

EOR Whitepaper

How to Create a Virtual EOR Community Across the Middle East?



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EXECUTIVE SUMMARY

Middle East EOR Community (MEEC): The 2nd Gulf EOR Workshop, which was hosted by ADNOC & PETRONAS in Abu Dhabi on Nov. 11th with almost 100 senior stakeholders from the region’s energy industry, academia and government, attempted to answer one critical question – **How to Build a Virtual EOR Community Across the Middle East?** This Whitepaper document is the intelligence harvested from that one-day debate and it contains 6 Recommendations for adoption.

Unity equals progress as energy stakeholders embrace their much-needed evolution from siloed efforts into collaborative synergies that make greater economic and environmental sense. Achieving this balance ultimately strengthens energy security; a holy grail for all.

Decades of trial and error means every Gulf country benefits from a strong foundation of knowledge, encompassing advanced expertise, technologies and policies. Now, this springboard for further innovation has extra bounce with the advent of the 4th Industrial Revolution. How can this unprecedented commercial array of digital tools streamline EOR operations?

A general sense of unity is already present amongst many national oil companies (NOCs), international oil companies (IOCs), academia, technology companies and financial institutions (FI). But a plethora of opportunities must still be leveraged to improve efficiency, cut costs and accelerate funding. As market pressures intensify, how best to knit Gulf countries’ hard-won knowledge together to establish a world-leading MEEC? ■

EOR: A snapshot

\$516.7bn

The valuation of the global EOR market stood at \$38.1 billion in 2012 and could soar to \$516.7bn by 2023, according to Transparency Market Research. Clearly, potential abounds.

75%

Robust EOR methods can literally pay their way. Oil extracted via primary recovery accounts for 5% to 15% of the total reservoir while secondary recovery can extract about 20% to 60% of the total oil present in the reservoir, according to Future Market Insights. But installing EOR technology means 35% to 75% of oil can be extracted.

34%

Can better EOR methods help BP Outlook’s forecast ring true? The energy major expects the Middle East to still be the largest oil producer by 2040, accounting for over 34% of global liquids production.

2025

Gulf countries’ EOR goals are becoming increasingly ambitious and well-supported. Oman has long been a leader, both regionally and globally, in this area. For example, state-owned Petroleum Development Oman (PDO) aims for 25% of its oil production to be supported by EOR by 2025.

15%

The UAE has already made huge strides in improving EOR methods. Between 10-15% of state-owned ADNOC’s oil is currently recovered with EOR technologies, primarily via miscible gas injection.

40%

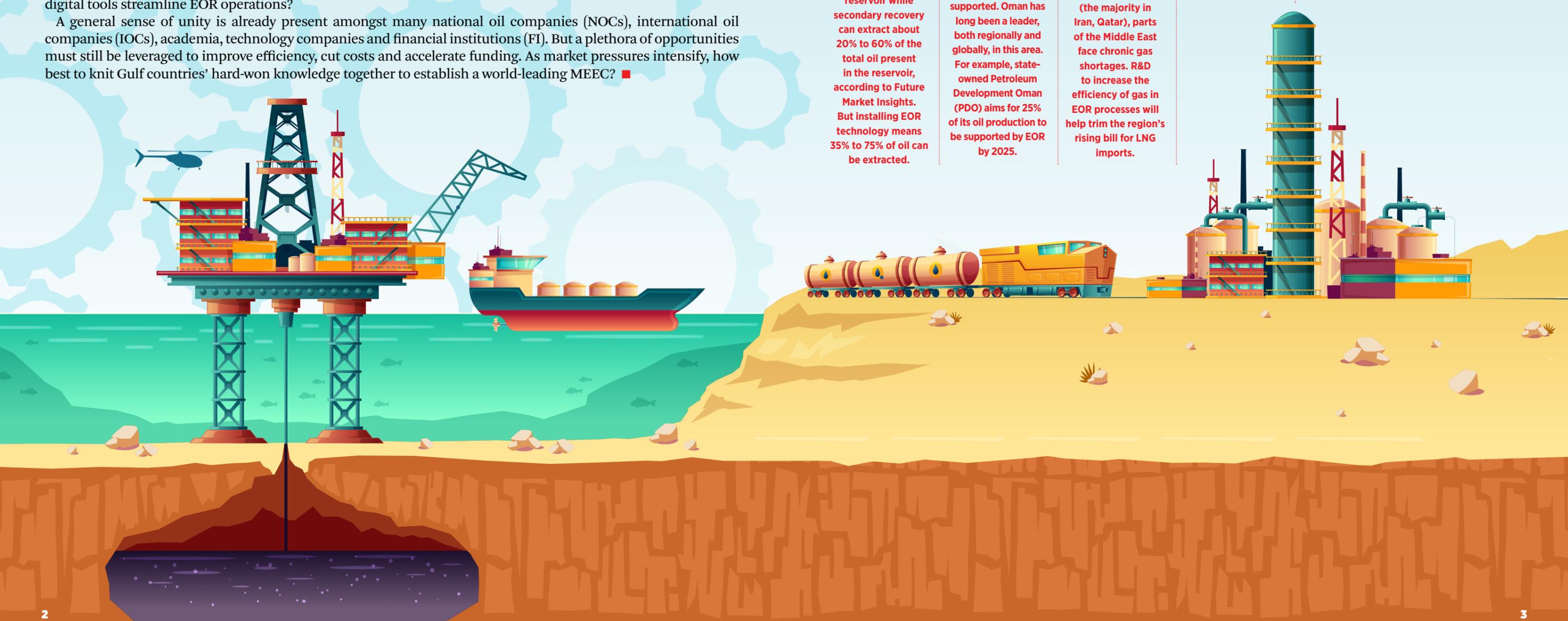
Despite sitting atop approximately 40% of the world’s natural gas reserves (the majority in Iran, Qatar), parts of the Middle East face chronic gas shortages. R&D to increase the efficiency of gas in EOR processes will help trim the region’s rising bill for LNG imports.

