ENERGY AND ENVIRONMENT
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Proceeding of Annual International Congress on

Renewable Energy

September 3-5, 2024 Oxford, United Kingdom

- International Conference on Energy Storage
- International Conference on Energy and Climate Change
- International Conference on Solar Energy Advancements
- International Conference on Environmental Development
- International Conference on Marine, Wave and Tide Energy
- International Conference on Biomass Opportunities and Challenges
- International Conference on Wind Energy and Environmental Sustainability
- International Conference on Geothermal Energy Revolution: From Theory to Practice
- International Conference on Advancements in Hydropower Technology and Innovation

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Leveraging Digital Solutions for New Energy Systems Modelling and Optimisation

Angela Solano[a], Arash Behrang[a,*], Juan Montelongo[a], Raul Cota[a], Victor Manuel Rodriguez De Vecchis[a], Valentina Gonzalez Perez[a]

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Abstract

This paper presents an integrated "pore-to-process" workflow designed for modelling and optimising new energy systems, including geothermal energy and carbon capture and sequestration (CCS). The digital framework seamlessly integrates reservoir, pipeline, and facility simulations, ensuring consistent thermodynamic calculations and automating data transfer. This approach enhances operational efficiency, minimises errors and enables real-time optimisation, offering a significant improvement over traditional segmented methods. The workflow's applications in geothermal and CCS systems demonstrate its potential to enhance system performance and inform decision-making processes.

Keywords: Digital Solutions, New Energy, Optimisation, Integrated Workflow

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Exploring the Effect of Climate Change via Parity-based Pulsed Times of Cosinusoidal Waves in Sustainably Controlled Marine Biosystems

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Abstract

In this paper, we consider trophic-halieutic systems which describe interactions between communities of grazers and predators in the presence of a compartment dedicated to the evolution of marine vegetation. The first system version is in the form of control differential equations. As we could not deny that most observations in this context may be collected at discrete times, we also add the study of those dynamics using the second system version and which takes the form of control difference equations despite the difficulty often met in their analysis, letting the literature focus on the continuous-time framework. Since it does not also seem that obvious to introduce the disruptions that may be caused by the climate change in such well-known and practical types of models, this work introduces the effect of such phenomena through bang-bang climate waves that we believe could be described using a periodic function like the cosine of πt with t the time variable and that takes the values of either 1 when the pulsed t of climate induced stability is an even number promoting the increase of the vegetation or -1 when the pulsed t of climate change is an odd number leading to the extinction of that biomass. In addition, as overfishing could also represent a direct cause to the disappearance of some fishes, our study investigates the behaviors of the marine species densities under harvesting efforts whose best values are sought through optimal control policies designed to conserve the populations of both forage and big fishes for the benefit of a sustainable environment.

Keywords: Climate change; Aquatic plants; Grazer–predator population; Fish harvesting; Environmental sustainability; Optimal control

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AI-enhanced profit optimization in multi-hydro plant prosumer systems

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Abstract

The disparity between the energy production and user consumption patterns augments the provision and distribution costs. The root of the problem is the lack of energy depots. Instead of artificial depots, one may employ natural river flows and reservoirs as a cost-effective alternative. However, the hydrological installations need to be properly controlled to maximize profits and avoid floods and droughts. Finding an earning-optimal sequence of dam control actions requires finely-tuned optimization methods. In this paper, a few popular artificial intelligence (AI) algorithms are evaluated for accuracy and efficiency while assisting the analytical solution when it operates outside the nominal conditions. In the considered class of problems – optimization of networked time-delay systems – the traditional AI methods, e.g., simulated annealing, happen to surpass newer ones, e.g., particle swarm optimization, otherwise praised for superior performance.

