SPE Review London

The official e-magazine of the SPE London branch

SPE International London Section

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SPE Grand Challenge Update on Geothermal Energy

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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, 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

FEATURES

Share your experiences and stories online https://www.spe-london.org/

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.Sc. 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

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Letter from the Chair

Dear SPE London members and colleagues,

I am honoured to be representing member of SPE London as the Section Chair for 2024-25.

To start, I extend my thanks to Shwan Dizayee for his excellent work as Chair for 2023-24. He was supported by our dedicated board and volunteers in providing a wide range of events. We will work to build on these activities in the coming year.

As we begin the 2024-25 activities, I am pleased to announce the theme for my year as Chair will be 'The Energy Trilemma'. This term describes the complex task of finding a balance between energy security, affordability, and sustainability. The Energy Trilemma is an ongoing and complex challenge for the UK, with no easy solutions. Each aspect of the Trilemma is crucial for our nation's energy future, with new approaches required for government and the industry. There is a wide scope for involvement of SPE members in tackling these challenges, and I encourage everyone to contribute their unique perspectives and expertise.

In recent years, the events held by SPE London focussed on the sustainability topics such as Net Zero, Carbon Capture and Storage, and New Energies. Understanding these is vital as we progress with the energy transition. The other two parts of the trilemma – energy security and affordability – are also essential for us to build our economy and maintain our high standard of life in the UK. SPE London will additionally direct our attention to these topics.

Throughout the year, we will organise events that explore various aspects of the Energy Trilemma. We aim to provide valuable opportunities for our members to engage with experts, share knowledge, and expand our professional networks. I encourage all members to participate and contribute their insights and expertise.

I have benefited greatly from my 25 years of membership and involvement with the SPE. I sincerely hope you too will build your knowledge, career and your network through your own association with the SPE.

Working this year as the Section Chair, I am keen to continue serving the members of SPE London. Please get in touch if you would like to volunteer or have thoughts and ideas to share.

Kind regards,
Adam Borushek

SPE London Section Chair for 2024-25

Letter from the Editor

Dear SPE London members and readers,

Welcome to the **August 2024 edition of the SPE Review London.** This publication marks the beginning of the new SPE Year, and we welcome Adam Borushek as the new Chair of the SPE London Section.

On page 9, we recognize the **2024 SPE Regional Awards – Europe recipients**, who have been acknowledged by their peers for their contributions to the Society.

Page 10 features our **C-Level Success Story with Dr. Renu Gupta**. Dr. Gupta's career journey from operational roles to corporate strategy provides valuable insights for professionals at all stages of their careers.

For those interested in the latest advancements in AI, don't miss the opportunity to register for the **SPE DSEA AI 4 Energy Workshop** highlighted on page 12. This event, taking place in Aberdeen on 3 October, will explore practical AI applications in our day-to-day jobs, offering insights from industry leaders.

On page 13, we explore how **Geo2Watts is turning abandoned oil wells into energy assets**. This article, originally published in the Journal of Petroleum Technology, sheds light on the transformative potential of their 'borehole battery' technology.

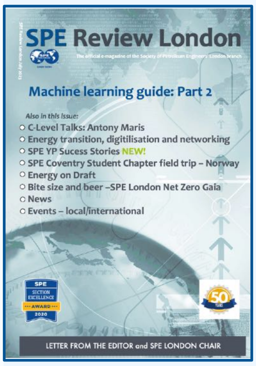
The **Road to Well Completions Electrification to Support Sustainable Field Development** on page 18 explores the results of the electrification road map implemented to evaluate the reduction of carbon emissions through electric wells.

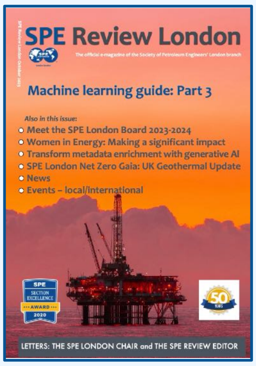
The **SPE Grand Challenge Update on Geothermal Energy** on pages 30-35 dives into the challenges and opportunities for geothermal energy in a net-zero world. This feature, part of a series on SPE's Grand Challenges in Energy, outlines how our industry's expertise can drive geothermal's growth.

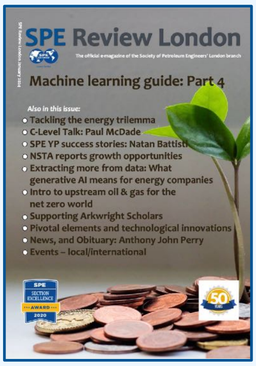
Finally, for upcoming **events and local initiatives**, turn to page 30, where you'll find details about SPE's local and international activities, keeping you connected and engaged with the wider community.

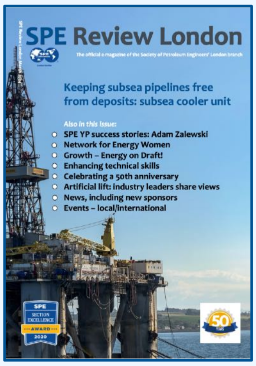
Do not hesitate to reach us out if you have any feedback or would like to join SPE London!

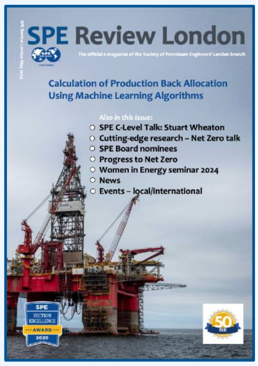
Sincerely Yours,
Elizaveta Poliakova











NEWS DIGEST… NEWS DIGEST… NEWS DIGEST

UK port partners to establish decom hub for North Sea oil & gas

The Port of Sunderland.
Photo credit: Offshore Energy

The UK's Port of Sunderland has partnered with Northern Metal Recycling to establish a decommissioning hub for the North Sea oil and gas industry.

The annual business opportunity is estimated to be nearly $3.3 billion.

Read more: **Offshore Energy**

bp electrifies 95% of Permian wells, increasing daily output by 100,000 barrels

Photo credit: bp

bp's U.S. onshore oil and gas division, bpx energy, has electrified 95% of Permian wells, boosting production by 100,000 barrels daily and reducing gas flaring to less than 0.5%.

Read more: **World Oil**

Rig prepares for the UK's inaugural CO2 well injection

A 1981-built rig has mobilised for the UK's first CO2 well injection test at the Leman gas fields in the UK southern North Sea.

Perenco UK and Carbon Catalyst Limited secured a license for the Poseidon CCS project, with Wintershall Dea joining in November.

The project is expected to come online by 2029, with initial CO2 injection rates of circa 1.5 million tonnes per annum.

Read more: **Offshore Energy**

Canadian oil & gas company makes $225.4 million bid to acquire UK firm

Canada's Gran Tierra Energy offered to buy i3 Energy in a deal valued at $226.23 million, representing a premium of 49% to the London-listed company's August 16 closing price.

Gran Tierra Energy aims to create an independent energy company of scale in the Americas, with increased production, reserves, cash flows, and development options across Canada, Colombia, and Ecuador.

Read more: **Reuters**

UK Oil & Gas secures site for second hydrogen storage project

UK Oil & Gas PLC secures terrain and subsurface mineral rights for a second underground salt-cavern hydrogen storage project in south Dorset, southwest England.

The company conditionally raised GBP 1 million in gross proceeds via a share issuance to support its hydrogen storage projects.

Read more: **Renewables Now**

Photo credit: Carbon Catalyst Limited

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

Billion-dollar oil and gas investment

Planned investment between $5.7 billion and $6.7 billion a year in oil and gas offshore Norway is based on Equinor's expectations for continuing strong demand for the fossil fuels.

"We see a long-term demand curve for Norwegian oil and that is why we continue to invest," Anders Opedal, CEO of state-controlled Equinor, told a press conference on Monday, 26 August.

Kjetil Hove, Equinor's head of domestic operations, said there are still "attractive opportunities" offshore Norway.

Read more: **Reuters**

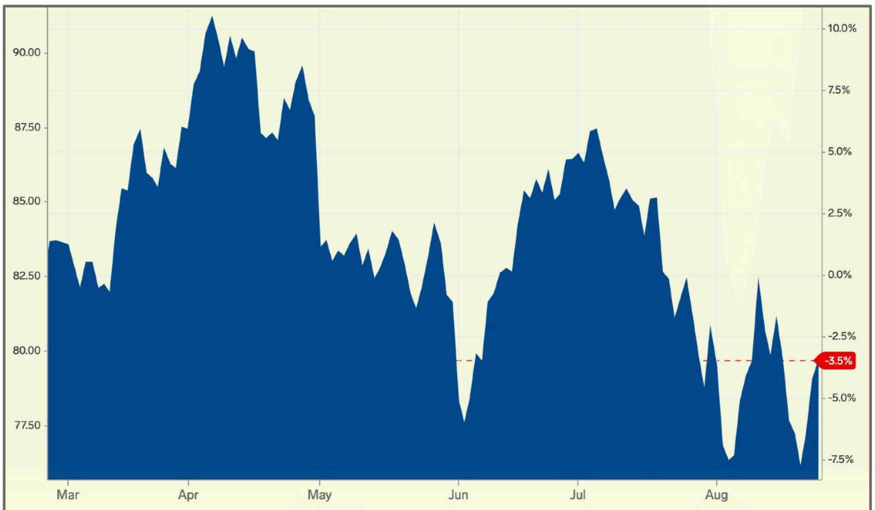
Seven-figure savings

A decommissioning project at a Scottish oil terminal has avoided the need for more than 4,000 m^3 of crude oil sludge to be tankered to incineration.

The OSSO-led project recovered 1,280 cubic metres of usable oil. The estimated cost saving is over seven figures. Only 200 tonnes of waste ultimately required off-site disposal at an estimated cost of £120,000.

Aberdeen-based OSSO specialises in fluid temperature control and separation solutions. It partnered with another contractor for the Scottish oil terminal project.

Read more: **OSSO**



Oil (Brent) 79.64 +0.62 (+0.78%) – 26/08/2024 (**Credit: Market Insider**)

Gas discovery

Transocean Norge. Source: Transocean

Completion of a wildcat well drilling in the Norwegian Sea has resulted in a gas discovery with estimated recoverable volumes between 30 and 140 million barrels of oil equivalent (boe).

A semi-submersible rig, owned by offshore drilling contractor Transocean, made the new gas discovery.

OMV Norge, a Norwegian subsidiary of Austria-headquartered oil and gas player OMV, is the production licence operator. The well was drilled with the Transocean Norge rig, the first semi-submersible rig that secured the Abate (Power+) notation for greenhouse gas abatement.

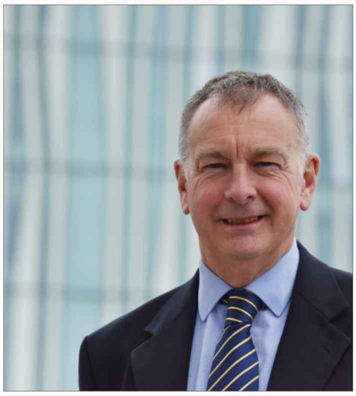
Read more: **Oil Price**

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

Industry investment supports energy transition acceleration

Companies in the energy sector are backing the University of Aberdeen's energy-transition research with £600,000 to support the creation of a new research initiative focused on decarbonising the oil and gas sector and advancing the shift to clean energy.

Nine companies (bp, Chevron, CNOOC, ExxonMobil, Equinor, Harbour – endorsed by Offshore Energies UK (OEUK)) are involved in the initiative. They are providing the funding to support training and PhD studentships as part of a new Centre for Doctoral Training (CDT) based in the School of Geosciences.



Professor John Underhill

Led by Professor John Underhill, the University's Director for Energy Transition, the new initiative will focus on delivering world-class academic research to accelerates the energy transition by equipping a new generation of researchers with the skills, knowledge and expertise required to provide energy security yet reduce emissions and decarbonise.

Acknowledging the significance of the award, Professor John Underhill said: "The starting point on the journey to net zero is very challenging as oil and gas still provides three quarters of the UK's energy needs and finding ways to decarbonize industry at pace while supplementing this activity with carbon storage, wind farms, geothermal and other renewable technologies.

"In supporting these studentships our funders have sent a strong message about the confidence industry has in the Centre's ability to progress the energy transition and support the industry's shift to a cleaner future.

"The University of Aberdeen has a long history of delivering innovative solutions that address current and future energy challenges. Over the past 10 years we've had 110 PhD students graduate from our existing CDTs, all of whom have been employed in a relevant discipline, showing the relevance of the programmes, and the appetite that exists for highly skilled and well-trained practitioners in the energy sector.

"Being situated in Europe's energy capital and a city renowned throughout the world for technological development and inspiring solutions, we are best placed and well connected to understand the needs of the industry and make a real difference by offering practical solutions that ensure Britain has the secure and reliable low-carbon energy sources it needs."