7.9%

In 2014, the Middle East imported 5.9bn cubic metres of gas as LNG – just under 2% of the global total LNG imports, according to Platts Analytics’ Eclipse Energy. By end-2016, LNG imports had moved to 28.6bn cubic metres a year –7.9% of the global total. The IEA also expects the region’s demand for natural gas to double from current levels by 2040.

25%

In Kuwait, the natural gas needed to produce the steam for Ratqa’s planned thermal EOR operations is equal to a quarter of the country’s current gas production, according to GlassPoint. The incentives to reduce reliance on gas for EOR operations is clear.



Workshop: Source of Whitepaper Findings

The Chatham House Rule was invoked at the meeting to encourage openness and the sharing of information: *“When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received. But neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.”*

OPEN MIC: Following the Welcome Note and introduction of the Critical Question by the moderator and featured speakers, the Stream Discussions followed an open floor format whereby all participants were encouraged to proactively engage in the free flowing conversation.

COME PREPARED WITH RECOMMENDATIONS: All participants were encouraged to come to the table with Recommendations in answer to the Critical Question.

SESSION A:
Shortlist 5 recommendations

SHORTLIST 5 RECOMMENDATIONS

The 1 hour sessions were broken into 3 parts:

- Commentary from featured speakers
- Open conversation with recommendations put forward
- Voting to identify top 5 recommendations per stream

SESSION B:
Reduce shortlist from 5 to 3 recommendations

SHORTLIST 3 RECOMMENDATIONS

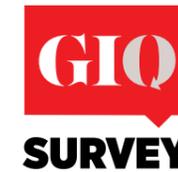
The 1 hour sessions were broken into 3 parts:

- Commentary from featured speakers
- Author of each of the 5 shortlisted recommendations had 5 minutes to promote and defend their recommendation
- Voting reduced shortlist to 3 recommendations per stream

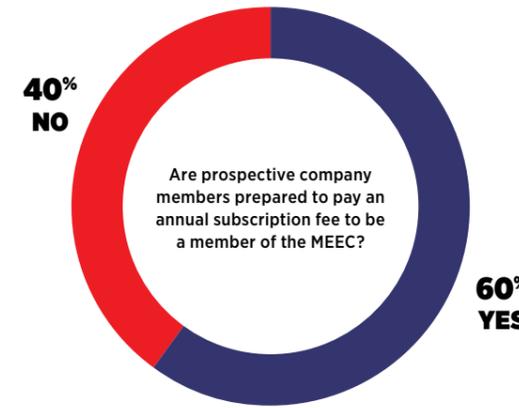
WORKING LUNCH:

Votes on the shortlist of 3 recommendations in each stream secured ranking in order of importance.

NOVEMBER 11 th , 2018	
PLENARY SESSION	
STREAM 1	STREAM 2
TOP 3 RECOMMENDATIONS ON COMMITMENTS AN INSTITUTION MUST MAKE TO BECOME A MEMBER OF THE MIDDLE EAST COMMUNITY OF EOR STAKEHOLDERS (MEEC)?	TOP 3 PRIORITIES THAT THE MIDDLE EAST COMMUNITY OF EOR STAKEHOLDERS (MEEC) SHOULD STRIVE TO FOCUS ON?
SESSION A SHORTLIST TOP 5 RECOMMENDATIONS	SESSION A SHORTLIST TOP 5 RECOMMENDATIONS
SESSION B TOP 5 RECOMMENDATIONS SHORTLISTED TO 3	SESSION B TOP 5 RECOMMENDATIONS SHORTLISTED TO 3
POLL SURVEY ON TOP 3 RECOMMENDATIONS IN EACH STREAM	
FINAL DECLARATION OF RECOMMENDATIONS AND CLOSING COMMENTS	

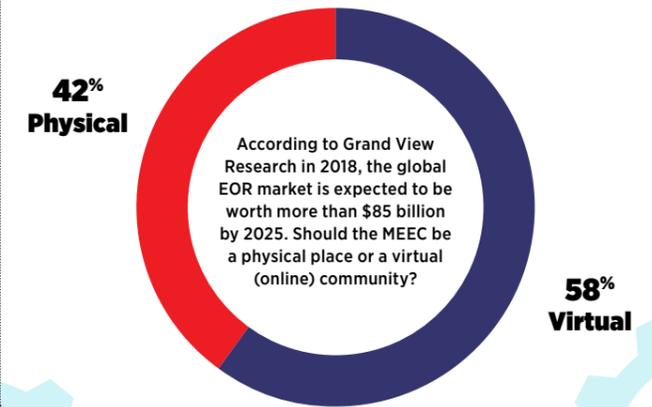
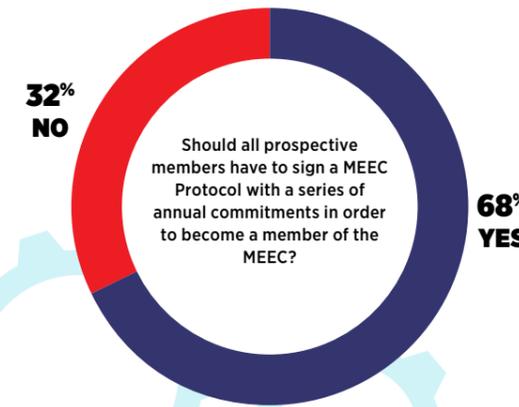
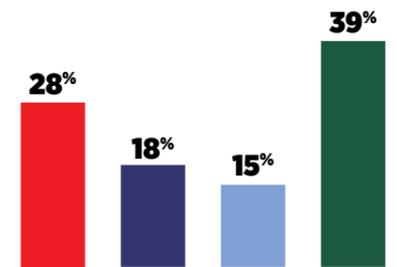


