المؤسسة الوطنية للنفط
National Oil Corporation
مركز بحوث النفط
Petroleum Research Center

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RESEARCH PAPER ABSTRACTS

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الجيل الجديد للتقنية
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ID 1

PV-powered net zero-energy houses in Libya: a case study

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ABSTRACT

Significant reductions in energy consumption and greenhouse gas (GHG) emissions can be achieved by switching to net zero-energy buildings (nZEBs) which are characterized by high energy performance and reliance on on-site renewable energy sources for covering their needs of energy. In this study, the energy consumption of a hypothetical common house in Tripoli-Libya was estimated on the basis of high energy performance using TRNSYS program. Then grid-connected photovoltaic (PV) systems were designed, using SAM software, for generating the energy required to meet the estimated demand of the house. These systems were designed assuming three scenarios for the annual growth rate of energy demand, -0.5%, 0%, and +0.5%. The energy consumption of the house was estimated at 9,365 kWh/year, which could be met using a PV system of about 6 kWp rated capacity with total area of about 30 m2. The annual average values of the energy use reduction, PV energy production, and avoidable CO2 emissions were estimated at 4,330 kWh/y, 9,550 kWh/y, and 13,640 kg/y, respectively. The results obtained showed the high potential of reducing energy demand of houses in Libya through the implementation of high energy performance measures. These houses, of low-energy demand, can be powered by small photovoltaic systems, which can be installed on the roof or integrated into the building, to secure a supply of sustainable clean energy.

ID 06

Study on the Possibility of Extraction Silver from Radiographic films

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ABSTRACT

This study focused on the possibility of extracting silver from radiographic films and developer solution used in their processing. Among the methods discussed were the precipitation method using sodium chloride and sodium hydroxide, as well as the metal replacement using aluminum metal. The results showed that extracting silver from radiographic films, after dissolved using nitric acid solution and precipitating it with sodium hydroxide was the most effective, yielding 16.66 gram of silver with a purity of 92.5%, as confirmed by XRF analysis.

Regarding the developer solution, the results showed that silver extraction from a long-used solution through metal replacement was the most effective, yielding 3 grams of silver with a purity of 50.3%, according to XRF analysis.

The method of precipitation and replacement of metals has been shown to be practical, economical and environmentally friendly in terms of silver waste.

ID 07

AI-Powered Time Series Forecasting for Sustainable Energy Management in Luxury Yachts

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ABSTRACT

The luxury yacht industry is undergoing a transformative shift toward sustainability, with increasing emphasis on reducing carbon footprints and optimizing energy consumption in onboard systems, particularly in the hotel sector. This study presents a novel application of the Nonlinear Autoregressive (NAR) neural network for time series forecasting of energy usage and generation aboard luxury yachts. Leveraging real-world datasets from BlueAI, the study focuses on three critical energy streams: hotel electricity consumption, HVAC energy usage, and solar energy production. The NAR model, a feed-forward neural network with a sigmoid activation function in its hidden layer, was trained using historical time series data to predict short-term energy trends. By forecasting six hours into the future, the model enables dynamic energy management, allowing operators to preemptively adjust load demands, optimize HVAC settings, and maximize the use of renewable energy resources like solar panels. Performance evaluations in both training and real-time environments showed high predictive accuracy across all subsystems. This predictive capability is a crucial step toward greener yachting by enabling more intelligent energy scheduling, reducing dependence on fossil fuels, and minimizing greenhouse gas emissions. The integration of AI-driven forecasting tools like the NAR model promotes renewable energy adoption and contributes to global climate change mitigation efforts. The research highlights how smart technologies can align the luxury maritime industry with the goals of sustainability and environmental stewardship.ntegrated into the building, to secure a supply of sustainable clean energy.

ID 08

Harmonic Distortion and Filter Design for a 50 MW PV Plant Connected to a 66 kV

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ABSTRACT

In this study, a 50 MW grid-connected photovoltaic system was designed and integrated with the Bani-Walid–Tninai 66 kV substation. The system's performance was simulated using PVSOL Expert 6, achieving an approximate performance ratio of 87% and an annual yield of 1,786.4 kWh/kWp. Annually, the system exported approximately 99.3 GWh to the grid. Following integration, ETAP was utilized to assess power quality through load flow, short-circuit, and harmonic distortion simulations. The integration introduced 42.6 MW to the grid, while 7 MW was consumed by the load; the short-circuit current jumped from 4.708 kA before integration to 5.245 kA afterward. Harmonic analysis revealed grid instability and a voltage increase to 67.18 kV, resulting in a total harmonic distortion (THD) of 19.01%. To comply with IEEE 519-2022 standards, the THD was successfully reduced to 0.529% through the implementation of harmonic filters designed for the 11th, 13th, and 23rd orders.

ID 14

Study of the ability of some fungi to degradation crude oil in the Tibesti field

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ABSTRACT

This study aims to isolate fungi from hydrocarbon-contaminated soils in Libya and to identify their efficiency in degrading crude oil. The identification resulted in the isolation of six fungi species: Aspergillus Fumigatus, Aspergillus Clavatus, Aspergillus Terreus, Aspergillus Oryzae, Penicillum Sp1, Penicillum Sp2. Growth diameters were measured in solid medium of potato agar and dextrose at different concentrations of crude oil (1%, 3% and 5%) v/v). The growth diameter of Aspergillus Clavatus was the highest at all crude oil concentrations, while Aspergillus Terreus had the lowest growth diameter among the other four strains. Gravimetric analyses were used to determine the percentage of degraded petroleum hydrocarbons, with Aspergillus Fumigatus achieving the highest consumption rates (90, 79 and 61%) for concentrations of 1, 3, 5 and 10%, respectively, while Penicillum Sp1 achieved removal rates of 86, 68 and 43% for concentrations of 1, 3, 5 and 10%, respectively.

ID 18

Technoeconomic visibility study of solar photovoltic systems in Buildings
(For an Administrative Building)

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ABSTRACT

Libya has relatively a large potential for the exploitation of renewable energy (RE), but so far, it depends on the production of fuel oil, whose importance cannot be denied, but which causes greenhouse gas emissions from its production, refining and use processes, leading to pollution of the surrounding air and climate change. It also depends for electricity production on fossil fuels - such as diesel, fuel oil and natural gas - which emit carbon dioxide. There are many resources and raw materials available in Libya that can be exploited, and the most important of these resources is solar energy. This study focuses on studying and investigating the extent of the opportunity to exploit solar energy (Photovoltaic (PV) system (in a buildings application. Building a PV system is the process of designing, selecting and sizing the system components.

ID 22

Sewage Sludge as a Valuable Resource for Sustainable Photocatalytic Nanomaterials: A Comprehensive Mini Review

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ABSTRACT

Sewage sludge (SS) contains significant amounts of carbon and vital plant nutrients, making it a valuable substance for improving plant development and reducing or controlling waste. A thorough analysis of recent developments in SS use is necessary to get optimal application performance. According to the US Environmental Protection Agency, sewage sludge is a pollutant, the main by-product of wastewater treatment facilities. Novel solutions for the economical and ecologically friendly purification and recycling of sewage sludge have been spurred by the growing output of sewage sludge globally, stricter laws, and the limitation of conventional choices for sewage sludge discharge. This work aims to examine the literature on the creation and uses of effective nanomaterials derived from sewage sludge. The key principles of the photocatalysis approach using sewage sludge are outlined, along with the textural features of the as-prepared nanomaterials and synthesis techniques of nanomaterials and sewage sludge properties. Additionally included are the primary uses of sewage sludge, such as photocatalytic CO2 reduction, H2 generation, and pollutant degradation. Finally, the findings and suggestions for the future use of sewage sludge in the energy and environmental remediation sectors are discussed.

ID 25

Current developments in MAX-based nanomaterials for solar energy-driven applications: A Mini Review

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ABSTRACT

MAX phase is important materials that have recently gained great popularity due to their special properties, which renders particularly useful in many applications, including photocatalytic applications.MAX phases, a unique class of ternary carbides and nitrides, exhibit an exceptional combination of metallic and ceramic properties. Several MAX-based nanomaterials with extraordinary characteristics have been proposed, prepared, and practiced as a co-catalyst due to its high thermal and chemical stability, low cost, large specific surface area, facile decoration, high adsorption capacity excellent electrical conductivity, and structural versatility. This review summarizes the recent synthesis developments in the synthesis, characterization, functionalization, and application of MAX phase-based nanomaterials, focusing on their integration into photocatalytic processes such as water splitting, CO_2 reduction, and environmental pollutant degradation. Ultimately, we also discussed the encounters and prospects for the future growth of MAX-based nanomaterials as ancient candidate in developing efficient photocatalysis systems. These advancements not only underscore the versatility of MAX phase

materials but also pave the way for their integration into scalable and cost-effective solar fuel technologies. By bridging the gap between materials science and photocatalysis, this review underscores the transformative impact of MAX phase nanomaterials on next-generation renewable energy and environmental remediation technologies to design efficient Photocatalysis systems. Overall, this review serves as a simple resource and guide for researchers engaged in the exploration and application of MAX phases, emphasizing the essential techniques of synthesis and characterization in harnessing their massive potential and proposing potential solutions, emphasizing the assessment of their suitability across a broad spectrum of applications.

ID 26

Optimization of Fuel Gas Management and Flare Gas Recovery System (FGRS) at Azzawiya Oil Refining by Using Aspen HYSYS Simulation

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ABSTRACT

This paper discusses the challenges related to Fuel gas management at Azzawiya Oil Refinery. The refinery is experiencing a fuel gas shortage, as the quantity required to meet the heating requirements (boilers and heaters) is higher than the quantity produced by the refinery units. At the same time, facing some difficulties in controlling the fuel gas pressure, some quantities of produced gas are flaring and wasted into the atmosphere via flare systems, which leads to economic losses and environmental damage. Flare Gas Recovery Units (FGRUs) help reduce these losses by capturing and preventing emissions, to reusing gases such as methane (CH4), ethane (C2H6), and other hydrocarbons. These are typically flared during industrial processes. The recovered gas can be reused for various applications, including fuel for power

generation, heating operations, and reinject into production. In addition to the above, the Flare Gas Recovery Units (FGRUs) also result in a significant reduction of the Refinery emissions including combustion by-products such as CO2, CO, and NOx from the burning of hydrocarbons. This study aims to simulate the implementation of (FGRS) within the refinery using Aspen HYSYS simulation software to evaluate its environmental and economic impacts. The goal is to benefit from (FGRS) technology, promote sustainable industrial practices, reduce environmental impact, and maximize resource utilization and economic gains.

