

# SPE Review London



The official e-magazine of the Society of Petroleum Engineers' London branch

## Machine learning guide: Part 4

*Also in this issue:*

- Tackling the energy trilemma
- C-Level Talk: Paul McDade
- SPE YP success stories: Natan Battisti
- NSTA reports growth opportunities
- Extracting more from data: What generative AI means for energy companies
- Intro to upstream oil & gas for the net zero world
- Supporting Arkwright Scholars
- Pivotal elements and technological innovations
- News, and Obituary: Anthony John Perry
- Events – local/international



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## ABOUT US

The Society of Petroleum Engineers (SPE) is a not-for-profit professional association whose members are engaged in energy resources, development and production. SPE is a non-profit professional society with more than 156,000 members in 154 countries, who participate in 203 sections and 383 student chapters. SPE's membership includes 72,000 student members. SPE is a key resource for technical knowledge related to the oil and gas exploration and production industry and provides services through its global events, publications, events, training courses and online resources at [www.spe.org](http://www.spe.org). SPE London section publishes SPE Review London, an online newsletter, 10 times a year, which is digitally sent to its 3000+ members. If you have read this issue and would like to join the SPE and receive your own copy of SPE Review London, as well as many other benefits – or you know a friend or colleague who would like to join – please visit [www.spe.org](http://www.spe.org) for an application form.

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# Behind the Scenes: SPE Review Editorial Board



## Elizaveta Poliakova, Editor in Chief

Elizaveta is a Reservoir Engineer at Trident Energy. She has an M.Sc in Petroleum Engineering from Imperial College London and a B.S. in Petroleum Engineering from the University of Leeds.

Elizaveta has been with SPE for more than seven years. She was the President of SPE Imperial College Chapter and the President of SPE Leeds Chapter. She was the SPE London Board Chair in 2022/23.



## Ffion Llwyd-Jones

Ffion is a business editor and writer, with a BA Honours in Environmental Studies / Language, and a Business/Corporate Communications degree from York University in Toronto, Canada. She is also edX certified for ChatGPT.

Ffion has extensive writing and editing experience in the technology, health, automotive and environmental sectors.



## Malvika Nagarkoti

Malvika currently leads the Global Brownfields Development and Production Enhancement segment at Baker Hughes. Previously, she was responsible for reservoir management in E&P companies and a petroleum economist in a consultancy organisation. Malvika has a B.Tech (Applied Petroleum Engineering) from UPES, and an MBA in International Oil and Gas Management from the University of Dundee.

**A big Thank You! to all the organisations supporting the SPE London section**





## Letter from the Editor

Dear Readers and Colleagues,

In this issue, we honor the memory of **Anthony John Perry**, a distinguished member of our Society. His enduring legacy, which we detail on **page 7**, remains a source of inspiration and a standard of excellence in our field.

As you explore this edition, you'll find a diverse array of articles that aim to share the events of our Section, latest updates of the UK Oil & Gas industry, and professional insights and advises. Beginning with our '**News Digest**' on **page 5**, we offer a snapshot of recent industry trends and developments. Our features commence on **page 8** with an **insightful NSTA report** that highlights new growth opportunities in the UK North Sea.

In '**C-Level Talks**' on **page 10**, **Paul McDade**, CEO and co-founder of **Afentra**, shares his fascinating story and career journey. On **page 14**, we spotlight **Natan Battisti**, Planning and Economic Adviser at **Harbour Energy**, presenting his success story and invaluable advice for YPs aiming to make their impact in the industry.

**Page 17** takes you on **SPE Coventry's field trip to Stavanger**, while on **page 21**, we explore the **transformative potential of generative AI** in reshaping data processing within energy companies.

The **SPE ICL Student Chapter** introduces its committee and shares its goals for 2024 on **page 26**. On **page 29**, we delve into the **critical interactions driving the energy transition** and recap the industry talk hosted by SPE London and SPE ICL chapter. On **page 30**, we also share a summary of the '**Introduction to Upstream Oil and Gas for the Net Zero World**' seminar in November organised by Adam Borushek, Chair for Continuing Education. On that note, I would like to warmly **congratulate Adam Borushek on his new role as SPE London Section Chair Elect**. We wish him every success! The educational series continues on **page 32** with **Part 4 of the Machine Learning Guide for Petroleum Professionals**.

Each article in this issue is crafted to inform, engage, and inspire our readership. Whether you are deeply entrenched in the energy sector or just starting out, these pages are filled with insights and perspectives for everyone. We welcome your feedback and ideas, please get in touch.

I'd also like to extend a special thank you to our Editor, Ffion Llwyd-Jones, and our new volunteer Editor, Malvika Nagarkoti, for their endless stream of brilliant ideas and the time they dedicate to SPE London Review.

Enjoy the read!

Sincerely Yours,  
**Elizaveta Poliakova**







### Driving energy security

Equinor ASA has commissioned its Blandford Road (Dorset) battery storage facility in the UK to help drive the country's energy security strategy, which aims for 95 per cent of the country's electricity to be low-carbon by 2030. The 25 megawatt (Mw)/ 50 megawatt-hour (MWh) facility is connected to the Southern Electric Power Distribution (SEPD) network.

Consisting of around 150 lithium-ion cells, Blandford Road can store enough electricity to power 75,000 homes in the UK for two hours, Equinor said in a recent press release.

Equinor owns 45 per cent of the facility's developer and operator, Noriker Power.

[Read more](#)

### bp CEO Appointment

Effective as of 17 January, Murray Auchincloss is the new bp of CEO. He served as interim CEO since September 2023 and will continue to be a board member. Murray said: "It's an honour to lead bp – this is a great company with great people. Our strategy – from international oil company to integrated energy company, or IOC to IEC – does not change. I'm convinced about the significant value we can create. Now, more than ever, our focus must remain on delivery – operating safely and efficiently, executing with discipline, and always focusing on returns."

[Read more](#)

### Hydrogen-enabling milestones

As part of its broader new energy

strategy, Baker Hughes recently announced several milestones in the development of its hydrogen-enabling technologies, and the delivery of several customer hydrogen projects and new collaborations.

"These low-carbon and carbon-free energy advancements illustrate how the urgency of the energy transition has transformed customer relationships into comprehensive partnerships for innovation across several projects," said Lorenzo Simonelli, Baker Hughes Chairman and CEO.

[Read more](#)

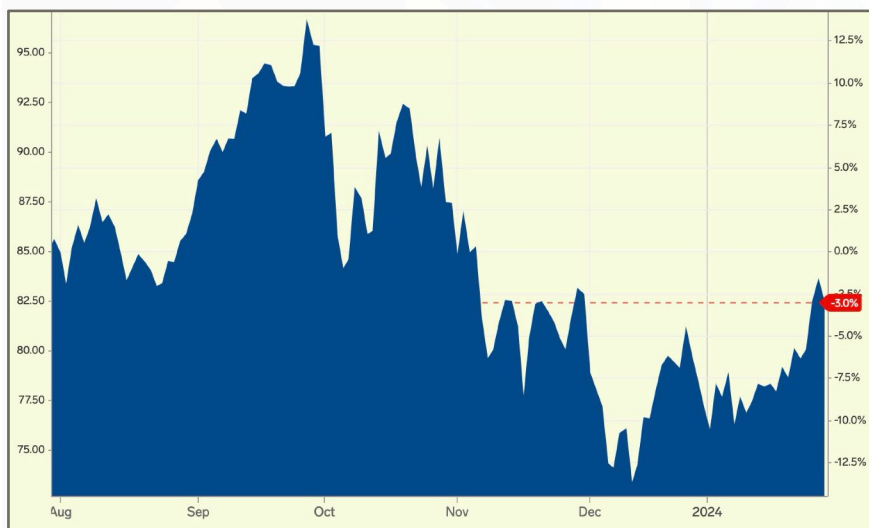
### Multi-billion dollar deal

Harbor Energy has agreed to buy the Wintershall Dea oil and gas assets from Germany's BASF and investment firm LetterOne for \$11.2 billion, backed by Mikhail Fridman and Petr Aven.

Harbor Energy's previous market value was slightly more than \$2 billion before the deal was announced.

The deal includes Wintershall's oil and gas fields in Norway, Germany, Denmark, Argentina, Mexico, Egypt, Libya and Algeria. On completion, Harbour's oil and gas production will increase to more than 500,000 barrels per day.

[Read more](#)



Oil (Brent) 82.86 +0.46 (+0.56%) – 30/01/2024 (Credit: Market Insider)

# NEWS DIGEST... NEWS DIGEST... NEWS DIGEST



## SPE Policy on AI-Generated Content in Publications

The SPE Board has approved a new policy allowing AI-generated content to be used within SPE publications but under specific conditions.

AI-assisted language tools (such as ChatGPT) have gained widespread attention recently, particularly for their capability to assist in drafting scientific papers. While these tools have the potential to enhance the efficiency and speed of academic and technical writing, the ethics and best practices for their use are still evolving. These tools may generate useful information and content but are also prone to errors and inconsistencies.

## The SPE Board has approved a new policy for authors who use AI language tools to generate content for their papers.

The policy states that AI-generated content may be used within SPE publications but under specific conditions.

- AI language tools may not be listed as an author. The AI tool cannot sign publishing agreements or transfers of copyright.
- Any AI-generated content that is used within a manuscript should be thoroughly vetted, fact checked, and disclosed.
- If AI language tools are used within a manuscript, their use should be clearly explained within the methodology or acknowledgment

section of the paper. If AI-generated content is included within a manuscript without an explanation, this can be grounds for rejection of the work at the discretion of SPE and may result in a code of conduct review.

- The authors of the manuscript will be held responsible for any errors, inconsistencies, incorrect references, plagiarism, or misleading content included from the AI tool.

It is important to note that technology for AI language tools is advancing rapidly. SPE plans to periodically review and update this policy to ensure its relevance and effectiveness. Any modifications to the policy will be communicated transparently and in a timely manner.



Userba011d64\_201/Getty Images/iStockphoto



## Groundbreaking pioneer: Anthony John Perry



**Anthony (Tony) John Perry was a groundbreaking pioneer in the oil industry, with a career that took him to many countries around the globe, including Syria, Canada, Venezuela, Abu Dhabi, Scotland and London.**

He was an exceptionally bright grammar schoolboy who studied Geology at Bristol University between 1954 and 1957 and then went on to gain a Masters in Petroleum Reservoir Engineering at the Royal School of Mines, Imperial College London.

Tony began his illustrious career as a petroleum engineer in 1959; it would eventually take him and his family (Verna, David and Marisa) around the world.

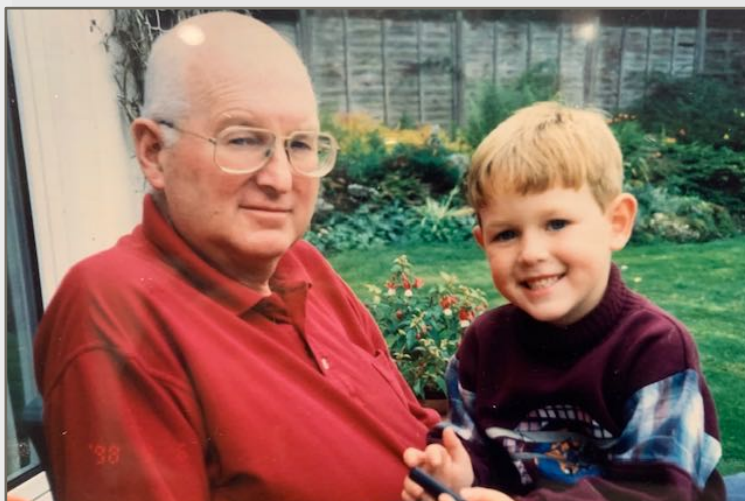
In 1960, Tony worked for Ultramar in Canada, and married Verna. He then worked for Gulf Oil in Venezuela for seven years, before BP took him to Abu Dhabi, Aberdeen and London. After that, Tony worked for Texas Eastern, Mobil Oil and ExxonMobil until he retired in 2000.

For the next 17 years, Tony continued to work in Executive Director roles, including for OPC and Huddleston Energy.

In addition, for 30 years, Tony was an external examiner for Petroleum Engineering PhD students at several universities including Imperial College London, Strathclyde, Robert Gordon and Herriot Watt.

He was the Chairman of the London Society of Petroleum Engineers (SPE), was inducted into the SPE Hall of Fame in 1990, and received the Distinguished Member award. Tony was also an SPE Legion of Honor Inductee, which is an honour that recognises 50 years of continuous membership in SPE.

7 April 1936 – 24 October 2023



# NSTA Reports ‘Significant’ Growth Opportunities Await Grasping in UK North Sea



**A drop in the number of wells drilled on the UK Continental Slope is concerning as many fields in the mature basin are reaching the point of production cessation.**

The UK North Sea is witnessing a "disappointing" lack of wells being drilled to curb the decline in production and secure more domestically produced hydrocarbons, according to a new report from the North Sea Transition Authority (NSTA).

The number of exploration and appraisal (E&A) wells has dropped over the past decade, from 67 in 2012 to 12 in 2022. The NSTA said that considering fewer operational constraints, the low level of activity is "likely due to limited capital available for UKCS E&A activity".