How to Create a Virtual EOR Community Across the Middle East?

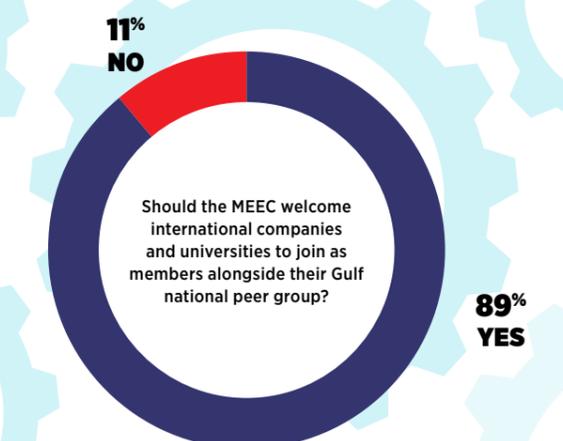
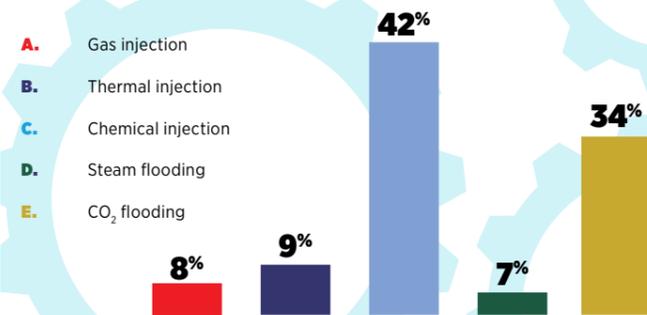


What would be the most important responsibility of a new MEEC with regards to fostering relevant R&D?

- A.** To contribute positively in the development of research and innovation activities at the regional level.
- B.** To participate in organizing and actively engaging in seminars, conferences, workshops and training to build EOR research and innovation capacity.
- C.** To leverage the available financial resources in supporting research and innovation activities.
- D.** To participate in a membership-based virtual collaborative platform where industry, academia and government can interact and engage in research and innovation activities.



Which of the following EOR (tertiary recovery) techniques should the MEEC seek to specialize in?





FOREWORD

BY MOHAMMED AL MARZOUQI
Manager, Development Unit, Abu Dhabi National Oil Company (ADNOC)

Enhanced Oil Recovery (EOR) is no longer a ‘nice to have’ research project. It is a key part of ADNOC’s strategic transformation plans, playing an integral role in the company’s aspiration to reach tertiary field recovery rates of 70% and above. It carries similar importance worldwide; more than 50% of oil companies invest in EOR.

The UAE’s journey in this space started more than 20 years ago in Abu Dhabi with immiscible gas injection. Today, we produce more than 150 million Btu. The future of EOR is a dynamic one. More and more energy companies are leveraging this tool, which has been used for more than a century, to relieve the pressure on their budgets while safely increasing production to meet rising demand. EOR is also an essential tool to sharpen the competitive edge of the oil industry in the UAE and wider Middle East. This is a main driver behind meeting both domestic needs (reducing import bills) and expanding the region’s presence in the global export market. Transparency Market Research expects the valuation of the global EOR market to soar from \$38.1 billion in 2012 to \$516.7 billion by 2023. The highest rate of growth is anticipated in the GCC, reaching \$140 billion by 2024.

New drivers

A recent step change emphasizes the importance of EOR; we are striving for gas self-sufficiency. Therefore, we must be smart about our production growth, especially as growing demand must be balanced against meeting the national obligations made in support of the Paris Agreement. ADNOC’s oil production capacity has increased from 3 million barrels a day (b/d) to 4m b/d – a 33% climb in the last two years alone. And recently, the Supreme Petroleum Council approved a target capacity of 5m b/d by 2030.

As gas supplies need to be deployed elsewhere, we are embarking on more investments in unconventional activities. ADNOC’s comprehensive technology roadmap highlights how we are committed to spearheading the maturation of new EOR concepts, such as carbonate reservoirs, through a series of innovative and ambitious industry trials. These will be piloted over the coming years, including chemical-based hybrid EOR technology.

“If we start from scratch at every turn, we will all lose time and money. Many hands make light work.”

One voice

Successful implementation of these technology trials will require strong collaborative efforts amongst ADNOC’s diverse set of stakeholders – siloes will not work. Our integrated strategy also focuses on linking efforts with wider industry and academia – cornerstones of an innovative and progressive energy market. We must leverage the wide experience of knowledge already at our fingertips so we can all put our strongest foot forward in conventional and unconventional exploration.

