Volume 49 February 2024

Petroleum Today

15 YEARS OF INNOVATIVE EXCELLENCE

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TOWARDS A SUSTAINABLE ENERGY FUTURE FOR EGYPT

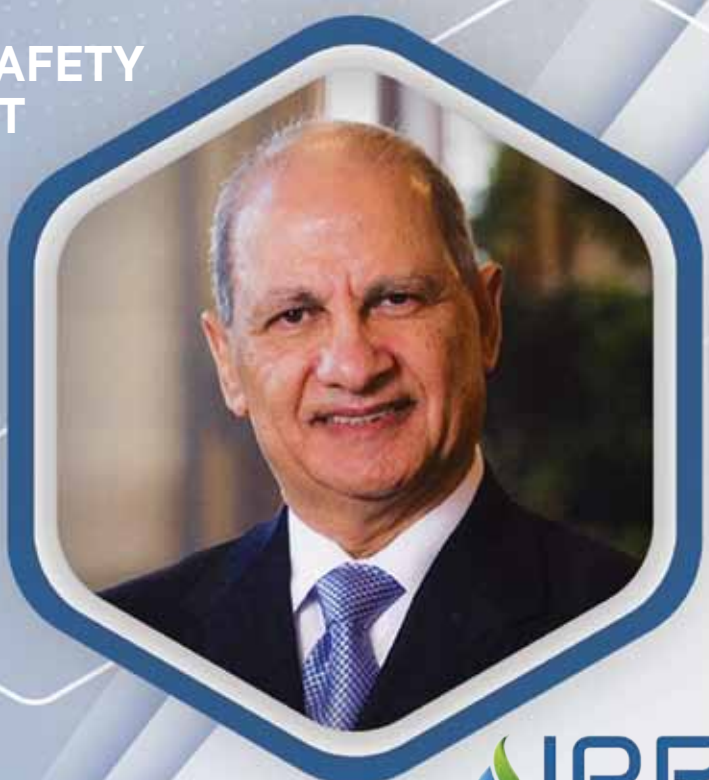
ASSESSMENT OF HEALTH, SAFETY AND ENVIRONMENT IMPACT OF FLAVONOID – DERIVED DEMULSIFIERS

TALENT & TECHNOLOGY

TECHNOLOGY APPLICATIONS

INDUSTRY AT A GLANCE

4 ACTIONS
FOR OIL AND GAS IN 2024



IPR ENERGY GROUP

AN INTERVIEW WITH
DR.MAHMOUD K. DABBOUS
IPR ENERGY GROUP CEO

مجمع إنتاج السولار
بأسيوط

ANOPC
ASSIUT NATIONAL OIL PROCESSING COMPANY
شركة أسيوط الوطنية لتصنيع البترول

يعتبر مجمع إنتاج السولار بأسيوط واحد من أهم المشروعات الاستراتيجية التي تحقق قيمة مضافة عن طريق تعظيم الاستفادة من الموارد المتاحة، وهو عبارة عن معمل عمليات تكرير متقدمة تقوم بمعالجة المازوت الناتج عن عمليات التقطير بمعمل شركة أسيوط لتكرير البترول وتحويله إلى منتجات رئيسية يحتاجها السوق المحلي وأهمها السولار منخفض الكبريت بالمواصفات الأوروبية بالإضافة إلى النافتا والبوتاجاز.

تستند رؤية الشركة المستقبلية على مبادئ التنمية المستدامة بإبعادها الاقتصادية والاجتماعية والبيئية، حيث يؤدي المشروع – علاوة على القيمة الاقتصادية المضافة وتوفير العملة الأجنبية – إلى فتح آفاق جديدة ومتنوعة للتنمية المجتمعية بمنطقة الصعيد والى ظروف تشغيلية صديقة للبيئة.

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HIGHLIGHTS

UEE has growing investment plans in adopting new technologies and enabling innovation for the future and achieving the Operations Excellence management considering the holistic approach, renewable energy, gas flaring and decarbonization solutions, cost optimization management, incident-free operations, and our social community development.

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Petroleum Today

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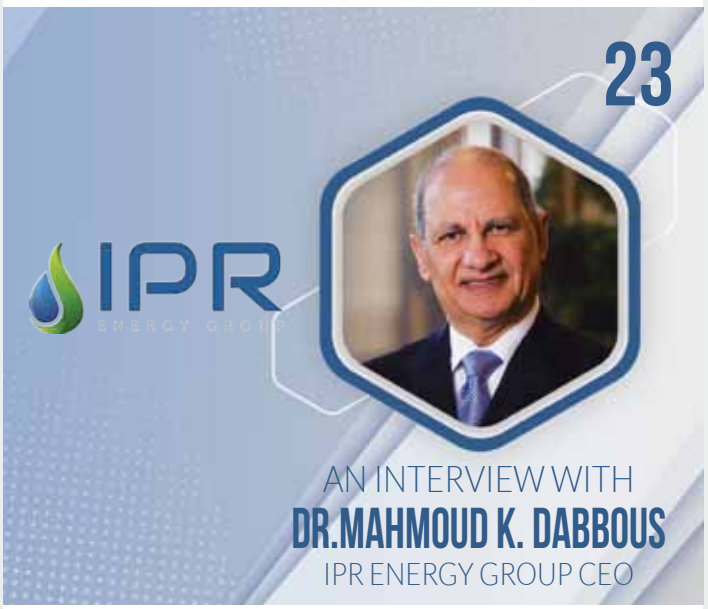

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15 YEARS OF INNOVATIVE EXCELLENCE

15 years of Success This issue, Petroleum Today Magazine marks its 15 years anniversary. Our success lies within this huge milestone that we would like to celebrate with all our partners. Petroleum Today has been a trusted petroleum data & news source since 2009, and it will continue to do so and provide its readers with insightful analysis & the industry trending topics.

The magazine content recipe relies on a unique mix of a scientific journal magazine that makes it the first destination to the diversified readers representing all petroleum segments.

Energy transition, decarbonization, LNG, Petrochemicals and reducing CO2 emissions are hot topics that have been discussed widely during the past five years.

Our team introduced a new chapter to the magazine that focuses on the industry innovations, new products & services that posted our readership to unrivalled levels.

A full integrated media portfolio can actually describe magazine's millstones track record

Finally, the Egypt Energy show 2024 is one of the main oil, gas & energy shows & petroleum today team as usual will take this opportunity to achieve excellence & be along side with great focus on the inspirational stories of the event.

In the end, greetings to you, Egypt has pride and dignity

Petroleum Today

Petroleum Today

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EGYPT NEWS

Egypt greenlights oil exploration contract in Ras Qattara

The Egyptian cabinet approved a draft law authorizing the Ministry of Petroleum and Mineral Resources to contract with the Egyptian General Petroleum Corporation (EGPC), Apex International Energy, and Croatian INA-Industrija nafte, d.d for oil exploration, development, and exploitation in the Western Desert's Ras Qattara, as per a statement on January 17th.

The cabinet approved the continuation of the free transit visa until the end of April 2024.

The application of the free transit visa began as on June 28th, 2023, and the number of beneficiaries hit 38,415 passengers, with an average of 120,000 tourist nights until December 24th.

Egypt, Aton Resources sign contract for gold exploitation

The Egyptian Mineral Resources Authority (EMRA) has inked a deal with the Canadian-based company Aton Resources to begin exploiting the gold ore and associated minerals in the Abu Marwat region of the Eastern Desert, according to a ministerial statement on Wednesday.

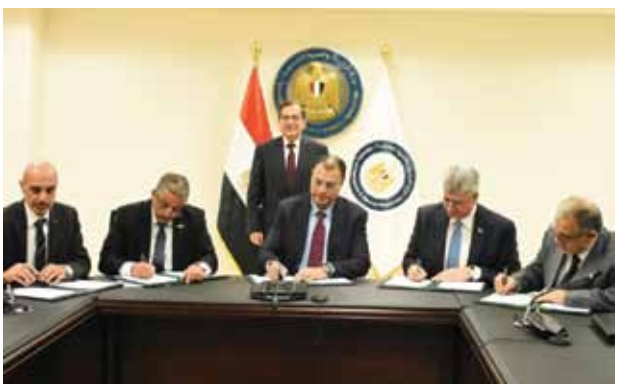
The contract was formalized following Aton Resources' commercial discovery of gold in the Hamama Gharb and Rodrin areas, covering 58 square kilometres within the Abu Marwat concession.

EMRA has also agreed with the UK-based company Akh Gold to explore gold in the Bir Asl and Jabal al-Mit regions of the Eastern Desert, encompassing an area of 350 square kilometres.

Egypt's state-owned oil companies to invest over EGP 23 bln in FY2024 / 2025

Egypt's state-owned oil companies are poised to invest over EGP 23 billion in the upcoming fiscal year (FY) 2024/ 2025, commencing in July. El-Molla's remarks came during the general assemblies' meeting, which aimed to approve the planning budget for the public sector oil companies in FY2024 / 2025. In September 2023, Egypt raised its projected total investments in oil and natural gas to $9 billion (EGP 277 billion) during the current FY2023 / 2024, ending in June. Furthermore, foreign companies operating within the Egyptian oil sector contributed around $5.7 billion in investments during FY2021 / 2022.

Abu Qir Fertilizers Company, ABB, MPS and Petrojet Sign Green Hydrogen MoU



Minister of Petroleum and Mineral Resources Tarek El Molla has witnessed the signing of a memorandum of understanding (MoU) between the Abu Qir Fertilizers Company, ABB International Group, MPS Infrastructure Company, and Petrojet.

The MoU aims to supply the North Abu Qir for Agricultural Nutrients Company the green hydrogen and renewable electricity needed to produce green ammonia, which is considered a raw material for the production of granulated ammonium nitrate fertilizer with a capacity of 2,400 tons per day.

Egypt ranks 22nd in global climate change performance index

The Egyptian Cabinet›s Information and Decision Support Center (IDSC) Tuesday said Egypt ranked 22nd among 63 countries in the Climate Change Performance Index (CCPI) 2024, recording 61.8 points.

Egypt came second in the Middle East and North Africa, following Morocco, the IDSC added.

The index, issued by the German Watch corporation, highlighted measures adopted by Egypt to expand investments in renewable energy projects, including encouraging reliance on solar and wind energies.

According to the index, Egypt has also promoted larger investments in fossil fuels, particularly fossil gas.

Egypt invests $23bln in refining expansion projects

Egypt has launched projects with a total value of nearly 707 billion Egyptian pounds ($23 billion) to expand refining capacity as part of overall development plans in its hydrocarbon sector. The Assiut Oil Refining Company, under the Ministry of petroleum and Mineral Resources, is carryout out the projects at its installations across the country. The projects, which were approved for the 2023 - 2024 fiscal year, comprise a new distillation unit with an output capacity of 5 million tonnes per year, a gas recovery unit, and the expansion of existing refining production facilities. The projects also include the construction of storage facilities for jet fuel with a capacity of 20,000 litres each and for recovered oils and caustic soda, it added.

ARAB & INTERNATIONAL NEWS

Mubadala Energy announce major gas discovery in Indonesia

Mubadala Energy announce a game-changing gas discovery from the Layaran-1 exploration well drilled in South Andaman, about 100 kilometers offshore North Sumatra in #Indonesia. With potential for over 6-TCF of gas-in-place and for multi-TCF expansion within the broader structure, this is one of the most significant Southeast Asia discoveries for many years.

This development is perfectly aligned with gas-based strategy as a key bridge fuel in the energy transition, and with 80% working interest in South Andaman.

Kuwait may delay some oil projects to cut deficit

Kuwait's state oil operator is considering delaying some hydrocarbon projects and taking other steps to slash a large deficit in its capital spending during its five-year plan ending in 2027. The Kuwait Petroleum Corporation (KPC), which manages the OPEC member's hydrocarbon industry, expects a deficit in capital spending during the plan at around 14 billion Kuwaiti dinars ($46.2 billion) due to an increase in spending on projects and other operations, the Arabic language daily Alanba said. Citing KPC documents, the Corporation aims to slash the shortfall in capital expenditure by its affiliated companies to KWD2.8 billion ($9.24 billion). According to the paper, the plan includes delaying or cancelling some projects to save a sum of KWD4.36 billion ($14.38 billion) and retaining around KWD3.7 billion ($12.2 billion) of the profits. Other steps comprise borrowing KWD1.5 billion ($4.95 billion) to fund operations, leasing some assets and cutting liquidity by KWD500 million ($1.65 billion), it added.

Iraq's Nasiriyah crude oil depot mega project is 55% complete

The construction of Iraq's biggest crude oil storage facility in Dhi Qar Governorate is 55 percent complete, the Ministry of Planning's spokesperson Abdul Zahra Al-Hindawi said. He said the total storage capacity of the crude oil depot in Nasiriyah city is 3 million barrels and it will add 500,000 barrels per day to Iraq's export capacity. The project consists of seven storage tanks with four allocated for heavy crude and the remainder for storing light crude, two relief tanks, nine small-sized slop tanks, two gas-turbine driven pump units delivering oil 2,250 cubic metres per hour (m3/h) and two auxiliary pumps delivering oil 4,500 m3/h.

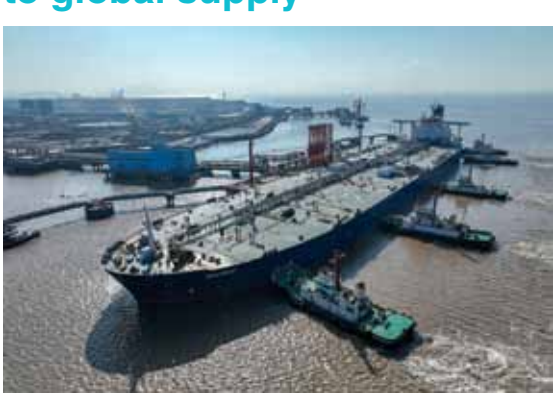
Russia's NORSI to restore 70% of gasoline output capacity soon

US liquefied natural gas (LNG) producers increased their exports in October, reaching a level of 7.92 million metric tons, according to data provider LSEG, marking the second-highest monthly level on record, just shy of the record 8.01 million metric tons achieved in April of this year. Notably, exports were up from 7.12 million metric tons in September, when plant maintenance reduced U.S. production.The increase in exports came as output fell at Berkshire Hathaway Energy's Cove Point, Maryland, terminal. The loss from a 12-day maintenance outage was more than compensated for by higher production at Cheniere Energy and Venture Global LNG plants, LSEG data showed.

Australia Secures New Gas Deals for East Coast Energy Marketsglobal supply

Australia has reached new gas supply deals for energy markets on its east coast. This development is expected to provide some relief for concerns over long-term supply gaps as the country transitions away from coal-fired power stations, said Energy Minister Chris Bowen. Over 260 petajoules (PJ) of gas will be supplied through 2033 through two new enforceable commitments with ExxonMobil's Esso unit and Woodside. These deals were made under the government's gas code rules, which were put in place to ensure domestic supply commitments for the country's east coast. Last year, Australia extended a price cap of A$12 ($8) per gigajoule on natural gas until at least mid-2025, but it relaxed the rule for big producers if they agreed on domestic supply commitments for the country's east.

China to boost January diesel, jet fuel exports, add to global supply



China will cap its crude oil refining capacity at 1 billion metric tons by 2025 to streamline the country's vast oil processing sector and reduce carbon emissions, the country's state planning agency affirmed in an online post. In 2022, China surpassed the United States as the world's largest oil processor by increasing its oil refining capacity to 920 million tons per year (mtpa), equivalent to 18.4 million barrels per day (bpd). The National Development and Reform Commission (NDRC) said earlier this month that it would limit new refining capacity and promote the upgrading and optimization of existing refineries in addition to accelerating the closure of small and outdated plants. The capacity cap of one billion tons, or 20 million bpd, was initially mentioned in October 2021 when Beijing announced its action plan for reaching peak carbon emissions by 2030.

CORPORATE NEWS

IPR Energy Announces Yidma/Alamein Discovery in Egypt

Texas-based IPR Energy Group (IPR) announced the discovery of exploration well West AY-1X and the successful testing and production from a new formation (Kharita) in Alamein-44, adding an incremental 2,850 BOPD to the Yidma-Alamein Western Desert Development Lease. West AY-1X was drilled to a depth of 13,166 ft, utilizing a 1500 HP drilling rig. This deep multi-target exploration well in the Yidma-Alamein Concession lease encountered 33 ft of perforated interval in the Basal Middle Bahariya (BMB) sand. The well was lifted by coil tubing/nitrogen, then placed on production with an ESP at a rate of 703 BOPD with 1% BS&W. IPR is currently evaluating the option for additional BMB sand development offset wells to West AY-1X.

GUPCO Start Production at North Safa Oil Field in Gulf of Suez

The Gulf of Suez Petroleum Company (GUPCO) has successfully brought the first well of the North Safa oil field in the northeastern Ramadan region of the Gulf of Suez online. This achievement marks a strong start to the new year and aligns with the Ministry of Petroleum and Mineral Resources' (MoPMR) strategy to bolster national crude oil production.

The swift startup of the North Safa well reflects GUPCO's commitment to accelerating the development of proven reserves and maximizing resource utilization. This success will contribute to strengthening Egypt's energy security and potentially boosting export revenues.

bp Expands Investments in Egypt's Gas and Low Carbon Energy

bp's Executive Vice President, Anja Dotzenrath, has announced the company's commitment to expanding operations and investing in Egypt's natural gas sector. This declaration came during a meeting with Minister Tarek El Molla, focusing on bp's activities in Egyptian concession areas, recent well developments, and ongoing drilling campaigns to boost natural gas production. Dotzenrath expressed keen interest in enhancing collaboration with Egypt, highlighting bp's projects in oil and gas exploration, emissions reduction, green energy, and sustainability. El Molla acknowledged bp as a strategic partner in Egypt's petroleum sector, emphasizing the company›s positive contributions to oil and gas exploration and production activities. He underlined the sector's dedication to resolving challenges for foreign partners and supporting integrated efforts.

Egypt Gas records 46% profit increase in 2023

Egypt Gas reported a 46% year-on-year (YoY) decrease in net profits after tax in 2023 to EGP 162.119 million from EGP 301.967 million, the firm disclosed on January 28th.
Meanwhile, revenues slipped 2% to EGP 6.871 billion from EGP 7.025 billion.
Established in 1983, Egypt Gas provides a wide range of services in the oil and gas field and other related fields, including natural gas distribution Engineering, procurement, and construction (EPC)-based projects.

PETRONAS Egypt Appoints Hany Esmat Ibrahim as New CEO, Country Head

PETRONAS Egypt (PICLE) has announced the appointment of Hany Esmat Ibrahim as its new CEO and Country Head for its operations in Egypt succeeding Shahrizal B Shahari, who has led PETRONAS Egypt successfully for the past four years. The appointment is effective from January 1, 2024.
Hany is a seasoned corporate leader with an illustrious 17-year tenure at PETRONAS, spanning strategic locations such as Malaysia, UAE, Iraq, Australia, and Egypt. His extensive expertise in Gas Business, LNG, and Upstream operations is a testament to his dedication and proficiency in navigating the intricacies of the global energy landscape.
In his prior capacity as Chief Financial Officer at GLNG OPL (Australia), Hany showcased his financial acumen and leadership in key committees, including the Gas Risk Management Committee as well as the Procurement Governance Committee.

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شركة سيدي كرير للبتروكيماويات "سيدبك": مساهمة مصرية في التنمية الصناعية

شركة سيدي كرير للبتروكيماويات "سيدبك" الخطوة التكاملية الأولي في صناعة البتروكيماويات في مصر و التي أُنشأت وسط رؤية استثمارية طموحة لوزارة البترول و الثروة المعدنية في نوفمبر 1997م للاستغلال الأمثل لاحتياطيات مصر من الغازات الطبيعية، فسرعان ما برز دورها الاقتصادي القوي بشكل واضح بتقديم منتجات ذات قيمة مضافة عالية من خلال انتاج خام البولي ايثيلين عالي الكثافة **HDPE** وعلامتها التجارية الشهيرة **"إيجيبتين"** و الذي يلعب دوراً حيوياً للعديد من الصناعات البلاستيكية و الصناعات ذات الصلة محلياً و عالمياً.

بدأت رحلة "سيدبك" منذ لحظة تأسيسها بسجل حافل من النجاحات الفنية، فقد شهدت على مدار السنوات الماضية و الحالية تحقيق أعلى معدلات للخطة الإنتاجية والتسويقية لعدة سنوات بما يتوافق مع الرؤية الاستراتيجية لوزارة البترول في قطاع البتروكيماويات ، حيث تتمثل سياسة "سيدبك" بالالتزام بتطبيق أعلي معايير السلامة و الصحة المهنية و الجودة واتخاذ موقف قوي تجاه الاستدامة وترشيد الطاقة و حماية البيئة و توفير بيئة عمل مُثلى في سياق عملياتها اليومية.

وفي إطار الخطوة التكاملية بين شركات **وزارة البترول و الثروة المعدنية** لتعزيز القدرة التنافسية للصناعات الوطنية من خلال **"الشركة المصرية القابضة للبتروكيماويات ECHEM"** تقوم "سيدبك" بتوفير مادة الايثيلين وهي المادة الرئيسية لصناعة خام **PVC** بشركة البتروكيماويات المصرية، و توفير مادة البيوتين1- لشركة "إيثيدكو" كعنصر أساسي في عملياتها الصناعية، كما تشارك بإنتاج كمية من غاز البوتاجاز غير المعالج **LPG** لشركة جاسكو.

تبرز شركة "سيدبك" بقدرتها على الابتكار والتكيف الفعّال مع التحولات المستمرة في قطاعها، حيث تتبنى الشركة أفضل التكنولوجيات والبرامج التدريبية الناجحة لتمكين موظفيها من تقديم حلول لخفض استهلاك الطاقة، ويجدر بالذكر أن "سيدبك" تعتبر داعماً رئيسياً لقطاع البتروكيماويات والصناعات البلاستيكية في مصر في مجال خفض استهلاك الطاقة، و في اطار جهود "سيدبك" الفعالة لتقليل الانبعاثات الكربونية من خلال المشاركة في العديد من المبادرات تم التعاون مع شركة Air Liquide الفرنسية لتعظيم الاستفادة من مخلفات العمليات الإنتاجية من خلال إمدادها بغاز ثاني أكسيد الكربون الذي يُستخدم في مجال الصناعات الغازية.

"25سنة من الخبرة ... نبني النجاح" يجسد قوة شعارها القيادة الحكيمة لشركة "سيدبك" ورؤيتها الاستراتيجية الواضحة التي ترتكز على التميز والابتكار، والتي أسفرت هذه الرؤية عن نجاح باهر حيث تمكنت الشركة من تحقيق صافي ربح يقارب 2.5 مليار جنيه في عام 2023، وهو إنجاز يعكس التخطيط الدقيق والإدارة الفعّالة المستمرة على مر سنوات من النجاحات، مما جعلها ضمن أفضل 50 شركة في مصر لعام 2023، للسنة الثانية على التوالي وفقًا لتصنيف مجلة "فوربس"، مما يؤكد على دورها الريادي في الساحة المصرية.

و في إطار سعي سيدبك في تحقيق النمو المستدام فقد تمكنت الشركة من زيادة رأس مالها وتطوير استثماراتها من خلال المشاركة في العديد من المشاريع الاستراتيجية مثل مشاركتها في **"المصرية لإنتاج الايثيلين و مشتقاته - إيثيدكو"** و **" الخدمات اللوجستية للبتروكيماويات – PLS "** و **" مجمع البحر الأحمر للبتروكيماويات "** و**" المصرية لتكنولوجيا الأخشاب - WOTECH "** وكذلك المشاركة في مشروع انتاج الايثانول الحيوى ، ولم تكتفِ "سيدبك" تواجد منتجاتها في الاسواق العالمية ، فقد وقعت شراكة مع شركة **"ران غاز Rungas"** النيجيرية لإقامة مصنع لأسطوانات الغاز المنزلي بطاقة إنتاجية تبلغ مليون اسطوانة سنويًا بمصر.

تعد شركة سيدبك من أفضل النماذج الصناعية في تعزيز الاقتصاد المصري و دعم الصناعة الوطنية.

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Unlocking History-Breaking Drilling Operational Efficiency:

The Even Wall® technology of the SpiroStar Supreme motor has revolutionized conventional motor designs, making it a game-changer in the rapidly evolving field of drilling technology. At its core, this innovation redefines performance standards by prioritizing two pivotal elements: Consistent Elastomer Thickness and Reduced Hysteresis and Swell.