There were 12 E&A wells drilled in 2022 – eight exploration and four appraisal wells – compared to 10 in 2021 (five exploration and five appraisal). Despite the shortfall in the number of E&A wells drilled, more than 334 million BOE of potential resources have been discovered in the past 3 years.

"Appraisal of this potential resource and progression towards development investment decisions is one of the keys to continued, secure domestic oil and gas production as the energy transition progresses," the NSTA said in the report.

As for development wells, only 48 were drilled in 2022, falling short of the NSTA's baseline ambition of 60 development wells per year. This shortfall is set to continue as there are only 53 wells planned for 2024 and 36 for 2025, compared to 62 wells in 2021 and 73 in 2020.

Of the 48 wells completed – mainly in the Central North Sea and Northern North Sea – 40 are producers, and eight are water injectors. This is down from the 62 wells completed in 2021. Total development well expenditure of £1.23 billion was slightly less than the £1.33 billion in 2021, which the NSTA said indicated that the average wellbore cost in the UKCS has risen.

"This may be, in part, due to a higher rate of nonproductive time in 2022 of 22 per cent of the cost, as compared to 17 per cent in 2021," the agency said, adding that the UKCS is a mature basin with existing well infrastructure.

The basin, particularly in the Central North Sea and West of Shetland, "presents opportunities to access new





## NSTA Reports 'Significant' Growth Opportunities... continued

areas of a reservoir and increase recovery factors, via new wells and sidetracks from existing wellbores". Well interventions, outside of restoring shut-in wells, have remained low, the NSTA said, with "only 88 optimization jobs completed and a decrease in safeguarding jobs from 235 to 208".

### Concerns and Turnarounds

The NSTA warns that this decline in activity poses a threat as operators may delay investment, leading to further production declines and bringing cessation of production (COP) closer. The total well stock has steadily reduced as fields reach COP and are not being replaced by new wells, it said, warning that the decline will continue as more fields reach COP by 2030.

"We are committed to helping ensure UK energy security, and well interventions which increase production from existing facilities can play a key role in that. Production from existing facilities can also have a lower carbon footprint," said Andy Brooks, NSTA director of new ventures.

"It is also vitally important that we increase development drilling in order to sustain domestic supply, and we are encouraged by the forecast pickup on exploration and appraisal activity in the next few years."

The NSTA said it is "concerned that operators only achieve around 60% of their projected drilling activity, and wants to see that figure substantially improve, as it gives the supply chain greater confidence in the volume of work coming through".

However, operators currently suggest that activity may pick up; with high and moderate confidence, they forecast that 77 E&A wells will be drilled between 2023 and 2025, the NSTA added, noting that:

- 12 of these 77 wells are forecast in 2023, 17 in 2024, with the remainder in 2025.
- 34 wells are in the Central North Sea, 15 in the Southern North Sea/Irish Sea, and
- 13 in the Northern North Sea/West of Shetland.

Other signs of a turnaround include the recent final investment decision taken by Equinor and Ithaca Energy to begin development of the Rosebank field located off the northwest coast of the Shetland Islands.

Government and industry leaders also expressed their support for increased activity on the UKCS at the recent Offshore Europe event.

In July 2023, UK Prime Minister Rishi Sunak committed to future oil and gas licensing rounds as a new analysis showed domestic gas production has around one-quarter the carbon footprint of imported liquefied natural gas.



**Jennifer Presley** is a senior technology editor for SPE's Journal of Petroleum Technology.

She has been a communications specialist and editor for 23 years, most of which have been spent covering the upstream oil and gas industry.

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# The importance of nurturing relationships and soft skills alongside professional abilities



Paul McDade has more than 35 years' experience in the oil and gas industry and is the co-founder and CEO at Afentra. Aiming to lead a responsible industry shift, Afentra seeks to be the go-to for IOCs/NOCs divesting mid-late life assets, ensuring their safe, beneficial management for local stakeholders.

Prior to founding Afentra, Paul worked in the UK, Africa, Latin America and the Middle East and was the COO and, later, CEO of Tullow plc.

Throughout his career, Paul has navigated businesses through crisis such as an oil downturn, asset failure and political boundary dispute along with managing safety and security crises.

## Who is Paul McDade? Please tell us about yourself.

I grew up in Glasgow and attended a local state school, eventually making my way to Strathclyde University to study civil engineering. While I enjoyed civil engineering, I realized in 1984 it wasn't the most lucrative career. I started looking for something with better prospects and found the oil industry, which was quite buoyant in the North Sea around the mid-eighties. That led me to shift my focus to petroleum engineering. I pursued a master's in petroleum engineering at Imperial College London and started my first job as a Reservoir Engineer with Conoco.

That was the start of my career in Oil & Gas. What I find interesting, now that I've worked in Africa, especially in Ghana, I saw a lot of enthusiasm among the young people there regarding the industry, as it is new. The sector is opening up a lot of new opportunities, much like how I remember seeing in Scotland in the late 1970s and early 1980s. It had a similar atmosphere of fresh possibilities and excitement.

## Please walk us through your career. How did you become the CEO of Afentra?

After studying at Imperial College, I joined Conoco, which was highly regarded for reservoir engineering. Despite enjoying the work, I left after two years, to seek broader opportunities abroad – a decision I later questioned.

I then joined ERC (now ERCE), influenced by a former mentor from Conoco, which broadened my skills and industry perspective. Despite some doubts about leaving Conoco, ERC was a valuable experience allowing me to get a broad view and to see different companies and different assets.

An opportunity with KUFPEC in Kuwait City led me to

move there in March 1990, eager to embark on this new adventure abroad with my wife. It was a significant change for us, which we were excited about. A few months later, that part of the story ended after Saddam Hussein's invasion of Kuwait and I was taken hostage for three months. After managing to leave Iraq in December 1990, I returned to the UK, where my former director at ERC kindly offered me a job, which I accepted.

In 1991, I joined LASMO in the UK, working in the North Sea. I then moved to Colombia in 1994 where I spent five years, transitioning from technical work to operational management. This also led me to undertake commercial roles, including leading the sale process of LASMO Colombia. After Colombia, I focused on commercial management in Indonesia with LASMO, and later, I decided to go back to the UK for family reasons. I got a secondment with Talisman as Asset Manager, where I learned a lot about M&A and the re-development of mature fields. These particular learnings are a crucial part of Afentra's strategy and directly applicable to what we are doing today, over 20 years later.

A few years later, LASMO was acquired by ENI and this is when I decided to stay with smaller independent companies and joined Tullow Oil, where we set up Tullow UK. From 2001 to 2004, my tenure involved growing Tullow UK and eventually becoming its MD. We then acquired a number of companies at which point I became COO of Tullow plc. We made important discoveries in Ghana, and then went on to oversee significant projects such as the Jubilee and TEN combined around \$10 billion of development investment. As COO and later CEO of Tullow Oil, I navigated challenges such as managing debt and shifting the company's focus. I started pivoting the company away from exploration to





# The importance of nurturing relationships and soft skills alongside professional abilities... continued

focus on other areas. I noted a major shift in the North Sea, a region I knew well from the late nineties. It had moved from being dominated by large international oil companies to smaller independents.

This change mirrored trends the industry had seen in Brazil and the Gulf of Mexico, which I found quite interesting. It represented a gradual transition over about 25 years. Reflecting on my experience in Africa, especially in West Africa, I noticed that large international companies still held many assets there. I foresaw a future where these firms might exit, selling their older assets; I was curious about who the new players would be.

Finally, after leaving Tullow in 2019, I took a break before co-founding Afentra with a colleague. Focusing on the African energy transition (AFENTRA) and paralleling the changes in the North Sea, we established Afentra in the early 2020s, aiming to facilitate a responsible industry transition and position Afentra as a counterparty of choice for IOCs/NOCs seeking to divest mid-later life assets to credible independents who would manage them safely for the benefit of all local stakeholders.

**You've outlined three major career shifts: from technical to non-technical roles, from non-technical roles to top management in oil and gas, and finally, energy transition. Which of these transitions was the most defining for you personally?**

The most pivotal moment was my time in the Kuwait/Iraq, which profoundly shaped my outlook on life and various other personal areas. On the professional front, my time in Colombia with LASMO was a turning point. There, I was given an opportunity despite being relatively inexperienced, largely due to my willingness to work in Colombia, a place not many wanted to go to at that time. This experience significantly impacted my career trajectory.

In Colombia, during the tumultuous nineties, I learned to navigate complex security challenges, the criticality of maintaining good community relations, and ensuring safe operations. These skills proved invaluable later in Africa, underscoring the need for strong relationships. In Colombia, I experienced how

strained relationships with local communities could significantly disrupt operations.

Such a strategy of nurturing harmony and mutual benefits was crucial as we grew our presence in Africa. A prime example was in Ghana, where we engaged with the government immediately after making the Jubilee discovery, seeking direction on handling their resources, a move quite distinct from the norm for international oil companies. This approach greatly aided our progress in Africa, teaching me the importance of fostering cooperative partnerships and laying the groundwork for future endeavours.

**You've worked in multicultural environments across Africa, Middle East and Latin America. How have these experiences shaped your leadership style and guided your current role at Afentra?**

My time in Colombia was key to my personal growth, especially in becoming more culturally mature. Before going there, I didn't fully grasp the nuances of different cultures. However, after my experience in Colombia, I developed a better understanding and appreciation for diverse viewpoints.

I've realized the significance of listening actively and viewing situations from others' perspectives, be it in Colombia, Ghana or Africa generally. This mindset is essential for developing effective solutions. For example, on entering Angola with Afentra, we tried to understand the Angolan perspective, considering what was important to them and the root causes of the initial obstacles we encountered. Engaging with our Angolan peers and valuing their input often revealed critical insights, prompting us to adjust our strategies or, sometimes, develop new solutions.

While this approach may seem straightforward, understanding and respecting different cultural viewpoints is incredibly important and impactful in our line of work. It leads to a much more collaborative approach resulting in all parties sharing in the success of our combined efforts.

**What are the key strategies you found most effective for navigating complex situations like oil downturns?**

Reflecting on my journey, a key lesson has been the



## The importance of nurturing relationships and soft skills alongside professional abilities... continued

importance of adopting a long-term perspective, especially in an industry like ours that inherently operates on extended timelines. Avoiding short-sighted decisions and focusing on long-term impacts is one critical strategy. Another is simply doing the right thing, regardless of the situation. This approach may not always yield immediate benefits, but it tends to be rewarding in the long run. An example can be 2015 when we faced a significant downturn and significant financial stress. We had to downsize Tullow from about 2,000 to 1,000 employees in about eight months, but we managed it respectfully, taking care of both those who were leaving and those who stayed, thereby maintaining our corporate reputation.

In business, especially among smaller companies, there's often a temptation to chase quick wins. However, those rarely lead to sustainable success. Valuing and respecting your people and nurturing good relationships are fundamental. A good example was when I received a call from ERC, a company I left earlier, offering me a job immediately after returning from Kuwait, a gesture I greatly appreciated. These simple yet effective strategies are crucial in any situation, but perhaps more so in stressful circumstances where the temptation to cut corners can be stronger.

For instance, in Ghana, we faced a difficult situation with our primary revenue source, the Jubilee field, when the turret on our FPSO malfunctioned. Despite the pressure, we took a calm approach, assembled a team, and developed a plan. This strategy, coupled with the competence of our team, allowed us to manage the crisis without losing production, which was vital not only for us but also for Ghana's energy needs. This experience reinforced the idea of taking a step back, thinking things through and planning effectively, especially when you have a strong team to support the work.

**Did you see any changes within your approaches from your technical management and top management roles to when you became a founder of Afentra?**

Reflecting on the early stages of founding Afentra, now nearly three years in, I find certain aspects reminiscent of the experience in 2001 when we

started Tullow UK. It's fascinating to undertake a similar venture but with a different team and under entirely different circumstances. This time, there's a sense of familiarity but also a greater level of knowledge and confidence. We learned a lot from our experiences with Tullow – both from our successes and but even more from our mistakes.

Now, with Afentra, I hope to replicate the successes with fewer missteps, drawing on the lessons learned over the past 23 years.

One key similarity, however, is the importance of a strong team. Just like our earlier success with Tullow was largely due to a phenomenal team, the same principle applies to Afentra. It is a key skill to know how to grow a team and a company responsibly to ensure you have the bandwidth and capabilities to match your growth ambitions. You also need to have the right strategy, at Afentra we feel we have a growth strategy tailored to the new world in terms of focusing on proven reserves, reliable cash flow and a robust financial footing.

So the success we're experiencing at Afentra is not just attributable to the management but to the entire team. We have 12 people, each with complementary skills, working cohesively. Their ability to maintain a positive attitude, remain calm under pressure, and work effectively together, even when things get tough, has been pivotal. The team dynamics, combined with our collective experience, shape Afentra's current narrative.

**Based on your experience, what advice would you give to young professionals who aspire to leadership roles in oil and gas?**

In my personal philosophy, especially in terms of the guidance it is the same as I give to my children, I believe in the principle of committing fully to whatever you do. My kids, who are now grown up, often remind me of this advice I've given them: to do things well or not to do them at all. They used to find it amusing but now acknowledge its value in a positive way. It's about taking the time to do things properly, which is essential.

