SPE Review London May 2024

SPE Review London

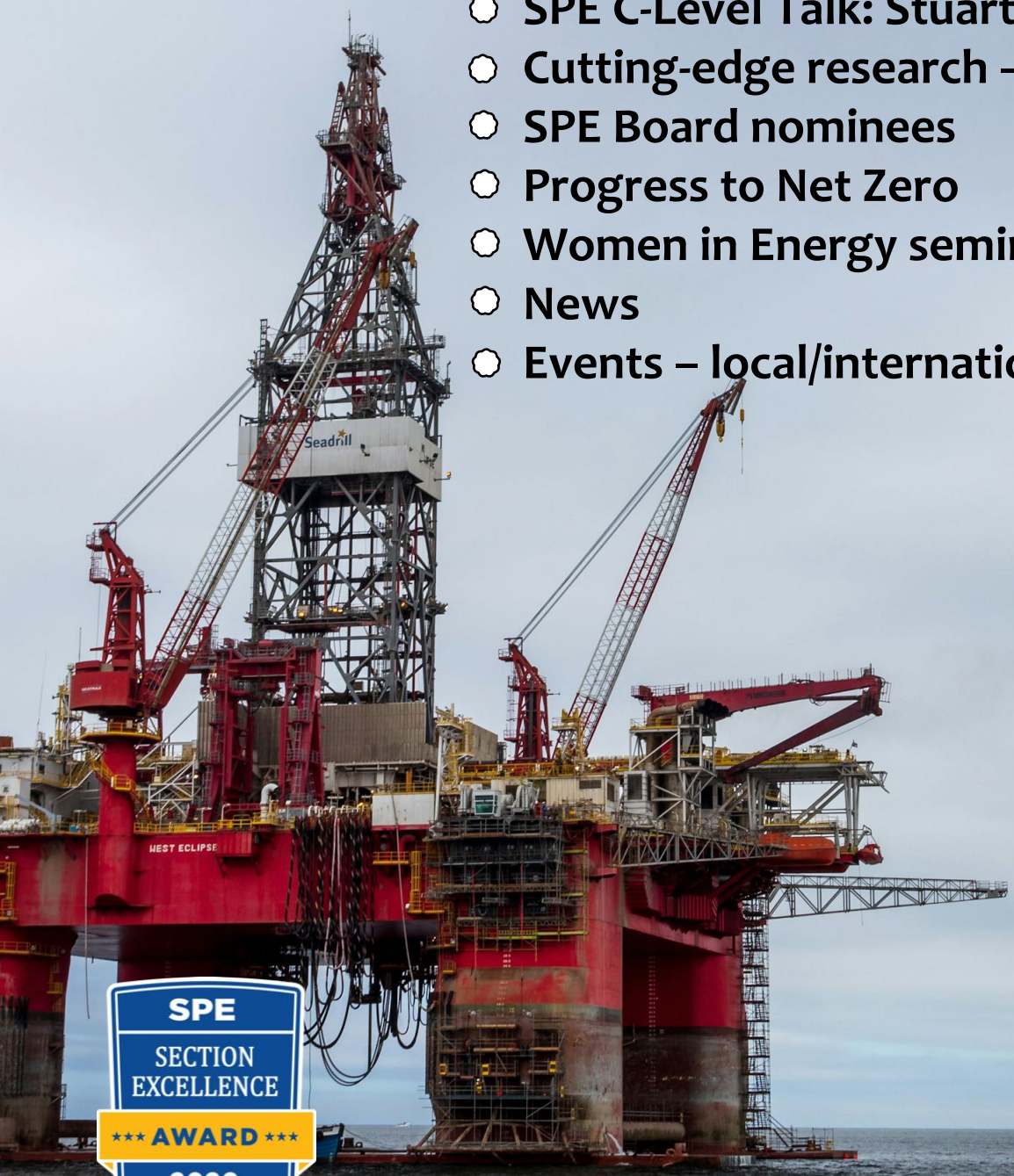
The official e-magazine of the Society of Petroleum Engineers' London branch

London Section

Calculation of Production Back Allocation Using Machine Learning Algorithms

Also in this issue:

- SPE C-Level Talk: Stuart Wheaton
- Cutting-edge research – Net Zero talk
- SPE Board nominees
- Progress to Net Zero
- Women in Energy seminar 2024
- News
- Events – local/international



SPE SECTION EXCELLENCE *** AWARD *** 2020

50 YEARS

SPE Review London

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

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. 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 for an application form.

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In this issue

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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.

Credit: Benjamin Davies

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

Gold — Rock Flow Dynamics

Silver — OPC

Bronze — SERICAENERGY

Letter from the Editor

Dear SPE London Members and Readers,

Welcome to the May 2024 edition of the SPE London Review.

In this edition we cover an informative webinar with **Dr Katriona Edlmann**, hosted by SPE London Net Zero, and discussing the role of hydrogen storage for meeting net zero targets. You can access the full playback and the presentation on our website and read more on page 7.

On page 08, we're pleased to feature a success story from **Stuart Wheaton**, whose journey from ExxonMobil to founding Wheaton Energy offers inspiration and valuable lessons for professionals at all stages of their careers.

In addition, we are thrilled to announce the relaunch of the **Women in Energy Seminar** this June. This will be the 14th seminar and the first one after a five-year break. This event aims to empower women in the rapidly changing energy landscape, with a focus on AI and the energy transition – more on page 13.

Follow on to page 14, to meet the **nominees for the SPE Board**. On page 18, we covered a webinar with **Dr Amanda Turner** hosted by SPE London Net Zero discussing trends and regulatory challenges shaping the energy sector nowadays.

Don't miss our technical feature on page 21, where we dive into the application of **machine learning algorithms in production back allocation**. The study by Hassani et al. shows how advanced technologies can enhance efficiency and accuracy in our operations.

A big thank you to our Editorial Team members, Ffion Llwyd-Jones and Malvika Nagarkoti, for their ideas, insights, energy and time spent preparing this publication!

Please reach out if you have any feedback, ideas, or wish to join SPE London!

Sincerely Yours,
Elizaveta Poliakova

NEWS DIGEST... NEWS DIGEST... NEWS DIGEST

Record high investment in Norway for 2024

New estimates indicate 1.3% higher investment in 2024 offshore Norway than in the first-quarter survey from February, according to Statistics Norway.

The statistics office said the increase is due to higher expected spending on exploration and field developments.

Investment will continue to be strong in 2025, although with fewer new developments. Total investments in oil and gas activity are estimated at $20.6 billion (216 billion crowns) in 2025.

More information: **Norway**

CNOOC secures exploration and production contracts

The Ministry of Mineral Resources and Energy of Mozambique and Empresa Nacional de Hidrocarbonetos have entered into petroleum exploration and production concession contracts with CNOOC Limited's wholly-owned subsidiaries.

The contracts are for five blocks located offshore Mozambique. The total area is approximately 29,000 km^2, with water depths from 500 to 2,500 m.

More information: **CNOOC**

Exxon confirms directors

Despite a 'vote no' campaign by shareholder rights activists, both chairman Darren Woods and lead director Joseph Hooley were re-elected on 29 May.

Exxon confirmed all 12 directors were elected by shareholders, with 95% votes on average cast in favor of the nominees.

The company added: "Their vote signals a belief that we are on the right track by overwhelmingly re-electing our directors."

More information: **Exxon**

Advancing geoscience initiatives

In a 'mutual commitment to advancing geoscience', OPC is now a Sustaining Sponsor for the Geoscience Energy Society of Great Britain (GESGB).

The company says the partnership will allow it to "continue sharing knowledge and supporting networking opportunities and educational programs in the industry, focusing on technical excellence and communal development to advance geoscience initiatives and foster growth in the energy sector".

More information: **OPC**

ConocoPhillips acquires Marathon Oil

A definitive agreement on 29 May, sees ConocoPhillips acquire Marathon Oil in an all-stock transaction with an enterprise value of $22.5 billion, inclusive of $5.4 billion of net debt, according to the company's website.

Ryan Lance, ConocoPhillips chairman and CEO said: "This acquisition of Marathon Oil further deepens our portfolio and fits within our financial framework, adding high-quality, low cost of supply inventory adjacent to our leading U.S. unconventional position."

Lee Tillman, Marathon Oil chairman, president and CEO said: "When combined with the global ConocoPhillips portfolio, I'm confident our assets and people will deliver significant shareholder value over the long term."

More information: **ConocoPhillips**

NEWS DIGEST... NEWS DIGEST... NEWS DIGEST

Tri-level celebration

SPE London is happy to announce new sponsors at three levels:

Gold level: **RockFlow Dynamics**
Subsurface modelling experts.

Silver level: **OPC**
Service provider and consultants.

Bronze level: **Serica Energy**
An E&P operator focused in the North Sea.

More information:
RockFlow Dynamics
OPC
Serica Energy

Serica Energy new CEO

Chris Cox is the new CEO at Serica Energy, effective 1 July 2024. David Latin, Serica chairman, will simultaneously cease his temporary role as Interim CEO.

Chris has more than 40 years' experience in oil and gas, including CEO of Spirit Energy, Interim CEO of Capricorn Energy, and chairman, Kellas Midstream.

David Latin said: "We are delighted to have secured the services of Chris Cox after a rigorous recruitment process."

More information: **Serica Energy**

Oil (Brent) 83.76 +0.67 (+0.83%) – 30/05/2024 (**Credit: Market Insider**)

Improving accuracy

A new license agreement sees Wintershall Dea using Halliburton Landmark's new Unified Ensemble Modeling (UEM) solution, with the first application of DecisionSpace 365 deployed in Norway's Maria Offshore Field.

UEM simultaneously integrates static and dynamic data in real time to represent subsurface conditions across multiple scales.

The company says UEM improves the accuracy of reservoir models by consistently incorporating geologic uncertainties.

More information:
UEM

New CEO at BW Energy

BW Energy Limited has appointed Brice Morlot as CFO effective 30 June 2024. He will be based in Lisbon.

Brice was previously the Managing Director of Assala Energy in Gabon, and held other leadership roles in Assala, SCOR and Perenco.

More information: **BW Energy**

Cutting-edge research informs Net Zero talk

On 21 May, the SPE Net Zero committee hosted a very informative webinar on hydrogen storage. Our speaker, Dr Katriona Edlmann who is Chancellor's Fellow at the University of Edinburgh, spoke eloquently with a wealth of knowledge on the role of hydrogen storage for meeting net zero targets, and on some of the pore scale effects of multiple cycles of injection and extraction of hydrogen in porous reservoirs.

Katriona outlined the scales of storage required to complement energy supply from variable supply renewable sources. She described a range of hydrogen storage options and demonstrated that storage of hydrogen within porous reservoirs was the leading solution for Terawatt scale storage with discharge times of months, suitable for addressing seasonal variance. Interestingly, she also noted the potential for discharge from porous reservoirs over shorter timeframes that would help boost the commerciality of such projects.

Katriona was able to draw on some cutting-edge research from the University that is helping us better understand pore scale interactions of hydrogen. Experiments have shown that hydrogen acts as a non-wetting gas, with low interfacial tension, making it highly mobile within reservoirs. This helps reduce residual trapping risk. Core experiments, with multiple cycles of hydrogen injection and extraction, have showed an approximate 7% residual hydrogen saturation after the first cycle but no significant increase in residual hydrogen after subsequent cycles. This greatly increases confidence in the long-term effectiveness of such stores.

