with fellow participants over **craft beer brewed on-site** and delicious snacks. It's a great opportunity to meet new people and old friends, share ideas, and soak in the authentic atmosphere of a working brewery. Join us for an evening of good company and a laid-back start to the event!

Gala Dinner

The Gala Dinner will be held at **Aquarius Restaurant**, a floating venue moored on the Vistula River at the foot of the Wawel Royal Castle. This unique location offers a direct view of the castle and the riverbanks, providing a distinctive backdrop for the evening.

As the main social event of the congress, a dinner at “Aquarius” is the final point of the official program. The venue’s location in the heart of the city makes it an ideal spot for a formal dinner and professional networking after the day's sessions. Join us for an evening of food and conversation right on the water.

Bóbrka: The World's Oldest Oil Mine - Field Trip

Step back in time to 1854, the year the global oil industry was born right here in Poland. The Ignacy Łukasiewicz Museum in Bóbrka is a unique site on a global scale – it is the world's first industrial oil mine, founded by the visionary pharmacist Ignacy Łukasiewicz alongside Tytus Trzecieski and Karol Klobassa-Zrencki. Recently recognized as an official Historical Monument by the President of Poland, this site is currently on its way to the UNESCO World Heritage list.

Unlike a typical museum, Bóbrka is a living piece of history where you can still see active, hand-dug wells like "Franek" and "Janina" that still hold "black gold" today. It's the perfect spot to soak up some industrial heritage while walking through the atmospheric forest that hides the roots of modern energy. Join us for a journey to the cradle of the oil industry where 19th-century innovation meets the unique soul of the Beskid Niski region.

Figure. Ignacy Łuksiewicz Museum of Oil and Gas Industry in Bóbrka
www.bobrka.pl/en/

Kraków City – The Heart of Polish Heritage

Kraków, one of Poland's most beautiful and historic cities, offers a unique blend of rich history, stunning architecture, and a vibrant cultural scene. As a former royal capital, it captivates visitors with its charm and atmosphere.

Among the city's highlights are the UNESCO-listed Old Town, home to the impressive Main Market Square and St. Mary's Basilica, the magnificent Wawel Castle, and the historic Jewish Quarter of Kazimierz.

Those interested in history can explore Schindler's Factory or visit the Auschwitz-Birkenau Memorial, located nearby.

For a different experience, the underground wonders of the Wieliczka Salt Mine are well worth discovering. Kraków also delights with its diverse culinary scene, lively nightlife, and warm hospitality, making every visit truly memorable.

Figure. Wawel Royal Castle
www.wawel.krakow.pl

English-Polish Dictionary

English	Polish
Hi / Bye!	Cześć / cheshch /
Good Morning!	Dzień dobry / dsyeni doh-bry /
Good Night!	Dobranoc / do-bra-notz /
Good.	Dobrze / do-bsheh /
Yes.	Tak / tahk /
No.	Nie / nyeh /
Thank you.	Dziękuję / dye-coo-yeh /
Please.	Proszę /prosheh /
Excuse me / I am sorry.	Przepraszam / pshe-pra-sham /
Cheers!	Na Zdrowie! / na zdro-vye /
How are you?	Jak się masz? / jak she mash /
I don't understand.	Nie rozumiem / nye roh-zoo-myem /
I don't speak Polish.	Nie mówię po polsku / nye mo-vyeh po pol-skoo /
Do you speak English?	Czy mówisz po angielsku? / che moo-veesh po an-gyell-skoo /
My name is…	Mam na imię… / mam nah eem-yeh/
I like you!	Lubię Cię / loob-yeh cye/
How much is it?	Ile to kosztuje? / ee-leh toh kosh-too-yeh /
Can I have the bill, please?	Rachunek, proszę / pro-she o ra-hoo-neck /
Can I pay with a credit card?	Czy mogę zapłacić kartą kredytową? / chi mo-ghe za-pla-tsits car-tom /
I am lost!	Zabłądziłem / zah-bwon-tzee-wehm /
Excuse me, how can I get to...?	Przepraszam, jak dojść do...? / pshe-prash-am, yahk doysh doh /
Excuse me, where is the toilet?	Przepraszam, gdzie jest toaleta? / g-jeh yest twa-leh-tah /
I'm not well. / I'm sick.	Jestem chory / yeh-stem ho-ree /
I have to see a doctor.	Potrzebuję lekarza / poh-tscheh-boo-yeh leh-cka-shah /
Could you take a picture of us, please?	Przepraszam, czy możesz nam zrobić zdjęcie? / pshe-prash-am, tshy moh-gheh zho-bich zdye-che /

Partners

Platinum Partner

Platinum Partner

Silver Partner

Bronze Partners

Honorary Patronage

AGH

Honorary Patronage of his Magnificence
Rector of the AGH University of Krakow
Professor Jerzy Lis

Kraków

Honorary Patronage of the Mayor
of the City of Kraków
Aleksander Miszalski

Media Patronage / Support

SPE International

Kraków.pl

KSAF

SITPNiG

Organizers

SPE International
Poland Section

SPE International
AGH University of Krakow
SPE Student Chapter

Book your time

15th EMW

May 2027