Regarding career advice, particularly for my 27-year-old daughter and 29-year-old son who are navigating their professional lives, I emphasize the importance



## The importance of nurturing relationships and soft skills alongside professional abilities... continued

of ambition and the natural desire to progress. However, I also remind them they are always under observation, not just during formal appraisals or presentations. This was a lesson I learned early in my career; it's not just the high-profile tasks but everything you do that gets noticed. My success at LASMO, for instance, came from simply enjoying my work as a young engineer and making an effort, which led to the trust and opportunity to work in Colombia.

My advice to young professionals therefore revolves around two key points: strive to excel in whatever you do and be mindful that your overall behaviour is being observed. These factors play a significant role when companies make decisions about promotions or select representatives for overseas assignments. Demonstrating consistent dedication and respect in all aspects of your work can significantly influence your career progression.


**How do you think this has changed? Do you think the companies are still willing to send outstanding young professionals abroad to gain more experience and exposure?**

To be honest, I'm not entirely certain about the current landscape, especially since I'm not involved in the larger companies that offer these opportunities. However whether it is Afentra or one of the larger IOC's a key role and challenge for the

CEO and senior management is accessing and developing young talent. It is such an important part of any industry to give young talent the platform to grow and showcase their ideas and capabilities as these perspectives might be totally different to the view of management and that collaborative engagement helps inform more effective strategies and decision making.


Observing my own children as they have started and continue to advance in their careers, it seems that it's much tougher nowadays. The process of landing a job has become quite complex. They have to go through several stages before they even get the chance for a face-to-face conversation. It's hard to showcase your true capabilities without that direct interaction.


**It's the personal interaction that often makes a difference. While evaluating someone's skills and suitability is crucial, young professionals might not yet fully realize the importance of their personal qualities and soft skills, along with their professional abilities. So, while I can't give a definitive answer to this question, I feel that it's probably much more challenging for young professionals today than it was back then. Nurturing relationships with other people and soft skills is, therefore even more crucial.**



## Evolve and Thrive with SPE

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In these challenging times it is more important than ever that SPE members continue to inspire and support each other locally, regionally, and globally. SPE has evolved to provide unparalleled insights, shared expertise, life-long learning and community strength to fuel the success of our members and the future of the industry. As a member, you are part of that!

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# Focusing on health, safety and the environment



Natan Battisti is a petroleum engineer who is passionate about energy, economy and politics. At Harbour Energy, he works for the international team as a Planning and Economics Adviser. He is also the STEM Ambassador London Chair, coordinating activities that promote the importance of STEM and energy.

In 2020, he co-founded (and led for two years) the Until the Last Barrel (Até o Último Barril) voluntary organisation, formed by professionals who seeks to place young people as the protagonists of these discussions.

## How has your journey at Harbour Energy – from a technical engineer in international business to a planning and economics adviser – shaped your professional growth?

When I joined Premier Oil (later to become Harbour Energy) in 2018, I was mostly interested in the technical aspects of the job as a petroleum engineer. I wanted to develop in areas such as reservoir, drilling, and completion production. However, to my surprise, the first area where I was given a lot of exposure was HSES, an unfamiliar area to me. From that moment, I understood that opportunities do not always come from where we are expecting so we need to adapt and extract as much and as fast as we can.

That was what happened when I moved from a job as technical engineer supporting several technical areas such to planning and economics. After three years working as a technical engineer, I decided it was time to do something different. My learning journey had reached a plateau and the comfort zone is something that, interestingly, makes me very uncomfortable. Every couple of years this feeling comes to me, and I need a change. Premier Oil at that time has just become Harbour Energy with many changes in the business.

At the same time, I was invited to present on the economic evaluation of E&P projects at an event organised by SPE Brazil. Although this was not an area in which I was an expert, it was something I had enjoyed doing during my university education.

I took a couple of weekends to gather various materials about economics, finance and project planning, and put together a presentation. Before giving it to an audience of 500+ people in Brazil, I decided it was wise to present it to the planning and economics team at Harbour. That action ended up opening a door for my future development as a planning and economics advisor covering the

international region. In summary, it's all about a growth mindset, creating opportunities and riding the waves as they come.

## Looking back at the early stages of your career, what were some pivotal moments or decisions that significantly influenced your career path?

If I had to break down my answer into three chapters, there is a sequence of events that critically changed my professional life in the early years of my career.

The first pivotal moment was deciding to go for the unknown and embarking on the petroleum engineering course. Leaving the farm where my parents live and pursuing a further education was something that no one in my family had done. I embraced the differences, accepted I knew nothing, and was humble to ask, ask, and ask, whenever I couldn't figure out what senior people were saying.

The second moment was joining the Society of Petroleum Engineers and devoting half my time to the society. This action opened several doors, including the opportunity to develop my leadership skills. At SPE, I understood that the easiest and quickest way to develop and be supported is by helping others and connecting people. The key for a valuable networking is being beneficial to both sides.

The third moment was when I came back from Colombia, where I had spent six months studying the beauty of the onshore upstream. I was in my last year at university and wanted to spend more time working rather than studying, pay my bills and not depend on my parents. It was a difficult time for the oil&gas sector and Pelotas (where I was studying) was 2,000 km from Rio de Janeiro, the capital of the petroleum industry in Brazil. There were no jobs, and no internships. I decided to look for opportunities elsewhere and do my best to transfer my skills and my knowledge to a company and an industry that





## Focusing on health, safety and the environment... continued

would give me the opportunity I was desperate for. That was when NewFields, an environmental consultancy company, called me to work for them as a business development intern helping to set up their commercial area in Brazil. Gladly, I took the leap and spent almost a year setting up the business that would be proven successful in a short term. I realised I was a petroleum engineer who could work in any other area or in any other industry, as long as I kept learning and making the connection between what I knew and what I had to learn to perform the required activities.

With these three key moments, the base upon I would build my next steps was formed.

### As an active member of the Society of Petroleum Engineers, how has your involvement with SPE influenced your career and personal development?

I usually say that SPE helped open doors (some of which I also constructed) during the past 10 years.

First and foremost, most of my friends are also SPE members – people I've worked with, shared good moments and good stories. It's also thanks to SPE that I developed leadership skills early on in my career, and got to be known through work at our student chapter. Through being an SPE volunteer, I managed to grasp everything that's important in terms of soft skills for any company. This included all the exposure, challenges, difficult decisions and priorities – everything I experienced by running events, programmes and social activities, ahead of the SPE UFPel Student Chapter.

It's also through SPE that I've met my greatest mentors, people who received me in their homes when I used to go to Rio de Janeiro for events or interviews. It was thanks to SPE that I met all my future employers.

In summary, I am thankful for what SPE provided. Nonetheless, I don't think that SPE gave me that for granted. I worked hard at SPE and good things happened. I like what Terry Palish, SPE 2024 President, says by comparing SPE to a gym membership: If someone has a gym membership but never goes to exercise, that member will not grow or become healthier, no matter how much they pay for the membership. At SPE, it is the same. A member

only extracts all the benefits from the association when they work hard, volunteer and accepts the challenge to work with a student chapter or a local section. That action is what will give the member the exposure and opportunities for their own career.

### You have a strong focus on mentoring and leadership, as evidenced by your role as Chair of the London STEM Ambassador programme. How do you approach mentoring young professionals, and why do you think it's important?

If I am doing something that I really enjoy and get paid to do, then that's because I had great mentors along my journey.

In 2014, I started mentoring through the SPE mentoring platform – that was a game changer for me. From that moment, even with my poor English and being in a remote location in south Brazil with no hydrocarbon production, I could connect with great people working in the industry and eager to share their knowledge and help other SPE members. With continued mentoring, I got enough knowledge to share. Although I felt inexperienced when I was still a university student, I decided to become a mentor and share what little knowledge I had.

Since 2017, I have had more than 20 mentees and I'm pleased to see them achieving success, getting jobs, building families and becoming my friends. I lead a group of volunteers at the STEM Ambassador chapter who are eager to share their knowledge and represent our industry. We visit schools across London, talking about the importance of energy and oil&gas for our society. In 2023, we performed eight activities, reaching a thousand students. After good discussions with students, the most impactful thing is the respect and students saying they want a career in STEM subjects, energy or oil&gas.

### With your involvement in projects such as the Long Range Plan dashboard using Power BI and the Intrapreneurship Hub, how do you see innovation and digitalisation shaping the energy sector?

There is a saying about the best company in the world being a well-managed petroleum company and the second best company being a poorly managed petroleum company. I strongly disagree with that. In the current landscape, with things changing so fast, we cannot accept to be poorly managed. We need to be the best we can be and



## Focusing on health, safety and the environment... continued

keep improving. The only way the industry can keep improving is by adopting new technology, being innovative and learning with others.

We need to keep learning and improving, getting knowledge from other companies and industries. Digitalisation is a key element. That's what we are doing at Harbour by digitalising critical data, simplifying process and making workflows clearer. Dashboards can have a good impact in the way you analyse data and use that as information for very informed decisions.

However, it needs to be well managed because it's easy to enter into a phase of digitalisation for the sake of digitalisation – and you end up with dozens of applications and dashboards that are not helping the decision-making process. That is unhelpful. The focus should be on what really matters and is controllable. Why to create a dashboard for a set of data that will not help in decision making? That risks deviating people from what is really important.

I would encourage all individuals to reconsider and decide if a dashboard is really a solution, or if it's just nice to have. At the end of the day, we shouldn't build something that will not help to improve the quality of decision making in our organisations.

### With your background in HSES and operations, how do you incorporate sustainability and ESG considerations into your planning and economic advisory role?

Firstly, safety is a priority. Without a safe workplace we can easily lose operation licenses. We cannot accept people going home injured or not even getting home. That situation is unacceptable and we need to keep working, keep investing to prevent it. The industry has improved in recent decades.

Secondly is the environmental aspect. It has been the focus for the past 30 to 40 years, starting with pollution control, including waste management, oil-spills prevention and material recycling, etc. In the past decade or so, emissions' avoidance has come into focus and the industry is doing a lot to reduce its scope 1 and 2 emissions. Employee health is often not given the same exposure as safety and environmental concerns, but it is a critical point, being essential for a healthy organization.

All these areas are critical for our business, so I feel

fortunate for having had that exposure, linked to operations. These are the foundation of my career. No matter what I do, I need to guarantee it's done with focus on health, safety and the environment (HSES). In my current job in planning and economics, I point out there is no oil being produced in the office – it is produced hundreds of miles offshore in rigs where brave men and women devote their time to run our facilities. We need to do our best in the office to provide the resources needed to keep frontline workers safe and mentally comfortable in performing their duties, and reducing risks as low as possible.

### Can you discuss the importance of networking and community involvement in the oil and gas industry, and how young professionals can effectively engage in these areas?

I really like the way that Terry Palish defines SPE membership. All networking at SPE can be done by using the association as a platform to meet people, help others and build a strong reputation.

I encourage every single young professional or student to join their local chapter or section, attend and lead events, and be supportive. Don't think that networking is one-way where others grant us what we want. That's not networking. We need to think how can we help others before that person can help you. Once you embed this process, then things will flow naturally.

### As you reflect on your career journey so far, what are some goals or aspirations you have set for your future in the energy sector?

I will continue contributing to more people getting the standard of living we currently enjoy in Europe, by producing more hydrocarbons in a safe and environmentally conscious way. There are more than two billion in people living in energy poverty around the world. In the US, people consume an annual average of 20 barrels of oil while most of the world live with less than one barrel per day. The latter are people that cannot afford to have a hot meal, or air conditioning during summer or heating during winter. This needs to change.

### As I grow as a leader in oil and gas/energy, I want to be in the place where my decisions have the impact to create jobs and generate wealth by extracting natural resources.



## Pivotal elements and technological innovations



Nasir Habib, an MSc reports on a transformative field trip to Norway, sponsored in part by Coventry University and SPE. The group explored cutting-edge facilities at the Ullrigg Test Center and the Kårstø Gas Processing Plant, saw advanced drilling simulations in Stavanger and learned about the intricacies of gas processing on the Norwegian continental shelf. The immersive experience was aimed at fostering a profound understanding of the oil and gas industry's pivotal elements and technological innovations.

### Day 01: Visit to the Norwegian Petroleum Museum

Our exploration of Stavanger, Norway commenced with a visit to the Norwegian Petroleum Museum, a central hub providing a comprehensive overview of Norway's pivotal offshore operations. Illuminating the intricate processes of oil and gas formation, the museum guided us through drilling and production methods, showcasing the industry's technical facets. Noteworthy exhibits traced the technological evolution from early rigs to modern subsea systems, emphasizing Norway's pioneering role.