More details about Aberdeen's Centre for Energy Transition can be found by accessing the following links:

abdn.ac.uk/research/documents/CET Brochure 2023_WEB.pdf

Accelerating the Energy Transition | Research | The University of Aberdeen (abdn.ac.uk)

2024 SPE Regional Award Recipients – Europe

Please congratulate the 2024 Regional Award recipients for being elected by their peers for outstanding technical and award accomplishments in their region. Here are the recipients in the Europe region. For a full list of recipients globally, please follow this link.

EUROPE REGION

Regional Completions Optimization and Technology
Vidar Mathiesen, InFlow Control

Regional Data Science and Engineering Analytics
Thomas Parenteau, TechnipFMC

Regional Drilling Engineering
Ralf Duerholt, Formerly Baker Hughes

Regional Sustainability and Stewardship in the Oil and Gas Industry
Leon Beugelsdijk, Shell Global Solutions International BV

Regional Distinguished Achievement Award for Petroleum Engineering Faculty
Snezana Komatina, Mihajlo Pupin Technical Faculty
Gerhard Thonhauser, Mining University of Leoben

Regional Young Professional Member Outstanding Service Award
Boris Vidos, ENNA Geo
Amy Conelly, Shell UK Ltd.

Regional Service Award
Elizabeth McAlpine, WellDecommissioned Ltd.
Sven Haberer, Baker Hughes

Adaptation, understanding and appreciation

Dr Renu Gupta is an experienced board advisor, chair and NED in the global energy sectors of oil and gas and renewables. She has special interest in the energy transition, infrastructure and real estate.
International experience in both corporate and capital markets give her a broad perspective of external environments and their impact on business strategy, risks, financing, performance and sustainable growth.
She is currently an Advisory Board Member with Be the Business, and Director with Luzmo Energy.

Who is Dr Renu Gupta? Please tell us about yourself.

I am a business leader with extensive experience in both corporate and capital markets within the global energy sector. I have worked for or with a diverse range of organisations, from large multinationals to small and mid-cap oil and gas companies.

Please walk us through your career, starting with the Commonwealth Scholarship given to individuals with the potential to positively impact the global stage.

After being recognised by top executives for my contributions at ONGC, winning the Commonwealth Scholarship – awarded to individuals with the potential to positively impact the global stage – was another significant achievement in my career. I worked on a European Commission project at Imperial College London with the industry partner Equinor (formerly Statoil). This work received industry-wide recognition through presentations and publications in international conferences and journals across Europe and the Americas.

At Schlumberger, I led oil and gas asset development and management projects for clients across Europe, CIS and Africa. To transition from operational roles to corporate-level strategy, I pursued an MBA at Imperial College Business School.

After completing my MBA, I worked as an equity analyst for the international investment bank Tristone Capital, headquartered in Calgary (later acquired by Macquarie Group). From the London office, I led investment research on London AIM-listed oil and gas companies operating internationally and covered companies with dual listings on the London AIM and TSX-V markets.

This was an exciting phase in my career – working closely with the Calgary team, interacting with and challenging boards and CEOs, assessing companies from an investor's perspective and making investment recommendations. Drawing on my industry and capital markets experience and network, I started a board advisory practice, supporting boards and C-suite executives on strategy, financing options, M&A and joint ventures.

My interests later expanded to renewables, decarbonisation and net zero. I developed deep expertise in ESG and sustainability, including the evolving regulatory landscape. I am now interested in pursuing non-executive and advisory board member roles. Currently, I sit on the Advisory Board of a medium-sized UK company providing water treatment solutions to clients globally, including the oil and gas industry.

You applied Artificial Intelligence (AI) solutions more than 20 years ago at Schlumberger. How have you seen AI developments change the energy (oil & gas) industry?

When I led the application of AI technology at Schlumberger to develop an operations monitoring solution for an underground gas storage reservoir, it was the first time we applied AI (specifically Machine Learning) in a commercial project for a client to overcome the challenge of disparate data.

Today, AI technology is at the forefront, playing a crucial role in improving efficiency and productivity in day-to-day operations across the entire spectrum of businesses.

AI is a powerful enabler for extracting significant insights from complex data, enhancing operational and customer data productivity. To my knowledge,

Adaptation, understanding and appreciation... continued

oil and gas companies, especially large organisations, are leveraging AI technology in operations such as drilling and exploration, and gaining customer insights.

As SPE London Board Chair in 2012-13, you focused on increasing investment in students and Young Professionals. What are you most proud of achieving in that role?

As SPE London Board Chair, I am most proud of closely integrating the Young Professional Committee into the Board. This integration enables us to create more learning, networking and professional development opportunities for students and young professionals.

Additionally, we leveraged their digital expertise to develop the SPE London website on the SPE international platform, resulting in substantial cost savings by transitioning the web hosting from a third-party service provider.

You also co-founded the SPE London Upstream Finance and Investment Annual Conference and chaired it for five years (2013-2017). What do you think were the key insights that developed from the conferences?

Co-founding and chairing the SPE London Upstream Finance and Investment Annual Conference was a rewarding experience for me. I worked tirelessly with sponsorship and marketing committees, in addition to chairing the programme committee responsible for creating a thematic programme. Collaboration with the SPE Europe team and support from the industry and the financial sector in providing speakers and sponsorships were significant factors in the conference’s success.

Through keynote sessions I chaired, it became clear that senior oil and gas company executives were increasingly aware of the need for decarbonisation across various sectors of the economy and energy transition. Overall, the conference reinforced the importance of industry partnerships to finance projects when capital markets are tight, the application of technology to improve operational efficiency, and the value of knowledge sharing.

To address climate change, how do you believe global energy (oil and gas) companies can best balance their portfolios?

Climate change is a global issue, and addressing it requires cooperation and collaboration across nations. International institutions such as the UN and national governments are key in driving a just energy transition and creating climate action plans under the Paris Agreement. Global energy companies need to operate within these frameworks to balance their portfolios. Company size will be a factor in determining how oil and gas organisations will set and achieve their emission reduction targets while contributing to energy security locally and globally.

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

I am most proud of having experience in both corporate and capital markets. This dual expertise allows me to understand the intricacies of organisational challenges while also appreciating the expectations and concerns of investors.

What advice would you give young professionals in the oil and gas sector?

The oil and gas sector is now under constant scrutiny as climate change demands a transition to a low-carbon economy. Professionals in this sector have always been affected by the macro-economic and geopolitical environment, which causes volatility in oil and gas prices and cycles of industry downturns and upturns. Climate change adds another dimension to the complex operational environment in which oil and gas companies operate.

My advice to young professionals in the oil and gas sector is to remain vigilant about the role of oil and gas in the energy mix, which will vary across geographies and sectors.

Be adaptive to the changing external environment, and always consider the broader context of your role while staying focused on the task at hand.

SPE DSEA AI 4 Energy One-Day Workshop

Everyone is talking about AI, yet how can we use it today?

We are leaping forward into the new technological era with the rise of AI as the centrepiece supporting our operations. With numerous claims being made, how can you navigate the uncertainties surrounding the technology? What tools are available to help you do your job today?

As Society of Petroleum Engineers, we recognise the opportunities brought to our industry by the new technologies that are able to analyse large volumes of data, streamline complex processes and suggest decisions. During this event, we will explore those options as they are available today.

No noise, no grand promises, no hot air. Join us for an event designed to share best practices, explore the do's and don'ts and bring practical examples! We want to ignite the conversation around the game-changing potential of Artificial Intelligence in the realm of Data Science and Engineering Analytics!

Why Attend? Expert Insights: Engage with leading energy professionals, data scientists, engineers, academics and researchers as they share their real-world experiences, successes, and even the occasional stumble on the path to AI integration.

Maximise ROI: Discuss practical solutions that deliver tangible benefits to your organisation. From optimised decision-making to cost savings, see how AI can improve productivity.

Real-Life Examples: Experience the tangible impact of AI in action as we showcase real-life examples of its transformative role in empowering energy efficiency, optimization, and sustainability.

Networking: An opportunity for professionals to network across the value chain.

Location: Ardoe House Hotel, Aberdeen
Date: Thursday, 3 October.

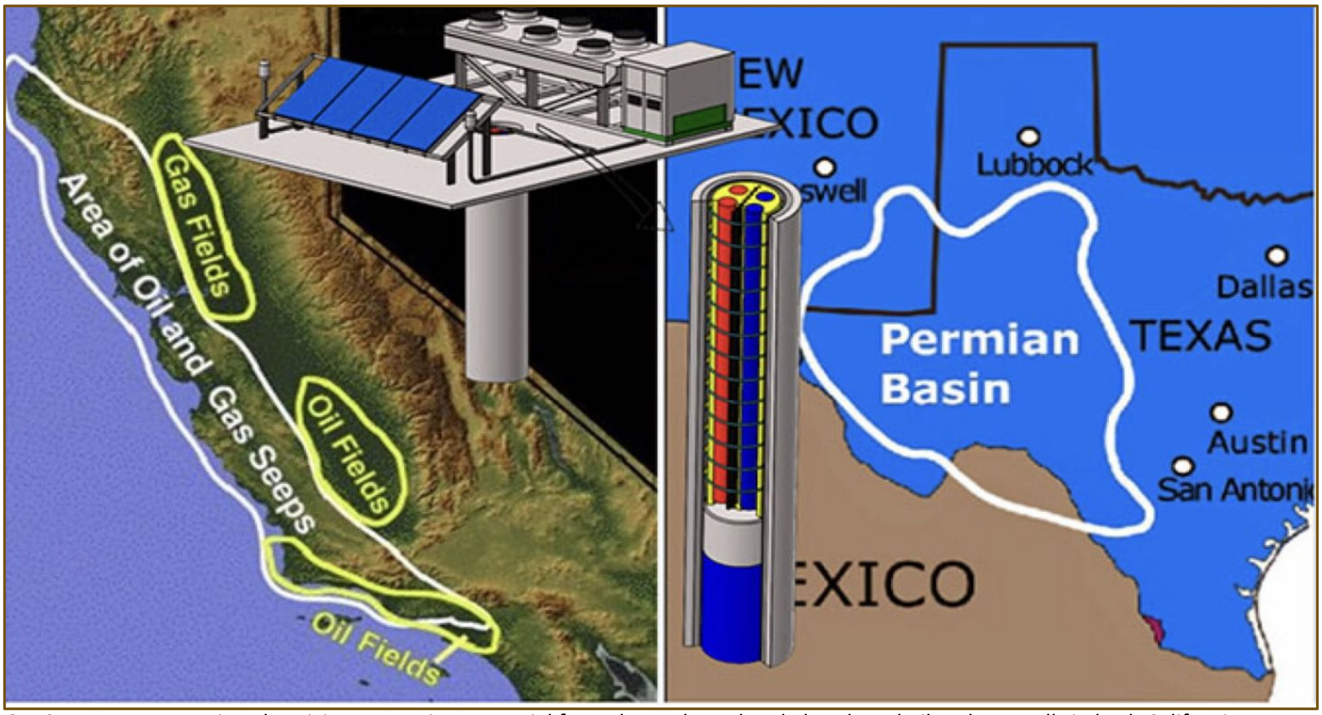
Keynote speaker will begin at 8.30am and the event will run until 5pm.

Please register via this link

For more information on the DSEA, please click here.

Innovative Approach: Geo2Watts sees Abandoned Oil Wells as Future Energy Assets

Geo2Watts is transforming abandoned oil and gas wells into renewable energy assets using solar power and sand. In this exclusive Q&A, co-founders Phil Cruver, Bill Bartling, and Ken Murray share their vision and the innovative technology behind their 'borehole battery'.



Geo2Watts sees massive electricity generation potential from the orphaned and abandoned oil and gas wells in both California and the Permian Basin of west Texas.

This article first published in T*he Journal of Petroleum Technology,* August 1, 2024, by Blake Wright, a journalist covering the upstream oil and gas industry for more than 25 years. He is based in Houston, TX.

Companies would not normally view abandoned and orphaned oil and gas wells as assets. Historically, this nonproductive and potentially hazardous infrastructure has been labeled a liability without a uniform set of regulations to address its future—and many times without an identifiable owner to hold responsible for it.

California-based Geo2Watts sees these wells differently. The company wants to repurpose these old producers into thermal energy storage systems capable of electricity generation using two chief ingredients: solar power and sand.

The team is led by co-founder and CEO Phil Cruver, who had previously worked in aquaculture and wind energy generation. Bill Bartling is a co-founder and director of regulatory affairs. He has worked in the tech and oil space, including a stint at Chevron. Ken Murray is co-founder and director of engineering and innovation. He has had a multidimensional career in engineering, research, development, management, and law.

The technology, which the company dubbed the borehole battery, would require new legislation and some permitting, but the company remains bullish on its prospects.

In this Q&A Cruver, Bartling, and Murray share their insights on the technology and their vision for the future.

Innovative Approach ... continued

JPT: Can you walk us through the technology that allows Geo2Watts to utilize idle and orphaned oil wells for grid installations for thermal storage and electricity production?

