



National Young
Professionals
Committee

وزارة الطاقة والمعادن
Ministry of Energy and Minerals



Spark

by NYP^{Edition III}
Competitive Energy





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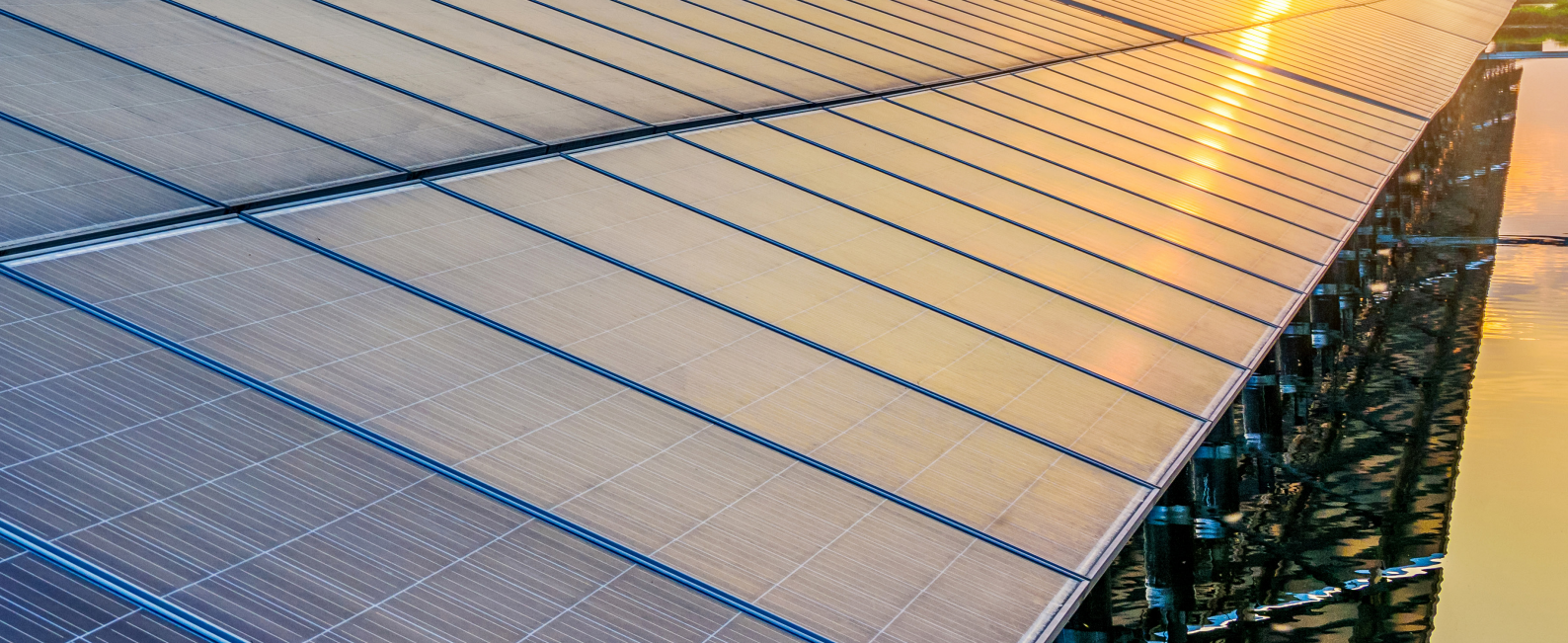
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Editorial Message

Dear Readers,

Welcome to the Third Edition of Spark by NYP Magazine!

Welcome to the third edition of spark by NYP Magazine, where we aim to ignite meaningful conversations and inspire action among young professionals in the energy sector. We are excited to present a diverse collection of articles that explore the dynamic and competitive world of energy. This edition includes insights from valuable experiences shared by industry experts in Pearls of Wisdom, and significant accomplishments celebrated in Notable Achievements. The Technical Cases section provides in-depth knowledge on solving complex industry challenges, while the Non-Technical Articles highlight essential skills for energy transitions. Our Industry Spotlight sheds light on trends, future opportunities, and sustainable practices. We close with perspectives from young professionals, encouraging dialogue on how they can play a more active role in shaping the energy sector to support our country's success and exploring the transformative impact of advanced technologies like AI and machine learning on Oman's energy outlook. Each article is crafted to equip you with the insights and inspiration needed to thrive in the energy landscape and contribute to a sustainable future.

We extend our heartfelt thanks to all contributors who made this edition possible, including the industry experts, young professionals, and editorial team whose dedication and hard work have enriched this magazine with valuable insights and perspectives and to you, our readers, for your continued support and engagement.

As you read this edition of NYP Magazine, ask yourself what you want to see and read. If you find what you're looking for, then we've succeeded. If not, this is your chance to contribute you could be the next member of the editorial team! Thank you for joining us for this third edition of Spark by NYP Magazine. We hope you enjoy reading it as much as we enjoyed putting it together.

Dr. Intisar Al Busaidi

Lecturer at University of Technology and Applied Sciences
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About NYP

The National Young Professionals (NYP) Committee is a professional platform that operates under the auspices of the Ministry of Energy and Minerals of Oman and is chaired by the Ministry Undersecretary (MEM HEUS). The Committee was officially launched in October 2018 and is dedicated for the young professionals working in the energy and minerals industry and students of disciplines that serves the industry.

The Committee provides a platform for knowledge sharing and networking with peers and local, regional or global emerging leaders. Whereby it aims to add value for its members through involving them in various planned activities. Through the different activities, it seeks to create synergy between all stakeholders, promote best practices and excellence in tasks delivery to accelerate experience gaining and essential soft skills mastering.

Vision

To empower the young professionals of Oman's Energy Sector by fostering skills development, driving innovation, promoting sustainability, and enhancing leadership capabilities, in alignment with Oman Vision 2040. For their voices to be heard and their perspective to help shaping Oman future.

NYP Pillars

Develop the skilled Young Professional that will employ for sector prosperity,

Drive for sustainability, promote renewable energy and research and development in the sector,

Promote Young Professionals innovation and entrepreneurship in the sector and

Engage young professionals in community service projects related to the sector.



Launch Event, 2018

Opening Remarks

His Excellency

Mohsin bin Hamad Al Hadhrami

The Undersecretary of Ministry
of Energy and Minerals



The energy industry stands at the threshold of transformation, where unprecedented challenges are met however, with equally bold opportunities. As we commit to a sustainable future, decarbonization has become a non-negotiable pillar of our growth strategy. This ambition demands more than incremental change; elevating renewable energy's role within our energy mix and systematically driving down the carbon footprint of hydrocarbon production and related processes. We are investing in a cleaner, smarter energy sector equipped with advanced technologies where progress and sustainability work hand in hand.

In the Sultanate of Oman, our confidence and count in youth role is resolute. We recognize that the future of energy will be shaped by the hard work, innovation and unique perspectives of the young professionals. The young leaders, students and industry professionals alike, are not just participants however a powerful catalysts in Oman's journey toward energy resilience and economic vitality.

In the light of the above, we proudly present the third edition of Spark by NYP, a magazine dedicated to present the accomplishments, technical expertise, and transformative vision of Oman's young professionals in energy. This edition celebrates the youth pivotal role in advancing a dynamic and sustainable energy future, showcasing their contributions as integral to a sector committed to both growth and responsible stewardship.



Pearls of Wisdom

Dr. Sultan Al Shidhani
Former Petroleum Engineering
Function Director (PDO)



■ A Journey of Growth

Balancing Career, Education, and Community Engagement

I was fortunate to grow up in a local Omani village (community), where I combined school learning with undertaking some family duties. After completing school, I joined colleges in Canada and the USA to graduate with a bachelor's degree in electrical engineering. Then, I joined PDO as a petroleum engineer and had the excellent opportunity to work in the field and various asset teams, including cross-posting in Brunei. During my 35 years of work adventure in the oil and gas industry, I have held various technical management roles and was involved in several continuous improvement initiatives and programs. Along with the formal work duties, I was heavily involved in community work, actively participating in professional organizations, and preparing and participating in many technical and business forums as a speaker or moderator. Additionally, I had a strong personal drive to continue my graduate studies as a part-timer, where I obtained my Master's and Doctoral degrees in Business management. These vast and diverse experiences, I believe, helped me shape my leadership style and approach to life, how to engage with people, and gave me a clear sense of purpose and meaning in doing my work, continued self-development, and community duties.

■ Evolving Energy Landscapes

Balancing Tradition and Transition

Energy is essential for living; therefore, humans have searched for it and developed its resources from early times. Wood and extracted oils were early energy resources used for cooking and illuminating. Then, naturally occurring forms, such as coal and petroleum oil, leaked from the earth were discovered and utilized. Renewable energy, such as wind and sun rays, was utilized for sailing ships, lifting water, and drying substances, though then were not considered energy resources. Coal and, later, subsurface petroleum resources were extracted to fuel the Industrial Revolution. The need for energy has increased significantly, enabling the expansion of industrial and urban development and advancing modern lifestyles. This led to expanding global and technological efforts to discover, develop, and utilize oil and gas resources, which became the primary energy resource. The increased and wide use of fossil fuels (coal, oil, and gas) resulted in increased greenhouse gas (GHG) emissions to the atmosphere, raising significant concerns about its adverse effects on the environment and the bio-ecosystems. Hence, calls are rising to reduce reliance on fossil fuels and to invest in cleaner, renewable energy, leading to a strong emergence of renewable and low-carbon-emitting energies. However, the need for affordable, sustainable, and accessible energy resources has brought a sense of reality regarding the continued high dependence on fossil fuels and rising preferences for renewable and cleaner energy. The energy landscape is taking shape gradually and in a manageable transition into a low-carbon and cleaner energy mix. The petroleum energy industry has responded adequately to this dilemma by investing heavily in decarbonizing its extraction and processing operations. These efforts were further enhanced and supported by significant progress in clean energy development, particularly renewable energy and green hydrogen.

■ The Role of Oil and Gas in a Gradual Energy Transition

Oil and gas will remain to provide the most reliable, affordable, and accessible energy resources during a long-term energy transition while alternative energies are being developed and matured. The focus will be on achieving an optimum and environmentally acceptable energy mix rather than a total and abrupt shift from oil and gas to renewable energies. With its capacity and capabilities, the oil and gas industry is the most able to lead in responding to the energy mix and transition challenges by providing the required significant investments and development efforts. The energy transition must be a gradual evolution with the pace defined by the time needed to achieve maturity, availability, and affordability of renewable energies which is expected to take longer time and significant technological development.

■ **Harnessing Digital Transformation**

Shaping the Future of the Energy Sector

The energy sector is at the forefront of deploying evolving technologies and in dealing with mega-big data. Hence, it is well suited to leverage advances in data analytics and digital technologies throughout its end-to-end workstreams, from evaluation to development and operational phases. Data analytics and digital solutions spanning from the use of artificial intelligence to robotics and automation will provide efficient energy use and effective operations on the one hand and provide more transparency to stakeholders about the efforts the industry is undertaking to combat GHG emissions and environmental impact on the other hand. Hence, re-establishing governments, communities, and all stakeholders' trust in the sector's efforts. This will enable working together to address the world's emerging environmental and developmental challenges.

■ **Balancing Environmental Protection and Energy Security Through Effective Policies**

Policy and regulations play a significant role in protecting the environment and ensuring energy security, both needed to enhance people's living conditions. Addressing environmental imperatives will require sustained and well-considered efforts, not a reactive ill-informed response to pressures from interest groups. The dilemma facing policymakers is how to make the balance between addressing environmental concerns and ensuring energy security. Policies should encourage and support the development of affordable and accessible clean energies and manage the transition phase in the least harmful way. Experts and informed specialists can assist in educating the public and informing policymakers.

■ **Advice for Young Professionals**

My advice is to learn in the flow of work, learn by doing, and not shy away from experimenting and trying new things. You need to balance competing things you undertake, e.g. technical and non-technical competencies, self-drive and teamwork, leaderful behaviours and servant leadership approach, and having a strong drive while being patient and considerate. Life and the workplace are the most impactful learning platforms, supplemented by reading and learning from others' experiences and not copying them. Develop your style and approach that differentiates you and enhances your contributions. Finally, do not hesitate to change your course if you believe there is a growth for you, though the energy sector will remain to be a major and essential sector in the modern age.

■ **Building Skills for the Future**

Enhancing Technical and Soft Competencies in the Oil and Gas Industry

The oil and gas industry is highly specialized, requiring various technical, commercial, environmental, and stakeholder management skills and competencies. Traditionally, there has been too much focus on developing technical competencies and deploying technologies and less on engagement skills and understanding the socio-economic imperatives. However, the landscape has changed significantly, with the public and governmental officials paying closer attention to the industry's response to the environmental and economic challenges. Hence, there is a pressing need to enhance the industry's capacity and capabilities to deal with the evolving technical competencies and the much-required soft skills needed to engage the public, policymakers, and broad stakeholders' base more effectively. It is critical to enable working professionals and new joiners to enhance further their technical and non-technical skills, experiences, and expertise. Industry leaders and professionals need to step up their dialogue with governments and societies and effectively utilize new media platforms to bring clear messages of the industry's efforts and contributions.

■ **Transforming the Energy Sector**

Building Trust and Driving Sustainability

The energy sector is undergoing an unprecedented and existential transformation. The initial industry response is encouraging: the industry realizes the need to transform and re-establish the trust of governments and societies by taking transformational and visible steps to combat climate change. Also, the industry is moving closer to society and taking up its socioeconomic responsibilities very seriously while continuing to drive technological advancements and improve the quality of life for its broad stakeholders. I am optimistic about the ongoing transformation of the energy industry and its role in leading the required transformation toward ensuring affordable, clean, and sustainable energy and its main contribution to the betterment of the world economy and development.

Dr. Mohammed Al Kindi
Founder & CEO of Erath Sciences



I completed a bachelor's degree in science at the University of Aberdeen, located in the northern part of the United Kingdom, where I studied Physics and Geology from 1999 to 2003. Aberdeen is renowned as a centre for petroleum operations, hosting numerous companies working in the North Sea. During my time there, I met many expatriates, including those from Oman, who mostly worked for short periods in these companies. The faculty members teaching Petroleum Geology at Aberdeen had extensive experience in various aspects of geology, and some topics we studied inspired me to pursue postgraduate studies. During my undergraduate studies, I maintained very good communication with our sponsor, Petroleum Development Oman (PDO), particularly its training centre and exploration department. PDO is an excellent place to grow knowledge and envision the future. They supported my decision to continue my studies in petroleum geology. When I chose the University of Leeds for my PhD, I agreed with my supervisors that the Salakh Arch, which forms the southern limit of the Oman Mountains, would be an ideal place to study the prediction of fracture patterns in fold and thrust belts and extrapolate that to the petroleum fields. I completed my PhD in 2006 after analysing the structural evolution and fracture pattern of the arch and correlating it to the adjacent petroleum fields.