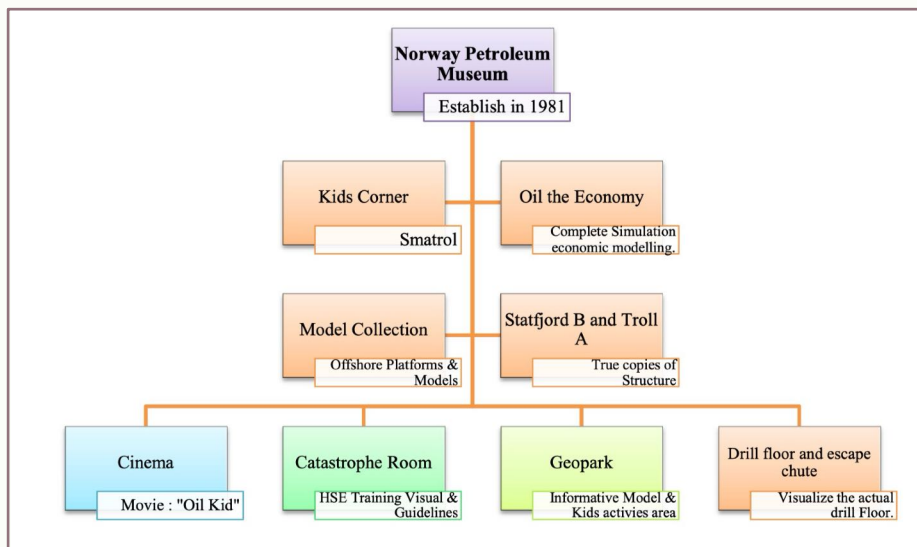
The museum uniquely addressed the societal impact of oil revenues on Norway's development, presenting a balanced perspective.

A highlight was the showcase of Hydrogen & CCUS units, offering a glimpse into the industry's future.

The Norwegian Petroleum Museum left an indelible mark, offering an enlightening journey through the nation's oil history and technological advancements. Notably, the exhibition on Health, Safety, and Environment (HSE) during oil and gas operations, conveyed through videos, underscored the industry's commitment to safety protocols. The concept of Norwegian oil for every citizen, coupled with lessons learned from past incidents, provided valuable insights into the industry's responsibility.



## Pivotal elements and technological innovations... continued



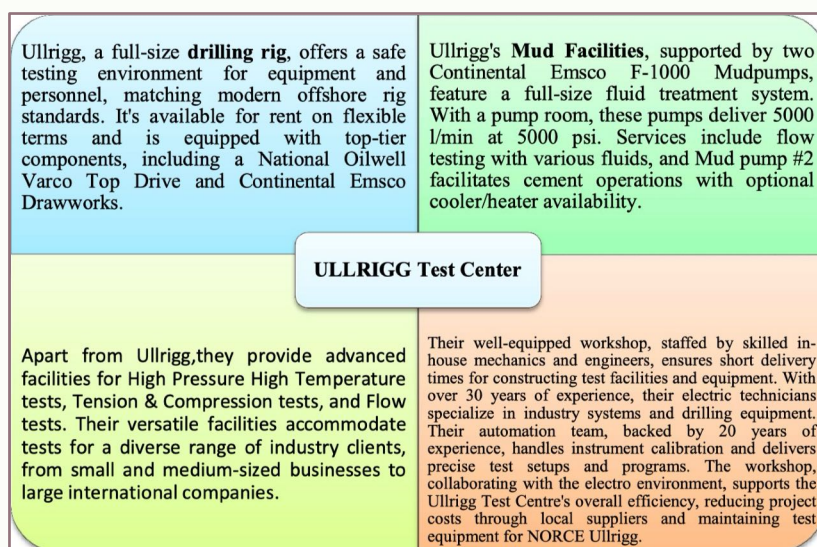
Furthermore, our understanding expanded with a comprehensive exploration of oil and gas piping simulation, processing plants, receiving terminals, and riser and compressor platforms.

Overall, it offered a holistic view of the industry's infrastructure and operational dynamics.

### Day 02: Visit to NORCA (Ullrigg Test Center)

On the second day of our enlightening field trip to Stavanger, Norway, our exploration of the Ullrigg Test Center (UTC), also known as NORCA, provided a comprehensive understanding of drilling and well activities.

The facility's key highlights, such as the full-scale offshore-type drilling rig and eight versatile well configurations immersed us in the intricacies of offshore drilling. Noteworthy was UTC's unwavering focus on Health, Safety, Environment, and Quality (HSE&Q), adhering to the highest standards.



Our visit expanded beyond testing, offering insights into the operational heart of UTC – the Control Room.

We observed both old and new digital control-room for rig and drilling operations, gaining valuable knowledge about the comprehensive health and safety mechanisms in place during operations.

Our understanding deepened as we explored the vital role of drill engineers and their assistants in ensuring the rig's seamless operation.

Additionally, a visit to the Mud Pump-room provided a first-hand understanding of its complete functions. This multifaceted experience added layers of practical knowledge, enhancing our appreciation for UTC's pivotal role in advancing drilling technologies.

Our journey at NORCA was truly enlightening, emphasizing the symbiotic relationship between testing, safety, and operational excellence in the oil and gas industry.





## Pivotal elements and technological innovations... continued



### Day 03 – Visit to Kårstø Gas Processing Plant in Nord-Rogaland

On our third day in Stavanger, our visit to the Kårstø Gas Processing Plant in Nord-Rogaland, a captivating exploration into a crucial hub for gas and condensate/light oil from the Norwegian continental shelf, proved insightful. Linked to approximately 30 fields through pipelines, the plant adeptly handles vast quantities of gas and condensate daily.

Moreover, the comprehensive health and safety mechanisms observed during our visit, including a detailed exploration of the Control Room and the monitored processes, showcased Kårstø's dedication to maintaining a secure work environment. We also earned about the accident response management system, adding a layer of appreciation for the plant's commitment to HSE practices.



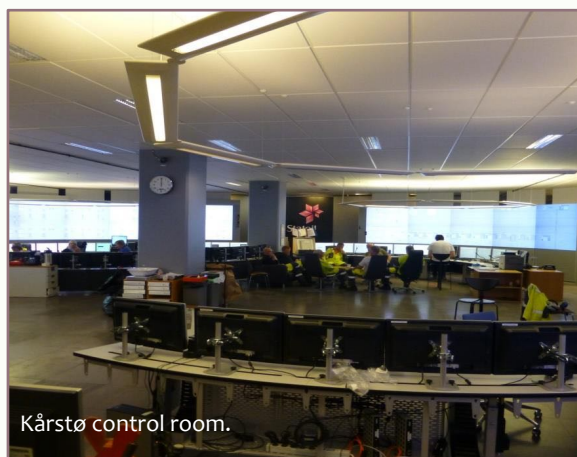
Kårstø Gas Processing Plant.

Key achievements at Kårstø include the effective separation of heavier elements from natural gas. This process results in converting raw gas into a marketable form, which is then distributed across Europe. These efficient operations have positioned Kårstø as the world's third largest producer of Liquefied Petroleum Gas (LPG).

Since its inception in 1985, the facility has consistently evolved, including significant expansions in 2000 and 2014. These developments have enabled it to handle over 90 million standard cubic meters of gas.



## Pivotal elements and technological innovations... continued



Kårstø control room.

Kårstø plays a vital role in the European gas market, forming an essential part of the value chain. It exports 25 per cent of Norway's natural gas, serving a substantial customer base across Europe. The plant's extensive facilities, including storage tanks, caverns, and a sophisticated laboratory (K-Lab), underscore its commitment to safety, environmental compliance, and global connectivity through its participation in the Gassled partnership.

Our visit shed light on the intricate processes, historical significance, and the pivotal role Kårstø plays in shaping Norway's energy landscape.



Pipeline network.

Since May 2000, two caverns at Kårstø store propane at -40 degrees Celsius, totalling 250,000 cubic meters. Situated 30 meters below sea level, each cavern is 195 meters long, 20 meters wide, and 33 meters high. Environmental studies since 1985 show no adverse impacts, and energy efficiency improvements have led to a 70% reduction in CO<sub>2</sub> emissions and an 80% reduction in NO<sub>x</sub> emissions per unit produced.

### Conclusion

The comprehensive field trip to Norway provided invaluable insights into the oil and gas industry's multifaceted operations, ranging from state-of-the-art drilling simulations at the Ullrigg Test Center to the intricate processes of gas processing at the Kårstø Gas Processing Plant.

The immersive experiences offered a comprehensive understanding of technological advancements, safety protocols, and environmental considerations within these critical sectors. Moreover, the commitment to health, safety, and environmental compliance observed during the visits underscored the industry's dedication to sustainable practices.

The knowledge gained from these field visits deepened our understanding of the intricate processes and systems and highlighted the industry's emphasis on continuous improvement and adaptability. The Ullrigg Test Center's customer-centric approach and its pivotal role in facilitating testing for various industries showcase its significance in research and development. Similarly, the Kårstø Gas Processing Plant's role as a vital link in the European gas market emphasizes its contribution to the overall value chain.

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# Extracting more from data: What generative AI means for energy companies

As John Downie, Senior Managing Director, Accenture explains in this article, Generative AI holds immense potential for reinventing energy companies. Why? Just think about all those vast reserves of data waiting to be tapped across the industry.

Energy has always been a data-rich business. And generative AI's ability to process, query, analyse and summarise that data nearly instantly is going to transform not only the way energy companies manage their information but also how they operate, how they augment their workers, and how they deliver value to customers.

Whether it's accelerating field development planning or augmenting the operations field force, generative AI enables the industry to dig deeper into its data and extract valuable insights in a faster, easier, more accessible, and, above all, human-like way.

So it's no surprise that a massive 93 per cent of energy executives report that in the next three years they anticipate a medium to high impact on their organisation's business processes as a result of generative AI chatbots, according to [Accenture's Tech Vision research](#), with 43 per cent reporting it as high/transformational change. In addition, 97 per cent of energy executives agree that generative AI will compel their organisation to modernise its technology architecture.

This report reflects that, according to Accenture analysis, oil and gas companies have numerous roles where a significant proportion of the working day has the potential to be augmented or automated through generative AI. This proportion includes 64 per cent of general and operations manager hours and 58 per cent of first-line supervisors of retail sales workers, among others. Furthermore, large language models (LLMs) have a high potential to automate/ augment field worker hours: for example, petroleum engineers (39 per cent), derrick operators (25 per cent), and rotary drill operators (18 per cent).

## An industry ready to capitalise

It's true there are challenges around data privacy, confidentiality and model accuracy/ auditability to be worked out. For instance, while it may be acceptable to have a 97 per cent accuracy rate for predicting the optimal placement of a well, that wouldn't be enough for recommending the next-best action in a safety-critical activity like a refinery repair. For most use cases, it will remain important to have a human in the loop as validation.

But there are already lots of interesting use cases being explored. And several energy companies have been experimenting with these models for some time, long before ChatGPT lit the touchpaper under global public adoption. Our research has shown almost two-thirds of energy executives anticipate making significant increases in the resources dedicated to AI in the next three to five years. And we've seen recent announcements from [Shell](#) about their plans to use generative AI to improve the speed and efficiency of sub-surface imaging.

At Accenture we've been working with one oil and gas major to use techniques like cognitive search and semantic modeling, as well as generative AI, to automate knowledge gathering and improve access to data.

## A game-changing technology

It's clear the industry is taking generative AI seriously. But why is it garnering such intense interest?

First and foremost, it's the value promise and potential to reinvent energy processes. Our research shows over two-thirds of executives expect AI foundation models to deliver accelerated innovation, among other benefits. Once they begin fully exploring the ways that AI can intersect with core processes, companies can open up advanced capabilities like complex scenario modeling, knowledge transfer between workers, and even reshaping the capital-expenditure cycle.

Another reason the industry is excited about generative AI is the way it democratises the technology. Whoever you are, whatever your role, you can query a model using simple natural language. And it will respond with



## Extracting more from data... continued

meaningful and consumable insights. That takes AI out of the data-science lab and puts it into everyone's hands.

Generative AI is also a significant departure from a technical standpoint. Because these LLMs have been pre-trained on internet-scale datasets, they're already very powerful out of the box. And they can be quickly fine-tuned for specific use cases. That significantly lowers the entry barrier, allowing for much faster adoption.

### Early wins

There are opportunities all the way along the energy value chain – not only in reinventing operations and knowledge management but also addressing critical workforce challenges and environmental reporting.

Employee experience will likely be one of the first places to see the impact. Take equipment maintenance for example. Every engineer who's ever had to repair a pump that was installed decades ago knows just how much documentation you often have to wade through. Generative AI's ability to plough through that material, summarise it, and accelerate the engineer's understanding of it, would provide a massive productivity boost.

Similarly, generative AI offers a lifeline for the decades of tacit know-how that risks being lost as an ageing workforce retires. If energy companies can capture that invaluable experience and expertise, the technology will allow them to transfer the knowledge to a new generation of workers and bridge the looming skills gap.

There are also likely to be early-use cases around end-to-end greenhouse gas emissions reporting. Because, of course, energy companies are significant consumers of energy, not just producers. Generative AI's ability to process and analyse the vast data sets has the potential to support this important challenge.

### Longer-term value

However, the really significant returns will likely come later, as foundation models are adapted and fine-tuned with energy companies' deep wells of industry-specific data. For example, there are interesting use cases around generating new failure modes for equipment or creating capital project optimisations in real time, which require the model to have an understanding of specific data sets like piping and instrumentation diagrams, timeseries data, schedules, and so on.

Another intriguing prospect is accelerating the upfront aspects of capital projects by getting generative AI to create the basic designs, concepts and feasibility studies. Being able to generate an 80% complete design in a matter of minutes would not only reduce project timelines massively, but also enable more accurate forecasts that feed into greater capital discipline.

### How to get started

We would always recommend clients approach this initially with an assessment phase. This is about exploring the potential, defining the overall vision and then prioritising use cases through a deep dive into the intersections with other technologies, the ease of deployment, and the business value on offer. Then the company can start running experiments with a handful of use cases (in a sandbox environment) and assess the overall business readiness. This can be followed by defining the reference architecture, setting out a deployment roadmap, maybe establishing a center of excellence, and kick-starting a program of upskilling and awareness across the business.