ID 27

Non-Optical Dual Axes Solar Tracking System

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ABSTRACT

This paper aims to maximize photovoltaic (PV) energy yield by using time based non optical a dual-axis solar PV tracking system. System's design, simulation, prototype implementation, and performance evaluation will be presented. The dual-axis system under investigation, in contrast to fixed or single-axis tracking systems, allows for optimal solar incidence throughout the day and throughout the seasons by adjusting the orientation of the solar panels along the east-west and north-south axes of the sun azimuth and tilt angles. The time based non optical tracker is used to avoid using sensors in the system to reduce the cost and maintenance of PV system. PVsyst software is used to execute a simulation for 10KW PV system to evaluate performance and demonstrate system efficiency. A prototype is built for 15W PV module with microcontroller that has been programmed using the Arduino IDE to make real-time angle adjustments. The results validate the potential of non-optical dual axis tracking systems for broad renewable energy applications by demonstrating a significant boost in energy generation efficiency.

ID 29

Solar Radiation Thermal Effect on Solar PV Panels Dedicated For Water Pumping in a Desertic Environment – Part 1

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ABSTRACT

Among the many applications of photovoltaic energy, water pumping systems stand out as a clean, reliable alternative suited to the needs of remote areas. This type of system essentially relies on the direct use of electricity generated by solar panels to power a pump, thus ensuring autonomous, economical, and environmentally friendly operation. In the MENA region, climatic conditions are generally harsh, and ambient temperatures are generally high. This greatly influences the performance of PV systems due to the negative effect of temperature on the efficiency of solar modules, despite these regions being characterized by considerable sunshine. To address this problem, various solutions have been presented in the literature, such as air or water cooling, whether active or passive. However, some are not admissible in real-world applications.

This article aims to present an effective and innovative methodology for PV pumping systems. A fraction of the pumped water is diverted to the PV generator for cooling and then reinjected back into the irrigation water flow. This improves the system's efficiency without the additional energy loss required to pump the cooling water. A theoretical simulation is performed, and an experimental platform is built to validate the results.

ID 34

Techno-Economic Comparative Analysis of RO-PV and MSF-PTC Desalination systems: A case study of Al-Zawia, Libya

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ABSTRACT

Libya faces simultaneous challenges in securing clean freshwater sources, yet it enjoys one of the highest rates of solar irradiance in the world. This makes solar energy a promising option for powering desalination projects. This study investigates the technical and economic feasibility of two desalination technologies: photovoltaic reverse osmosis (RO-PV) and multistage flash powered by Parabolic Trough Collector (MSF-PTC). These technologies could compete with the Zawia desalination plant, which operates using Multi-Effect Distillation with Thermal Vapor Compression (MED-TVC) technology and produces 80,000 m^3 of fresh water per day, using natural gas as its primary fuel. Toachieve this, a sensitivity analysis based on the balance between energy performance and cost was conducted for a range of parameters, including the DC/AC ratio of the PV system, the effect of multiple solar energy sources, thermal energy storage, receiver types, heat transfer fluids, and cooling systems on the PTC system, to select the optimal configuration with low economic indicators. Simulations were performed using SAM and DEEP software. The results showed that the proposed photovoltaic system could generate 141,730 MWh at a cost of $0.035/kWh, while the PTC system produced a higher surplus of 455,969 MWh at a cost of $0.1698/kWh. Given the high cost of water, which is heavily dependent on energy prices, the cost per cubic meter for the PV-RO system was $0.79, five times lower than the $3.99 cost of the MSF-PTC system. The results justify the PV option as a cost-effective energy solution, while the PTC option meets the flexibility requirements. This study provides policymakers and researchers with a clear vision to intensify their efforts to develop sustainable desalination in Libya.

ID 40

Multiscale Simulation of Nanostructured TiO2, ZnO, and MAPbI3: Bridging DFT Electronic Properties with Optical Absorption Modeling

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ABSTRACT

Nanomaterials such as TiO2, ZnO, and hybrid perovskite (CH3NH3PbI3) are fundamental to the advancement of next generation photovoltaics. This study presents a multiscale computational investigation of their electronic and optical properties by integrating Density Functional Theory (DFT) using Quantum ESPRESSO with device level optical modeling in OghmaNano. The calculated bandgap values were 3.24 eV for TiO2, 3.30 eV for ZnO, and 1.40 eV for MAPbI3 using the PBE GGA function. These parameters were incorporated into optical simulations to evaluate spectral generation densities under AM1.5G illumination. The results show that MAPbI3 exhibits superior light absorption, while TiO2 and ZnO demonstrate high transparency in the visible region, confirming their suitability as electron transport layers (ETLs). This combined approach provides a consistent framework for correlating atomic scale electronic properties with device level optical behavior in perovskite solar cell architectures.

ID 42

Machine Learning-Based Ensemble Models for Prediction of Reservoir Porosity

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ABSTRACT

Accurate prediction of reservoir porosity is crucial for reservoir characterization, petrophysical evaluation, and geological studies. As it directly influences fluid volume estimation within the reservoir. However, traditional porosity estimation methods, such as core sampling, are time-consuming, expensive, and often limited in spatial intervals. Additionally, empirical equations derived from well-logging interpretation introduce uncertainties that affect prediction reliability. This study proposes a machine learning-based approach to enhance porosity prediction by ensemble models, specifically Decision
Trees (DT), Random Forests (RF), Gradient Boosting (GB) and Extreme Gradient Boosting (XGB). The objective is to develop an efficient, cost-effective, and more reliable alternative to conventional techniques. The dataset comprises measured and calculated well-log data, correlated with core porosity measurements. Four well-log parameters: bulk density (RHOB), gamma ray (GR), compressional travel time (DT), and neutron porosity (CNL), were selected as input features based on their strong correlation with porosity. A total of 734 data points from seven wells in a Libyan oil field were used for training, while an eighth well, containing 202 data points, served as a blind test set to evaluate model generalization. Feature selection and hyperparameter tuning were applied to optimize model performance, and the models were assessed using statistical metrics, including R^2, and RMSE. The results indicate that ensemble models provide a robust and efficient alternative to conventional porosity estimation methods, offering improved predictive accuracy and reliability. This study highlights the potential of machine learning in reservoir characterization, contributing to more data-driven decision-making in petroleum engineering applications.

ID 45

دراسة بحثية تشبيهية حول بعض الظواهر المصاحبة للتحليل بمتسلسلة فوريه للإشارات المتقطعة كما في دوائر القدرة الإلكترونية في منظومات الطاقات المتجددة

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الملخص

تهدف هذه الدارسة التحليلية التشبيهية إلى تسليط الضوء على بعض الظواهر المصاحبة لتحليل الإشارات غير المتصلة باستخدام متسلسلة فوريه (Fourier series) [1] ، كما يظهر في تطبيقات دوائر القدرة الإلكترونية ضمن أنظمة الطاقات المتجددة . وقد بدأ هذا التوجه انطلاقا من الجدل التاريخي بين فوريه وكوشي، حيث رفض الأخير قبول تمثيل الدوال غير المتصلة بهذه المتسلسلة، لاحقا تم ايجاد توافق بشروط محددة يُعرف بشروط ديرشليت (Dirichlet) الثلاثة. تُنتج دوائر القدرة الإلكترونية إشارات غير متصلة، ما يجعل تحليلها باستخدام فوريه محفوفا ببعض الظواهر الخاصة مثل ظاهرة غيبس (Gibbs) التي تشير إلى ظهور نبضات حادة في أماكن عدم الاتصال، وظاهرة التراكب والتشويه (Aliasing) التي تحدث عند تجاهل شرط تردد نيكويست (Nyquist) الأدنى المطلوب لأخذ العينات. كما تم التطرق في الدراسة إلى مفاهيم التوافقيات البينية والتحتية، والتي غالبا ما تكون غائبة عن مناهج طلاب الهندسة الكهربائية، رغم وجودها في الأنماط الدولية التي تتحدث عن شروط جودة الطاقة مما يعكس أهميتها الكبيرة في فهم الإشارات المركبة داخل الأنظمة الحديثة، مثل العواكس الجهدية ثنائية ومتعددة المستويات. أجريت محاكاة تشبيهية لهذه الظواهر لتوضيح ماهيتها وكذلك توضيح تأثيرها على عمل وتحليل هذه الدوائر الغير خطية بمنحنيات متقطعة، بشكل نعتقد انه مبسط ومفهوم للمهندسين الكهربائيين، وذلك بهدف تعزيز وعيهم بأهمية شروط ومتطلبات تحليل فوريه في التطبيقات الهندسية التي تتطلب تحقيق شروط اضافية، وتفادي التشوهات الناتجة عن إساءة استخدامه في السياقات العملية.