Keywords: Hydro-power plants; Networked systems; Green energy

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PVDF/Bi $_{1.05}Fe_{0.92}Nb_{0.08}O_3$ based Bi-functional Catalysts for Fuel Cell applications

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Abstract

The development of efficient and sustainable energy solutions has driven interest in advanced materials for unitized regenerative fuel cells (URFCs). This study explores the PVDF/ $xBi_{1.05}Fe_{0.92}Nb_{0.08}O_3$ (PVDF/BFNO) polymer-ceramic composite as a bifunctional catalyst for URFCs. Polyvinylidene fluoride (PVDF) provides mechanical strength and chemical resistance, while $Bi_{1.05}Fe_{0.92}Nb_{0.08}O_3$ (BFNO), a modified bismuth ferrite with a perovskite structure, offers catalytic activity for both the oxygen reduction reaction (ORR) and the oxygen evolution reaction (OER). Cyclic voltammetry (CV) revealed multiple redox peaks, with the OER current surpassing the HER current, indicating superior catalytic activity for OER. The composition with x = 0.075 exhibited the highest maximum current and a linear increase in current with scan rate, suggesting an adsorption-governed phenomenon. These results underscore the composite's potential as an effective and durable bifunctional catalyst for URFCs, particularly with x = 0.075, demonstrating its promise in enhancing URFC performance and contributing to sustainable energy technologies.

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Reservoir Heterogeneity and its Implications to CO_2 Storage: A Case Study of the Bima Formation, Northern Benue Trough, Nigeria

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Abstract

Subsurface CO_2 storage is regarded as one of the reliable technologies presently considered to achieve the net zero emissions target. Here, we present for the first time the Bima Formation as a potential reservoir rock for subsurface CO_2 storage. Though, at present, the formation is still generally understudied, however, this study presents preliminary investigation on its reservoir heterogeneity in relation to CO_2 storage using detailed outcrop facies analysis integrated with petrophysical, structural and diagenetic analyses covering parts of Gongola and Yola sub-basins. Outcrop sections studied identified depositional facies (e.g. debris flow, gravelly/sandy channels and bars, sheet flood, floodplain, abandoned channel, lacustrine, etc.) interpreted as potential reservoir flow units that could allow efficient migration and potential storage of injected CO_2. While the mudstone/shale units of the floodplain, abandoned channel and lacustrine facies could potentially constitute permeability barriers and baffles to the stored CO_2. Structural heterogeneities at macro and micro scales evidence from meter-scale-spaced faults and deformation bands which could potentially provide path ways for efficient fluid flow (CO_2) within the reservoir. However, such structures could also potentially compartmentalize the reservoir and reduce connectivity limiting its potential for large scale CO_2 storage. Diagenetic alteration within the reservoir has resulted in the formation of quartz overgrowth. However, the formation of grain-coating Fe-rich clays like illite and chlorite inhibited the extensive quartz overgrowth, thereby preserving porosity of the formation. Dissolution of feldspars during telodiagenesis has also enhanced the secondary porosity. These diagenetic processes are possibly the reason for the good porosity observed from this work.

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Impact of scale-up and substrate concentrations on the efficiency of microbial fuel cells for wastewater treatment

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Abstract

Although wastewater treatment plants effectively degrade organic pollutants, they often fail to eliminate certain industrial pollutants, such as aromatic hydrocarbons. Microbial Fuel Cells (MFCs) inoculated with hydrocarbon-degrading bacteria is a promising alternative for the treatment of such wastewater and has been demonstrated in our lab. A scale-up study was conducted using MFC systems of varying volumes, which revealed that increasing the reactor volume was not a suitable model for scale-up. Consequently, the MFC system was designed to operate in continuous mode, treating synthetic wastewater spiked with 5 mM and 20 mM sodium benzoate (SB). The system featured multiple anodic and cathodic chambers separated by a proton exchange membrane (PEM). MFC performance was evaluated based on voltage generation, sodium benzoate degradation, and COD reduction. In continuous mode of MFC with 5 mM SB, the COD level decreased from 1275 ppm to 207 ppm, achieving 83.8 % removal efficiency over 15 days. Whereas the MFC system with 20 mM SB showed a 68.5 % removal efficiency, reducing the initial COD level from 6665 ppm to 2100 ppm in 15 days of run. Thus, this system effectively reduced the organic load even at four times the initial concentration, displaying the potential of the developed MFC to treat wastewater with high organic load.