**There are new wells of opportunity waiting to be discovered all across the energy value chain, from capital planning through to retail. To find out more about capitalising on this seismic shift, please get in touch.**



**John Downie** is a Senior Managing Director who has been with Accenture for more than 35 years and leads Accenture's Energy Industry globally. He is a member of the company's Global Resources Executive Committee (REC) and the Global Leadership Council (GLC); the REC and the GLC are made up of the most senior leaders in Accenture.

During his time with the company, John has worked across every aspect of Accenture's business including running resources across Europe, the Middle East, Russia, the former Soviet Union, Africa and Latin America.



## SPE London's growing cadre of Arkwright Scholars



The SPE London Section welcomes its newest Arkwright Engineering Scholar, Natalie Jackson, to its growing cadre of SPE Arkwright Scholars.

It was a great pleasure to represent the SPE London Section at the Arkwright Engineering Scholarship Award Ceremony. Natalie received her certificate during the award ceremony at the Institute of Engineering and Technology.

Natalie joins Lauren, our 2022 scholar, as currently active SPE Scholars. The section maintains sponsoring two scholars over a rolling two-year timescale.



The Arkwright Engineering Scholarship programme has operated for more than 30 years, helping nearly 6,700 scholars in over 1,100 schools, with a growing percentage of females.

The SPE London Section has supported the scheme for several years. In April 2019, the SPE London board backed a commitment to sponsoring our first Arkwright Scholarship student for two years, commencing September 2019. The April 2019 issue of SPE Review London explored details of this scholarship scheme and an overview of its potential benefits. (LINK)



The benefits associated with SPE sponsorship of the Arkwright Scholarship Scheme are founded on five core commitments, visualised here (left). These commitments are interdependent, and the outcome is a tripartite mutually beneficial win for the Scholar, Arkwright and SPE London.

In its most recent support programme, the Section had the opportunity to sponsor five aspiring engineers as they considered how they could impact the considerable engineering challenges faced in the 21st century.



## SPE London's growing cadre of Arkwright Scholars... continued

### Arkwright Engineering Scholarship Status

The Arkwright Engineering Scholarship aims to support exceptionally talented 16- to 17-year-old students who show a deep interest in following an engineering career. The SPE London Section highlights the engineering careers within the evolving energy industry, from traditional choices to those that will support the energy transition.

With the support of our fifth scholar, we are contributing to the increasing diversity within the Arkwright Scholar Awards. This year, the ratio of male to female scholars is at 60/40 per cent, respectively, and the number of scholars selected from state schools is approaching 70 per cent.

The Section focuses on supporting scholars attending local authority schools, with a preference towards encouraging more females to enter the world of engineering. The Arkwright scholarship scheme attempts to have as balanced a scholar-gender representation as is possible.



### The Future of Engineering Report 2022

The Smallpiece Trust, under which the Arkwright Engineering Scholarships sit, has issued its report on the Future of Engineering 2022, which I encourage anyone within the engineering community to read. The link is here: <https://www.arkwright.org.uk/downloads/research-report---single-page-spreads.pdf>

The report's three important conclusions are:

- skills shortages will continue,
- drawing engineering talent from all sectors of the community is essential, and
- skill sets need to broaden from the central technical skills, with communication, coding and digital skills becoming increasingly important.

More support is needed. Learn more: <https://www.arkwright.org.uk>



With our members' and sponsorship partners' support, the Section aims to maintain its commitment to the Arkwright Engineering Scholarship program.

### New Arkwright contact at SPE London Section



From 2024, the section's relationship with the Arkwright Engineering Scholarship scheme will be handled by Mehdi Alem, who is taking over from Adrian Southworth. We thank Adrian for all his efforts and commitment in supporting the Section's Arkwright programme.

To ensure the success of our continued commitment, we still need more partnership support. So, if your business wants to support young engineering talent, please get in touch with Mehdi at [mehdialem@live.com](mailto:mehdialem@live.com)



## SPE London section sponsorship opportunities



The SPE International London Section (SPE London) is a not-for-profit technical organisation. Its main purpose is the support of SPE International's mission and vision statement. In fulfilling this purpose, SPE London provides a diverse range of technical and non-technical events to its broad membership base and to non-members.

Strong industry support allows SPE London to fulfil its purpose.



SPE is a well-recognised brand within the broader energy industry, and businesses can leverage their support through many communication channels.

- The section's digital platforms, monthly and Special Interest Groups (SIG) events offer visibility to the association's wide audience of members and non-members.
- Supporting business logos are prominently displayed on the SPE London section website, in the bi-monthly e-magazine (*SPE Review London*), and during SIG events and monthly evening meetings.
- By partnering on shared topics of interest, a business can demonstrate its commitment to Social and Corporate Responsibility (CSR).
- The section offers complimentary access to all live monthly evening and continuing education events, with 4 tickets per £1,000 of financial or equivalent support.

Ways in which your business can support SPE London

- **Traditional direct financial contributions**, which start at £1,000 and are generally of 12-months' duration from January to December.
- **Supporting a specific evening lecture program** is £500, and is offered when a business is presenting at the event or wants to be associated with a particular topic or theme.
- **Special Interest Groups (SIG's)** offer an opportunity to partner on specific industry themes. Support can be for venue/ hosting and may also include promotional materials and 3rd party services.

### Key contacts – for more information about how your business can support SPE London

#### Annual Sponsorship and specific evening lecture support:

Sponsorship Chair, Mehdi Alem, [mehdialemlive.com](mailto:mehdialemlive.com)

#### Special Interest Groups

- **Net Zero:** Barny Brennan, [barny.brennan@gmail.com](mailto:barny.brennan@gmail.com)
- **Diversity and Inclusion:** Isabel Asenjo, [Isabel.Asenjo@eu.sasol.com](mailto:Isabel.Asenjo@eu.sasol.com)
- **Continuing Education:** Adam Borushek, [Adam.Borushek@riscadvisory.com](mailto:Adam.Borushek@riscadvisory.com)
- **Young Professionals:** Samad Ali, [sali72@slb.com](mailto:sali72@slb.com)
- **Arkwright Engineering Scholarship:** Mehdi Alem, [mehdialemlive.com](mailto:mehdialemlive.com)
- **Digital Transformation:** *To be determined*



# Tackling the energy trilemma for the future



L-R: Daniel Pourabrisham, Rami Khouli, Nhoyidi Nsan, Sonia Liu, Mohammed A Mulhim, and Akhil Toram.

**In this article, the SPE Chapter Imperial College London shares its inspiring goals for the upcoming year. The Chapter aims to enhance engagement with diverse energy generation and tackle the energy trilemma – balancing energy security, environmental sustainability and affordability. Its objective is to spearhead initiatives that raise awareness and actively involve the community in shaping the future of energy.**

A key avenue for achieving this vision is through educational initiatives, utilising platforms such as Energy4me. The goal is to empower young minds with a comprehensive understanding of the energy industry, fostering a new generation of professionals well-versed in traditional and sustainable energy practices.

To facilitate this, we will organize regular knowledge-sharing sessions, bringing together industry experts and academia to cover a range of topics, including environmental considerations, health and safety practices, sustainability initiatives, and the integration of data science and analytics in the energy sector. These sessions will serve as a bridge between theory and practice, offering our members first-hand experiences from industry professionals.

We also look to explore opportunities to visit industry sites and organize 'A Day in a Life' sessions to give students a first-hand view of what it feels like to be an industry professional. Our overarching goal is to provide a holistic view of the oil and gas industry, emphasizing technical aspects alongside the critical importance of sustainability and innovation. In addition, we recognize the significance of addressing work-life balance in the dynamic energy industry, aiming to prepare our members for successful and fulfilling careers.

Together, as the Imperial College SPE chapter, we are dedicated to shaping the future of energy and nurturing a community that is well-informed, inspired and ready to contribute to a sustainable and balanced energy future.

## Proposed Activities for Term 2 (January 2024 – April 2024)

- Energy4me event at a high school for knowledge sharing about the energy industry
- Two seminars based around technical and behavioural topics
- Membership drive day
- Site visits



## Tackling the energy trilemma for the future... continued



### President: Nhoyidi Nsan

Nhoyidi serves as SPE president of the Imperial College London student chapter. He is currently enrolled in the MSc Geo-Energy with Machine Learning and Data Science course, and hopes to leverage the application of data science to the energy industry. Nhoyidi holds a bachelor's degree in petroleum engineering from Covenant University Nigeria and an MSc in Renewable Energy Engineering from the University of Aberdeen, United Kingdom.

His previous experience, with industry leaders TotalEnergies and Nigeria's Petroleum Technology Development Fund, means Nhoyidi is poised to make meaningful contributions to the energy industry. He actively engages in the SPE community, recognizing it as a platform for professional growth, exposure and networking opportunities. His dedication to merging academic knowledge with real-world experiences positions him as an aspiring leader in the ever-evolving landscape of the energy industry.



### Vice President: Rami Khouli

Rami Khouli, currently pursuing an MSc in Geo-Energy with Machine Learning and Data Science at Imperial College London, is driven by a passion for energy solutions and data-driven analysis.

Coming from a background in petroleum engineering with degrees from Kuwait University, Rami's commitment to continuous learning led him to supplement his education with online courses in data science and machine learning. Eager to address global challenges such as energy inequality and climate change, Rami chose to study at Imperial because of its excellence in these fields.

As an active member of the academic community, Rami serves as the SPE Vice President at Imperial and is the class representative of the Geo-Energy with Machine Learning and Data Science programme. He envisions a future career making meaningful contributions to clean-energy initiatives, leveraging Imperial's education to innovate in sustainable, global energy solutions. His long-term goal is to apply these innovations in Syria and the Middle East, fostering regional development and energy independence through sustainable practices. Rami believes that, in the face of a new era in energy, data science is the compass and innovation is the vessel guiding us toward a sustainable future.



### Memberships Chairperson: Sonia Liu

Sonia, hailing from China, is currently enrolled in the MSc Geo-Energy with Machine Learning and Data Science program at Imperial College London, leveraging her background in earth science and geology.

Beyond academia, Sonia is enthusiastic about hiking and photography. She is actively engaged in the academic community as the SPE Membership Chairperson, where her responsibilities include guiding individuals through the membership application process, leading initiatives to boost engagement, recruitment and retention, and aiding graduating students transition to professional membership. In this role, Sonia elucidates the processes and advantages associated with professional membership, contributing to the smooth progression of individuals from academia to the professional sphere.

Her commitment to this leadership role reflects both her dedication to the academic community and her interest in facilitating her peer's growth and professional development.

## Tackling the energy trilemma for the future... continued



### Secretary: Akhil Veera Sai Toram

Akhil is a top-tier petroleum engineering graduate from JNTU Kakinada, currently pursuing an MSc in GEMS at Imperial College London. His expertise was honed at industry giants such as Exxon Mobil, Halliburton and TechnipFMC.

Akhil is proven in Subsurface Engineering and Reservoir Surveillance, and has earned accolades, especially from EM. Since his undergraduate studies, Akhil has represented O&G professional bodies such as SPE and FIPI.

He is recognized nationally by *The Economic Times*, and was listed as one of the Top 91 Engineers in India in their Campus Stars 2.0. Akhil combines technical acumen with leadership through initiative and ownership. He is poised for impactful contributions in the energy sector.



### Treasurer: Mohammad A Mulhim

Mohammed Almulhem is currently the SPE Treasurer Chairperson at Imperial College London. He began his academic journey with a BSc in Petroleum Engineering from West Virginia University, USA.

Currently, he is expanding his expertise through an MSc in Geo-Energy, specializing in Machine Learning and Data Science at Imperial College London.

With a notable seven-year experience at Saudi Aramco, Mohammed excelled as a Facility Lead Engineer, enriching not only his technical skills but also honing leadership and strategic thinking capabilities. Having been a dedicated member of SPE in Saudi Arabia, he actively volunteered in various events, fostering a deep appreciation for the community and the professional development opportunities.

Now a key member of the Imperial College London SPE team, Mohammed is eager to leverage his experiences and skills to contribute to the chapter's growth and success. He looks forward to collaborating with the dedicated team to organize enriching events and create valuable opportunities for members. His goal is to ensure the chapter remains a vibrant platform for learning, networking and professional development. His commitment reflects a dedication to enhancing the SPE community at Imperial.



### Communications Chairperson: Daniel Pourabrisham

Daniel is currently the SPE Communications and Outreach Chairperson at the Imperial College Chapter.

He holds a BSc in Petroleum Engineering from the University of Houston and is pursuing an MSc in Geo-Energy with Machine Learning and Data Science at Imperial College London.

With a professional background in data analytics, particularly in the oil&gas sector, Daniel emphasizes the impact of his prior involvement with SPE on his professional development and career trajectory.

Expressing a readiness to give back, Daniel serves as a reliable liaison for all matters related to SPE. Leveraging his experience, he is excited to collaborate with the dedicated team to organize enriching events and provide valuable opportunities for the chapter.

Recognizing the significance of engagement and participation from members, Daniel anticipates sharing these experiences and contributing to the success of the SPE Imperial College Chapter. His commitment reflects a desire to foster a vibrant and supportive community within the organization.