ID 48

استثمار الطاقة الشمسية في ليبيا : مقارنة استراتيجية مع النموذج المغربي لتجاوز تحديات التحول الصناعي

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الملخص

تستعرض هذه الورقة البحثية بالدراسة والتحليل المقارن إمكانيات استثمار موارد الطاقة الشمسية في ليبيا، مع التركيز على الكثافة الاشعاعية والتوافر الزمني. ولتحقيق عمق تحليلي، تم إجراء مقارنة مرجعية مع تجربة المملكة المغربية، التي تمثل حالة رائدة إقليميا، استناداً إلى معايير التشابه المناخي والجغرافي والموقع الاستراتيجي المطل على حوض البحر الابيض المتوسط. لقد أحرزت المغرب تقدماً نوعيا في الانتقال بمشاريع الطاقة المتجددة من الطور البحثي الى التطبيق الصناعي واسع النطاق، بقدرة إجمالية مرتقبة تبلغ 750 ميجاوات، ويتميز برنامجها بتنويع مصادر الطاقة، وتحقيق الاستدامة البيئية، ودعم الاقتصاد الوطني. تهدف الدراسة إلى استكشاف الفرص والتحديات التي تواجه تفعيل مشاريع الطاقة الشمسية العملاقة في ليبيا، وتقديم مقترحات عملية في هذا السياق. كشفت النتائج أن التحدي الجوهري لا يكمن في ندرة الموارد الطبيعية أو في الجانب التكنولوجي، بل في عوامل مؤسسية وسياسية. إذ تبين أن العقبة الاساسية تتمثل في قصور الإطار الإداري والمعرفي، وغياب الارادة السياسية المستقرة. بناءً عليه، تسعى هذه الورقة إلى تزويد الجهات المعنية وصناع القرار بالمعلومات العلمية الدقيقة، مستلهمة الدروس من التجربة المغربية، بهدف تذليل العقبات التي تحول دون تحقيق الاستفادة المثلى من الامكانيات الواعدة للطاقة الشمسية في ليبيا.

ID 49

عاكس جهدي متعدد المستويات ذي المتجهات الفراغية المتعامدة OVT مع مرشح غير فعال في دائرة العاكس الجهدي المساعد

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الملخص

تستعمل دوائر القدرة الإلكترونية بوفرة في منظومات تحوير الطاقات المتجددة، والعواكس الجهدية خصوصا في تحويل الطاقة الكهربائية من دوائر التيار الثابت كما في الخلايا الوقودية والشمسية والبطاريات إلى تيار متغير بالتردد المطلوب. العواكس تنتج موجات نبضية في العادة تكون DC/AC Converter الجهدية مما يسمح بإزاحة PWM مصممة بتقنية تعديل عرض النبضة طيف التوافقيات العليا إلى الاعلى وبالتالي يسهل ترشيحها عبر المرشحات السلبية، وذلك للحصول على موجة جيبية أو شبه جيبية وبالرغم من شيوع الحل. THD بمعامل تشوه هرموني قليل نسبيا المذكور إلا انه يملك عدة سلبيات مثل حدة حافة النبضات الجهدية التي تمتلك ميل عدة عشران من الكيلو فولت إلى كل ميكرو ثانية مما يكون سببا في انهيار العوازل للأجهزة الكهربائية نظرا للتيارات السعوية. كذلك تؤثر سلبا على جودة الطاقة الكهربائية في منظومات في الشبكة. من العيوب ايضا THD القوى حيث تسبب رفع معامل تداخل التوافقيات مما يسبب في حدوث ظاهرة الرنين عند التوافقيات العليا وايضا التشويش والفواقد نوع فصل وصل لأنها تعمل بترددات تصل الى عدة عشرات من الكيلو هيرتز في العادة من عشرين الى IGBT. ثلاثين كيلو هرتز عند استعمال ترنزستورات ما تم ذكره من عيوب للعواكس الجهدية ثنائية المستوى والتي تعمل كان سببا في ظهور عائلة جديدة من العواكس الجهدية PWM بتقنية تسمى بالعواكس الجهدية متعددة المستويات. في هذه الورقة تم استعراض اهم الأنواع من هذه العواكس مع دراسة تشبيهية للعاكس الجهدي ذي المتجهات الفراغية المتعامدة مع ادخال تقنية الترشيح للعاكس المساعد مما سمح بتحسين DC الغير فعال في دائرة الربط الدراسة وضعت مقارنة THD شكل الموجة وبالتالي تقليل معامل مع مقترح سابق لنفس العاكس الجهدي ولكن بمرشح في دائرة العاكس الجهدي الرئيس من جهة التيار المتغير.

ID 51

تقييم الرواسب الطينية كسوائل حفر بمنطقة عين الغزالة شمال شرق ليبيا

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الملخص

تقع منطقة عين الغزالة على طول الطريق الساحلي شرق طبرق في شمال شرق ليبيا، وهي منطقة واعدة جيولوجيا لارتباطها بتكوين الفايدية، المعروف برواسبه الغنية بالطين، وخاصة البنتونيت. تهدف هذه الدراسة إلى دراسة الخصائص المعدنية والكيميائية لطين البنتونيت في المنطقة وتقييم مدى ملاءمته للتطبيقات الصناعية مثل طين الحفر. أجريت تحليلات ميدانية ومختبرية في موقعين رئيسيين في عين الغزالة، حيث طبقات طينية مكشوفة سطحيا يصل سمكها إلى 10 أمتار، مغطاة بطبقات من الحجر الجيري والدولوميت يتجاوز سمكها 15 مترا. كشف التحليل المعدني باستخدام حيود الأشعة السينية (XRD) عن هيمنة معادن مجموعة السمكتيت، وخاصة المونتموريلونيت. ومع ذلك، أظهرت الاختبارات الكيميائية محتوى أكسيد الكالسيوم أعلى من أكسيد الصوديوم، مع وجود نسبة صفر من الصوديوم في بعض العينات. ونتيجة لذلك، تم تحديد الطين على أنه بنتونيت الكالسيوم، والذي يفتقر إلى خصائص الانتفاخ اللازمة للاستخدام الفعال في عمليات الحفر. تُبرز النتائج إمكانات المنطقة كمصدر للمعادن الصناعية، إلا أنها تُشير أيضا إلى محدودية بعض الاستخدامات نظرا لطبيعتها الجيرية. تدعم الدراسة الجهود المبذولة لاستغلال الموارد الطبيعية المحلية في استراتيجيات التنمية المستدامة.

ID 55

Solar-Powered AI Weather and Air Quality Station for Industrial Safety and Residential Environmental Monitoring

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ABSTRACT

Sudden weather volatility and air quality deterioration pose critical risks to operational continuity in the Oil, Gas, and Renewable Energy sectors, while simultaneously threatening residential public health. This paper presents the design and implementation of a versatile, self-sufficient weather station capable of monitoring these hazards across diverse environments, from urban neighborhoods to remote industrial fields. Leveraging a Raspberry Pi 5 with on-device AI acceleration, the system fuses real-time data regarding wind, rain, atmospheric pressure, temperature, lightning distance, and air pollution, including particulates and gases like CO2 and COe. Unlike standard meteorological systems that rely on distant forecasting, this device utilizes local AI processing to perform nowcasting, identifying immediate weather threats and environmental anomalies as they happen. This capability is critical for ensuring worker safety while providing homeowners and commercial facility managers with actionable data to automate building systems and asset protection in off-grid industrial zones. Powered by a dedicated solar energy management architecture, the proposed solution demonstrates a scalable, resilient approach to environmental monitoring where reliable grid power and internet connectivity may be limited.

ID 57

زلزال كريت سنة 563 م: كارثة طبيعية غيرت وجه الساحل الليبي

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الملخص

يهدف هذا البحث إلى دراسة تأثير زلزال كريت 563 ميلادي على الساحل الليبي، مع التركيز على التغيرات الجيولوجية والطبوغرافية التي أحدثها هذا الحدث التاريخي. يستعرض البحث العلاقة بين النشاط التكتوني وتوزيع الأحواض الهيدروكربونية في ليبيا، وكيف ساهمت الفوالق التكتونية في تكوين وتوزيع هذه الموارد. كما يناقش البحث تأثير التغيرات المناخية وارتفاع مستوى سطح البحر على المناطق الساحلية الليبية، مع تقديم توصيات للتخطيط المستقبلي والتنمية المستدامة لمواجهة هذه التحديات. يخلص البحث إلى أن التخطيط الحضري الواعي واستراتيجيات التخفيف من الكوارث الطبيعية هما أساس حماية المجتمعات الساحلية وضمان استدامتها في مواجهة المخاطر الطبيعية المتزايدة.

ID 58

تأثير تراكيز ملوحة متدرجة على نمو وتزهير شتلات المانجروف الرمادي (Avicennia marina) تحت ظروف المشتل

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الملخص

تبحث هذه الدراسة تأثير الري بمياه ذات ملوحة متدرجة على نمو وتزهير شتلات المانجروف الرمادي (Avicennia marina) في مشتل مُتحكَّم به بتاجوراء شرق طرابلس. تراوحت تراكيز المواد الصلبة الذائبة (TDS) بين 103.4 و 30,000 ملغم/لتر، مع متابعة مستمرة للرقم الهيدروجيني والموصلية الكهربائية لمحاكاة بيئات ملوحة متغيرة مثل بحيرة فروة . أظهرت النتائج قدرة عالية للشتلات على تحمل الملوحة، مع تأخر طفيف في التزهير مقارنة بالشتلات المزروعة في الإمارات. كما سجلت الدراسة تحسنا تدريجيا في النمو الخضري بارتفاع الملوحة، مما يشير إلى قدرة النوع المدروس على التأقلم الإيجابي وربما حاجته إلى حدود معينة من الملوحة لتحقيق أداء فسيولوجي أفضل . وتبرز النتائج أهمية الري التدريجي في تقليل الإجهاد الملحي أثناء تهيئة الشتلات، إضافة إلى دور التربة الرملية الغرينية تصنيف (SM) في دعم النمو، مع الحاجة لرفع المحتوى العضوي لتحسين الاحتفاظ بالماء والمغذيات . تمثل هذه الدراسة امتدادا لعمل سابق على 28 شتلة مانجروف تحت الظروف الليبية، ويدعم إمكانية استزراع المانجروف الرمادي في الساحل الليبي، خاصة في البيئات عالية الملوحة مع الإدارة الدقيقة للري والنمو.