Geo2Watts: This technology is being developed to transform idle oil well assets into long-duration, on-demand, dispatchable zero-emissions electricity generation to be deployed during low-generation/high-demand energy cycles inherent to renewable generation systems.

For oil well conversions we must first distinguish the differences among the wells targeted for our venture: An abandoned oil well has been permanently taken out of production. The well is permanently sealed, plugged, and buried per state, local, and/or federal regulations to prevent the release of oil, gas, or other substances into subsurface water reservoirs and the environment.

An orphaned oil well is one that has not been plugged and sealed and where the last known well operator is no longer in business, deceased, or cannot be located.

Our company is interested in idle wells which in California are defined as a well that has not been used for production, injection, or subsurface data collection for 2 years or more and has not yet been properly plugged and abandoned. Other states and federal definitions for idle wells include wells producing less than 15 BOED. The concept of repurposing, while concurrently plugging these idle and low-producing wells for generating clean electricity, offers the owners a strategic and lucrative opportunity in preparing for their “end of life.”

After the producing zones of the idle oil well are plugged and the remaining casing is demonstrated to be mechanically and structurally sound, it is filled with a thermal storage/harvesting substance such as phase-change materials along with a novel and proprietary heat exchanger to add and extract heat from the converted well. This effectively converts the well into a thermal energy storage (TES) system.

Solar thermal collectors are the source of renewable heat, although heat pumps and resistance heaters may also be used, for heating pressurized water up to 175°C. This heated water is pumped into the TES within a closed-loop heat exchanger to charge the TES. During electricity production, the pressurized water flows through the same heat exchanger of the TES, but this part of the cycle harvests heat and delivers it to the evaporator/boiler of an organic Rankine cycle (ORC) power plant. This heat drives the power cycle to produce electricity.

The optimized design of the TES and its heat exchanger, coupled to the ORC power plant and solar collector field, are the critical components of the closed-loop system called the “borehole battery” which is a patent-pending technology. Research and design are underway to evaluate the best thermal storage substances, heat exchanger design, and optimization of the process for this system.

JPT: You estimate that 37,000 wells in California have the potential to produce electricity with this technology. What are some of the parameters idle wells must meet to be deemed electricity-ready?

Geo2Watts: Our current design assumes 7-in. casing for installing the borehole battery. Some wells, especially shallow wells, may have smaller casing which would require a modification of the borehole battery design. Well depth may play a role in well selection. Our ongoing research will define those limits which will be foundational to parsing out those wells best suited for conversion from the huge current inventory of idle and soon-to-be decommissioned active wells.

The surface footprint of the heat and power generation system that charges and harvests heat from the borehole battery is less than what is required for typical operations that have easements for workover rig access.

Innovative Approach ... continued

Ideally, we want to work with fiscally sound responsible operators for idle oil well conversions. Orphan wells that are not in operation and have no owners of record, can have expensive remediation issues that come with the abandonment. While these wells can potentially be converted, the cost and effort of doing so make them a future opportunity rather than a near-term priority.

There is much written about the projected cost of full Asset Retirement Obligations (ARO) for California's orphan, idle, and active wells and the reality for this being currently underfunded. Most operators carry a full or partial reserve on their books for paying for end-of-life events for their wells and associated assets. The Investment Tax Credit (ITC) allowance in the Inflation Reduction Act (IRA) provides for up to 50% recovery of capital (see question 6 below) used to convert oil wells to zero-emissions energy systems, such as our technology. Therefore, for companies with ARO reserves insufficient to abandon all their wells, converting the well into a borehole battery may allow fully meeting mandatory ARO.

In parallel, new statutes and regulations are being enacted in California every year that in many cases dramatically shorten the productive life of wells. This may create a situation that affects even those operators who have diligently taken accumulated reserves from production revenues for the eventual abandonment where the shortened producing life of the well may leave their reserve with a shortfall. This conversion program can help these operators meet their abandonment requirements while complying with the new statutes and regulations and contributing to the creation of clean, long-duration, and dispatchable electricity revenue streams.

JPT: How much, if any, leakage is expected from any single well used to store electricity? What about general efficiency expectations such as life-of-well post-conversion and maintenance schedule?

Geo2Watts: As far as gas and fluid leakage out of the well into the atmosphere or underground reservoirs, the hydrocarbon-bearing zones of the wells will be sealed, plugged, and abandoned per state and federal regulations.

Regarding leakage of working fluids in the borehole battery heat exchanger system, we expect none as the downhole heat exchanger is a closed-loop system. In addition, the borehole battery will be installed inside the borehole casing strings, most of which are cemented to the surface. We also plan to install fiber-optic (DAS/DTS) monitoring systems to provide measurements of temperature distribution and changes in the borehole battery and acoustics to detect leaks in the closed-loop heat exchanger. We are modeling the use of water as the working fluid which would not pollute underground reservoirs in the event there was a leak in the heat exchanger.

Water is the preferred vector for transporting heat as it has excellent thermophysical properties including specific heat and heat transfer coefficients. The repurposing of an underground oil well as a TES system provides inherent benefits to the overall efficiency. The multiple thick layers of concrete casing and the geology that the well was drilled into act as potent heat insulators, and the fact that it is buried rather than being exposed to the ambient air (and especially wind) significantly reduces heat losses. Initial estimates of heat losses, over the span of 10 hours, is just 1% of the thermal energy stored. Though more detailed analysis about surrounding soil and downhole geology temperatures is required for higher accuracy, such low values of heat loss make the technology an ideal candidate for long-duration energy storage.

The life of the well post-conversion in large part is dependent upon the state of the well pre-conversion. The conversion of the well and installation of the borehole battery is an industry standard and local regulatory-defined abandonment except for the portion of the well converted to the TES system. The well casing will be tested and confirmed to have structural integrity before converting it to a TES system, and as previously stated, fiber-optic monitoring will be installed to monitor the performance of the TES and provide early warning of any leaks in the heat exchanger. The expected life of the well is not changed from what would be expected if the conversion had not been done.

Innovative Approach ... continued

We expect very little maintenance required as there are no moving parts downhole in the borehole battery. It is possible that the heat exchanger closed-loop system may develop a leak over time which would require pulling the heat exchanger and thermal exchange materials and replacing them. The DAS/DTS will provide both a detailed measurement of temperature distribution and time variant changes throughout the borehole battery volume for optimization of its performance, and the acoustic monitor will provide early detection of any fluid leakage from the heat exchanger. Therefore, maintenance is not expected to be on a scheduled basis but rather as needed to remedy any system failures. As stated previously, the working fluid in the heat exchanger will be water that is contained inside of cemented casing, so the impact of a leak is only to the performance of the borehole battery and will not present any risk to the environment.

Drilling and completion technologies and regulations differ in each state but all hydrocarbon wells in the US are built with industry engineering standard fluid, pressure, and drinking water protection control systems that include cemented steel casing in the wells. Thus, all wells constructed in this manner are candidates for conversion into our technology.

JPT: What additional infrastructure would be needed to move electricity generated by these wells into the market?

Geo2Watts: We will initially target “other-side-of-the-meter” customers in California where the commercial and industrial rates are more than 20¢/kWh and select the ideal wells having existing infrastructure.

In the Permian Basin of Texas and New Mexico, an independent analysis estimated that there are more than 100,000 idle wells that we feel have the potential to be converted to clean sources of electricity to replace natural gas and diesel using its infrastructure for power generation.

Regarding cost of infrastructure and the potential 50% recovery of capital, the Inflation Reduction Act (IRA) provides a 30% base Investment Tax Credit (ITC) for qualifying projects that generate zero-emission electricity. Projects can qualify for additional ITC such as the 10% Domestic Content adder, which applies if a significant portion of the project’s components are sourced from within the US. The 10% Energy Community adder is available for projects located in areas that have historically been involved in fossil fuel production. Borehole battery components are manufactured in the US, and Geo2Watts-targeted locations for repurposing and plugging the idle oil wells meet the Energy Community criterion.

JPT: The borehole battery concept sounds a bit like the ROPES system, which looks to repurpose offshore pipelines as energy storage vessels. Both are novel solutions for aging infrastructure. How do you “sell” the concept past the novelty in the eyes of skeptics and into the practical?

Geo2Watts: The offshore ROPES system addresses a different market, but it is akin to our concept repurposing aging infrastructure for novel energy storage. The ROPES system uses idle offshore pipelines as an energy storage vessel for high-pressure seawater, essentially storing energy in the form of mechanical energy in a compressed fluid.

On the other hand, the borehole battery uses terrestrial oil wells as the containment shell of a TES into which heat is deposited, stored, and later extracted and converted into clean and dispatchable electricity through a thermal power plant.
This is a relevant question because we have been challenged to validate the efficacy and economics of the borehole battery concept and technology by skeptics from the oil and gas, renewable energy, and environmental community. We have found that there is an aversion among renewable energy scientists to revitalizing aging hydrocarbon assets; however there is a valid and interesting use case for plugged oil wells as a TES Carnot battery which is a hot topic in renewable energy research.

Innovative Approach ... continued

The large volume of a deep oil well allows the storage of incredible quantities of thermal mass at relatively low costs as the shell of the TES (i.e., the inner casing of the oil well) is already in place. Moreover, the fact that the oil well is underground and has several thick layers of steel and concrete casing reduces the thermal losses of the stored heat in the TES as compared to a hot tank aboveground that must be constructed with several layers of thermal insulation.

JPT: What stage of development is the technology in? Has there been a successful pilot? Has it been commercially deployed?

Geo2Watts: We are continuing to research heat storage and harvesting materials to optimize the efficiency and financials of the system and are modeling the thermodynamics. In parallel, we are calculating the economics and have filed patents for numerous novel designs. Our research continues for developing novel designs for TES focusing on low-cost, easily accessible, thermally stable, and nontoxic substances. The spectrum of thermal storage materials, each with their own unique characteristics, opens doors for innovative designs for generating enhanced efficiencies.

We have proposals for developing a prototype and are in the process of selecting the location for a pilot project. We are also in discussions with renewable energy developers, oil and gas well owners and operators, and tax-equity investors for structuring commercial scaling employing favorable tax benefits.

JPT: Will this new type of well use require new regulations?

Geo2Watts: California is reviewing new legislation on this topic and will likely promulgate new regulations within a few years if the bills pass. In the meantime, as our well conversion solution is essentially an abandonment, the only well permits required would be either workover or partial abandonment which the state has the authority to issue. Since there is no injection of fluids or gas involved, EPA water-quality permits are not required. There may be local land use or air permits required but as the installation decommissions and removes the surface equipment at the wellhead, the permits should not be difficult to acquire.

JPT: Outside California, the struggles of the Texas power grid in recent years are well-documented. Could this technology translate into a new electricity source from, say, idle wells in the Permian Basin?

Geo2Watts: The Texas Railroad Commission oil and gas regulatory agency does not have a category of “idle well” in its database. However, there are five categories of wells including no production, observation, partial plug, shut-in, and temporary abandoned. These wells are initial targets for conversion into a borehole battery, and there are 129,583 wells in these categories.

According to MineralAnswers.com, New Mexico currently has 114,385 wells and only 43% are producing. Comparing this to California’s current idle well inventory, the Permian Basin market potential is significantly larger, and the entire region qualifies as an Energy Community for the extra 10% ITC with the IRA.

The Permian Basin is facing a substantial increase in electrical load demand. According to S&P Global, the demand is projected to rise from the current 4.2 GW to 17.2 GW by 2032. More than a third of the forecast growth is coming from oil and gas operators converting operations and if the current rate of load addition continues, only 55% of the demand forecast will be met by 2040.

Implementing our downhole technology on a large scale would significantly reduce the number of idle wells in the Permian by sealing producing zones to prevent methane leakage and repurposing existing infrastructure. This would also add energy storage capacity for oil production operations by providing on-demand, zero-emission dispatchable electricity during peak hours.

Road to Well Completions Electrification to Support Sustainable Field Development

In this paper, we present the results of the electrification road map that was implemented to evaluate the reduction of carbon emissions through electric wells. We describe the comprehensive approach that included data collection, case studies, and techno-economic analysis. We also highlight the main achievements and benefits of the electric completion system in terms of reservoir management, well design, and environmental performance. We demonstrate that the transition to electric wells has shown that completion technology can play a pivotal role in addressing environmental concerns within the oil and gas industry. We conclude that electrification can facilitate the coexistence of sustainable practices and profitability, offering a promising outlook for the future.

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What Is an All-Electric Completion?

All-electric completions are integral part of the full electrification of oil and gas production systems that aims to replace the entire hydraulic infrastructure downhole, at seabed, and topside with electric systems, thus opening new performance capabilities while considerably simplifying operations (Fig. 1). The global benefits of electrifying the entire production system are well explained in Ross (2022) and its impact to lower carbon emissions is summarized by Hiron and Edmundson (2023).