# Crucial interactions and the energy transition

The SPE London Section, in collaboration with the SPE Imperial College chapter, successfully organized a virtual industry talk that left a lasting impact on student chapters from the University of Manchester, Coventry University and Imperial College London. The event featured two esteemed Reservoir Engineers, Alison Isherwood, AJ Isherwood Consulting and Mehdi El Faidouzi, Senior Reservoir Engineer at Genel Energy, who shared their expertise and insights.



Mehdi El Faidouzi

Mehdi's extensive experience across the O&G value chain captivated the audience as he delved deep into the daily life of a Reservoir Engineer, highlighting the crucial interactions with other disciplines in the upstream industry.

Meanwhile, Alison drew on her background in O&G and her recent focus on the energy transition to provide invaluable knowledge on the various options, pathways, and careers in the energy transition sector. Her PostGrad certification in sustainable business further enriched her perspective.



Alison Isherwood

We express our heartfelt gratitude to Alison and Mehdi for volunteering their time and empowering the students with their experience. The students cherished this opportunity for personal development and gained immense value from the session.

**To all industry professionals interested in supporting future learning endeavours, we invite you to reach out to Mehdi Alem, the SPE London Student Chapter Liaison at [mehdialemlive@gmail.com](mailto:mehdialemlive@gmail.com). Your contribution will undoubtedly make a meaningful difference in the journeys of all aspiring professionals.**

## Are you a forward-looking, curious and energetic professional in the petroleum industry?



**The SPE London committee is actively looking for volunteers to join the team for the year 2023\24.**

We strive to meet our members' evolving professional needs through technical events, workshops, webinars, networking opportunities – and the SPE Review London e-magazine. To ensure we provide the best experience, we need volunteers to help us with the essential work that makes it all happen!

Volunteers may find themselves helping out with coordinating events (also a great chance to network and meet some fascinating people), creating and tracking social media, learning about magazine production and design – or perhaps finding a new opportunity to add value to the section.

**To find out more** about how you can be part of the great team at SPE London, please email us at: [speylondon@gmail.com](mailto:speylondon@gmail.com)

Or contact Elizaveta Poliakova at: [elizaveta\\_poliakova@outlook.com](mailto:elizaveta_poliakova@outlook.com)

**To learn more about us** and the various industry committees, go online at: <https://www.spe-london.org/committees/>

# Introduction to Upstream Oil and Gas for the Net Zero World - the 16th annual seminar

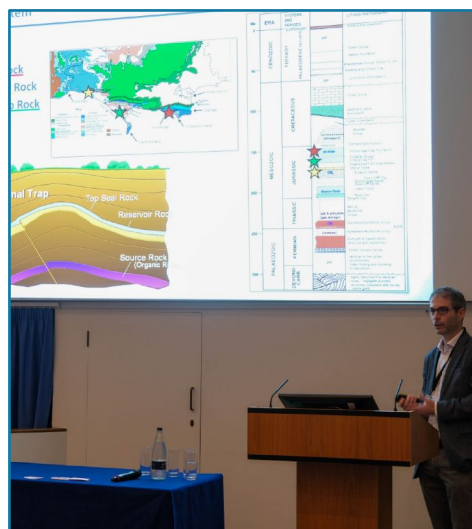


In November 2023, SPE London organised its 16th annual introductory seminar ‘Introduction to Upstream Oil and Gas for the Net Zero World’. Many thanks are due to Adam Borushek for organising this informative and instructive event.

Tamerlan Suleymanov provided the report, and Antonina Barsukova provided the images.

The seminar provided an introduction to the full life cycle of exploration and production (E&P) industry, including geoscience, drilling, operations, reservoir engineering and commercial terms. The speakers also discussed key issues facing the industry related to sustainability and ESG reporting, and recent trends in energy-transition careers. Nine industry professionals, with decades of experience across the industry, presented an introduction to their discipline, showcasing the complexity of the E&P industry.

Topic	Speaker
The Role of E&P in the Energy Transition	Robert Clews, Bechtel
Geoscience	Paul Wilson, Perenco
Drilling	Ian Hutchison, Merlin Energy
Reservoir Engineering and Reserves	Adam Borushek, RISC Advisory
Production Facilities	Shwan Dizayee & Francesca Tate, Accenture
Upstream Economics	Natan Battisti, Harbour Energy
Upstream Deals, Financing and M&A	Arnaud Millie, Tullow Oil
Sustainability and Reporting	Rosalind Griffiths and Anna Shaw, PwC
Energy Transition Careers	Alison Isherwood, Storegga



Attendees at The Geological Society formed a diverse audience in terms of professional background and experience.

The day started off with 'The Role of E&P in the Energy Transition', covering areas such as electrification, carbon capture usage and storage, and hydrogen.

After setting the scene in which E&P and the energy transition interact, the presentations were linked up following the life-cycle of projects, starting with Geoscience.

After the first networking coffee break, the discussion continued around the technical aspects of the E&P industry, introducing the audience to the next phase of activities once a potential reservoir in a petroleum system is located, being drilling, followed by reservoir







# Intro to Upstream Oil & Gas for the Net Zero World... continued



engineering and reserves. The presentation covered different well types and phases as well as cost and time considerations.

The Reservoir Engineering presentation provided an overview of different types of reserves and resources, and the applicability of reserves' and resources' estimation techniques in the context of carbon capture and storage and geothermal energy projects.

The first session following the lunch break presented insights into production facilities, covering topics such as production optimisation as well as renewable energy, carbon capture and hydrogen use cases in the context of E&P.

Following the technical sessions, it was time to move towards the economic and commercial components. The audience was first introduced to upstream economics, with an overview of business risks, types of E&P contracts and common techniques used to evaluate assets from a commercial point of view to make important strategic decisions around which assets to prioritise.

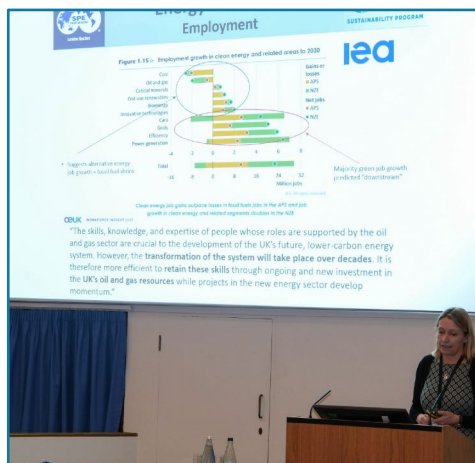
This brought the asset life-cycle circle to a close, and beyond learning the basics of each stage, the emphasis on communication and co-operation between each business unit was highlighted.

Before the afternoon break, participants were introduced to the topic of upstream deals, financing and M&A, including macro factors affecting the North Sea oil and gas investment landscape over the last decade.

After a short break, the last section of the seminar introduced the audience to evolving ESG and sustainability considerations in the E&P industry, and subsequent reporting requirements in this area. The day ended with attendees learning about energy-transition careers and current employment trends in the E&P industry.

We would like to thank all speakers, organisers and volunteers for helping to make this a highly successful event. SPE London plans to repeat this event in late 2024.

PDF files of the presentations are available on the SPE London website in the [Resources section](#), under [Continuing Education](#).



**Tamerlan Suleymanov**

Tamerlan is an Assistant Director in the E&NRvaluations team at Deloitte, UK.

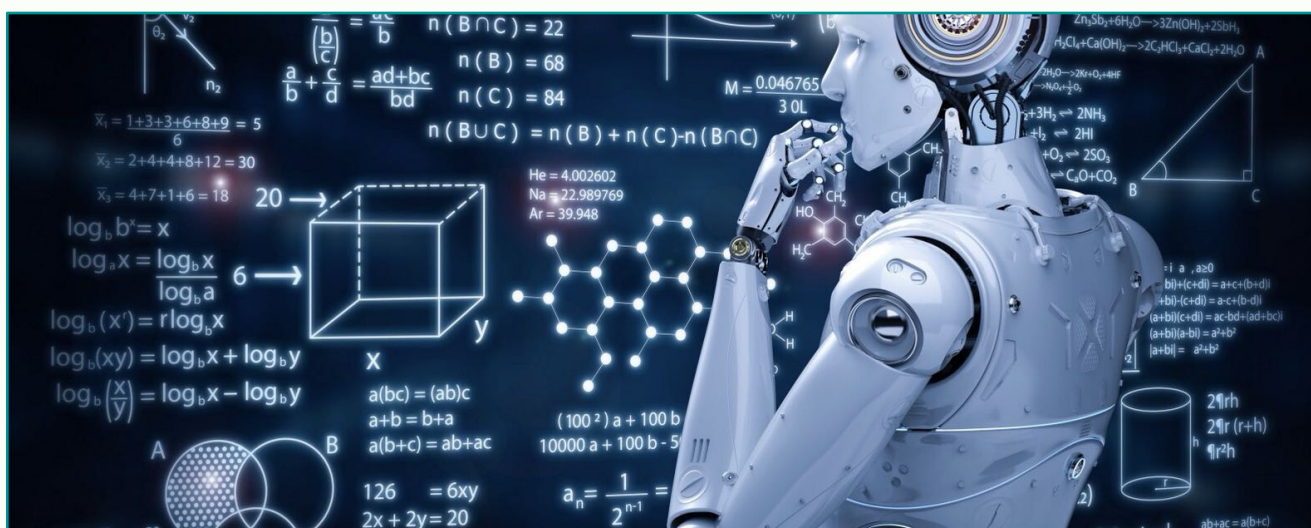


# Machine Learning Guide for Petroleum Professionals: Part 4



Join us for the final installment in our four-part series focused on addressing the implementation of AI in the petroleum industry using a real case study. Written and illustrated by Saif Ur Rehman, this article was first published (February 2023) in *The Way Ahead*, which is written by and for young professionals in the oil and gas sector, covering career development, business and technology.

**Saif Ur Rehman** is a deep learning mentor volunteer at DeepLearning.AI. With a background in petroleum engineering, he is passionate about merging machine learning with reservoir simulation to provide AI-driven solutions to petroleum industry challenges. He holds a BS in petroleum engineering from Dawood University of Engineering and Technology (DUET), and has been actively involved with SPE since 2015. He currently serves as the International PetroBowl Question Writing Volunteer for 2023 and held the same role in 2022. He was also an Ambassador Lecturer for SPE in 2021 and served as president of the SPE DUET Student Chapter in 2017.



In this concluding part, we'll be taking our understanding to the next level by discussing the L-layers model, exploring some essential data preprocessing techniques and understanding the training and testing data sets. (Photo credit: PhonlamaiPhoto/Getty Images/iStockphoto)

Welcome to the final part of our machine learning journey. In Part 1, we covered some basics of machine learning, while in Part 2, we delved into nonlinear activation functions. In Part 3, we explored the fascinating world of deep learning. In this concluding part, we'll be taking our understanding to the next level by discussing the L-layers model, exploring some essential data preprocessing techniques and understanding the training and testing data sets. We'll then tie everything together by applying our newfound knowledge to a real-world oil and gas case study using a complete set of data. By the end, you will be fully equipped to apply machine learning to real-world oil and gas problems and make accurate predictions. So, let's dive in!

In Part 3, we explored the three layers model (two hidden layers and one output layer). We also discussed the notations, forward steps, and backward steps for each layer. Just a recap, the forward propagation of the second hidden layer is:

$$Z2 = W2.A1 + b2$$

$$A2 = g(Z2)$$



## Machine Learning Guide ... continued

And backward propagation (derivatives) for the same (second) layer is:

$$\begin{aligned}dA2 &= W3^T \cdot dZ3 \\dZ2 &= dA2 * g2'(Z2) \\dW2 &= \frac{dZ2 \cdot A1^T}{m} \\db2 &= \frac{\sum dZ2}{m}\end{aligned}$$

Did you notice a pattern here? For forward propagation, the input to the second layer (A2) is A1, which is the output of the first layer. To generalize, we can say that input to the L-layer is the output of the L-1 layer or previous layer, denoted by A(L-1). So, the generalized form is:

$$\begin{aligned}Z(L) &= W(L) \cdot A(L-1) + b(L) \\A(L) &= g(Z(L))\end{aligned}$$

Where  $W_L$  and  $b_L$  are the weights and biases of the  $L$  layer, respectively, while  $A(L-1)$  is the output of the L-1 layer (a layer comes before the L-layer). Same goes for  $Z_L$  and  $A_L$ . One point to notice is that  $A(L-1)$  for the first layer,  $A_1$ , is  $X$  (input data) and is denoted by  $A_0$  (A-zero).

The same intuition can be applied to backward propagation. For  $dA_2$  (second layer), we use the  $W_3$  and  $dZ_3$  (next layer terms). So, to generalize it, we can write:

$$\begin{aligned}dA_L &= W(L+1)^T \cdot dZ(L+1) \\dZ_L &= dA_L * gL'(Z_L) \\dW_L &= \frac{dZ_L \cdot A(L-1)^T}{m} \\db_L &= \frac{\sum dZ_L}{m}\end{aligned}$$

Where (L-1) means a layer before the L layer and (L+1) means a layer after the L layer.

Now let's explore some data preprocessing techniques. There are different ways to preprocess the data, but I will discuss the two types only. They are:

**Data Cleaning.** This is simply removing missing or duplicate data, correcting errors, and removing outliers that can adversely affect the model's performance. We use filters and functions in Excel, and in Python, the NumPy library provides convenient functions like `np.null`, `np.unique`, etc. to clean our data.