Katriona's presentations sparked a host of interesting questions, and unfortunately, we didn't have time to address them all. But this is surely a sign that more sessions about hydrogen are needed in the future – watch this space!

Both the event playback and Katriona's two presentations can be accesses via the SPE London website: https://www.spe-london.org/spe-net-zero-virtual-programme/

Being authentic, true to oneself – and having fun!

Stuart Wheaton is an upstream oil and gas leader with nearly four decades of experience spanning onshore, offshore (shallow and deepwater) environments across continents from the North Sea to Australia, and South America to Africa. Now, as an Independent Consultant with Wheaton Energy, he advises on global projects covering upstream and geothermal energy assets, focusing on sustainable practices and comprehensive project lifecycle management. Stuart's career is marked by a profound commitment to safety first and a keen ability to lead, manage and inspire teams across diverse cultural landscapes.

Who is Stuart Wheaton? Please tell us about yourself.

I'm an Ipswich Town football and Gloucester rugby fan, which causes daily elation and despondency, but am happily married to my childhood sweetheart Tanya, who is a maths teacher. My two (kind-of-grown-up) sons, Jack and John, now provide carbon offset to my upstream career by working in renewables.

I studied chemical engineering at Imperial College, London, back in the medieval times of the 1980's, when there wasn't even an internet.

Beyond being a sports fan in anything that moves these days (having kids encourages this), I used to play rugby and judo. My main interests centre on travel and walking holidays, wine (drinking it and collecting it) and reading history. It's amazing what the past has to teach us about the present and the future.

Please walk us through your career. How did you ultimately become a Founder and Independent Consultant at Wheaton Energy?

When leaving school for a year before, and when at university, I was sponsored by British Gas. This was the national corporation and not the later BG or Centrica, i.e. before Maggie privatised it. This provided various great eye-opening experiences at sites around the UK. This included a summer at the original Rough gas storage site at Easington, when it was being built, and a later summer at the Hornsea salt cavity gas storage site further up the same coast.

On the latter, a Halliburton rig crew came on site with a land snubbing unit – it was my 'first well'. It was these experience that got me interested in the upstream industry. And the more I looked at it, all the better. I was really keen on the opportunity for international experience and travel – there is a whole wide world out there. And this was a long time before cheap flights with Ryanair, easyJet and the like.

After considering various options, in 1989 I joined the mothership 'Big E' – Exxon/Esso – in London, as a graduate reservoir engineer. I still look back and thank Exxon very much, now ExxonMobil, for how they developed me, and the mentoring received. This was by formal courses in 'exotic' Houston alongside being very fortunate to work for and with great teachers such as Jess Stiles – later of SCAL fame, and known to many petroleum engineers out there today.

This was in the heyday of the Shell-Esso Joint Venture in the UK sector producing over a million barrel of oil equivalent (BOE) per day. My first field started small on Brent doing some 350 kbd oil at the time! It was a non-operated but very busy environment at Esso with a great variety of fields to work on.

After some two-and-a-half years the opportunity came up to go operating in Australia with Exxon. So, in late 1991, off we went to Melbourne (we were married by then), and this meant working on Bass Strait, Australia – at that time some 15 producing platforms and 400+ active offshore wells.

I started on sub-surface there, but then went into production operations including in the final year being trained up to be a platform supervisor/OIM on the mighty Cobia. Marvellous! A great experience over three years plus. Being a young Pom offshore in Australia is never to be forgotten.

Exxon then took me from surfing and sun in Oz, to Aberdeen, where you can still surf but it's a bit colder. This continued my operations work as an onshore superintendent seconded in to Shell Expro working fields such as Cormorant, Eider and Dunlin. I did this for two years. But then this is that moment

Being authentic, true to oneself and having fun!... continued

after some 7-8 years where you then have to decide in a large company to make the long-term commitment, possibly to be a 'lifer', or go and try elsewhere. I did the latter in 1996.

Firstly, I was a production engineer on Liverpool Bay for BHP for two years, and then their field partner LASMO tempted me to move over and go international. Those years at LASMO were a great grounding and as a production technologist I ended up working in Libya, Venezuela, Iran and other very not mundane locations. This was largely on single status rotations to the remote field. I look back with gratitude and smile greatly at the places and people experienced: 50°C in Libya Sahara well testing, to torrential downpours in Venezuela trying to make rod pumps work under armed guard.

But oil prices at the time weren't great and LASMO was taken over by Eni, but as a door closed, another opened. BHP asked if I would come back, and I worked for them for a further two years out of London on a North Sea subsea project. By then our two sons had been born and a settled life beckoned!? So, you know what happens next…

A great industry friend contacted me in early 2003 and asked if I might be interested in a sub-surface manager type role in Cairn India. Well, the rest is history. We went out as a young family for four years and I was very fortunate to be in the Cairn India family in Chennai and then Delhi, for what was to be the ride of my working life.

The growth of the original offshore fields such as Ravva and CB/OS-2 was cause enough, but the discovery of the onshore Rajasthan oil fields another level. Some 125 (yes, one hundred and twenty-five) onshore E&A wells were drilled and nearly all tested in a period of about two-and-a-half years years. I led the sub-surface team that executed this amazing programme, alongside some towering drilling and operations individuals.

Then, seven Field Development Plans subsequently put together and approved, and a team built up to some 150 people. When people ask me today if I'm working hard (and having fun), nothing can quite compare to what happened there. It was the making of my working career and for us as a family with what we experienced. The Rajasthan fields have now happily produced over 700 million barrels, and still look like they are going along nicely today.

But it's also fair to say that it was proving difficult to then stay longer in India – our elder son needing secondary education not available in India at that time, and yes, I was a bit worn-out! So, it was a good time to take a break and a change. I did some consulting for ~6 months but realised I really missed the operating and doing.

It was in early 2008 that the opportunity came up again via a great contact, the former BHP HR manager who knew me and was now at Tullow. By then I'd also realised that I was more of an independent oil and gas company person than a super-major one.

After interview I took the job as North Sea Asset Manager doing my best to lead a team working the mature ex-Phillips assets in the southern North Sea including the Bacton terminal and Hewett Field.

But in life you must also have some luck as well as be good, and Tullow with its partners hit big with the deepwater Jubilee find offshore Ghana about two months after I had started in the Chiswick office.

Now this really was a 'tiger-by-the-tail' moment for 'little' Tullow, but it was a company up for the challenge. I was transferred over, essentially as Ghana Development employee Number 1, and the deepwater baptism immediately started.

By creating an Integrated Project Team (IPT) with field partners Kosmos, Anadarko and GNPC, the field was appraised, developed and on-line by the end of 2010 – in some 1,200 metres of water with a 120 kbd FPSO on top of it. Tullow's role was the well construction and building the country organisation to then produce the field following handover from the IPT. We did it. This was the experience that truly exposed me to multi-billion dollars, multiple international location projects involving world-scale contractors and interfaces. Remarkable. The country of Ghana is a wonderful location.

After a year or so of production at Jubilee, Tullow moved me on to a 'head of function' type role across all technical and operations disciplines, and a seat on their Excom. It was a wild and busy time in Tullow

Being authentic, true to oneself and having fun!... continued

with activities in more than 20 countries centered mainly on Africa. More discoveries in Uganda, Kenya and other locations followed.

However, I am believer that all good things, do in the end, come to an end; they just do. And the 2014 oil price slump hit hard and the ability to carry on, as we had, then had to stop.

Sometimes, an opportunity will arise, which is out of the blue really, and may catch your eye on a day when on others it possibly wouldn't. And this is what happened in 2015 when Premier Oil contacted me to ask if I might be interested in a role leading their UK business out of Aberdeen. I took it. It was an opportunity to truly lead and be accountable for a multi-field set of assets – mature ones, new ones and some in development. With the 2014 drop in oil prices and a 'troubled' new project at Solan trying to start-up, it was quite a time to keep things safe, control costs and deliver on the promises.

The period 2015-2018 lives in the memory for what we all did – sorting out Solan as best we could, running our assets safely and to a profit, and delivering the big Catcher project to its schedule and cost budget – also ahead on its production promise. Lots of JV Partner, other oil company and Government interaction – and this was at the time the OGA, now the NSTA, was finding its feet. Premier also purchased the upstream E.ON UK assets at the time so integrating the businesses together was also very rewarding. Lots of people managing and leading experiences here!

In 2018, Premier moved me to London, and I again took up a world-wide HSE, technical and operations lead role. This now included the Falkland Islands, Mexico, Indonesia and Vietnam, in addition to the UK. We even drilled a well in Alaska. It was great to be back in international 'variety'. `

In early 2020 I was made up to the Chief Operations Officer bringing in the Business Units also under my role with related HSE and P&L accountability. But of course, you never know what is round the corner, and the small matter of Covid-19 soon arrived.

Like many others we launched intensively into how to manage this safely and effectively, while maintaining production and projects. We did this but the arrival of very low, even negative oil prices (remember that day?), was a big hit on Premier, like it was for many others. By the end of 2020 we had been taken over by Chrysaor to form Harbour Energy. All the same, I positively decided to stay and lead the company's International Assets as an Executive VP in the new company's leadership team.

The recovery from Covid and integrating the two companies together, while also remembering Chrysaor had evolved itself from bringing assets from three companies together, was again a challenging time but was completed. A particular highlight in this time was the Andaman Sea deepwater gas discovery at Timpan in 2022 off Sumatra, Indonesia – acreage Premier had acquired several years before. Further large gas discoveries have been made since that time.

So, we get to 2023, and Harbour launched a needed organisation re-work after it had been up and running for some two to three years. I had made it to the grand old age of 57 and decided, very amicably, to depart as part of this review. The final year had involved working on the now well progressed Wintershall-DEA and Harbour Energy deal. All the best to the Harbour/WDEA team on the next steps.

But, for me, not to retirement, just yet, and in 2024 I formed my own 'one-man band' consultancy and I'm very gratified that in recent months several clients have already asked me to look at assets in a variety of countries including Angola, Austria and Kazakhstan.

It's been interesting to bring together my wide-ranging experiences of over 35 years and apply them to support others including their current operations and forward investment decisions. I'm working now on about half time, and in this condition it's also time to do that 'big jobs' list you never seemed to get round to and take some more holidays. Never say never to full time working again, as you never know what's coming, but this is a happy place to be today.

Could you describe the key moments or experiences that facilitated your transition from hands-on technical roles to executive leadership positions and to, most recently, become a Founder?

In writing the above career progression, I would pick

Being authentic, true to oneself and having fun!... continued

out the moves and roles in Australia, India, Ghana and later to Aberdeen (Premier) as the four key steps – after Exxon had given me such an excellent grounding.

All these steps were a progression in variety of work and/or responsibilities. Where the variety of work was not just about the technical but much about people, culture and organisation interfaces. Seeking out breadth of experience and location has truly helped – and make sure to do the field work as well as the office. I can't overstate enough the importance of that last point. I still really enjoy time in the field where, frankly, the real work gets done.

And then finally, without being arrogant, be confident, given those experiences, to step out of one's comfort zone. I didn't know anything much about deepwater when starting on Ghana but after three years of a very steep learning curve, with a great team to learn from, we were running the 120 kbd production of a major deepwater project in a country that had never seen that before. It can be done.