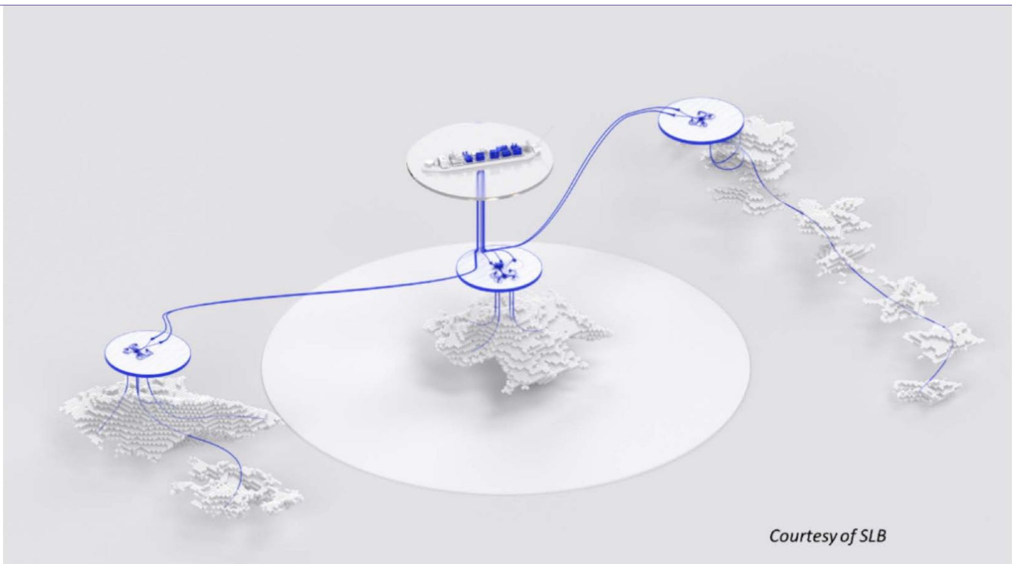

Fig. 1. All-electric subsea field

All-electric completions basically consist of replacing any hydraulically powered equipment with electrically controlled and powered equipment (Fig. 2, on the next page). This includes equipment operated by hydraulic control lines but also equipment actuated by tubing or annulus pressure.

All-electric downhole tools can be multi-dropped on a same single line as opposed to hydraulically controlled equipment that requires dedicated control lines per device. The single electric line distributes power and provides bidirectional communication between the topside control system and all downhole tools.

All-electric completions go beyond just replacing multiple hydraulic control lines with a single electric cable: They open the possibility of controlling conventional equipment such as gas lift valves or chemical injection valves with much higher precision with control from topside of any equipment that would otherwise require wellbore or annulus pressure to be actuated (such as packers, isolation valves, and sleeves).

Road to Well Completions Electrification ... continued

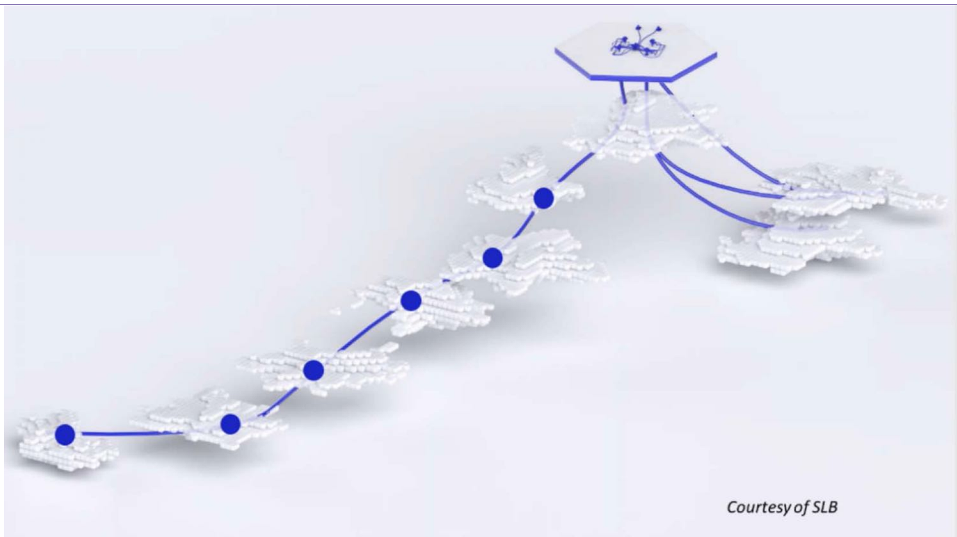

Fig. 2. All-electric multizone completion

The typical completion equipment that can be electrified are as follows (not an exhaustive list):

- Flow control valves (also called interval control valves [ICVs]) in various versions: inline/ shrouded, annular or integrated with sand screens, in upper or in lower completions
- Surface-controlled subsurface safety valves (SCSSV), including contingent electric SSV
- Gas lift valves, with infinitely variable adjustable port sizing on command
- Chemical injection valves, with infinitely variable adjustable distribution port on command
- Packers, with electric setting/unsetting on command from surface
- Isolation valves, with port sleeves electrically controlled from surface.

Electric completions can also come with ancillary equipment such as inductive couplers replacing downhole wet connectors for high- reliability operations, wireless deployment tools for monitoring and controlling electric equipment installed in lower completions during deployment when no cable can be used with drillpipe, and, of course, sensors for measurements of all kinds, including pressure, temperature, flow rate, water cut, and gas fraction.

All these devices can be theoretically connected to the same electric cable, which is called tubing encased cable (TEC) or permanent downhole cable (PDC). Practically speaking, where power, risks, or safety aspects need special management, using two electric cables may be desired for configurations where a large amount of equipment is under consideration. Typically, all-electric SCSSV would run on a separate line (with possible redundancy) from any other equipment in the well for safety reasons.

Technical Benefits of All-Electric Completion

Using all-electric completions brings numerous benefits, as summarized herein.

No Limitation on the Number of Devices

Because direct hydraulic control of downhole equipment requires a minimum of one hydraulic control line per device, intelligent completions are practically limited to no more than three hydraulic flow control valves per well due to the complexities of deployment and installation. The electric systems that are all multi-dropped on the same line have no practical limitations in the number of devices other than the amount of power that can possibly be sent to the wellhead (wet tree applications may be more constrained than dry tree applications with regard to API Standard 17F (2014), previously Intelligent Well Interface Standardisation (IWIS). In the last 10 years, SLB has routinely deployed completions with six all-electric flow control valves with one or two inductive couplers, each of them multidropped on a single electric line.

Although electrohydraulic systems can offer more devices than direct hydraulic technology, they will

Road to Well Completions Electrification ... continued

never match all-electric capabilities due to two main limitations inherent to hydraulic technology: the chokes remain with discrete positions, thus limiting the controllability of pressure drawdown when used in large number of zones, and pressure transmissibility has limits over long distances, with a further complication that sensitivity to temperature variations could lead to undesired self-cycling of valves. Fig 3 through Fig 6 show realized customer applications for extended reach or multilateral solutions with SLB all-electric systems.

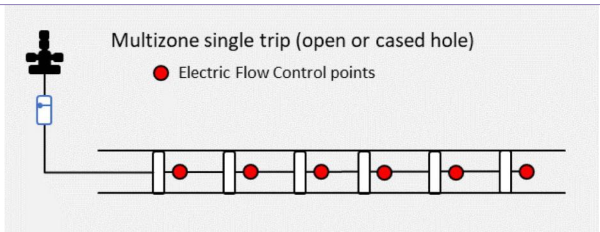

Fig. 3. Single-trip six zones all-electric completion

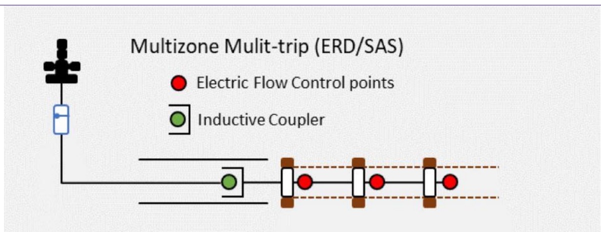

Fig. 4. Multi-trip three zones all-electric completion

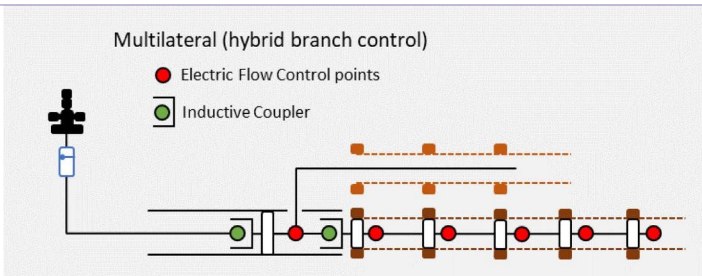

Fig. 5. Multilateral hybrid six zones all-electric completion

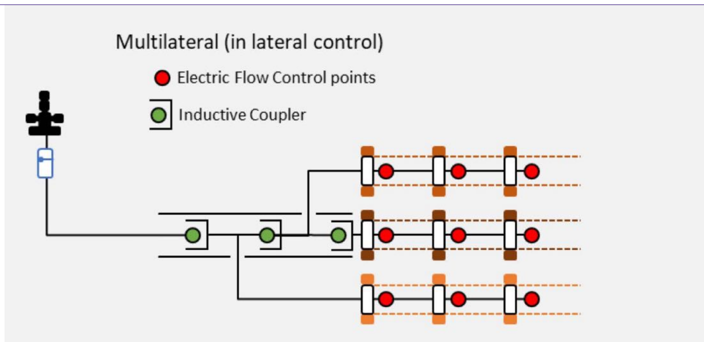

Fig. 6. Multilateral three branches for three zones all-electric completion

Simplification of Installation

The deployment of hydraulic and electrohydraulic systems requiring multiple control lines is time consuming, tedious, and complex, potentially affecting system reliability and creating HSE risks. The more control lines there are, the more reels on deck—sometimes on lower decks—with complex interoperability during deployment, hence higher risk of damaging a line during installation that could compromise the integrity of the installation. In subsea applications, the multiple control lines require multiple dedicated wet connector penetrations between the subsea tree and tubing hanger. The result is creation of a jumble of coiled control lines in contraction joints, which need making up numerous connections and pressure testing at the rig floor, increasing the risk of technician fatigue and the occurrence of HSE issues.

By contrast, all-electric completions are deployed from a single electric line and a single wet-mate connector,

Road to Well Completions Electrification ... continued

greatly reducing the number of connections to be made during installation and enabling simple coiling when using contraction joints and fewer penetrations in packers. This simplicity returns significant time savings for running an entire intelligent completion of up to 20% from normal completion when including the thousands of meters of tubing strings that run in hole faster because clamping a single control line is much faster than clamping half a dozen hydraulic lines altogether. Fig 7 compares the different technologies for a three-zone system.

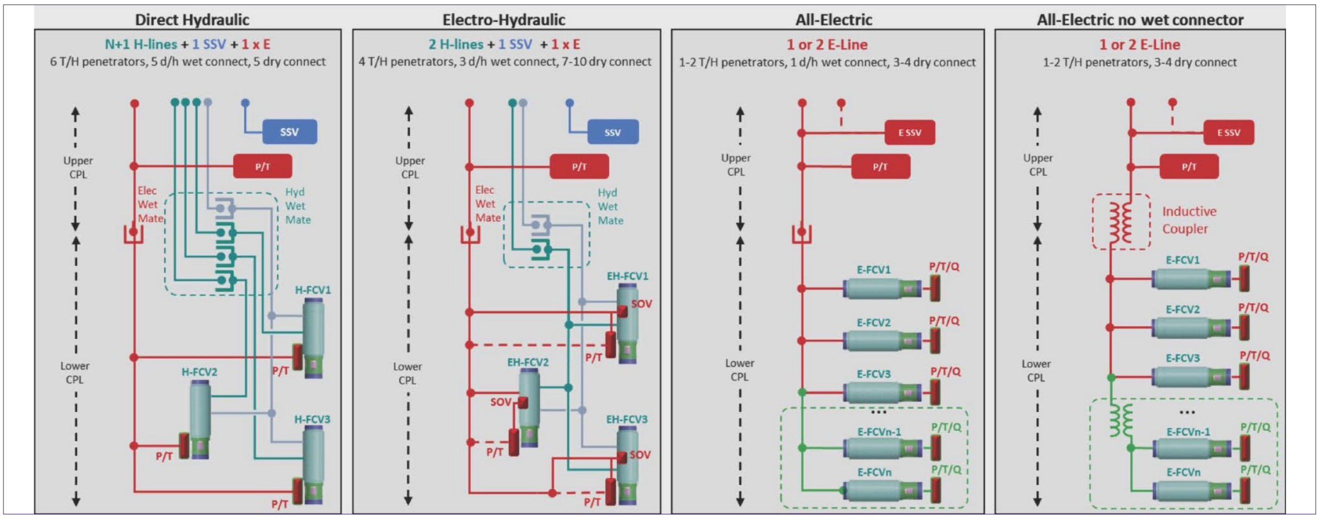

Fig. 7. Comparison of direct hydraulic, electrohydraulic, and all-electric systems

As shown on the figure, the hydraulic version requires many control lines, as opposed to the all-electric version. The level of complexity with a downhole wet connector is obvious if the control equipment is in the lower completion. Although an electrohydraulic system reduces the number of control lines, it adds complexity with hydraulic multiplexers using solenoid valves. An all-electric system uses a single wet connector as opposed to multiple wet connectors. The use of an AC power bus also supports replacing downhole electric wet connectors with high-reliability inductive couplers that are contactless devices, totally immune to fluid effects.