In the competitive landscape of drilling technologies, the SpiroStar Supreme motor with Even Wall® technology stands tall as a beacon of innovation and efficiency. It's not just about drilling; it's about transforming drilling excellence into a tangible reality.

Join the revolution today and unlock a new era of drilling efficiency with the SpiroStar Supreme motor—the epitome of Consistent Elastomer Thickness and Reduced Hysteresis and Swell, redefining the very essence of drilling operations.

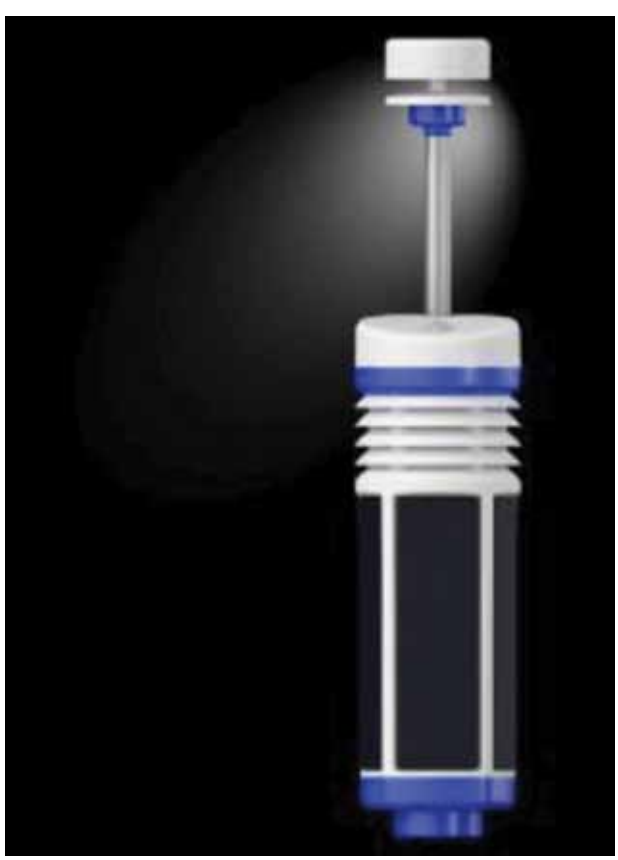
SLB launches methane measurement instrument

SLB's End-to-end Emissions Solutions (SEES) business has introduced its next generation methane point instrument, a self-installed continuous methane monitoring system that uses IoT- enabled sensors to quickly and cost effectively detect, locate and quantify emissions across oil and gas operations.

Effective monitoring is essential to reduce emissions of methane, a greenhouse gas which has a climate change impact up to 84 times greater than carbon dioxide over a 20 year timescale and represents about half of the oil and gas sector's operational emissions.

The methane point instrument represents a step change in methane measurement technology, providing operators with industry-leading leak detection sensitivity in a small, durable, first-of-its kind 'plug-and-play' solution. The technology automates continuous methane monitoring – eliminating the need for manual data collection during typical intermittent site visits, which only offers producers a small sample of their emissions.

"Designed for 'always on', accurate measurement and fast, affordable deployment at any scale, our next generation point instrument widens the accessibility to continuous methane monitoring for the industry, providing producers with a practical pathway to achieve a more complete picture of their emissions profile," said Kahina Abdeli-Galinier, Emissions Business Director, SLB.



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FluidicsLab, offered a comprehensive all-in-one fluid testing technology that brings the full laboratory experience right to your fingertips. Our microfluidic systems enable the miniaturisation of various devices and lab applications, such as PVT and porous media flow solutions.

InspIOR®, our revolutionary microfluidic technology platform, is bringing the power of a fluidics laboratory straight to your fingertips!

Whether you›re in the oil and gas industry or working in underground storage for hydrogen or CCS/CCU applications, InspIOR® is here to elevate your experiments. Join the future of fluid testing with InspIOR!

Our range of specialised micromodels – including flow assurance, porous media flow, wax and asphaltene precipitation chips, MMP chips, and foam stability chips – are complemented by unique workflows that support or even replace traditional testing processes. With fewer chemicals required and less time required compared to conventional methods, we not only provide a differentiated solution but also ensure minimal environmental impact.

East Daley Analytics introduces new gas pipeline data tool

East Daley Analytics has announced its new Gas Customer and Shipper Contract Pipeline Data product with the ability to visualise and analyse gas pipeline contracts geospatially across the USA.

Available through East Daley's Energy Data Studio, the new product brings the power of visualisation to gas contract data providing users with valuable insights to make more informed decisions.

"Navigating gas contract data via Excel documents can be an arduous task. However, the data becomes truly powerful when it can be seen and understood in the context of geospatial maps," said Justin Carlson, co-founder and Chief Commercial Officer of East Daley Analytics.

"We're excited to introduce the industry's first visual, geospatial tool for viewing and analysing this data, with a robust dataset that users can trust and rely on to drive their business forward."

The Gas Customer and Shipper Contract Pipeline Data provides two visualisation options for exploring gas pipeline contracts:

• Gas pipeline customer contracts: This focuses on providing in-depth analysis to help understand how gas pipelines are contracted. It can be searched and filtered by various criteria such as shippers, pipelines, counties, states, and more. Through interactive maps, users will gain valuable context and insights into pipeline contract distribution.

• Shipper contracts across gas pipelines: This allows users to explore how different shippers contract on pipelines across the country. By visualising the contractual relationships between shippers and pipelines, users can identify trends, spot opportunities, and make more informed business decisions.

It offers a user-friendly interface and advanced filtering options, making it easy to navigate through the data and customize the analysis from a high-level overview to more detailed explorations

Cased pipeline corrosion protection

Horizontal directional drilling (HDD) techniques have reduced the number of new cased pipeline crossings installed under roads. However, that does not eliminate the fact that hundreds of thousands of existing cased pipelines around the world still have less than satisfactory corrosion protection. CorroLogic® VpCI® Gel Filler equips pipeline owners and maintenance crews to launch a campaign for pipeline integrity management by protecting one cased pipeline crossing at a time.

Vapour phase corrosion inhibiting gel

CorroLogic VpCI Filler is a patented technology comprised of a twopart system: liquid VpCI concentrate and a powder gelling agent. The liquid VpCI component (Part A) can be diluted to the right concentration onsite; the powder gelling agent (Part B) can be added just prior to application to increase viscosity and leave behind a soft gelled substance inside the casing. This filler offers the dual advantage of discouraging the ingress of water and debris while inhibiting corrosion on metal surfaces that it directly touches. It also releases corrosion inhibiting vapours that can migrate throughout void spaces and under dis-bonded coatings to form a molecular corrosion inhibiting layer on areas that would normally be unprotected by traditional coatings or wax fillers.

Celeros Flow Technology offers new valve system

The M&J Valve 4-way diverter valve system from Celeros Flow Technology is specifically designed to meet the rigid requirements of bi-directional meter proving, including frequent cycling, zero leakage and reliable, repeatable sealing.

The M&J Valve 4-way diverter valve system from Celeros Flow Technology is specifically designed to meet the rigid requirements of bi-directional meter proving, including frequent cycling, zero leakage and reliable, repeatable sealing.

The M&J Valve 4-Way Valve System is an ideal choice for meter proving in oil and gas metering systems, tank storage, fuel loading and transport pipelines. It has been developed using the cumulative expertise of the M&J Valve team, who have designed, tested and started up some of the world's largest, most sophisticated metering systems over the past decade.

Its unique design and operating characteristics mean that the 4-Way Valve System can be cycled hundreds of times per day, completing each cycle in a matter of seconds. Field adjustable mechanical stops between the body and plug virtually eliminate operator failure, seal misalignment and leakage common in other valves. Large, heavy-duty stems and bearings plus field replaceable mechanically retained resilient seals (Viton standard) make this valve highly robust and low in maintenance.

A pressure gauge indicator of positive seal between flow streams provides proof of a double block-and-bleed type seal after each operation, as required by the API Liquid Measurement Manual 2531. The differential check relief valve assembly is set to hold a 25 psi lower pressure in the body than the prover or valve port. This differential is indicated on the easy-to-read differential 050- psi pressure gauge.

The differential pressure gauge seating method is simple, automatic and does not use solenoids, making it simple and reliable in the harshest operating conditions. There is also the option to install a differential pressure switch for remote indication. M&J Valve 4-Way Valve Systems are available in line sizes 3 in. – 24 in., class 150 – 900.

HIMA introduces new SILworX version 14.0.0

The development of new Industry 4.0 technologies and functions is much faster than the further development of classic process automation equipment. Adding new functions to safety devices requires particular care. The engineering, diagnostics and test tools in the new version of SILworX® will become the hub for the digitalisation of data from safety devices.

Whether in the engineering of large and distributed automation projects, in the diagnosis of faults or in regular testing, the specification, configuration and maintenance of safety devices in process plants requires a level of effort and careful attention that should not be underestimated. If new functions are added to components of safety devices, time-consuming recertification was traditionally necessary. HIMA is taking a new and important step in terms of digitalisation with the next version of SILworX to help to reduce this effort through consistent digitalisation and new functions in order to simplify these tasks while still being able to use modern Industry 4.0 functions flexibly.

A distinction is made between core functions for programming safety controllers and Industry 4.0 functions. New functions that are not safety-related can be integrated using modular plug-ins via an interface that does not affect the core safety-rated SILworX functions. This modular structure makes it possible to digitalise automation processes quickly and flexibly, and users can create extensions themselves or use plug-in modules from HIMA or other providers.

This enables planners and plant operators to quickly and easily add new functionality, or adapt or replace existing functions in a compliant, efficient and future-proofed way. This significantly increases efficiencies in engineering, diagnostic and test tasks by reducing efforts and costs.

«The ability to integrate external plug-ins into SILworX without compromising the safety function is an important step in our ‹Safety goes Digital› strategy,» says Peter Sieber, Vice President Strategic Marketing at HIMA. Under the motto #safetygoesdigital, HIMA is driving forward the digitalisation of functional safety with added value.

In addition to plug-ins, the new version of the engineering tool also simplifies collaboration in automation projects: the new «Multi-File Project» option enables projects to be saved as a library of related files for the different parts of the project, with version control embedded into each component. These can be imported individually into external versioning tools and later reassembled into a project. This makes team collaboration on large projects much easier and more efficient.

Baker Hughes launches new RTP technology

Energy technology company Baker Hughes has announced the launch of its new PythonPipe™portfolio, the latest in reinforced thermoplastic pipe (RTP) technology that enables faster installation, reduced time to first production and lower lifecycle emissions.

Offering up to 60% reduction in installation time and at one-fifth the cost of comparative steel installation, the PythonPipe portfolio consists of American Petroleum Institute 15s qualified, flexible and non-metallic RTP with an extensive selection of sizes, materials and liner options.

Achieving up to 75% reduction in carbon emissions throughout its lifecycle, up to 80% reduction in maintenance costs and up to 60% reduction in crew required, PythonPipe enables both efficient and sustainable operations.

Within the PythonPipe portfolio, Baker Hughes offers the only 8 in. spoolable, non-metallic RTP product in the market and demonstrates its three-layer co-extrusion liner technology across the entire portfolio range, allowing cost effective use of Polyphenylene Sulfide, Nylon, High Density Polythylene or High Density Polyethylene Raised Temperature liners within the RTP.

The PythonPipe portfolio will offer pressure capacities of up to 3000psi and temperature resilience of up to 180°F. The advanced co-extruded liner technology enhances durability and reduces permeability, making it suitable for challenging and corrosive environments.

«Our PythonPipe technology is a testament to our extensive industry expertise, underlined by over 10 000 km of successfully installed pipes," said Jeff Shorter, Product Management Director, Flexible Pipe Systems at Baker Hughes. "Our commitment to positioning for new energy frontiers via continual development firmly establishes Baker Hughes as an innovator in this field. The diverse liner options in the PythonPipe portfolio provide chemical and permeation resistance combined with a wide range of reinforcement types, product sizes, temperature and pressure capacities to address our customers' diverse needs."

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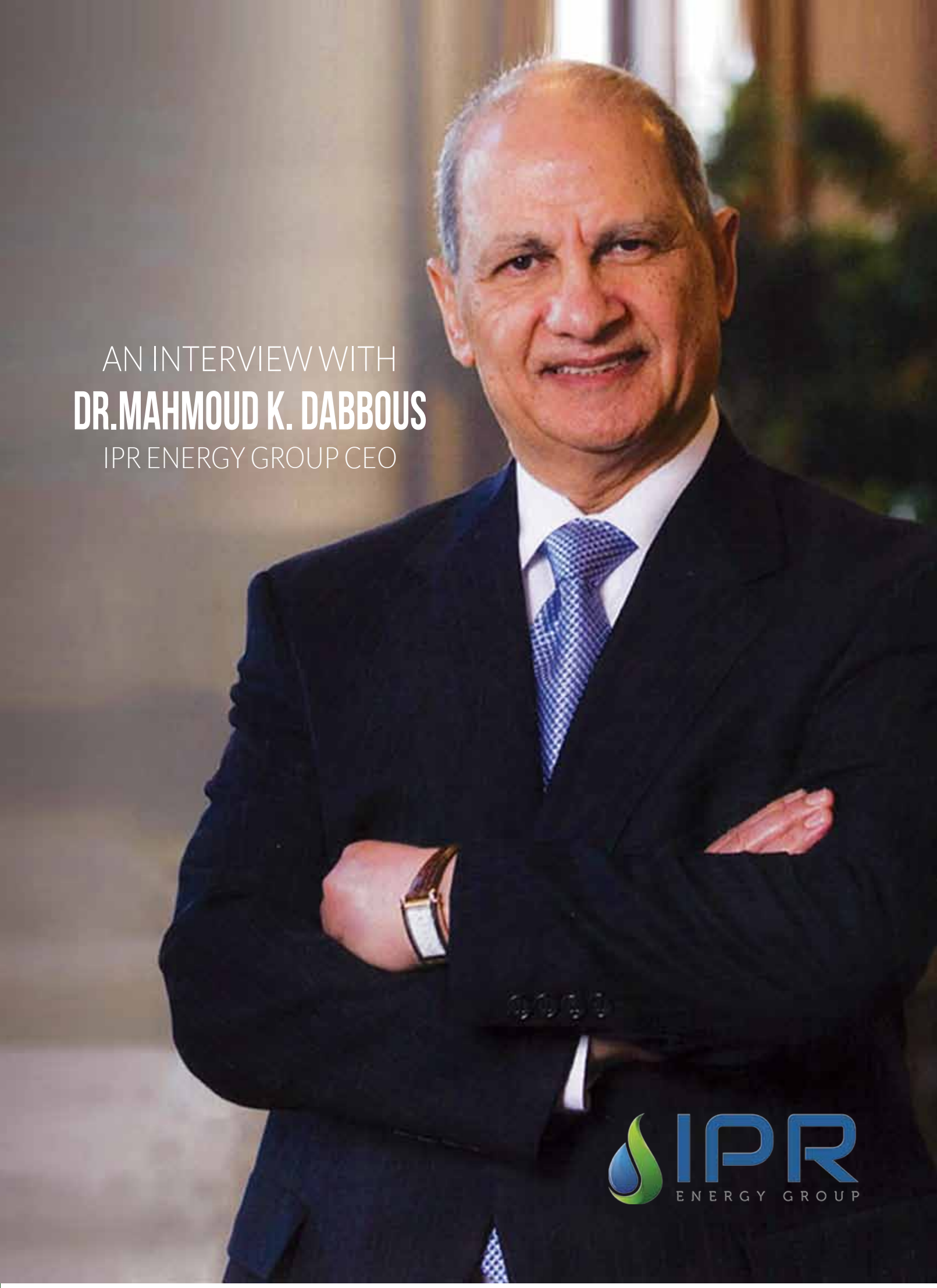
AN INTERVIEW WITH
DR.MAHMOUD K. DABBOUS
IPR ENERGY GROUP CEO
IPR
ENERGY GROUP

Strategic Direction:

Can you discuss the core vision that has guided IPR Energy Group since its inception and how it has evolved to navigate changes in the energy sector?

IPR's vision from its inception was that leading edge technologies, including secondary, enhanced, and tertiary recovery methods, must be implemented, knowing the easy oil has already been found and produced. Staying true to this original vision, IPR has been instrumental in exploiting fields worldwide to optimize production.

What key strategies have driven IPR's impressive growth in production and reserves, averaging over 180% annual reserves replacement since 2013?

IPR has kept its annual Reserves Replacement Ratios (RRRs) very high through organic and inorganic growth. Both growths materialized by cost effectively optimizing production, developing & delineating prospects and derisking exploration to generate revenue to pursue and capture undervalued and underexploited growth opportunities.

Innovation and Technology:

How has IPR continued to be a pioneer in technological advancements to enhance petroleum recovery, and can you provide specific examples of their impact on current operations?

Use of a pioneering produced water management system in one of IPR's core assets in the Western Desert of Egypt using available AGP to power oilfield operations is one example of technological advancements as well as the optimization of artificial lift systems to reverse natural decline in mature brown fields. These innovative reservoir management and exploitation practices not only have prolonged but have accelerated production significantly in this cluster of matured fields.

How does IPR's Technical Services Division contribute to the company's competitive edge?

For over four decades, IPR's Technical Services Division has been instrumental in devising and optimizing field development plans for our worldwide clients, as well as IPR's own portfolio. Field implementation of the recommendations of one such study resulted in increasing the daily production of a massive limestone field of a client in the Middle East by 50%, from 80,000 to 120,000 BOPD. Implementation of recommendations of IPR's Technical Services Division production optimization studies in our own portfolio have resulted in doubling and tripling of production rates in many fields.

Global Operations and Sustainability:

In light of IPR›s global presence, what challenges and opportunities arise in operating across diverse international markets?

While IPR is focused on Egypt for opportunities and investment, as an opportunity driven organization, we continue to seek expansion in our existing and entry into new markets. Opportunities are similar in nature, that is, mainly brownfield acquisition and their exploitation and development, rather than frontier exploration for IPR. Operational challenges exist everywhere, and IPR tackles and resolves them as we do in Egypt.

Could you elaborate on IPR's commitment to sustainable practices, including the pioneering water disposal well in Egypt and the use of APG to power oilfield operations?

As a prudent Operator, IPR has committed itself to protect the environment by reducing water discharge and greenhouse effects. Water disposal is a top priority; more than 10,000 BWPD is being injected into an Alamein formation 8,500 ft deep to protect the environment and especially fresh water horizons.

Gas flaring and venting, which contributes to climate change through CO_2 and methane emissions, have been reduced drastically by replacing diesel-powered electric generators by gas-powered generators. It is estimated that about 10,000 liters/day of diesel in the El Fayum Concession has been replaced by gas.

The recent announcement highlights the success of the West AY-1X well and the recompletion of Alamein-44, contributing significantly to the Yidma-Alamein Western Desert Development Lease. Can you provide insights into the strategic importance of these discoveries, and how they align with IPR's overall exploration and production goals in the Yidma-Alamein Concession lease?

These discoveries attest to IPR's highly decorated

techno-managerial skills in evaluating these fields and devising their optimal plan of development. As natural flow ceases, well-specific artificial lift methods are devised to capitalize on the well's production potential. Furthermore, success in these wells has opened a new era for IPR finding the bypassed oil and provide the basis for other drilling and workover campaigns that are being planned in these mature brown fields, which is anticipated to increase production in excess of 50% in 2024 / 2025.

Organizational Culture:

You've expressed appreciation for the dedicated efforts of IPR›s people. How does the company foster a culture of collaboration, innovation, and resilience to overcome challenges?

By investing and developing our people, encouraging and rewarding collaboration and promoting a working spirit, together we can overcome challenges to achieve our vision. It should be added that IPR's Technical Services Division has been promoting the same culture through on-the-job training as well as human resource development courses conducted for our worldwide clients.

What strategies does IPR employ for talent development and retention in the dynamic energy industry?

While IPR's workforce is highly competent, committed and loyal, talent development and retention is something all oil and gas companies must endeavor to do. IPR emphasizes continuous training, upskilling and redeploying our current workforce. IPR undertakes to better cement our reputation as a people-centric organization and foster innovation, collaboration and wellbeing

.

Future Outlook:

Looking ahead, what do you identify as the main challenges and opportunities for IPR in the evolving energy landscape?

In Egypt, IPR, as well as many of its peers, is largely challenged by currency devaluation and the government's limited access to U.S. foreign currency in order to satisfy ongoing local & foreign obligations and continued expansion.

Nevertheless, access to local currency has allowed most operations to run as planned until monetary issues stabilize in country. As a strong believer in Egypt, we feel this dynamic phenomenon will correct itself with time and IPR will continue its projected growth.

While IPR's mission is to profitably grow and diversify its portfolio in the energy sector, it remains committed to safety and its environmental and social responsibility, including decarbonization in the oil and gas industry.

Decarbonization is vital to combating climate change, but must be measured and balanced to ensure not only the industry's economic stability, but avoid global economic consequences.

Can you highlight any upcoming projects or initiatives that align with IPR's long term goals?

Initiatives would be to grow and expand in all facets of its business, i.e., production optimization, maximizing/ replacing reserves, increasing and upgrading technologies and expanding service offerings.

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Admasco committed to facilitate its esteemed customers with professional services, quality products, timely deliveries and excellent pre and post-sales supports through highly qualified Admasco team and pioneered principals.

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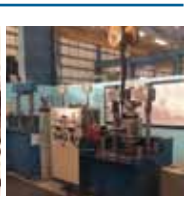
ISO 1402 - API 570 - API 598 - API 7K & 16C – API RP 53 and API 510

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OUR MISSION

Our mission is to encourage every organization to put in place sensible health and safety control measures to ensure everyone arrives home safely. We support our clients by providing the best customized safety solutions through our highly qualified technical team. We deliver premium safety products with a competitive price in a timely manner.

OUR VALUES

RESPECT

Respect for people is our most important value. Our people have the opportunity to progress irrespective of gender, ethnicity, or other differences.

HONESTY

Staff are encouraged to Speak Up and celebrate those who do the right thing.

INTEGRITY

By committing to our rules, we empower our Staff to say "No" to anything that would compromise our ethical standards.

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4 ACTIONS FOR OIL AND GAS IN 2024

Moving forward, resilient companies will maximize operations, amplify capital, manage emissions and innovate new low-carbon markets.

The energy transition will require both significant new investments in low-carbon energies and continued use of traditional hydrocarbons to meet the expected energy demand of an expanding global economy. Fortunately, the past two years of oil and gas outlook have demonstrated the sector has the capability to lead in both facets of the new energy economy.

Most immediately, responding to strong global expansion and supply disruptions around geopolitical unrest, companies operating in the oil and gas sector have steadily increased production of oil and natural gas. They have done so while still driving greater efficiency and amid market uncertainties, continuing to return value to shareholders even as oil prices cooled. This continued discipline positions the sector well for the increasing likelihood of much slower economic growth, or even the possibility of a recession in major markets in 2024.

Oil and gas companies have committed billions of dollars to develop future businesses around carbon capture, use and storage (CCUS) and hydrogen, aimed at abating the climate

impact of hydrocarbon fuels and providing decarbonized energy solutions for those industrial emissions not easily decarbonized through electrification. By some estimates, committed CCUS projects will reduce carbon emissions at a scale equal to those mitigated by the rapid adoption of electric vehicles (EVs).

Importantly, these companies are doing so while continuing to deliver value to shareholders, basing their strategic turn into the energy transition on solid footing with their investors. To continue this strong performance in 2024, oil and gas companies should focus on four main levers.

TRANSACT TO TRANSFORM THROUGH STRATEGIC SECTOR M&A

While high interest rates and inflationary pressures cooled dealmaking in many sectors, the sector has seen a surge in announced oil and gas mergers and acquisitions (M&A) activity last year, driven by strong cash flows, renewed investor confidence and increasing recognition that oil and gas will

continue to play an important role in the energy landscape.

While deals have grown again, including more enterprise-level transactions than seen in the recent past, companies are executing transactions in areas that meet well-defined strategic rationales, in both the traditional oil and gas space, as well as in new low-carbon businesses.

One indication of this disciplined approach is the lower premiums paid for in many of these deals, compared with similar deals in the recent history of the sector. Identifying a target, completing your due diligence, and announcing the deal is only the beginning of the hard work. Oil and gas companies need to attack post-close integration with the same vigor to realize the full value of these deals. Integrating the best of both organizations, across their front- and back-office operations, enables success.