I began working at PDO at the end of 2006. Immediately after returning to Oman, I wanted to serve as a committee member of the Geological Society of Oman (GSO). GSO is the hub for earth scientists in Oman to share knowledge and exchange ideas. The lectures and field trips conducted by GSO provide amazing opportunities to learn many applied aspects of earth sciences in different industries. It encourages both young scientists and experts to conduct research in the

country. I later became the executive director of the society, and between 2013 and 2015, I served as the president. Serving on GSO's board committee allowed me to meet officials in the country and gain a better understanding of Oman's energy vision for the future. I realised that there excessive of opportunities in this country for research and consultancy. In 2014, I decided to leave my job and become an independent consultant. It was not an easy decision for someone in their early thirties, but I was confident about moving forward. I wanted to pursue my own interests and have full control over my time. However, the end of 2014 was also when oil prices began to plummet. Tough luck! It seemed I had picked the wrong time to leave my job. I started working in mid-2015 as a subconsultant for Vision Advanced Petroleum Solutions (VAPS). In 2015 and 2016, we all began to feel the pressure wave of difficulties. But every challenge presents an opportunity, and it was no different for me. I decided to step outside my comfort zone and explore other industries. In 2016, I established the Earth Sciences Consultancy Centre (ESCC). The idea behind the ESCC was to enable me to earn income through consultancy while also supporting my passion for research and development projects in earth sciences. My vision was to make it a hub for geoscientists to conduct research in Oman.

A Journey of Innovation & Leadership in Earth Sciences

Embracing Change

Pursuing Passion and Opportunities in Oman's Evolving Energy Landscape

First and foremost, I wanted to control my own time and decide what I want to do each day, month, and year. I wanted to follow my passion and pursue what I found meaningful. After working at PDO and completing my voluntary assignment on the GSO committee, I also recognized the opportunities hidden within Oman's energy and mineral sectors. In my early thirties, in 2014, it was not easy to leave my "very good" job, especially since I had no other source of income and oil prices were starting to collapse. However, Oman is a country full of opportunities. If one path does not work out, another will. You just need to keep exploring and thinking, and never give up. Today, it is the wave of petroleum; tomorrow, it will be mining; and the day after, it will be renewables. God knows what is next. You need to be prepared for the future so that you can seize opportunities when they arise. I believe that is the key. Your inspiration ignites your energy and that is essential to venturing into the future and create a lasting success. You need to remember to do that while enjoying your time and not "over" stressing yourself and messing up priorities.

Passion in Practice

Advancing Geoscience and Energy Innovations in Oman

I am not sure I ever intended to do any of that. I just wanted to follow my passion: doing fieldwork, studying rocks, integrating data from both the surface and subsurface, and making sense of it all. Hopefully, this leads to something new or worthwhile. We must remain persistently positive and continue exploring. There is always something new to discover and opportunities to be found. You just need to focus on the basics and not worry too much; the rest will follow. Through the ESCC, I believe we have contributed significantly to various industries in Oman. In the petroleum sector, we have collaborated with clients to develop new approaches and enhance existing methods for field development plans (FDP) and appraisal studies. We also worked to add new reserves of both oil and gas while working with VAPS for different clients in Oman and abroad. In the mining sector, we have worked with nearly all commodities in the country, discovering and allocating new resources for several of them. We also identified new sites and previously unknown commodities. One of our proudest achievements is the development of the Mining Development Program (MDP). This unique

initiative was designed for the staff of the Ministry of Energy and Minerals (MEM) and several mining companies, including Minerals Development Oman (MDO) and Oman Chromite Company (OCC). The program lasted for two years and consisted of nine modules, each lasting one week. Participants attended courses in geology, geophysics, mining engineering, feasibility studies, innovation, and HSE. The program included several case studies of minerals in Oman and the region. Participants also visited nearby countries to learn more about the mining industry and potential integrations.

In the hydrogen sector, we recently completed a study assessing potential hydrogen storage sites in Oman and are concurrently investigating the potential of geological (white) hydrogen. With God's will, we will continue working with the MEM and Hydrogen Oman (Hydrom) to develop hydrogen resources in the country. Additionally, through our partner VAPS, we conducted a comprehensive study for PDO on screening potential carbon storage and utilization sites. In geotourism, we have uncovered numerous sites of scientific interest and adventure potential in Oman, including caves, fossil sites, unique geological features, and more. These included dinosaur fossil specimens, petrified wood from various geological eras, fossils of primitive elephants and other mammals, amazing previously undiscovered caves in different parts of Oman, areas where amazing rock sequences, faults, folds and fractures are well exposed. We have also published a several papers and books about the geology of Oman and its unique sites.

White Hydrogen

Unlocking Oman's Potential in Clean Energy

White hydrogen, also known as geologic hydrogen, is generating significant buzz in the energy world today some White hydrogen (or geologic hydrogen) is a hype today in the world. Some also like to call it Gold Hydrogen. We know that we have an opportunity in Oman in geologic hydrogen, but we still do not know the size of this opportunity and its economic viability. There are a few sites that we currently study for the potential of geologic hydrogen and we continuously update the MEM about our progress in the topic. In simple terms geologic hydrogen is naturally occurring in the subsurface. Some resources of it are oozed to the surface through fault zones, vents or between the rock layers. It is a clean and cheap energy source, emitting no carbon dioxide when used.

Among the hurdles to making white hydrogen a commercially viable energy source are the size of resources, the cost of extraction and production, infrastructure development, and public acceptance. Overcoming these challenges will require coordinated efforts from the Ministry of Energy and Minerals, interested investors, and researchers to drive innovation, reduce costs, and build the necessary infrastructure for white hydrogen to become a mainstream energy source.

Thank you

NYP Board 2018-2024



■ **Alaa Al Zarafi**
Former President
Digital Integration Services Engineer, SLB

The mission of the NYP Committee is to promote a culture of innovation, sustainability, career development, diversity & inclusion, environmental awareness and future leadership. The empowering of the young workforce is crucial for any country as it is proven to be the key driver for resources security, economic growth, and most importantly social development by fostering the sense of responsibility and community involvement. Our country has an ambitious plan to position itself as a competitive player on the regional and global stage and we can only do that by developing strong technical foundation and master the fundamentals of the domains we are working in, develop soft skills, embrace lifelong learning in emerging areas and be adaptable in a dynamic and multifaced industry. Only by combining technical expertise with forward thinking mindset we will position ourselves as valuable asset to our company, community and country. management. These vast and diverse experiences, I believe, helped me shape my leadership style and approach to life, how to engage with people, and gave me a clear sense of purpose and meaning in doing my work, continued self-development, and community duties.



■ **Hilal Al Ghefili**
Former Sponsorship Principal
Bahja-Rima Production Coordinator, PDO

In October 2018, I joined the Oman National Young Professionals (NYP) Board with excitement and curiosity. I was eager to learn, grow, and contribute to a platform that empowers young professionals to lead with purpose. Over six transformative years, Oman NYP became more than an organization—it became a school of life, a stage for collaboration, and a space for meaningful contributions.

My journey began on a high note, representing Oman NYP at the 3rd Tomorrow's Leaders Symposium, organized by the World Petroleum Council (WPC) in Serbia. Walking into that room filled with passionate, driven individuals from across the globe, I quickly realized the energy sector's challenges and opportunities are universal. This experience opened my eyes to the power of dialogue and the importance of stepping out of one's comfort zone. It shaped how I viewed collaboration—not as a competition but as a shared responsibility. What I brought back to Oman was a renewed sense of purpose and the belief that young professionals, when united, can drive impactful change.

In 2019, I worked with the board on organizing the First Edition of Energy-Olympics, a platform designed to inspire innovation and critical thinking among young professionals. What I found most rewarding was not just organizing but witnessing the participants push their limits and spark new ideas. Later that year, the Future Leaders Forum (FLF) in Saint Petersburg, Russia, reinforced my understanding of leadership. The discussions I participated in challenged me to think strategically, act decisively, and embrace diversity in thought. These lessons became invaluable as I worked with my NYP peers to improve our initiatives back home. In 2019, when the pandemic of COVID-19 appeared as a big challenge to the world, Oman NYP adapted. We launched a series of virtual talks to keep our community engaged. Topics ranged from lean applications and behavioral economics to hydrogen fuel technology. Moderating the first session was a nerve-racking yet fulfilling experience. I discovered how crucial it is to create a space where participants feel valued and heard. Beyond moderation, organizing the subsequent sessions taught me the importance of resilience and innovation in the face of adversity. Together, we ensured the spirit of NYP continued to thrive, even during uncertain times. 2021 marked my involvement in NYP's first magazine project, #Spark by NYP. As part of the editorial team, I didn't just help tell stories; I learned to listen deeply. Each article was a testament to the potential of young professionals in Oman. The process of curating and editing these stories taught me the power of collective storytelling in building a sense of community. It was fulfilling to contribute to a project that celebrated our peers' achievements and inspired others to take their own steps toward growth. In 2022, I had the privilege of organizing the Young Professional Forum at the SPE OPES Conference,

themed "Towards Leading the Energy Sustainability." It was more than an event; it was a call to action. Watching participants passionately discuss their roles in driving sustainability, I felt a deep sense of pride. Similarly, supporting the Hydrogen Challenge Program for Students was an eye-opening experience. The innovative ideas presented by students reminded me of the importance of mentorship and providing platforms for the next generation to thrive. Moderating a panel discussion at the Green Hydrogen Summit & Exhibition in Oman added another layer to my understanding of clean energy transitions. It wasn't just about the technical solutions discussed; it was about connecting dots—bringing experts, industries, and youth into one conversation that could spark actionable change. By 2023, I found myself speaking on the global stage at the VII WPC Youth Forum in Almaty, Kazakhstan, discussing "Carbon Neutrality: Modern Technologies and Clean Energy Solutions." While it was an honor to represent Oman NYP, the real highlight for me was realizing how the experiences from past NYP initiatives shaped the insights I shared. The year also saw the creation of the Taqa Lounge at OPES 2024, a collaborative space for young professionals. Being part of the organizing team gave me a chance to bring my vision of connection and knowledge-sharing to life. The lounge was designed not just as a venue but as an experience—a place where ideas could be born, and relationships could flourish. My time with Oman NYP, from 2018 to 2024, was not just a chapter of my career; it was a journey of growth and discovery. I leave with a heart full of gratitude for the experiences, the challenges, and the people who made it all worthwhile. For anyone considering becoming part of Oman NYP, I encourage you to dive in wholeheartedly. It's not just about events or titles—it's about the transformation you undergo and the impact you can make along the way.



■ **Elham Al Eisri**
Former Program Principal
People & Culture Manager, OPAL

Reflecting on my time with the National Young Professionals Board from 2018 to 2024, I'm filled with gratitude and pride for the experiences and growth it brought me. Being part of the cycle that managed impactful initiatives like the PetroOlympics, engagement sessions, and the introduction of the *Spark by NYP* magazine, as well as organizing numerous online webinars, provided me with invaluable opportunities to connect with leaders in the oil and gas industry, expand my network, and contribute to the future of our field. Attending key events like the Future Leaders Forum and the WPC Congress gave me firsthand insights into the challenges and opportunities facing the industry on a global scale. While balancing these responsibilities with my full-time job was challenging at times, the rewards—both personal and professional—were immense. To the new board members stepping into this role, my advice is simple:

embrace the challenges, stay resilient, and lean into the sense of community. There will be moments when the workload feels overwhelming, but know that it is through these very challenges that the most growth occurs. You are part of something much bigger than any individual task, and your contributions will have a lasting impact on the industry and the next generation of young professionals. Use this opportunity to learn, connect, and challenge yourself. The industry is evolving, and your fresh perspectives are needed now more than ever. As part of the board, you have a unique chance to help shape its future. Stay passionate, support one another, and always keep the bigger picture in mind. The experiences, networks, and lessons you gain over the next few years will be incredibly rewarding, and I have no doubt that you will continue to build on the legacy we've helped create. Best of luck, and enjoy the journey ahead!



■ **Khalid Al Dhuhli**
Former Media Principal
Production Technologist, CCED

Being part of NYP during its startup phase was a pivotal step in my professional career, offering me a great opportunity to grow beyond the routine tasks. This experience allowed me to hone a variety of skills that have proven essential across multiple domains. I enhanced my communication abilities with industry professionals, refined the technical aspects of business, and promoted a strong network of connections with organizations and leaders in key positions.

A significant focus was placed on events marketing, public communication, and managing media platforms, which were critical responsibilities of the media and communication section. This naturally fostered an environment that encouraged innovation and creativity, enabling us to effectively engage with individuals and organizations to ensure successful events and align with NYP's vision and mission.

Furthermore, NYP's diverse range of stakeholders, which often expanded depending on the type of event or targets, provided me with hands-on experience in facilitating and managing relationships with various parties. This dynamic environment not only strengthened my interpersonal and organizational skills but also emphasized the importance of adaptability and collaboration in achieving shared goals.



2019





PDO YPN

Spotlight of YP Committees

The PDO Young Professionals Network; The History

The PDO Young Professionals Network was first proposed in 2004 by Musallam Al Mandhry, who was by then, the Human Resources representative for PDO's North Directorate. Along with a group of early members—Nada Al Kindy, Salima Al Mahruqi, Rifaat Al Mujaini, and Ibrahim Al Ismaili—Musallam identified the need for a platform where young professionals could network, share knowledge, and develop skills to address shared challenges. Initially, the network included only four Petroleum Engineers from the North Petroleum Directorate (ONP). It soon expanded to include members from Cost & Planning, Contracts & Procurement (C&P), and Finance, marking the first steps beyond its engineering roots.



From right to left : Badr Al Amri, Nada Al Kindy, Ibrahim Al Ismaili, Saud Al Salmi, Rifaat Al Mjeni, Khamis Al Abdali, Issa Al Mahruqi, Hamed Al Jabri.

In October 2005, the PDO Young Professionals Network (YPN) was formally launched to foster the development of young talent across the company. Inspired by similar models abroad, this network was created to provide a dedicated support system, offering young professionals opportunities for mentorship, skill enhancement, and structured career growth. Today, the YP Network is a vital part of PDO's strategic vision for the future, playing a significant role in building the next generation of leaders under a dynamic and dedicated leadership team.

Vision and Objectives

The PDO YP Network's vision is to “foster the development and engagement of young professionals” by creating a vibrant, supportive environment that promotes cross-functional collaboration, continuous learning, and personal growth—often outside the traditional office setting. The network's objectives align with PDO's strategic goals, supporting both individual and organizational development in a dynamic, creative space.