Also shown on Fig 7 on the far right is a typical configuration stacking multiple inductive couplers to access the multilateral branches, with each branch equipped with all-electric devices. Such an application would be impossible with hydraulic systems.

At rig site, using multiple hydraulic lines is cumbersome and requires a high level of preparation work. Running multiple drums while lowering the completion in the ground is a delicate operation. Fig 8 shows typical photographs of multizone hydraulic installations compared with all-electric ones.

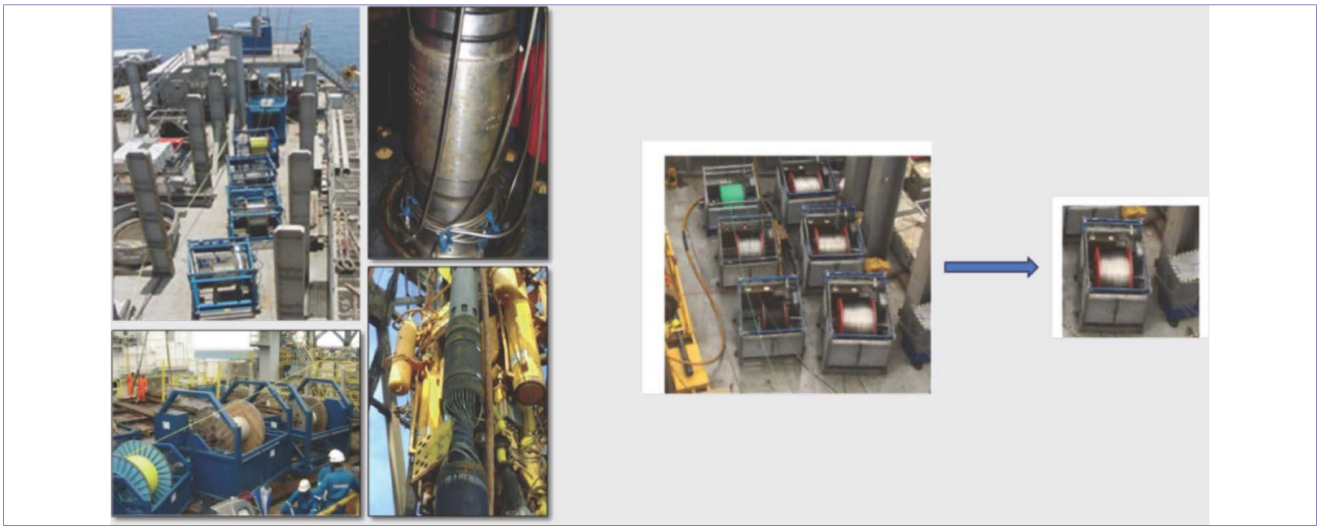
Fig. 8. Photographs of hydraulic installations in contrast to the expected simplification with all-electric installations

Road to Well Completions Electrification ... continued

Simplification of Design

Hydraulic flow control valves use discrete choke positions that are calculated and geometrically dimensioned for simulated expected reservoir conditions. If reality differs from the simulations, production engineers are stuck with the choke openings as they are, at suboptimal opening size. Even with correct simulations, reservoir conditions change over time, making the initial choke openings inappropriate after several years of production. None of these inaccuracies can happen with electric flow control valves because the chokes can move with infinitely variable displacement; they can be always set at the exact desired position. There is no need for predefined settings.

Another design simplification is the completion itself. The use of multiple flow control valves at the sandface can simplify completion design by eliminating the need for intermediate completions, or even isolation or barrier valves, if they meet the desired criteria.

Topside Simplification and HSE Improvement

Hydraulic technology requires topside hydraulic power units (HPUs) and a hydraulic distribution system, in turn requiring deck space and frequent maintenance. HPUs expose personnel to high pressure and must continuously consume power to keep a constant pressure in the operating lines.

All-electric systems are much simpler topside, generally needing no more than a 19-in. rack with a power supply and communication interface to the downhole cable. Of course, electric systems also have safety aspects; however, once an electric cabinet has been properly wired by a certified technician, there is no HSE risk for an operator. Electric wires do not have potential energy like hydraulic control lines that can create HSE risks.

Hydraulic Pressure Independence

The industry has experienced a lot of unplanned movements of hydraulic downhole flow control valves due to temperature variations inducing pressure variations in control lines, which cause cycling of the downhole chokes in an untimely and undesired manner. Electric actuators are pressure independent and immune to temperature or pressure variations downhole. Additionally, electric lines are pressure- tight and do not offer a leak path to topside like hydraulic control lines.

Electrically actuated SSVs operate independently of pressure, as opposed to hydraulic SCSSVs, for which pressure is acting against a spring (or compensated with nitrogen charge for deep-set SCSSVs). No spring or nitrogen charge is used with all-electric SCSSVs.

High-Precision Control

Electric flow control valves provide continuous displacement for chokes and therefore can reach any precise position defined by topside optimizers. Electric chokes are at the right position 100% of the time, contrary to hydraulic or electrohydraulic systems that use discrete positions that can only be at the right position for those discrete positions. Any other position calculated by a topside production optimizer is mechanically unreachable. For the assumption that 1% resolution is sufficient in terms of position accuracy for good production control (i.e., 100 positions between full close and full open), a hydraulic valve with 6 choke positions would then provide 14% opening increments (assuming equally distant positions) with correct positions for only 6 of them—rendering 94 out of the 100 desired positions unreachable.

A maximum error of 7% can happen (halfway between 2 positions). The average error from an ideal position is statistically half of these 7%, or 3.5% (Fig 9, on the next page). This means that with hydraulic chokes, production is on average 3.5% away from an optimal point. This can represent a lot of oil (and income) over several years. By contrast, all-electric chokes can always be at the optimal position, all the time.

It is also worth noting that information about choke position is inherent to the drive mechanism of an electric choke. By design, electromechanical actuators, stepper motors, or DC brushless motors with resolvers know their exact position at any point in time.

Road to Well Completions Electrification ... continued

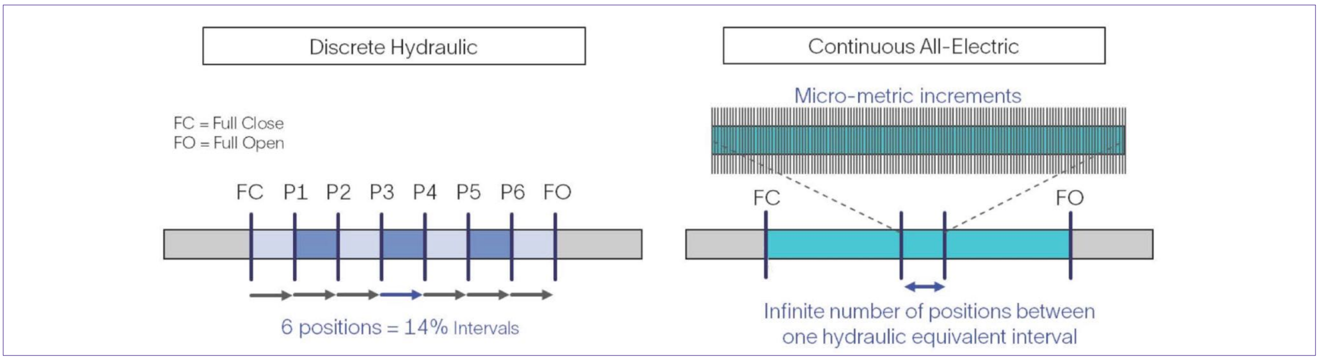

Fig. 9. Incremental control of hydraulic versus continuous control electric

The mechanical transmission between motor and yoke always translates this information into an exact choke position. Conversely, hydraulic chokes must be associated with a position sensor mechanically attached to the choke itself. The industry has a long history of failed position sensors or loss of control, leading hydraulic chokes to be often in an unknown position. When this situation occurs, the only way to regain position knowledge is to shut down a zone entirely and restart the cycle count from the beginning.

From a reservoir management perspective, high-precision control enables moving chokes by very small increments and reading the effect on pressure and flow instantaneously without significantly affecting production (Fig 10). This functionality can be used to do mini well tests at zero cost.

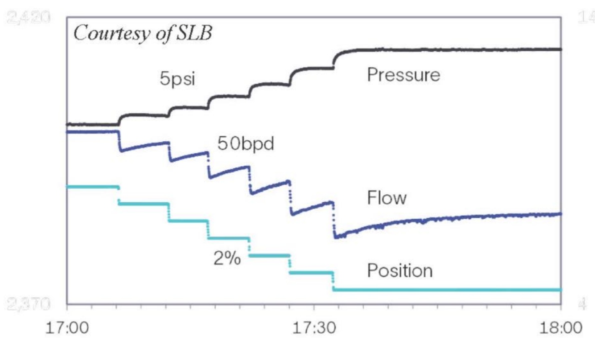

Fig. 10. Precise control and monitoring of position, pressure, and flow

Cycle Time

All-electric systems operate at a much faster speed than hydraulic systems. Some hydraulic choke designs using indexers need tens of minutes to move from one position to another. Going backward one position requires moving ahead through all the positions and crossing the full open/full close ones. This can take more than one hour. Instead, an all-electric choke moves in seconds, totalizing less than 10 minutes for a full open-full close cycle. This benefit can be particularly important with sandstone reservoirs prone to heavy sanding during transition regimes, for example. All-electric systems alleviate this problem.

Instant Control and Reach

The speed of electricity is near the speed of light in conductors, as opposed to pressure pulses in hydraulic flow control lines. Hydraulic control lines of small diameters create pressure transmissibility issues, limiting reach in distance, depth, and response time. Electric equipment can be controlled instantaneously, thus reducing any production deferment due to pressure cycling. Electric lines admittedly also suffer power losses, but not in quantities that affect operations for the distances under consideration in oil and gas applications.

Electric Gas Lift

Gas lift operations are also considerably simplified with electric gas lift,
There is no need to calculate port sizes and no need to change them over time by conducting expensive

Road to Well Completions Electrification ... continued

interventions. Electric porting adjusts automatically to the optimal position with a simple click at surface. Optimizing the volumes of gas necessary to lift liquids in turn reduces the energy needed to compress the gas at surface.

Electric Chemical Injection

Considerable benefits are also provided over conventional injection ports by optimizing the distribution of chemicals at critical locations in the completions. In conventional installations, chemicals are usually overdosed to be on the safer side from a flow assurance perspective. As explained in Manach et al. (2023), all-electric downhole chemical injection devices have the capability of controlling the distribution of chemicals at different injection points, in the exact required quantity, when needed. All-electric wells will be equipped with sensors providing pressure, temperature, flow rate, water cut, and salinity that will inform of the risk of forming hydrates, for example.

Quantities of injected chemicals can be adjusted to the real risk of flow assurance issues. As opposed to conventional chemical injection where one control line is deployed per injection point, electric chemical injection is distributed out of single injection line connected to several injection ports controlled electrically (providing that the same chemistry is used at different injection points), thus saving hydraulic control lines and installation time.

While the industry is still developing these services, electrification of completions is not new: More than 100 electric flow control valves have been deployed in the last 10 years. High-reliability downhole electronics and electric connectivity (cables, connectors, wet connectors, and inductive couplers) coupled with rigorous preparation and installation processes have contributed to highly successful all-electric installations on a routine basis.

Electrical Completion Benefits for Carbon Capture and Sequestration Projects

All-electric systems are particularly well adapted to carbon capture and sequestration (also called carbon capture and storage, CCS) projects. CCS reservoirs are often located far from shore, requiring long tie-backs for connectivity. Subsea trees for CCS applications need far fewer functions than those for conventional oil and gas production trees. As such, implementing an entire hydraulic infrastructure from shore to the reservoir for just a few functions is less economical than using all-electric technologies. On the completion side, several elements play in favor of electrification:

An all-electric surface-controlled subsurface safety valve (e-SCSSV) provides full compatibility with an all-electric subsea tree.

The e-SCSSV tends to be indifferent to the extremely cold environments that occur in CCS injection profiles, as opposed to hydraulic systems using viscous fluids in control lines and numerous sealing areas. The e-SCSSV is powered by an electric cable, providing nearly gas tight performance, as opposed to hydraulic control lines that create a natural leak path to topside from gas migration through numerous sealing areas.