Establishing a MEEC for the region would be a major step in the right direction to addressing the existing challenges on technology and policy. It would also set a realistic timeline for EOR deployment. Sharing costs and risks when piloting new technology supports often strained budgets and timetables; many hands make lighter work.

One example is the solar-thermal EOR being implemented at the Miraah project in Oman. Have the details of this success story been shared adequately? Perhaps not.

We should all embrace the advancements in technology that are being made by different partners in the region and we must all be quicker and more effective in identifying opportunities to develop these ideas. With a limited pool of subsurface talent, it is crucial to support regional R&D investments and align efforts across the Gulf. ADNOC cannot do this alone.

Critics may argue that this approach could lead to challenges in managing diverse solutions, but that is where ADNOC can be a facilitator. The goal in ADNOC’s upstream division is to identify and facilitate solutions by studying different assets while preserving the confidentiality of each technology for each partner. Essentially, we aim to enable sharing in a commercially safe environment. If we start from scratch at every turn, we will all lose time and money.

Together, we move faster. ■



“ADNOC’s oil production capacity has increased from 3 million barrels a day (b/d) to 4m b/d – a 33% climb in the last two years alone. And recently, the Supreme Petroleum Council approved a target capacity of 5m b/d by 2030.”



Panel Insights

Opportunities in a Digital Marketplace for a Virtual Industry-Academia Community?

PANELISTS:

- Mohammed Al Marzouqi, Manager, Development Unit, Abu Dhabi National Oil Company (ADNOC)
- Dr. Shahin Negahban, Director of TORP & Associate Professor, Department of Chemical & Petroleum Engineering, The University of Kansas
- Dr. Nasir Haji Darman, CTO of Group Research and Technology, Project Delivery & Technology Division, PETRONAS

MODERATOR:

Sean Evers, Managing Partner, Gulf Intelligence

Sean Evers: Should the MEEC reach out to international companies and universities to join as members alongside their Gulf national EOR group? Or would it be better served keeping it within national universities and national research centers?

Mohammed Al Marzouqi: EOR in the region itself has matured but it lacks the different aspects of some technologies and R&D. That's where international academia and shareholders are comparably active and would be advantageous.

Sean Evers: Which EOR technique should a new MEEC seek to specialize in or prioritize its focus? For example, chemical or CO₂ injection? Solar thermal?

Mohammed Al Marzouqi: In the UAE, we are focused so far on chemical injection and CO₂ flooding, because that suits the condition of our reservoirs.

Sean Evers: Do you think that would be something that would be shared by your neighbors across the region?

Mohammed Al Marzouqi: Last week, ADNOC had a very good workshop with Aramco, not necessarily for EOR, but more for carbon capture and technologies. We also have agreements with Kuwait Oil Company (KOC) and Petroleum Development Oman (PDO), but we need to do more and to be more agile and quick.

Sean Evers: Dr. Nasir, what are your thoughts on the best type of EOR to focus on from a global perspective? And where technology development is at?

“Where does the future of EOR lie? In integrating artificial intelligence for field management with the physics of reservoir engineering.”

Dr. Nasir Haji Darman: We need to remember that it is not so much the technology that we select but rather the issue that we are trying to solve. These can be very specific and unique to the country and reservoir. If the reservoir needs chemical or CO₂, then the whole technology program needs to align with that. So, it's an asset question.

Sean Evers: Dr. Shahin, do you agree on this need to focus on analyzing the problem before deciding on what technology solution to research?

Dr. Shahin Negahban: You have to do a detailed study of reservoirs, screening what type of oil you have, depth and so on. Then you select the route. At ADNOC, chemical injection and CO₂, or a hybrid of both, is ideal.

Sean Evers: What about other solutions? Look at the US when it continued to pursue research into shale; they have added 5m b/d to their production in the last decade.

Dr. Shahin Negahban: Shale technology has been key for production increases in the US but it also brings a lot of challenges.

Sean Evers: Dr. Nasir, PETRONAS is operating now all over the world, in Iraq, in Mexico and new concessions at home in Malaysia. Is it a challenge when you're dealing with so many geographies with EOR?

Dr. Nasir Haji Darman: We basically need to look at all technologies because every country requires a different solution. For example, thermal in Malaysia is useless because the nature of our oil is very light and it is offshore. But we still have to study thermal because we also operate in Sudan where the oil is very viscous and we can only inject gas.

Sean Evers: Do you have to develop competence in house for all these different applications?

Dr. Nasir Haji Darman: It's multi-pronged. If we look at Malaysia, we basically have a physical center where our service providers can come in and work with us. In international areas, we have several partners, such as CNPC in China. And we have other partners, such as Shell. We know their strengths and they know our strengths – then we share the results.

Dr. Shahin Negahban: EOR is not a new technology. The number one challenge in the Middle East is people. We have to develop the expertise. The second thing is you can look at all these processes but you will always end up doing a techno-economic analysis to come up with an optimum solution. CO₂ might be the best solution but if it costs you a lot of money to produce it, that's not a true solution. You need to make sure that the process you're using for the country benefits the most in terms of cost also.



Sean Evers: Regarding the MEEC, will companies becoming members of this potential center be willing to actually pay for annual subscription fees and secondly, what would be the most important responsibility of a new center? For example, to conduct relevant R&D or leveraging available financial resources in support of innovation? Being able to participate in a membership-based collaborative platform where industry, academia and government can interact and engage in research and innovation activities? Or a digital platform where project details can be exchanged and project teams set up and so on?