ID 63

تصميم وتشغيل وحدة هضم حيوي لمخلفات الأبقار بهدف معالجة المخلفـــات العضـــــوية وإنتـــــاج الغاز الطبيعي

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الملخص

تهدف الدراسة إلى تقييم جدوى استخدام روث الأبقار لإنتاج سماد عضوي محسن وغاز حيوي قابل للاحتراق عبر التحلل اللاهوائي في الظروف المناخية الليبية. أُجريت تجربة ميدانية لمدة 22 يومًا في تاجوراء باستخدام هاضم بسيط محلي التصميم، يتكون من خزان مغلق مع خلاط يدوي وأنبوب لنقل وتخزين الغاز في إطار مطاطي. تم قياس التغيرات الفيزيائية والكيميائية للروث ورصد إنتاج الغاز وتحليل خصائصه. أظهرت النتائج تحسن خصائص المادة المعالجة بانخفاض الروائح الكريهة، وزيادة تركيز العناصر المغذية، وتراجع مسببات الأمراض، كما أكد إنتاج غاز حيوي عالي الجودة من خلال لهب أزرق عند الاشتعال، مما يشير لتركيز مرتفع من الميثان. تُظهر الدراسة أن التقنية تمثل حلًا مستدامًا وفعالًا لإدارة المخلفات العضوية وإنتاج الطاقة المتجددة في المناطق الريفية الليبية، داعمة للتنمية المستدامة والفوائد الاقتصادية والبيئية.

ID 65

Models for Predicting Refrigeration Coefficient of Performance of Simple and Multi-Stage Propylene Refrigeration Cycles

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ABSTRACT

Accurate model development is crucial for predicting the performance of refrigeration systems, given rapid development in various fields and the importance of cooling utility in natural gas processing, petroleum refining, and petrochemical manufacturing. This study used GPSA refrigeration system data to forecast the performance of single-stage and multi-stage vapour compression refrigeration systems. Three (two) regression models and artificial neural network models were compared for prediction efficiency, and validated aganist reference data. With a maximum error rate of less than 3% and a correlation coefficient (R2 > 0.988), the results are consistent with the well-established data source. The outcomes demonstrate the applicability and high accuracy of the developed models in forecasting the performance of the propylene refrigeration system. As a result, engineers and scientists can swiftly screen and optimize the sub-ambient system across various operating conditions. This novel approach eliminates the need for extensive simulation, saving time and cost and enabling the creation of more energy-efficient and sustainable systems.

ID 69

Wind Farm layout Optimization in Sabratha using Local Beam Search Algorithm

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ABSTRACT

Wind energy presents a critical renewable alternative to fossil fuels. This study optimizes the layout of a wind farm in Sabratha, on Libya's western coast, to maximize power output while minimizing costs, accounting for wake effects. First the wind speed data were collected and analyzed for period between January 2016 until December 2019. Then wind resource was characterized using EasyFit software, identifying the Dagum distribution as the best fit for local wind speeds, which averaged between 4.48 m/s and 11.08 m/s at 10m height. The optimal layout was determined using a Local Beam Search algorithm for a 2×2 km^2 square wind farm site discretized into 100 possible turbine locations in MATLAB. Three wind scenarios were analyzed:
(a) constant speed and direction, (b) constant speed with variable direction, and (c) variable speed and direction. The results show that the optimal number of turbines is 30, 34, and 40 for scenarios (a), (b), and (c), respectively, yielding average power outputs of 20.17 MW, 26.12 MW, and 24.74 MW. confirmed the effectiveness of their approach. This demonstrates the algorithm's effectiveness in determining efficient configurations. under complex wind conditions. With high power output while minimizing the objective function.

ID 70

Hydrogen Embrittlement Damage on High Strength Natural Gas Pipeline Steel at Aqueous Environments

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ABSTRACT

Hydrogen embrittleness of steel is defined as a deterioration in the mechanical properties of a metal due to stress-corrosion cracking. This process typically begins with crack formation and progresses to fracture due to decreased ductility and increased brittleness. This undermines the reliability of these metals in industries such as automotive, oil and gas, and construction, which rely heavily on steel structures. This process has been studied in numerous scientific studies, but its understanding remains uneven. To address this problem, it is first necessary to understand the underlying mechanisms and factors affecting hydrogen brittleness. This paper aims to review the literature and publications related to hydrogen brittleness on high-strength steel and its impact on steel pipes used in aqueous environments. The paper focuses on recent developments and methods that have contributed to a better understanding of the relationship between steel structure, properties, and performance, with a particular focus on the factors that cause and affect hydrogen brittleness.

ID 71

High Temperature Thermal Energy Storage: A Comprehensive Review of Advanced Materials, System Design, and Applications

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ABSTRACT

The escalating global demand for sustainable and efficient energy systems highlights the critical role of thermal energy storage (TES) in balancing energy supply and demand. High-temperature thermal energy storage (HT-TES) systems, operating typically above 400°C, are particularly vital for enhancing the efficiency and reliability of concentrated solar power (CSP), industrial waste heat recovery, and advanced nuclear energy systems. Despite significant progress in TES materials and system design, challenges persist in optimizing energy density, thermal stability, cost-effectiveness, and long-term performance under extreme conditions.

This comprehensive review systematically examines the state-of-the-art of HT-TES, addressing three key research areas: material innovations, system design, integration and applications and integration. We assess promising advanced materials for HT-TES, including sensible heat storage materials such as molten salts, packed beds, sand, and enhanced concrete, as well as latent heat storage materials, including nano-enhanced and encapsulated Phase Change Materials (PCMs). The review also covers thermochemical heat storage materials, including gas-solid reactions and metal oxides. Key engineering challenges in HT-TES system design, differentiating between direct and indirect systems, are discussed, along with novel configurations for improved efficiency and scalability.

Furthermore, the paper explores the effective integration of HT-TES into existing and future energy systems, particularly within Concentrated Solar Power (CSP) plants, wind and solar hybrid systems. Application of storing the access energy as heat, which is called Carnot Battery, various industrial processes and chemical processing are also discussed in this piece of work. Furthermore, emerging applications in electronics, thermal management, and transportation are considered. The findings aim to identify critical research directions, highlight unresolved technical barriers, such as material degradation and low thermal conductivity of PCMs, and propose pathways for the commercialization of high-performance HT-TES solutions. This analysis contributes to the discourse on sustainable energy storage and the transition toward decarbonized energy systems.

ID 73

Smart Oil Vision:Integrating Artificial Intelligence and Geographic Information Systems for Intelligent and Sustainable Energy Operations in the Oil Sector

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ABSTRACT

The oil and gas industry plays a critical role in global energy supply, yet it faces growing challenges related to operational efficiency, environmental impact, and alignment with global energy transition goals. Traditional exploration and operational approaches are increasingly inadequate in handling complex geological conditions, large-scale spatial data, and real-time production dynamics.

This paper proposes Smart Oil Vision, an intelligent framework that integrates Artificial Intelligence (AI) with Geographic Information Systems (GIS) to enhance energy efficiency, exploration accuracy, and environmental sustainability in oil operations.

The framework combines spatial, geological, operational, and environmental data to support predictive exploration, well performance forecasting, anomaly detection, and environmental risk assessment.

Experimental evaluations conducted on realistic oil-field datasets demonstrate that the proposed approach improves exploration accuracy by up to 30%, reduces operational failures, and contributes to measurable reductions in emissions and environmental risks. The results confirm that integrating AI-driven intelligence with spatial analytics provides a scalable and effective solution for transforming traditional oil systems into intelligent and sustainable energy operations.

ID 74

Material demand and sustainability risks in scaling emerging perovskite photovoltaics for global energy deployment

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ABSTRACT

Photovoltaics (PVs) deployment can supply a substantial portion of the global energy demand. Perovskites are an emerging type of PVs that utilize significantly less material due to solution processing of thin layers, eliminating the need for expensive manufacturing techniques, which are expected to reach commercial-stage manufacture soon. With lab-scale power conversion efficiencies (PCEs) reaching 27%, credited to the use of lead (Pb), perovskites have surpassed the PCEs of established silicon PVs (20 – 24%). However, the materials demand required to fulfil projected energy deployment are still unknown. Herein, data from five perovskite PVs were collected, each of distinct architecture, and materials demand were calculated based on predicted PCEs and market share, assuming a commercial module lifetime of 25 years.

Market share was varied as a percentage of an already reported scenario which predicts PVs deployment over the next 25 years, namely the Teske 1.5oC scenario. Materials demand vary depending on device architecture and application. Obtained results indicate that supply risks associated with indium, silver, tin and iodine may hinder large-scale deployment of perovskites. Iodine, in particular, displays a higher supply risk than has been highlighted to date. Sensitivity analyses reveal that perovskites must enter the market at high PCEs to expressively maximise materials savings. These findings can be used as a foundation for life cycle assessments to identify the optimum module architecture from both environmental and economic perspectives.

ID 75

Removal of Oil Spill and its Derivatives Spilled in Seawater by Using Natural Materials

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ABSTRACT

In this research, the oil removal tests were divided into two primary experiments. In the initial experiment, each natural material was evaluated in isolation, while in the subsequent experiment, each natural material was tested in conjunction with iron rust (iron oxide), with a 1:1 ratio maintained between the two. The natural materials employed in this study encompassed Artemisia, iron rust (iron oxide), Ispaghula husk, olive tree mulch, wheat bran, and pomegranate peels. The procurement of these materials was conducted through commercial channels. The outcomes of the study demonstrated that the combination of iron rust (iron oxide) with wheat bran and olive tree mulch yielded the most optimal outcomes, achieving 51.8% and 50.7%, respectively. Conversely, when the materials were tested individually, ispaghula husk and artemisia demonstrated the most favourable results, achieving 69% and 61%, respectively.