Finally, recent studies have demonstrated the value of using infinitely controlled all-electric downhole chokes to properly control the temperature regime of the CO2 injected in the reservoir. While advanced simulations can be run to define appropriate choke sizes with hydraulic systems, electric chokes can better address uncertainties and deviations from simulations. And, here again, electric systems use nearly gas tight cables as opposed to hydraulic systems, thus eliminating any leak path to surface.

The power consumption of an all-electric system is extremely low, far less than 100 W downhole in use and requiring only a few watts for the 99% of the time it is not used, as opposed to hydraulic systems that require remote HPUs that are continuously powered to keep the hydraulic lines under pressure, even when not needed.

Road to Well Completions Electrification ... continued

How The Benefits of All-Electric Completions Support Lower Carbon Footprint

Reduction in the Number of Wells

'Intelligent completions' or 'smart wells' have been used extensively with hydraulic flow control valves in the last 20 years, but most of the time with limited applications. Very often, flow control valves, even with multiple discrete positions, are just used as remotely controlled sliding sleeves to open or close producing zones without costly interventions. When used for partial opening, they end up being rarely cycled by fear of losing position or control, resulting in considerable suboptimal utilization of multizone production systems.

Not only does all-electric technology offers the possibility to connect many flow control valves on the same line, producing multiple compartments with heterogeneous reservoir properties is made possible because of the precise adjustment of each choke position at each producing zone, enabling optimal commingled production from different compartments into the same wellbore. This capability has been demonstrated on several installations with six reservoir compartments (Bouldin et al. 2017; Kosset et al. 2019; Golenkin 2020; Basak and Gurses 2015), enabling producing in one well what would normally necessitate two or three wells for equivalent reservoir drainage.

Typical applications can be in fractured reservoirs such as carbonates but also single reservoirs that can be compartmentalized to control production (or water entry) along the horizontal drain. Using electric compartmentalization on long horizontal wells enables precisely monitoring which part of the reservoir is contributing (or not) between the heel and toe of the well. This information can be used to finetune future drilling programs and eliminate drilling sections that add no value to oil recovery.

To summarize, an operator attempting to reach up to six reservoir compartments is now given the choice of accomplishing that with one all-electric well with six downhole electric chokes as opposed to two or three wells each equipped with two or three conventional hydraulic chokes.
In a deepwater environment, saving one well could save more than USD 100 million in costs per well, and it also would reduce significant CO_2 emissions: A deepwater drillship generates about 5,700 t of CO_2 emissions over a 40-day drilling period, with the following breakdown by consumer (Allen M 2022) (Fig 11).

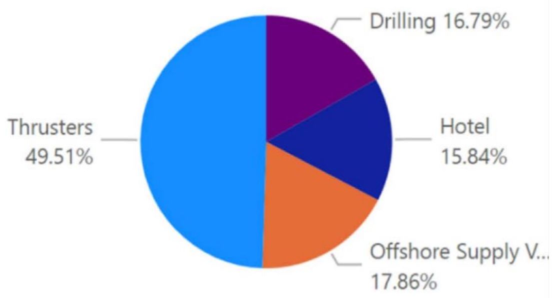

Fig. 11. CO_2 emissions partitioning for subsea drilling (after Allen 2022)

To this can be added the embodied carbon material saved by not constructing this well, which is essentially steel and cement. A typical presalt subsea well would require 350 to 400 m3 of cement and about 1,200 t of steel casing. With 3-kg CO_2e/kg steel and 1-kg CO_2e/kg cement (Circular Ecology 2023) [1.5 g/cm3 of cement], this equates to saving 600 t of CO_2 for the cement portion and 3,600 t of CO_2 for the steel portion, totaling 4,200 t of CO_2 saved per well.

The combination of drilling emissions and embodied carbon for the construction of a well is close to 10,000 t of CO_2 per well. Shortening drilling programs for long horizontal wells follows the same logic, with cost and CO_2 savings proportional to the reduction.

Completions Installation Time Reduction

There are some key differences between the two systems of hydraulic vs. all electric in terms of installation,

Road to Well Completions Electrification ... continued

operation, and performance. In a typical subsea deepwater environment, hydraulic smart well completion requires installation of the intermediate completion with associated inline and annular reservoir isolation valves to isolate the reservoir prior to running the upper completions, whereas allelectric well completion can isolate reservoirs after the lower completion installation, eliminating the need for an intermediate completion. This reduces both rig time and cost of the all-electric well completion.

Another advantage of all-electric well completion is that for completions requiring downhole sand control screen, running wash pipes in the lower completion's sand control screen assembly during installation is not required. Similarly, all ICVs can be integrated in the screen assembly, which is remotely controlled while it is being run. Only the bottom ICV is left open to allow completion or cakebreaker treatment fluid circulation before setting the packer. This also saves rig time and minimizes the risk of damage to the ICVs.

A simulation conducted in one of TotalEnergies's deepwater developments showed that electric well completion can save up to 4.25 days of rig time compared with hydraulic smart well completion, resulting in significant cost savings and improved efficiency (Fig 12). In terms of greenhouse gas effects, this is an equivalent reduction to 642 t of CO2 per well (Allen 2022). All-electric well completion also enables more flexibility and reliability in controlling the flow from multiple zones, because it does not depend on hydraulic pressure or fluid communication.

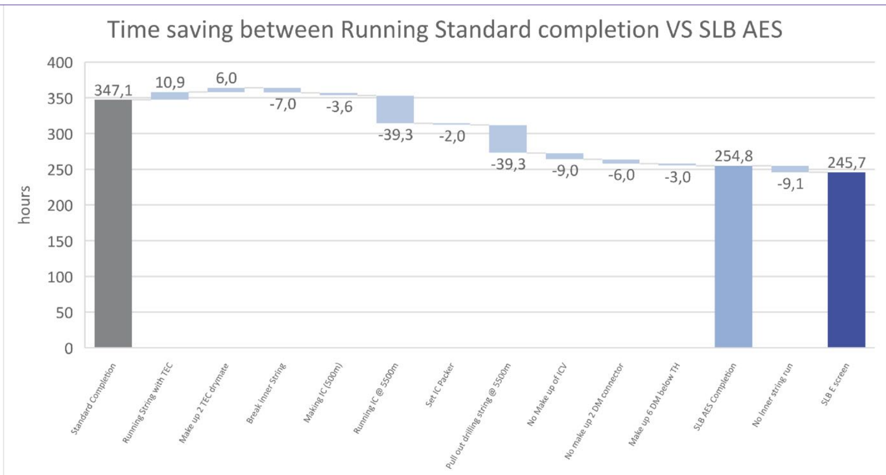

Fig. 12. Comparison of conventional hydraulic smart well with all-electric smart well showing time savings

Reducing Water Treatment Requirements

Numerous reservoir simulations have been run for various operator case studies using Petrel™ subsurface software with the Petrel advanced completions optimization (ACO) module. This module enables comparing total oil and gas production over 25 years with different completion architectures and with or without flow control valves. For scenarios with flow control valves, ACO can compare passive inflow control devices (ICDs), hydraulic flow control valves with discrete positions, or all-electric flow control valves with infinitely variable chokes. Some of these studies conducted in the North Sea, Middle East, and Caspian Sea are summarized in Fig 13.

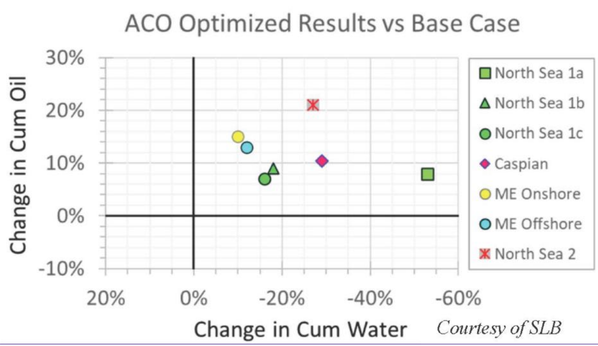

Fig. 13. ACO studies showing positive cumulative changes with all-electric flow control valves

Road to Well Completions Electrification ... continued

On average, a gain of +8% to +20% is demonstrated in cumulated oil, while cumulated water could be reduced by 25% on average, in some situations up to 50%.

An increase in cumulative oil production by +10% is conservative, because certain reservoirs can return much more oil with continuous chokes as shown in Fig 14. In a study for an other operator, the cumulative oil is expected to increase by +46% over a period of 25 years, with +39% more oil than with discrete hydraulic flow control valves.

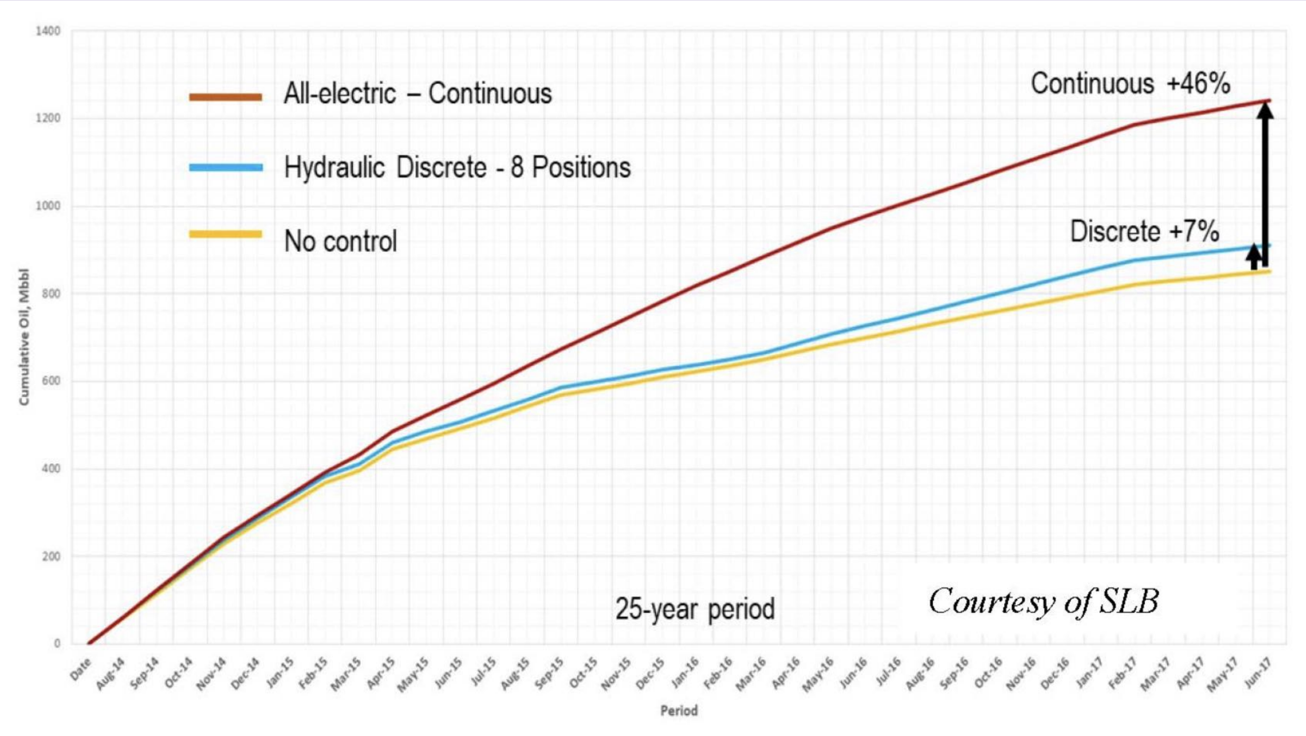

Fig. 14. Cumulative oil delivery by all-electric continuous chokes versus discrete chokes

Reducing water production significantly reduces the carbon impact of production. Water is a byproduct of oil and gas production that is a waste to our industry. Water has a high cost of processing for operators and significantly contributes to the carbon footprint due to the energy required to properly treat it. Reducing water production reduces the energy consumption (hence, CO2 emissions generation) in several areas:

Lifting costs. Oil wells all need a lift strategy at some stage in their production life when the natural energy of the reservoir is no longer sufficient to lift hydrocarbons to the surface. The addition of unwanted produced water from the reservoir requires more energy for the electric submersible pump (ESP) or gas lift to lift the mixed oil-water-gas to surface. A well producing 50% water consumes at least 50% of the lifting energy for something that has no value. The less water coming out of the reservoir, the lower the lifting costs per barrel of oil.

Processing costs topside. Production platforms or flowing production, storage, and offloading vessels (FPSOs) are equipped with water separation and processing units, which are necessary to separate and clean the water before reinjecting it into the reservoir or before disposing overboard. These units are high energy consumers. Here again, the less water coming topside, the lower the energy required to process it. The closer to the reservoir that the water separation occurs, the better, ideally in the reservoir and acceptably at seabed.

Lifting water across significant water depths before separation and processing is a total waste of energy that contributes significantly to the CO2 emissions footprint.