Mohammed Al Marzouqi: We need to leverage everything, be it by conducting workshops or the actual development of EOR activities.

Sean Evers: Dr. Shahin, you've participated and worked a lot in Abu Dhabi and you're now at the University of Kansas. How do you compare institutions here for research and fundraising and so on with the US? What advice would you have?

Dr. Shahin Negahban: You have got to be smart in terms of profitability and efficiency and you don't want to reinvent the wheel. If you look at petroleum-related universities in the US, it's not a large

“ EOR has just begun...look at the US! They pursued their research into shale and have added 5m b/d to their production in the last decade.”

number but they are very specific in what they do. If you want to do numerical work, you go to Stanford and the University of Texas, for example. We should consider universities based on what they offer and try to align what they offer with ADNOC's vision. Focus on the most important strategies of the conflict in terms of how best you can bring in technology and implement it in the field.

Sean Evers: Dr. Nasir, what are your thoughts and advice in terms of the challenge of creating a regional center of excellence, which essentially means cooperation and partnership?

Dr. Nasir Haji Darman: Let's divide the issue into two. One is solving the problem of the asset and the second is solving the technological challenge. The idea of collaboration is not new. There are many joint industry project (JIPs) where multiple companies contribute along with 40 or 50 sponsors, which enables budgets to be quite big. PETRONAS is a true believer in

that. We have many JIPs that we join in this nature and although they are not providing a solution on a particular asset, we can gain the knowledge and possibly use that technology elsewhere.

Sean Evers: How do you overcome the idea of intellectual property (IP) i.e. the inherent idea to protect while trying to collaborate and create new solutions?

Dr. Nasir Haji Darman: At PETRONAS, we don't mind sharing the IP on early blue-sky research. If we develop one which is good, even if it fails, we can learn from it. However, when that technology becomes very specific to our competitive advantage, that is where we strengthen our position. So, our IP position is not static. It's very dynamic depending on the maturity of the project that we're going to do.

Mohammed Al Marzouqi: This is a very challenging aspect in our EOR activities. It's a blessing when you have more than a dozen shareholders, but that also means



“ CO₂ might be the best solution but if it costs you a lot of money to produce it, that's not a true solution. You need to make sure that the process you're using for the country benefits the most in terms of cost also.”

managing the different technologies coming from each one and where that can be applied, and in which reservoir, etc. That is where ADNOC can come in as a facilitator. The smart thing is to build where people have finished. Our goal in ADNOC's upstream is to facilitate and work things out between the different assets, while appreciating the confidentiality of each technology for each partner.

Dr. Shahin Negahban: The IP issue could create a challenge within the MEEC.

Sean Evers: But in the context of the Gulf, we've got NOCs, such as KPC, Aramco, ADNOC and PDO who don't have any competitive issues to be concerned about. They obviously all want IP but they're not

competing with each other in the way that Shell or Exxon or PETRONAS might be. And so perhaps there will be less sensitivity around IP?

In terms of the commitments that countries or companies would need to make to a Protocol document as members of the MEEC, what would those typically be? For example, assign a focal person to liaise with the virtual digital platform or a point person to lead the initiative? Another condition could be to provide a list of industrial research challenges and aspirations. Inevitably, if we're going to solve problems, we need to know what those problems are and companies need to be ready to be a bit transparent about their challenges and then active in supporting a particular R&D challenge and commit to it through to adoption.

Dr. Shahin Negahban: EOR is a proven technology so the focus should now be on areas like the 4th Industrial Revolution and deep learning and application of methods, so that we can minimize the use of composition modelling, for example. It is also important to get to the 70% recovery factor and to do that, you have to focus on displacement efficiency at the core level. Integrating artificial intelligence for field management with the physics of reservoir engineering is where the future lies.

Dr. Nasir Haji Darman: EOR starts at the subsurface, goes up through to the surface and onto the fill point. There is not one company that can be good at everything in this whole value chain. Collaboration is the only way to go. We should all leverage the strength of our partners in solving our own interests. We can study a particular asset and then share that new knowledge.

Mohammed Al Marzouqi: Despite many memorandums of understandings (MoUs) signed between GCC countries, they are not moving forward enough on cooperation. There is a gap that must be plugged. ■

**Edited transcript*



WORKSHOP – STREAM 1

What are the Top 3 Commitments a Company Should Make to Qualify for Membership of the Middle East EOR Community (MEEC)?

MEEC that brings all stakeholders together to share knowledge and solutions would be a huge benefit in an industry that often operates out of sync. The importance of sharing knowledge under one ‘roof’ – such as the MEEC – will only intensify as the EOR market grows. The MEEC must offer clear incentives and benefits to spark and sustain members’ loyalty. How to achieve this win-win outlook?

Developing a Protocol for NOCs, such as membership to the MEEC, could accelerate much-needed innovative and groundbreaking R&D that can cut costs and boosts efficiency. Arguably, the more members there are, the less risk. For example, more than a third (37%) of respondents to a GIQ Industry Survey at the Gulf EOR Workshop 2017 said regional academia and industry should prioritize R&D for

chemical EOR. CO₂ and solar projects took second and third place, respectively. How can pooling efforts make aspirations from last year – and reaffirmed this year – a reality going forward?