How have you navigated and adapted to the dynamic nature of the energy sector throughout your career, both in terms of responding to the changing landscapes of the industry and evolving your leadership strategies during these periods?

I am a firm believer that you must make your own choices to develop your career. I think that's even more the case today, whatever the industry or arena you work in. Always be kind and respectful, and thankful for what you receive but, to progress, you must choose what's next and not just what's given. I believe my career history is an example of this. Work hard where you may be and do what you say you will do, but then you will know when it's time for a change – be it an internal move or to move to another place.

Also keeping the faith, as when things are down – including the oil price! – then opportunities will still come. Those moments of working hard and doing your best will be recognised by others and remembered, and I think that's happened to me several times. And when that call comes, don't ignore, take a good look and take some risk. India could have worked out differently for us, but it didn't. I'd like to think those I have worked with, and I have led, will say I'm empathetic (nearly all the time!). That I seek out to mentor and coach by giving time, and that I am driven for the team to deliver. I've held this all the way through, and it seems to have worked.
Be authentic always – you are what you are – a bag of genes and experiences gained from when you were born. Others will need to be asked about their views of me, mind!

And finally, even when rising through the ranks, I kept my technical work and interests up to date. I'd highly recommended keeping your roots intact and healthy. It's all coming back to me right now as a one-man consultancy. But it's more than that, you can talk with and encourage everyone, throughout an organisation, when you are genuinely understanding and are interested in how everyone can and does contribute to the wider success.

Looking back on your career, what are you most proud of, and what would you have done differently?

Taking some care here, that with pride there can soon be a fall!

I look back with deep fondness on the time in India and what was delivered, and especially now that the young team we grew there is widely spread across the industry. They are working in all kinds of countries and projects. The Rajasthan exploration and appraisal campaign is unlikely to ever be repeated with so much covered in such a short space of time – can you believe we cut 4.5 km of core… and we used it too.

I think also understanding that safety and environmental performance to very high standards is so very important. Leaders set the standard here in what they do, what they ask, and then they speak by actions rather than words. For example approving asset integrity budgets, approving training programs, and yes making sure safety comes in front of production. I've learnt and done all of this. It really matters.

Many of my other experiences beyond India are a

Being authentic, true to oneself and having fun!... continued

very close second!
But in summary, the most pride I take is seeing the people I have met and worked with, positively proceeding with their working lives, and hoping I had a small contribution in helping them get there.

And what could I have done differently? There was a time when I was so engrossed in the technical delivery of my work that you can lose sight of the wider picture, and the role of others. Delivery in upstream is not by individual contribution, it's too big for that and the issues too wide-ranging. I learnt that and it's a lesson well learnt – if you get that, you'd be amazed how many times extraordinary things can be delivered by extraordinary teams!

How have you built and sustained high-performing teams during challenging periods, such as mergers or global crises, in your roles as Chief Operating Officer and EVP Head of International Business?

Thinking back, I've probably experienced four major up-and-down cycles in the oil patch in my career. I can only re-emphasise the need for well-selected and motivated teams that want to go to work, enjoy it and get well rewarded with fun, development, recognition and, yes, well paid, for doing that. Every time, the successful workplaces have done this.

I think it's also key for the leadership to lead and know that they cast a shadow – people watch you and take notes! So even if there is pressure on, prioritise safety and don't cut back. Keep the core team together and motivated through the tougher times. And know how to celebrate success. I will repeat that being authentic as a leader is so important – don't be what you aren't, and be empathetic, as you usually do not know what is really on someone else's mind.

I have found if you do all of this – and it's not easy to be it all the time – then when the tougher times come, there is at least understanding of why it is this way.

Reflecting on your vast experience, what advice would you give to young professionals aspiring to leadership roles in the oil and gas sector?

I will keep this to a bullet point list!

• The industry isn't disappearing because it can't disappear, the world needs us. But let's do a safe and environmentally friendly version of us, always.

• Make your own career decisions, after listening respectfully, but make your own ones, do not leave it to others.

• Take some risk – get out of your comfort zone and try something new, or even very different, especially if you aren't enjoying what you are doing.

• Go out and see the world – the oil and gas industry is everywhere, so do not stay home all the time. Of course, sometimes we must think of others too, but you'd be surprised how much they want to come with you. We went overseas with our sons at ages 2 and 4, and never looked back.

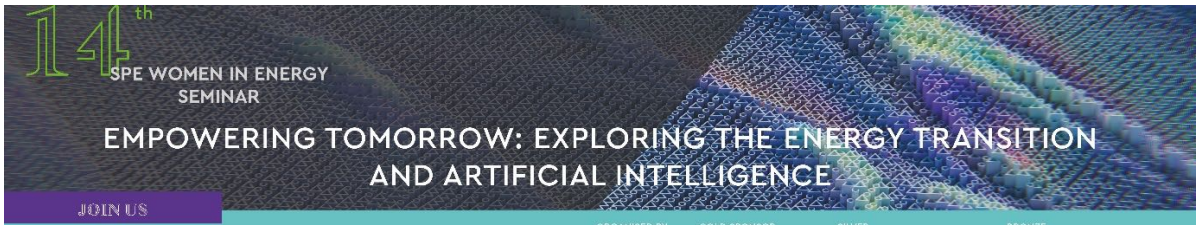
• Be the best version of yourself – work hard, play hard, be kind, be respectful, but be yourself (and not some MBA version you think you need to be!).

• Keep your technical and operational heartbeat. Keep yourself up to date. I'm eternally grateful to the SPE, with whom I'm a Life member now, for a being a great vehicle to do that – go on, write a few papers, add to the industry record, and above all help others to get the knowledge!

• "Proceed until apprehended" – it's so easy to reason why not to do something, not even get started, so let's get going!

• And finally – have fun!


Libya 1999



SPE Women in Energy 2024 Seminar

The SPE Women in Energy Committee is delighted to announce that the Women in Energy Seminar is to be relaunched this June! Following a five-year hiatus the 14th Annual Seminar is back, bigger and better than before.

The theme for 2024 is ***Empowering Tomorrow: Exploring the Energy Transition and A I***

Join us on **Thursday 20th June** at the **Keyworth Centre, London South Bank University** (SE1 6NG) with for a day that will leave you feeling inspired, supported, more connected and ready to take on your personal and professional challenges with fresh energy and new perspectives.

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We will have keynote speeches from Ann Davies (BP), Michael Wynne (S&P Global) and Amy Challen (Shell). As well as a panel discussion with speakers from Ørsted, Perenco, Lean-in Network, NEO and Nuclear Waste Services.

Our line-up this year also includes a series of workshops covering the topics of ESG and Biodiversity in the Energy sector, Navigating an industry in a state of flux, Energy Transition Careers advice, Self-Coaching Fundamentals and Introduction to AI for an Energy Industry Transition

In this empowering seminar, we'll explore how women can navigate and excel in the rapidly evolving landscape of the energy transition and artificial intelligence. From leveraging technological advancements to breaking through barriers, we'll discuss strategies for success and reflect on what companies can do but mostly what we as individuals can do. Whether you're very senior or just starting your career journey, this event offers invaluable insights, networking opportunities, and inspiration to help you thrive in this dynamic field.

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The seminar promises to be one of the top networking events of the year and men are not only invited - but encouraged to join us!

Purchase tickets for £35.26 (includes vat + fee) here: https://SPE_women_in_energy_2024.eventbrite.co.uk

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SPE Board Announces Nominees for 2026 President and 2025 Directors

Jennifer L. Miskimins is the nominee for 2026 SPE President. She and six others make up the new slate of nominees recommended for positions open on the SPE International Board of Directors.

2026 SPE President

Jennifer L. Miskimins is a professor and the department head of the petroleum engineering department at the Colorado School of Mines (Mines), where she holds the F.H. Mick Merelli/Coterra Energy Distinguished Department Head Chair.

She has over 30 years of experience in the petroleum industry, starting with Marathon Oil Company as a production engineer. Miskimins began teaching at Mines in 2002 and has held various appointments since then. From 2013–2015, she held a part-time appointment at Mines while working at Barree & Associates. In 2016, she returned full-time to the university.

Miskimins served as the first Completions Technical Director on the SPE International Board of Directors. She was an SPE Distinguished Lecturer in 2010–2011 and 2013–2014. She was awarded the 2014 SPE Completions Optimization and Technology Award, and in 2022, she received the SPE Distinguished Achievement Award for Petroleum Engineering Faculty.

Miskimins has served on a variety of conference organizing committees, including chairing the 2023 and 2024 SPE Hydraulic Fracturing Conference and Exhibition, and as a technical editor for SPE journals, including serving as the executive editor of Production & Operations for 3 years. She was the editor in chief for the 2019 SPE Monograph update “Hydraulic Fracturing: Fundamentals and Advancements.” Miskimins has served on the AIME Board of Trustees since 2018 as an SPE trustee and was the 2022 AIME president.

2025 SPE Directors

Africa Regional Director

Riverson Oppong is an oil and gas business analyst with 15 years of global experience across the oil and gas value chain. He is the commercial manager in charge of economic modeling, risk management, and policy planning (ERP) at Ghana National Gas Company and holds the position of director of the SPE Ghana Section, after serving as a section chair from August 2022 to September 2023.

With lifetime membership status, his dedication to SPE spans decades, during which he has contributed to various SPE international committees, including Business and Leadership Committee, Awards Committee, ATCE Program Committee, and served as a judge for SPE’s Student Paper Contest since 2016.

Oppong was recognized by Gurus and Prospects magazine as one of the 'Top 10 Energy Thought Leaders in Africa and Diaspora'. He received the 2023 SPE Africa Regional Management Award, 2022 SPE Africa Regional Distinguished Service Award, the 2022 Ghana Communication Technology University/ Coventry University Lifetime Achievement Award, and the 2020 Presidential Millennium Excellence Award, Oil and Gas. He has authored and coauthored many SPE technical papers, and articles published widely in various publications. Oppong holds a PhD in international oil and gas management with a focus on finance and economics, a

SPE Board Announces Nominees ... continued

diploma in earth geoscience, a master's degree in petroleum engineering, a bachelor's degree in materials engineering, and a diploma in project management.

Asia Pacific Regional Director

Koji Yamamoto serves as a senior vice president of the Japan Organization for Metals and Energy Security. In this role, he leads the organization's technological efforts in the energy sector, encompassing oil, gas, carbon capture and storage, and low-carbon fuels.

Throughout his career, he has been extensively involved in petroleum geomechanics projects, played a key role in developing a hydraulic fracturing simulator, and conducted borehole stability analyses for various oil fields in Asia, the Middle East, and Oceania. He also served as a leader in field operations for Japan's national gas hydrate research and development project. He teaches technical topics at Kyoto University and Kyushu University. Yamamoto holds a PhD from Tohoku University in engineering, where his research focused on acoustic scattering in poroelastic media.

Completions Technical Director

Margaretha 'Peggy' Rijken is the chapter manager, geomechanics, at the Chevron Technology Center, Houston. Rijken has 23 years of experience in geomechanics and completions and manages an organization of subject-matter experts supporting development and application of well, completions, and reservoir geomechanical technologies that are integral to exploration, appraisal, development, and abandonment activities. She has authored and coauthored more than 50 papers and holds multiple patents.