MAXIMIZE OPERATIONS ACROSS THE FRONT AND BACK OFFICE

The influx of oil and gas M&A also creates a case for companies to improve business fundamentals, such as driving down operating costs, leveraging scale, jumping the curve on differentiated capabilities and strategically thinking about talent management.

Maximizing operations is not a new description for simply doing "more with less." Rather, it is operating by exception and problem-solving using technology at speed, innovation at scale with humans at the center.

Real-time data and emerging technology are essential to enable better, faster, and more strategic decisions. This is true holistically across the entire value chain – in both the front office and back office, but also specifically in subsurface prediction, drilling and completions, asset surveillance and optimization, maintenance, and materials management.

Considering different operating models, such as managed services, is particularly important when companies develop new business areas. For example, the front- and back-office functions for low carbon will be different from traditional oil and gas. As low-carbon business areas begin to scale, companies should consider multiple operating models before committing to specific processes and technologies. This will allow them to find synergies by integrating traditional business areas or pivot to innovative and emerging ecosystem models.

Lastly, oil and gas companies that are able to integrate artificial intelligence (AI) and generative AI (GenAI) capabilities in their everyday decision-making will jump the curve on business value. This shift will require companies to establish a strong foundation of trusted data while also implementing AI and GenAI engineering best practices, robust governance and risk management. The adoption curve for AI is faster than for any other technology so far, so companies must act quickly.

By 2025, the 10% of enterprises that establish AI engineering best practices will generate at least three times more value from their AI efforts than the 90% of enterprises that do not.

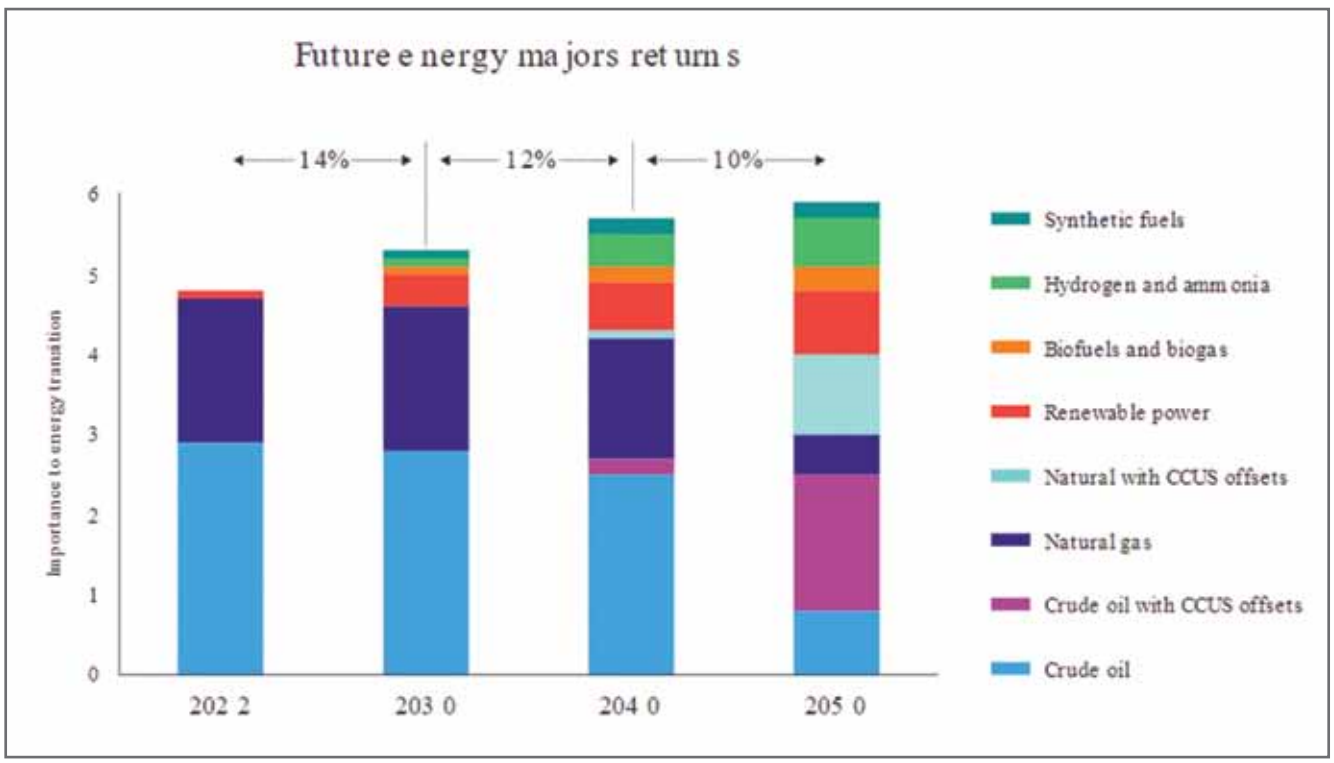
Manage emissions with proactive, strategic planning, and embrace operational decarbonization

New operating models and the introduction of low-carbon businesses both underscores the ways oil and gas companies can accelerate the net zero journeys of their customers and places a premium on having a more strategic perspective around their own greenhouse gas (GHG) footprint. In 2023, the state of California and the European Union finalized and provided clarity around reporting requirements for affected companies – some of these impacts could occur in 2024 with reporting in 2025, the SEC has proposed rules that it has yet to finalize but finalization is expected in the near term. This regulatory uptick led petroleum companies to accelerate efforts to reliably monitor and report Scope 1 and 2 and at least some Scope 3 emissions. Uncertainty around the timing and fullest scope of the proposed SEC rule – and the lack of uniform standards for GHG emissions reporting more generally – has been a complicating factor; there is also an opportunity for companies to move to an approach that treats emissions data almost on par with production data.

DEVELOP NEW DECARBONIZED MARKETS FOR CARBON CAPTURE AND HYDROGEN BEYOND TRADITIONAL USE CASES

Oil and gas portfolio evolution (illustrative)

Once oil and gas companies have an enterprise view of the emissions impact of their product, they also unlock the opportunity to rethink their product portfolios. Skepticism may argue against the viability of fuel differentiation based on carbon content, but plastics perhaps offers an illustration of an alternative path. Consumer preferences for reduced plastic waste have not been translated directly, but rather through bottling companies and others, seeking greater circularity in their operations. And petchems manufacturers, including the integrated oil and gas companies, have been able to differentiate their product offerings by helping these manufacturers meet



Source: EY analysis of ERTA model data and O&G majors strategies.

consumer demand. Demand for lower carbon content in fuels could follow in a similar path.

Carbon exists not only as an attribute for a company's existing products, but also as a future stand-alone product. Oil and gas companies have already responded dramatically to changing investment conditions for decarbonized energy technologies, especially CCUS and hydrogen. The federal government has offered generous support via tax credits in the Inflation Reduction Act (IRA) for hydrogen production and CCUS and a further $7 billion from the Infrastructure Investment and Jobs Act (IIJA) to establish seven hydrogen hubs around the country.

But the commitment from a range of oil and gas companies also reflects the technical expertise, financial wherewithal, and ability to manage and operate projects at scale that give them not only a competitive advantage in this space, but also allow them to significantly advance the decarbonization agenda through their participation.

Government support for these low-carbon solutions has not been met with similar subsidies or tax credit for downstream CCUS of hydrogen markets. And adoption of a federal carbon tax – a straight-forward means of fostering these markets – is not politically viable in the short term.

Architects of the IRA believed the support for hydrogen production and CCUS would incentivize the market to create its own demand. And the real winners of the IRA and IIJA will be those companies that can best innovate new commercial approaches to these novel business areas.

To accelerate decarbonized development, oil and gas companies will need to adopt both more holistic views of their ecosystem, and more collaborative ways of working with their value chain, from suppliers through the customers of their customers.

SUMMARY

Oil and gas companies that seize opportunities to maximize their operations, proactively manage emissions, transform via transactions and embrace new energies will thrive in the decades to come.

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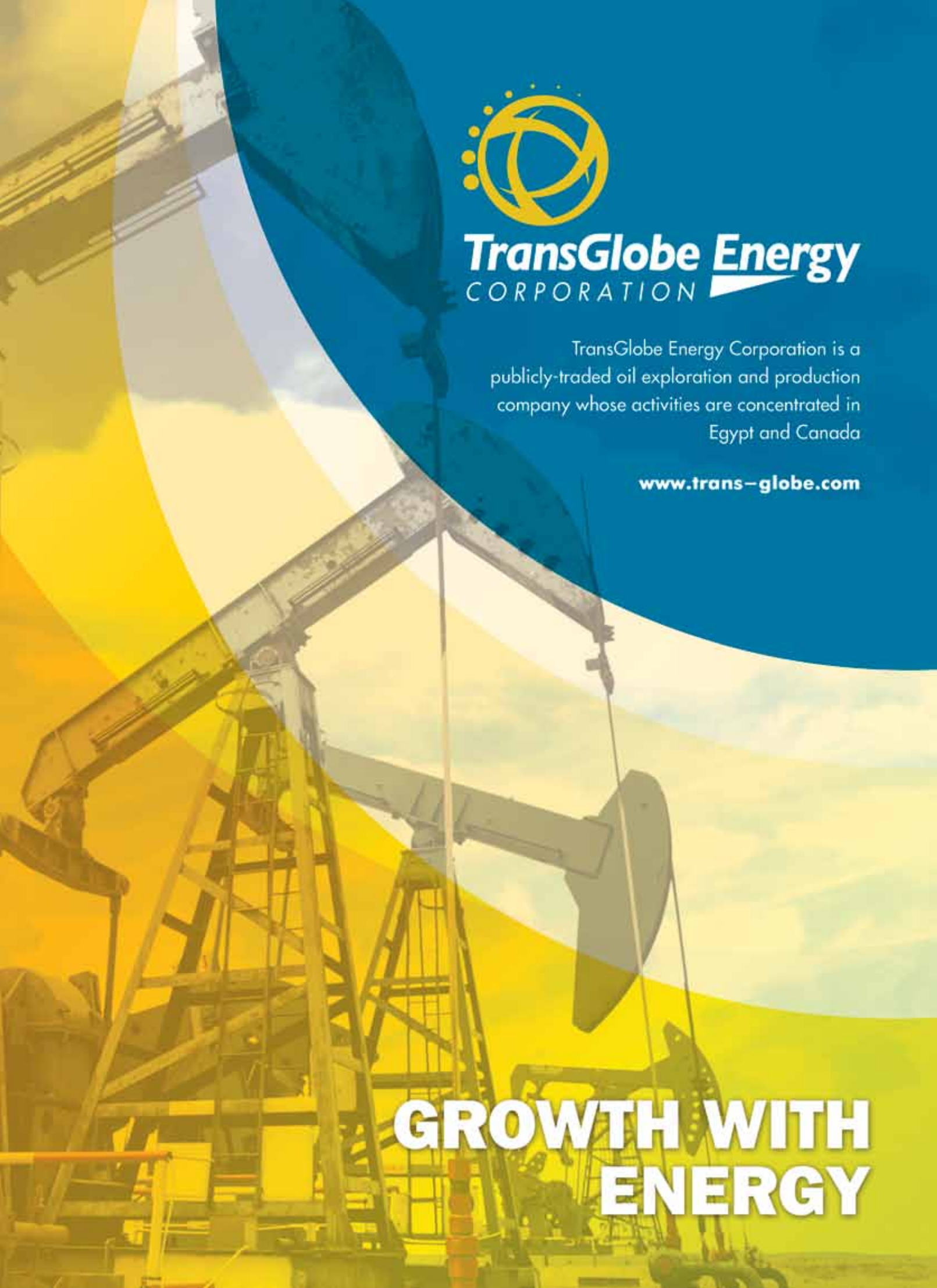

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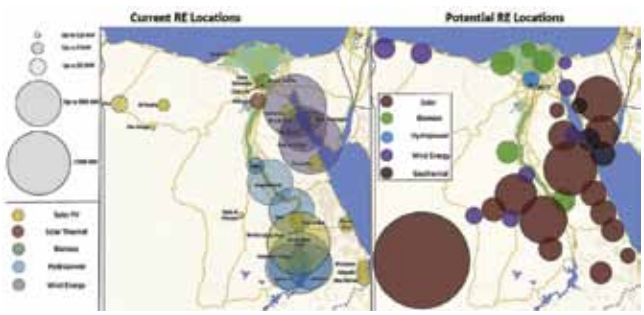
TOWARDS A SUSTAINABLE ENERGY FUTURE FOR EGYPT

A SYSTEMATIC REVIEW OF RENEWABLE ENERGY SOURCES, TECHNOLOGIES, CHALLENGES, AND RECOMMENDATIONS

Egypt has a significant role in international energy transit, being one of the major economies in the African continent. However, its energy sector is still overwhelmed with the local energy demands. It has been predicted that Egypt's CO2 emissions could increase by around 125% from 2012 to 2035 if the nation›s energy demand is met using conventional power generation technologies. Given that Egypt has signed the Kyoto protocol and recognised the role of international cooperation in facing climate change, the country should focus on meeting the growing energy demand using clean energy technologies. In the meantime, Egypt has been facing many challenges due to the water scarcity issues and environmental risks arising from the lack of efficient solid waste management strategies over the last few decades. It has been predicted that the country's crude oil reserves might be depleted within the next 15 years

or so. To face these challenges effectively and enforce the Egyptian role in international energy transit, renewable energy (RE) technologies and their applications should be the main focus of the current/future Egyptian energy frameworks. This review summarises the current energy outlook of Egypt while analysing the country's potential to harness energy from sustainable sources. In general, it has been found that Egypt›s renewable energy sector is yet to be exploited for sustainable energy production through its diverse and plentiful resources. Eventually, two scenarios have been proposed to consider in achieving the nation›s 2035 energy target, which is to generate 42% of the country›s energy need through renewable sources. This study should help Egypt and other countries to set the way forward in achieving the NET ZERO target that the whole world aims to fulfil over the next few decades.



INTRODUCTION

Cleaner production, focused on preventing environmental damage, aligns with sustainable development goals through efficient energy management and technological advancements (Giannetti et al., 2020). The UN's 2030 agenda emphasizes the need to substantially increase renewable energy›s global share (UN, 2015). To combat climate change, the Paris agreement stresses maintaining a temperature rise below 2°C, requiring a 70% reduction in annual CO2 emissions by 2050 (IRENA, 2018a).

Global reliance on fossil fuels, responsible for 80% of energy consumption in 2019, poses environmental threats (REN, 2021). The disappearance of the A68 iceberg highlights the irreversible consequences of human activities (Bhuiyan et al., 2021). Renewable energy sources offer a cleaner alternative, contributing to emissions reduction and improved well-being.

The EU's carbon-neutral goal, adopted by Egypt, can be achieved through sustainable technologies like wind farms and solar photovoltaics, creating job opportunities and positively impacting the environment and economy (Potrč et al., 2021). Egypt, strategically located with key transportation routes, plays a significant role in the international energy market (IRENA, 2018b). Failure to transition to renewable sources may lead to a 125% increase in CO2 emissions by 2035 (Bottoms, 2016).

In conclusion, a shift to cleaner energy is crucial for both Egypt and the global community to address environmental challenges and ensure a sustainable future.

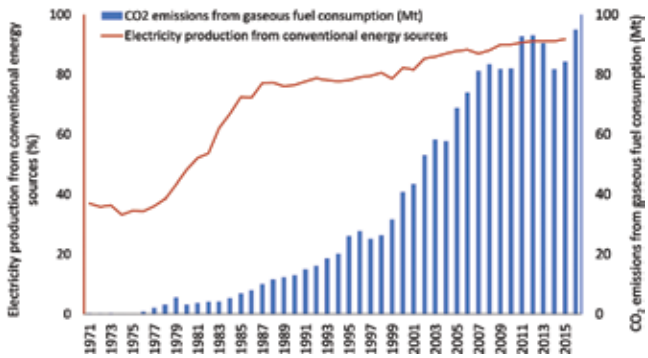


Figure 1. Electricity production from conventional energy sources and CO2 emissions from gaseous fuel consumption (Mt) over the years from 1971 to 2016 (The world bank, 2022).

Egypt's electricity demand has surged due to various factors, reaching 156300 GWh in 2015 / 16, with natural gas dominating supply (IRENA, 2018b). Despite being Africa›s second-largest solar energy user, renewable sources only contribute 8% to Egypt›s energy mix (IRENA, 2021). While wind power capacity has grown, currently providing 1.44% of total electricity, hydroelectricity from the Aswan High Dam remains vital (Shouman and Khattab, 2015).

Egypt holds immense renewable energy potential, particularly in solar and wind, with concentrated solar power (CSP) and wind energy offering substantial generation capacity (DLR, 2005). However, renewable energy accounts for only 10% of Egypt's installed capacity, falling short of its potential (IRENA, 2018b). Despite this, Egypt aims to achieve 42% of its energy from renewables by 2035 (IRENA, 2018b).

Several studies have explored Egypt›s renewable energy potential and strategies for its development (Khalil et al., 2010; El-Kholy and Faried, 2011; Ibrahim, 2012; Jamel et al., 2013; Aliyu et al., 2018; Obukhov and Ibrahim, 2017). However, gaps remain, particularly in addressing neglected sources like wave and tidal energy.

This review aims to comprehensively analyze Egypt's renewable energy landscape, assess its potential across various sources, and evaluate progress towards its 2035 energy plan (Dasanayaka et al., 2022). Recommendations will be provided to guide Egypt towards achieving its renewable energy goals and becoming a NET-ZERO nation, aligning with global sustainability objectives.

2. EGYPT COMPARED TO WORLD AVERAGES

In the process of planning to increase the renewable energy establishments of a country, it is important to identify its position compared with other countries that are on the same journey. Therefore, this section provides a comparison of Egypt's RE potential/market with other countries.

2.1. HYDROELECTRICITY

Hydropower is an integral part of the electricity generation of many countries. Some countries such as India, Russia, Canada, the United States, Brazil, China and Norway generate at least 50% of their electricity from hydro; where the estimated global hydropower capacity has increased from 35 GW in 2014 to about 1055 GW as of July 2018. It has been predicted that hydropower will account for around 15% of the world's electrical energy needs by 2040. Hydropower is the highest utilised renewable energy source worldwide, and its growth is expected to continue due to its effectiveness and given the future availability of water sources. With respect to Egypt, the share of renewable sources in the total electricity demand achieved 30%, as shown in Fig. 2, when Aswan High Dam started working in 1985. Nonetheless, the share of electricity production from RE sources gradually declined with the rapid increase of non-renewable energy sources to cater to the growing energy demand with no considerable expansion in renewable energy production. As shown in Fig. 2, Egypt has re-captured its renewable energy-momentum and the electricity generation from low-carbon sources and started to bounce back from its lowest level, which was around 9% in 2017.

Around 94% of the nation's hydroelectricity is still produced by the Aswan High Dam (2650 MW), while Esna, Naga Hammadi and New Asyut Barrage also generate 84 MW, 64 MW, and 40 MW, respectively. Egypt now is the fourth highest country in Africa with a total capacity of 2800 MW, but compared to the rest of the world, the hydropower in Egypt is unrecognised (Shouman, 2017). Unfortunately, the hydropower capacities of Egypt and Sudan will be significantly affected as the Grand Ethiopian Renaissance Dam (GERD) starts to fill the second dam (which will happen in 3 years). This would reduce the water quantities received by Sudan and Egypt.

2.2. SOLAR ENERGY

The overall global capacity of solar energy utilisation has reached 177 GW, marking another record year of expansion with 40 GW of new capacity in 2021. Even though there was a considerable decrease in new installations across the EU, China reached the goals for distributed solar systems with a

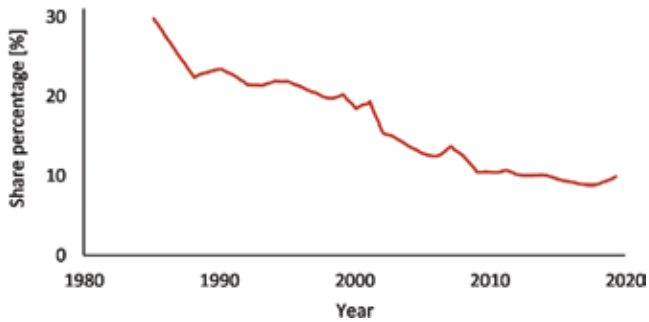


Figure 2. Share of electricity production from low-carbon sources in Egypt (Ritchie and Roser, 2020).

total installed capacity of 43 GW as of 2015. Around 60% of the worldwide solar PV capacity was installed within 3 years, from 2014 to 2017. Egypt has the highest daily typical irradiance values in Northern Africa, averaging from 2000 to 3200 kWh/m2/y with average sunshine of 9–11 h/d. According to the Egyptian government, the solar energy generation capacities could be extended further by 3500 MW by 2027 (Shouman, 2017). In 2020, solar energy in Egypt accounted only for 1.9% of the produced electricity, making it the country's second-highest renewable energy source. Egypt is the second-highest solar energy generator in Africa after South Africa, whilst it is the thirty-first worldwide (IRENA, 2021).

2.3. WIND ENERGY

Many countries, including Denmark, Nicaragua, Portugal, and Spain, have the potential to achieve their electricity needs using wind energy (Europe Statistics, 2021). The USA leads the world wind energy generation while Asia is in second place, passing Europe›s share for the seventh consecutive year. In Asia, China dominates the wind energy market holding a share of more than 70%. In 2001, Egypt generated 5.4 MW and 545 MW of wind power from Hurghada and Zafarana wind farms, respectively. At a reported cost of $6.8B, the Zafarana wind farm was completed in 2015, and then it had grown its capacity to 545 MW by 2018. As a part of the strategy to increase wind power to 7.2 GW by 2022, the Egyptian government intends to develop wind energy generation capacity during the next few years. In 2020, wind energy was responsible for 1.44% of the total produced electricity, making it the third-highest renewable energy source in Egypt (Shouman and Khattab, 2015).

2.4. OTHER RENEWABLE ENERGY SOURCES

Egypt would have an excellent potential for both biomass and geothermal usage in the future if the government encouraged investments in Feed-in-Tariff (FIT) as they did with solar energy. In 2020, all renewable energy resources

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other than hydro, solar, and wind technologies were responsible for only 0.16% of the country's total electricity generation (Shouman, 2017).

In summary, based on the IRENA report in 2018, only 15% of Egypt's electricity consumption has been supplied by renewable energy resources, including hydro energy. Nonetheless, the nation aims to satisfy 42% of its energy demand from renewable energy resources by 2035 which seems to be challenging. Therefore, the following sections discuss Egypt's potential in different renewable energy technologies and propose possible scenarios for utilising this potential to achieve this 2035 energy target.

3. SOLAR ENERGY TECHNOLOGIES (SET)

3.1. SOLAR THERMAL TECHNOLOGIES

The potential CSP locations across globe are identified using the global distribution of direct normal irradiance (DNI) (Trieb, 2009); where commercially feasible CSP plants should maintain a DNI of at least 2000–2800 kWh/m2/y, which is equivalent to 5.5–7.7 kWh/m2/d. Accordingly, the "Sun Belt" region is North Africa, the Middle East, the Mediterranean, and vast areas in the United States (Islam et al., 2018). Egypt is one of the Middle East and North African (MENA) region countries with an average direct solar radiation ranging from 5.5 to more than 9.0 kWh/m2/d and a sunshine duration of duration of 9–11 h/d. In 1991, Egypt's solar Atlas was released, and this showed annual direct normal intensities ranging between 1970 and 3200 kWh/m2. The Global Atlas platform of the International Renewable Energy Agency (IRENA) combines the recent irradiation potential with a new solar Atlas released in 2016; this also has recognised Egypt›s high solar potential. Accordingly, Egypt is one of the most suitable regions globally to exploit solar energy for power generation and thermal heating applications (IRENA, 2018b). Solar energy farms should preferably be located near areas with a high DNI, which are indicated by the orange and red zones in Fig. 3; where the highest potential areas are the cities located along the Red Sea coast.

Various CSP technologies have been assessed in Egypt, revealing promising prospects. Horn et al. (2004) found that integrating solar combined cycle power plants with parabolic trough collector (PTC) systems is economically viable, with levelized electricity costs (LEC) comparable to conventional combined cycles. El-Haroun (2012) demonstrated the potential of solar chimney power plants, capable of producing significant power output. Abdelhady (2014) explored stand-alone power plants using parabolic trough fields, indicating substantial reductions in fossil fuel consumption and CO2 emissions.