Many workshop participants support the concept of a digital MEEC platform, therefore enabling all members to contribute, monitor and feedback on changes in real-time. Not requiring a physical space or sign above the door can also help streamline cross-border progress, encouraging broader membership. The technology available under the umbrella of the 4th Industrial Revolution is already available to make this a reality; the Internet of Things (IOT), artificial intelligence (AI), blockchain, big data analytics and robotic technologies and many more are commercially available.

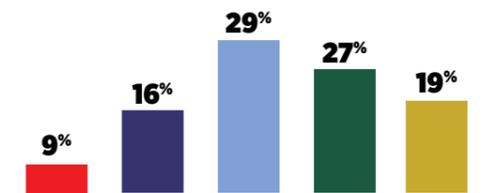
Ease is paramount. All those in the oil value chain

“ Knowledge sharing, participation and innovation: these three key ingredients propel growth!”

already have multiple economic and environmental checklists. The aim of the MEEC is not to add to this myriad of bureaucracy and paperwork, but to make progress easier. The tightrope is real. Efforts to meet the 54% growth that BP Outlook anticipates in the Middle East’s energy consumption by 2040 must abide by increasingly strict lower-carbon targets that support the Paris Agreement at a time when oil prices are hovering around \$60/bl. Hastening progress is also a driver to many Gulf countries’ National Visions to become competitive and knowledge-based economies, therefore climbing the global intellectual league table. What boxes must be ticked for companies to join the MEEC? How to unite these EOR brothers in arms?

Which of the following membership criteria would be most important to include in the MEEC Protocol?

- A. Assign a focal person to liaise with the platform.
- B. Provide a list of industrial research challenges and aspirations.
- C. Support at least one R&D project initiative per year over the next three years. This will be on a project basis and subject to the Technical Committee agreement.
- D. Reasonable endeavor in deploying and commercializing the output of R&D activities into their respective industry, through developing plans or endeavor to adopt some of the outcomes.
- E. Provide possible industrial funding based on submitting research proposals tackling industrial research challenges or consultancy requests.



See GIQ Industry Survey Results; page 5

Points to consider

What would be the top aims of the MEEC by 2025? What overall obligations would the Protocol tie signatories to? What expectations would the Protocol expect from its signatories? Would the market want utmost transparency on this platform? Would that be a prerequisite, or would there be concerns over sharing, i.e. safeguarding IP? What management structure should the MEEC adopt? Should it host a committee? Should hosts be seconded representatives of members on a rotating basis? ■

54%
The growth in the Middle East’s energy consumption by 2040. A flourishing EOR market will play a major role in keeping pace with rising energy demands.



STREAM 1

Top Three Recommendations

1. Commit to sharing intangible resources

Every brick that goes towards building a knowledge bank requires deep-rooted collaboration. Research on reservoir data, technical reports, maintenance records, legalities, copyright, IP and many other areas fall under the banner of intangible resources. Such sharing not only helps those in the MEEC strengthen the efficiency of established operations, but it also gives those with a zest for innovation more tools to redefine the status quo as quickly and as safely as possible. Pinning down members' goals is critical to ensure that resources – finances, talent, time – are directed towards resolving specific challenges that offer the broadest benefits i.e. applied research. This is not a new idea. Nearly all (95%) of respondents to a GIQ Industry Survey at the Gulf EOR Workshop 2017 said Gulf countries should cooperate

“ This virtual platform is a starting point. We are not trying to build a house, but the front door of a house. The walls and roof will come with every successful project. With every conversation, we are literally building the foundations of the MEEC.”

on identifying bespoke and regional EOR solutions. This sentiment has only strengthened in the last twelve months. Now, a merging of minds, funds and time must increasingly result in tangible progress. The route of applied research can be complemented by more exploratory research; investigations without a defined end goal. How resources are split between these two methods will depend on where members' risk-reward barometer lies. Perhaps unsurprisingly, workshop

participants in 2018 shared concerns over the confidentiality of data as one of the main deterrents to regional cooperation. Such concerns must be managed so that transparency is leveraged without dulling competitive edges. Taking a closer look at protection when sharing intangible resources is pertinent as cyberhackers, the world's largely invisible mafia, deepen their digital foothold. Cybercrime accounted for \$600 billion, or 0.8% of global GDP, last year, according to McAfee.

2. Commit to a membership of 3-5 years with a rotating leadership

EOR can be complex. Golden solutions take time and are beyond the capability of one entity. Longevity is a cornerstone of building market confidence in the MEEC, as is rotating leadership between experts in industry, academia and government. A longer-term membership requires more commitment; a public statement to resolve and thrive together. Membership that lasts several years enables companies to make significant progress on development programs under the MEEC, including R&D and talent enhancement. Identifying local champions from member countries – some of whom may be the future thought leaders in EOR – can reinforce the MEEC' knowledge bank and credibility. A start-stop approach risks more paperwork and few solutions. In a busy world, simplicity is vital. How membership is



categorized and managed must be clearly communicated to ensure all participants are on the same page. For example, how to make the bar to entry high enough to reinforce the credibility of the MEEC while ensuring it is not so high that it deters members? And amid the current energy transition, how best to categorize membership as companies' remits can evolve and shift over three to five years?

Should membership be categorized by corporations' goals, existing projects, R&D expertise or structure i.e. state-owned, private, joint ventures (JV)? Or should there be no categories? How best to identify leadership and should it change on an annual or bi-annual basis? Plentiful questions illustrate progress; a market without questions is a stagnant one.