ID 77

Evaluating the Impact of Grid-Connected Photovoltaic Systems via Different Modeling Techniques with MPPT Control

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ABSTRACT

Grid-connected photovoltaic (PV) systems require accurate modeling and effective control to ensure reliable operation and optimal energy extraction. Two main simulation approaches are typically adopted: detailed switching models, which capture converter switching dynamics and harmonics with high accuracy, and average-value models, which simplify the representation of converters to achieve faster simulations. In this study, both approaches are implemented and compared for grid-connected PV systems equipped with maximum power point tracking (MPPT) controllers. The evaluation focuses on key performance indicators, including efficiency, dynamic response and power quality. Simulation results demonstrate the strengths and limitations of each approach, highlighting the trade-off between accuracy and simulation speed. This comparative analysis provides practical insights for researchers and engineers in selecting appropriate modeling strategies for PV system design, control, and grid integration studies.

ID 79

Technoeconomic visibility study of solar photovoltic systems in Buildings
(For an Administrative Building)

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ABSTRACT

This presentation explores the innovative integration of polyethylene (PE), a widely used and recyclable polymer, into asphalt mixtures to enhance road infrastructure sustainability and performance. By leveraging the chemical inertness, durability, and thermal stability of PE-particularly in forms like LDPE and HDPE-engineers can significantly improve asphalt's resistance to rutting, cracking, and moisture damage. The study outlines both dry and wet mixing methods, technical parameters, and performance metrics, demonstrating that PE-modified asphalt can increase Marshall Stability by up to 30% and extend pavement lifespan by 20-50%. Environmental and economic benefits include reduced CO, emissions, lower fuel consumption, and diversion of plastic waste from landfills, aligning with global sustainability goals. Case studies from India, the United States, Pakistan, the UK, and the Netherlands validate the practical success of PE-enhanced roads. Material innovations such as PE-9-MA, PE wax additives, and hybrid blends further optimize mix quality and performance. Despite challenges like plastic sorting inconsistencies, lack of unified standards, and concerns over microplastics, ongoing research collaborations and policy initiatives are driving adoption. The presentation concludes that polyethylene in asphalt represents a promising path toward resilient, eco-friendly, and cost-effective road systems.

ID 81

Production of Sodium Hypochlorite from Brine of the West Tripoli Desalination Plant Using a DSA Titanium Anode

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ABSTRACT

This study addresses the application of an electrochemical technique for the production of sodium hypochlorite (NaOCl) from brine discharged from the West Tripoli Desalination Plant, aiming to reduce the environmental impact of the reject water. Two variables were investigated: the applied voltage and the distance between electrodes, using a DSA titanium anode coated with a layer of ruthenium oxides (RuO_2) and a carbon cathode. The experiments were conducted at applied voltages of 3.5 V, 4.5 V, and 5.0 V, and electrode distances of 1.0 cm, 1.4 cm, 2.0 cm, and 2.8 cm. The concentration of free chlorine was measured in parts per million (ppm) at operating times of 20, 40, 60, 80, and 100 minutes. The results showed that increasing the applied voltage significantly enhanced the rate of free chlorine production, with the highest free chlorine concentration reaching approximately 582.2 ppm at 5.0 V and an electrode distance of 1.0 cm after 100 minutes of operation.

The results confirm that controlling the electrode distance and the applied voltage represents two key factors in improving the performance of electrochemical cells for efficient chlorine production.

ID 84

Integrating AI and Metaverse Technologies for Big Data Optimization in Renewable Energy

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ABSTRACT

The integration of Artificial Intelligence (AI), Big Data analytics, and Metaverse technologies particularly Extended Reality (XR)—presents new opportunities to enhance the operation and planning of renewable energy systems. This paper conducts a structured literature review of peer-reviewed studies (2020–2025) to assess current applications, integration challenges, and potential synergies across these domains. Based on the review, a conceptual framework is proposed that combines AI-driven forecasting, anomaly detection, and dispatch optimization with XR-based digital twins for immersive visualization and scenario analysis.

The framework comprises three layers: (1) data acquisition for real-time and historical energy data; (2) AI processing using deep learning models such as LSTM; and (3) immersive interaction through XR environments. Performance was evaluated through simulation and semi-field validation using datasets from NREL, NOAA, and OpenEI. Results showed improvements of 63% in forecasting accuracy, 27% in cost reduction, and 25% in battery efficiency compared to a baseline microgrid.

This work advances energy informatics by bridging intelligent control with immersive simulation. It underscores the potential of AI–Metaverse integration to build adaptive, efficient, and user-centric energy systems. The proposed model lays the groundwork for future empirical validation and deployment, while highlighting key challenges in integration complexity, data quality, and cybersecurity.

ID 85

Examining the Effect of SEC Courtyard Orientation and Proportions on Its Efficiency and Solar Performance

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ABSTRACT

This study investigates the impact of the orientation and geometric proportions of a Semi-Enclosed Courtyard (SEC) on its solar performance and efficiency in hot arid climates. Courtyards have long been recognized as passive design elements that influence indoor comfort and energy consumption. However, limited research addresses how their orientation and dimensional ratios directly affect solar heat gain and shading efficiency. Using simulation-based analysis, a series of SEC models with varying orientations (north, south, east, west) and proportions (width-to-length) are evaluated under standardized climatic conditions. The study employs SOLARGEO to simulate solar radiation exposure, shading behavior, and indoor thermal conditions throughout different times of the year. The findings are expected to offer design guidelines for optimizing SEC configurations to enhance passive solar control, and improve environmental comfort in contemporary sustainable architecture.

This research contributes to the refinement of climate-responsive design strategies suitable for residential buildings in hot climates such as Libya.

ID 87

Production of Electrical Energy Using Low-Emission Fuel Produced from Wastewater Sludge Anaerobic Digestion

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ABSTRACT

The growing demand for sustainable energy highlights the importance of biogas as a renewable and low-emission fuel. This study investigates the potential for biogas production from wastewater sludge anaerobic digestion as a substitute for natural gas in power generation plants. A comparative analysis was conducted at the Al-Khums power plant located in Libya, focusing on efficiency and environmental impacts. The anaerobic digestion process was modeled through its four stages, namely: hydrolysis, acidogenesis, acetogenesis, and methanogenesis. The resulting biogas composition was found 58.10% CH4, 35.90% CO2, and 0.99% H2S with minor components including H2, NH3, O2, and N2 consistent with literature ranges. Process simulations using Aspen Plus v.12 evaluated the performance of biogas versus natural gas under varying loads. Key indicators, including thermal efficiency, specific fuel consumption, and CO2/NOx emissions, were compared. The electrical energy per cubic meter (m^3) was evaluated for both fuels, natural gas and biogas, in MWh generation for a typical wastewater plant. The electrical energy generated per cubic meter (m^3) from each fuel showed that biogas demonstrates significant environmental advantages, supporting its role in the sustainable energy transition.

ID 88

Impact of Distributed PV Generation on Voltage Profile and Power Losses in the Gharyan 66 kV Network

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ABSTRACT

This paper investigates the impact of integrating a 5 MW photovoltaic (PV) distributed generation (DG) unit into the Gharyan 66 kV sub-transmission network in western Libya. The study aims to enhance voltage stability and minimize active power losses through the optimal allocation of PV generation. The network was modeled in NEPLAN using real grid data provided by GECOL, while the PV system was designed and simulated in PVsyst based on the site's solar irradiance and temperature conditions. Two operating scenarios were compared: the base case without PV generation and the case with the 5 MW PV DG integrated at a selected bus. The results demonstrate a significant improvement in voltage profile, where the minimum voltage increased from 85.1 % to 95.3 %, and total active power losses decreased from 1.209 MW to 0.93 MW, representing a reduction of approximately 23 %. Additionally, the integration of PV generation contributed to a measurable reduction in CO_2 emissions, highlighting its environmental benefits. These findings confirm that distributed PV generation can effectively support voltage regulation, reduce network losses, and promote sustainable energy integration within Libya's medium-voltage networks.

ID 92

Evaluating the Suitability of Libyan Quartz Sands Samples for Solar Grade-Silicon

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ABSTRACT

This study examines Libyan quartz sands at two sites in Libya, with specific emphasis on the types of impurities that affect the electronics sector and their concentrations in the raw material (quartz). It also examines the optimal techniques for producing Solar Grade-Silicon regarding lowest cost and energy consumption. The sample findings will evaluate their suitability for producing Solar Grade-Silicon, which has excellent economic implications for investment in solar cell manufacturing.

ID 96

Evaluating the Suitability of Libyan Quartz Sands Samples for Solar Grade-Silicon

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ABSTRACT

Accurate short-term load forecasting (STLF) is essential for power system stability, energy trading, and grid management. This study presents a comprehensive, explainable machine learning framework comparing three paradigms: gradient-boosted trees (XGBoost), recurrent neural networks (LSTM), and classical time series decomposition (Facebook Prophet). Applied to a multi-year hourly dataset from PJM Interconnection, the framework incorporates engineered temporal features lagged loads (1-48 hours), cyclical datetime encoding, and hour-of-day effects trained via chronological 80/20 splits to maintain temporal integrity. Performance evaluation employs absolute (MAE, RMSE) and relative (MAPE, WMAPE, R^2) metrics, augmented by XGBoost's native feature importance for interpretability.

Results unequivocally demonstrate XGBoost's dominance, achieving MAPE of 0.87% and R^2 of 0.9952, surpassing LSTM (MAPE: 1.53%, R^2: 0.9907) and dramatically outperforming Prophet (MAPE: 22.31%, R^2: -0.2644). Feature importance analysis reveals recent lags (1h, 24h) and diurnal patterns as primary drivers, validating domain expertise integration. XGBoost's superiority stems from its robustness to tabular time series, computational efficiency, and inherent explainability via tree-based SHAP approximations. This work delivers a reproducible pipeline, benchmark metrics, and actionable insights for utilities, affirming tree ensembles as optimal for feature-rich STLF while highlighting Prophet's limitations without extensive customization. The framework advances explainable AI in power systems, enabling trustable deployment in operational environments.