- 1. Networking Opportunities:** Building strong relationships across different functions within PDO to facilitate communication and collaboration.
- 2. Continuous Learning:** Organizing events, workshops, and mentorship programs to enhance professional and personal skills.
- 3. Enhanced Communication:** Strengthening ties between young professionals and senior management to ensure alignment with PDO's vision.
- 4. Well-being and Work-Life Balance:** Promoting initiatives that encourage healthy work-life integration and a positive work environment.
- 5. Environmental Responsibility:** Emphasizing sustainable practices to inspire a sense of environmental stewardship among young professionals.

Steering Committee

Under the leadership of YPN President Areej Al-Ghaithi and Vice President Mustafa Al Ajmi, the current steering committee is organized into specialized teams responsible for social events, professional development, and planning. This structure enables the committee to efficiently coordinate a range of activities aimed at engaging young professionals and fostering a strong sense of community within PDO.



From right to left Row 1: Dhiyab Al-Mahrezi, Amjad Al-Kharusi, Issa Al-Shukaili, Dr. Aflah Al-Hadhrani PDO MD, Mustafa Al Ajmi, Ibrahim Al-Rajhi.

From right to left Row 2: Esraa Al-Maani, Areej Al-Ghaithi, Maryam Al-Balushi.

Criteria for Membership

The PDO YP Network is open to PDO employees between the ages of 20 and 35, with less than 10 years of experience. This inclusive criteria aims to capture a broad range of young professionals and create a network that reflects the diversity of PDO's workforce. Currently, the network represents approximately 4,000 young professionals within PDO.

Key Events and Values

The YP Network organizes numerous events throughout the year to support its goals, each event crafted to provide specific value to participants and encourage engagement :

- 1. Omani Youth Day** (October 2023 and October 2024): Celebrating young talent within PDO and recognizing their contributions to PDO's success.
- 2. Decarbonization Event** (November 2023) A workshop aimed at raising awareness of sustainable practices, emphasizing PDO's commitment to environmental responsibility.
- 3. Personal & Process Safety Competition** (November 2023) A competition designed to boost safety awareness among young professionals, reinforcing PDO's safety-first approach.
- 4. YPN Connect** (December 2023 and December 2024): An annual networking event bringing together young professionals from diverse departments to foster cross-functional relationships and create a cohesive PDO community.



- 5. Coffee Corner with MD** (first quarter 2024): Friendly coffee corner conversations with an aim to have an informal dialogue with the MD, emphasizing the value of bridging the gap between different levels of the organization.
 - 6. Mentoring Programs** (2024): Impactful sessions with the Executive Directors fostering direct engagement and guidance from senior leadership.
 - 7. Carbon Capture, Utilization and Storage Session** (June 2024): This session provides insights into the role of CCUS in mitigating climate change, fostering energy transition, and reducing industrial emissions.
 - 8. Commercial Mindset Activities** (July 2024): Training sessions focused on developing a business-oriented approach among young professionals, aiming to align personal goals with PDO's commercial objectives.
- Additional events, such as sports tournaments and volunteering opportunities, occur throughout the year, promoting a holistic approach to career development and personal well-being.

Young Professionals Insights

I am grateful for the opportunity to contribute to meaningful initiatives within PDO YPN, connecting with inspiring young professionals and engaging with management on impactful projects. This experience has deepened my commitment to creating positive change and building a strong professional network that drives our shared vision forward.” Raiyan Al Busaidi, Production Seismologist. “Being part of the YP Network has greatly enriched my professional journey at PDO, expanding my knowledge in critical industry areas and strengthening my network across the company. Participating in various events has allowed me to build lasting relationships with peers and boosted my confidence in contributing to team initiatives. The network also promotes a healthy work-life balance through engaging development sessions and social gatherings. I believe PDO's YP Network is dedicated to ensuring that all young professionals feel connected, valued, and empowered to grow, making a positive impact on our careers and the company culture.” Mundhir Al Maadi, Lead Project Engineer. “Reflecting on the recent mentoring session with PDO YP, I'm grateful for the chance to expand my professional network and deepen my industry knowledge. Engaging with my mentor provided invaluable insights as he shared both expertise and personal experiences, allowing me view challenges and opportunities from a seasoned perspective. The guidance on career navigation and the connections made have already opened doors within the industry. These sessions were a meaningful confidence boost and a powerful reminder of the value of mentorship in professional growth.” Najma Al Waily, Energy and Water Policy Advisor.

Building a Bright Future Together

The PDO Young Professionals Network is dedicated to shaping a forward-thinking, vibrant community of future leaders who will contribute to PDO's long-term growth and success. With a diverse and committed steering committee, a strong vision, and impactful events, the YP Network is empowering PDO's young professionals to become the industry's next generation of leaders.

Pioneering Carbon Capture & Sequestration in Oman, a Strategic Imperative for a Sustainable Future

Climate change is one of the most pressing issues of our time, with global temperatures rising due to increased greenhouse gas emissions. The Intergovernmental Panel on Climate Change (IPCC) has emphasized the urgent need to limit global temperature rise to 2°C above pre-industrial levels to avoid the worst impacts of climate change. Oman, as a signatory of the Paris Agreement, has committed to achieving net-zero emissions by 2050. This commitment is part of a broader strategy to mitigate climate change and transition to a sustainable energy future. While switching to renewable energy sources is crucial for reducing emissions, hard-to-abate sectors like cement, steel, and chemicals still require carbon capture, utilization, and storage (CCUS) to significantly reduce their CO₂ emissions. This article provides an in-depth overview of CCUS in Oman, covering carbon capture technologies, CO₂ transportation, and utilization or sequestration strategies, while highlighting the country's potential to lead in this critical area.

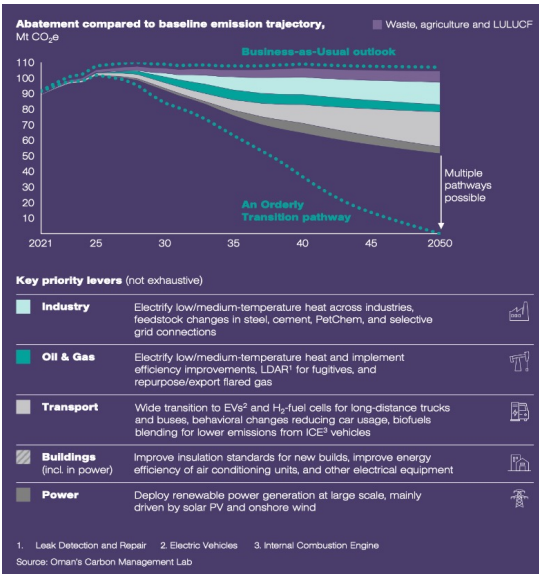


Figure 1: Emission abatement pathways for Oman (2021-2050) under “Business-as-Usual” and “Orderly Transition” scenarios, highlighting sector-specific priority actions for reducing CO₂ emissions (Source: Oman’s Carbon Management Lab).



■ **Sulaiman Al Mani**
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The Necessity of CCUS

Transitioning to renewable energy can significantly reduce emissions from the power sector, but certain industrial processes produce CO₂ emissions that are difficult to eliminate. For these hard-to-abate sectors, CCUS offers a viable solution by capturing CO₂ emissions at their source or directly from the atmosphere. In Oman, this technology is essential to meet its net-zero targets and contribute to global climate goals. The necessity of CCUS becomes apparent when considering the structure of Oman’s economy, which heavily relies on industries that are challenging to decarbonize. Implementing CCUS not only aligns with Oman’s sustainability goals but also enhances the resilience and competitiveness of its industrial sector. Additionally, CCUS and Carbon Dioxide Removal (CDR) are recognized globally in IPCC models as necessary components to achieve net-zero emissions.



Carbon Capture Technologies

Carbon capture technologies can be broadly categorized into Point Source Capture (PSC) and Direct Air Capture (DAC). PSC involves capturing CO₂ emissions directly from industrial sources such as power plants, cement factories, and chemical plants. This method is particularly effective in Oman due to the high concentration of these industries within the country. Advanced solvent-based, membrane-based, and cryogenic capture technologies are being developed and deployed to enhance capture efficiency and reduce costs. These technologies capture CO₂ before it is released into the atmosphere, preventing significant emissions from entering the environment. Additionally, technologies like oxy-combustion, which involves burning fuel in oxygen instead of air to produce a concentrated CO₂ stream, are being explored for their efficiency in CO₂ capture. On the other hand, DAC captures CO₂ directly from the ambient air. This technology is crucial for addressing emissions from dispersed sources and achieving negative emissions. Oman's vast open spaces and high solar irradiance provide ideal conditions for deploying large-scale DAC facilities, which can be powered by renewable energy sources to ensure carbon-neutral operations. Although energy-intensive, DAC is necessary for the hardest-to-abate industries, and establishing DAC hubs in Oman could leverage the country's abundant and low-cost renewable energy.

CO₂ Transportation

Efficient transportation of captured CO₂ is vital for the success of CCUS projects. In Oman, this involves developing a robust infrastructure that includes pipelines and trucks to transport CO₂ from capture sites to utilization or storage locations. CO₂ pipelines are the most efficient and cost-effective method for transporting large volumes of CO₂ over long distances. Oman's existing oil and gas pipeline infrastructure cannot be easily repurposed for CO₂ transportation, but existing corridors and routes can be repurposed since oil and gas fields are likely to transition to CO₂ sequestration sites. The selection between pipeline or trucking for CO₂ transportation is a function of distance and volume, with higher volumes and longer distances favouring pipelines. For shorter distances or smaller volumes, CO₂ can be transported using trucks. This method is flexible and can be quickly deployed to connect capture sites with utilization or storage facilities. By integrating these transportation methods, Oman can ensure the efficient and cost-effective movement of CO₂ to its final destination. Additionally, the establishment of common infrastructure in industrial areas can lead to economies of scale, with central capture and conditioning facilities providing services to multiple industries. This approach allows for dedicated players to operate and provide carbon capture as a service, further enhancing the feasibility of CCUS projects.



CO2 Utilization & Sequestration

Once captured and transported, CO₂ can be either utilized in various industrial processes or sequestered in geological formations. Utilizing captured CO₂ in industrial processes can create valuable products and reduce overall emissions. Potential applications in Oman include Enhanced Oil Recovery (EOR), chemical production, and the creation of building materials. EOR involves injecting CO₂ into oil fields to enhance oil recovery while simultaneously sequestering the CO₂. This method not only increases oil production but also provides a steady stream of revenue that can fund further CCUS initiatives. Chemical production using CO₂ as a feedstock can produce valuable chemicals like methanol and urea, contributing to the development of a low-carbon industrial sector. Additionally, CO₂ can be converted into synthetic fuels, providing a method to decarbonize the airline industry by creating sustainable aviation fuels. However, it is important to note that while utilization provides a clear business case for carbon capture, it may not be ideal from a climate perspective. The primary goal should be permanent sequestration to ensure long-term CO₂ reduction. Nevertheless, utilization creates an immediate market and financial incentives for developing carbon capture technologies, which can pave the way for broader adoption and policy development. Geological sequestration involves injecting CO₂ into underground rock formations for long-term storage. Oman's geological landscape, including depleted oil and gas reservoirs, saline aquifers, salt domes, and dry prospects, offers significant potential for CO₂ sequestration. Depleted oil and gas reservoirs are ideal for CO₂ storage due to their proven capacity to hold hydrocarbons. By injecting CO₂ into these formations, Oman can utilize existing infrastructure and expertise, ensuring safe and efficient storage. These reservoirs have been extensively mapped and studied, providing valuable data for the safe injection and storage of CO₂.

Globally, several CO₂ sequestration projects have proven the efficacy and safety of the industry. The Sleipner project in Norway has been injecting CO₂ into saline aquifers since 1996, demonstrating the long-term viability of geological sequestration. Similarly, Carbfix in Iceland has been mineralizing CO₂ since 2012, converting it into stable minerals within basaltic rock formations. These projects provide valuable lessons and best practices that can be applied to CCUS initiatives in Oman. However, there are challenges associated with CO₂ sequestration, particularly concerning pre-existing wells and ghost

wells with integrity issues that pose storage leakage risks. Addressing these challenges requires robust monitoring and management practices to ensure the integrity of storage sites. Early identification and remediation of potential leakage pathways are essential for maintaining the safety and efficacy of CO₂ sequestration.

Oman's diverse geology offers numerous sequestration options, de-risking carbon capture and transportation. The availability of multiple storage sites, including salt domes and dry prospects, enhances the flexibility and resilience of Oman's CCUS strategy. This geological diversity allows for tailored solutions that maximize storage capacity and ensure the long-term success of carbon sequestration efforts.

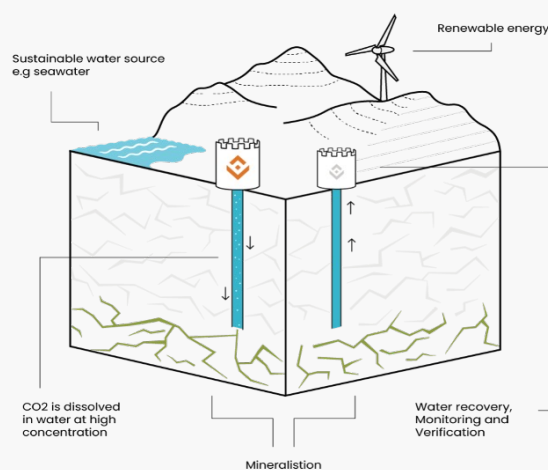


Figure 2: Schematic of CO₂ sequestration through in-situ mineralization in reactive rock formations, illustrating the injection and storage process (Source: 44.01).