3. Commit to diversify membership between industry, academia and technology developers

How to ensure all the voices in the market are heard? Promote a diversified membership. Equally, these voices must be managed so that they unite in a symphony rather than a clang. Some workshop participants suggested that the organizational model of the MEEC' could consist of four parts; technical evaluation, troubleshooting, financial management and a steering committee. Within these pillars would be a fair representation of industry, academia, government and technology developers. Financial institutions should also be engaged in the

“ It doesn't make sense to try and create new technologies with the current oil price, but it does make sense to improve the efficiencies of the ones we already have. That's where the value is!”

development of the MEEC, as a sustainable pace of substantial funding is paramount. For example, if a company using EOR recovers 5% of a reservoir that has 10 billion barrels at \$50/bl, the revenue earns \$25 million. If the company reinvests 2%

of that earning into R&D under the MEEC umbrella, it amounts to \$500,000. Still, this would only represent one step in the funding journey. The good news is that successful R&D can pay for itself many times over; the math justifies the effort.



Other Recommendations From Stream 1

- COMMIT TO:**
- ✓ Filling the academic gap in EOR studies
 - ✓ Sharing the current status of EOR technologies
 - ✓ Sharing IP for all participants (when appropriate)
 - ✓ Contributing to research and/or application
 - ✓ Crowd sourcing of ideas and solutions from the R&D community
 - ✓ Hosting a group of EOR experts with a large funding source
 - ✓ Joint financial investment to drive R&D funding
 - ✓ Creating better value added to the technique and solution ■



WORKSHOP – STREAM 2

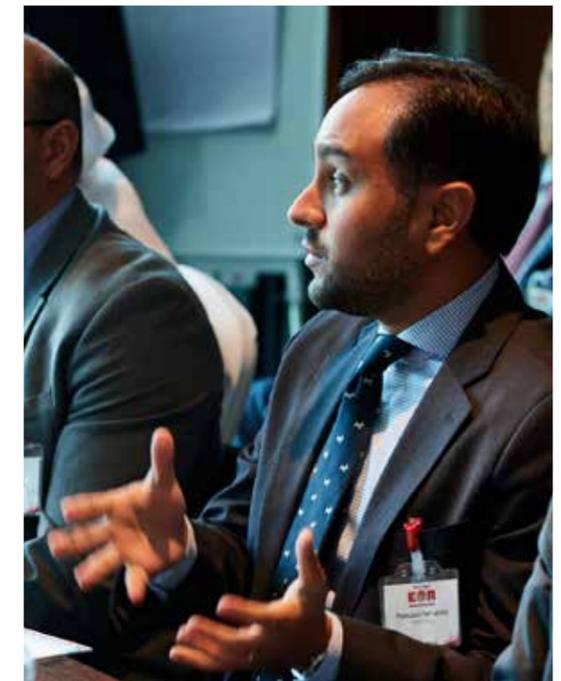
What are the Top 3 Priorities that the Middle East EOR Community (MEEC) Should Focus on?

The current EOR lens is very broad; multiple R&D ideas to explore, applications to test and geographies to adapt to. But the majority of efforts happen in siloes with lessons learned in one project failing to migrate to another, even if both lie within the same border.

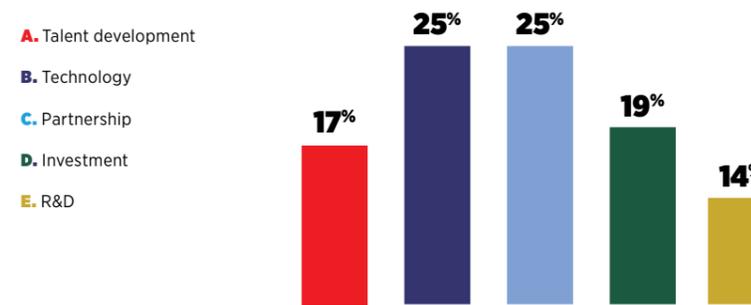
Organizing these factors into a cohesive system, such as under the umbrella of the MEEC, will mean stakeholders do not waste time and money reinventing the wheel. Equally, the MEEC cannot

be a jack of all trades, at least not to start with. Attempting to cover all bases risks spreading resources too thin and alienating potential members.

Therefore, a clear focus with quantifiable goals is paramount to build the credibility of the MEEC, encouraging membership and ultimately, strengthening the overall ecosystem of knowledge and progress. EOR stakeholders all have a common goal; to affordably bolster oil production to meet



Which of the following is the most critical area to advance in order to make EOR operations more economically viable across the Gulf? This includes achieving recovery targets of 70% in the UAE, which is twice the world average.



See GIQ Industry Survey Results; page 5

“With so much diversity and so many ideas, how best to identify a common voice with a streamlined focus?”

domestic needs and sharpen the region’s global competitive edge while hitting lower-carbon targets. Pinning down three key goals that have the widest applicability for members to collectively work towards in the MEEC is a good starting point. What priorities top the list?