**Data Scaling.** Machine-learning algorithms often perform better when the input data are scaled to a similar range. For example, all the values of input are between zero and one or something like that. We usually do this by dividing all the input values by the maximum values of that input. For example, if  $X$  is  $[1,2,3,4,5]$ , we will divide all the values by the maximum value of  $X$  (which is 5 in this case) to get  $[0.2,0.4,0.6,0.8, 1.0]$ . If we have hundreds of thousands of data, we simply use a max function in Excel and in Python to find the maximum value. Generally, this method is called min-max normalization and is used for positive data only.

## Machine Learning Guide ... continued

We also use Z- score normalization. This means we transform the data so that it has a mean of zero and a standard deviation of one. This can be done by this formula:

$$X_{\text{normalized}} = \frac{X - \text{Mean of } X}{\text{Standard Deviation of } X}$$

For example, for a data set  $X = [1, 2, 3, 4, 5]$ , the mean is 3 and the standard deviation is  $\sqrt{2}$  or 1.41. So,  $X_{\text{normalized}}$  for the first value of  $X$ , which is 1, is:

$$X_{\text{normalized}} = \frac{1 - 3}{1.41} = -1.41$$

After normalizing all the values of  $X$ , we have  $X_{\text{normalized}} = [-1.41, 0.70, 0, 0.70, 1.41]$ . All data range from -1.41 to 1.41.

Now let's discuss the training and testing data sets. In machine learning, we use the training and testing data sets to train and evaluate our models. The training data set is used to train the model, while the testing data set is used to evaluate the model's performance.

The idea behind using separate data sets is to check the performance of the model on unseen data or new data. If we use the same data set for training and testing, the model will perform well on that specific data set (training set), but it might not generalize well on new data. This is known as overfitting, and it can lead to poor performance when the model is used to make predictions on new data.

Therefore, to avoid overfitting, we randomly split the data into training and testing data sets. The usual split is 80% of the data for training and 20% for testing, but this can vary depending on the size of the data set and the complexity of the model.

Incidentally, underfitting occurs when the model is too simple and cannot capture the underlying patterns in the data. In other words, the model does not fit the data well enough and performs poorly on both the training and testing data sets. To curb underfitting, we usually increase the model complexity (increasing the number of hidden layers and/or neurons), gather more data, etc.

Now it's time to combine all our knowledge and apply it to a real set of data. But first of all, I would like to thank [Professor Michael Pyrcz of The University of Texas at Austin](#) for generously providing me the porosity and permeability data used in this article. The complete dataset is [available here](#).

I am using the data of a file name 'Stochastic\_1D\_por\_perm\_demo' in that repository. [You can see all the Python code here](#). I encourage you to open the link in a new window and read side by side with this article.

One caveat is that it's important to note that porosity is just one of the factors that affects permeability. Therefore, it's important to keep in mind that our data presented in **Table 1** (on the next page) is for educational purposes only, as there are many other factors that affect permeability beyond just porosity.



## Machine Learning Guide ... continued

	Unnamed: 0	Porosity	Permeability
0	0	13.746408	193.721529
1	1	9.608479	105.718666
2	2	11.664361	138.539297
3	3	8.375338	93.719985
4	4	13.183358	169.738824
100	100	8.042614	84.564471
101	101	19.887759	453.228801
102	102	11.118544	128.606149
103	103	16.051620	265.341789
104	104	17.762477	337.335817

Table 1.

**Table 1** displays the top and bottom five cells of our data. The numbering of the samples starts from zero, indicating that there are a total of 105 samples. Column 1 (Unnamed: 0) contains serial numbers; column 2 shows porosity; and column 3 displays permeability. We don't want serial numbers (column 1) to be a part of our data, right? Let's delete it using the drop function of Pandas. Additionally, I checked for missing values, and fortunately, our data does not have any null values. The updated version of the data is shown in **Table 2**.

	Porosity	Permeability
0	13.746408	193.721529
1	9.608479	105.718666
2	11.664361	138.539297
3	8.375338	93.719985
4	13.183358	169.738824
100	8.042614	84.564471
101	19.887759	453.228801
102	11.118544	128.606149
103	16.051620	265.341789
104	17.762477	337.335817

Table 2.

Let us consider  $X$  as our input variable, which represents porosity, and  $Y$  as our output variable, which represents permeability. **Fig. 1** displays the curve between the two variables.

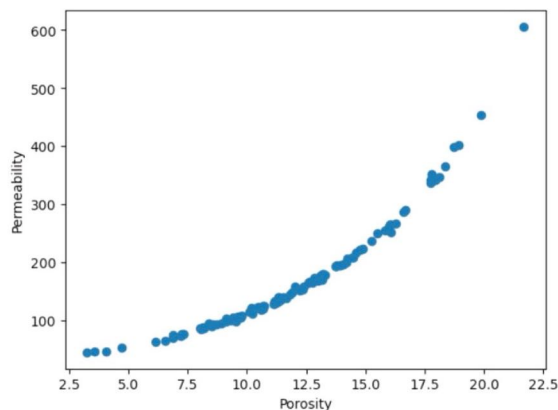


Fig 1. Porosity vs. permeability plot. All images created by author.

## Machine Learning Guide ... continued

The x-axis of Fig. 1 displays the porosity values ranging from 2.5 to 22.5. Let's scale it to range from 0 to 1 by dividing all the  $X$  values by the maximum values of  $X$ . We can accomplish this in Python using the command ' $X = X/\text{np.max}(X)$ '. Once the scaling is done, we can redraw the curve between  $X$  and  $Y$ , and this time the x-axis will range from 0 to 1. The resulting graph is presented in **Fig. 2**.

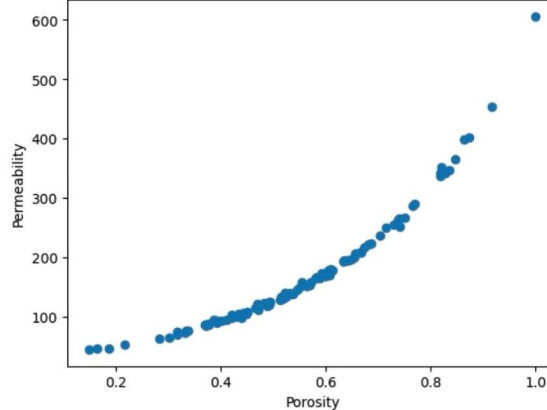


Fig 2. Porosity vs. permeability scaled plot.

Upon comparing Fig. 1 and Fig. 2, it is evident that they are similar except that in Fig. 2,  $X$  values are scaled to range from 0 to 1. This scaling improves the performance of the model and reduces the running time. It is recommended to scale the input data to a suitable range to ensure that the model can effectively capture the underlying patterns and relationships between the input and output variables.

To prepare our data for training and testing, we use a function called **split\_data** which splits our dataset into training and testing sets. The training set consists of 80% of our data, while the testing set consists of the remaining 20%. Additionally, this function transposes our data so that the features (porosity) are in a row, and the number of examples is in a column. As a result, we obtain the following dimensions for our data:

$X_{\text{train}}$  shape: (1, 84)

$Y_{\text{train}}$  shape: (1, 84)

$X_{\text{test}}$  shape: (1, 21)

$Y_{\text{test}}$  shape: (1, 21)

These dimensions indicate that we have 84 samples for training and 21 samples for testing.

The next function is **initialize\_parameters\_deep**. This function initializes the parameters (weights and biases) using the [He et al. \(2015\)](#) initialization method, as discussed in Part 3. This method helps to improve the convergence of our neural network and prevent vanishing or exploding gradients.

The **linear\_forward** function defines the linear function, which is represented as  $Z = WX + b$  or  $Z = WA + b$ . The **relu** function applies the ReLU activation function to the output of the linear function, which is represented as  $A = g(Z)$ . The **linear\_activation\_forward** function combines both the **linear\_forward** and **relu** functions to perform the forward propagation step of our neural network. Finally, the **compute\_cost** function calculates the cost ( $J$ ) of our model. Together, these functions make up the feedforward propagation step of our neural network.

## Machine Learning Guide ... continued

Now it's time to implement the backward propagation step to update our parameters. To do this, we need to compute the gradients (derivatives) of the cost function with respect to the parameters. From Part 3, we know that the derivative of the loss with respect to the output of the last layer, denoted by  $AL$  or  $\hat{Y}$ , is simply  $dAL = AL - Y$ , where  $Y$  is the actual value of permeability. This will be used as the starting point for the backward propagation algorithm. We feed this to **relu\_backward** function to determine the derivative of  $Z$  with respect to the loss, denoted by  $dZ$ . Next, we use the **linear\_backward** function to determine the derivatives of the weights ( $dW$ ), biases ( $db$ ), and the previous layer's activations ( $dA_{prev}$ ) with respect to the loss. Finally, we use the **linear\_activation\_backward** function to call the **relu\_backward** and **linear\_backward** functions and compute the derivatives for the entire layer.

Furthermore, the **update\_parameters** function is used to update the parameters. The **L\_model\_forward** function performs forward propagation through all  $L$  layers of the network, while the **L\_model\_backward** function performs backward propagation through all  $L$  layers of the network to compute the gradients. Finally, the **L\_layer\_model** function integrates all the aforementioned functions to train an  $L$ -layer neural network. With the completion of the implementation, we are now ready to run the model on our data.

We define the number of layers and neurons using **layers\_dims**. Let's try different models. For Model 1, we assume that **layers\_dims** is equal to  $[X\_train.shape[0], 3, Y\_train.shape[0]]$ . This means that the number of input features is 1 (porosity only) as indicated by  $X\_train.shape[0]$ . The hidden layer has three neurons, and the output layer's neuron is 1 (permeability only) as indicated by  $Y\_train.shape[0]$ . We set the learning rate to 0.01 and the number of iterations to 1000. By running our Model 1 with the **L\_layer\_model** function, we obtained the following results.

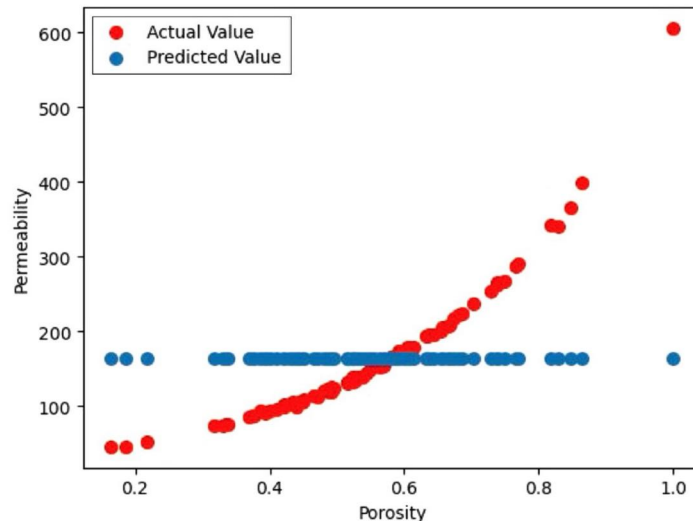


Fig 3. Model 1.

You can see that the predicted values of permeability in Model 1 are quite different from the actual values, indicating a poor fit.

Let's try Model 2, where we set the **layers\_dims** to  $[X\_train.shape[0], 3, 5, Y\_train.shape[0]]$ . This means that we have two hidden layers, with the first layer having three neurons and the second layer having five neurons. The number of input features and output neurons is the same as in the previous model. We will keep the learning rate and the number of iterations the same as in the previous model.



## Machine Learning Guide ... continued

After running our Model 2 using the `L_layer_model` function, we obtained the following results.

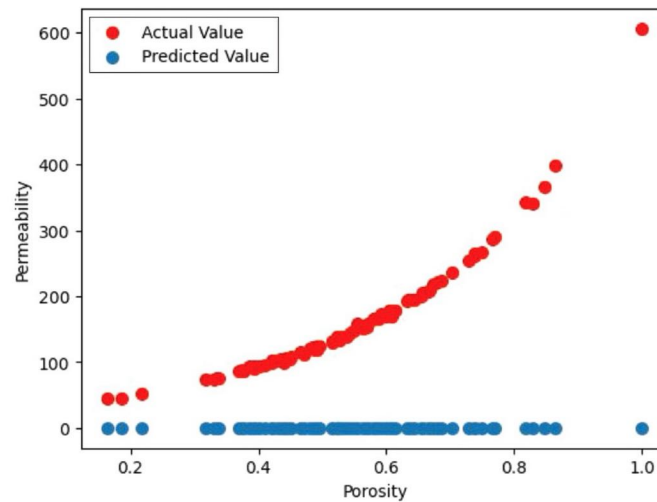


Fig 4. Model 2.

Once again, we can observe a poor fit between the actual and predicted values of permeability for Model 2.

Let's try Model 3 with the same number of hidden layers and iterations as in Model 2, but the learning rate is decreased to 0.001. The result of Model 3 is shown in **Fig. 5**.