The implementation of CCUS in Oman has significant environmental and economic benefits. Environmentally, it helps mitigate climate change by reducing CO₂ emissions and promoting sustainable practices. By capturing and storing CO₂, Oman can significantly reduce its carbon footprint, contributing to global efforts to combat climate change. This aligns with the country's commitment to achieving net-zero emissions by 2050 and supports international climate goals. Economically, CCUS diversifies revenue streams, creates jobs, and attracts international investments. The integration of CCUS with existing industries can enhance their competitiveness and ensure long-term viability. For instance, industries that adopt CCUS can produce low-carbon products, which are increasingly in demand in global markets. This not only opens up new market opportunities but also enhances Oman's industrial base. To fully realize the potential of CCUS, Oman needs supportive policies and incentives. Placing a price on carbon emissions can drive investments in carbon capture technologies. This economic mechanism makes emitting CO₂ more costly, incentivizing industries to adopt CCUS to reduce their carbon liabilities. Additionally, offering tax incentives, grants, and subsidies for CCUS projects can lower financial barriers and encourage innovation. These financial incentives can support the development and deployment of advanced carbon capture technologies, making them more accessible and cost-effective. Upscaling CCUS through Enhanced Oil Recovery (EOR) and gradually shifting to dedicated storage can provide a steady revenue stream to fund sequestration initiatives. This phased approach ensures that Oman can build on its existing capabilities and infrastructure while expanding its CCUS efforts. Social acceptance challenges are also significant for the CCUS industry. Public engagement and early educational campaigns are crucial to increase social awareness and acceptance of CCUS projects. By addressing public concerns and highlighting the environmental and economic benefits of CCUS, Oman can foster a supportive environment for the development and implementation of these technologies. Just as with hydrogen, being a leader in CCUS allows for the local development of technologies and positions Oman to maximize capitalizing on the growth of the industry globally by exporting expertise and technologies developed locally. Oman's strategic approach to CCUS positions it as a leader in the global transition to a low-carbon economy. By leveraging advanced carbon capture technologies, developing robust CO₂ transportation infrastructure, and utilizing geological formations for sequestration, Oman can significantly reduce its carbon footprint. The combination of supportive policies and economic incentives will further stimulate the growth of the CCUS industry, ensuring a sustainable and prosperous future for Oman and con-

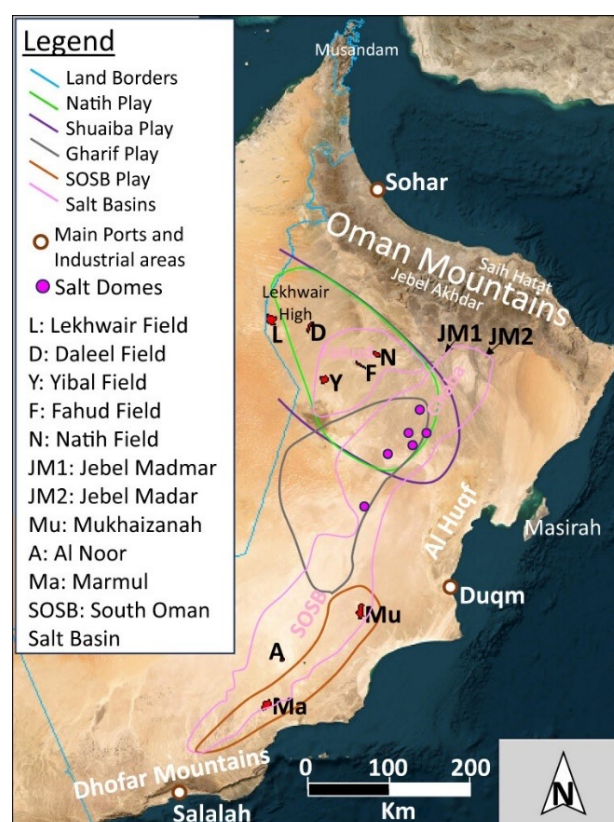


Figure 3: Map of Oman, showing the boundaries and locations of the plays, basins, fields, ports and salt domes. Source: Overview of the carbon capture and storage opportunities in Oman (Al-Kindi, 2024).

tributing to global climate goals. Through these efforts, Oman not only addresses its own emissions but also sets an example for other nations in the fight against climate change.

In conclusion, Oman's ambitious CCUS initiatives, supported by comprehensive policies and innovative technologies, underscore its commitment to sustainability and environmental protection. By harnessing its geological potential and integrating CCUS with existing industrial activities, Oman is well-positioned to lead the global transition towards a low-carbon economy. This strategic vision not only aligns with national development goals but also contributes to global efforts to combat climate change, ensuring a sustainable and prosperous future for generations to come. Through these efforts, Oman not only addresses its own emissions but also sets an example for other nations in the fight against climate change. The combination of environmental benefits, economic opportunities, and supportive policies makes CCUS a cornerstone of Oman's sustainable development strategy, positioning the country as a leader in the global effort to achieve a low-carbon future.

The Next Frontier in Green Technology: Advancing Fuel Cell Efficiency with Artificial Intelligence

In an era where sustainable and clean energy sources are not just optional but a necessity, the innovations and advancements in Proton Exchange Membrane (PEM) hydrogen fuel cells signify a leap towards a greener future. At NAFUN Electronics, a groundbreaking AI-based predictive maintenance framework for PEM fuel cells has been developed. This initiative not only showcases the commitment to sustainability but also exemplifies the potential of AI in revolutionizing the energy sector. PEM fuel cells, celebrated for their high efficiency and low environmental impact, are recognized as being at the forefront of clean energy solutions. However, their widespread adoption has been hampered by challenges related to performance, durability, and maintenance. To address these challenges, deep learning algorithms have been ingeniously applied to predict and improve the operational efficiency of PEM fuel cells. Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Artificial Neural Networks (ANNs), and Autoencoders are used to analyze performance data, marking a significant stride toward enhancing the reliability and lifespan of these energy sources.

A Deep Dive into the Predictive Maintenance Framework

The cornerstone of the approach is the development of a deep learning-based predictive maintenance framework that meticulously monitors and predicts the health condition of PEM fuel cells. A comprehensive array of deep learning algorithms is leveraged to ensure real-time monitoring and diagnosis, enabling proactive maintenance interventions. This methodology is instrumental in reducing downtime and costs while also playing a crucial role in extending the operational efficiency and sustainability of PEM hydrogen fuel cells.



▀ **Mazin Al Habsi**

Process and Maintenance Engineer

▀ **Ruaa Al Gharibi**

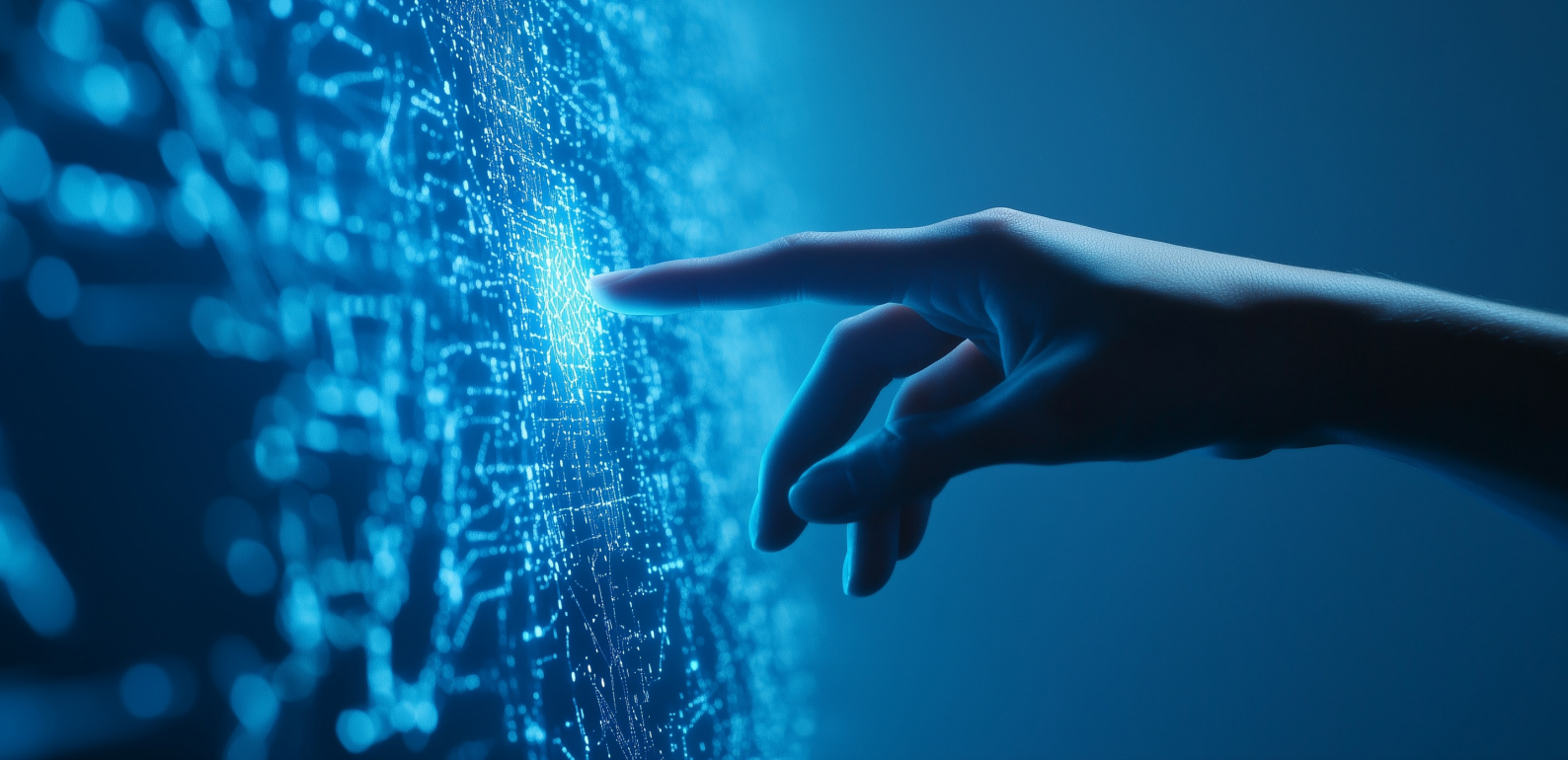
Electronics Instrumentation Engineer

Comprehensive Analysis and Real-World Validation

The research encompasses a thorough review of existing literature on PEM hydrogen fuel cells, focusing on key operational characteristics and performance parameters. The predictive maintenance framework employs an ANN algorithm, chosen for its unparalleled ability to process voluminous data and identify complex patterns. This advanced algorithmic approach facilitates accurate predictions of key performance indicators, such as voltage, current, power, and state of health (SOH), thereby ensuring the optimal performance of PEM fuel cells.

The predictive accuracy of the deep learning-based approach is exemplified in its application to various maintenance tasks, including fault detection, classification, and remaining useful life estimation. The integration of CNNs, RNNs, and Autoencoders into the framework enhances the capability to address specific maintenance challenges, such as voltage prediction and fault diagnosis, with remarkable precision.





Showcasing a Leap in Innovation at LEAP

The spotlight at LEAP 2024 shone brightly on the visionary contributions of Ruaa Al Gharibi and Mazin Al Habsi, the minds behind the transformative AI-based predictive maintenance solution for PEM fuel cells. While their groundbreaking project received significant backing and investment from NAFUN Electronics, it was Al Gharibi and Al Habsi who conceived the idea and spearheaded the development efforts. This prestigious international tech gathering served as the perfect backdrop to highlight their innovative approach, underscoring the critical role of artificial intelligence in advancing the sustainability and operational efficiency of clean energy technologies.

Participation in LEAP 2024 was not just about presenting findings; it was about igniting a conversation on the future of clean energy technologies. By showcasing the AI-based framework, the critical role of innovative technologies in overcoming challenges related to the adoption and optimization of PEM fuel cells was highlighted. The project exemplifies how AI can be leveraged to predict maintenance needs, optimize performance, and reduce the environmental impact of energy production. An overwhelmingly positive response was received following the presentation at LEAP 2024, with various companies, CEOs, and business leaders expressing keen interest in the project. Consideration for funding by the Saudi Water Innovation Center and ANKA's proposal for incubation signify the potential impact beyond academic circles, promising real-world applications and advancements. These collaborations and support are seen as pivotal in scaling the project, exploring new avenues for implementation, and driving forward the integration of AI in the clean energy sector.

Impact on the Drone and Consumer Appliance Industries

Findings and methodologies presented at LEAP 2024 have particularly resonated with stakeholders in the drone industry and the broader consumer appliance sector. The application of an AI-based predictive maintenance framework in these industries underscores the versatility and significance of this work. Enhanced energy efficiency and reliability can be achieved in drones, which are increasingly used for a variety of commercial and environmental purposes. Similarly, consumer appliances can benefit from reduced operational costs and improved sustainability offered by this technology.

The success at LEAP 2024 marks the beginning of a new phase. The vision extends beyond PEM fuel cells, aiming to create a ripple effect of sustainability and innovation across various sectors. Continuous research and development will be pursued, with a focus on refining methodologies, expanding collaborations, and contributing to a sustainable future powered by clean, efficient energy solutions.

Effect of Cu and Ni Inclusion on Tribological Performance of Tribocatalytically - Active Coatings in Hydrocarbon Environments



Rawan Al Sulaimi
Materials Engineer at BMRC

Project Summary

Tribocatalysis, a process that involves the formation of protective carbon films at the sliding interface of mechanical systems, offers a promising solution to reduce friction and wear. Catalytic metals like platinum, palladium, copper, and nickel can significantly enhance this process by lowering the energy required for hydrocarbon transformation. Electrochemically deposited cobalt-phosphorus (Co-P) coatings, known for their versatility and compatibility with various hydrocarbon sources, are particularly suitable for tribocatalytic applications. This study aims to explore the impact of copper and nickel on the tribocatalytic behavior of Co-P coatings, with the goal of evaluating the universality of tribocatalysis across different hydrocarbon environments and synthetic oils.

Methodology

To investigate the effects of the composition and content of catalytic materials on the tribocatalysis behavior of CoP-based coatings, two sets of coatings with different inclusions of Ni and Cu were electrodeposited by adjusting the quantities of metallic precursors in the electrolyte. The coatings exhibited an amorphous nature, ensured by ~12 wt% of P and a uniform distribution of constituent elements across a 12 μm thickness. Tribological experiments were conducted using low-viscosity fuels—ethanol and decane—and a synthetic oil, PAO4, to evaluate the effect of the hydrocarbon source on protective tribofilm formation. The coefficient of friction (COF) and wear rate values were measured and compared to those of uncoated AISI 52100 steel and an amorphous CoP coating, as shown in Figure 1.

Main Finding

The results demonstrated that the inclusion of catalytic elements, such as Ni and Cu, improved the protection and wear resistance of the coating. Co5NiP exhibited lower COF and wear rate values compared to Co7NiP, while Co7CuP outperformed Co5CuP, showing significantly lower friction and wear rates. Further investigations into the top performers with 5 wt% Ni and 7 wt% Cu were carried out. The incorporation of ethanol in the vicinity of the catalysts Cu and Ni initiated the formation of carbon-based films that successfully mitigated friction and wear within the sliding interfaces. Remarkably, Co7CuP demonstrated enhanced wear resistance in low-viscosity fuels, a characteristic attributed to the elevated surface energy and catalytic activity of Cu when interacting with organic molecules. The surface energy promotes better adhesion of carbon-based films, further enhancing the reduction of friction and wear in the system, and the catalytic activity accelerates dehydrogenation and scission of bonds in hydrocarbon molecules.

In the case of PAO4, the results indicate that the effect of oil lubricity was enhanced by tribofilm formation for the Co5NiP coating. Characterization of the wear tracks (Figure 2) suggests that, among the considered samples, the tribofilms formed on the surface of Co7CuP have the highest concentration of graphitic carbon, leading to a more significant reduction in the COF and wear rate. The carbon tribofilm formation was more pronounced in decane and synthetic oil than in ethanol, which is attributed to the difference in the length of the hydrocarbon molecules affecting viscosity and lubricant film thickness during boundary lubrication sliding.