Points to consider

The exploration and implementation of new EOR technologies in such a wide space – geographically, politically, economically – is very complex and costs could soar. How could MEEC partners merge strategies to ensure shared success? What would be the risks for MEEC members, if any? What are the strengths of each Gulf country in this process and how can they be leveraged? How important is unity? What are the main hurdles? How beneficial and realistic would it be to have joint EOR projects – collaborating from the laboratory to the field – in order to accelerate the knowledge sharing and application process? ■



STREAM 2 Top Three Recommendations

1. Integrate an asset model of reservoir management across the whole value chain, which can also highlight examples of best practice

The noise of conflicting agendas can make it hard to hear the full worth of stakeholders' insights, adding unnecessary time and costs to already challenging projects. Identifying a common asset model of reservoir management under the umbrella of the MEEC would provide a much-needed beacon of clarity; essentially a language everyone can look to and understand. Less opacity would support more sophisticated levels of reservoir characterization, reservoir management, reservoir modelling and

reservoir monitoring. Stronger integration between sub-surface and surface R&D and operations can also help improve the continuity, efficiency and ultimately the safety of operations. These improvements all help strengthen budget management; gold dust to hedge against unpredictability i.e. oil prices, geopolitics, natural events. Highlighting best practices and success stories in an industry that often has its flaws, rather than qualities, in the headlines is essential to driving positive momentum.

“The MEEC cannot be a jack of all trades. Equally, it cannot alienate members and new ideas. Where does the balance lie?”

2. Ensure R&D, service providers and E&P companies jointly coordinate on MEEC projects

Any joint operations must earmark time to ensure all parties are singing from the same hymn sheet before the band starts playing i.e. clarify quantifiable goals and methods before parties start funnelling resources into a joint project. Collaborations need clarity. Opacity in joint projects bleeds into delayed timetables and increased costs; neither is attractive to members of the MEEC, nor investors. One route suggested by workshop participants included focusing on the least complex technology that can have the widest applicability in the region, therefore promoting holistic techno-economic development. Others said blue-sky thinking has equal value, but appreciated the high risk associated with such R&D means that it must complement,



not dominate, the agenda. Workshop participants pointed to several key areas for collaboration, including how cut the costs associated with CO₂ capture while hitting environmental targets and how to enhance expertise in the wider EOR ecosystem. For the latter, EOR and digital expertise must be 'programed' within

human resources; it is not automatically known. That does not mean the MEEC should become a training facility but it can be an 'intellectual home' of a cross-pollination of ideas. As long as the findings thread back into the MEEC' ecosystem, the time taken on talent enhancement is a win-win.

3. Create an architecture for a basic standard of data definition

In alignment with Moore's Law, computer power has doubled every year since the 1970s and more data has been generated in the last two years than in all of previous recorded history. What does this mean? Proper data management (PDM) is vital across the energy industry, including in the MEEC. Poor data handling risks leaving the EOR ecosystem as a lame duck as the wider energy industry actively enhances its digital acumen. The MEEC must keep pace with the 4th Industrial Revolution to be viewed as a relevant and valuable marketplace of knowledge and ideas. NOCs and other Gulf energy companies have made bold moves in recent years to remove bricks from the walls safeguarding their data – much of which has more value in a collaborative environment. But these are just the first steps; more national and cross-border cohesion is required. Smart data generation, harvesting and analysis in a central data bank could be a cornerstone of enabling affordable and lower-carbon scalability. Members contributing data to such a bank could pick and choose what information to share. But all contributors must ensure that they define and manage their data in a 'common language' that is compatible with the broader data bank

“A central digital bank of data means members can extract valuable knowledge to support their own R&D and projects. But this only works if members also 'deposit' their data inputs!”

in the MEEC. The benefits of creating and leveraging a central data bank are far reaching, from accelerating innovative R&D and commercialization to exploring application in new geographies in the Middle East. But remember: simplicity is crucial as complicated data storage systems will confuse a market already grappling with a myriad of uncertainties.



Other Recommendations From Stream 2

COMMIT TO:

- ✓ Cutting the cost of EOR implementation
- ✓ Managing the voluntary versus paid discussions and give collaborations credibility
- ✓ Defining the trends of underlying building blocks for EOR
- ✓ Focusing on talent development and critical thinking, as well as linking the world's top universities to improve efficiency practices
- ✓ Collaborative incentives, such as crowd funding
- ✓ Continuity and fit-for-purpose EOR to enable sustainable progress
- ✓ Improving efficiency, collaboration and integration between surface and sub-surface efforts
- ✓ Coordinated data solutions ■

CALENDAR 2019

The Gulf Intelligence UAE Energy Forum 2019

Under the Patronage of
His Excellency Eng. Suhail Mohamed Al Mazrouei
UAE Minister of Energy & Industry
Abu Dhabi, Jan. 9th, 2019

Oman Energy Leadership Summit

Muscat, Feb. 7th 2019

The Gulf Intelligence IPWeek Middle East Energy Summit

Hosted by the Energy Institute - IPWEEK
London, Feb. 28th 2019

The Middle East LNG Workshop

Abu Dhabi, Mar. 19th 2019

The Gulf Intelligence Saudi Arabia Energy Forum

Under the Patronage of
H.E. Khalid Al Falih
Minister of Energy, Industry and Mineral Resources,
Kingdom of Saudi Arabia
Riyadh, Apr. 8th 2019

The Middle East Oil Markets Workshop

Dubai, Jun. 18th 2019

The Gulf Intelligence Energy Markets Forum

Under the Patronage of
His Highness Sheikh Hamad Bin Mohammed Al-Sharqi
The Ruler of Fujairah, UAE
Fujairah, Sept. 23rd - 24th 2019

The Gulf EOR Workshop

Abu Dhabi, Nov. 10th 2019

The Gulf Intelligence Abu Dhabi Knowledge Series

Abu Dhabi, Nov. 11th - 14th 2019

The Gulf Intelligence Oman Energy Forum

Muscat, Nov. 26th 2019



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