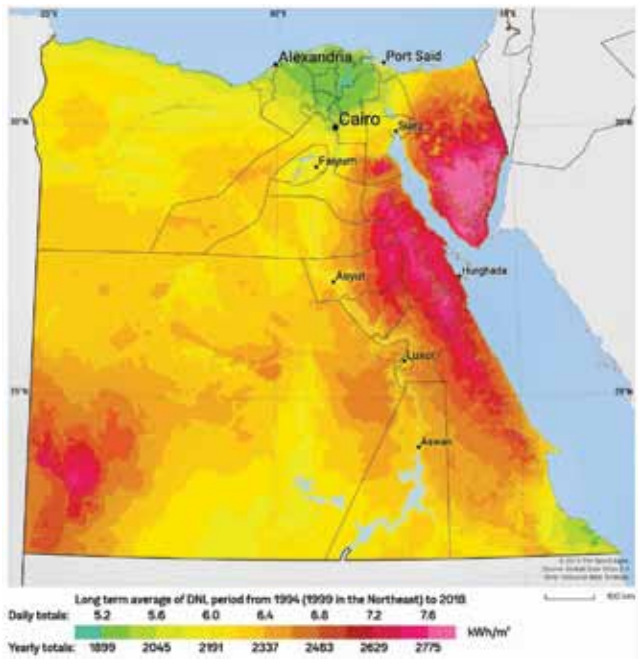

Figure 3. Egypt›s Solar Atlas with the details of direct normal radiation (Energy-Data).

Rady et al. (2015) and Elmohlawy et al. (2018) evaluated the performance of PTCs in solar thermal plants, highlighting their efficiency in different seasons. Temraz et al. (2020) and Abdelhady (2021) investigated ISCC and solar dish (SD) power plants, respectively, under Egyptian conditions, showcasing their energy production capabilities and environmental benefits.

Despite potential, only one ISCC plant operates commercially in Egypt. However, initiatives like the tender for a 100 MW CSP system in Kom Ombo-Aswan and plans for five CSP plants totaling 250 MW indicate a growing commitment to renewable energy. Implementing hybrid CSP technologies could significantly reduce CO2 emissions, although low natural gas prices currently hinder renewable energy adoption. Leveraging local manufacturing for CSP components could help overcome cost barriers and foster regional renewable energy development.

3.1.1. CSP COMPONENTS MANUFACTURING POTENTIAL IN EGYPT

Egypt possesses several advantages for manufacturing CSP components, including low labor and energy costs, access to raw materials like glass and steel, and a robust manufacturing sector (The World Bank, 2022). Khalil et al. (2010) proposed an action plan to develop local components and enhance renewable energy competitiveness, aiming to supply 16% of energy demand from RE technologies by 2022 and 50% of electricity consumption by 2050, resulting in significant CO2 emissions reduction (Khalil et al., 2010).

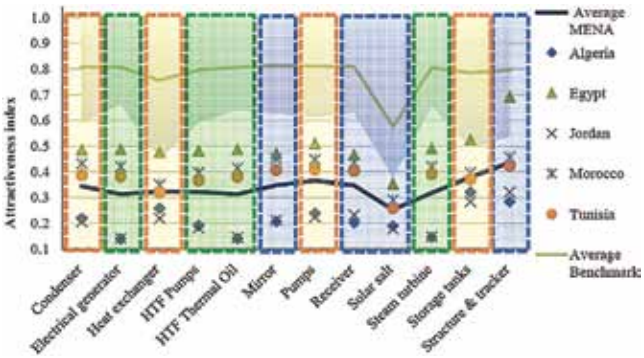

Figure 4. Normalised attractiveness index for CSP component industries (Servert and Cerrajero, 2015a).

Studies by Fatouh et al. (2003) and Servert and Cerrajero (2015a) confirmed the feasibility of local manufacturing for CSP systems in Egypt, highlighting strategic challenges such as technical knowledge gaps and high interest rates. While steel and float glass facilities exist, additional investment is needed to meet CSP glass requirements, posing a challenge. However, recent decreases in interest rates may alleviate investment hurdles (Moneim, 2021).

Expanding the solar market could generate 3000 new jobs and boost GDP by over $300 million annually, offering economic benefits (Servert and Cerrajero, 2015a). Overall, leveraging Egypt's strengths for CSP component manufacturing presents opportunities for economic growth and renewable energy advancement.

3.2. PHOTOVOLTAIC TECHNOLOGIES (PV)

Solar photovoltaic (PV) systems have been extensively utilized in Egypt since the early 1980s for various applications including lighting, pumping, commercial advertising, desalination, and cold storage (IRENA, 2018b). Egypt›s abundant sunshine, particularly along the Red Sea coast and cities like Luxor, Aswan, and Asyut, makes it ideal for PV panel deployment.

El-Shimy (2009) identified 29 optimal sites in Egypt for PV plants, with locations like Wahat Kharga and Safaga showing potential for high energy production. Sultan et al. (2018) confirmed the suitability of Southeast Egypt and areas along the Nile River for large-scale PV plants, projecting significant CO2 reduction with a 100 MW solar plant. Shouman et al. (2016) demonstrated the cost-effectiveness of standalone PV systems for rural households, while Rezk et al. (2019) and Shouman (2017) highlighted the advantages of PV-battery systems over diesel generators in remote regions. Sadeq et al. (2020) identified Aswan as particularly promising for PV technology, with high yield and low energy costs. Gabr et

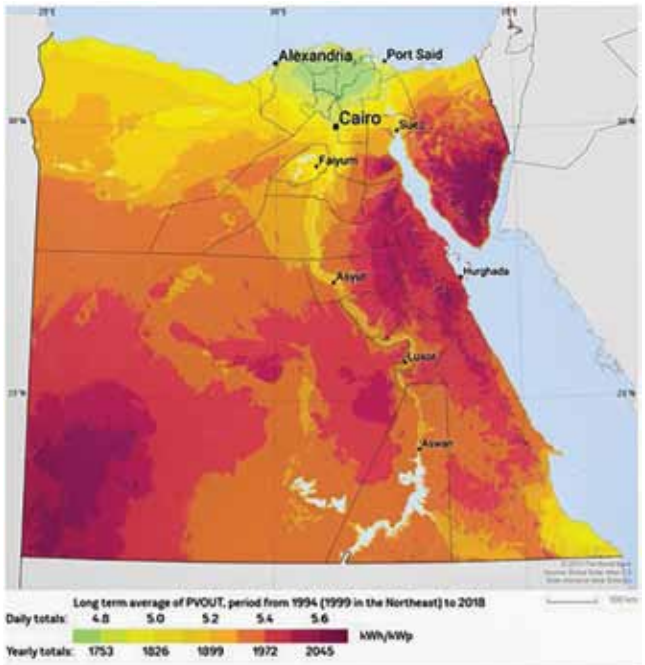

Figure 5. Solar photovoltaic potential in Egypt (Energy-Data).

al. (2020) assessed rooftop grid-connected PV systems for residential buildings, recommending a 20 kWp system for optimal cost-effectiveness. Sadeq and Abdellatif (2021) developed an online tool to facilitate PV system sizing and feasibility studies. A comparative analysis between concentrated solar thermal and photovoltaic technologies in Luxor, Egypt, and Gela, Italy, favored CSP plants in Egypt due to better feasibility in terms of energy production and land use (Desideri and Campana, 2014). However, results varied between cities, with El-Fayoum showing different technical potentials for CSP and PV systems (Effat and El-Zeiny, 2017). Egypt's PV installation capacity grew significantly after the introduction of the feed-in-tariff (FIT) scheme in 2014, reaching five times the capacity of 2013 by the end of 2016. The government›s utilization of PV panels for addressing electricity shortages, such as in street lighting, further underscores their importance in Egypt›s energy landscape.

3.2.1. GRID-CONNECTED SOLAR PV

New and Renewable Energy Authority (NREA) has completed the feasibility studies of two major photovoltaic plants in the Hurghada and Kom Ombo regions, with a capacity of 20 MW and 26 MW respectively. These plants are expected to produce approximately 32 GWh and 42 GWh respectively each year and should reduce approximately 40,000 t of CO2 emissions together. Table 1 lists additional details of planned grid-connected projects in Egypt.

Table 1. Grid-connected PV plants in Egypt (IRENA, 2018b).

Project	Size (MW)	Statues
Benban Solar Park	1465	Operational
PV Net Metering	100	Operational
West Nile	200	Operational
Decentralized PV systems	32	Operational
Private Sector	200	Under construction
Kom Ombo	26	Under construction
West Nile	600	Under Development
Kom Ombo	50	Under Development
Zaafarana	50	Under Development
Private Sector	200	Under Development

The solar park in Benban is a power plant complex composed of 41 solar power plants in Aswan, Egypt. The project consists of small PV plants developed by several independent companies with a total energy generation capacity of 1.8 GW and will be developed under NREA supervision. This project is a part of the Nubian Suns Renewable Energy FIT Programme announced in the last quarter of 2014 to support the Egyptian government to realise its plans for generating 20% of the nation›s electricity demand from responsible renewable sources by 2022 (EgyptNews, 2019). The early phase of this project started with developing a 50 MW solar power plant by Infinity Solar, which began operations in March 2018 and was completed in 2019. This produces more than 4 TWh of power and contributes to reducing 2 Mt of CO2 emissions annually (Ritchie and Roser, 2020).

3.2.2. DISTRIBUTED SOLAR PV

Since 2013, Egypt has launched various initiatives to install small-scale PV systems. Initially, a government initiative mandated PV systems on over 1000 government buildings, resulting in a total installed capacity of 20–30 MW. The first phase of the feed-in-tariff (FIT) in 2014 facilitated distributed PV systems on the grid, reaching a total installed capacity of 300 MW. NREA, in collaboration with the United Arab Emirates, implemented off-grid PV projects in 201516/ for remote communities with a total capacity of 32 MW.

Solar PV distribution technology is rapidly advancing in Egypt, with over 125 installed solar PV power plants totaling 9000 MW, leading to approximately 9 t/y of CO2 emission reductions (Egypt-PV, 2021). Key areas for PV plant development include regions between the Red Sea coast and cities like Asyut, Luxor, and Aswan. The construction of the Benban Solar Park has positioned Egypt as a leading country in clean electricity generation from PV panels. Potential areas for PV technologies are largely in desert regions, offering opportunities for electricity production if new initiatives, akin to the Benban solar park, are pursued.

3.2.3. SOLAR WATER HEATING

The annual energy report declared that the residential sector accounts for 47% of the total energy consumption in Egypt, as shown in Fig. 6. Solar water heating (SWH) constitutes an excellent potential for reducing energy consumption from conventional energy sources such as the consumption of electricity, diesel or natural gases (Abdrabo and Soliman, 2008). Egypt has a solar water heating potential of around 16 PJ/annum for chemical, food, textile and agriculture industries operating at temperatures below 100 °C with a collector area of 4.6 M m2 (Sharma et al., 2017). Several researches focused on investigating the feasibility and the performance of different solar water heating systems in Egypt while investigating the potential locations for implementing this technology. A summary of the findings reported by the existing studies on developing SWH systems under the Egyptian climate is presented in Table 2.

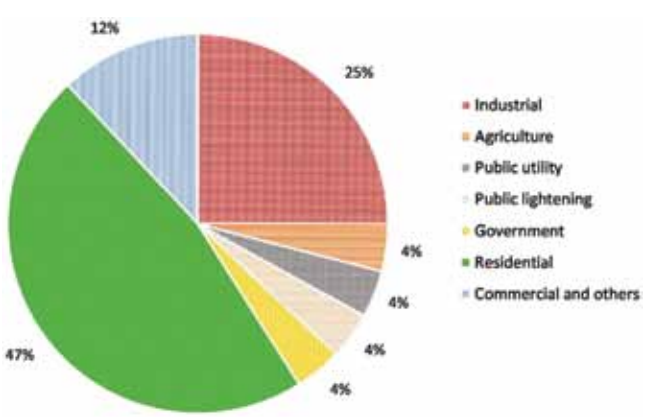

Figure 6. Annual report 201516/ by the Egyptian electricity holding company (IRENA, 2018b).

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Table 2. A summary of the findings reported by previous studies on solar water heating technologies in Egypt.

Description of the study/Remarks	Location	References
Examined the optimum parameters for solar water heating system	Alexandria	Ammar et al. (1989)
Proposed a design for solar water heating system that fulfils the energy needs of water and space heating for a house	Alexandria	Ghoneim et al. (1993)
Investigated the feasibility of solar water heating and cooling systems	Aswan, Kharga, Asyout, Cairo and Matruh	Sorour and Ghoneim (1994)
Investigated the aspects of choosing the tilt angle for solar flat plate collectors	Helwan	Elminir et al. (2006)
Assessed the economic aspects of solar water heaters	–	Abdrabo and Soliman (2008)
Proposed a typical water and space heating solar system for a hospital building	Sante Catherine	Fahmy et al. (2010)
Examined the optimisation of a residential scale solar driven adsorption cooling system	Assiut	Reda et al. (2016)
Assessed the solar industrial heating in many countries including Egypt	–	Sharma et al. (2017)
Integrated a tubular daylight device with SWH	Cairo	Marmoush et al. (2018)
Investigated the performance of using nanofluid as the working fluid in a thermosyphon solar collector under the Egyptian weather	Cairo	Eltaweel and Abdel-Rehim (2019)
Introduced an enhancement for a hybrid solar desalination system	Alexandria	Abd Elbar and Hassan (2020)
Investigated the potential of domestic solar hot water usage in Egypt	–	Shiqwarah et al. (2020)
Presented an assessment study for the productivity, exergy, exergoeconomics, and enviroeconomics of hybrid solar distiller using direct salty water	Upper Egypt	Hassan et al. (2021)
Examined a hemi-spherical solar collector under the Egyptian climate	Cairo	Ebaid et al. (2021)

The feasibility of solar water heating and cooling systems has been investigated in different locations in Egypt, including Aswan, Kharga, Asyout, Cairo and Matruh in 1994. This study showed that the solar water heaters are feasible for all locations based on the calculated life cycle savings. It has been found that the optimum solar collector area varies significantly with the location in Egypt (Sorour and Ghoneim, 1994). Unfortunately, Abdrabo and Soliman (2008) found that SWH is hard to compete with conventional heaters owing to the low demand level for the technology and the lack of market incentives in the Egyptian market. This is due to the previous installation of low-quality SWH, and the low quality, lack of reliability and durability of such heaters had a negative effect on the SWH sales recorded over the period from 1994 to 1997 (Abdrabo and Soliman, 2008).

Calise et al. (2021) provided a techno-economic assessment for energy efficiency options in Naples, Italy and Fayoum, Egypt. The proposed systems are based on driving domestic

water heating using evacuated tube collectors (ETC) and PV panels. The proposed energy measures resulted in 67% and 58% primary energy savings in Fayoum and Naples districts respectively. The higher savings achieved in Egypt are due to the higher solar radiation in Fayoum compared to Naples. The payback period in Naples was 5 years compared to 23 years in Fayoum due to the subsidised cost of natural gas in Egypt. The performance of solar water heaters has improved significantly for both passive and active systems with the introduction of nanofluids to be used as a working fluid, which could encourage their use in the next few years (Eltaweel and Abdel-Rehim, 2021).

As for the environmental impact of the SWH technologies, Reda et al. (2016) examined the optimisation of a solar-driven adsorption cooling system for a residential application located in Assiut, Egypt. The proposed system resulted in lower carbon dioxide emissions; the CO2 level has been reduced from 1062 kgCO2eq/kWc (for a system entirely driven by natural gas) to 193 kg CO2eq/kWc for a system driven by solar energy.

Based on the aforementioned studies, solar heating systems constitute promising alternatives for the residential sector in Egypt by reducing the consumption of conventional energy resources and CO2 emissions.

3.3. SOLAR DESALINATION SYSTEMS

Desalination plants in the MENA region constitute around 75% of the world›s desalination plant capacity (Al-Otaibi, 2015). Around 35 Bm3/y of water consumption is supplied by non-sustainable water sources, including groundwater and fossil fuel desalination. Meanwhile, the global water deficit is expected to reach 155 Bm3/y by 2050 (DLR, 2005), and Egypt will be affected by it. Egypt is under water scarcity limit owing to insufficient resource management. Additionally, the Nile River share of 5 Bm3/d is threatened by GERD (Walsh and Sengupta, 2020). Around 5.8 and 1.5 M people are still living in rural and urban slums, respectively, where the accessibility of spring water is limited (UNICEF, 2017). The Egyptian government has already initiated some programs for water desalination to overcome this problem (Amin et al., 2020a). Solar desalination systems are promising candidates for providing sustainable water sources in Egypt, considering its CSP potential (32 GW) and available coastal areas on the Mediterranean and the Red Sea (El-Sadek, 2010). In this context, several researches focused on investigating the feasibility and the performance of different solar water desalination systems in Egypt, as well as identifying the potential locations suitable for this technology. As a result, some promising locations for solar water desalination have been identified as follows:

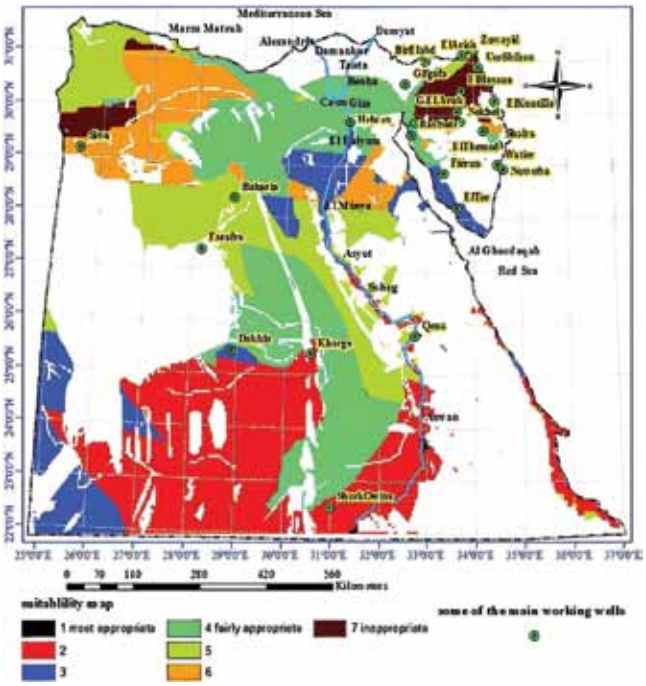

Figure 7. Suitable locations for groundwater solar desalination in Egypt (Salim, 2012).

• Along the Red Sea coast, brackish water with total dissolved solids (TDS) of 1000 ppm

• Along the northwest coast, brackish to saline water with TDS of 1000–10,000 ppm

• Sinai coastal zone and wadis, brackish water with TDS of 1000 ppm

• The northern desert (El-Sadek, 2010).

A multi-criteria analysis has been conducted to choose the optimum locations for solar water desalination. This assessment was based on some of the key factors such as solar radiation, transportation networks, topography, land cover/land use, saline water surfaces parameters and population (Mohamed, 2020). As a result, vast areas in the western desert and around the coastal areas were found to be suitable for solar desalination stations. Around 24.6% of the land in Egypt was considered appropriate for solar desalination stations accounting for 24,0842 km2 near the saline water surfaces. Additionally, up to 17% of the land (166,146.36 km2) was classified as a moderate suitability. The remaining 58.4% of the land was classified with low suitability for solar desalination plants.

Upper Egypt›s big cities, including Asuit, Sohag, Aswan, Qena, ElKharga oasis and Toshka are gifted with the highest potential for groundwater solar desalination, as indicated in Fig. 7. The West Delta area is selected for surface water and

the Mediterranean Sea for desalination (Salim, 2012). These locations were specified based on a multi-criteria analysis, including the effects of aquifer depth, solar radiation, aquifer salinity, distance from the Delta and the Nile Valley, dunes, the incidence of flash floods, rock faults, and seawater intrusion in the North Delta.

Various solar desalination technologies have been explored in Egypt, offering solutions for remote areas. Reverse Osmosis (RO) systems, examined by Abou Rayan et al. (2001) and Ahmad and Schmid (2002), showed promise in regions like Sinai and the Gulf of Aqaba, where PV panels can replace diesel generators. A stand-alone RO unit powered by PV, capable of desalinating brackish water, was installed in remote areas, producing 3–5 m3/d of freshwater (Abo Zaid, 2015). However, intermittent solar power and battery costs pose challenges, resulting in water costs of 5.6–9.3 LE/m3. While solar PV technologies for desalination are more expensive than solar thermal options, they are still viable for small-scale applications in remote regions (Lamei et al., 2008).

Integration with renewable energy has enhanced desalination methods. Modified solar stills integrated with parabolic trough collectors showed increased water productivity by 18% (Abdel-Rehim and Lasheen, 2007). Similarly, coupling a multi-effect distillation system with a solar central receiver system in Al-Kosseir doubled annual water production, albeit with a slight reduction in electricity generation potential (Servert and Cerrajero, 2015b). Multi-Effect Distillation (MED) and RO systems integrated with PTC solar systems in Ras Gharib were found to be technically and economically feasible, producing freshwater at competitive rates (Moharram et al., 2021).

Offshore desalination plants, like floating desalination plants (FDP), have been explored for implementation in Egypt. Amin et al. (2020b) concluded that FDPs offer better motion responses than floating production storage and offloading systems (FPSO) in Ras Ghareb. They further proposed a hydrodynamics-based design supporting FDPs and wind turbines (Amin et al., 2021). The feasibility of offshore FDPs integrated with marine renewable energy in Ras Ghaleb showed promise, offering stability and efficiency under Egyptian environmental conditions (Amin et al., 2020a). A summary of the previously reported works focusing on solar desalination systems in Egypt is presented in Table 3.

Table 3. A summary of the previous works focusing on solar desalination systems in Egypt.