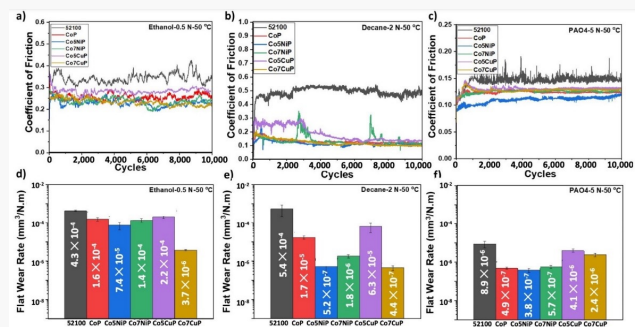


Figure 1: Coefficient of friction of the coatings and an uncoated AISI 52100 steel in (a) ethanol, 0.5 N, (b) decane, 2 N, (c) PAO4, 5 N. The flat wear rate values of (d) ethanol, 0.5 N, (e) decane, 2 N, (f) PAO4, 5 N at 50°C.

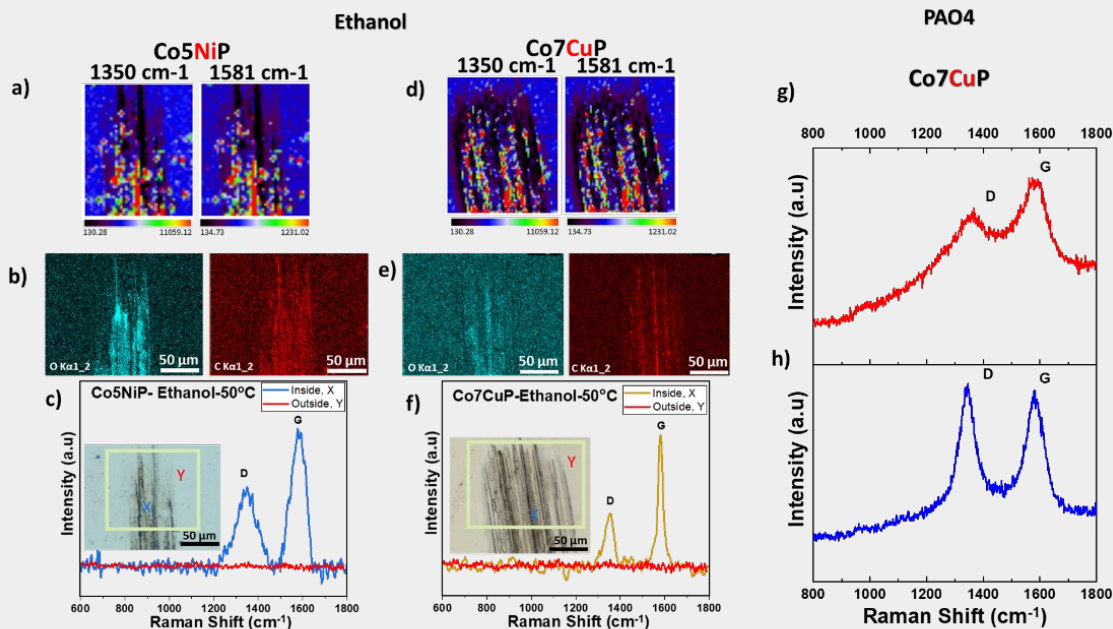


Figure 2: (a-c) Characterization summary of Co5NiP wear track in ethanol, (d-f) Characterization summary of Co7CuP wear track in ethanol, (g-h) Raman spectra inside the wear track of Co7CuP in PAO4.

Overall, the research findings highlight the importance of composition and catalytic elements in enhancing the tribological performance of coatings and promoting the formation of carbon-based tribofilms. The study provides valuable insights into the behavior of coatings in different lubricating environments and contributes to the development of improved lubrication strategies for mechanical systems

From Waste to Gain, Maximizing Returns by Improving Enhanced Gas Flotation Tank (EGFT) Water Quality through Chemical Solutions

The South Oman Nimr oil production station faced significant challenges with oil-water separation due to increased production volumes and insufficient residence time in the upstream tanks. This led to substantial carryover of oil and water downstream, negatively impacting the water injection system and reed bed wastewater treatment. The introduction of the Enhanced Gas Flotation Tank (EGFT), designed to use multistages of microbubbles for improved separation and enhanced discharge water quality, initially failed to achieve the target of less than 50 ppm oil-in-water. This shortfall highlighted the need for additional interventions to optimize the EGFT's performance and address ongoing separation issues.

In response, in addition to microbubble optimization, chemical interventions were introduced to enhance the EGFT's performance. Specifically, demulsifiers were used to break down emulsions and promote oil droplet aggregation, while deoilers targeted the reduction of residual oil in the treated water. This dual approach was designed to complement the existing EGFT technology, address its initial shortcomings, and achieve the target water quality of less than 50 ppm oil-in-water.

Project Summary

The EGFT technology is designed to handle gross produced fluid. This technology is currently in use at the South Oman Nimr main production station. Upon commissioning, it faced challenges in achieving the design outlet specifications due to the effectiveness of oil-water separation. The EGFT technology is designed to handle gross fluid and achieve specifications by utilizing microbubbles to improve separation efficiency without the need for chemical treatment. Despite the introduction of microbubbles, the technology failed to meet the target water quality of less than 50 ppm oil-in-water. To address these challenges, different chemical injection strategies were tested, including the use of demulsifiers and deoilers. This study investigates the efficacy of these chemicals in enhancing the separation process, reducing oil concentrations, and improving overall water quality. The results demonstrated that the application of demulsifiers significantly destabilized emulsions, while deoilers effectively reduced residual oil in the water. Consequently, the EGFT system achieved the desired water quality standards, reducing operational issues and enhancing downstream process performance.



Moza Al Ruqaishi
Production Chemist
PDO

A Methodical Approach to Chemical Injection for Efficient Oil-Water Separation

To tackle the separation challenges of the EGFT, comprehensive laboratory testing was conducted for the proposed chemical injection strategy. A demulsifier was chosen to destabilize emulsions and promote the aggregation of oil droplets, while a deoiler was utilized to reduce the residual oil content in the separated water. The methodology included the following steps:

1. Chemical Selection and Dosage

Identifying appropriate chemicals based on their compatibility with fluid characteristics and EGFT operating conditions, and determining optimal dosages after field trials.

2. Chemical Injection

Implementing a controlled injection system to ensure accurate chemical injection rates and treatment dosages.

3. Monitoring and Analysis

Conducting daily sampling and analysis of water quality to assess the effectiveness of the chemical treatments. Key performance indicators included oil-in-water concentration, separation efficiency, and other operational metrics.

4. Optimization

Adjusting chemical dosages and injection rates based on performance data to maximize the efficacy of the treatment.

Results & Discussion

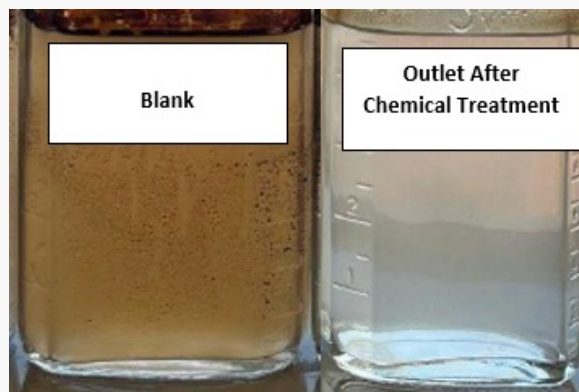
The introduction of demulsifier and deoiler significantly improved the oil-water separation efficiency of the EGFT. Prior to the intervention, oil-in-water concentrations were between 500-700 ppm. After applying these chemicals, the concentration dropped to 40-70 ppm, highlighting the effectiveness of the treatment in resolving the system's initial issues.

The successful enhancement of water quality has also led to a considerable recovery of oil and cost offset. In addition, the operational improvements are expected to contribute to a reduction of 200 tons of CO₂e GHG emissions. This reduction is primarily attributed to decreased power consumption, less sludge treatment, and lower transportation needs. The enhanced separation efficiency also improves process safety by reducing oxygen ingress into the system, thereby addressing integrity, health, safety, and environmental concerns related to manpower exposure, transportation, and sludge treatment. Despite these benefits, achieving sustained performance will require permanent engineering solutions and additional operational investments.

The Added Value of Chemical Integration in EGFT

The integration of Demulsifier and Deoiler into the Enhanced Gas Flotation Tank (EGFT) system has successfully addressed the initial separation challenges, resulting in substantial improvements in oil-water quality. The reduction in oil-in-water concentration demonstrates the efficacy of the chemical interventions. This enhancement not only contributes to significant oil recovery annually, but also supports a notable decrease in GHG emissions and improves process safety.

The positive impacts on environmental and operational aspects underscore the value of chemical treatments in optimizing the EGFT system's performance. However, for long-term success and sustainability, the adoption of permanent engineering solutions and management of additional operational expenses will be essential. Continued monitoring and adjustments will be necessary to maintain and further enhance the system's efficiency and effectiveness in the future.



Stream pictures before & after chemical improvement.

STAY *tuned*

Young Professionals Hub
at Oman Petroleum Energy Show OPES 2025

12 –14 May



Awarded British Solar Renewables Prize for Fabrication of $\text{WO}_3/\text{Fe}_2\text{O}_3$ Heterostructure Photoanode Using PVD

Nawaf's groundbreaking work on the fabrication of a $\text{WO}_3/\text{Fe}_2\text{O}_3$ heterostructure photoanode using Physical Vapor Deposition (PVD) for photoelectrochemical applications has garnered significant recognition in the field of renewable energy. His research was published in the prestigious Solar Energy Materials and Solar Cells journal, highlighting its scientific impact. Nawaf's project was awarded The British Solar Renewables Prize for the best solar project, affirming its innovative approach and contribution to solar technology. Additionally, the project was selected as one of the top 10 projects to participate in the Future Energy Leaders program at the Green Hydrogen Summit Oman, where it achieved an impressive 2nd place. These accolades underscore Nawaf's dedication to advancing clean energy solutions and his role as a promising leader in the field.

Project Summary

The bottleneck of cost-effective green hydrogen production through the PEC water splitting process is the lack of suitable materials. To address this material challenge, we have fabricated a heterostructure nanorod utilizing a high-throughput radio frequency (RF) sputtering Physical Vapor Deposition (PVD) technique. With optimized parameters, such as an as-deposited Fe thickness of 70 nm, a deposition angle of 70° , and an annealing temperature of 500°C , photoanodes with a morphology of vertically aligned nanorods were fabricated. A rod-like morphology with nanoparticles was synthesized by the addition of 15 nm of tungsten oxide (WO_3) to the nanorods. To study the optical behavior and morphology, the pristine and WO_3 heterostructure thin films were characterized using ultraviolet photoelectron spectroscopy (UPS), ultraviolet (UV) spectroscopy, X-ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDS), and X-ray photoelectron spectroscopy (XPS). This resulted in a 5-fold improvement in PEC performance (0.588 mA/cm^2 at 1.23 V vs. RHE for the mixture compared to 0.122 mA/cm^2 at 1.23 V vs. RHE for the pristine). As a co-catalyst, WO_3 successfully suppressed recombination and assisted in hole transfer, which significantly increased the photocurrent density of the fabricated photoanodes. This was illustrated via electrochemical impedance spectra, including both Nyquist and Mott-Schottky plots, with and without illumination. When sustained under steady illumination for 900 seconds, this photoanode displayed highly stable behavior under PEC conditions.

Impact on Climate Change

Photoelectrochemical (PEC) water splitting is currently one of the most promising approaches for producing green hydrogen in an economically effective and environmentally friendly manner. The heterojunction structure is attracting significant interest because its photocurrent density has been found to be much higher than that of the respective bare films. One of the primary reasons for the improved PEC water splitting is believed to be the interfacial electrical structure. Among various materials, tungsten (W) has been widely investigated and is considered a promising material for PEC water splitting photocatalysts due to its effective photostability, visible light absorption, and lower cost. Single iron oxide metal, on the other hand, has low conductivity and a short hole diffusion length (2-4 nm). As a result, hematite often suffers from the recombination of electron-hole pairs in the thin film. Fabricating heterojunctions within semiconductors can effectively lead to the rapid separation of photogenerated holes and electrons, thereby enhancing PEC performance.



Nawaf Al Aisae,
Renewable Engineering Engineer at the Public Authority
for Special Economic Zones and Free Zones

Leading the Way to Net Zero, Achievements of the Sultan Qaboos University Team at ADIPEC 2023



The Sultan Qaboos University team that participated in the 2023 SPE ADIPEC University Programme, held in October 2023, consisted of experienced Petroleum and Natural Gas Engineering graduates with a passion for sustainable and clean energy. The ADIPEC competition unfolded in two distinct phases. Initially, 27 universities from various countries across the Middle East and North Africa contended fiercely to advance to the second stage. Out of these, only 12 teams were shortlisted for the final round. The participating teams were tasked with addressing several considerations related to COP and its effect on the oil and gas industry, as well as the efforts of participating countries towards achieving a net-zero carbon target in the long term. Moreover, the participants had to propose recommendations for the upcoming COP28 and suggestions for their respective countries to achieve the Net Zero goal. Additionally, they needed to highlight the future role of petroleum engineers and geoscientists in the journey of adapting to a low-carbon circular economy. In the culmination of the competition's second stage, the Sultan Qaboos University team, with the mentorship of Ms. Safa Al Breiki and Dr. Intisar Al Busaidi, stood out as the clear first-place winners.

■ The Team's Recommendations for Future COP Conferences

Some recommendations for COP28 include recognizing public engagement and awareness by encouraging the active involvement of civil society and youth organizations in the conference. This approach ensures that each person takes the initiative to set their own personal goals to reduce emissions, such as carpooling. Additionally, monitoring countries' status and progress semi-annually is essential to guarantee accountability. This can be achieved by strengthening the reporting and review mechanisms under the Paris Agreement, promoting the use of standardized methodologies for measuring and reporting emissions, and ensuring robust monitoring, verification, and reporting systems. Furthermore, setting up funds for recent disasters related to climate change is crucial for providing timely aid and recovery.

■ The Oil and Gas Industry's Role in COP

The oil and gas industry provides more than 50% of the global energy and is responsible for 55% of total GHG emissions. Thus, the change should start from this sector to align with COP goals. The eight leading companies in the industry have started transitioning towards achieving the net-zero goal by implementing Carbon Capture, Utilization, and Storage (CCUS) and investing in renewables. For instance, BP is investing in electric vehicle charging stations in green businesses and plans to increase capital expenditure to 50% by 2030.