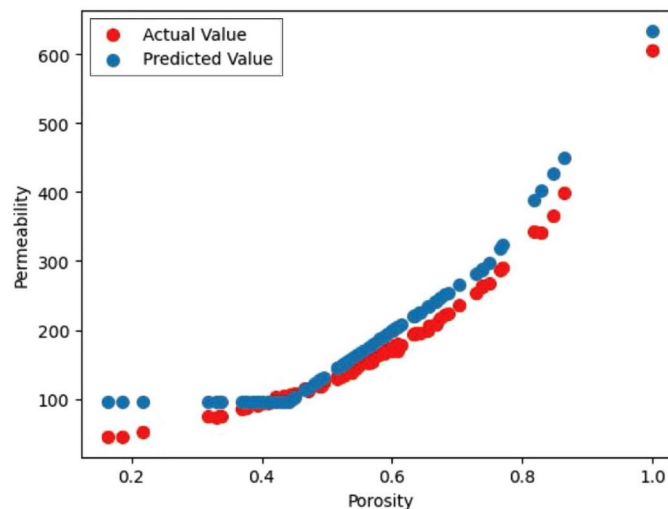


Fig 5. Model 3.

The performance of Model 3 is much better than the previous two, with a training accuracy of 85.37%. However, there is still room for improvement. We can try tweaking the hyperparameters, such as learning rate and number of iterations, or try adding more layers and neurons to see if the model performance improves.

For Model 4, we increase the number of iterations to 5000 and decrease the learning rate to 0.0001. The result is shown in **Fig. 6** (on the next page).

## Machine Learning Guide ... continued

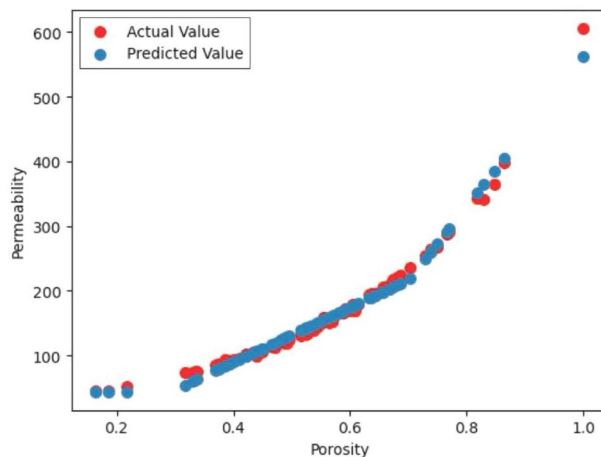


Fig 6. Model 4.

Wow! Model 4 performed very well, with a training accuracy of 95.30% and a training error of 4.69%. However, the ultimate goal of our model is to make accurate predictions on new, unseen data. Let's evaluate the model's performance on our testing data.

The **test\_model** function uses the parameters (W and b) learned by Model 4 and predicts the permeability for the X\_test values. The resulting predicted permeability values are shown in **Fig. 7**.

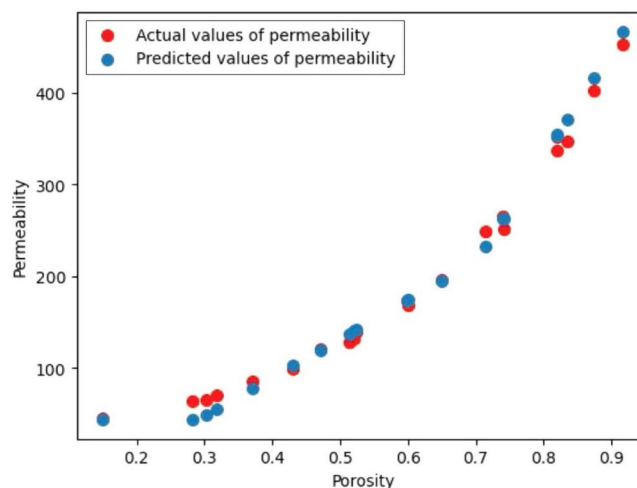


Fig 7. Test result.

The testing accuracy of 93.11% and testing error of 6.88% indicate that our model generalized well and did not overfit. **Table 3** shows the first five and bottom five values of actual and predicted permeability.

	Actual Permeability	Predicted Permeability
0	65.227602	48.423159
1	98.809947	102.649599
2	173.684221	173.418657
3	251.375148	263.172400
4	120.779829	119.351362
16	84.564471	77.245457
17	453.228801	466.938151
18	128.606149	137.328746
19	265.341789	262.251597
20	337.335817	353.538548

Table 3.

## Machine Learning Guide ... continued

We can see that the predicted permeability values are very close to the actual values for most of the test data, indicating the effectiveness of our neural network model.

If you wish to represent this model in mathematical notation, it can be written as follows:

$$\text{Permeability} = \text{Relu}(W3.\text{Relu}(W2.\text{Relu}(W1.\text{Porosity} + b1) + b2) + b3)$$

This equation represents a mathematical form of our neural network Model 4 with three layers. The equation takes the porosity as an input and predicts the permeability as an output. The input feature, porosity, is multiplied by the weight matrix  $W1$  and added to the bias vector  $b1$ . The resulting value is then passed through the ReLU activation function to introduce nonlinearity. The output of the ReLU function is then multiplied by the weight matrix  $W2$  and added to the bias vector  $b2$ . This process is repeated for the remaining two hidden layers ( $W3, b3$ ). Finally, the output of the last ReLU function is the predicted permeability.

**Fig. 8** displays the values of all parameters that were learned by Model 4. These parameters include weights and biases for each layer in the neural network and these learned parameters are used to make predictions on new, unseen data.

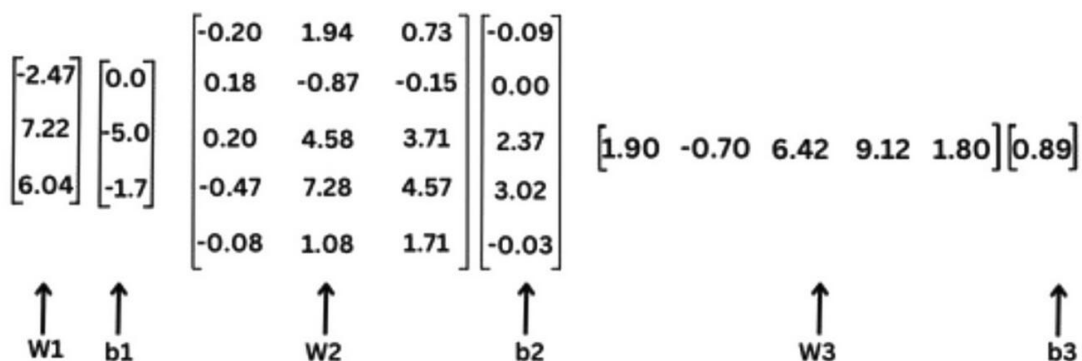


Figure 8. Values of parameters, learned by Model 4.

So, that's the end of this article and the end of our machine-learning journey. Thank you for reading until the end. Now that you have learned how to apply machine learning to oil and gas problems, it's important to keep in mind that the quality of your model depends on the quality of your data. As the saying goes: 'garbage in, garbage out'. Therefore, it's essential to ensure that your data is of high quality to obtain accurate and reliable results.

Feel free to customize the code provided to suit your own data and specific needs. I hope these articles have been helpful to you and that you feel confident to apply machine-learning techniques to your own oil and gas problems.

Once again, thank you for your time and attention.  
See you soon with more freshly brewed content!



# SPE events calendar – local and international

## LOCAL – in the UK

**February 20-21, 2024 (London, UK)**

### **SPE Workshop: Fiber-Optic Sensing Applications for Field Development, Integrity and Optimisation**

Delve into the world of fiber-optic monitoring technologies, unlocking their immense potential in optimizing reservoir and field development and operations. Join us at the forefront of innovation and exploration into in-well fiber-optic sensing. Together, let's unlock the potential of these groundbreaking technologies for unparalleled field development, integrity, and optimization. Register and book in advance.

More information: [SPE workshop](#)

**June 05-06, 2024 (Aberdeen, Scotland)**

### **SPE Oilfield Scale Symposium**

Welcome to the prestigious SPE Oilfield Scale Symposium, a premier event tailored for the global oil and gas industry. Prepare to embark on a two-day immersive experience, meticulously designed to cultivate knowledge, foster innovation, and encourage collaboration. Join us as we gather esteemed industry experts, thought leaders, and visionaries under one roof. Prepare to be captivated by the insights, discoveries, and best practices shared by key players across the field.

More information: [SPE Oilfield Scale Symposium](#)

## INTERNATIONAL

**February 04-09, 2024 (Dallas, Texas)**

### **SPE Forum: Artificial Intelligence in Upstream E&P 2030**

The forum will address the thought-provoking concepts of the future and discuss the aspirational impact of further improvements of the software and hardware technologies on the engineering and geoscience workforce. Underlying questions include: Which tasks do we envision to be remaining by the year 2030? What do we teach when all the book knowledge can be accessed through AI?

More information: [SPE forum](#)

**February 6-8, 2024 (The Woodlands, Texas)**

### **SPE Hydraulic Fracturing Technology Conference and Exhibition**

The conference showcases existing and new hydraulic fracturing technologies, using experiences from fracture-stimulated wells, and the application of global learnings. Attend one of the most popular SPE events that brings together E&P professionals and experts to learn about the latest developments and practices in hydraulic fracturing, exchange knowledge, explore the exhibition of innovative products and services, and network.

More information: [SPE conference](#)

**April 17, 2024 (Bergen, Norway)**

### **SPE Norway Subsurface Conference**

Meet with innovators and leaders across the Norwegian Continental Shelf as we welcome you to the 2024 edition of our renowned SPE Norway Subsurface Conference. Running for more than 30 years, it is the perfect platform for collaboration and learning. Focusing on innovation, technology, and the rapidly developing energy transition, it is the place to be to expand your technical knowledge and delve into the key issues facing upstream E&P professionals today.

More information: [SPE conference](#)

**June 26-28, 2024 (Turin, Italy)**

### **SPE Europe Energy Conference and Exhibition**

Times call for the scientific community and industry to take on the energy transition's challenges and seize the opportunity to join the energy, environmental, technological and economic communities to ensure energy security, pursue sustainable technology development and promote climate change mitigation. It is this awareness that inspires the new edition of the Europe Energy Conference, Europe's main SPE event. Formerly known as EuropEC.

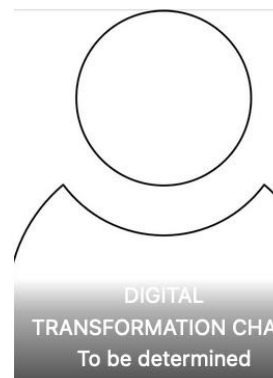
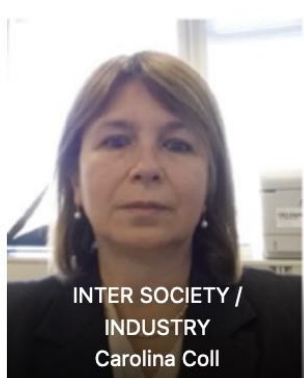
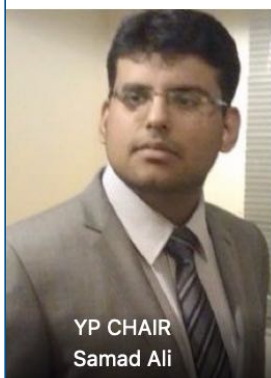
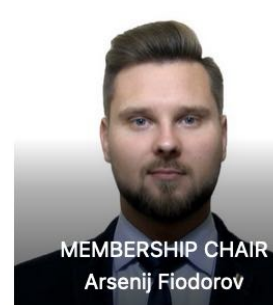
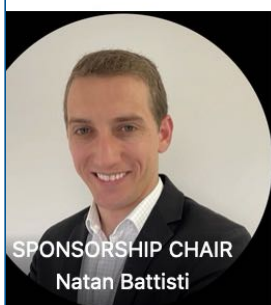
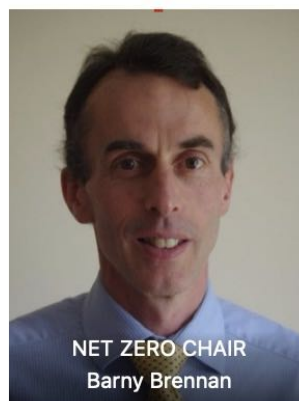
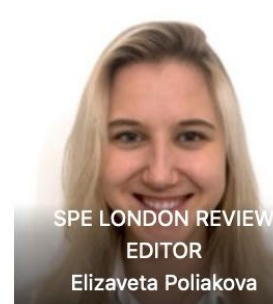
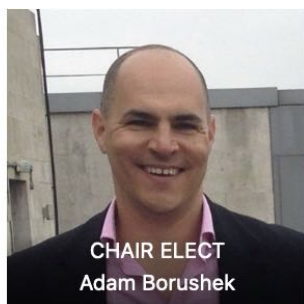
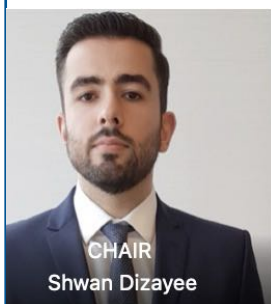
More information: [SPE Europe Energy conference](#)

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And, for more information about SPE training courses, calls for papers, and opportunities for sponsorship: [sponsorship.spe.org/en/events/about-events/](https://sponsorship.spe.org/en/events/about-events/)

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