Road to Well Completions Electrification ... continued

MEG injection and reclamation. Oil and gas production is subject to the formation of hydrates. Subsea production systems are protected from hydrate formation with intensive use of monoethylene glycol (MEG) injected at critical points along the production process. The more water produced, the more MEG needed, with a typical industry figure of 1:1 volume ratio between MEG and produced water. Beyond the cost of the chemical itself, MEG injection is costly in terms of energy for the injection pumps, but also for the reclamation process on topside facilities. Reducing water production reduces the amount of chemical needed by the same amount and therefore reduces the energy necessary to reclaim it. All-electric technology helps contain this unwanted water in the reservoir, saving thousands of tons of CO_2/year. Consider calculations using the following assumptions:

- 4,000-m3/d BOPD per well
- Typical water/oil ratio of 1:1
- Reduction of produced water by 25%
- MEG/water volume ratio of 1:1
- 0.5 MW.h/m3 of energy required for processing rich MEG topside
- 0.4-kg CO_2e/kW.h (US EPA 2023).
- **We can save as much as 11,700 t of CO_2/well/year**
- We can save as much as 11,700 t of CO_2/well/year: For an FPSO with a processing capacity of of 100,000 BWPD, saving 25% of this water can save close to **3 megatons of CO_2/year**.

Emission Reduction During Life of Field
In wells prone to scaling, issues often arise with downhole-actuated completion equipment, such as SCSSVs and ICVs, due to scale deposits on critical components. These deposits hinder the valves from closing or opening on demand, necessitating regular function tests (typically every 3 to 6 months) to ensure that the scale buildup does not impede valve functionality. For hydraulically actuated valves, this involves fully cycling the valves, resulting in production shutdown. Moreover, reopening the SCSSV typically requires pumping a significant amount of MEG into the tubing to equalize pressure across the SCSSV flapper, typically resulting in 2 t of CO_2e emissions equivalent per well every 6 months. Over a 20-year field life, this translates into 80 t of CO_2 emissions per well. In the worst case, through-tubing intervention may be needed to remove deposits, with a monohull light well intervention vessel (LWIV) emitting an average of 45 t CO_2/day. Assuming a 7-day intervention duration per well, this translates to 315 t of CO_2 emissions per well intervention.

In contrast, downhole electric valves, because they are electrically actuated, can be programmed to allow regular small movements of the flow tube or sleeve without fully actuating the valves. This prevents significant scale deposition, eliminating the need for frequent regular valve function tests and thereby reducing the previously explained emissions.

Conclusions

In summary, the technical benefits outlined underscore the transformative impact of all-electric completion systems on well operations, from increased flexibility in well design to simplified installation processes, enhanced design adaptability, improved safety aspects, and precise and efficient control over flow and chemical injection operations.

The successful deployment of over 100 electric flow control valves over the past decade attests to the reliability and viability of this technology in routine well applications. As the industry continues to develop these services, electrification of completions stands as a proven and promising solution for optimizing oil and gas production. The technical innovations and operational advantages of all-electric completions not only enhance efficiency and reduce costs but also play a pivotal role in advancing the industry's commitment to environmental sustainability by minimizing carbon emissions and resource consumption throughout the entire life cycle of oil and gas production.

Road to Well Completions Electrification ... continued

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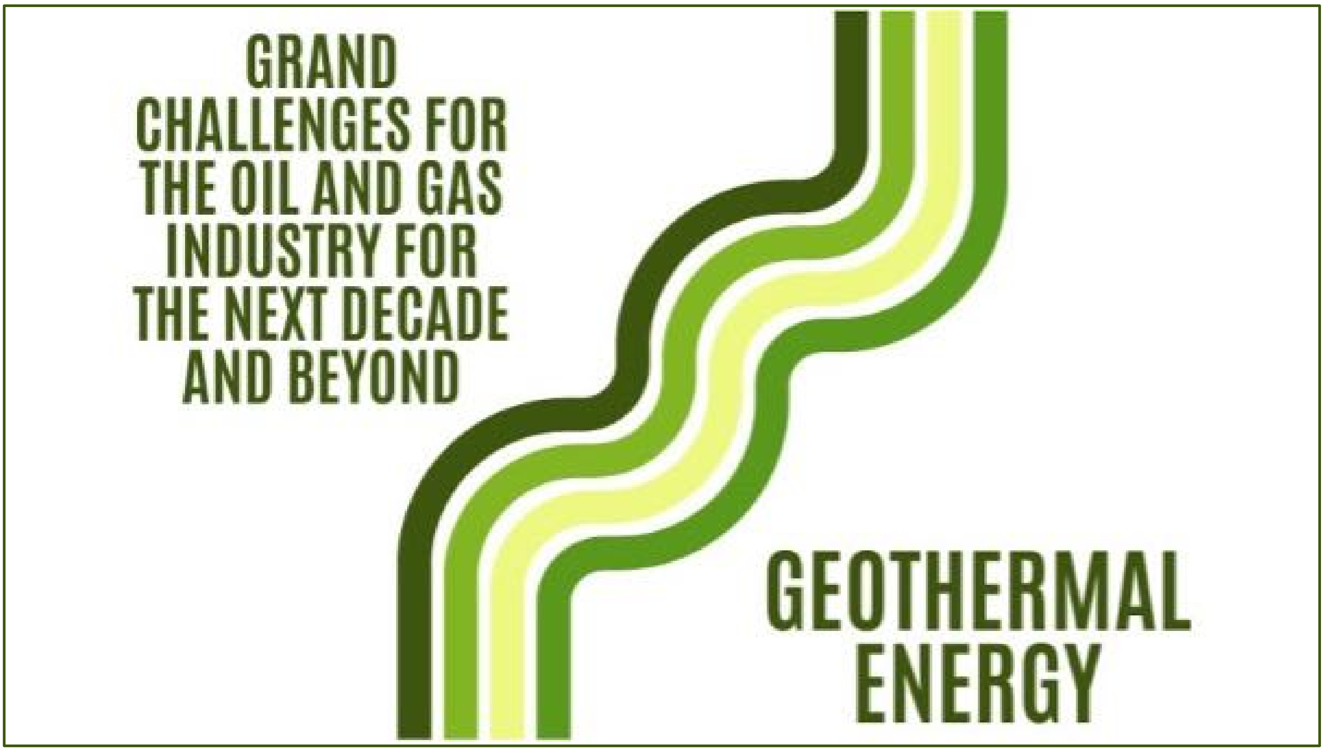
SPE Grand Challenge Update on Geothermal Energy

The challenges that geothermal energy faces to become a leading player in the net-zero world are well within the areas of expertise of the SPE community, ranging from rapid technology implementation and learning-by-doing to assure competitiveness to establishing suitable funding mechanisms to secure access to capital.

Originally published April 01, 2024 in the Journal of Petroleum Technology. Authors: Jeffrey R. Bailey, Taylor Mattie, Tim Lines, and Daniel Merino-Garcia.



This is the first of a series of six articles on SPE's Grand Challenges in Energy, formulated as the output of a 2023 workshop held by the SPE Research and Development Technical Section in Austin, Texas.

Described in a JPT article last year, each of the challenges will be discussed separately in this series: geothermal energy; improving recovery from tight/shale resources; net-zero operations; carbon capture, storage, and utilization; digital transformation; and education and advocacy.

SPE identified five technical "Grand Challenges" in 2023 which, if successfully developed, could advance the interests of the SPE community in a net-zero world and help ensure our longevity and contributions to a prosperous future (Halsey et al. 2023).

Access to the subsurface is a key skillset of the SPE community, including geology and geophysics, well construction and completion, reservoir engineering, production operations, and facilities. The challenges that geothermal energy faces to become a leading player in the net-zero world are well within the areas of expertise of the SPE community. These challenges include rapid technology implementation, learning-by-doing to ensure competitiveness, and establishing suitable funding mechanisms to secure access to capital.

The increasing presence of geothermal-related sessions in SPE workshops and conferences shows the interest to explore novel methods to harness geothermal energy for power supply, thermal-use applications, and energy storage, illustrated by the threefold increase in OnePetro references since 2020 **(Fig. 1).**

SPE Grand Challenge Update on Geothermal Energy... continued

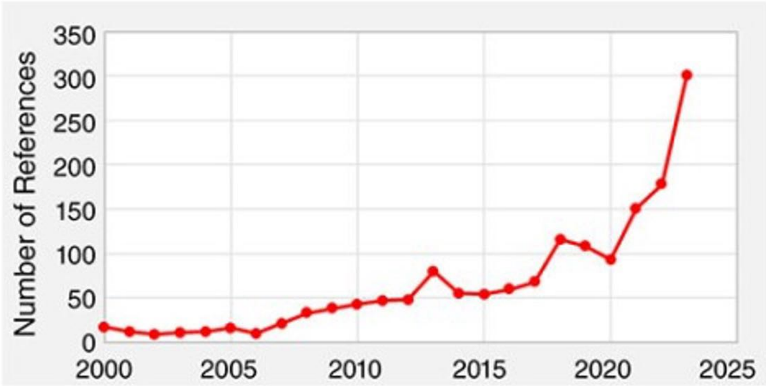


Fig. 1. Number of references to 'geothermal energy'. *Source: OnePetro*.

The Role of the Oil and Gas Industry

Geothermal energy offers a path forward using business models that are well-suited to the oil and gas industry, which can apply its current technology and expertise to produce clean, reliable power and thermal energy at scale. Geothermal is also the only baseload renewable energy source that produces heat, presenting an avenue to mitigate the largest contribution humanity makes to carbon emissions: heating and cooling which account for 40% of all carbon emissions globally (Lund and Toth 2021).

Table 1 presents some of the current applications.

Industry	Installed Geothermal Capacity (MWth)	Top 5 Countries in Rank Order
Space heating (32 countries)	12,768	Turkey, Japan, Russia, USA, Switzerland
Greenhouse (32 countries)	2,459	Turkey, China, Netherlands, Russia, Hungary
Aquaculture (21 countries)	988	China, USA, Iceland, Italy, Israel
Industrial process heat (14 countries)	852	China, New Zealand, Iceland, Russia, Hungary
Agricultural crop drying (15 countries)	257	China, France, Hungary, USA, Japan
TOTAL	**17,324 MWth**	

Table 1. Global installed geothermal heat capacity by economic activity (excludes ground-source heat pumps). *Source: Derived from Lund and Toth 2021*

In 2023, the Energy Institute of The University of Texas at Austin released a comprehensive report, “The Future of Geothermal in Texas,” led by Project InnerSpace (Beard and Jones 2023). The report presented a challenge to leverage the technical capabilities and resources in the state.

It estimated that “should the industry drill 15,000 geothermal wells each year for four years, it would provide the energy equivalent of all oil and gas used for electricity and heat production in the State today, including

SPE Grand Challenge Update on Geothermal Energy... continued

industrial heat." This initiative is part of a broader movement in Texas, the spiritual home of the US fossil fuel industry, where a new geothermal energy ecosystem is emerging with veterans of the oil and gas business playing pivotal roles.

Geothermal energy cannot only help to reduce the state's emissions but also through its baseload and energy storage capabilities, it can support a power grid that has struggled to cope with severe weather events as demand has grown. Texas serves as a prime example of a location deeply tied to fossil fuels, where numerous oil and gas developers are announcing plans for geothermal expansion. This trend is not confined to Texas alone; similar developments are underway in other US states, Europe, the Middle East, and the Far East.

Moreover, there are synergies between the production of hydrocarbons and the production of hot water for energy. The basic drilling technologies that grant access to these resources are fundamentally similar, although geothermal drilling costs are high, and the technology and tools face challenges posed by hard rocks and extreme temperatures. Current commercial geothermal wells necessitate circulating large volumes of fluid due to the lower energy density relative to hydrocarbons.

For traditional hydrothermal projects, the key requirement is the presence of an in-situ aquifer and artesian production whereby fluid pressure moves the fluid from the subsurface to the surface. However, these systems occur in limited geographic regions.

Next-generation concepts are appearing to overcome the need to find a subsurface aquifer and facilitate scalability. In enhanced geothermal systems (EGS), permeability is artificially created in hot, dry rock with the use of hydraulic fracturing, drawing upon shale and tight-reservoir oil and gas technologies. This cross-disciplinary approach highlights the potential for innovative solutions in both conventional and renewable energy sectors.

In advanced geothermal systems (AGS), closed-loop circulation of fluid is achieved in the subsurface without flow exchange between the wellbore and reservoir. Fluid is pumped down from the surface, picks up heat from the surrounding formation via conduction and, in some technologies, localized convection, and returns to surface in the same wellbore.

Recent Breakthroughs

Since the publication of the SPE Grand Challenges last year, significant milestones across multiple facets of the geothermal industry have been achieved to show that "cross-pollination" between oil and gas and geothermal technologies are advancing the learning curve to provide a competitive solution.