■ Oman's Clean Energy Projects

Oman has committed to reaching the net-zero goal by 2050. Consequently, HYDROM was established in 2022, targeting green hydrogen projects to produce 1 million tons of renewable hydrogen by 2030. Furthermore, Oman's government-owned company, PDO, aims to reduce its 2019 emissions by 50% by 2030, taking its first steps towards large-scale solar power projects. The primary initiative involves using solar energy to produce steam for enhanced oil recovery (EOR) operations.



Figure 1. A hydrocarbon field prototype integrating renewable energy technologies.

■ The Team's Recommendations for Oman

The team believes that applying the following recommendations will aid Oman in reducing its emissions and reaching the net-zero goal. The first recommendation is to add more renewable energy disciplines in Oman, as the country has high potential in renewable energies. According to statistics from the International Energy Agency (IEA), Oman has a solid opportunity to utilize solar and wind energies.

Another suggestion from the team is to create a hydrocarbon field prototype that applies clean energy technology and methods to help achieve the net-zero goal. As shown in the design created by the team, the field uses solar and/or wind energy for its operations and includes an electric vehicle charging station for transportation. It also incorporates CCUS and features trees to absorb some of the CO₂ in the air.

The team proposed an innovative idea (Figure 1) that could lead to groundbreaking progress in oil and gas extraction processes. A greenhouse gas sensor could be implemented in the field to detect the amount of emissions released nearby. This allows global environmental agencies to monitor each field's emissions and ensure that the involved companies are held accountable.

■ The Future of Petroleum Engineers and Geoscientists

Petroleum engineers and geoscientists play a major role in the renewable energy sector by extracting and providing essential materials required to build solar panels, driving technological innovation, having well-rounded experience in subsurface analysis and management, and engaging in interdisciplinary collaboration. Their skills and experience are necessary and can be applied in all sectors of the renewable energy industry.



From left to right : Abdullah Mohammed Al Mayahi, Abdulaziz Mohammed Al Matroushi, Dr. Intisar Al Busaidi, Rawan Hussein Abdel Rahman, Sondos Ahmed Issa.

MENA Best Paper Award

Advancing Oil Recovery

Innovations



Kifah Al Busaidi
Reservoir engineering at PDO

An aspiring reservoir engineer at PDO, Kifah Al Busaidi, secured first place in the master's-level student paper contest at the GoTech 2023 conference, held in Dubai from March 13-15. Competing against peers from across the Middle East and North Africa, Kifah's paper, titled Experimental Investigation of Wettability Alteration of Oil-Wet Carbonate Surfaces Using Engineered Polymer Solutions, earned her the top position in the region. This remarkable achievement qualified her to represent the Middle East and North Africa in the international competition, showcasing her innovative research in the field of oil recovery on a global stage.

Project Summary

Engineered water polymer flooding (EWPF) is a promising method to improve oil recovery in carbonate reservoirs holding more than half of the world's oil reserves. It involves combining engineered water (EW) and polymer flooding (PF) to modify rock wettability, reduce mobility ratio, promote polymer stability, and lower required polymer concentration. However, limited studies addressed the simultaneous effect of engineered water compositions (i.e. potential determining ions (PDIs)) on the viscosity of polymer and wettability alteration of various carbonate surfaces. Accordingly, this study aimed to investigate the effect of salinity, PDIs, and polymer functional groups (partially hydrolyzed polyacrylamide (HPAM), and acrylamide tertiary butyl sulfonic acid (ATBs)) on the wetting properties of calcite, chalk, and dolomite surfaces as well as the viscosity of solutions at static conditions. The experimental protocol included viscosity, contact angle (CA), pH, and static adsorption tests. Two combinations of PDIs were considered in the study: $[Mg^{2+}/SO_4^{2-}]$, and $[Ca^{2+}/SO_4^{2-}]$. The results revealed that the polymer becomes more tolerant to the salinity as the sulfonation degree increases, given the same molecular weight. However, at a polymer concentration of 5000 ppm, the HPAM polymer showed higher viscosity than the ATBs-based polymers, as the formation brine (FB) was diluted to 100 folds (100DFB). The tendency of shifting the wettability of carbonate surfaces towards a more water-wet state using EW and EWP treatment solutions decreased in the following order: Chalk \geq Calcite $>$ Dolomite. The study also indicates that, the wettability alteration towards favorable condition is dependent on the initial wettability of the carbonate surface. The higher level of oil-wetness detected in aged dolomite, compared with calcite and chalk, resulted in less effectiveness of EWP for dolomites. However, the low polymer interaction with dolomite surfaces indicates a positive impact on reducing polymer consumption. Moreover, the HPAM polymer was more effective in altering the wettability of dolomite towards a water-wet state compared to the ATBs-based polymer. The overall results indicate that ATBs-based polymer is a potential candidate for optimizing the effectiveness of EWPF in carbonates.

■ Effect of $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ Ratio

Fig. 1a shows the influence of $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratios on the viscosity of SAV10MPM, AN125VLM, and FLOPAAM3130S polymer solutions. As can be seen, the change in the viscosity of the polymer solutions follows a complex trend. In general, the viscosity of SAV10MPM polymer solutions increases with an increase in $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratios. This polymer causes viscosity enhancement of around 33% at $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratio of 0.25 (EW1) due to the intramolecular and intermolecular repulsion among the anionic polymer and sulfate ions, which is expected to be the dominant interaction. The presence of sulfate ions at high concentration in the solution stimulates its viscosity. As the $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratios increase, the SAV10MPM polymer consistently displays an improvement in viscosity, reaching around 60%. In addition to the repulsive interaction among the polymer chains and the sulfate ions, the presence of magnesium ions forms hydrogen bonds with the polymer, which results in additional volume and, consequently, viscosity increase (Fig. 1b). The $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratios impacted the viscosity of AN125VLM differently when compared with SAV10MPM. This variation in performance may be attributed to the presence of an amide group on the AN125VLM polymer's backbone. Increasing sulfate ions concentration improved the viscosity by around 10% at $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratio of 0.25 due to the repelling interaction with sulfate ions. Moreover, the possibility of amide group interaction with sulfate ions is low due to the fact that the configurational arrangement of the sulfonic group and its negative charge at high concentration could offer extra protection to the amide group. The viscosity change noticeably reduces, and then it remains constant despite the increase

in $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratios. With increasing magnesium ions concentration with the presence of sulfate ions, hydrogen bonds are created and, as a result, charge diminishes and the repulsive forces lessens. Consequently, the amide group will not be further protected by the anionic polymer. Therefore, it is likely that the sulfate ions will be drawn to the amide group resulting in polymer coiling. However, a rise in the viscosity of the AN125VLM polymer solution of about 6% was observed at a ratio of 2. FLOPAAM3130S polymer results show that viscosity reduces at all ratios. The high polarity and configurational arrangement of the carboxylic group and the presence of the amide group are responsible for this performance. The amide group receives less protection because the carboxylic functional group is directly attached to the polymer's back bone. The percentage of viscosity reduction is stabilized as the ratio of $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ increases, then sharply reduces at the ratio of 4. The high concentration of magnesium ions, at the ratio of 4, may weaken the polymer's negative charge density and reduce its viscosity. The hydrogen bonds between the anionic polymer and the hydrated magnesium ions may explain this significant reduction at the ratio of 4. Due to the high polarity of the carboxylic group in comparison to other polymers, a more substantial number of hydrogen bonds will be formed, lowering the charge density of the polymer and reducing its intramolecular repulsive forces and viscosity. Given the complex trend of polymer viscosity change with $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratios, especially with polymer containing ATBs groups, further investigation is needed using molecular dynamic simulations to confirm these interactions.

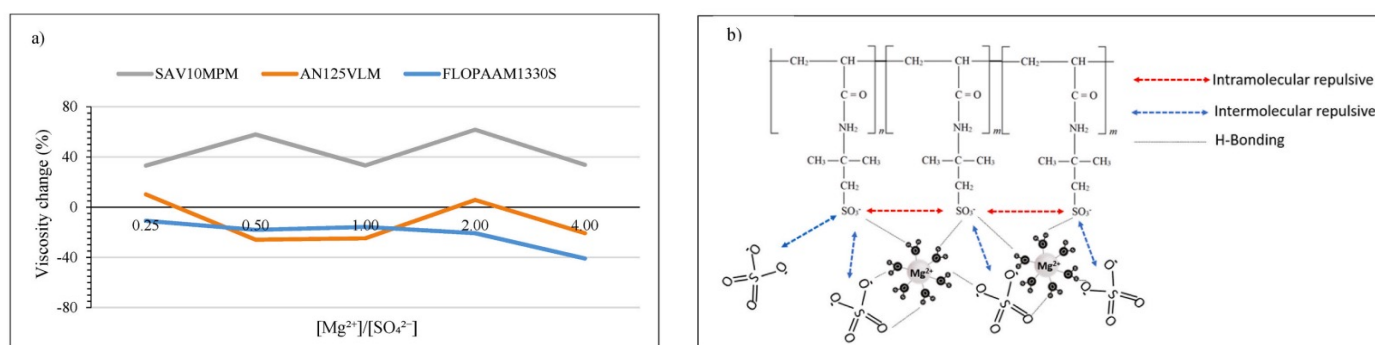
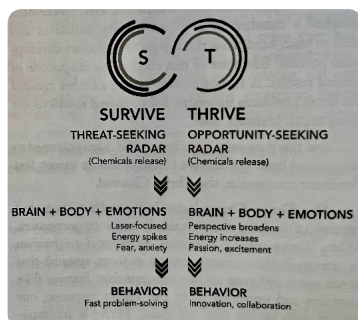


Figure 1. a) Viscosity change of SAV10MPM, FLOPAAM3130S, and AN125VLM polymer solutions at different $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratios at 5000 ppm polymer concentration, at 75 °C and shear rate of 10 s⁻¹, b) The interactions of SAV10MPM polymer solution at $[\text{Mg}^{2+}/\text{SO}_4^{2-}]$ ratio of 0.50.



Cultivating a Continuous Improvement Culture in the Energy Sector

Energy is a very dynamic industry in which change is inevitable. Considering that we are living through a time during which the rate of change is changing itself, we are faced with a tough decision to make. Either we vanish or survive or thrive! However, as an Omani YP you have no choice but to thrive! It is an obligation that each every one of us has to take in order to foster our growth as individuals and eventually achieving Oman Vision 2040. Random efforts to solve our issues and day to day activities will not help us in the long run. Nor quick fixes that do not consider eliminating problems from the roots. Hence, cultivating a Continuous Improvement Culture is crucial. It will play a vital role as an enabler to face the upcoming complex challenges in our industry. It is the way to flourish in such globally difficult times. Continuous Improvement is more than a set of problem-solving tools. It is not just a process to follow nor a document to be filled. It is a way of thinking. It is a behaviour. Therefore, before attempting to solve a problem, knowing our status of mind would be critical. What system is activated in our brain currently as we approach the upcoming challenge? is it survive or thrive? The picture below explains the difference between both systems. Complex problems should be faced with a Thriving mindset. In this article, one problem solving methodology is selected which is Lean methodology. Lean methodology offers a set of techniques and tools to help organizations in their process improvement. This methodology was pioneered by Toyota in the 1940s. It provides a way to specify value, line up value-creating actions in the best sequence, conduct these activities without interruption and perform more effectively. In short lean thinking provides a way to do more with less (Womack, J.P. and Jones, D.T., 1997). It is the pursuit of perfection through small incremental improvement.

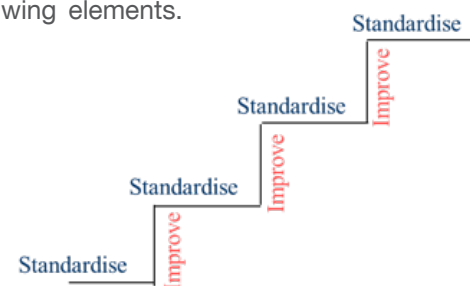


Survive VS Thrive (Kotter, J., Akhtar, V., and Gupta, G. (2021) Change : How Organizations Achieve Hard-to-Imagine Results in Uncertain and Volatile Times. Hoboken, NJ: Wiley).

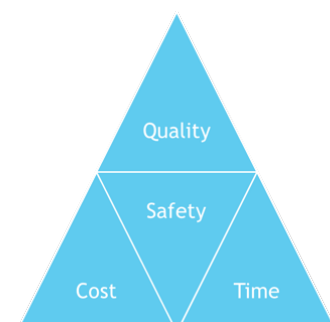


Abdullah Al Amri
Senior Continuous Improvement Coach
PDO

The first step in any change is to create a sense of urgency (Kotter, J.P. and Rathgeber, H., 2006). The best way is always by showing statistics to quantify the problem and show how big it is. The critical point for lean thinking is value (Womack, J.P. and Jones, D.T., 1997). In the energy industry the value to be created from the project should be related to one of the following elements.



Next step is to scope the project by using a project charter. The project charter is a very important step to define the purpose of the project. Also, it will help in creating a focused team on a clear SMART goal. Pulling together the guiding team is the next step to start the project (Kotter, J.P. and Rathgeber, H., 2006). This is a very critical step towards the success of the project. As they are the people who will make it happen. To identify the stakeholders, SIPOC (Supplier, Input, Process, Output, Customer) tool is used. It is also a tool to identify the boundaries of the project.



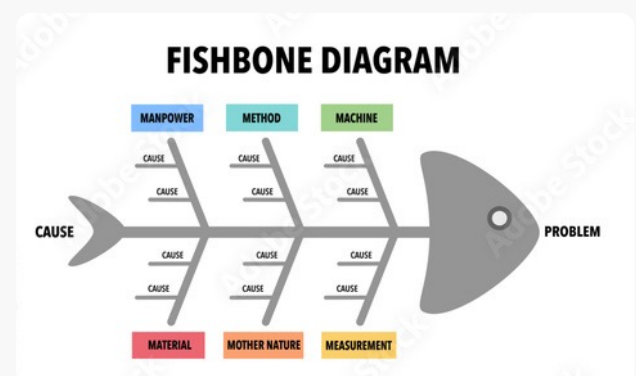
The working team could involve people from multiple departments within the organization. It can be even stakeholders from different organizations or a mixture between people working in the field or those based in the main office. Therefore, as part of the preparation for the project, and for you as a lean practitioner to understand is the process better you will have to go and see for yourself to thoroughly understand the situation. Use your feet to investigate processes and not use your computer (Liker, J.K., 2021). These site visits are also known as gemba walks. During these visits, it is very important to focus on the process not the people. The ultimate goal is to build trust with the team members so they don't hide problems (Bremer, M., 2014).