Rijken has an extensive SPE volunteer history including serving as the 2022 SPE Hydraulic Fracturing Technical Section Chair and chairing the SPE Completions Optimization and Technology Awards Subcommittee. She was the 2019 SPE Annual Technical Conference and Exhibition Program Committee Chair. She is the recipient of the 2019 SPE Distinguished Membership Award and was also the recipient of The University of Texas Distinguished Alumni of Petroleum and Geosystems Engineering Award in 2015. She holds a PhD from The University of Texas at Austin in petroleum engineering and an MSc from Delft University of Technology in Mining and Petroleum Engineering in engineering geology.

Middle East and North Africa Regional Director

Abdullatif A. Al-Omair holds the position of director of northern area reservoir management department at Saudi Aramco. Prior to this, he served in several managerial roles including the manager of Saudi Aramco's reservoir description organization, manager of Khurais reservoir management organization, and the manager of Khurais field operations organization.

With over 20 years of extensive industry experience, his expertise spans field development planning, formation evaluation, reservoir and production management, carbon capture and sequestration, and digital transformation. Al-Omair is an active SPE member who served as chair of the SPE Saudi Arabia Section, its Annual Technical Symposium, and the YP and Student Outreach Committee and various technical programs. He served in several international conferences and technical programs including the International Petroleum Technology Conference (IPTC) and the Middle East Oil and Gas Show.

SPE Board Announces Nominees ... continued

He was awarded the 2011 SPE Young Member Outstanding Service Award. He also served as a member in the SPE Awards and Recognition Committee, SPE Forum Series Implementation Committee, and as the chair of the SPE International Distinguished Service Award Committee. He currently serves as a member of SPE Middle East Advisory Council and as the chair of Host Committee of IPTC 2024.

Al-Omair holds a BSc degree in petroleum engineering from The University of Tulsa, an MSc degree in petroleum engineering from Texas A&M University, and an MBA from Hong Kong University of Science and Technology.

North America Regional Director

Carlos A. Torres is the founder of Royal Oaks Energy Services, a service company focused on technical and business consulting in well intervention for the oil and gas industry, and recently involved in technological transition into geothermal energy. He previously worked for SLB where he held management, engineering, operations, technical and sales positions in well intervention and pressure pumping.

In 2016 he joined Gulfstream Services Inc., where until 2018 he served as director of sales and business development, managing six different product lines: cementing systems, frac/gravel pack-support equipment, rental tools, wireline pressure control, decommissioning services, and HP iron rentals.

Torres has been an SPE member since 2002, served in the SPE Delta Section from 2009 to 2015, and in 2019 he joined the SPE Gulf Coast Section Board, becoming section chair in 2022. He is also a committee member of the SPE/ICoTA Well Intervention Conference and Exhibition held in Houston. He has authored and coauthored several technical publications for the industry. He holds a BSc in chemical engineering from UNIMET in Venezuela.

Reservoir Technical Director

Rahim Masoudi is the custodian (chief) of reservoir engineering at Petronas and the subsurface technical lead at Malaysia Petroleum Management of Petronas. He has led strategic field development and asset management projects, alongside carbon capture, utilization, and storage initiatives within Petronas and the industry. He also serves as a technology advisor to Petronas global technology centers in the UK and Malaysia and chairs the Technology Readiness Level Committee.

Masoudi has over 24 years of experience across industrial, business, and research/academic sectors in exploration, development, and production, and energy domains spanning several countries such as Malaysia/Southeast Asia, the Middle East, and the North Sea. He has served as an adjunct professor at Adelaide University, visiting professor at Imperial College, and Distinguished Industry Advisor to University Tech Petronas.

His contributions extend to his longstanding support of SPE, where he has been a member since 2001. He currently chairs the SPE Asia Pacific Regional Technical Advisory Committee and has served as an SPE Distinguished Lecturer in the 2011–2012 season. He held roles as chair, co-chair, advisor, and invited speaker at numerous conferences and workshops in the oil and gas industry, both regionally and globally, including IPTC, APOGCE, ATCE, OTC Asia, SPE, and EAGE.

He holds a PhD in petroleum engineering from Heriot-Watt University.

SPE Board Announces Nominees ... continued

How SPE Board Members Are Selected

SPE is governed by a board of directors comprising 20 member representatives from around the world, including three officers and 17 representatives of geographic regions and technical disciplines. Officers and directors are elected to a 3-year term, with approximately one-third of the board rolling off each year. Officers and directors include representatives of both geographic and technical constituencies, and three presidents (current, past, and elect).

Nominating a Candidate

The nomination period opened in October and ended in January 2024. Any SPE member may nominate a candidate for a position on the board. The process involves submitting an online nomination form and supporting documents such as a curriculum vitae, resume, and letters of support.

The Election Process

Candidate nominations submitted online are reviewed by the SPE Nominating Committee. Chaired by the immediate past president, the committee met in March to make recommendations for the available positions. These recommendations were submitted to the SPE International Board of Directors for approval at a meeting of the board held in mid-March.

Following Board Approval of Nominees

The Board of Directors reports the nominations in the Journal of Petroleum Technology (JPT). SPE members will have the opportunity to review the board-approved nominees' biographical information in the April issue of JPT and on www.spe.org.

Nominees approved by the board stand as elected unless SPE members nominate additional candidates by petition. The petition process must be completed no later than 45 days following the publication date (1 April) of the slate of Board of Directors' approved nominees in JPT.

Board of Directors' nominees for positions for whom no petition with the requisite number of signatures is received within 45 days following the publication date of the slate of nominees in JPT shall be deemed elected to such positions. Additional nominations require a petition from 1.0% of the voting members of SPE on petitions for president-elect, and 2.0%, or a minimum of 150 members, from the represented group for regional director and technical director positions. A ballot election will be held if any qualified petitions are received.

The Board Takes Office

If the board slate is elected, the person nominated as president would take office as president-elect at the close of the SPE Annual Technical Conference and Exhibition. This year, the conference will be held 23 – 25 September in New Orleans, Louisiana.

Originally published in The Journal of Petroleum Technology.

SPE London Net Zero Programme Talk: Progress to Net Zero for oil & gas companies

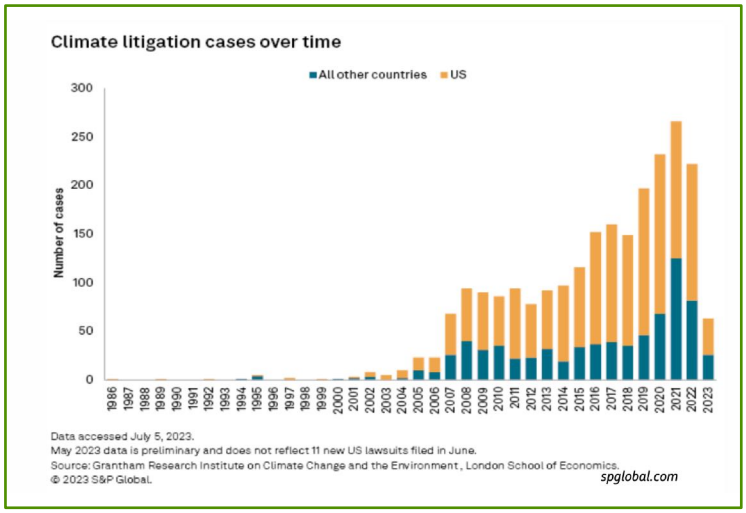
Dr Amanda Turner is Founder and Principal Consultant at Sussex Sustainability, Consultant at Sustain:able, Visiting Lecturer at University of Westminster, Board Trustee at South Downs Leisure, and CEO at Lir Resources.

During the Net Zero talk, Amanda shared several pressing trends and regulatory challenges shaping the energy sector. Her insights are grounded in her extensive background in geology and her current role advising companies on environmental strategies.

Here is an overview of the crucial areas highlighted during the talk.

Litigation and Data Integrity

Amanda highlighted the increasing incidence of litigation related to environmental claims. As an example, she referenced recent actions where Sweden's climate plan was criticized by watchdogs, and a major lawsuit was launched in New York against a leading meat producer. Such cases underscore the necessity for companies to back their sustainability claims with accurate and verifiable data.

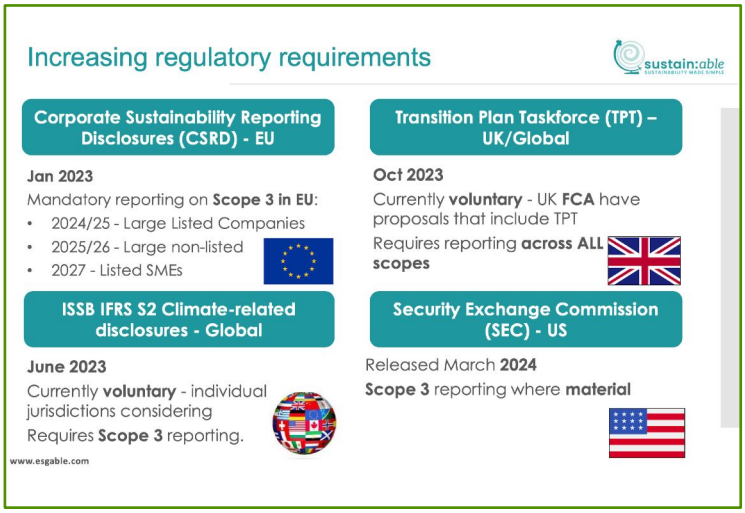


She also pointed out that the integrity of data and the transparency of reporting are paramount to avoid reputational damage and legal liabilities as environmental claims become a focal point for legal scrutiny.

The image on the left shows how climate litigation cases have increased in the US and the rest of the world.

Evolving Standards and Regulatory Frameworks

Navigating evolving standards and frameworks remains a challenge for companies, globally. Amanda discussed the complexity of these frameworks, which vary by region but are unified by a trend towards stricter enforcement and detailed reporting.

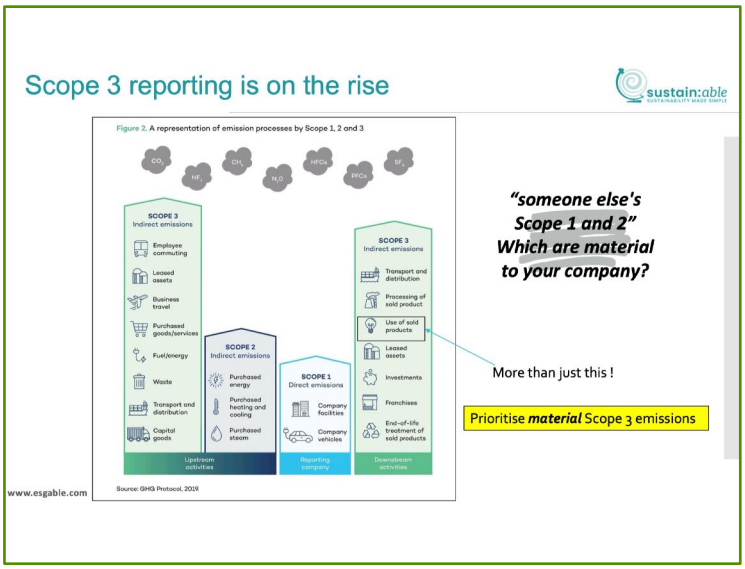


She emphasized the global shift towards integrating financial disclosures related to biodiversity and natural resources, such as those advocated by the Task Force on Nature-related Financial Disclosures (TNFD). This trend reflects a broader understanding of the financial impacts of environmental factors on corporate performance. The image on the left shows some recent key regulatory requirements for corporate sustainability reporting.