ID 98

Development of a hybrid artificial lift system utilizing PIPESIM software, (Field, Libya)

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ABSTRACT

The production system is a key component of the oil and gas industry, with operations generally divided into natural and artificial flow methods. When natural production declines, artificial lift techniques implemented. Artificial lift utilized when reservoir pressure drops to a level where it can no longer sustain economically viable production or raise oil to the surface. Although the reservoir's energy might still push oil to the bottom of the well, additional assistance is required to extract it to the surface. This research explores a hybrid artificial lift system that integrates two technologies: a gas injection system and an electric submersible pump (ESP) system within a single well. The primary objectives of the study include preserving reservoir efficiency, maximizing well performance, enhancing production rates, and minimizing downtime by reducing production stoppages. With PIESIM software, the research achieved promising results in increasing production and optimizing operational time. In terms of gas lift performance, the highest flow rate recorded was in the larger tubing scenario, with a value of QL = 11,038.52 STP/d, followed by progressively smaller flow rates as tubing size decreased. For the ESP system, based on the actual pump performance curve, the maximum flow rate observed corresponded to a gas-oil ratio (GOR) of 1000, producing a flow rate of 10,159.6 bbl. /d. While the figures are relatively close, it noted that a reduction in GOR led to a significant decline in flow rate, high lighting a direct relationship between the two variables.

ID 99

Solar-powered reverse osmosis brackish water treatment for residential use in Tripoli

Design, performance, and economic feasibility

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ABSTRACT

This study presents the design, performance and economic feasibility of a centralized solar-powered reverse osmosis (RO) desalination system for a residential compound of 10 buildings in Tripoli, Libya. Pretreatment was modeled using Aspen Plus V.12, and the RO unit was simulated with IMSDesign. The FilmTec CPA5-LD-4040 membrane achieved a 70% recovery and produced permeate meeting WHO and Libyan drinking-water standards, with TDS of 335 mg/L, pH of 7.6, and an LSI of 0.

A dosing-sensitivity analysis identified 92.7 mg/L of 5% $Ca(OH)_2$ solution as the optimal value for post-treatment stabilization. To minimize costs, the system was configured as a battery-free PV-powered design using 4 monocrystalline IBC Solar modules (395 W each, 1.58 kWp total). CO_2-emission sensitivity analysis showed a decrease from 7 kg CO_2/day under grid supply to zero for fully solar operation. The RO unit`s energy demand was 7.8 kWh/day, fully met by the PV array. The Levelized cost of water ranged between 8–21 LYD/m^3 depending on lifetime and discount rate. Compared to bottled water consumption for the 300-resident compound, the system provides substantial annual savings resulting in a payback period of 133 days. Overall, the results confirm the strong technical performance, economic viability, and long-term sustainability of deploying stand-alone PV-driven RO desalination for residential applications in Libya.

ID 103

توظيف تقنيات الذكاء الاصطناعي للكشف المبكر عن المخاطر التشغيلية في منصات النفط والغاز (دراسة وتصميم)

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الملخص

تواجه منصات النفط والغاز تحديات تشغيلية كبيرة نظرا لتعقيد بيئتها الصناعية وارتفاع مخاطرها، مما يجعل الكشف المبكر عن الاخطار امرا حاسما لضمان السلامة واستمرارية الانتاج. تهدف هذه الدراسة إلى معرفة مدى امكانية توظيف تقنيات الذكاء الاصطناعي، وبالاخص نماذج الشبكات العصبية العميقة مثل YOLO و Deep Convolutional Neural Networks – CNNs ، لرصد المخاطر التشغيلية بصورة لحظية. ترتكز منهجية الدراسة على جمع بيانات تشغيلية تحاكي بيئة المنصات، وتصميم نموذج ذكاء اصطناعي قادر على اكتشاف السلوكيات الخطيرة وملامح التلف والتسريب، لتقييم أدائه بناء على دراسة الادبيات السابقة، وفق معايير الدقة، وزمن الاستجابة، ومعدل الانذارات الكاذبة. ووفقا لذلك، فان النموذج المطور يتمتع بدقة عالية وقدرة محسنة على الاستجابة السريعة مقارنة بالاساليب التقليدية، مما يعزز فعاليته كأداة داعمة لأنظمة السلامة الصناعية.

تؤكد الدراسة جدوى دمج تقنيات الرؤية الحاسوبية في مراقبة منصات النفط والغاز، وتبرز دورها في تقليل الحوادث التشغيلية وتعزيز التحول نحو منظومات مراقبة ذكية وأكثر أمانًا.

ID 107

Green Hydrogen Production Using Wind Energy: A Comparison Between AWM and PEM Electrolyzers

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ABSTRACT

This study presents a comprehensive simulation-based anal- ysis of hydrogen production driven by wind-powered electrolysis using MATLAB/Simulink.

The proposed system integrates a wind energy con- version model with an advanced electrolysis process to assess the feasibil- ity of sustainable hydrogen generation. Two types of electrolyzers—Alkaline Water Membrane (AWM) and Proton Exchange Membrane (PEM)—are developed and compared in terms of efficiency, dynamic response, and hydrogen yield. A fuzzy logic-based Maximum Power Point Tracking (MPPT) control strategy is implemented to optimize the extraction of electrical energy from the wind turbine under fluctuating wind condi- tions. The electrolyzer models are examined for their voltage-current characteristics, power consumption, and pressure generation capabilities over a 60-minute simulation period. Results reveal that the AWM elec-trolyzer demonstrates robust pressure stability and operational durabil-ity, while the PEM electrolyzer achieves superior transient response and energy conversion efficiency. The findings contribute to the design and optimization of renewable hydrogen systems, emphasizing the potential of intelligent control algorithms in improving overall performance and efficiency of wind-driven electrolysis.

ID 108

Hybrid Renewable Energy Applications: Wind-Powered Hydrogen Production and Storage

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ABSTRACT

The increasing demand for sustainable energy has highlighted the need for innovative solutions that integrate inter- mittent renewable energy sources into practical and scalable ap- plications. This study presents a hybrid renewable energy system that couples wind power generation with hydrogen production via alkaline electrolysis, enhanced by AI-based control strategies. The proposed Sono-Hydro-Gen system is designed to maintain efficient hydrogen production under variable wind conditions while ensuring grid stability and energy storage optimization.

The system utilizes a fuzzy logic Maximum Power Point Tracking (MPPT) controller to dynamically adjust electrolyzer operating conditions in response to fluctuating wind input. MATLAB/Simulink simulations demonstrate that the proposed approach achieves a 15–20% improvement in hydrogen yield compared to conventional control strategies. Additionally, the integration of hydrogen storage enables the effective utilization of excess energy, supporting continuous operation and enhancing system flexibility.

This research highlights the feasibility of combining advanced control techniques with renewable energy technologies for sus-tainable hydrogen production. The findings provide insights into optimizing hybrid renewable energy systems for industrial applications and contribute to the broader goal of transitioning to a low-carbon energy economy.

ID 109

واقع استخدام الطاقات المتجددة في ليبيا

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الملخص

الدراسة المنهج الوصفي التحليلي , توصلت الدراسة عدة نتائج من أهما:
لا تقدم الحكومة الحوافز الضريبية والجمركية للأجهزة والمعدات الضرورية واللازمة لاستخدام الطاقات المتجددة, لا توفر شركة الكهرباء كافة المعلومات اللازمة والمهمة عن الطاقات المتجددة, لا تقدم الحكومة الدعم المالي للاستثمار في مجال الطاقات المتجددة , لا يتوفر العناصر البشرية لصيانة وتطوير الأجهزة الإكترونية والبرمجيات الضرورية لعملية استخدام الطاقات المتجددة , توصي الدراسة بالآتي: يجب أن تقدم الحكومة الحوافز الضريبية والجمركية للأجهزة والمعدات الضرورية واللازمة لاستخدام الطاقات المتجددة, يجب على الحكومة تقديم الدعم المالي للاستثمار في مجال الطاقات المتجددة, ضرورة تدريب الباحثين عن عمل على استخدام الأجهزة والمعدات الخاصة بالطاقات المتجددة.

ID 111

Analysis of stress and deformation of a solar PV stand structure under different parameters

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ABSTRACT

As the global energy landscape shifts towards renewable energy sources, photovoltaic (PV) systems are being increasingly deployed. However, their structural stability, particularly under wind loading, remains a key challenge that affects both safety and long-term performance. This study investigates the aerodynamic and structural response of PV panel support systems under various environmental conditions.

Using ANSYS Workbench, several simulation cases were performed, exploring a range of tilt angles (5° to 45°), wind directions (45° to 180°), mounting heights (0.5 m to 3.35 m), and panel sizes. The most critical scenario was identified at a 45° tilt with a 45° wind direction, resulting in the highest levels of stress and deformation. Although such a configuration can maximize solar exposure, it introduces a significant mechanical integrity concern.

In this paper, and to optimize the PV performance in local Libyan climatic conditions, considering a wind direction of 45°, a design featuring a tilt angle of 30°, a mounting height of 2.5 meters, and a medium panel size (2×3 m) was recommended. This configuration achieves a balance between structural integrity and aerodynamic performance. It crucially improves overall system efficiency by minimizing vibrations and deformations, factors that reduce electrical output over time. The study concludes with practical recommendations for the deployment of robust and efficient PV systems in wind-prone areas.

ID 112

Advanced Spatio-Temporal Statistical Modeling of Rainfall in the Arzat Valley Basin, Nalut.

An Integrated GIS-Based and Multivariate Analytical Approach

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ABSTRACT

This study develops a systematic and integrated approach using both Geographic Information Systems (GIS) and Remote Sensing (RS) as well as different types of multivariate statistics to examine and model rainfall over time and space in the Arzat Valley Basin area of Nalut. The structure of the analysis includes the following: Mann-Kendall trend testing to identify long-term monotonic trends; Sen's slope estimator to measure average rate per year; linear regression for assessing overall slope and a determination of the statistical significance of that slope; one-way Analysis of Variance (ANOVA) for measuring seasonal variation in rainfall by month; and Principal Component Analysis (PCA). The study uses monthly rainfall records from 1970 to 2010 that were digitally extracted from original tables sources and then standardized into normalized matrices to make sure the data is accurate and reliable. The results show that there is a statistically significant downward trend in the spring season (Mann–Kendall $p \approx 0.049$; Sen's slope ≈ -1.06 mm/year). On the other hand, the overall annual slope shows a non-significant downward trend (slope ≈ -1.79 mm/year; $p \approx 0.139$), which suggests that winter precipitation is redistributed to a greater extent during the spring season. . This study solidifies a basis for high-resolution spatio-temporal decision maps that can be implemented in future water resource planning and sustainable natural resource management in semi-arid regions.