At this stage, the aim is to connect people and process through continuous process flow to bring problems to the surface (Liker, J.K., 2021). To do that, a tool called Value Stream Mapping (VSM) is used. Whenever there is a product for a customer, there is a value stream. The challenge lies in seeing it (Rother, M. and Shook, J., 2003). VSM enables you to visualize waste in the existing process. On top of that, the exercise of creating a VSM is an opportunity for the whole project team to learn the full process. It is a moment of establishing team bonding as everyone gets to see the roles and responsibilities of each team member. It creates a critical element in team which is trust. Being the lean practitioner for the project means that you will lead a group of people from different disciplines & departments. This is one of the biggest challenges that might be faced in a lean project. With trust comes a sense of value. You have to earn trust by communicating and demonstrating that you share the same value. In turn, those who trust work hard because they feel like they are working for something bigger than themselves (Sinek, S., 2011). Below is an example of value stream map.

After constructing the VSM, it is time utilize it to spot the wastes present in this process. Toyota managers and employees use the Japanese term “muda” when the talk about waste and eliminating muda and the seven forms of muda are often the main focus of lean efforts because they are the most obvious (Liker, J.K., 2021). Muda means waste, specifically any human activity which absorbs resources but creates no value (Womack, J.P. and Jones, D.T., 1997). The Picture below shows the different types of waste that could be found in any process.



Finding the root causes of the problem starts by using the fishbone diagram (Also, cause and effect diagram) to find the possible causes that contribute to the main problem which is “delay on the flow line modification”. The effect goes at the head of the fish. Then team members brainstorm around and add the possible causes of this problem in the bones.



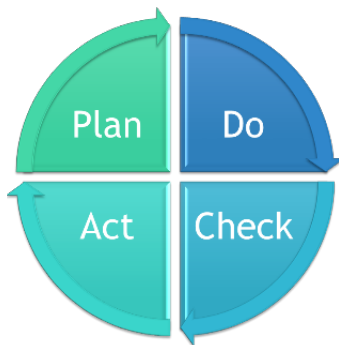
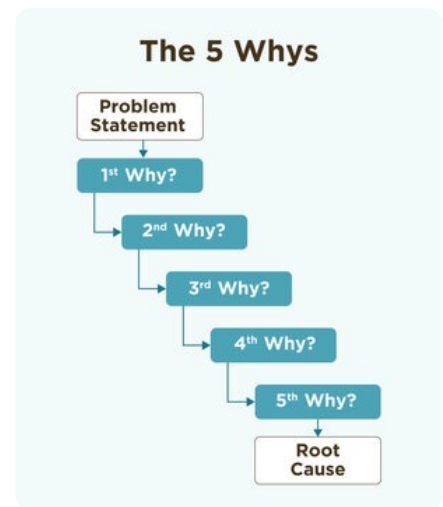
Fishbone tool is not enough to find the root cause. Taiichi Ohno emphasized that true problem solving requires identifying the root cause rather than the source, the root cause lies hidden beyond the source. Without solving the root cause of the problem, it is likely to keep returning (Liker, J.K., 2021). The next tool that compliments the process is the 5 whys tool. This tool leads to finding the root cause of the problem then solving it.

Countermeasures are developed by the team to work to solve the root causes. These actions are prioritized based on Benefit and effort.

The countermeasures that can create the biggest value shortly are converted into actionable plan with specific target date and responsible person. At this step, it is critical to empower others to act. Also, produce quick wins (Rother, M. and Shook, J., 2003). Next is to pilot the agreed action plan and monitoring the performance of the process to assess the success of the projects.

The last step of any project is to sustain the success of the project by using Standard of Procedures (SOP), Visual Management Board (VMB) and Leaders Standard Work (LSW).

More important than sustaining the success of this project only is to create a new culture (Kotter, J.P. and Rathgeber, H., 2006). One that allows people to continuously improve. Using Operational Excellence as a strategic weapon (Liker, J.K., 2021). Enabling people and the organization to continuously improve by following PDCA cycle.



Training our brain to accept uncertainty and creatively test ideas to overcome unexpected obstacles as we discover them is a fundamental skill in today's complex, rapidly changing world (Liker, J.K., 2021). Always remember that, Change is the only constant!



The Art of Collaboration, Planning Cross-Functional Projects in the Energy Sector

■ **Abir Al Shuaili**
Planning Engineer
OQEP



The energy sector is evolving rapidly, driven by the global push for sustainable solutions and the need to adapt to shifting market and environmental priorities. Whether in oil and gas or renewable energy, organizations must tackle intricate challenges while delivering reliable energy to meet growing global demands. Collaborative efforts across functions—spanning engineering, operations, finance, environmental compliance, and more—are essential for achieving strategic objectives.

■ The Power of Strategic Planning and Implementation

Strategic planning lays the groundwork for achieving cross-functional success in both oil and gas projects and renewable energy initiatives. It involves aligning business goals with organizational resources and establishing a clear roadmap for execution. A key component of this process is the Strategic Circle of Decisions, a framework that outlines the stages of effective decision-making within an organization. It includes:

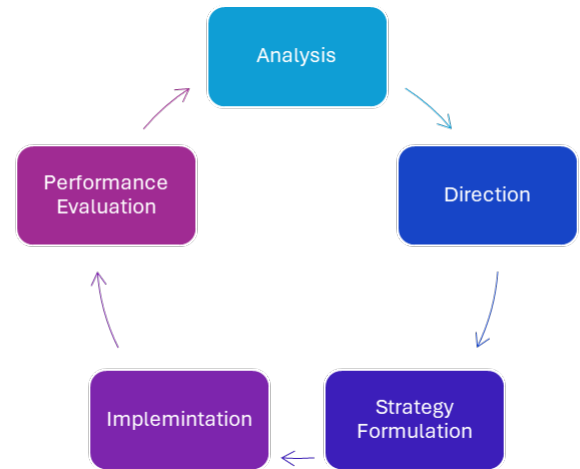
- **Strategic Analysis** : Assessing the organization's internal and external environment to identify strengths, weaknesses, opportunities, and threats (SWOT).
- **Strategic Direction**: Setting the vision, mission, and long-term goals while identifying key priorities.
- **Strategy Formulation** : Developing actionable strategies tailored to the organization's objectives, such as market expansion or innovation.
- **Strategy Implementation** : Allocating resources, creating action plans, and ensuring organizational alignment for seamless execution.
- **Performance Evaluation** : Measuring outcomes, analyzing KPIs, and refining strategies based on feedback and results.



This iterative process enables organizations to adapt and make informed decisions in a dynamic environment. To achieve strategic goals, organizations must integrate diverse perspectives. For example, a renewable energy project such as a solar farm requires input from engineering teams on site design, financial teams on cost projections, and compliance teams to navigate regulatory challenges. Similarly, in the oil and gas sector, upstream exploration projects depend on collaboration between geologists, drilling teams, surface projects teams and environmental experts to balance operational efficiency with regulatory requirements. Strategic execution depends on robust project management practices. Tools like Gantt charts, integrated project management software, and regular cross-functional reviews ensure that milestones are met. Transparent communication between departments is critical to preventing delays or misaligned priorities.

■ The Art of Monitoring and Control

Monitoring and control mechanisms are crucial for ensuring that resources are used efficiently and that strategic objectives are met without compromising sustainability. These processes involve tracking the progress of projects, ensuring adherence to budgets and timelines, and ensuring that key performance indicators (KPIs) are consistently met. In both oil and gas and renewable energy sectors, the ability to gather and analyze data in real time is critical. Advanced data analytics and performance dashboards allow decision-makers to make informed adjustments as needed, identifying bottlenecks and inefficiencies early on. In addition to economic considerations, monitoring and control also involve tracking environmental and safety impacts. For example, in the oil and gas sector, emissions and waste management must be continuously monitored to ensure compliance with environmental regulations. In renewable energy projects, monitoring systems can track energy output, grid integration, and the environmental footprint of production. By integrating these monitoring tools, companies can achieve a balance between profitability and environmental responsibility, ensuring that projects are not only financially successful but also contribute to sustainable development goals.



■ Managing Strategic Change

Managing strategic change is a critical aspect of ensuring that organizations can adapt and thrive in a constantly evolving energy landscape. Strategic change involves not only shifting internal processes, technologies, and structures but also adjusting to market dynamics, regulatory requirements, and global trends. In the oil and gas industry, strategic change might involve the adoption of new drilling technologies, enhanced safety protocols, or a shift towards more sustainable practices. In the renewable energy sector, it could include scaling up renewable projects, integrating innovative energy storage solutions, or complying with changing environmental regulations. Effectively managing strategic change requires a structured approach, where the drivers of change are identified, analyzed, and addressed with a clear, well-communicated plan that involves all levels of the organization. As the energy sector faces rapid transformation, effectively navigating strategic planning, execution, monitoring, and change management is essential for achieving long-term success. National young professionals, with their fresh perspectives and digital fluency, are uniquely positioned to drive these transformations. By contributing to cross-functional projects and embracing strategic decision-making, they can play a key role in shaping a sustainable energy future, ensuring their countries meet global energy demands while promoting economic and environmental sustainability.

Transforming Waste into Clean Energy

Inspired by Oman's 2030 vision to reduce carbon emissions, the inception of X2E was driven by the ambitious «Mission 15,» which aims to remove 15 gigatons of carbon annually by 2030, impacting billions of lives and fostering a sustainable future. The company's core focus is on waste-to-energy, transforming waste into renewable energy and maximizing the value of discarded materials.

A Culture of Empowerment and Innovation

In this dynamic environment, a culture of empowerment is felt strongly among young professionals. Direct engagement with clients and industry experts is encouraged, and decisions are made with confidence, supported by a belief in the abilities of the team. Professional growth is valued, and contributions are driven by a shared vision. Although the company is still new in the renewable energy sector, an openness to opinions and innovative ideas is fostered, inspiring employees to push the company forward. Continuous learning and development are emphasized, with numerous opportunities for training and skill enhancement provided. Young professionals are actively involved in key projects, where real-world experience is gained, and leadership skills are developed.

Contributing to Oman's Economy and Community Development

X2E's projects in Oman and the surrounding region are focused on creating lasting value for the local economy by prioritizing In-Country Value (ICV). Rather than hiring locals merely to fulfill tender requirements or for superficial benefits, the emphasis is on recruiting the most talented local professionals to develop new skills and support the growth of emerging industries. The goal is to establish a strong local workforce and industry base, positioning the compa-

ny to sell its products domestically once supportive policies and regulations are in place. A prime example of this commitment is the investment in Wakud, Oman's first biodiesel plant. Despite the challenge of competing against subsidized diesel, X2E has chosen to offer unsubsidized fuel blends that enhance market viability. This strategic decision supports the government's 2050 CO2 emission reduction targets and underscores the need for policy adjustments to create a fairer competitive environment.

Key Projects in Oman: Challenges, Implications, and Benefits

Wakud, the first biodiesel plant in Oman capable of being fully powered by solar energy, is a significant project. Due to challenges in the local market, including competition from subsidized hydrocarbon diesel, 70% of production is currently exported. While X2E's goal was to sell all biodiesel locally to help reduce carbon emissions and support Oman's 2030 vision, the company is actively working with government ministries to overcome these barriers, reinforcing its commitment to sustainability and economic development. Additional projects focus on converting waste to energy, producing biogas, and biofuels.



Sustainability and Environmental Responsibility Initiatives in Oman

Committed to sustainability and environmental responsibility, X2E focuses on turning waste into renewable fuels and power, significantly cutting down fossil fuel reliance and carbon emissions. A notable example is the B100 biodiesel, which achieves a 75-80% reduction in CO₂ emissions. A strong emphasis is placed on hiring local talent to foster skills and build industries within the community. The investment in Wakud is a key example; despite competition from subsidized diesel, the company is confident in the market potential of its unsubsidized biofuel blends and their role in achieving Oman's 2050 CO₂ reduction targets. Currently, 90% of the workforce comprises Omani nationals, with over 30-40 local graduates trained in advanced biofuel production.

Staying Ahead in a Competitive Industry

X2E sets itself apart from competitors through a strategic blend of technical innovation, policy adaptation, and economic strategies. The company customizes its technology choices to fit the specific needs and challenges of each project, avoiding a one-size-fits-all approach. It's adaptability to market conditions and proactive engagement with government entities to shape renewable energy policies help it stay ahead of potential opportunities. Additionally, X2E emphasizes strategic partnerships and value sharing, ensuring that all stakeholders benefit, fostering a collaborative environment that drives long-term success and innovation in local and global markets.

Expansion Plans and Opportunities for Young Professionals

X2E is expanding with initiatives like a carbon sink program, a new Sustainable Aviation Fuel (SAF) plant, and a biofuel feedstock program, reflecting its strong commitment to renewable energy. Collaborations with global leaders and a focus on high-potential regions offer young professionals transformative project experiences, advanced training, and expert mentorship. By integrating local SMEs, X2E supports the broader ecosystem and creates valuable career opportunities for young talent in the industry.

Success Stories of Young Professionals: From Engineers to Leaders

Take the story of an Omani engineer Ibtihal Al Bahrani who started with X2E as fresh projects engineer and quickly rose to become a projects manager. With the company's support, this young professional is now a PMP candidate, preparing for upcoming projects. Similarly, Aaisha Al Maktomi, another young professional at X2E, has been given the freedom to develop an R&D project focused on optimizing e-fuel assets. Her innovative work is now advancing towards IP registry and development, showcasing X2E's commitment to nurturing talent and fostering innovation.

Advice for Young Professionals Aspiring to Join the Renewable Energy Sector

For young Omanis starting their careers, don't hesitate to join a startup company in the renewable energy sector. Startups offer unique opportunities for growth, even if things don't always go as planned. While the journey may come with setbacks, persistence and a proactive mindset are key. Take initiative, demonstrate your capability, and treat the company as if it's your own. Success in this field is about more than just doing a job—it's about believing in a vision and working passionately towards it. Continuous learning and development are also crucial. Staying updated with the latest trends and technologies in renewable energy will make you more valuable to your company. Network with others in the industry, find mentors, and build strong professional relationships. And most importantly, let your passion for renewable energy and sustainability drive you. It's this passion that will inspire not only your own success but also the growth and innovation within the entire renewable energy sector.



Pioneering the Future of Drone and AI Technology

Since its inception in 2017, ESBAAR has established itself as a trailblazer in the drone and AI technology sectors, achieving remarkable milestones that underscore its technical prowess and economic impact. With each year, the company has expanded its capabilities, evolving into a key player in the industry. This narrative will explore ESBAAR's journey, from groundbreaking technical achievements to economic successes, and how the company navigates challenges while maintaining its competitive edge.