SPE London Net Zero Programme Talk ... continued

Scope 3 Emissions Management

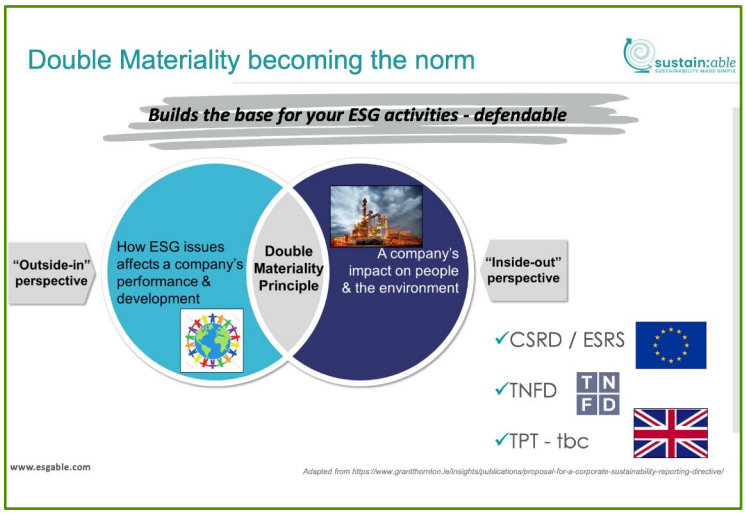
Amanda highlighted the growing importance of managing Scope 3 emissions, which encompass indirect emissions from a company's value chain. These emissions are often the largest part of a company's carbon footprint but are notoriously difficult to measure and manage. She used the example of her work with companies to develop strategies that not only track but also effectively reduce these emissions. Addressing Scope 3 emissions is becoming a critical element of corporate sustainability strategies as they are increasingly scrutinized by regulators and stakeholders.



The image on the left is a representation of the emission processes by Scope 1, 2 and 3. Scope 1 encompasses direct emissions, Scope 2 includes all the indirect emissions particularly purchased energy, and scope 3 includes upstream and downstream activities.

Importance of Materiality Assessments

The role of materiality assessments in aligning sustainability strategies with business operations was another key point.



Amanda explained that these assessments help companies identify and prioritize the environmental and social issues that are most significant to their operations and stakeholders.

This strategic alignment is essential for companies to effectively focus their resources and make impactful decisions that support long-term sustainability goals.

The image on the left illustrates how double materiality is becoming the norm.

Strategic Emission Reduction Plans

Amanda detailed the strategies that companies are adopting to reduce emissions across their operations. She mentioned the development of Environmental Reduction Emissions Reduction Action Plans (ERAPs) for assets, which are critical in outlining how companies plan to achieve targeted emissions cuts. These plans often include measures such as optimizing operations, investing in carbon capture and storage technology, and enhancing overall energy efficiency.

The OGA Plan and its implications

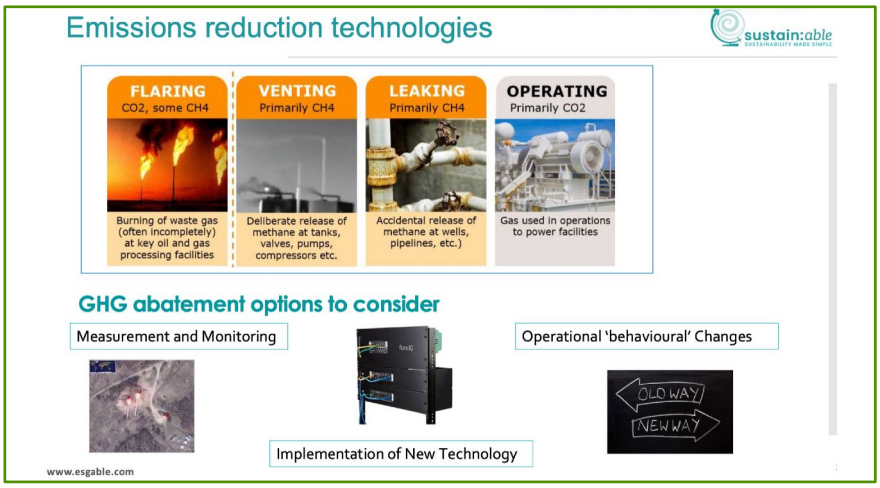
Discussing the specifics of the Oil and Gas Authority's (OGA) plan, Amanda highlighted how it outlines rigorous requirements for emission reductions within the UK oil and gas industry. The plan emphasizes the need for

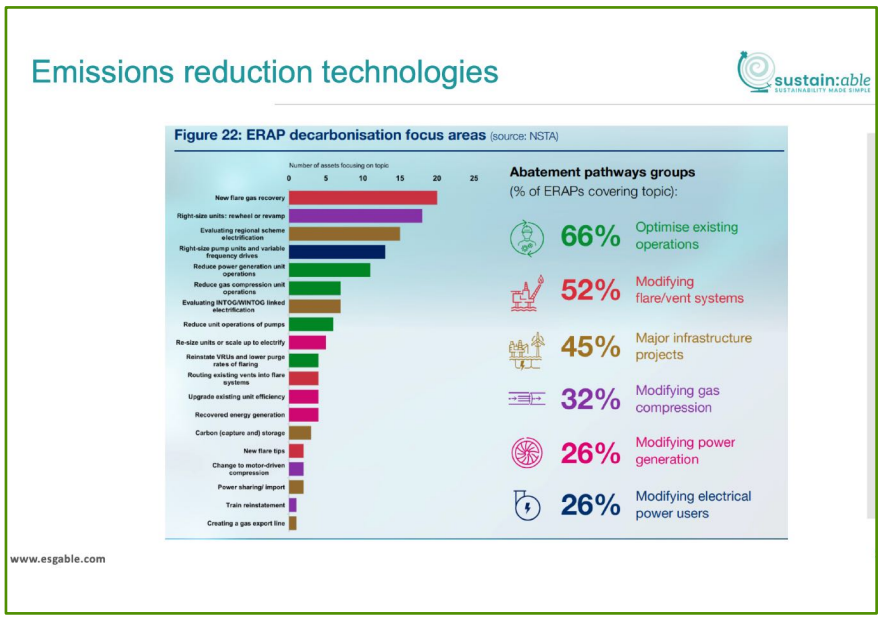
SPE London Net Zero Programme Talk ... continued

continuous, substantial reductions in production emissions, support for carbon capture and storage projects, and the exclusion of emissions offsetting from compliance calculations. This reflects a broader regulatory push towards direct emission reduction actions rather than reliance on offsetting.

Technologies for emission reduction

Amanda discussed the latest technologies for emission reduction, covering four key areas that companies can target to cut their emissions. These areas include flaring, venting, leakages and general operations.





Four technologies are shown in the image on the left.

Communication and engagement strategies

Amanda advocated for robust communication strategies both within and outside organizations. Internally, clear communication helps in defining roles and integrating sustainability into the core business strategy. Externally, transparent communication with stakeholders builds trust and supports stakeholder engagement. Amanda mentioned how companies are increasingly nominating sustainability champions within their teams to foster a culture of sustainability and ensure continuous engagement on these issues.

Preparing for future regulations

Finally, Amanda touched on the necessity for proactive preparation in response to upcoming regulations. She advised companies to stay informed about potential regulatory changes and begin aligning their practices ahead of time. This proactive approach not only helps companies avoid penalties but also positions them as sustainability leaders in their industry, potentially securing a competitive advantage.

Conclusion

Amanda's presentation provided a comprehensive overview of the current landscape in energy sector sustainability, highlighting the challenges and opportunities facing companies. Her experience offers valuable perspectives on the integration of rigorous environmental practices into corporate strategies, emphasizing that effective sustainability management is integral to long-term business success in the energy sector.

This talk was arranged as a part of the SPE London Net Zero Programme. Please access the full playback here: https://www.youtube.com/watch?v=4xHD6Tvfxcg

Calculation of Production Back Allocation Using Machine Learning Algorithms

The petroleum industry is reliant on precise and efficient back allocation, a process that calculates individual well production rates from shared facilities or multi-well platforms. Especially in matured facilities and legacy assets, traditional measurement techniques often fail to provide the necessary accuracy due to a lack of pre-installed flow meters and individual measurement mechanisms. Furthermore, these methods frequently require additional interventions, a factor that could potentially defer production, incur significant costs, and require extensive supply chain management. Despite these challenges, back allocation remains an essential process for effective reservoir, well, and field production performance management, as well as for ensuring accurate revenue allocation throughout a field's economic life cycle.

This study explores the application of machine learning (ML) as an advanced, data-driven approach to overcome the complexities of back allocation and streamline the process with increased accuracy and reduced interventions. Three ML models were implemented for this purpose, namely XGBoost, Random Forest, and LightGBM. These models were designed to predict individual well oil rates based on various parameters easily obtainable from wellhead locations, including wellhead pressure, temperature, and choke size. A meticulous preprocessing stage was performed to make sure the data was ideally suited for the ML models. Further, hyperparameter tuning was applied to enhance model accuracy and performance. Of the three models, XGBoost showed remarkable performance, producing high R2 scores of 0.97, 0.98, 0.96, and 0.96 for each well. These scores underscore the model's strong capability to predict individual well oil rates with high precision, highlighting the potential of ML in addressing complex problems in the oil and gas sector.

The study's findings present a promising advancement in the application of ML, particularly XGBoost, for accurate back allocation in combined production systems. The model's superior performance and prediction accuracy pave the way for improved decision-making related to reservoir management, well diagnostics, and cost optimization. The utilization of ML for back allocation holds considerable promise for boosting operational efficiency and profitability in oil and gas production systems. Looking ahead, further research will seek to apply the model on a larger scale and test its efficiency across varied field conditions and scenarios. This investigation will help to further validate the substantial advantages of employing ML methodologies in the petroleum industry.

Authors: H. Hassani, A. Shahbazi, and A. Yusifov, RiseHill Energy Solution, London, United Kingdom; Z. Hamdi, Aarhus University, Aarhus, Denmark; A. M. Hassan, Khalifa University of Science and Technology, Abu Dhabi, United Arab Emirates; R. Masoudi, Imperial College London, United Kingdom; M. Bataee, Curtin University, Sarawak, Malaysia.

Introduction

Various methodologies are employed in the complex process of back allocation for oil and gas wells, aiming to accurately assign production to contributing wells. Traditional methods such as well testing, multiphase flow meters (MPFMs), and virtual metering technology have been utilized in this context (Sanzo et al., 2020). Kappos et al. (2011) proposes a holistic approach based on the inflow performance relationship equation, demonstrating accuracy through field validation, albeit with challenges under certain operational conditions. Despite these challenges, the method shows potential for resolving production allocation problems (Kappos et al., 2011).

Rafiee et al. (2021) present an innovative approach to subsurface back allocation by combining reservoir physics and machine learning, challenging the industry's reliance on simplified, static methods like KH (permeability length of the completion). This technique, tested on a Southern Argentina Field with over 80 layers, showcases improved efficiency and precision in the allocation process, particularly in accounting for

Calculation of Production Back Allocation ... continued

mass balance equation imbalances. The newly developed tool not only completes the allocation process in under an hour but also effectively estimates reservoir properties, enhancing other reservoir engineering workflows (Rafiee et al., 2021).