Description of the study/remarks	Location	References
Integrated solar still with a reverse osmosis (RO) system for future applications in supplementary irrigation	along the Red Sea coast, along the northwest coast, Sinai coastal zone and wadis	El-Kady and El-Shibini (2001)
Investigated the feasibility of installing solar desalination units	Sinai and Gulf of Aqaba	Abou Rayan et al. (2001)
Investigated the feasibility of desalinating brackish water using PV technologies	rural areas	Ahmad and Schmid (2002)
Introduced two modifications for solar desalination systems	Cairo	Abdel-Rehim and Lasheen (2005)
Introduced a modification for an existing solar still desalination system	Cairo	Abdel-Rehim and Lasheen (2007)
Conducted a cost analysis for desalination plants based on both PV and solar thermal technologies	remote areas	Lamei et al. (2008)
Demonstrated the importance of seawater desalination for water security in Egypt	Egypt	El-Sadek (2010)
Conducted a feasibility analysis for an integrated hybrid concentrating solar power (CSP) and seawater desalination (DES) system	Mediterranean countries including Egypt	Moser et al. (2011)
Investigated the promising locations in Egypt for solar water desalination based on the solar radiation	–.	Salim (2012)
Evaluated the thermodynamic characteristics of coupling solar power plants and desalination units	Port Safaga, Egypt	Blanco et al. (2013)

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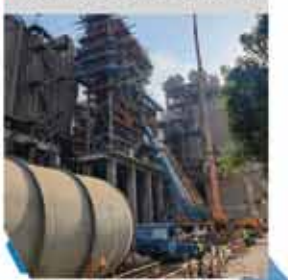

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Examined the feasibility of a stand-alone reverse osmosis desalination unit powered by photovoltaic systems	Northwest coast of Egypt	Abo Zaid (2015)
Introduced a multi-effect distillation system coupled powered by a solar central receiver system	Al-Kosseir, Egypt	Servert and Cerrajero (2015b)
Installed a water desalination system driving water for a small green house hydroponic cultivation	–.	Khattab et al. (2016)
Conducted an energy and exergy analysis for a solar still	New Borg El-Arab City, Alexandria, Egypt	Yousef et al. (2017)
Evaluated the performance of a combined solar tower power plant with low temperature desalination systems	ELGouna, Egypt	Wellmann et al. (2018)
Conducted a multi-criteria analysis model for groundwater management	Moghra Oasis, Egypt	Sayed et al. (2019)
Highlighted the suitable areas for the installation of future solar desalination stations	Western desert and around the coastal areas	Mohamed (2020)
Introduced a novel mobile floating desalination plant	Ras Ghareb city in Egypt	Amin et al. (2020b)
Investigated the performance of a hybrid renewable energy system used to drive a small RO desalination	Ras El Bar city, Egypt	Ibrahim et al. (2020)
Developed a model to investigate the feasibility of integrating a CSP plant with water desalination systems	Ras Gharib, Egypt.	Moharram et al. (2021)
Reviewed desalination processes integrated with renewable technologies	remote areas	Kashyout et al. (2021)

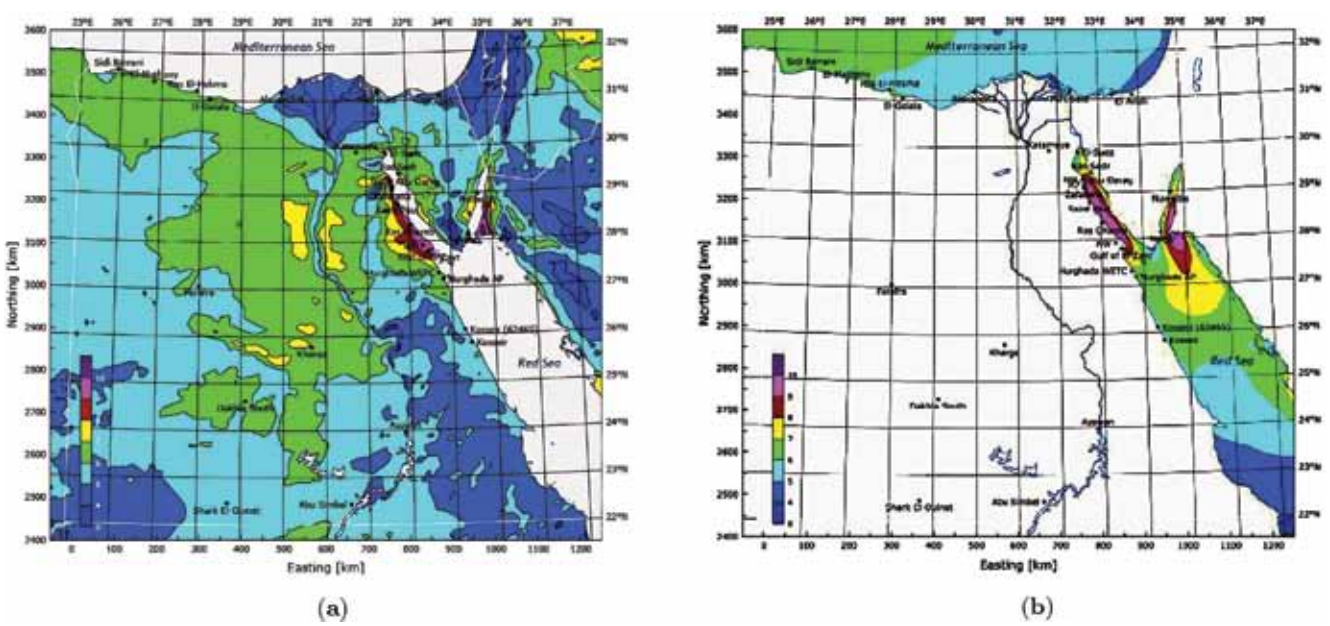

Figure 8. (a) Egypt›s wind atlas; colour bar from dark blue to dark purple stands for the different wind speeds where the highest and lowest speeds are donated by the purple and blue colours, respectively at a 50 m altitude, (b) Offshore wind resource map of Egypt : mean wind speeds at 50 m altitude (Global Energy Network Institute). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Some other countries, like Pakistan, also face the water scarcity problem similar to Egypt; where using improved irrigation systems and low cost RE electricity (i.e. the desalination sector powered by RE) have been found to help in facing this problem (Caldera et al., 2021). Given that Egypt has a great potential for solar water desalination, a similar analysis should be carried out to investigate the potential of powering the desalination sector in Egypt with RE resources. This should simultaneously solve water and energy shortage problems in Egypt while reducing CO2 emissions.

4. WIND ENERGY TECHNOLOGIES (WET)

Wind energy resources have been evaluated in various locations in Egypt. The new wind atlas of Egypt, which was published in 2016 on IRENA's Global Atlas platform, is presented in Fig. 8a and 8b. Along with the developed wind maps, numerous studies have previously examined potential wind energy plant locations in Egypt. Hamid (2011) investigated cost-effective wind farm locations in Egypt by developing a new geographic information system (GIS) linked to a multi-criteria decision support system. The results of this study suggested that 30% of the Egyptian land is suitable for harnessing power from the wind.

Figure 8. (a) Egypt's wind atlas; colour bar from dark blue to dark purple stands for the different wind speeds where the highest and lowest speeds are donated by the purple and blue colours, respectively at a 50 m altitude, (b) Offshore wind resource map of Egypt : mean wind speeds at 50 m altitude (Global Energy Network Institute). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Egypt›s wind energy potential has been extensively studied across various locations. Marsa Matruh, El-Suez, and El-Kharjah exhibit average annual wind speeds between 4.6 and 5.5 m/s, making them viable for wind energy projects (Rizk, 1987). Coastal and interior areas, including Aswan and Cairo, show promise, with power densities ranging from 30 to 467 W/m2 (Mayhoub and Azzam, 1997). El-Dakhla and Kharga are identified as potential sites for wind power generation, with power densities of 333 to 377 W/m2 (Ahmed, 2012).

Despite Cairo›s low wind resources, a wind project could be financially viable with appropriate pricing adjustments (Hamouda, 2012). Mediterranean Sea locations like Sidi Barrani and Marsa Matruh offer consistent wind speeds between 5 and 6 m/s, suitable for wind-based electricity generation (Shata and Hanitsch, 2006). Ports like Port Said also exhibit favorable wind speeds, supporting medium-

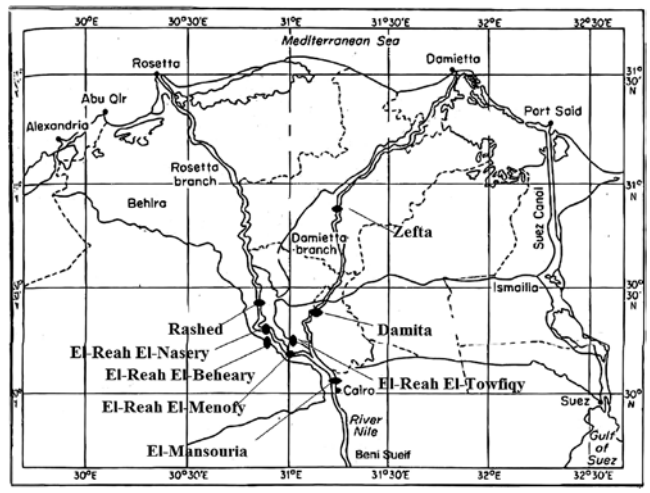

Figure 9. Potential locations of small hydropower plants in Northern Egypt (Hatata et al., 2019).

sized wind turbines (Lashin and Shata, 2012).

In Aswan, wind speeds range from 5.3 to 6.1 m/s, making it suitable for large-scale wind farms (Ahmed, 2011a). The Gulf of Suez region presents significant wind energy potential, with turbines like NORDEX identified as optimal for sites like El-Zafarana and Ras Ghareb (EL-Shimy, 2010).

Offshore wind energy facilities along the Mediterranean Sea have demonstrated high capacity factors, with Ras Seder and Nabq identified as prime locations (Ahmed, 2018b). Sinai Peninsula and Ras Ghareb further showcase Egypt's wind energy potential, with average annual wind speeds exceeding 8 m/s and 360 W/m2, respectively (Ramadan, 2017; Ahmed, 2011b).

Energy storage systems like compressed air energy storage (CAES) are being explored to stabilize wind energy supplies and integrate them into the grid (ElBeheiry, 2011; Ramadan et al., 2016). Despite drawbacks, advances in technology offer solutions to maximize wind energy›s potential in Egypt (Chowdhury et al., 2022). Overall, Egypt boasts abundant wind resources in various regions, presenting ample opportunities for wind-based electricity generation. A summary of potential locations with high wind energy capacities is presented in Table 4, together with key characteristic parameters.

To exploit the immense potential of wind energy in Egypt, the first wind farm was constructed in Hurghada in 1993 with a total installed capacity of 5.2 MW. Afterwards, the NREA developed a series of large-scale wind farms with a capacity of 545 MW in 20102011/ in cooperation with multiple countries, including Japan, Germany, Spain and Denmark. Then, this capacity increased to 750 MW by November 2015, under an engineering, procurement and construction

Table 4. A summary of potential wind energy locations in Egypt.

Location	Power density (W/m2)/height (m)	Wind speed (m/s)/height (m)
Aswan (Ahmed, 2011a)	363.0 / 100.0	5.3–6.1 / 10.0 & 6.9 –7.5 / 50.0 – 70.00
Assuit (Mayhoub and Azzam, 1997)	128.9 / 25.0	3.5–5.7 / 25.0
El-Kharga (Ahmed, 2012)	377.0 / 70.0	5.4 / 10.0 & 6.5 / 24.5
El-Dakhla (Ahmed, 2012)	333.0 / 70.0	5.2 / 10.0 & 6.4/ 24.5
Mersa Matruh, El-Suez and El-Kharga (Rizk, 1987)	73.0–112.0 / 20.0	4.6–5.5 / 20.0
Sidi Barrani, Mersa Matruh and El Dabaa (Shata and Hanitsch, 2006)	260.0–330.0 / 50.0	5.0–5.4 / 10.0
Sallum, Dekheila, and Port Said (Shata and Hanitsch, 2006)	180.0–210.0 / 50.0	4.4 - 4.6 / 10.0
Port-Said city (Lashin and Shata, 2012)	19.0–72.0 / 10.0	4.6–5.8 / 19.0 – 50.0
Ras Ghareb (Ahmed, 2011b)	338.0–625.0 / 10.0	6.4–10.2 / 10.0
Ras Seder and Nabq (Ahmed, 2018b)	59.0–268.0 / 10.0 & 42.0– 192. 0 / 10.0	8.6 & 8.0 / 50.0
Ras Seder (Ramadan, 2017)	66.8–481.6	6.52 / 10.0 & 7.21/ 25.0
Shark El-Ouinat City (Ahmed, 2018a)	582.0 / 100.0	6.5 / 10.0

(EPC) scheme in Zaafarana and Gulf of El Zayt. This scheme provided an energy production of 260 GWh and 2058 GWh in 200102/ and 201516/, respectively. Due to the installation of these farms, fuel savings were increased from 58 Mtoe to 432 Mtoe from 200102/ to 201516/. The CO2 emissions have also been reduced by 0.143 and 1.131 Mt in 200102/ and 201516/, respectively (IRENA, 2018b). As per a signed memorandum of understanding between Siemens and the NREA in April 2015, several projects accounting for a generation capacity of 2000 MW are being developed by Siemens. The details of these planned wind projects until 2023 are presented in Table 5.

Table 5. A list of wind energy projects to be installed in Egypt up until 2023 (IRENA, 2018b).

Project	Size (MW)	Status	Contract
Gulf of Suez	250	Under development	NREA-KfW, EIB, AFD EPC scheme
Gulf of Suez	250	Under development	GDF Suez, Toyota, Orascom BOO scheme
Gulf of Suez	200	Under development	NREA-Masdar EPC scheme
Gulf of Suez	200	Under development	AFD-KfW EPC scheme
Gulf of Suez	2000	Under development	Siemens EPC scheme
Gabal El Zayt	220	Under construction	NREA-Japan-JICA EPC scheme
Gulf El Zayt	320	Under construction	Italgen BOO scheme
Gabal El Zayt1	120	Under construction	Spain-NREA
West Nile-1	250	Under development	BOO scheme
West Nile 1	200	Under development	Japan EPC scheme
West Nile 1	600	Tender-bidding Phase	NREA IPP scheme

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Lessons Learned from Drilling a Long Open Hole Interval and Recovery from a Stuck Pipe Incident

By: Ayodele Akinfolarin, Obinna Amah, Isijokelu Ijeh, Chiwar Djauro, Samson Omoregie, Mike Usim, Willhelm Tien, John Emesi, and Joseph Mordi, The Shell Petroleum Development Company Nigeria Limited

Abstract

Drilling long open hole sections has been known to result in many challenges including wellbore instability problems which may lead to stuck pipe problems. However, well design or operational challenges may necessitate making such risky decisions. In such situations, precautionary measures will need to be taken to ensure that the hole is successfully drilledwith minimum to no wellbore instability problems which have negative impact on time and cost.

The case study, well FX-3 is a well drilled by one of the major oil and gas companies in the Niger Delta.

The tophole was planned to be drilled in two sections: a pilot hole to the planned section total depth and then with a hole opener to open the pilot hole to the required hole size. Due to the abrasive formation type and difficulties encountered while drilling to the planned depth, decision was made to set the casing shallower than planned. This necessitated drilling the 12-1/4" hole section longer than planned. With this decision,several challenges were encountered and eventually overcome. The well was successfully completed.

The objective of this paper is to present the lessons learned in drilling a long open hole interval and the recovery operations from a stuck pipe incident within that interval in the well. It discusses both the well design and actual field practices, with significant emphasis in the recovery operations from the stuck pipe incident. One of the key events is the spotting of special pipe freeing pills, which in combination of other activities led to the freeing of the stuck bottom hole assembly which had a radioactive source. Some of the key learnings are the need to optimise the well design, proper hole cleaning and mud conditioning prior to drilling to section total depth. The knowledge of the pipe sticking mechanism and the application of the right pipe freeing formulations are important considerations in freeing any stuck pipe

Introduction

Drilling long open hole sections could lead to many borehole stability problems such as improper hole cleaning, stuck pipe or hole collapse. In some cases, long open hole intervals that travess different formations (such as a combination of depleted intervals with high pressure intervals) may also lead to loss of drilling mud to the formation, consequently resulting in loss of hydrostatic head and potential well control problems in extreme cases (Warlick, 2009; Hassan, 2018). With stuck pipe taking up a huge part of drilling costs (Bradley, 1991), various approaches have been designed to prevent and also recover from its occurrence, including the use of pipe freeing pills (Aadnoy, 1999; Krol, 1981).

Well FX-3 is a development well that lies somewhere in the coastal waters in the Niger Delta. The well is located on a platform on the shallow waters off the coast of the Niger Delta. The well was drilled with a Jack-up rig. The initial design of well FX-3 involved the drilling of about 6300ftah of open hole in the 12 ¼" section after drilling and securing the 16" hole with 13 3/8" casing. This design was predicated on the isolation of freshwater aquifer and the installation of a blow-out preventer before penetrating the shallowest hydrocarbon. It was also required to set the production casing deep enough to acquire sufficient shoe strength both for well control and equivalent circulating density considerations and to minimise the 8 ½" hole interval. The overall casing design concept of well FX-3 is presented in Figure 1 below. The well plan showing the well deviation is also presented below (Figure 2).

This paper presents the drilling of some sections of Well FX-3 and the recovery operation from a stuck incident in the 12 ¼" hole.

The Drilling of the Top-Hole Section of Well FX-3 The tophole section of Well FX-3 involved the drilling of the 8 1/2" pilot hole to 4845ftah for shallow gas hazard mitigations and the opening of the 8 ½" pilot hole to 16" hole prior to the installation and cementation of the 13 3/8" casing. The 8 ½" pilot hole was drilled in two bit runs to 4845ftah. The first bit run was a milled tooth bit (IADC 137) and it drilled from 356ftah to 3261ftah; it came out with a dull grading of 3-5 WT-A-E-1/4-CT-BHA. The second 8 ½" pilot BHA drilled with an insert bit (IADC 437) from 3261ftah to 4860ftah and it came out with a bit dull grading of 5-4-WT-A-E-1/8-

NO-TD.

The 8 ½" pilot hole was opened directly to 16" with an 8 ½" × 16" hole opener. This was considered an optimisation to save time rather than opening the 8 ½" hole in stages. For example, the 8 ½" could have been opened from 8 ½" to 12 ¼" and a different run would have been made to open the 12 ¼" hole to 16".

Alternatively, a staged hole opener could have been used in a single run. The first 8 ½" by 16" hole opener run opened the 8 ½" to 16" from 356ftah to 2926ftah. The hole opener came out of hole with a dull grading of 4-WT-A-E-5/8-BU-TQ. A second 8 ½" × 16" hole opener BHA was run in hole and it opened the 8 ½" hole from 2926ftah to 3182ftah. There was no further progress made due to high torque and extremely low rate of penetration. It came out with a dull grading of 4-WT-A-E-16/16-BU-TQ. Due to the low performance of the hole openers, a 16" insert bit was run to ream the 8 ½" hole to 16". However, the bit drilled to 4054ftah and had to be pulled out of hole due to very low rate of penetration. The bit dull grading was 2-3-WT-A E-3/16-BT-TD.

During the deployment of the 13 3/8" casing, the string encountered restrictions at 3,154ftah - 3,174ftah, 3,211ftah and 3595ftah. The casing string was also stuck at 3651ftah but was worked free with 250klbs over pull and 100 klbs slack off weight with 300gpm circulating rate. However, the casing was successfully run to setting depth of 4045ftah and cemented in place.

An investigation into the reasons the two-hole opener BHAs could not open the 8 ½" pilot to the planned section total depth indicated that the formation was abrasive as the five bits deployed within this interval all came out under gauge. The investigation also showed that the hole openers could have been made of PDC or TCI cutters or milled tooth cutters of higher IADC classification.

The Drilling of the Intermediate 12 ¼" Hole Section of Well FX-3

The 12 ¼" hole section was drilled from 4045ftah to 11200ftah - an open hole interval of 7155ftah. This was drilled in one bit run without any tool failure in 149 hours. An IADC M323 six bladed, 3in gauge with 16mm-cutters bit was selected for the section based on offset bit analysis and bit engineering that took into consideration the formation data such as rock mechanics and lithology. The bit total flow area was optimised for bit hydraulic horsepower, hence the pump rate range was selected to achieve that objective with hole cleaning, mud properties and ROP taken into consideration.

There were other factors that constrained the ROP. For example, while drilling initially (prior to the drilling fluid warming up and shearing properly) there was constant drilling fluid overflow at the shakers which necessitated cutting down on the designed flow rate. There was some directional work and anti collision monitoring that had to be done to meet the well objectives. Furthermore, the required RPM was limited to about 130 by the rig's Top Drive System. There were also issues that bothered on communication as the rig team comprised of multi-national personnel, some who were not proficient in English Language.

Factors that helped in achieving the drilling objective of the 12 ¼" hole were good collaboration of all the service providers, early call out of tools and personnel, surveys were done before connection to minimise stationary time, a rotary steerable system bottom hole assembly (BHA) was used and drilling parameters such as weight on bit were optimised taking into consideration torque limitations.

The 12 ¼" bit dull grading after it was pulled to surface was 2-5-RO-G-X-1/8-LN-TD, shown in Figure 3. The ring out of the bit did not appear to be formation related. However, a long cement shoe track of about 120ft was drilled and a bit nozzle was lost to the formation.

Sticking and Retrieval of the 12 ¼" Bottom Hole Assembly

The 12 ¼" hole was drilled to the section total depth of 11200ftah. However, prior to drilling to section total depth, it was observed that the low-end mud rheology and electrical stability were sub-optimal and commencement of the required mud treatment was not possible due to logistics challenges. The hole was circulated clean with a minimum of three annular volumes. After a fifteen-minutes flow check was done, the first stand of 5 ½" drill pipe was pulled out of hole with intermittent drag which kept dropping off.

An attempt to pull the second stand was not successful. The drill string was pulled with 60klbs overpull without success. Part of the string weight was slacked off and the pipe did not come free. Attempts were made to rotate the string, but no pipe rotation could be initiated. However, the pumps were started, and full circulation was established with normal circulating pressures. The string was subsequently worked with maximum allowable torque and slack off weight and then also with maximum overpull without it getting free. All attempts to fire the jar did not indicate that the jar was firing. A stretch calculation indicated that the string was stuck across the drill collars and above the jar in one of the depleted sands close to the 12 ¼" section total depth.

A 57bbls pipe lax pill (about 90% by volume of base oil) was prepared and pumped across the suspected stuck interval and allowed to soak for about six hours. The string was kept in compression with torque.

After the soaking period, the string was worked severally without success. A second 60bbls pipe lax pill was prepared and soaked across the suspected stuck interval for about six hours. The string was worked subsequently with slack off weight and overpull without it coming free.

A specially formulated caustic pill was prepared. 60bbls of the pill consisted of 20ppb of caustic soda and 3% (v/v) of drilling detergent. The fluid pumping train comprised of 10bbls of base oil ahead followed by 20bbls of surfactant pill and the caustic pill. This pill was spotted across the suspected stuck BHA interval and allowed to soak for about six hours with the pipe in compression and torque. An attempt to work the pipe in compression was successful as pipe movement and rotation was restored. The stuck interval was reamed severally with circulation. The rotation and circulation were stopped, and an attempt was made to pull the drill string out of hole on elevators, However, it was observed that the drill string had immediately got stuck again. Several attempts to work the string free was unsuccessful.

A second caustic pill formation was prepared and spotted across the suspected stuck interval and the pipe put in compression and torque. After allowing the pill to soak for about four to ten hours, the pipe was worked on severally applying the maximum allowable tension and compression (with torque). However, the 5 ½" drill pipe parted at about 76ft below the derrick floor while attempting to pull the string free in tension.

An overshot fishing assembly was made up with 5-3/8" basket grapple (due to the reduced outside diameter of the necked-out top of fish) and the fish was engaged. It was then observed that the drill string was free; it was pulled to the rig floor. The parted string was laid down and the remaining string and bottom hole assembly were back-reamed out of hole to the 13 3/8" casing shoe at 4045ftah. The back-reaming operation was done at close-to-normal drilling parameters. At the 13 3/8" casing shoe, a viscous pill was pumped, and twice annular content circulation was carried out. The back-reaming and circulations brought a substantial amount of non-fresh cuttings to surface. Subsequently, the string was pulled freely on elevators to surface. This led the team to suspect that the sticking mechanism may initially have been "mechanical sticking", a scenario where cutting bed (lying on the low side of the well and restricting the hole ID) may have wedged the string at bottom resulting in the inability to pull the string out of hole but not causing sufficient flow restriction to result in a pack-off and pressure spikes. It is quite possible that subsequently, the mechanical sticking may have progressed into a differential sticking scenario as there was substantial overbalance (>1000psi) across some permeable and depleted sands. Fred, et al (2010) have explained the difference between differential and mechanical sticking A review on how the string came free the first time could have been a combined effect of the pipe lax pills pumped initially which lightened the hydrostatic across the stuck interval and the caustic pill that broke down the filter cake. An analysis of the freeing mechanism the second time the string was free indicated help from two likely sources. First, the caustic pill may have broken down the filter cake across the stuck interval. Second, the axial force due to the parting of the string may have led to some severe shock load (combined slacking of the weight of the entire string with some impulse force) on the stuck interval, leading to the freeing of the stuck string and allowing it to fall to bottom.

After the pipe was pulled to surface, a decision was taken to immediately run the 9-5/8" production casing since extensive back-reaming operation was done while pulling the stuck string to surface. The casing was run without much issues through all the intervals that were back-reamed up to 11049ftah where it was held up. That depth interval, 11049ft to 11200ft, was not back-reamed. The casing tally was adjusted, the casing pulled to 11016ft and the casing hanger landed. The casing was cemented successfully. Worthy of note while displacing the cement was that the plugs where not bumped after displacing the calculated displacement volume. Additional volume of about 6bbls was pumped to bump the plugs. The additional volume was calculated from the mud compressibility correlations. Subsequently, the well was drilled to the final target depth and other well operations were conducted successfully.