ID 113

AI-Driven Cybersecurity Framework for Energy Research Infrastructure and Geoscience Data Systems

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ABSTRACT

This study aims to design, evaluate, and validate an AI driven cybersecurity framework tailored specifically for energy research infrastructures and geoscience data systems that operate mission critical scientific workloads. Artificial Intelligence (AI) has become essential to strengthening cybersecurity in national energy research environments that host sensitive geoscience workloads. This paper introduces an AI driven cybersecurity framework that correlates machine learning–based anomaly detection with identity, endpoint, and network telemetry to surface early stage attack signals. The evaluation combines operational metrics from production geoscience servers with internal detection benchmarks derived from Microsoft security platforms in the institutional environment. Production telemetry reports 12 restart cycles per year, zero unplanned technical outages, no security incident downtime, and 168 annual downtime hours—equating to 98.08% availability. Across controlled detection exercises, the AI layer reduced Mean Time to Detect (MTTD) by approximately 30% relative to the historical triage baseline while improving endpoint compliance visibility. These results highlight the value of integrating AI analytics with existing controls to harden geoscience data systems and mission critical research services in national energy institutions.

ID 114

Extraction and Analysis of Morphometric Characteristics Using Digital Elevation Model (DEM) and Geographic Information Systems (GIS): A Case Study of Arzat Valley Basin, Nalut, Libya

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ABSTRACT

Located within the Nalut region of northwestern Libya, Arzat Valley (Wadi Al-Arzat) represents one of the most important semi-arid draining systems on this side of the country. This project conducted an initial systematic extraction of morphometric characteristics from the Arzat Valley Basin, making use of the 2008 ALOS PALSAR Digital Elevation Model (DEM) with a spatial resolution of 12.5 meters that have been processed in ArcGIS 10.8. Data obtained indicates that total area of the basin is about 709 square km, thus a small basin classification. Basin shape is relatively long (elongation ratio of 0.69), elliptical (circularity ratio of 0.32), flat (form factor of 0.38), and slightly compact (compactness coefficient equal 1.77). Relief analysis has produced a relatively high basin relief ratio indicating that active geomorphological processes are occurring in the basin; the relief ratio was measured at 6.65m/km. The drainage network in the basin consists of 1,102 tributaries that can be found in 6 Strahler stream orders. The drainage density of the tributaries was determined to be 1.51km/km^2 with a stream frequency of 1.55 streams/km^2. Based on the hypsometric integral value of the basin (43.93%), the basin is classified as being in the mature stage of its geomorphological cycle. Three drainage patterns were identified in the Arzat Valley Basin; these drainage patterns are called dendritic, trellises, and deranged. The creation of digital geodatabase and morphometric maps that will serve as baselines for future water resource planning and rainwater harvesting infrastructure in this area that is highly limited in water resources.

ID 114

Corrosion Failure Analysis of Lean Amine Cooler Tube: Mechanism and Root Cause

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ABSTRACT

Lean amine cooler is a critical component in gas sweetening units, operating under corrosive environments due to the presence of amine solutions, CO2, and trace amounts of oxygen. This study investigates a failed lean amine cooler tube to determine the root cause of premature failure and to assess the corrosion mechanism involved. The tube experienced a corrosion-induced failure after seven years of continuous service. Detailed metallurgical and corrosion analysis were performed to identify contributing factors. Metallographic examination of the fractured surface at the bond line revealed localized pitting corrosion initiated on the inner surface, promoted by acidic conditions and the presence of chloride ions. Both internal and external tube surfaces showed minor surface defects in the bond line region, caused by the extrusion process, uneven metal flow over the dies, and incomplete welding. The findings emphasize the importance of integrated corrosion monitoring and preventive maintenance in amine systems to ensure long term integrity and extend the service life of similar equipment.

ID 116

AI-Enabled Cybersecurity for Sustainable Operations in the Oil and Gas Sector: Supporting Energy Efficiency and Climate Risk Reduction

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ABSTRACT

Rapid digital transformation is taking place in the oil and gas industry to improve operational dependability, safety, and efficiency. Increased accessibility, however, puts vital infrastructure at danger from cyberattacks that might cause operational delays, energy losses, and risk to the environment. By using automated response systems, predictive analytics, and intelligent threat detection, artificial intelligence (AI) improves cybersecurity. AI-enabled cybersecurity enhances energy efficiency and assists sustainable development objectives and climate risk mitigation by increasing operational stability and decreasing downtime [1], [2].

In order to improve resilience and environmental performance, this study offers an analytical framework for applying AI-driven cybersecurity into oil and gas systems.

ID 117

Radiative emissions resulting from the generation of electricity from non-renewable and renewable sources

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ABSTRACT

Among the United Nations Millennium Development Goals and Sustainable Development Goals, ensuring the improvement of human health and well-being throughout the world is the continuous, reliable and affordable supply of electricity. In contrast, climatic, environmental, political, economic and resource-related challenges impose a constant and continuous search for improving and developing sources and technologies for generating electricity around the world. This increases the environmental concern parallel to this rapid development, which makes international organizations, governments and researchers take into account, among other things, the various effects that these technologies may have on the public and the environment. Exposure to ionizing radiation is only one of the many effects that such assessments may take into account.

Pollution in general and greenhouse gas emissions in particular are inevitable facilities for the production of electrical energy and this is one of the facts that has become axioms that everyone knows, but what most interested people do not realize is that the production of electricity is likely to increase the radiation dose for individuals or human communities worldwide, not only because of the production of electricity by nuclear energy but also other sources such as coal, which contributes more than half of this dose, gas, oil, and even geothermal energy and renewable energies as well, albeit indirectly.

ID 118

An environmentally friendly oil waste incinerator featuring an integrated water filtration system, designed for high combustion efficiency

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ABSTRACT

This invention presents an environmentally friendly oil waste incinerator featuring an integrated water filtration system, designed for high combustion efficiency while rigorously protecting the environment.

The patent is registered with the Intellectual Property Office under number (2024/5923), Industrial Research Center / Tajoura, marking a pioneering step toward responsible and sustainable management of petroleum waste. The burner is engineered to handle all categories of oil waste, including used fuels, oils, oily sludges, emulsions, and fats, with the added capability of recycling waste in several forms to suit industrial and mid-scale applications. The innovative system promotes resource sustainability through closed-loop water processing, where impurities are removed and processed water is recycled, reducing natural resource consumption and addressing air and aquatic pollution.

Methodologically, the invention uses controlled combustion paired with effective filtration and cooling to minimize gaseous emissions and solid pollutants to levels compliant with international standards, while maintaining high process efficiency and affordable operating costs. This burner enables diverse applications and scalable deployment according to waste type and organizational needs, reinforcing environmental safety and reducing petroleum waste.

The concept embodies a commitment to responsible innovation, improving the energy supply chain, and delivering sustainable value from waste through waste-to-resource pathways.

ID 119

A Review of Gas Turbine Emissions: From Environmental Challenge to Diagnostic Tool

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ABSTRACT

This review examines the intersection of gas turbine condition-based maintenance and climate change, emphasizing the critical role of emissions monitoring in enhancing operational efficiency and environmental sustainability. Gas turbines are pivotal in energy generation, yet their emissions - comprising nitrogen oxides, carbon monoxide, unburned hydrocarbons, and particulate matter - pose significant environmental challenges. Recent research underscores the potential of emissions data to provide insights into combustion stability and operational health, enabling timely interventions to improve turbine performance.

The review highlights advancements in emission detection, mitigation strategies, and predictive maintenance methodologies, particularly through the integration of artificial intelligence and data analytics.

It notes a significant increase in research publications, reflecting a global commitment to addressing the dual challenges of improving gas turbine efficiency and reducing environmental impact. Furthermore, the review identifies critical gaps in the current understanding of emissions from hot gas path sections and advocates for the development of real-time emission analysis techniques. By leveraging advanced technologies and fostering interdisciplinary collaboration, the gas turbine industry can enhance its contributions to climate change mitigation while ensuring reliable energy generation. This work serves as a roadmap for future research and development efforts aimed at optimizing gas turbine operations and promoting sustainable practices in the energy sector.

ID 120

Enhancing Pipeline Sustainability: The Role of Drag Reducing Agents in Mitigating Climate Change Impacts in Crude Oil Transportation

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ABSTRACT

In the evolving landscape of the global energy sector, optimizing midstream infrastructure is crucial for achieving sustainable development goals and addressing climate change. Building on a recognized research gap, this paper explores the strategic application of Drag Reducing Agents (DRA) as an innovative solution for enhancing the sustainability of crude oil transport, with a particular focus on their environmental benefits. While DRAs are traditionally recognized for increasing pipeline throughput, this study emphasizes their significant role in reducing the carbon footprint of oil and gas logistics. By introducing long-chain polymers into turbulent flow regimes, the frictional resistance between the fluid and the pipe wall is substantially minimized. This reduction in drag leads to a significant decrease in pressure drop across long-distance pipelines, directly lowering the energy demand of pumping stations. The paper provides a technical analysis of how DRA implementation enables operators to maintain required flow rates at lower discharge pressures, resulting in quantifiable energy savings and a reduction in greenhouse gas (GHG) emissions associated with heavy-duty machinery. Furthermore, the study discusses the operational flexibility offered by DRA, including the potential to bypass intermediate pumping stations and reduce mechanical wear on infrastructure. The reviewed literature demonstrates that DRA technology is not merely a production booster but a vital tool for the decarbonization of fossil fuel distribution, aligning petroleum operations with modern environmental standards and economic efficiency. This research contributes to the ongoing dialogue on sustainable practices in the oil and gas sector, emphasizing the importance of innovative solutions in transitioning towards a low-carbon economy.