Gabriela Chaves et al. (2021) introduces a novel back allocation methodology incorporating well outflow and flowline information, reservoir inflow simulation, algorithms, and an optimization process. This approach provides accurate well flow rate estimates and insights into their current status using real-time data, simulations, and evaluation algorithms. Demonstrating robustness and success over two years of realtime field measurements, this methodology offers a comprehensive solution to back allocation challenges (Gabriela Chaves et al., 2021).

Graf et al. (2006) contribute to the literature with a workflow utilizing data from intelligent wells for real-time back allocation. The developed algorithm assigns production volumes to individual wells, proving valuable for production optimization, regulatory reporting, and reserves accounting. The workflow incorporates validation strategies, including a genetic algorithm based on a proxy model, ensuring the accuracy of the back-allocation and optimization process (Graf et al., 2006).

Zakum Development Company (ZADCO) addresses back allocation challenges with a novel computation system, effectively visualizing networks and monitoring gathering system functionality over time (Hamad et al., 2004). Despite its efficacy in a complex production network of over 1000 nodes, the system requires specific values and substantial resources for back allocation calculation (Hamad et al., 2004).

In 2012, Qatargas introduces the Well Production Back Allocation System (WBA), aiming to reproduce accurate estimations of individual well production within the network. This system marks a significant progression towards reliable well production data, robust oversight of reservoirs and wells, and optimized field production (Abdelmoula & Montiel Dunlop, 2015).

Sanzo et al. (2020) utilize a neural network model for predicting oil, gas, and water flow rates in single wells, acknowledging a significant error for water flow rates. Shoeibi Omrani et al. (2018) explore data-driven methods for flow rate estimation, highlighting the efficacy of both feedforward and recurrent artificial neural networks, particularly in accommodating transient production behavior.

Despite the variety of back allocation solutions available, the literature reveals a gap in utilizing machine learning in this field. The current study aims to fill this gap by introducing a technologically advanced approach to predict individual well oil rates using machine learning. Three regression algorithms—Random Forest, XGBoost, and LightGBM—are employed, utilizing techniques such as grid search cross-validation and hyperparameter tuning to enhance model precision. The model requires input data in the form of Wellhead Pressure (WHP), Wellhead Temperature (WHT), Choke size, and Gas-Oil Ratio (GOR). Using field-specific data for training and testing ensures the model's reliability. The application of machine learning proves superior to traditional and analytical methods, offering a more efficient analysis of large datasets from various sources, including logs, sensors, and surface drills, leading to significant improvements in accuracy and consistency.

Data Description and Machine Learning Applications

Research Approach

The research undertook a methodical methodology, which encompassed the comprehensive procedure involved in the creation of machine learning (ML) models. This included data collection, preprocessing, model formulation, precision assessment, and ultimately, conserving the most accurate predictions for estimating

Calculation of Production Back Allocation ... continued

each well's oil rate. Data was accumulated from the field and subsequently directed towards a data wrangling phase for cleansing and quality improvement. This stage involved eliminating outliers and conducting an in-depth statistical data analysis to examine the data's range, dispersion, and correlation coefficient. Following the thorough data preprocessing stage, the process of creating the ML models was initiated. This phase required intensive scrutiny to optimize the model parameters, ensuring the best possible predictive outcomes. Performance evaluations of the models were conducted using statistical metrics, comparing the predicted values against the actual ones. If the model's predictive performance was found lacking, it would be subjected to retraining using more data or varying algorithms until the highest level of accuracy was attained. Finally, the most effective predictions from the fine-tuned ML models were presented, demonstrating the predictive prowess of the models.

Data Description

The data for this research was sourced from four distinct wells. Each well provided a variety of parameters including Wellhead Temperature, Wellhead Pressure, Oil Rate, Water Rate, Gas Rate, Gas-Oil Ratio, and API. Notably, there are some gaps present in the dataset. Figure 1 below illustrates the distribution of Wellhead Pressure and Oil Rates for each well. After undergoing data cleaning, a total of 178 rows were made available for further analysis. It is pertinent to mention that all measurements were synchronized in time to ensure the accuracy and relevancy of the data on which the model was trained.

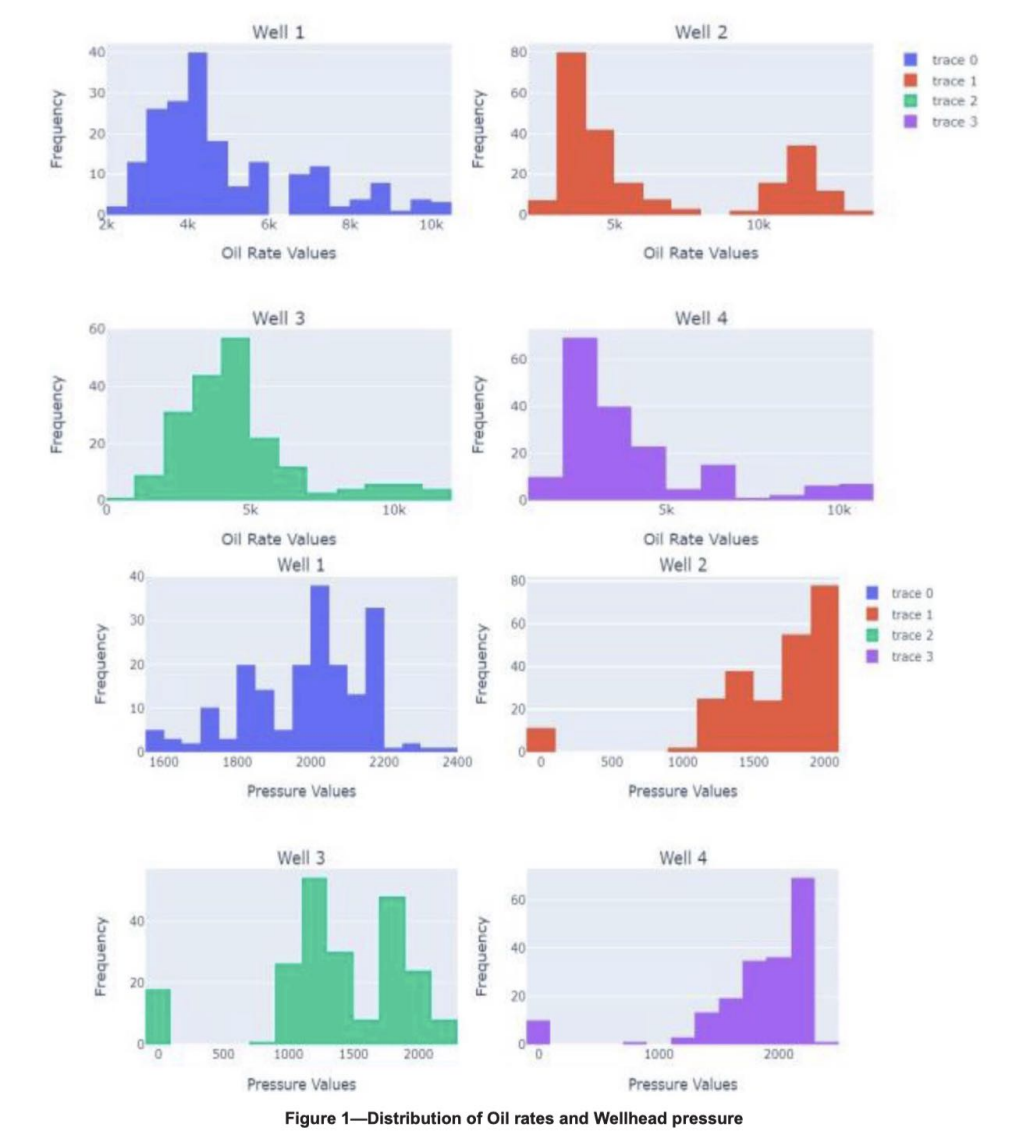


Figure 1—Distribution of Oil rates and Wellhead pressure

Calculation of Production Back Allocation ... continued

Data Wrangling and Analytics

The dataset was meticulously analyzed and purged of any nonsensical values. Notably, more than 50% of the data was missing for API values, necessitating the removal of this column. Additional extraneous columns, such as wellhead pressure in alternative units and another type of calendar, were also eliminated. To compensate for the missing data in the wellhead temperature, oil rate difference, and GOR, an analysis of their respective distributions was conducted. Furthermore, a correlation matrix was generated for each well to scrutinize the relationship between the oil rate and other parameters. As illustrated in *Figure 2* (below), the oil rate shows a high correlation with GOR (0.45), wellhead pressure (-0.91), wellhead temperature (0.57), and choke size (0.91).

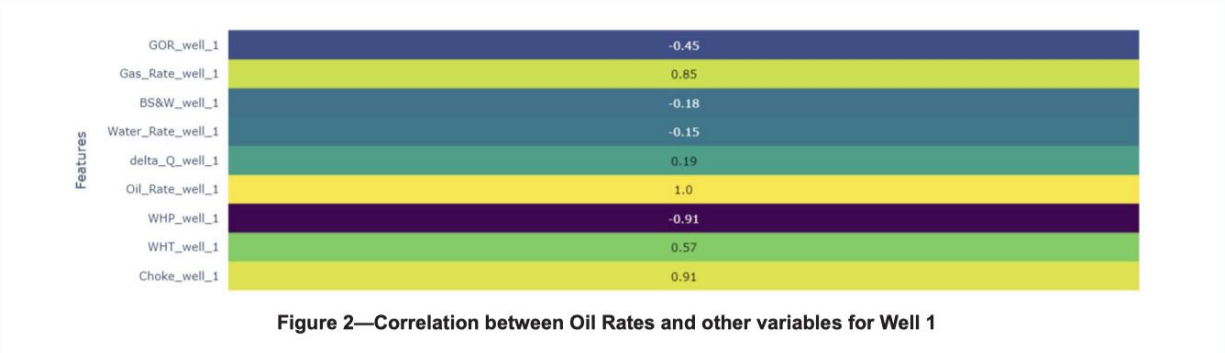


Figure 2—Correlation between Oil Rates and other variables for Well 1

Figure 3 below shows the scatter plot of Choke size and Oil rates plot.

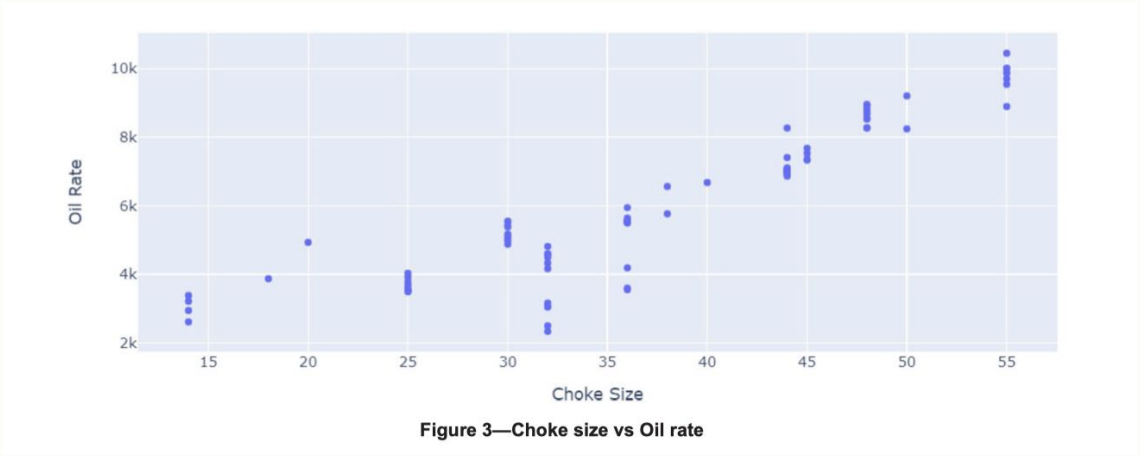


Figure 3—Choke size vs Oil rate

As observed from *Figure 3*, the pair plot, there exists a complex correlation between the target variable and other features. This complexity underscores the importance of employing advanced machine learning algorithms to navigate and leverage the intricate nature of the problem at hand.