Lessons Learned from drilling a long open hole interval and retrieval of a stuck pipe The following were some of the lessons learned in drilling a long open hole interval and retrieval of a stuck BHA:

i. 8 ½" hole can be opened directly to 16" hole. The Cutters of the hole openers should be selected based on the formation to be drilled. Review offset data if available
ii. Consider the possibility of short wiper trip runs when drilling a long open hole interval
iii. Condition mud properties to the required specification while drilling (across depleted intervals) and prior to pulling out of hole the bottom hole assembly
iv. Check that the HPHT filtrate loss is within the programmed value and the filtrate is all oil without water indent prior to pulling out of hole the drill string.
v. Circulate the well clean till there are no significant returns of formation cuttings from the shakers
vi. Consider running casing rather than a wiper trip when the open hole interval has been back-reamed at drilling

or close to drilling parameters

vii. In highly deviated wells, it is possible for the drill string to be stuck mechanically and have full returns if the cuttings bed is lying on the low side and not causing substantial obstruction to the drilling fluid flow path. Mechanical sticking can be prevented by conditioning the drilling fluid rheology to the right specifications and circulating the well free of cuttings

viii. Have enough quantities of caustic soda and pipe lax on location when drilling across intervals with high risks of differential sticking

ix. Have acid (e.g. 15% HCl) on location when drilling across depleted intervals with a CaCO3 weighted mud

x. The caustic pill was effective in freeing the pipe from the filter cake

xi. Consider pumping a long column of base oil across stuck intervals or above as may be required to reduce the hydrostatic across the stuck interval while taking well control and other borehole stability issues into consideration

xii. Once a decision is made to back-ream, consider back-reaming the entire open hole and circulate the well clean at the previous casing shoe

xiii. Back reaming should be done at close to drilling parameters with control over the rotary overpull to minimise the risk of twist off if restriction is encountered

Conclusion

The 8 ½" top hole section of well FX-3 was opened directly from 8 ½" to 16" and the stuck 12 ¼" bottom hole assembly was successfully recovered. The 9 5/8" casing was run and cemented in place without any significant issue. Cutter selection based on formation lithology should be taken into consideration in the 8 ½" × 16" hole opener design. About 7151ft of 12 ¼" open hole was drilled successfully in one bit run without any equipment downtime. Hole cleaning and mud conditioning to the required specification should be taken into consideration in drilling a long open hole interval, especially if depleted intervals are to be penetrated.

The deployment of caustic pill formulation was effective in freeing the stuck BHA. The additional lesson learnt was that the 9 5/8" casing was deployed close to setting depth after backreaming the open hole interval without much borehole related issues.

Acknowledgement

The authors wish to thank all those that participated in the successful drilling of the surface and intermediate hole sections of well FX-3 especially van Zwol Cee, Princewill Ekeadah and Grace Nnorom. The drilling contractor personnel, the service company personnel, the company supervisors at both the well site and onshore were some of the people that participated in the successful drilling of the more than 7000ft of open hole and the retrieval of the stuck bottom hole assembly. We also wish to thank the Shell Petroleum

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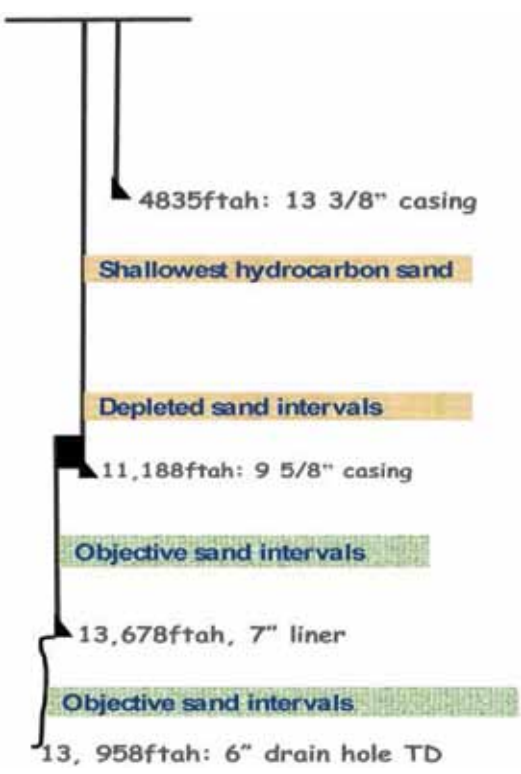

Figure 1—Casing scheme for well FX-3

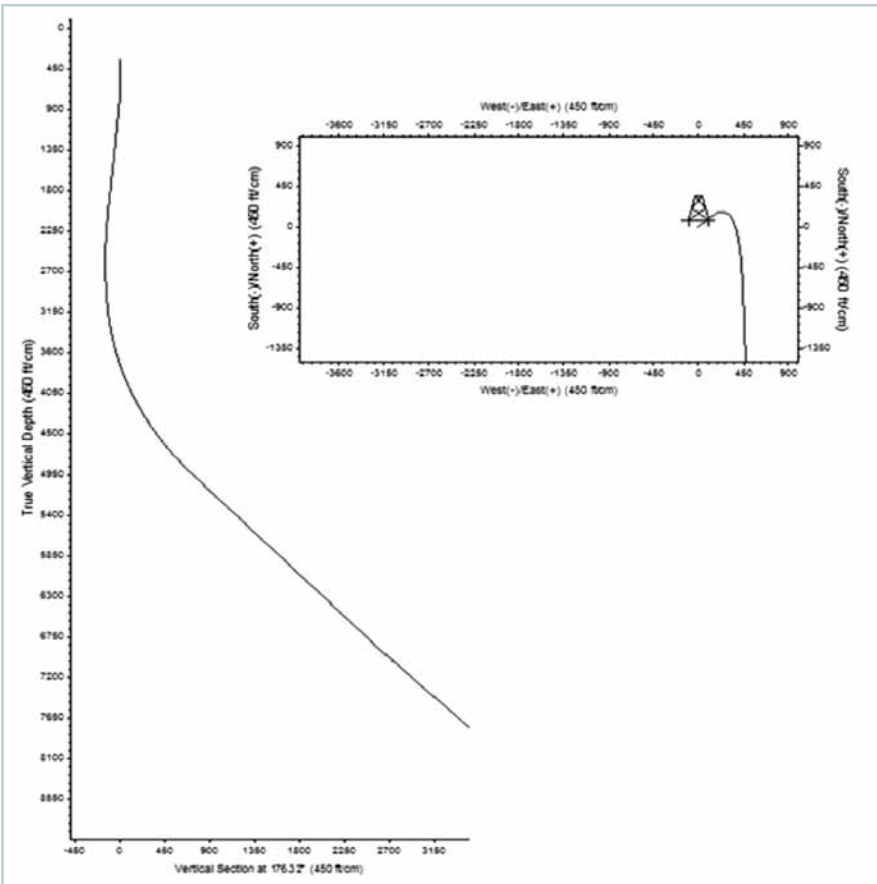

Figure 2—Wall plot for Well FX-3

Figure 3—12 ¼» PDC bit pulled to surface

Figure 4—Part of the string that parted on surface. The lower part of the fish was in hole at the time of this picture.

AN INTERVIEW WITH

MOATH AL RAWI

CEO ARGAS

Established in 1966, how do you describe the company's journey throughout the past years? What are the services ARGAS provide?

The Arabian Geophysical and Surveying Company ("ARGAS") was established in 1966, with almost 60 years of experience. the Joint Venture was established and still a partnership between Arab Saudi TAQA, a semi-government entity, along with the French CGG, a leading Geoscience company. The purpose is to nationalize exploration knowledge to develop "natural resources" in the region and to champion Geological and Geophysical surveys thought-out the different methods including, but not limited to seismic data acquisition.

ARGAS expanded its operations to many other countries in the region, and currently serving customers, not just in the Kingdom, but also in other countries, including Egypt, for example, where we have been working here for the past 49 years.

Today, we have a wide reach as we provide Exploration Services, including geophysical and geological measurements in number of countries serving customer in fields of Geothermal Energy, oil and gas, and mining services.

ARGAS, proudly is the oldest geophysical data acquisition services company in the world. ARGAS resilience and process survived decades and served many customers to deliver energy and wealth to our societies.

We work with our technology partners to deploy the best available technologies using our capabilities. We invest in people, equipment, and knowledge to operate mega operations in remote areas, providing challenging logistical and life support to our exploration team with the aim of providing a complete and seamless solution to find natural resources and energy to the world by increasing the economic value of information to help our customers improve their exploration success rate.

ARGAS work in Egypt for almost 50 years, how was that period? And what were the challenges?

Our experience here in Egypt is beyond limits. We operate in a beautiful country across different terrain types, including Western Desert, Delta area, transition zones, and shallow waters.

ARGAS was the first company ever that provided geophysical services in Egyptian western desert where we made a world record of 45 thousand vibrator point acquisition. Our team here in Egypt is made by 90% solid experienced Egyptians, who have global exposure and training to run our operations. We invest in our people and ensure mobility to our staff, so we develop their experience from different markets. For example, we move people from Egypt to Saudi and then to Oman, or Omanis from Oman to Egypt, so we develop their experience and enrich their knowledge.

As an example, working in Egypt is unique experience, as we operate in environmentally sensitive areas, and therefore, our team outside Egypt learns a lot from relocating to our Egypt operation, similarly, we apply different Geophysical operations in Saudi that allow us to secure low frequencies data for better underground imaging, therefore, moving our Egyptian team to Saudi will help them expand their knowledge.

In Egypt, we have just completed on successful survey south of Al-Alamin: the area was environmentally sensitive, high density, challenging terrain types, unexploded ordinance from the World War Two. Very interesting challenge, and we did it safely and completed our survey ahead of schedule and with great deal of data value to our customer.

'Since 2006 the company has acquired over 47000 square kilometers of seismic data' How did ARGAS manage to maintain work plans amid especially in the last 3 years challenging conditions?

ARGAS's experience exceeds 6000 project and more than 3 million square kilometer of data acquisition. We go further and beyond to find energy to the world. Our goal is to explore "natural resources" regardless of the application, whether it was oil, gas, gold, water or geothermal energy. We find underground wealth using Airborne, Ground operations, or marine Surveys. ARGAS is illuminating the subsurface.

We are the "boots on the ground" , the passionate explorers who actively participate in serving our communities. We have number of programs in association with Saudi ministry of energy and Egyptian ministry of petroleum and mineral resources, and our national and international customers, including ENI, Saudi Aramco, Apache, ADNOC and many others that we have been working with in the region, and especially in Egypt.

Our aim is to provide economic solutions by optimizing survey designs to bring the best "value of information" to our customers while sustaining economic and reasonable costs and maintaining lower footprint on our environment. We take our social responsibility very seriously.

Employees career: how does it reflect on your operations?

Currently, almost 59% of our staff (Globally) has more than 10 years of career with ARGAS. more than 48% of our staff worked only for ARGAS in their career. We have many of our employees (in Saudi and Egypt) who worked for ARGAS for more than 20 years.

Everything we do is around the "human" , and humans

represent our cornerstone of business, because, we are "the boots on the ground". Therefore, we are committed to develop the human.

We currently employee around 1,200 people in just one site of our business, just one location. Its intense people operation. the location is almost 700 Km away from the nearest city. Completely at the wildness. Beautiful experience away from noise and city pollution. Our people are the driver of this success, and we remain strong by them.

Today, ARGAS has policies offering equal and fair chances to everyone, including not just employment, but career development. We have zero tolerance to any barriers. We believe that knowledge and wisdom could exists in every person and in any social category.

What are ARGAS activities as for CSR "corporate social responsibility"?

Shortly, everything we do is a service to the humankind, finding energy sources, water, and minerals, are all to help improving economy and the lifestyle of our humanity. We have implemented solid policies to contribute to our society. We hire from the places we work. We add value to the local economy, and we focus in creating "In-Country-Value" by applying policies to BUY LOCAL and hire availably fit services. We also provide training, not just for our employees and staff, but also to our neighboring society. As an example, we may operate areas close to farms, or the public. Our "social permit" is our passport to access lands. We interact with our neighbors on daily basis, YES, it does cause some inconvenient for our neighbors, and therefore, we have take our social responsibility very seriously to make sure that we help and educate the public on our business and fair support to them.

As the oil and gas industry tries to move forward, what is ARGAS's strategy for growth?

Unfortunately, the world did not invest enough in Energy Exploration. We all aim to develop sustainable energy sources, but this takes time. It's a transition and it takes a lot of effort until we do this. therefore, Oil and Gas remains critical to our life: source of energy and to support the transition. The drop in exploration spends, since 2014, resulted in somehow unbalanced risks in the industry.

Today, we see demand increasing on real exploration. The challenge is to sustain affordable energy to our societies. And therefore, finding energy and improving our proven reserves is a global security.

The challenge is that, still, some of our customers use Return on Investment to measure the value of information while capitalizing their spend on exploration. This means, we are running behind a moving target, as commodity price change. Our industry must recognize that "value of information" is much higher than just the commodity price.

ARGAS growth is driven by natural resource exploration's demand, not just oil and gas. We are focused on Geothermal Energy, mining, and water. We add life to life. sustainable business growth, driven by population and lifestyle.

This year, we are planning to invest more than $300 million USD develop infrastructure, equipment, and facilities to support market demand. Our shareholders and customers are confident in the value we add to improve the success rate of any exploration program.

Harsh work environment! What are your HSE precautions?

Over the past 60 years, we maintained solid and sustainable Health, Safety, and Environmental practices. We never lost a life in an accident related to work. We had zero environmental disaster in the history of ARGAS.

This was the result of great people's work, teamwork, hard work, and commitment driven by all employees. Our leadership example is a model that we improve on daily basis.

"Our Trace" is the name of our Code of Conduct. It was developed to the highest level of commitment toward integrity, quality and safety of our people, and the people around us. Our commitment to our society and environment is the cornerstone of our business. This is our license to operate. We take it very seriously, with zero tolerance.

Finally, would we see ARGAS in more countries soon?

ARGAS is an international company, and it's the most mature and experienced company in our field. 60 years of action. Many other companies could not survive this business. we master it.

We offer success to our customers, better integrity of data, resulting in quality of underground imaging. Our value to our societies and people is our key enabler, as we add value to local business.

Competition could be hard, sometimes, yes, but we educate our customers. Some customer focus on the "price" of the survey, but the price of poor data is much more painful: lower success rate, poor reserves replacement ratio… name it.

We are confident that we will open new markets. Since our inception, and we operate in the Kingdom of Saudi Arabia, the leader of energy in the world: who knows more about oil? We export knowledge and best practice to global level, to enrich other markets, drive value, improve lifestyle and supply economic energy to the world. This is our inspiration.

Assessment of Health, Safety and Environment Impact of Flavonoid-Derived Demulsifiers

By: Florence Airiagbonaye, ACE-CEFOR, University of Portharcourt; Ozioma Achugasim, University of Portharcourt; Onyewuchi Akaranta, ACE-CEFOR, University of Portharcourt

Abstract

This paper aims at quantifying the Health, Safety and Environment (HSE) impact of some flavonoid-derived demulsifiers using Chemical Scoring Index (CSI). The CSI is based on the three-hazard categories defined by United Nations' Globally Harmonized System for Classification and Labeling of Chemicals (GHS) for defining greener chemicals. Chemical components of each flavonoid-derived product were quantified by scoring the level of hazard posed by the component in relation to its percentage composition in the product.

a carcinogen in a 10% component of a product will be scored higher than in a 1% composition. Additionally, a carcinogen is weighted higher than an 'irritant'. As such, products with low CSI within same usage group are considered to have lower intrinsic hazard and therefore used in selecting best HSE green chemicals. Eight (8) products were quantified; five (5) modified flavonoids and three (3) commercial demulsifiers. 'Modified Flavonoids-A' was considered best HSE chemical with a CSI of 420, while 'Commercial demulsifier-B' was the least HSE chemical with CSI of '1980'. It is recommended that rather than focus on only the performance and cost of a chemical product, it is essential to consider the Health, Safety and Environment impact in the selection of oilfield chemical products. This model will assist HSE professionals in quick assessment of safer chemicals alongside their performance.

Keywords: Flavonoids, Demulsifers, Green chemicals

Introduction

In meeting operating performances, large portfolio of chemicals are used by production companies. In oil exploration and production companies in particular, catalogue of chemicals exist for their various operations, namely: drilling, completion, stimulation, workover and production of their wells. Demulsifiers are among the frequently used chemicals in the oil and gas industries. Demulsifiers comprise of various chemical formulations used in breaking water-in-oil/oil-in-water emulsions.

Emulsion problems in oil and gas industries can lead to high operating/capital cost, corrosion, frequent breakdown of processing units and out of specification products hence must be eradicated. Abedini and Mosayebi (2013), reported that the volume of dispersed water in emulsions, occupies space in the processing equipment and pipelines. Moreso, emulsion causes changes in the characteristics and physical properties of crude oil. Foxenberg et.al (1998) reported that stable water-in-crude oil emulsions, characterized by high viscosity and rigid film can cause significant formation damage to the reservoirs.

Oil and gas companies often make use of chemicals in solving their operational problems and meeting their production goals. They are also under stringent obligations to comply with all legislation set by regulatory authorities, environmental groups and stakeholders.

Oil and Gas companies are mandated to manage all chemicals, products and by-products' hazards to As Low as Reasonably Practicable (ALARP). This means imbibing the culture of Product and Environmental Stewardship.

Verslycke et al (2014), reported that a broad spectrum of chemicals exhibit wide range of potential hazards to human health, physical safety and the environment (HSE). They further, explained that; performance and cost were historically the primary criteria for chemical selection. Sanders et al (2010) also reported that the primary criteria for chemical selection were cost and performance.

The entrance of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) in 1990 added criteria for Environmental hazards in product development and selection.

In meeting five (5) of the Sustainable development goals of; Good health and well-being, Clean water and sanitation, climate action, life below water and life on land, companies

and professional have the responsibility of developing safer products by ensuring that HSE standards are prioritized in chemical selection processes. This would in a long run effectively reduce the inherent impacts of these chemicals, meet and exceed our production performances and make the earth conducive for all.

The HSE hazards can be quantified by scoring the various chemical components in each formulation using the three-hazard categories defined by United Nation's Globally Harmonized System for Classification and Labeling of Chemicals (GHS).

Knowing the HSE risks contributed by each chemical component will aid in improving the production and replacement of high HSE risk component with less HSE impacting chemical of same function or with a diluted one.

Sanders et al (2010), further reported the replacement of three (3) of Halliburton's chemical products through the knowledge of CSI with chemicals of lower HSE risks that performed just as good as the former.

CSI rating of hazards helped Halliburton to replace chemicals produced in the 70s and 80s with better and safer chemicals in recent years.

It is worth noting that CSI scores must be equated with price and performance of the product in selecting the qualify candidate for the operation.

This paper documents quantification of HSE hazards in eight(8) demulsifiers. Five(5) of which products were prepared from chemically modified flavonoids (natural products extracted from onions skin wastes), while the other three(3) products were commercial demulsifiers.

The GHS hazard categories and ratings gave the guidelines, while the chemical scoring index was chosen for scoring and ranking each hazard categories. The screening of the three major hazard categories(Physical, Health and Environmental) was carried out for all eight(8) products. The best performing HSE/safe product would be selected based on overall lowest CSI score for all three(3) hazard categories. Thereafter, the best product for the operation will be selected from bottle test result, the product with the highest water dropout; low cost and low HSE impact.

Methodology

Five (5) different demulsifier products derived from modified flavonoids were analysed for their HSE impacts along with three (3) commercial demulsifiers. Major hazards of interest were selected from the three (3) categories of hazards based on GHS (Physical, Health and Environmental).Tables 2.1, 2.2, and 2.3, gives the various categories of Environmental, Health and Physical Hazard criteria respectively in GHS.

The selected hazards of interest and levels were extracted from each chemical component's Safety Data Sheets (SDS). Thereafter a weighted score was assigned from the CSI to each hazard in relation to the percent availability of the chemical component in the measured demulsifier. Tables 2.4, 2.5 and 2.6 give the CSI weighted scores assigned to the health, physical and environmental hazard categories respectively in relation to the percent availability of the chemical component in the measured product.

CSI, assigned weighted scores to various hazards based on the categories, percent composition and level of harm for instance 'carcinogen' is weighted ten times higher than an irritant'.

A computation template is drawn as seen in table 3.0, this is to aid in accurate record of required information from the SDS and appropriately assign the correct score to each component in the products.

The scores of each hazard category for all contributing components in a product are then summed up to achieve the CSI for each hazard category in the product.

To calculate the total CSI for HSE risk in a product, the computed values from the physical, environment and health CSIs for the product in question are then added together.

To select the best demulsifier for the operation, the chemical performance and cost then comes into play amongst the less HSE risk product. To achieve this, 'bottle test' analysis was then carried out, by rating the percent water dropout by each demulsifier on treatment of emulsion from a known field with emulsion problem.

Results and Discussion

The quantified hazard scores of the eight (8) products are shown in Tables 3.1, 3.2, 3.3, 3.4 and figures 1.0, 2.0, 3.0, and 4.0. Table 3.0 is a sample of the computation table, showing the hazard categories and how the various scores for each product were reached. Fig. 5.0 also shows how each hazard categories contributed to the total HSE hazards CIS for each product.

Modified Flavonoid A was calculated as having lowest HSE impact with a total CSI score of 420, while Commercial demulsifier B was calculated as having the highest HSE impact with total CSI score of 1980 as shown in table 3.1, figs.1.0 and 5.0. These scores can be explained thus: scores increases with increasing number of chemical components that make up each demulsifier; each adding its contributory factor on the end product.

The reviews of the individual hazard categories contributing to the total HSE risk CSI, played out in a different trend as shown in tables 3.1–3.4 and figs 1.0 – 5.0. The product with least total HSE CSI score was not necessarily the least in the individual hazard categories. Modified flavonoid-A, was in

exception as it maintained the best in all categories. (This is generally adduced to its fewer chemical components and the components are all derived from natural products).

As shown on table 3.2, commercial demulsifier C that ranked sixth(6th) on the overall HSE CSI, became the second(2nd) best performing demulsifier in environmental risks with an environmental CSI score of 200 coming after modified flavonoid-A with CSI of 150. The observed low value in commercial demulsifier C can be adduced to its contributing component being highly volatile and readily biodegradable. The fact remains that one of the limiting factor in CSI computation is insufficient data in the SDS. This limitation affected the environmental computation for Commercial Demulsifier C in recorded as the best because there were no data for some of its components on the available SDS, hence high values were slammed on those components as prescribed by CSI guideline.

In the same line of reasoning, in table 3.4 and fig 4.0, comparison of the physical hazards CSI scores ranked, Commercial Demulsifier B (that was seen as the worst performing in overall HSE impact) second(2nd) with an environmental CSI score of 47 after modified flavonoid A with a CSI of 40. The major hazard considered in the physical hazard category was flammability because of its high relativity to risk of fire.

On the physical hazard scores for the demulsifiers in Table 3.4 and Fig.4.0, Commercial Demulsifier C was ranked the worst performing on Physical hazards with a score of 85. This can be adduced to the fact that the most contributory component in the product is defined to be highly flammable in the category 1 scale on GHS. This finding once again prooves that CSI rating corresponds with the hazards effects of each chemical product if appropriately assigned on fair judgment.

On comparison of health hazard scores in Table 3.3 and Fig.2.0, health hazards being the highest contributory hazard to the overall CSI score. A trend was observed that the health risk increased with increased number of chemical components. This could be observed as we progressed from Modified Flavonoid A, through B to C, D and E on Table 3.1. The trend was also applicable for the commercial demulsifiers as seen from the tables that Commercial Demulsifier B with five (5) was obviously higher in hazard score than the ones with four (4) or three (3) components.

It is worth noting that Modified Flavonoids C,D and E though with five(5) chemical components had lower score than the commercial counterpart. This could be adduced to the fact that three(3) out of their five(5) components are natural products extracted from onions skin, cashew shell and corn cob wastes and are defined to be non toxic, hence their minimal health impacts.

In considering the best operational chemical with less HSE risks and excellent performance, demulsification bottle test was carried out. Fig.6 and 7 displayed the effectiveness of each demulsifiers in water seperation from the emulsion at room temperature and 60°C-the average operating condition of a separator in the oilfield. The result showed Modified Flavonoid C as the best candidate for the operation.

Conclusion

In conclusion, it was verified that the Chemical Scoring Index is a valid and reliable method of quantifying HSE hazards inherent in any chemical product. It was observed that the lower the chemical components of the demulsifiers the lesser the HSE impacts.

Quantification of HSE hazards in chemicals will promote selection of HSE performing chemicals and replacement of components with high HSE risks during chemical formulations.

It is worth noting that the best HSE CSI scores might not necessarily be the selected candidate for the operations, selection must always go with effective performance, cost and HSE.

It is important to conclude that, rather than base chemical acceptance on output performance only, the health, safety and environmental impacts of these chemicals should be reviewed.