ID 121

Operational Noise Assessment in an Oil Refinery: Field Measurements and Compliance Benchmarking Against OSHA, NIOSH, and EU 2003/10/EC

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ABSTRACT

This study reports field noise measurements across critical areas of an operating oil refinery—including fired heaters, compressors, boilers, the turbine house, pressure let down station, and control rooms—and benchmarks the results against three international frameworks: OSHA 29 CFR 1910.95, the NIOSH Recommended Exposure Limit (REL) and EU Directive 2003/10/EC. Peak A weighted levels ranged from 68 to 105 dB(A), with the turbine house, pressure let down station, and one boiler burner showing the highest readings. Under OSHA's 5 dB exchange rate, several locations would exceed the 8 h permissible exposure limit (PEL) without engineering/administrative controls; under NIOSH's 3 dB exchange rate and REL of 85 dB(A), allowable times are markedly shorter; and under EU rules, many points require proof that at ear exposure does not exceed 87 dB(A) after real world hearing protector attenuation. A combined control strategy—source/path noise treatments, exposure time management, and fit tested hearing protection—can reduce at ear exposure to 85–87 dB(A) and achieve sustained compliance.

ID 122

Production and Characterization of Biodiesel from Used Cooking Oil

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ABSTRACT

The increasing environmental pollution associated with fossil fuel consumption has intensified the need to develop sustainable and economically viable alternative fuels. Biodiesel has emerged as a promising renewable substitute for conventional diesel due to its biodegradability, low toxicity, and reduced emissions. In this study, biodiesel was produced from used cooking oil collected from local restaurants. The production process involved a two-step approach consisting of acid-catalyzed esterification to reduce the free fatty acid (FFA) content, followed by base-catalyzed transesterification. Methanol and potassium hydroxide (KOH) were used as the alcohol and catalyst, respectively. Used cooking oil typically contains more than 2% free fatty acids, which can negatively affect the transesterification reaction. Therefore, a pretreatment esterification step was applied to reduce the FFA level before biodiesel production. Optimal conversion was achieved using a 9:1 alcohol-to-oil molar ratio at a reaction temperature of 60 °C for 60 minutes in the presence of 1 wt.% KOH catalyst. The produced biodiesel was characterized according to American Society for Testing and Materials (ASTM) standards. Key fuel properties were evaluated, including density, kinematic viscosity, acid value, flash point, cloud point, pour point, cetane number, and water and sediment content. The kinematic viscosity of the produced biodiesel was 4.54 mm^2/s at 40 °C, while water and sediment content were negligible (0%). The cloud point and pour point were recorded at +5 °C and 0 °C, respectively. The measured fuel properties were found to be within the acceptable limits of ASTM biodiesel standards. The results demonstrate that used cooking oil is a viable and sustainable feedstock for biodiesel production. Furthermore, blending the produced biodiesel with fossil diesel can enhance fuel properties while reducing environmental pollution associated with conventional diesel fuel. **KEYWORDS:** Biodiesel production, Waste cooking oil, Transesterification, Renewable energy, Sustainable fuels, ASTM fuel properties, Alternative diesel fuel.

ID 123

Hybrid Nuclear–Renewable Energy Systems for Future Power Generation: Applications in the Libyan Oil and Gas Sector

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ABSTRACT

The global oil and gas industry is under increasing pressure to reduce carbon emissions while maintaining reliable and cost-effective energy supply. Hybrid Nuclear–Renewable Energy Systems (HNRES) provide a practical solution by integrating nuclear power with renewable energy sources to deliver continuous, low-carbon energy. This paper evaluates the feasibility of implementing such systems within the Libyan oil sector, focusing on environmental benefits, operational efficiency, and economic performance. It highlights real-world applications, including hydrogen production, enhanced oil recovery, and remote field electrification.

The findings indicate that HNRES can significantly reduce emissions and operational costs over time, positioning them as a strategic solution for Libya's energy future.

ID 124

Barium Sulfate Scale Formation, Inhibition and NORM Accumulation in Oilfield Water Injection Process

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ABSTRACT

This paper investigates the compatibility of formation brine with injection water (GP8, WSW2) and chemical selection to assess mineral scaling risks. Laboratory analysis and computer simulations were conducted at surface (55 °C) and reservoir (120 °C) conditions. Results identify dominant barium sulfate (BaSO4) and associated with calcium sulfate (CaSO4) scales species. Due to the chemical similarity between barium and radium (Ra226/228), these sulfate scales act as the principal host matrix for Naturally Occurring Radioactive Material (NORM), co-precipitating radioactive isotopes into the crystalline lattice.

Scale precipitation is strongly influenced by mixing ratios, with GP8 exhibiting the highest scaling tendency at a 50/50 vol% ratio under surface conditions. Kinetic analysis confirms the rapid precipitation behavior of $BaSO_4$, while X-ray diffraction (XRD) and microscopic imaging reveal complex crystalline morphologies.

A comparative evaluation of two commercial inhibitors EC57A (polymer-based, polyvinyl sulfonate) and CH10N (phosphonate-based) demonstrates that polymeric inhibitors provide superior performance. EC57A achieved up to 93% inhibition efficiency at 15 ppm and maintained thermal stability at 120 °C, whereas CH10N showed lower efficiency under similar conditions. Dynamic loop testing established 15 ppm as the minimum inhibitor concentration (MIC) and identified 25 ppm as the optimum dosage to prevent flow restriction.

The results indicate that polyvinyl sulfonate (PVS) based inhibitors offer effective control of both BaSO4 and CaSO4 complex scale formation, thereby supporting improved flow assurance and mitigation of NORM-related risks.

ID 125

Monetization of Remotely Located Gas by GTL Technology and the Initiation of the Journey Towards Transforming Libya into a Zero-Flaring Nation

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ABSTRACT

Libya is the 7th top global gas flaring country, which contributes 6801.34 million m3 per year of flaring gas while it is 40th in gas production. During oil production, associated gas is produced from the reservoir together with the oil. The majority of the associated gas produced in remotely located Libyan oilfields is flared. Gas flaring is a waste of valuable natural resources that should be utilized or converted rather than flared. Flaring of gas contributes to climate change and impacts the environment through emission of CO2, black carbon and other pollutants. It is a major source of greenhouse gases (GHG) contributing to global warming. Flaring of gas is a serious environmental problem. In addition to harming the environment, there can be serious health implications of flaring. To tackle climate change and its negative impacts, world leaders at the UN Climate Change Conference (COP21) in Paris reached an agreement on 12 December, 2015. This agreement is given a name Paris Climate Agreement. Libya is a signatory to this Paris Climate Accords, which it ratified in August 2021. Libya also signed the Global Methane Pledge during the COP26 in the United Kingdom.

The initiative of "Zero Routine Flaring by 2030" introduced by the World Bank. It brings together governments, oil companies, and development institutions who recognize flaring described above as unsustainable from a resource management and environmental perspectives. Parties involved agreed to cooperate to eliminate routine flaring no later than 2030. Routine flaring of gas is flaring during normal oil production operations in the absence of sufficient facilities or amenable geology to re-inject the produced gas, utilize it on-site, or dispatch it to a market. Venting is not an acceptable substitute for flaring. The main reason of flaring associated gas of some remotely located oilfields in Libya is the fact that there are no significant market for its utilization near oilfields and there is no pipeline exists to transport the gas to the significant market or to export terminal.

This paper presents techno- economic study of conversion of natural gas at remotely located oilfields into value-added liquid products using Gas-to-Liquid (GTL) technology. GTL technology is a downstream value-added industry of natural gas.
It is an important technology to convert natural gas into liquid products. It provides good and promising means to meet the energy needs with cleaner fuels.
The produced diesel is free of sulfur, aromatics and polycyclic aromatics and having high cetane number. The combustion of GTL diesel results in virtually no emissions of SO2, NOx and unburned hydrocarbons.
Another product, naphtha, is considered to be an ideal feed stock for ethylene production.
Absence of aromatics in naphtha gives rise to higher ethylene yield as compared to ethylene from conventional naphtha.
The installation of GTL plant in Libya will allow to utilize stranded natural gas which is being flared at present.

ID 126

A Practical Design of a Local Cell for Green Hydrogen Production A Step Toward Clean Energy and Environmental Sustainability

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ABSTRACT

The worldwide demand for the use of sustainable energy has increased as societies strive to meet growing energy needs while addressing climate change challenges. Green hydrogen, is created by water renewable energy-powered electrolysis, is a carbon-free energy carrier with great potential to decarbonize industrial sectors. This study presents the design, construction, and testing of a locally manufactured solar-powered alkaline electrolysis cell using low-cost and readily available materials such as acrylic casings and 316L stainless steel electrodes, aiming to provide a cost-effective alternative to commercial electrolyzers.

Experimental evaluation under different operating conditions demonstrated a Faraday efficiency of approximately 85%, confirming the effectiveness of the electrochemical reactions. Energy efficiency was found to vary with applied voltage, decreasing from 4.8% at 2 V to 0.8% at 12 V, highlighting the influence of overpotential losses. The hydrogen production rate ranged from 0.5 L/min at 8.24 A to 3.0 L/min at 49.44 A, exhibiting a linear correlation with current density.

The membraneless design of the electrolyzer contributed to a lower overall system efficiency by reducing the effectiveness of gas separation, which increased the possibility of partial recombination of hydrogen and oxygen, decreasing the net useful energy output. Furthermore, fluctuations in the solar input introduced instability in the DC power supply, leading to transient mismatches between the PV system and the electrolyzer's operating point, which further reduced the sun-to-hydrogen conversion efficiency. These results underscore the potential of locally developed systems to deliver affordable and decentralized hydrogen energy solutions. All things considered, this work contributes to global decarbonization efforts by offering a viable route for sustainable hydrogen production utilising local resources.

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