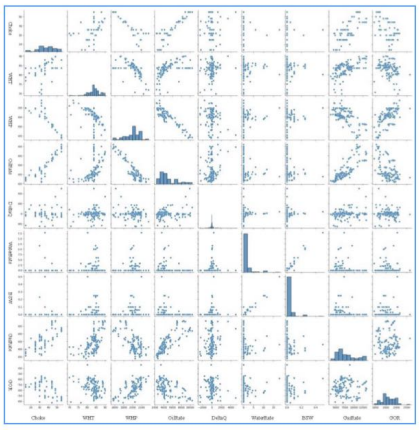


Figure 4—Pair plots of the variables for Well 1

NOTE: There is a larger image at the end of the article, after the references.

Calculation of Production Back Allocation ... continued

These data cleansing procedures were uniformly implemented across all wells. Subsequently, the data from all four wells were consolidated into a single dataframe. Upon analyzing the correlations, it was discerned that the most influential variables were wellhead pressure, wellhead temperature, choke size, and GOR. *Figure 5* illustrates a scatter plot detailing the relationship between oil rates and wellhead pressure for each individual well.

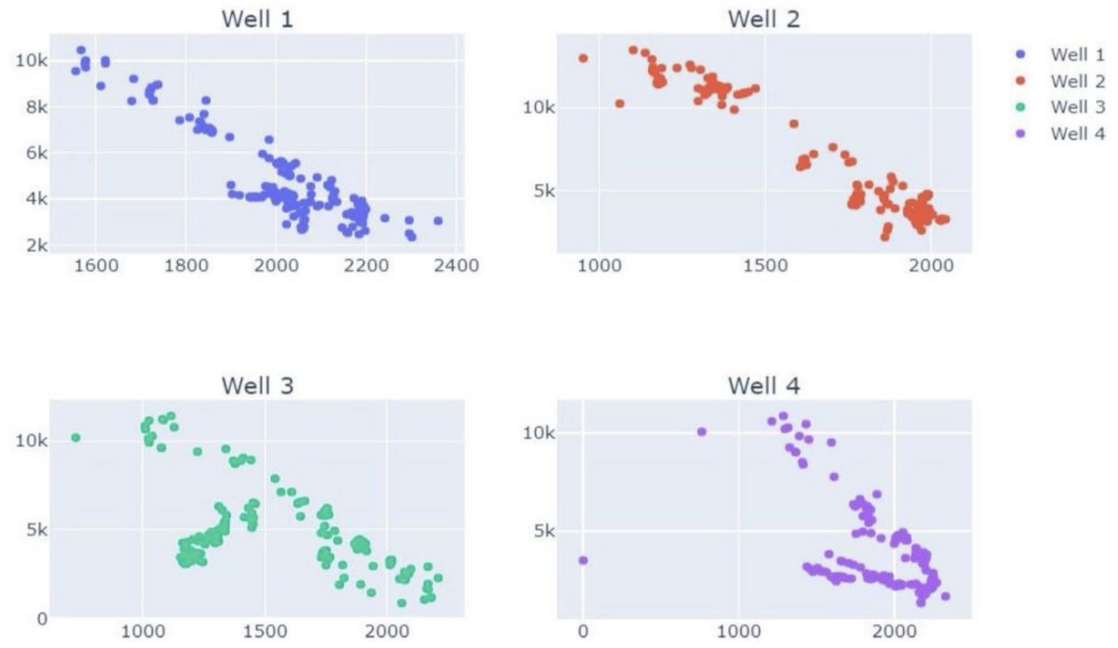


Figure 5—Scatter plot of oil rates and wellhead pressure

A comprehensive statistical analysis was also performed on the independent variables. As observed in *Table 1*, the wellhead pressure values for the wells fluctuate within the range of 1000 to 2300 psia. The range of wellhead temperature values exhibits a similar pattern. However, a considerable variation in range is noted for both choke size and GOR values.

Table 1—Independent variables of the study.

	WHP_well_1	WHP_well_2	WHP_well_3	WHP_well_4	WHT_well_1	WHT_well_2	WHT_well_3	WHT_well_4
count	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000
mean	2002.073539	1673.471067	1557.495506	1926.325000	83.657051	86.625562	83.137278	80.450667
std	164.027487	314.614842	350.797969	322.154823	3.582334	4.805447	5.351390	3.007181
min	1554.900000	951.200000	725.000000	0.000000	69.800000	76.900000	60.100000	68.300000
25%	1906.387500	1353.212500	1237.575000	1759.575000	82.025000	83.425000	82.525000	79.225000
50%	2026.065000	1782.775000	1456.525000	2012.600000	83.800000	84.725000	84.400000	80.450667
75%	2123.935000	1963.300000	1891.887500	2180.800000	85.500000	92.575000	86.275000	82.300000
max	2359.360000	2043.050000	2209.800000	2328.700000	90.000000	93.800000	90.500000	85.400000

	WHP_well_1	WHP_well_2	WHP_well_3	WHP_well_4	WHT_well_1	WHT_well_2	WHT_well_3	WHT_well_4
count	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000
mean	2002.073539	1673.471067	1557.495506	1926.325000	83.657051	86.625562	83.137278	80.450667
std	164.027487	314.614842	350.797969	322.154823	3.582334	4.805447	5.351390	3.007181
min	1554.900000	951.200000	725.000000	0.000000	69.800000	76.900000	60.100000	68.300000
25%	1906.387500	1353.212500	1237.575000	1759.575000	82.025000	83.425000	82.525000	79.225000
50%	2026.065000	1782.775000	1456.525000	2012.600000	83.800000	84.725000	84.400000	80.450667
75%	2123.935000	1963.300000	1891.887500	2180.800000	85.500000	92.575000	86.275000	82.300000
max	2359.360000	2043.050000	2209.800000	2328.700000	90.000000	93.800000	90.500000	85.400000

Calculation of Production Back Allocation ... continued

Machine Learning Models

In this study, we have employed a diverse range of regression algorithms, including Linear Regression, Support Vector Machine, Decision Trees, Boosting algorithms, and Random Forest algorithms. These specific algorithms were chosen for testing as they are well-recognized within the oil and gas industry (Zhang et al., 2022). Our primary focus was on boosting algorithms, specifically XGBoost and Gradient Boost, as well as Random Forest algorithms due to their superior accuracy in our tests. XGBoost is widely acclaimed for its speed and performance (Chen et al., 2015), while Random Forest is prized for its robustness and simplicity (Biau & Scornet, 2016).

Random Forest is a highly versatile machine learning algorithm, registered by Leo Breiman and Adele Cutler in 2006. It operates by generating a collection of decision trees and using their combined predictions to produce a more accurate and stable outcome. Each tree in the 'forest' is built from a different sample of the data, and each split in the tree is constructed using a random subset of the features, hence the name 'Random Forest'. This process of "bagging" and feature randomness leads to models that are robust to overfitting and capable of handling both regression and classification tasks with high dimensionality and multicollinearity. Since its inception, Random Forest has been widely adopted in various fields due to its simplicity, robustness, and ability to provide a straightforward measure of feature importance.

XGBoost, short for "Extreme Gradient Boosting", is a high-performance implementation of the gradient boosting algorithm, designed for efficiency and speed. Originating from the research of Tianqi Chen and Carlos Guestrin in 2016, it quickly gained popularity in the machine learning community due to its robustness and excellent performance across various tasks. Notable features include in-built handling for missing data, a regularization term to prevent overfitting, and the ability to utilize the power of multi-core processors through parallelization (Chen & Guestrin, 2016).

Model Performance

The performance of the model was a crucial factor in its development. The primary objective of this model was to predict oil rates for each well, using the available parameters. Evaluation of its performance hinged on the following metrics: the R-squared score and the mean squared error.

The R-squared score, also known as the coefficient of determination, is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model. It provides an indication of how well the model fits the data, and can range from 0 to 1. A higher R-squared value indicates a better fit, with 1 meaning that the model explains all the variability of the response data around its mean. It is computed using the Formula 1:

$$R^2 = 1 - (SS\_res / SS\_tot)$$

where SS_res is the sum of squares of the residual errors and SS_tot is the total sum of squares. The residuals are the differences between the observed and predicted values, while the total sum of squares is the variance of the observed data.

Mean Squared Error (MSE) is a common metric used to evaluate the performance of a regression model. It represents the average of the squares of the differences, or errors, between the predicted and actual values. The errors are squared to remove any negative values and to amplify the impact of larger errors. Essentially, MSE quantifies the spread of the residual errors. It is always non-negative, and a value of 0 indicates a perfect fit to the data. The formula to calculate MSE is as Formula 2:

$$MSE = (1/n) * \sum (actual - prediction)^2$$

In this formula, 'n' is the total number of observations or data points, 'actual' is the actual value, and 'prediction' is the predicted value from the model. The summation (Σ) runs over all data points.

Calculation of Production Back Allocation ... continued

Results and Discussion

Every algorithm underwent testing with various parameters to identify the most optimal ones for predicting oil rates. Upon analysis, it became evident that factors such as wellhead pressure, wellhead temperature, gas-oil ratio, and choke size were the most critical determinants.

Model Optimization

In the quest for model optimization, we employed hyperparameter tuning, facilitated by Grid Search Cross-Validation (CV). Grid Search CV systematically works through multiple combinations of parameter tunes, cross- validating as it goes to determine which tune gives the best performance. Following several trials, XGBoost demonstrated superior accuracy compared to other algorithms. Consequently, we applied hyperparameter tuning specifically to the XGBoost model. This strategic application effectively enhanced the accuracy of predicting oil rates for each well.

Model Accuracy

In an effort to avoid overfitting, the data was split into training and testing datasets. Out of a total of 178 data points, 124 were allocated for training and the remaining 54 for testing. Table 2 presents the results for each well based on the test data. As evidenced, the average R-squared score for XGBoost approximates 0.97, indicating a high degree of accuracy in our results. *Figure 6* visually compares the R-squared scores.