Keywords: Scale up, Continuous Mode of MFC, Wastewater Treatment, COD Reduction, Green Electricity Generation

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Performance Analysis of Solar Water Heater for the Optimal Tilt Angle at different flow rates by using flat plate collector

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Abstract

The goal of the current work is to investigate the performance characteristics of solar flat plate collectors at various tilt angles. One of the most significant solar energy-capturing devices is the flat plate collector, which runs on either water or air. The very simple flat plate solar collector is the most widely used of the numerous solar collector ideas now under development. Its features are well-known, and when weighed against other collector varieties, it is the simplest and least costly to build, install, and operate. Furthermore, it can employ sun radiation in both diffuse and direct beam forms. Flat plate collectors can generate heat at high enough temperatures for buildings, domestic hot water, and swimming pools, both for home and commercial use. This paper evaluates the performance of flat plate solar collectors for solar water heating system were tested. The efficiencies for the collectors are tested at different flow rate (60kg/hr,90kg/hr,120kg/hr) and at different tilt angles (15^0,30^0,45^0). The method has been verified through comparison with the experimental data. On the basis of the measured efficiencies, the efficiencies for the collectors as functions of flow rate and tilt angle are obtained. The calculated efficiencies are in good agreement with the measured efficiencies

Keywords: Solar Water Heater; Optimum Angle; Optimum Flow Rate; Heat Transfer Fluid

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Effect of Multi-Diffusers Proximity on wind Energy Potential

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Abstract

This paper investigates multi-diffusers proximity on potential energy generation through CFD simulation. Due to the initial successful attempts of joining 2 to 3 diffusers at fixed distances on their energy yield; the number of diffusers and their distances apart are investigated here, without the presence of turbines. The resulting wind velocities and power coefficient Cp compared to a single diffuser's results are basis of comparison. It's found that adding more diffusers results in progressive increase in mean Cp from 2.89 in the case of a single diffuser to arrange from 5-17.5 Cp depending on number of diffusers (i.e., 2 to 6), proximity between them (i.e.,20cm-90cm) and incident velocities. The arrangement of 5 Diffusers 30cm apart and 6 Diffusers 70cm apart produced the highest increase in resulting velocities and Cp of 27.9% and 30.6% for velocity respectively. While for CP the former achieved a Cp of 16, while the later achieved a Cp of 17.5.

Keywords: Diffuser; wind energy augmentation; building integrated diffusers; wind energy optimization in buildings; Diffusers optimization; diffusers proximity

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Modeling Energy Management System of a Small Powered FCEV Considering Load Demand

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Abstract

In the future, with the decrease in fuel cell systems (FCS) costs, there will be needed to develop efficient EMSs in terms of both reducing vehicle weight and transferring power from batteries to the load more efficiently. In parallel with this situation, fuel cell EV (FCEV) vehicles have also started to become widespread. In this study, an energy management system (EMS) that takes into account the load demand for a small powerful FCEV consisting of a fuel cell and a battery is modeled. The case of an electric vehicle (EV) with a permanent magnet synchronous motor (PMSM) being fed from a powertrain consisting of a fuel cell and a battery is considered. The EMS, which ensures that the fuel cell and battery operate at the highest efficiency and that the PMSM speed and torque changes are continuously supported by the powertrain dynamically, is modeled with Matlab/Simulink. The developed EMS, PMSM, has been tested under different operating conditions and it is aimed for the EMS to have a fast response time and for the powertrain to transfer power from the fuel cell and/or battery to the load with the highest efficiency. The results obtained show that the developed EMS can operate the fuel cell most efficiently according to the operating conditions of the PMSM without reducing the battery charge rate below critical levels. It is thought that the developed BMS can be developed in a structure that can be applied in practice in the future by integrating different control methods and optimization methods.

Keywords: Fuel Cell; FCEV; Battery Management; Energy Management System; PMSM

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Bioenergetics of the Polyphosphates Accumulation