The major limitation on HSE hazards using the CSI model is incomplete data in most Safety Data Sheets.

It is recommended that regulatory bodies should ensure standard and complete safety analysis of produced chemicals.

Acknowledgements

The authors would like to acknowledge the leadership of Production Chemistry Laboratory, NPDC for the support and use of the laboratory for this research.

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Figure 1.0—Comparison of Total CSI HSE Hazards Scores

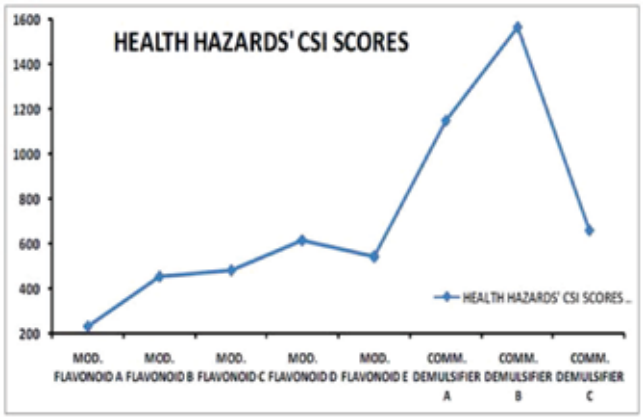


Figure 2.0—Comparison of Health Hazards› CSI Scores

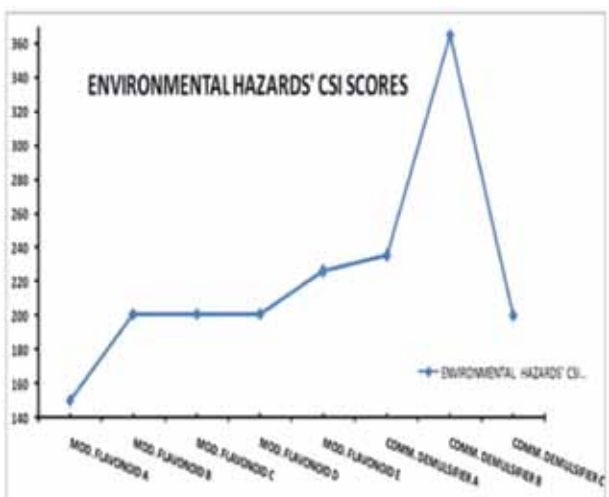


Figure 3.0—Comparison of EnvironmentalHazards› CSI Scores

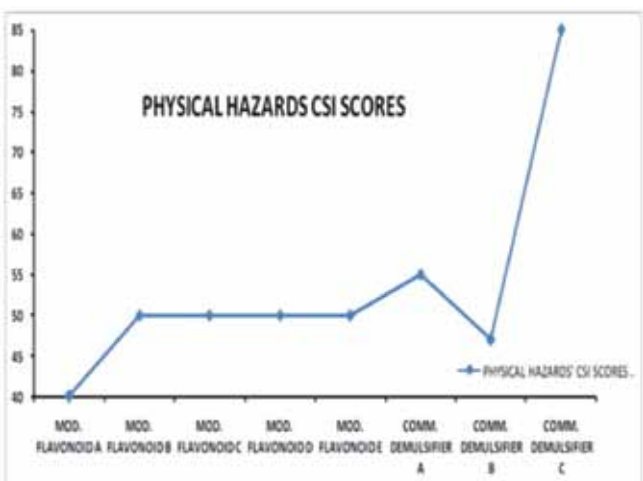


Figure 4.0—Comparison of Physical Hazards CSI Scores

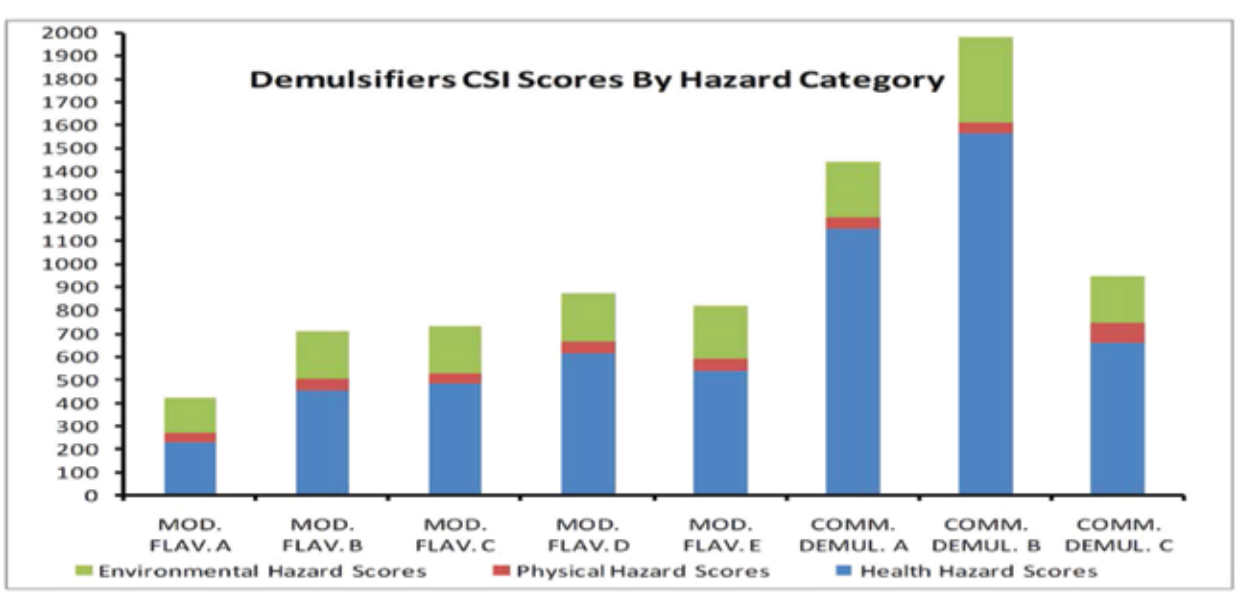


Figure 5.0—Hazard Categories' Contributions to Total CSI Scores

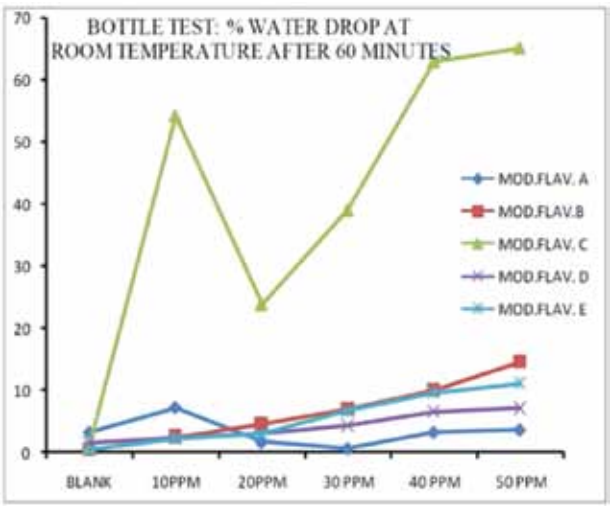


Figure 6.0—Comparison of Demulsifiers Efficiency at Room Temperature

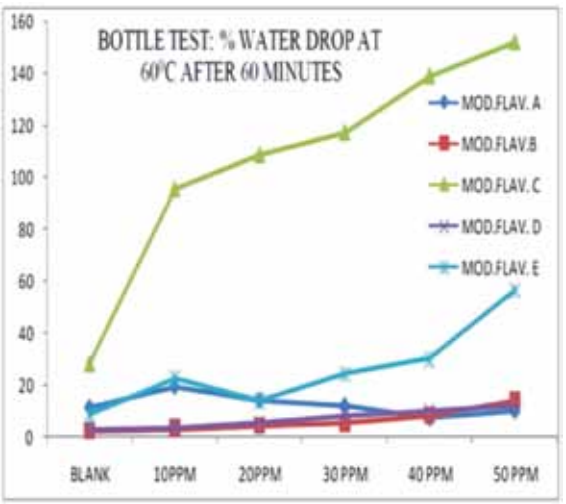


Figure 7.0—Comparison of Demulsifiers Efficiency at 60°C

Table 2.1—Compiled GHS Environmental Hazard Criteria

Categories	Category 1	Category 2	Category 3
ACUTE AQUATIC TOXICITY *96hr LC50(for fish)*	≤ 1mg/l	>1 but ≤ 10mg/l	>10 but ≤ 100mg/l
48hr EC50(Crustacea)	≤ 1mg/l	>1 but ≤ 10mg/l	>10 but ≤ 100mg/l
72hror 96hr ErC50(for Algae or other aquatic plants)	≤ 1mg/l	>1 but ≤ 10mg/l	>10 but ≤ 100mg/l
CHRONIC AQUATIC TOXICITY			
Chronic NOEC or EC_X (for fish)	≤ 0.1mg/l	≤ 1mg/l	Not Applicable
Chronic NOEC or EC_X (for Crustacea)	≤ 0.1mg/l	≤ 1mg/l	Not Applicable
Chronic NOEC or EC_X(for Algae or other aquatic plants)	≤ 0. 1mg/l	≤ 1mg/l	Not Applicable
OZONE DEPLETION	≥ 0.1mg/l	Not Applicable	
Bioaccumulation Potential		BCF>500 or if absent log Kow > 4	
Rapid Degradability		> 70% in 28days	

Table 2.2—Compiled GHS Health Hazards Criteria

Categories	Category 1		Category 2	Category 3	Category 4
CARCINOGENICITY (≥ 0.1%)	**CAT 1A (Known)**	**CAT 1B (Presumed)**	**CAT 2 (Suspected)**	NOT APPLICABLE	NOT APPLICABLE
ACUTE TOXICITY					
ACUTE ORAL TOXICITY (mg/kg body weight)		**5**	50	300	2000
ACUTE DERMAL TOXICITY (mg/kg body weight)		50	200	1000	2000
ACUTE INHALATION TOXICITY (Gases(ppmV)		100	500	2500	20000
ACUTE INHALATION TOXICITY (Vapours(mg/l)		0.5	2.0	10	20
ACUTE INHALATION TOXICITY (Dust and Mists(mg/l)		0.05	0.5	1.0	5
CORROSIVITY (IRRITANT)		**≥ 5%**	≥ 1% but < 5%	≥ 10%	NOT APPLICABLE

Table 2.3—Compiled GHS Physical Hazards Criteria

Categories	Category 1	Category 2	Category 3	Category 4		
EXPLOSIVE	Division 1.1	Division 1.2	Division 1.3	Division 1.4	Division 1.5	Division 1.6
FLAMMABLE GAS(at 20°C and 101.3kPa)	Ignites in ≤13% mixture with air	Have a flammable range with air mixture	Not Applicable			
FLAMMABLE LIQUID (flash point)	< 23°C; Initial B.pt < 35°C	< 23°C; Initial B.pt >35°C	≥23°C and ≤60°C	> 60°C and ≤ 93°C		Not Applicable
FLAMMABLE SOLID(Burning rate test)	Wetted zone does not stop fire and Burning rate >2.2mm/s	Wetted zone stops fire at least 4mins and Burning rate>2.2mm/s	Not Applicable			
OXIDIZING LIQUID	Mean pressure rise < 1:1 by mass of 50% perchoric acid and cellulose	Mean pressure rise time of 1:1 mixture by mass of 40% aqueous sodium chlorate and cellulose	Mean pressure rise time of 1:1 mixture by mass of 40% aqueous nitric acid and cellulose	Not Applicable		
SELF-REACTIVE SUBSTANCE	Type A	Type B	Type C& D	Type E & F		Type G
SELF-HEATING SUBSTANCE	+VE test on 25mm samp	-VE test on 25mm but +VE on 100mm sample cube at 140°C	Not Applicable			
EMIT FLAMMABLE GASES IN CONTACT WITH WATER	Reacts vigorously and gas evolution rate of ≥10litres/kg of substance over any 1min	Reacts readily and maximum gas evolution rate of ≥20litres/kg of substance per hour	Reacts slowly and maximum gas evolution rate of ≥1litres/kg of substance per hour	Not Applicable		

Table 2.4—Chemical Scoring Index for Environmental Hazards (Source: Verslycke et.al 2014)

ENVIRONMENTAL HAZARDS		PRODUCT COMPONENT PERCENT RANGE (BY WEIGHT)							
S/No.	Hazard Categories	Max Score	>0%-0.09%	0.1%-0.9%	1%-4.9%	5%-9.9%	10%-29.9%	30%-59.9%	60%-100%
1	NO DATA AVAILABLE	100	10	25	50	75	100	Do not Evaluate	Do not Evaluate
2	ACUTE AQUATIC TOXICITY CAT.1	100	1	5	10	25	50	75	100
3	ACUTE AQUATIC TOXICITY CAT.2	75	0	1	5	10	25	50	75
4	ACUTE AQUATIC TOXICITY CAT.3	50	0	0	1	5	10	25	50
5	OZONE DEPLETION	50	5	10	50	50	50	50	50
6	VOLATILE ORGANIC COMPOUNDS	50	5	10	50	50	50	50	50
7	HAZARDOUS AIR POLLUTANTS	50	1	5	10	25	40	50	50
8	HAZARDOUS WATER POLLUTANTS	50	1	5	10	25	40	50	50
9	BIODEGRADATION -Persistent	50	5	10	50	50	50	50	50
10	BIODEGRADATION- Inherent	10	1	10	10	10	10	10	10
11	BIOACCUMULATION	50	5	10	50	50	50	50	50
12	ENDOCRINE DISRUPTORS	50	10	25	50	50	50	50	50
13	NO HAZARD	0	0	0	0	0	0	0	0

Table 2.5—Chemical Scoring Index for Health Hazards (Source: Verslycke et.al 2014)

HEALTH HAZARDS		PRODUCT COMPONENT PERCENT RANGE (BY WEIGHT)							
S/No.	Hazard Categories	Max Score	>0%-0.09%	0.1%-0.9%	1%-4.9%	5%-9.9%	10%-29.9%	30%-59.9%	60%-100%
1	NO DATA AVAILABLE	100	10	25	50	75	100	do not evaluate	do not evaluate
2	CARCINOGENICITY CAT.1	100	25	100	100	100	100	100	100
3	CARCINOGENICITY CAT.2	75	10	75	75	75	75	75	75
4	ACUTE TOXICITY CAT.1	100	10	25	50	75	75	100	100
5	ACUTE TOXICITY CAT.2	75	5	10	25	50	50	75	75
6	ACUTE TOXICITY CAT.3	50	0	1	5	10	25	50	50
7	ACUTE TOXICITY CAT.4	10	0	0	1	5	5	10	10
8	MUTAGENICITY	50	10	25	25	50	50	50	50
9	REPRODUCTIVE TOXICITY	50	10	25	40	50	50	50	50
10	ACUTE TARGET ORGAN TOXITY	50	1	5	10	25	25	50	50
11	CHRONIC TARGET ORGAN TOXITY	50	1	5	10	25	25	50	50
12	SENSITIZERS	25	5	10	25	25	25	25	25
13	CORROSIVITY CAT.1	25	0	1	5	5	10	25	25
14	CAT.2(IRRITANT)	10	0	0	0	5	5	10	10
15	ASPIRATION HAZARD	10	0	0	0	1	5	10	10
16	NO HAZARD	0	0	0	0	0	0	0	0

Table 2.6—Chemical Scoring Index for Physical Hazards(Source: Verslycke et.al 2014)

PHYSICAL HAZARDS		PRODUCT COMPONENT PERCENT RANGE (BY WEIGHT)							
S/No.	Hazard Categories	Max Score	>0%-0.09%	0.1%-0.9%	1%-4.9%	5%-9.9%	10%-29.9%	30%-59.9%	60%-100%
1	NO DATA AVAILABLE	50	0	5	10	25	50	Do not Evaluate	Do not Evaluate
2	EXPLOSIVE	100	25	75	100	100	100	100	100
3	ORGANIC PEROXIDE	100	5	10	75	75	100	100	100
4	FLAMMABLE GAS	75	5	10	25	50	75	75	75
5	FLAMMABLE LIQUID CAT.1	75	0	5	10	25	50	75	75
6	FLAMMABLE LIQUID CAT.2	50	0	1	5	10	25	50	50
7	FLAMMABLE LIQUID CAT.3	25	0	0	1	5	10	25	25
8	FLAMMABLE LIQUID CAT.4	10	0	0	0	1	5	10	10
9	FLAMMABLE SOLID	75	1	5	50	75	75	75	75
10	OXIDIZING GAS	75	5	10	25	50	75	75	75
11	OXIDIZING SOLID	75	1	5	50	50	50	75	75
12	PYROTECHNIC	75	5	10	25	50	75	75	75
13	PYROPHORIC(LIQUIDS AND SC	75	1	5	10	25	50	75	75
14	OXIDIZING LIQUID	50	0	1	5	10	25	50	50
15	SELF-REACTIVE SUBSTANCE	50	0	1	5	10	25	50	50
16	GASES UNDER PRESSURE	25	1	5	25	25	25	25	25
17	SELF-HEATING SUBSTANCE	10	0	0	1	1	5	10	10
18	EMIT FLAMMABLE GASES IN CONTACT WITH WATER	10	0	0	1	1	5	10	10
19	CORROSIVE TO METALS	5	0	0	1	1	5	5	5
20	NO HAZARD	0	0	0	0	0	0	0	0

Table 3.0—Computation of HSE Hazards and Weighted Scores

PRODUCT	MODIFIED FLAVONOID B									COMMERCIAL DEMULSIFIER C						
COMPONENTS	XX		XX		XX		XX		TOTAL CSI	XX		XX		XX		TOTAL CSI
CAS NO.	XX		XX		XX		XX			XX		XX		XX		
CONCENTRATION%	1%		0.09%		1.40%		95-97%			40-50%		<10%		<0.6%		
ENVIRONMENTAL HAZARD																
ACUTE /CHRONIC AQUATIC TOXICITY	NO DATA	50	24MG/L CAT.3	0	CAT 4	1	1840mg/l CAT.4	0	51	28200mg /Lcat.4	25	CAT.2	25	NO DATA	25	75
BIODEGRADATION-	Readily degradable (1324mg/mg	0	BOD 46%	0	NO DATA	50	NO DATA	100	150	yes	0	NO DATA	75	NO DATA	25	100
		50		0		1		0	201		25		100		50	175
HEALTH HAZARD																
CARCINOGENICITY	NO DATA	50	CAT.2	10	not present	0	not present	0	60	NO DATA	100	NO DATA	75	NO DATA	25	200
ACUTE ORAL TOXICITY	CAT3	5	CAT.2	10	NO DATA	50	CAT.4	10	75	CAT. 3	50	NO DATA	75	NO DATA	25	150
ACUTE INHALATION TOXICITY	CAT4	1	CAT.3	1	NO DATA	50	CAT.4	10	62	CAT. 3	50	NO DATA	75	CAT.3	1	126
ACUTE DERMAL TOXICITY	CAT4	1	CAT.4	0	NO DATA	50	CAT.4	10	61	CAT. 3	50	NO DATA	75	NO DATA	25	150
ACUTE EYE TOXICITY	CAT4	1	CAT.2	10	Cat 2A	25	CAT.1	100	136	CAT. 4	10	DATA	75	DATA	25	110
CORROSIVITY	CAT4	1	CAT.2	0	NO DATA	50	CAT.2	10	61	CAT. 3	50	NO DATA	75	NO DATA	25	150
		5		31		225		140	455		310		450		126	686
PHYSICAL HAZARD																
FLAMMABLE LIQUID	NO DATA	10	NO DATA	5	NO DATA	10	CAT.3	25	50	CAT.1	75	CAT.4	5	NO DATA	5	85
	0	10		5		10		25	50		75		1		5	85
Total CSI SCORES	706									946						

Table 3.1—TOTAL HSE HAZARDS SCORES

SAMPLE DESCRIPTION	CSI SCORE	POSITION
MODIFIED FLAVONOID A	420	1ST
MODIFIED FLAVONOID B	706	2ND
MODIFIED FLAVONOID C	732	3RD
MODIFIED FLAVONOID D	867	5TH
MODIFIED FLAVONOID E	816	4TH
COMMERCIAL DEMULSIFIER A	1440	7TH
COMMERCIAL DEMULSIFIER B	1980	8TH
COMMERCIAL DEMULSIFIER C	946	6TH

Table 3.2—ENVIRONMENTAL HAZARDS' CSI SCORES

SAMPLE DESCRIPTION	CSI SCORE	POSITION
MODIFIED FLAVONOID A	150	1ST
MODIFIED FLAVONOID B	201	3RD
MODIFIED FLAVONOID C	201	3RD
MODIFIED FLAVONOID D	201	3RD
MODIFIED FLAVONOID E	226	6TH
COMMERCIAL DEMULSIFIER A	235	7TH
COMMERCIAL DEMULSIFIER B	365	8TH
COMMERCIAL DEMULSIFIER C	200	2ND

Table 3.3—HEALTH HAZARDS› CSI SCORES

SAMPLE DESCRIPTION	CSI SCORE	POSITION
MODIFIED FLAVONOID A	230	1ST
MODIFIED FLAVONOID B	455	2ND
MODIFIED FLAVONOID C	481	3RD
MODIFIED FLAVONOID D	616	5TH
MODIFIED FLAVONOID E	540	4TH
COMMERCIAL DEMULSIFIER A	1150	7TH
COMMERCIAL DEMULSIFIER B	1568	8TH
COMMERCIAL DEMULSIFIER C	661	6TH

Table 3.4—PHYSICAL HAZARDS' CSI SCORES

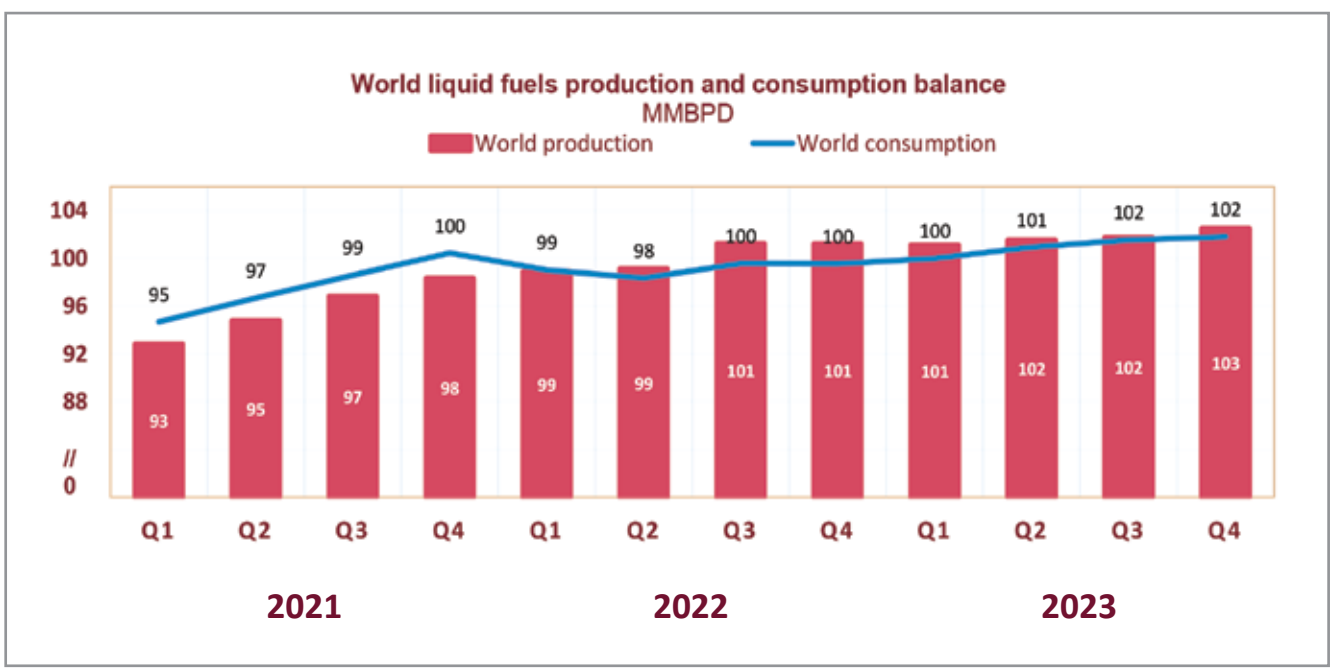
SAMPLE DESCRIPTION	CSI SCORE	POSITION
MODIFIED FLAVONOID A	40	1ST
MODIFIED FLAVONOID B	50	3RD
MODIFIED FLAVONOID C	50	3RD
MODIFIED FLAVONOID D	50	3RD
MODIFIED FLAVONOID E	50	3RD
COMMERCIAL DEMULSIFIER A	55	7TH
COMMERCIAL DEMULSIFIER B	47	2ND
COMMERCIAL DEMULSIFIER C	85	8TH