Technical and Economic Milestones

ESBAAR's journey began with a groundbreaking moment in 2018 when it conducted its first commercial drone operations for one of Oman's largest oil and gas companies, marking the start of its rapid ascent in the industry. In 2022, the company reached a new technical milestone by implementing Beyond Visual Line of Sight (BVLOS) operations, allowing drones to function beyond the operator's line of sight. This capability was pivotal for expanding the scope of remote and large-scale projects, demonstrating a commitment to pushing the boundaries of drone technology. By 2023, operational safety and efficiency had been significantly enhanced through the integration of AI-driven safety measures and risk assessment protocols. This advancement earned ISO certifications for drone operations, positioning it as one of the few drone companies globally to achieve this level of recognition. These technical achievements were complemented by significant economic successes, with clients reporting up to 70% cost savings and higher returns on investment due to the precision and efficiency of the drone and AI solutions. The company's growth is also reflected in its workforce expansion, growing from a small team to 150 employees by the end of 2023. This increase mirrors the rising demand for its services and expanding operations, solidifying its position as an industry leader.

Addressing Technical Challenges with Advanced Drone Technology

ESBAAR's advanced drone technology addresses some of the most technically challenging applications across various industries. In hazardous environments like oil refineries, chemical plants, and power stations, drones excel at conducting inspections that would be dangerous for human workers. Equipped with advanced sensors and cameras, they safely and effectively navigate and inspect areas, ensuring infrastructure integrity without compromising safety. For asset integrity management, the drones use high-resolution imaging and data analytics to detect and assess

structural defects, corrosion, and wear in critical assets like pipelines and offshore platforms, which is essential in industries where maintaining infrastructure integrity is crucial. In the construction sector, they support project planning, progress monitoring, and site surveying by providing accurate topographic mapping and volumetric measurements, helping project managers optimize resources and enhance safety.

Staying Compliant in a Dynamic Regulatory Landscape

Compliance with evolving drone regulations and policies is a top priority for ESBAAR. The company employs a proactive approach, continuously monitoring regulatory updates across different regions to ensure that its operations adhere to all legal standards. A dedicated compliance team works closely with regulatory bodies, staying informed through industry conferences and workshops to keep up with the latest regulatory trends. All drone operators at ESBAAR are required to obtain necessary certifications and licenses, ensuring they are well-versed in the regulations and best practices of drone operations. The company also invests in ongoing training for its team, incorporating safety drills and compliance workshops to ensure that all employees are equipped to navigate the dynamic regulatory environment.

AI Solutions: A Competitive Edge

ESBAAR's AI solutions, such as RIG AI and ESBAAR ENGINE, stand out in a crowded market by offering advanced technology integration and real-time analytics. RIG AI uses computer vision analytics and AI-powered WITS data processing to monitor rig floors, increasing safety and reducing downtime. ESBAAR ENGINE processes UAV-collected data, detecting anomalies and patterns with machine learning algorithms to enhance decision-making. What sets ESBAAR's AI solutions apart is their seamless integration into existing systems, minimizing disruptions and maximizing efficiency. These solutions offer significant economic benefits by optimizing operational costs, automating routine tasks, and providing actionable insights, leading to higher productivity and long-term value for clients.

Overcoming Technical Hurdles in AI Development

Developing and deploying AI solutions at ESBAAR has not been without challenges. One of the primary hurdles has been ensuring high-quality, relevant data for training AI models. ESBAAR has addressed this by implementing rigorous data collection and pre-processing protocols. Collaborations with industry partners have also provided access to diverse datasets, enhancing the robustness of the AI models and ensuring they are equipped to handle the complexities of real-world applications.

RIG AI: Revolutionizing Rig Operations

RIG AI is one of ESBAAR's flagship offerings, designed to monitor safety and operational efficiency on rig floors. By employing advanced object detection algorithms, RIG AI identifies and tracks personnel and equipment, ensuring compliance with safety protocols. It provides real-time alerts for any safety breaches, helping to prevent accidents and optimize processes. The market has responded positively to RIG AI, with deployments on seven rigs in Oman and interest from oil and gas leaders across the region. The solution's ability to enhance safety and productivity has translated into significant economic benefits, including cost savings, reduced downtime, and improved resource utilization.

Navigating Industry Challenges

Navigating the challenges in the tech industry, particularly regarding AI and drone technology, requires strategic policy approaches. ESBAAR's compliance and regulatory adherence are bolstered by a dedicated compliance team that monitors and adapts to changing regulations. The company also adheres to strict ethical guidelines in AI development, ensuring transparency, accountability, and robust data privacy measures. Risk management is another critical area, with comprehensive protocols in place to identify and mitigate potential risks. ESBAAR also engages with stakeholders to gather feedback, ensuring that its solutions meet the needs and expectations of clients and regulatory bodies.

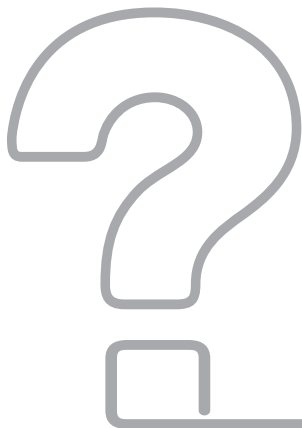
Advice for Aspiring Professionals

For young professionals aspiring to work in the tech industry, particularly in AI and drone technology, ESBAAR emphasizes the importance of continuous learning and practical experience. Engaging in hands-on projects, internships, and hackathons can provide valuable insights and opportunities to apply theoretical knowledge in real-world scenarios. Networking and collaborating with industry peers can also open doors to new opportunities and enhance understanding of industry practices. ESBAAR encourages young professionals to stay curious and proactive, seeking out opportunities to learn and grow. By embracing continuous learning, gaining practical experience, and building a strong foundation in both technical and interpersonal skills, aspiring professionals can position themselves for success in the rapidly evolving fields of AI and drone technology.



Future Outlook

Young Professionals Perspective



What do you think is the impact of introducing advanced technologies such as AI and Machine Learning into energy sector in Oman ?

The adoption of AI and Machine Learning in Oman's energy sector unlocks immense potential that drives innovation in transformative projects like PDO's Amal Solar Plant and OQ's hydrogen production. These technologies improve efficiency, optimize resource consumption, reduce downtime, and lower emissions. They not only enhance Oman's oil and gas operations but also support its growing role in renewable energy, low-carbon solutions and environmental sustainability. This transition aligns with Oman's vision for energy efficiency, productivity and AI integration. Additionally, it creates an opportunity to upskill the workforce through training programs, empowering Omani professionals to lead innovation.

Ahmed Al Harthi

Petroleum Engineer
Student at SQU

Abir Al Shuaili
Planning Engineer
at OQEP

Advanced technologies such as AI and machine learning have the potential to revolutionize Oman's energy sector by driving efficiency and fostering innovation. However, adoption faces challenges like data accessibility, high costs, skill gaps, and cybersecurity risks, requiring investments and collaboration to overcome. As the young generation, we must embrace AI-powered tools to improve productivity and work quality, while understanding that humans remain the key problem-solvers, with AI as support. People are better suited than AI for a much broader spectrum of tasks. By recognizing AI's potential and aligning it with our specific industry needs, exploring and applying these technologies can streamline maintenance, boost production, and optimize supply chains. It also supports sustainability goals by integrating renewables, reducing emissions, and promoting circular economy practices. We must adapt these technologies to meet our country's local requirements.

The integration of AI and Machine Learning is revolutionizing Oman's energy sector by optimizing operations, enhancing predictive maintenance, and driving efficiency. These technologies enable real-time monitoring of assets, reducing downtime and costs while improving safety in high-critical operations. Furthermore, AI-driven data analytics supports better decision-making in renewable energy integration, aiding the nation's transition toward sustainability. As Oman embraces digital transformation, these advancements are pivotal in achieving energy resilience and maintaining a competitive edge in the global market.

Saud Al Saifi
Petroleum Engineer
Student at SQU

ML and AI possess the capability to elevate Oman Energy sector to its PRIME phase. Such superb tools can harness and leverage the current expertise, building on extensive years of experience and vast amount of data, in which minor tasks and large-scale projects can be accomplished optimally.

This technological advancement aligns with the Oman 2040 vision, fostering comprehensive development and sustainability across the sector.

These technologies will empower stakeholders to maximize value and drive scalable solutions, opening new avenues and leading to total GROWTH.

**Al Mundhir Al
Jadidi**
Reservoir Engineer
PDO

Al Ghalia Al Jabri
Chemical Engineer
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Due to increasing population and energy demand in Oman, energy systems are critical to societal function. To address this growing demand efficiently, AI-powered models, algorithms, and ML have become essential tools for optimizing energy systems. An advanced AI system can process information and perform calculations at a speed and scale far exceeding human cognitive capabilities. AI relies on multiple machine learning techniques that identify patterns within data sets and generate predictive models. AI and machine learning can revolutionize Oman's energy sector by increasing efficiency, optimizing operations, and enabling the transition to renewable energy sources. This can lead to cost savings, reduced environmental impact, and improved energy security in Oman.

The introduction of AI and machine learning into Oman's energy sector can significantly enhance operational efficiency. These technologies enable real-time monitoring and predictive maintenance, reducing downtime and operational costs. Additionally, AI can play a pivotal role in advancing sustainability by helping design and implement renewable energy solutions, aligning with Oman's Vision 2040 goals. Moreover, the ability of AI and ML to process and analyze huge amounts of data ensures improved decision-making, reducing human error and providing strategic insights for optimizing energy resources.

Nihad Al Balushi
Integrity Engineer at
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**Dr. Abdullah Al
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Senior Manager of
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Introducing AI and ML in Oman Energy Sector play a significant role in developing the sector. Introducing these technologies into the energy sector in Oman will enhance economic and environmental sustainability, and support the achievement of the goals of Oman Vision 2040 related to sustainable development. AI and ML can improve the system energy efficiency, smart grid implementation, promoting renewable energy. It also provide support in the operation and maintenance of the systems. As well, improving customer services by improving the customer experience through the automation processes such as issuing invoices and providing technical support faster and more accurately.



How do you think Young Professionals can be more involved in the discussions & decisions to support the prosperity of Energy Sector in Oman ?

Young Professionals can significantly impact Oman's energy sector by actively engaging in industry forums, driving sustainability projects, and collaborating on innovative research. By joining platforms like SPE and Oman Energy Association, we can bring fresh perspectives, especially in areas like green hydrogen and renewables. Utilizing digital platforms to share insights, advocating for forward-looking policies, and continuously upskilling in technologies like AI and CCS will strengthen our voice. With a proactive approach, we can be central to Oman's Vision 2040, guiding the energy transition and fostering a sustainable future.

Abulhadi Al Saadi

Petroleum engineer
Halliburton

Imad Al Yaqoobi

Associate RE
Oxy

By actively participating in knowledge-sharing platforms, taking part in policy discussions, and working with industry leaders on creative projects, young professionals may play a crucial role. Promoting leadership, skill-building, and mentoring initiatives will guarantee that their viewpoints and experience help to shape Oman's energy future.

As young professionals, we can be involved in the discussion and decisions by empowering us with pivotal responsibilities in real decision-making processes to support the prosperity of energy sector in Oman. These responsibilities could start from participating in negotiations preparations, actual negotiations to the final says in international conferences. In addition, we should be empowered in the process of new technologies' evaluation, selection and implementation. Moreover, it is crucial to be involved in business strategies discussions and decision to be proactive in dealing with any disruption occur and ensure our sector's sustainability and growth while considering humanity, safety and environment.

Rafiah Al Hammadi

Well Services Engineer
Oxy

Sultana Al-Nasseri

Electrical Energy Studies Engineer at Ministry of Energy and Minerals

The youth category is the main driver in the system of all countries, as they are the core of creativity and innovation, and the country must pay attention to this category through: raising awareness in sustainable energy, skill development, supporting their innovation, creating dialogue spaces and highlighting success stories. Through these measures, young Omanis can be motivated to play an active role in supporting and stimulating the prosperity of the energy sector in Oman.

Young professionals can impact Oman's energy sector by bringing fresh ideas, innovative approaches, and diverse perspectives to the table. By participating in global conferences, they can exchange knowledge and address challenges in energy transition, such as green hydrogen and CCUS technologies. Engaging in scientific research and leading pilot projects within organizations will drive decarbonization and sustainable practices. Supporting youth-led organizations and providing a platform for their voices will encourage active involvement. Additionally, investing in professional development through training and leadership opportunities empowers young professionals to take ownership and drive positive change. Their contributions will align with Oman's Vision 2040, advancing a sustainable energy future.

Maryam Al Lawati

New Business Analyst
Birba Energy Services
LLC

Yaseen Al Lawati

Job Seeker

To drive Oman's energy sector forward, young professionals need both the right tools—like advanced training in renewable energy and project management—and opportunities in leadership roles where they can actively shape the sector's future. Structured programs, such as rotational leadership roles or dedicated innovation councils, would further equip them to contribute meaningfully. Open channels of communication, such as advisory boards and industry forums, encourage continuous dialogue, allowing young talent to share fresh ideas with policymakers and senior leaders. A feedback loop that values their input and implements viable ideas fosters a culture of inclusivity, innovation, and alignment with Oman's energy goals.

To ensure the continued prosperity and advancement of Oman's energy sector, it is crucial to actively involve young professionals in the ongoing discussions and decision-making processes. Their energy, innovative perspectives, and adaptability to new technologies present a unique opportunity to shape the sector's future. One effective approach is through education and specialized training programs that equip young professionals with the expertise needed to tackle the evolving challenges of the energy sector. By fostering partnerships between academic institutions, industry leaders, and governmental bodies, Oman can cultivate a highly skilled workforce capable of driving sustainable development. Creating platforms for dialogue is equally essential. Initiatives such as conferences, seminars, and policy forums allow young professionals to engage meaningfully in discussions on energy policies, ensuring that their ideas and solutions are integrated into the sector's future strategies. Furthermore, mentorship and networking opportunities are vital to facilitate knowledge transfer and collaboration. Encouraging seasoned professionals to guide young talent can not only empower the next generation but also strengthen the sector as a whole through cross-generational partnerships. Additionally, young professionals are often at the forefront of innovation and sustainability. By encouraging their involvement in research and development projects, Oman can leverage cutting-edge technologies and ideas that align with the country's goals of energy diversification and sustainability.

Salman Al Sarmi

Quality Specialist at
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Dr. Mohammed Al Saidi


Assistant Professor
at UTAS


Engaging young professionals in the prosperity of Oman's energy sector through open strategy techniques can leverage their technical skills and commitment to sustainability. By adopting open innovation frameworks, such as collaborative design thinking and digital co-creation platforms, young engineers and scientists can contribute to developing advanced solutions for energy efficiency and renewable integration. Such approaches proved their Effectiveness in the past. Also, open data initiatives can enable professionals to access critical datasets on energy consumption, production, and environmental impact, fostering data-driven innovation in areas such as grid optimization, energy storage, and carbon capture technologies. Participation in interdisciplinary innovation hubs, focused on AI-driven energy forecasting or smart grid deployment, allows young professionals to experiment with cutting-edge technologies while aligning with Oman's sustainability goals.






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