Table 2—R2 score and MSE for each well

	Random Forest		XGBoost	
Well	R^2	MSE	R^2	MSE
Well 1	0.97	79411.76	0.97	97609.31
Well 2	0.98	161397.90	0.98	136622.80
Well 3	0.96	147761.34	0.97	123183.47
Well 4	0.92	330645.53	0.95	218027.77
Average	0.96	179804.1	0.97	143860.8

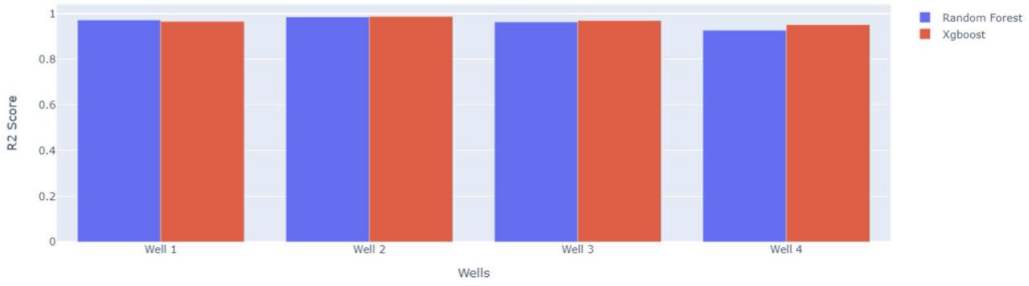


Figure 6—R2 Scores for each algorithm

After the application of hyperparameter tuning, there was a slight improvement in the results for the XGBoost model. *Figure 7* illustrates these results before and after the hyperparameter tuning process.

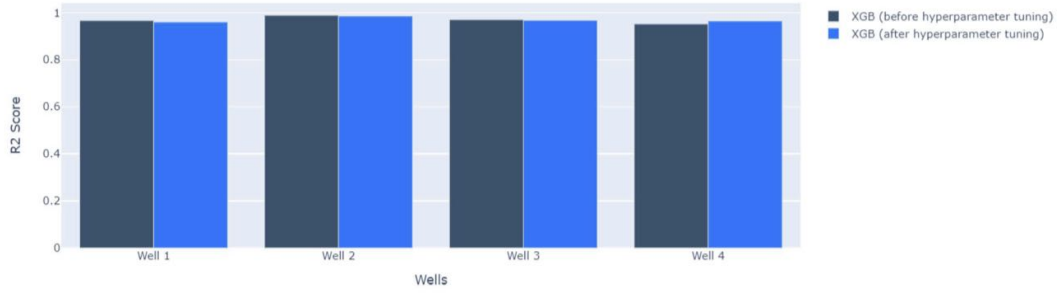


Figure 7—Before and After Hyperparameter Tuning

Calculation of Production Back Allocation ... continued

Conclusion

Back allocation is critical as it optimizes resource allocation, enhances project performance, mitigates risks, enables adaptability, promotes accountability and transparency, and encourages continuous improvement within organizations. This study proposed a machine learning application designed to allocate oil rates for each well using various parameters. The experiment utilized data from four wells. The workflow involved data collection, wrangling, model building, and hyperparameter optimization. Two algorithms, Random Forest and XGBoost, were employed to create the models. Both algorithms demonstrated impressive accuracy with R2 scores of 0.96 and 0.97 respectively. It was observed that XGBoost delivered higher results, prompting the application of hyperparameter tuning to this particular algorithm. Moreover, the model's performance could potentially be improved by fine-tuning hyperparameters in conjunction with ongoing data collection.

Machine learning provides an intelligent solution for problems such as this. Back allocation plays a significant role in project performance. Traditionally, allocation has been conducted using historical data and various types of correlations. However, machine learning is gaining recognition as a powerful tool for back allocation calculations due to its inherent characteristics that enhance efficiency and effectiveness. Its primary strength lies in its ability to manage large-scale data, analyzing it quickly while identifying complex patterns and correlations often unattainable by human computation. Furthermore, the scalability of machine learning algorithms is a commendable feature. As data influx continually grows, traditional manual or semi-automated methods of back allocation can become overwhelmed and inefficient. In contrast, machine learning models can seamlessly scale up to handle this increasing data load, maintaining accuracy and speed, which is essential in sectors such as finance and logistics where data quantities are vast and continually growing. Notably, machine learning algorithms can model non-linear relationships and interactions between multiple variables in a complex manner. This is a crucial aspect of back allocation scenarios where relationships between various parameters influencing allocation may not always be linear or straightforward. Furthermore, the automation capabilities of machine learning models significantly enhance their efficiency. Once trained, these models can independently perform back allocation calculations, minimizing human errors and freeing human resources for more strategic, value-added tasks.

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Calculation of Production Back Allocation ... continued

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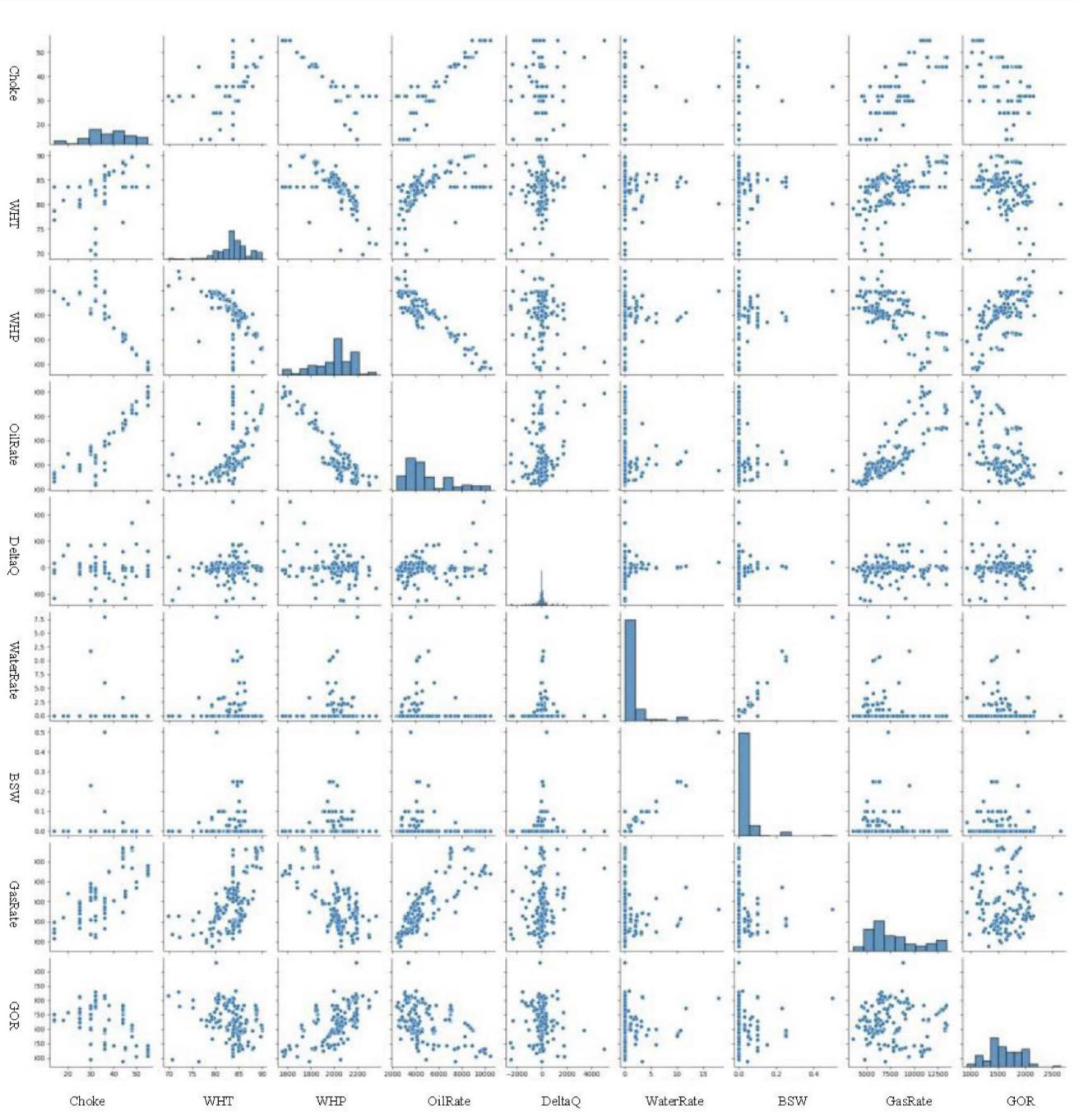

SPE events calendar – local and international

LOCAL – UK

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**

September 2-5, 2024 (Aberdeen, Scotland)
SPE Offshore Europe Conference & Exhibition
Offshore Energies UK (OEUK) CEO, David Whitehouse will chair the conference and executive committee for SPE Offshore Europe 2025 (OE25). He said: "The conference shines a spotlight on the UK sector and its excellent people to a global audience. As we consider the national and global challenges facing us, we must make sure everyone understands the enormous potential benefits of a transition led by integrated homegrown energies – oil, gas, hydrogen and wind and more."
More information: **SPE Offshore Europe**

INTERNATIONAL

June 17-19, 2024 (Houston, Texas)
The Unconventional Resources Technology Conference
The Unconventional Resources Technology Conference (URTeC) is a premier event focused on the latest science and technology applied to exploration and development of unconventional resources, with special emphasis on integration of the technical/professional disciplines. An opportunity to exchange information, formulate strategic ideas, and solve problems to manage and optimize your unconventional resource plays.
More information: **URTEC**

June 26-28, 2024 (Turin, Italy)
SPE Europe Energy Conference & Exhibition
Themes covered by the conference will include subsurface geology, engineering and management, energy storage, plant conversion, decarbonisation, innovative technologies, new materials, NetZero energy economics, machine learning and AI, with special attention to the overall sustainability in the energy industry. Participating researchers, scholars, professionals, contractors and policymakers will have an unique opportunity to contribute to shaping the future of the energy sector.
More information: **SPE conference**

August 7-8, 2024 (Bangkok, Thailand)
SPE/IADC Asia Pacific Drilling Tech. Conf and Ex.
To better serve the growing membership and industry professionals in Asia Pacific, the SPE/IADC Asia Pacific Drilling Technology Conference and Exhibition (APDT) has been held biennially since 1996, rotating amongst major cities in Asia Pacific. Over the past decade, APDT has established itself as a major technical conference on drilling technology and operations in the region. It provides crucial insights into the latest industry trends, technical expertise, best practices and innovative applications.
More information: **SPE conference**

September 10-12, 2024 (Abu Dhabi, UAE)
SPE International Health, Safety, Environment, and Sustainability Conference and Exhibition
For more than 25 years, the SPE International Conference on Health, Safety, Environment, and Sustainability has been the E&P industry's premier international event highlighting HSE best practices and challenges.
Our goal is to reach beyond the energy industry by introducing presentations, special topical sessions, and networking opportunities unavailable anywhere else.
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The Society of Petroleum Engineers (SPE) is a not-for-profit professional association whose more than 140,600 members in 144 countries are engaged in oil and gas exploration and production.
The SPE London board oversees the SPE London activities including our evening programme and other events. Our different committees have specific focus for the members including Young Professionals, Women in Energy, Net Zero, and associated student chapters. As well as engineers who make up our core, we also welcome qualifications in geology, geophysics, earth science, environment, health and safety, mathematics, information technology, as well as management and economics.


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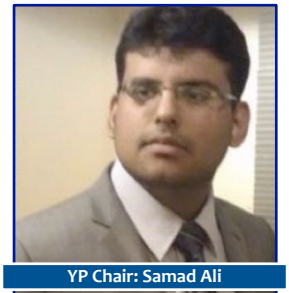
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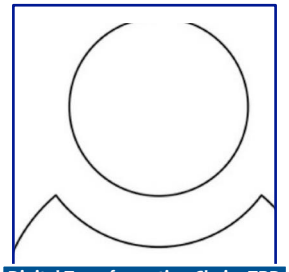
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SPE policy on AI-generated content in publications

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.

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