INDUSTRY AT A GLANCE

by: **Ali Ibrahim**

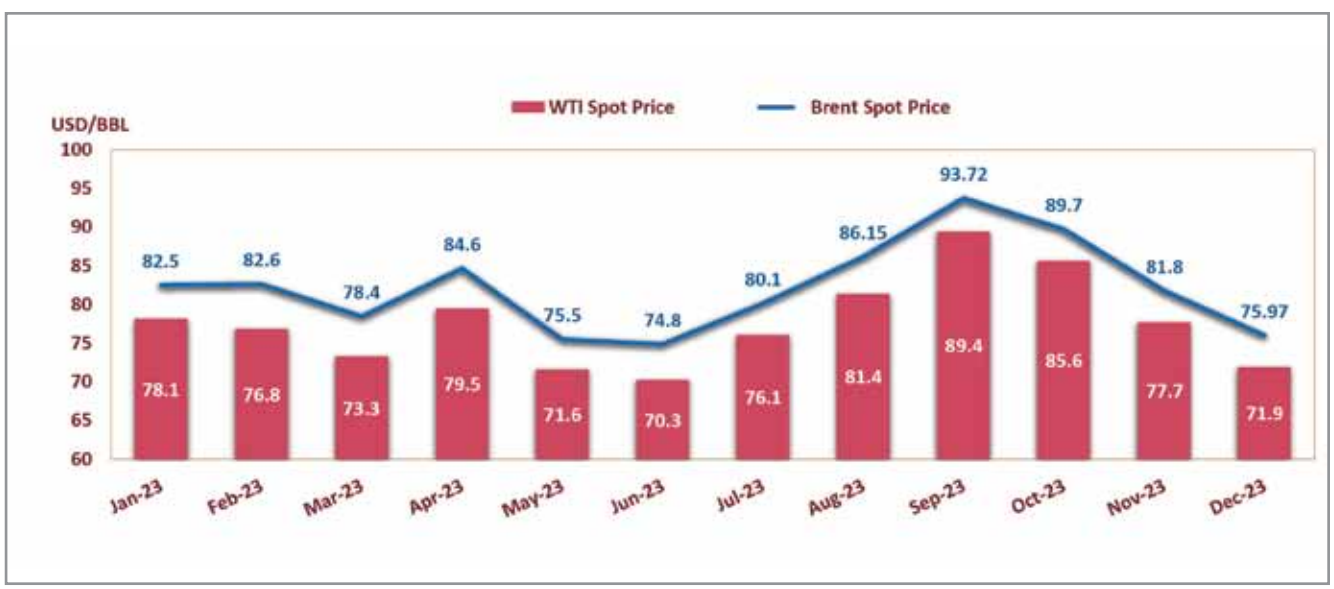
World liquid fuels production and consumption balance (MMBPD)

million barrels per day



OPEC Crude Oil Production

Crude Oil Prices



NYMEX Natural Gas Prices

USD/Million BTU

اينـاب سيبترول تعلن عن نجاح بتروشهد في اجتياز المرحله الثانيه لشهادتي الأيزو في السلامة ونظم إدارة البيئة

أعلنـت شركـة ايناب سيبـترول فرع مصر عن نجـاح شركة بتروشهـد للسنة الثانية علـي التوالي في اجتيـاز المراجعة الثانيه لشهادتي الأيـزو ٤٥٠٠١ في مجال السلامة والصحة المهنية وأيضا ١٤٠٠١ في مجال نظم الإدارة البيئة من خلال شركة بيرو فيرتاس كجهة معتمدة ومانحة للشهادة وذلك بمختلف الإدارات العامـة بالشركة وتسهيـلات الإنتاج في منطقه امتياز شرق رأس القطارة والحقول بمنطقة امتيـاز شرق رأس القطارة بالصحراء الغربية. ومن الجديـر بالذكر أن شركة بتروشهد حصلت على شهـادات الايـزو في يناير ٢٠٢٢ ، ثم في ينايـر ٢٠٢٣ و ٢٠٢٤ تم إجراء مراجعـه من قبل Bureau Veritas (BV) للتحقق من أن جميع المجالات والوظائف التي يغطيها نطاق نظام الإدارة المتكامل يتـم مراقبتها بشـكل منتظم ومراعاه كافة التغييرات في نظام إدارة السلامـه و الصحه المهنيه و بيئة العمل لشركه بتروشهد.

رقم قياسي تسجله صادرات الغاز الطبيعي المسال عالميا في 2023

حققت صادرات الغاز الطبيعي المسال رقما قياسياً خلال الربع الأول من عام ٢٠٢٣ حيث بلغت حوالي ١٠٤,٥ مليون طن.

وذكـر تقريـر نشرتـه منظمـة الأقطـار العربيـة المصـدرة للبـترول "أوابـك" أن صـادرات الغـاز تراجعـت خـلال الربـع الثاني مـن العـام الماضي إلى ٩٩,٤ مليـون ثم إلى ٩٩,٧ مليون خلال الربع الثالـث، لكنها عاودت الصعود مـرة أخرى خلال الربـع الرابع لتسجل رقمـاً قياسياً جديداً بلغ نحو ١٠٥,٤ مليون طن.

وأضـاف التقرير أنه إجمـالا كأداء على مدار عام ٢٠٢٣، قـد بلغ إجمـالي صادرات الغـاز الطبيعي المسال عالميـاً نحو ٤٠٩,٣ مليون طـن، وهو أعلى رقـم تسجلـه صناعـة الغـاز الطبيعـي المسال في تاريخهـا الممتـد لقرابـة ستة عقـود، وذلك مقابل ٣٩٥,٩ مليـون طـن عـام ٢٠٢٢، بنسبـة نمو على أساس سنوي حـوالي ٣,٤ بالمئة، وهـو يعد معدل نمو متوسط، مقارنة بالسنوات السابقة.

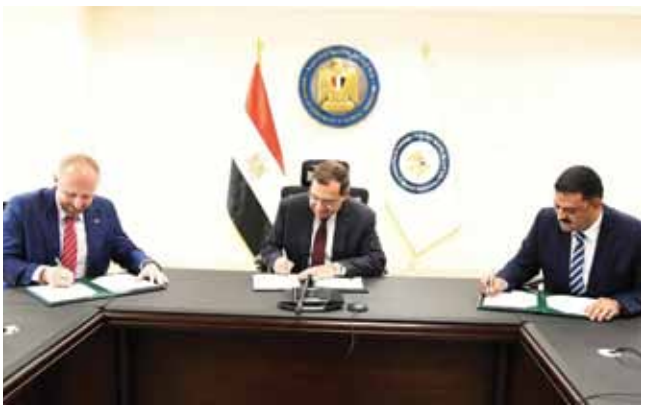
وعلـى مستوى الدول المصـدرة، استمرت الولايات المتحـدة في تصدير معدلات قياسيـة من شحنات الغاز الطبيعـي المسال خلال الفترات ربع السنوية مـن عـام ٢٠٢٣، حيـث بلغـت الصـادرات خلال الربـع الثاني من العام نحـو ٢١,٨ مليون طن، ثم تراجعت قليلاً خلال الربع الثالث إلى ٢١,٥ مليون طن، لكنها حققـت قفزة كبيرة خلال الربع الرابع بوصولهـا إلى ٢٥,١ مليون طـن، وهو أعلى معدل ربع سنـوي تحققه الولايات المتحدة في تاريخها.

وبحسـب التقرير، فقـد نجحت الولايـات المتحدة في تحقيـق تلـك المعـدلات نتيجـة عـودة محطـة Freeport LNG إلى طور التشغيل الكامل منذ شهـر فبراير ٢٠٢٣، بعد توقفت لعدة شهور بسبب الحـادث الذي تعرضت له في شهـر يونيو من عام ٢٠٢٢ نتيجـة تسـرب غاز الميثان مـن أحد خطوط شحن الغاز الطبيعي المسال.

وقـد بلـغ إجمـالي مـا صدرتـه Free Port LNG خلال عـام ٢٠٢٣ نحو ١٣,٢٢ مليـون طن، وذلك مقابـل ٦,٣ مليـون طـن خـلال عـام ٢٠٢٢، أي بزيادة في الإنتاج بلغت قرابة ٧ مليون طن.

وإجمـالا كأداء خـلال عـام ٢٠٢٣، بلـغ إجمـالي صـادرات الولايـات المتحدة وفق تقديـرات أوابك الأوليـة نحـو ٨٩,٥ مليـون طن، وذلـك في مقابل ٧٨ مليـون طن عـام ٢٠٢٢، أي بنسـبة نمو سـوي ١٤,٧ بالمئـة، لتتصـدر الولايـات المتحـدة ولأول مـرة في تاريخها دول العالم كأكـبر مصـدر للغاز الطبيعي المسال عالمياً خلال عام ٢٠٢٣.

البترول: توقيع عقدين للتنقيب عن الذهب بالصحراء الشرقية



وقع المهندس طارق الملا وزير البترول والثروة المعدنية عقد استغلال خام الذهب والمعادن المصاحبة فى منطقة ابومروات بالصحراء الشرقية بين هيئة الثروة المعدنية وشركة أتون ماينج الكندية وذلك بعد تحقيقها كشفاً تجارياً للذهب بمنطقتى حمامة غرب ورودرين الواقعتين بإمتياز ابومروات فى مساحة حوالى ٥٨ كيلو متر مربع. كما شهد المهندس طارق الملا توقيع عقد بين هيئة الثروة المعدنية و شركة AKH GOLD الإنجليزية للبحث عن الذهب على مساحة ٣٥٠ كيلو متر مربع بمنطقتى بئر أسل و جبل الميت بالصحراء الشرقية و ذلك فى اطار توسع الشركة الانجليزية فى الاستثمار فى البحث عن الذهب فى مصر بعد فوزها بعدد من المناطق فى المزايدة العالمية للبحث عن الذهب بجولتيها الاولى والثانية .

بروتوكول تعاون بين كارجاس وإندرايف لتسهيل تحويل السيارات للعمل بالغاز الطبيعي لسائقي إندرايف

وقعت شركة الغاز الطبيعي للسيارات (كارجاس) إحدى شركات قطاع البترول بروتوكول تعاون مع إندرايف منصة الخدمات الحضرية والتنقل العالمي، حيث تقدم شركة كارجاس من خلال هذا التعاون خدمات تحويل سيارات سائقي إندرايف للعمل بالغاز الطبيعي مع تقديم مميزات وتسهيلات خاصة بهم، ومن جانبها تتولى إندرايف مهمة الترويج لخدمات ومنتجات شركة كارجاس من خلال التطبيق الذكي الخاص بها وكذلك خلال الدورات التدريبية للسائقين.

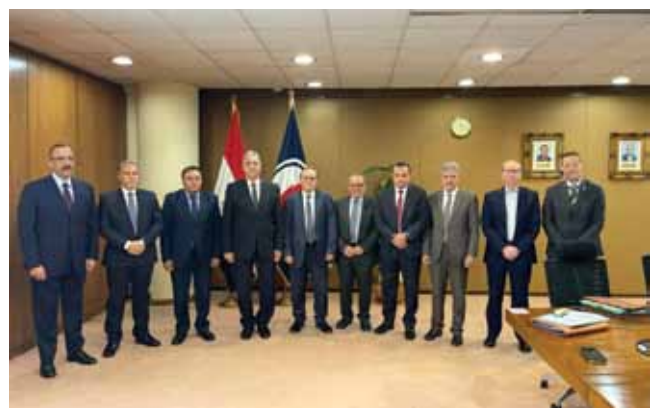
ويهدف البروتوكول إلى فتح قنوات تسويقية جديدة وإيجاد محفزات وتيسيرات لتشجيع المواطنين على تحويل سياراتهم للعمل بالغاز الطبيعي، ويأتي ذلك في إطار استراتيجية وزارة البترول والثروة المعدنية بالتوسع في استخدام الغاز الطبيعي كوقود للسيارات، لما يحققه من وفر للمواطنين وتخفيف الأعباء عن الموازنة العامة للدولة وتحقيق الاستدامة البيئية.

قطاع البترول ينفذ مبادرة تطوير وتنمية قرية نجع العرب بمحافظة الأقصر

تضمن المشروع إعادة بناء عدد من المنازل بالقرية وتوصيل المياه والكهرباء لها بالإضافة إلى تجهيزها بالأثاث اللازم والأجهزة الكهربائية .كما تم تنفيذ عدد من المشروعات التنموية الصغيرة التي تهدف إلى تحقيق دخل مستدام وبما يتناسب مع البيئة المحيطة وأهمها مشروع تسليم رؤوس الماشية للأسر الأكثر احتياجا بالقرية، فضلاً عن تسليم عدد من الأكشاك. وفى المجال الطبي تم تنفيذ عدد من الخدمات الطبية تنوعت ما بين إجراء ٢٥ عملية قلب، و١٠٠عملية عيون، وتوفير ٢٥ جهاز تعويضي، وتم اختيار المستفيدين من عمليات القلب والعيون والأجهزة التعويضية من خلال استهداف الأشخاص ما بين سن ٢٠ الي ٥٠ سنة الذين يعانون من أمراض القلب أو العيون أو في احتياج إلى أجهزة تعويضية مما يسبب لهم إعاقة عن ممارسة العمل لمساعدتهم ليكونوا أشخاص قادرين على العمل والإنتاج.

حققت أعلى إنتاج في تاريخها.. نوربيتكو تخطط لحفر 18 بئرًا تنمويًا

عُقِدَت الجمعيـة العمومية الخاصة بشركة شمال البحرية للبترول "نوربيتكو" التابعـة لوزارة البترول والـثروة المعدنية، لمناقشة واعتمـاد تعديلات الميزانية للعام المالي ٢٠٢٣/٢٠٢٤ والميزانية الأصلية للعام المالي ٢٠٢٤/٢٠٢٥. وأعلن خـلال الاجتماع، أن الميزانيـة المعدلة للعام المـالي ٢٠٢٣/٢٠٢٤ بلغت حوالي



٩٢ مليـون دولار، مقارنة بالميزانية الأصلية التـي كانت تقدر بنحو ١١٣ مليون دولار. وتم أيضًا استعراض مصاريف التنمية خلال العام المالي ٢٠٢٣/٢٠٢٤، والتـي بلغت نحو ٤٨ مليـون دولار، وشملت حفر ٦ آبار تنمويـة، بالإضافة إلى العديـد من عمليـات إصلاح الآبار وتحسينات في تسهيـلات الإنتاج ومحطات الكهربـاء التي تعتمـد على الغاز، وأيضًا المرحلة الثانيـة لتطوير المعسكر. كما تم استعراض الميزانية المقترحة للعام المـالي ٢٠٢٤/٢٠٢٥، والتي بلغت مبلغ ١١٥ مليـون دولار، وهـي إحـدى أعلى الميزانيـات في تاريخ الشركـة. وأشاروا إلى أنـه من المخطـط أن تصل معدلات الإنتاج إلى حـوالي ١٦٥٠٠ برميل من الزيـت، وتتضمن هـذه الخطط حفر ١٨ بئرًا تنمويًا (١٢ بئـرًا منتجًا و٦ بئرًا لحقـن المياه)، بالإضافة إلى بئر استكشافي واحد. وقام الدكتور علاء البطل، الجيولوجـي والرئيـس التنفيـذي للهيئة المصريـة العامة للبـترول، بالإشادة بـالأداء الملحـوظ لشركة شمال البحريـة للبترول في الفـترة الأخيرة، خاصة فيمـا يتعلق بزيادة إنتاجها، حيـث وصلت الشركة إلى أعلى مستويات إنتاج في تاريخها، وحققت أرقامًا غير مسبوقة.

مبـاحثات بين مصر وفنزويلا

لدعم التعاون في مجالات البترول والغاز الطبيعي

لتقى السفير كريم أمين، سفير مصر فى فنزويلا، بوزير البترول الفنزويلي بيدرو رافايـل تيتشيا لبحث مجـالات التعـاون الثنائي بين البلدين في مجـالات البترول والغاز الطبيعي. قام السفـير كريم أمين بتسليم الوزير الفنزويلي الدعوة الموجهة إليه من وزير البترول والثروة المعدنية للمشاركة كمتحدث وعضو مشارك في لجنة السياسـات الوزاريـة العالمية في مؤتمر ومعرض مصر الدولي للطاقـة "إيجبس ٢٠٢٤" المقـرر عقده بالقاهرة خلال الفترة من ١٩-٢١ فبراير ٢٠٢٤. من جانبه، أشـاد الوزير الفنزويلـي بالإمكانيات المصرية المتزايدة في مجـال البترول والغاز الطبيعـي، والقدرات البشرية التي تمتلكها مصر في هذا المجال، معرباً عن رغبته في زيـادة مجـالات التعاون بين البلديـن في هذا المجال الحيوي الـذي يمثل أولوية لكلا البلدين، ومؤكداً على قبوله الدعوة الموجهة له للمشاركة في معرض "إيجبس ٢٠٢٤"، كمـا أعرب عن شكره وامتنانـه لوزير البترول. وصرح السفير كريم أمين بـأن لقائه بالوزير تيتشيـا كان مثمراً، وأنـه أكد علـى الإرادة السياسية للدولتين الشقيقتين لزيادة مجالات التعاون الثنائي فيما بينهما.

الملا: شركات البترول العامة تستهدف 23 مليار جنيه استثمارات بموازنة 2024-2025

اعتمـدت الجمعيـة العامة لشركات القطـاع العام البترولي (شـركات أسيوط والاسكندريـة والعامرية للبـترول والبتروكيماويات المصريـة)، برئاسة طارق المـلا وزير البترول والـثروة المعدنية، الموازنة التخطيطيـة للعام المالي ٢٠٢٤-٢٠٢٥. وبحسب بيان للبترول، تستهدف شركات القطاع العام البترولي والبالغ عددهـا ١٢ شركـة ضخ استثمارات بقيمـة ٢٣ مليار جنيه. وبـدوه، أكد طارق الملا، علـى أهمية التطوير الـذي شهدته منطقة أسيـوط الجغرافية البترولية والمستمر حتى الآن عبر إضافة طاقات تكرير جديدة منها مجمع البنزين عالي الأوكتان، ومشروع مجمع أنوبك لإنتاج السولار الجاري العمل عليه وغيرها من المشروعات بالمنطقة التى تستهدف تطويرها وزيادة قدرتها.

مذكرة تفاهم بين مصر والسعودية للتعاون في مجال الثروة المعدنية

علـى هامش مشاركته فى مؤتمـر التعدين الـدولي الثالث، والـذى تستضيفه مدينـة الرياض بالمملكـة العربيـة السعودية، وقـع المهندس طـارق الملا وزير البـترول الـثروة المعدنية، مذكرة تفاهـم مع بندر بن إبراهيـم الخريف، وزير الصناعة والثروة المعدنية السعودي.

وعقـب التوقيع أوضـح الملا، أن الاتفاقيـة تهدف الى التعـاون الفني في مجال البحث وتبـادل المعلومات الجيولوجية والتدريب وتنميـة المهارات بين الدولتين في مجـالات البترول والتعدين، لا سيما انه الدوليتـين يفصلهما البحر الأحمر وبينهم مساحات تقارب تجعل التنمية يستفيد منها الطرفين.

وأضـاف الملا أن هنـاك نجاحات في مصـر على مستـوى المنـاخ الاستثماري التعديني، من خلال إجراءات إصلاحية مهمة على المستويين التشريعي والمالي، مؤكداً اهتمام الوزارة بتحقيق أعلى قيمة من التوسع في قطاع التعدين، في إطار استكمـال خطـوات برنامج تطوير وتحديث قطـاع التعدين علـى المحاور كافة، والعمل على جذب استثمارات جديدة، ودعم التحول الرقمي في أنشطة القطاع.

عجيبة للبترول تحقق كشفين بتروليين بالصحراء الغربية

حققـت شركـة "عجيبة للبترول"، إحدى شـركات قطاع البـترول المصري، كشفين بتروليـين جديديـن في الصحراء الغربيـة المصرية همـا "إيرس001- X" و"ندا شرق002- X". وقال مسؤول بقطاع البترول المصري تحدث لـ"العربية business"، إن الكشفـين مـازالا في مراحـل التقييم للوقـوف على الاحتياطي ومعـدلات الإنتاج المتوقعـة من الزيـت والغاز الطبيعـي". وأضـاف أن الاكتشافـات المُحققة بمنطقة "تنميـة مليحة المندمجة" بالصحراء الغربية جاءت بناء على البيانات السيزمية ثلاثيـة الأبعاد التـي تم مسحها في عام ٢٠١٠ وتمت إعادة معالجتها في عامي ٢٠١٦ و٢٠١٩. بـدأ قطـاع الاستكشاف بإجـراء تحليل ومحاكاة للبيانـات السيزمية وتتبع التراكيـب الجيولوجيـة العميقـة وحسـاب كميات الزيـت في المكامـن أو الخزانات المختلفة. بحسب المسؤول فإن البيانات السيزمية مكنت الشركة خلال ٢٠٢٢- ٢٠٢٣ مـن تحقيـق كشفين نفطيين هما "مليحـة ورد 001- X ومليحة جـاردن001- X"، بمنطقـة "تنمية مليحة المندمجـة" الواقعة جنوب مدينة مطـروح المصرية. وجرى وضـع البئرين الاستكشافيتين بمعدلات إنتـاج أولية مضافة ٧٦١ برميل يوميًا، ونحو ١٤,٩ مليون قدم مكعب غاز يوميًا.

تجهـــيز 7 شركات جديدة في القطاع ضمن برنامج الطروحات الحكومية

أعلـن طارق الملا وزير البترول والثروة المعدنية، فى تصريحات لـ«الشروق»، الانتهاء مـن بيـع حصص من ٥ شـركات تابعـة لقطاع البـترول ضمن برنامـج الطروحات الحكوميـة، ومن المزمع البدء فى تجهيز ٧ شركات أخـرى ليصل إجمالى الشركات المطروحة إلى ١٢ شركة، ضمن البرنامج الأولى للطروحات الذى تنفذه مصر.

ولفت الوزير، على هامش فاعليات النسخة الثالثة من مؤتمر التعدين الدولى المنعقد بالرياض، إلى أن هـذه الشـركات الخمس مـن أفضل الصفقات التـى تمت ضمن البرنامج الذى تعمل عليه الحكومة.

وتعد أبرز الشركات التى تم طرحها إيلاب وموبكو وأبوقير للأسمدة والحفر المصرية وإيثيديكو.

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كما قامت الشـــركة بالدراســـات والقياسات التســـويقية التى تتيح لها ظهور المنتجات الجديدة فى أفضل صورة وكذلك أعلى جودة تلبى توقعات عملاء الشركة المستهدف الوصول إليهم.

كما قامت الشـــركة بوضع إستراتيجية تستهدف تحقيق إنتشـــار داخل السوق المصرى مبنى على الإستدامة بتطبيق نظام الموزعين وتجار الجملة التى تخدم هذه الإستراتيجية.

لذا قامت شـــركة النيل لتســـويق البترول بتطوير عبواتها من الزيوت مع التركيز على حماية المنتج من الغش والحفاظ على الجودة بإستخدام أحدث أساليب الحماية.

بالاضافه الى تحديث وتطوير كافه محطات تموين السيارات من حيث الشكل والخدمة ووضع هيكل تنظيمى للشركة يتماشى مع إستراتيجية الشركة الجديدة لفتح النطاق الجغرافى لها فى انحاء الجمهورية لتكون قادره على المنافسة.

ودائما تســـعى شركة النيل لتســـويق البترول باســـتمرار لتحقيق الريادة والتميز في كافه مجالاتها وتلبية احتياجات العملاء والمجتمعات التي تخدمها.

ويبقى الإلتزام بالجوده هو حجر الاساس فى استراتيجيه الشركة

أسيوط : المركز التجارى بجامعه اسيوط
تليفون: ٢٣٧٥٣١٦ - ٠٨٨/٢٣٧٥٣١٧ فاكس: ٠٨٨/٢٣٧٥٣١٩
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