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Abstract

Bacteria as catalysts in batteries for electricity generation and storage are by-products of waste treatment. P. aeruginosa is electroactive because it produces pyocyanin, a redoxone; this bacterium also accumulates large amounts of polyphosphates, which are linear orthophosphate polymers that act as buffers for pH changes and as reservoirs for energy and cations; in addition, polyphosphates complex with polyhydroxybutyrate to form selective membranes for Ca+2 transport, making them interesting for selective transport of H+ at the battery interface or as stabilizers of Li+, which has low metal stability at the anode. Inside the bacteria, polyphosphate is synthesized by polyphosphate kinase (PPK) and degraded by exo-polyphosphate phosphatase (PPX), so we determined its properties and optimal activities in different environments. Our results indicate that PPX is a periplasmic enzyme activated by cations with r/q of 0. 27 and inhibited by the rest, with an affinity for polyphosphates ranging from Km 0.5 to 1 μ M and a Vmax of 50 to 100 nmol PO4≡ /min/g, depending on the carbon source. PPX inhibition was not significant so the large increase in polyphosphates (379%) was due to the significant increase in PPK activity (242%) in the membrane We also found that polyphosphate accumulation was dependent on the redox state of the carbon source used.

Keywords: Pseudomonas; polyphosphates; batteries; electricity; energy storage; polyphosphate fosfatase; polyphosphate kinase; ATP.

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Evaluation of the potential of biomass use in Albania

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Abstract

Biomass is a natural renewable material originated from agricultural, forestry and household residues, which can generate a low or no cost renewable energy and it has various advantages in terms of sustainable development and environmental protection. Nowadays, agriculture is one of the most important sectors in Albania generating high number of residues which can be used for energy production. In this paper we evaluated biomass use of Nickel hyperaccumulator (HA) plants. Agromining is an emerging technology aiming at recovering metals from soils using hyperaccumulator) plants. Plant cultivation and pyro- and hydrometallurgical processes have been designed for nickel (Ni) recovery. In this chain of processes, dry plants are burnt to obtain Ni-rich ashes that are subsequently treated. *Odontarrhena calchidica* can be cultivated in Albania, in 11% of the country (Bani et al., 2021) and yields > 150 kg of Ni per hectare can be achieved. Since the early 2000's, efforts have been made to recover Ni from the biomass of HAs, to obtain Ni metal, Ni-based catalysts or Ni salts. Most often, the plants are burnt to produce ashes. Ash has several advantages: ash is a true bio-ore containing 15 to 20% of Ni, which is higher than any Ni ore, without organic matter, while the energy produced from burning can be recovered. Albania has real capacities in increasing biomass use that come by different sources, but intelligent use of this resources is needed.

Keywords: Biomass, Ni recovery, hyperaccumulator plants, energy.

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Control of an autonomous photovoltaic-wind system with batteries intended for off-grid areas

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Abstract

The subject of our study is the optimization and smart control of an isolated photovoltaic-wind system. To achieve this, a smart power management control (SPMC) is used. It is based on fuzzy logic control with specific decision criteria aided in the control of the studied system. The key decision factors for a SPMC strategy are the power level provided by the PV generator and the state of charge of the batteries (SOC). The use of management allows maximum power to be produced from both photovoltaic and wind generators, protecting the batteries against overcharge, and deep discharge and satisfying the energy needs. The principle of the fuzzy logic controller is to generate the control signals, Ksupply, Kcharge and Kdischarge, from three inputs: PLoad charging power, SOC battery state-of-charge and PHyb hybrid (photovoltaicwind) system power. Through the application of the SPMC, the batteries were protected from deep discharges and overloads, ensuring uninterrupted power supply to the load. Three optimization algorithms were used to maximize output from both sources: perturbation and observation (P&O), optimal torque control (OTC) and fuzzy logic control (LFC). Simulation results demonstrate the superior performance of both the proposed power management approach and the optimization algorithm using the FLC method. These results are consistent for two different profiles, underlining the effectiveness of our approach under various operating conditions.

Keywords: Photovoltaic; wind; storage; fuzzy logic; smart management;

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Cascaded Thermal Energy Storage: Efficiency Analysis

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Abstract

The current study analyses the charging process and heat transfer characteristics of a three-stage cascaded latent heat thermal energy storage unit (LHTES) with longitudinal fins utilizing a 3D transient CFD analysis with ANSYS Fluent 19.3. The numerical approach that has been developed uses the governing equations and the enthalpy method to model the phase change phenomenon, was validated against the experimental results. Three PCMs (PCM-1, PCM-2, and PCM-3) are employed, each with a distinct melting temperature and the heat transfer fluid (HTF) was hot silicon oil. The results reveal that melting time is reduced by 21.38%, 34.98%, and 45.17% in cascaded LHTES with fins compared to single-stage, single-stage with fins, and three-stage cases respectively. However, in this novel structure, total energy storage has increased by around 0.16 to 46.57%. Furthermore, the charging efficiency has been improved by 77.95%, indicating an improvement in thermal performance.