US Department of Energy (DOE)/University of Utah FORGE Project

DOE funded a technology development and demonstration effort focused on a field test site in Milford, Utah. FORGE, the Frontier Observatory for Research in Geothermal Energy, is offset a few miles from the conventional Blundell Power Plant that accesses the Roosevelt Hydrothermal System. DOE budgeted $220 million for this multiyear EGS system test and for the development of associated technology, with a possible $135 million extension beyond 2025 (McKitrick 2022).

In June 2023, the Utah FORGE geothermal research project achieved a breakthrough with confirmed connectivity between an injection/production well "doublet" system that is inclined at 65°. Initial tests involving the injection and recovery of 1,800 bbl of water showed promising results, with further assessments needed for commercial viability (O'Donoghue 2023). Data analysis confirmed flow connectivity, and seismic monitoring indicated minimal seismic activity.

Fervo Energy

Fervo demonstrated a fine example of applying oil and gas technology to EGS with a successful horizontal pair EGS doublet flow test at the Blue Mountain, Nevada, test site (Cariaga 2023). Later in 2023, Fervo announced

SPE Grand Challenge Update on Geothermal Energy... continued

the Cape Station project in Utah, offset from FORGE, to deliver up to 400 MW capacity in 29 wells (Jacobs 2023).In February 2024, they reported drilling success, surpassing DOE expectations for EGS. “Drilling time accounts for over 75% of total well cost, and through eight horizontal wells, a 60% reduction in drilling time has been realized” (El Sadi et al. 2024).Fervo attributed its success to improved dysfunction mitigation, increased rates of penetration, and extended drill-bit life using polycrystalline diamond compact (PDC) drill bits typically used in shale basins.

Sage Geosystems

In September 2023, Sage published results from a pilot that demonstrated the ability to provide 18 hours or more of electricity storage capacity for continuous baseload energy when coupled with solar or wind generation. The pilot generated 200 kW for over 18 hours and 1 MW for 30 minutes. Sage’s energy storage technology proved cost-competitive with lithium-ion batteries, pumped storage hydropower, and natural gas peaking plants, making it a promising clean energy solution for enhancing grid reliability. Their novel energy storage system uses deep induced fractures to provide pressure and storage volume in a cyclic process based on “ballooning” fractures (Jacobs 2023). In February 2024, Chesapeake announced a $17 million investment to evaluate the Sage energy storage process in Texas (Jacobs 2024).

Eavor

In March 2023, Eavor completed construction of its AGS demonstration project in New Mexico, with a directional well system reaching a depth of 18,000 ft. This leveraged advanced directional drilling technology adapted from oil and gas to construct horizontal well sections with the final objective being a closed-loop system resembling a radiator. This demonstration occurred in parallel with additional projects underway in Europe and Asia. A performance increase in drilling was observed with the implementation of proprietary technology and use of insulated drillpipe (Cariaga 2023).

Project InnerSpace

In December of 2023, Project InnerSpace announced the beta launch of GeoMap, a freely accessible geothermal exploration tool developed in partnership with Google (geomap.projectinnerspace.org). The tool aims to showcase untapped geothermal potential in regions with limited energy data access, addressing the need for cleaner energy sources. Development plans include the release of additional continents and high-resolution case studies, aimimg to cover all continents and the world’s top 100 population centers by 2025.

Technical Challenges

A key uncertainty regarding geothermal resources concerns forecasting both the flow rate and the temperature of the produced water. The temperature and/or reservoir pressure in a geothermal project may decline over time as replenishing heat needs to travel greater distances to the wellbores. EGS requires the fracturing of hot, dry rock to create flow conduits between cold water injectors and hot water producers, with some seismicity risk. By contrast, AGS does not require hydraulic fracturing, and therefore it has fewer social license risks. However, the lower surface area in contact with the rock requires a higher temperature drop for heat flow, leading to an overall increase in the levelized cost of electricity (LCOE) for a given initial reservoir temperature.

Low flow rate risk may be mitigated with increased deployment scale. Most EGS pilot system demonstrations have been designed as doublets with one injector and one producer. There is risk that injected fluid is not produced but flows elsewhere. Both FORGE and Fervo’s Nevada test systems have offset distances of about 300–400 ft between injector and producer. Close spacings assure more fluid communication, but if larger spacings are proven feasible, multiple injection wells could flow fluid to multiple producers, reducing fluid loss and short-circuit risks and increasing the volume of hot rock contributing to the system.

Deeper and larger geothermal wells are costly and a challenge to investment hurdle criteria. Oil and gas experience with novel financing mechanisms, connection to external capital pools, and cost-reducing technology development could all reduce barriers to funding geothermal development. Disclosed investments

SPE Grand Challenge Update on Geothermal Energy... continued

into geothermal startups are nearly $1,500 million for the 2014–2023 period, with more than 80% of the total occurring in the past 3 years **(Fig. 2).**

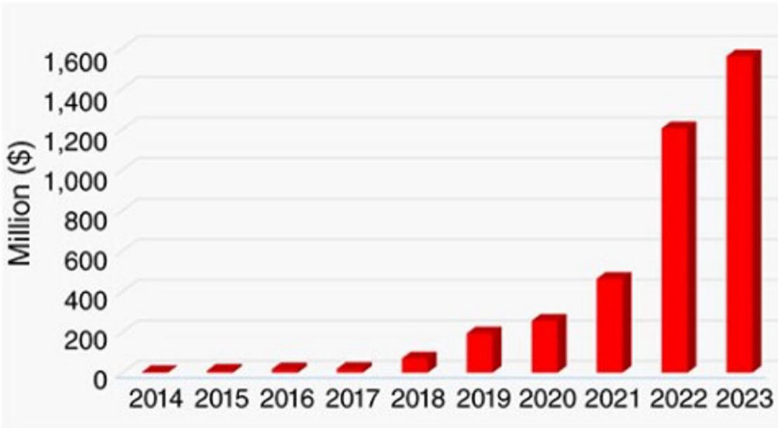


Fig. 2—Venture capital investment for geothermal startups since 2014. *Source: Lavine 2024*

Locating geothermal projects adjacent to mothballed power generators may also offer some economic protection, with the substantial benefit that a local grid connection may already exist. Co-location of geothermal projects near other energy transition projects, such as carbon capture, utilization, and storage (CCUS) or green hydrogen generation, bring additional synergies in supplementing or fully supplying those processes with baseload renewable energy.

Ownership rights to geothermal heat are inconsistent or ill-defined across much of the world. Clarification of ownership must precede investment. Texas enacted new laws in 2023 that bestowed ownership of geothermal energy to the landowner or the owner of the surface estate of the land (Boschee 2023).This model might have wider applicability in North America and other jurisdictions.

The Way Forward

As mentioned above, the 2023 UT-Austin report ended on a provocative note: Divert some fraction of the thousands of wells drilled in Texas each year to geothermal energy development, and in this decade, there could be a significant shift to lower CO_2 emissions from the power sector, with potentially attractive economics.The opportunities for geothermal energy to provide direct thermal use energy and electric power are present and growing. Great progress has been made in just a few years, and the pace is accelerating. The oil and gas industry can provide many of the needed skills and resources to help make this happen. Investors, consumers, and governments can impact the market in ways that better reward oil and gas firm investments in geothermal via risk-sharing financial models, tax incentives, feed-in tariffs, and more. The collaboration of the oil and gas industry, with their infrastructure, technology, and workforce, will support the uptake of geothermal energy in the pivot to cleaner energy.

For Further Reading

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Utah FORGE: New Renewable Energy Project in the Middle of Nowhere in Utah to Benefit the Entire World*by Cathy McKitrick,* Utah Stories 2022.

SPE Grand Challenge Update on Geothermal Energy... continued

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Fervo Energy Launches First Phase of 400-MW Geothermal Project in Utah *by Trent Jacobs,* JPT 2023.
SGP-TR-227 Review of Drilling Performance in a Horizontal EGS Development*by K. El Sadi, B. Gierke, E. Howard, and C, Gradl,* Proceedings 49th Workshop on Reservoir Engineering, Stanford University, 2024.
Is Hydraulic Fracturing the Next Big Breakthrough in Battery Tech? *by Trent Jacobs,* JPT 2023.
Chesapeake Leads $17 Million Investment To Build Geopressured Battery *by Trent Jacobs,* JPT 2024.
Eavor Completes Eavor-Deep Geothermal Demonstration Project *by Carlo Cariaga, ThinkGeoEnergy.com 2023.*
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The Big Deal: XGS Continues Wave of Investment for Geothermal Startups *by Robert Lavine,* Global Corporate Venturing 2024.
Who Holds the Rights to Geothermal Heat Sources?*by Pam Boschee,* JPT 2023.

Jeffrey R. Bailey retired in 2022 after 36 years working for major oil and gas companies in the areas of drilling, subsurface technology, and related computational modeling of dynamic processes. He holds undergraduate degrees in physics and economics from Stanford University and graduate degrees in mechanical engineering and technology policy from the Massachusetts Institute of Technology. He is the author or coauthor of more than 60 technical articles and patents.

Taylor Mattie, director of technology transfer and deployment, Project InnerSpace, has 8 years of experience in the energy industry. He previously worked as director of geothermal strategy and growth at Baker Hughes. Mattie is obsessed with geothermal energy and figuring out ways to scale its potential to global availability, which has led to articles in various publications. He holds a BS in petroleum and natural gas engineering from Penn State University and a master of energy from the University of Auckland.

Tim Lines, consultant, Project InnerSpace, and CEO of Texas developer Geothermal Wells LLC. He has 40 years' experience in upstream oil and gas, geothermal energy, power generation, and district heating. He co-founded Oilfield International, an energy consultancy; served on the boards of UK, Thailand, and Cyprus energy companies, controlling 1.2 billion bbl of oil reserves; and led a legislative team drafting regulatory and tariff frameworks for district heating and central heating plants for central and eastern Europe countries. Lines authored Chapter 7 of "The Future of Geothermal in Texas," The University of Texas at Austin, January 2023, and on behalf of SPE collaborated on the winning Project InnerSpace/SPE/Geothermal Rising tender submission for the $165 million US Department of Energy GEODE grant, "Geothermal Energy from Oil and Gas Demonstrated Engineering."

Daniel Merino-Garcia, Project InnerSpace, moved from the oil and gas industry into the geothermal energy sector in 2023 after 20 years working for European oil and gas companies in research and technology development in the areas of production engineering, flow assurance, and fluid characterization. He has authored or coauthored more than 40 technical articles. Merino-Garcia holds a graduate degree in chemical engineering from Valladolid University (Spain) and a doctorate in petroleum engineering from the Technical University of Denmark.

SPE events calendar – local and international

LOCAL – UK

September 25, 2024 (London, England)
Tech Talk: Asia-Pacific – A Review of E&P Activities and Opportunities
SPE London continues its series of TechTalks in September, with speaker Ian Cross, Managing Director, Moyes & Co, London.
Ian is also President of South East Asia Petroleum Exploration Society (SEAPEX), Chairman of the SEAPEX 2019 and 2023 Conferences in Singapore, and joint PESGB/SEAPEX Asia-Pacific in 2018 and 2023 Conferences in London.
To book tickets, and get more information:
SPE London Tech Talk

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

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.
More information: **SPE conference**

September 17-18, 2024 (Rio de Janeiro, Brazil)
IADC/ SPE Managed Pressure Drilling & Underbalanced Operations Conference and Exhibition
DGD is a reality with numerous wells drilled, and many exciting prospects on the horizon. New applications of these drilling practices take place every year, and their frequency continues to grow. This conference is a world recognized forum to help the energy industry better understand the technology and the effective, safe utilization of the various applications of UBD, MPD and DGD.
More information: **IADC/ SPE conference**

September 23-35, 2024 (New Orleans, USA)
SPE Annual Technical Conference and Exhibition
'Celebrating out past, powering our future'
Through an insightful discussion, we aim to provide a comprehensive understanding of the past, present, and future of innovation within the Oil & Gas industry, inspiring a new era of energy professionals committed to shaping a resilient and sustainable energy landscape.
Join us for ATCE 2024 and be part of this historic event. Experience the excitement, entertainment, and networking opportunities.
More information: **SPE ATCE 2024**

October 15-17, 2024 (Perth, Australia)
APOGCE 2024
The energy industry is undergoing a significant transformation, with a strong focus on moving towards a net-zero future.
As we navigate this transition, it is crucial to discuss and explore strategies that address the energy trilemma.
APOGCE 2024 aims to provide a comprehensive platform for industry leaders and experts to share insights, best practices, and innovative solutions to achieve these goals.
More information: **SPE APOGCE 2024**

For a complete listing of all events on the SPE Global Events Calendar: spe.org/en/events/calendar/
And, for more information about SPE training courses, calls for papers, and opportunities for sponsorship: sponsorship.spe.org/en/events/about-events/

Meet the SPE London Board

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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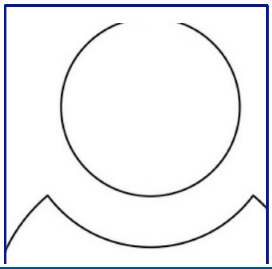
Digital Transformation Chair: TBD

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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