Keywords: Energy efficiency, CFD , PCM, cascaded LHTES, HTF

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Conduit hydropower: Sustainable power generation and leakage reduction in Pescara water network

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Abstract

Water and energy are the two major elements that help in the smooth functioning of modern civilization. In water distribution networks (WDNs), energy in the form of pressure is required to supply water from the source to the consumer. Every demand node requires a minimum required pressure to satisfy demand. In many cases, the pressure head in the network is much greater than the minimum required pressure head. The difference between the available and minimum required pressure head can be defined as the excess head which can be used to generate power. Excess pressure head also causes an increase in the volume of leakage as leakage is directly proportional to pressure. Hence, application of power generation devices (PGDs) like micro-turbines or pump acting as turbines (PATs) in WDNs, which is termed as conduit hydropower, can benefit by saving both water and energy. The major problem in using conduit hydropower is the complexity involved in finding the amount and location of placement of turbines or PATs. This paper suggests a numerical methodology that uses non-parametric Rao algorithm to find the optimum location for placement of conduit hydropower or PGDs in WDNs. The optimization procedure is carried out using Python code by linking it to EPANET 2.2. Optimum pipe locations for the Pescara network are found using this technique. In addition to power generation, this technique helps in reducing the water footprint and carbon footprint by minimizing the amount of leakage and providing a renewable source of energy.

Keywords: Hydropower; leakage; optimization; Rao algorithm; water distribution network

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Thermodynamic analysis of latent heat storage unit with paraffin wax for thermal energy storage systems

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Abstract

Phase change materials are utilized to store solar energy in latent heat storage (LHS) units for thermal applications to minimize the energy demand and supply mismatch. The thermal analysis of Paraffin wax (PW) based LHS unit (PLU) at different temperatures has been done through HYTHERM 600 (HTF) in the current study. The fin and tube heat exchanger distributes uniform heat inside the PLU. Heat transfer through conduction and convection happens during the melting, whereas conduction happens during the solidification operation. The PW takes less melting time in the upper as compared to the lower region inside the PTU because of convection. The PW requires 230 and 200 minutes during charging and the same duration during discharging at 80°C and 90°C. The melting duration reduces with the rise in HTF temperature because HTF supplies more in less duration at higher temperatures. The PW stored and released 7.84 % and 11.44 % more energy and exhibited 30.13 % and 19.43 % more melting and solidification efficiency, and 13% less melting time at HTF temperature of 90°C than 80°C. Therefore, less melting time, high energy storage, and high efficiency of PW at 90°C than 80°C shows that PW performs better at higher temperatures within the PLU.

Keywords: Paraffin wax; Latent heat storage unit; Phase change materials; Heat exchanger; Thermal energy storage

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Research advances in the holistic controller for grid-following and grid-forming inverters by using real-time simulation

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Abstract

Grid-forming inverters (GFMI) and grid-following inverters (GFLI) have become indispensable components of modern power systems, as they play a crucial role in enhancing the stability and reliability of the grid operation. However, there are several research gaps related to GFMI and GFL that need to be addressed to gain a better understanding of their functioning. This paper aims to present the last developments that address the use of the holistic controller proposed in the previous publications of the group but include the capabilities that a powerful real-time simulator OPAL-RT provides for expanding the analysis and test of multiple scenarios, increasing the scope of the research for addressing challenges oriented to the use of renewable energies and energy storage systems.

Keywords: Holistic control; grid connected inverters; real time digital simulation.

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Increasing The Efficiency of Electricity Use of PLTP Motor Control Center (MCC) Using Automatic Electronic System at PT PGE

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Abstract

The government's efforts to maintain national energy stability through programs to increase supply and save energy must be supported by all levels of society, including the upstream side. This study analyzes the potential percentage of electrical energy savings on the upstream side, namely the generation sector. In this study, we will discuss the potential for saving electrical energy own use at PLTP Karaha 1 Pertamina Geothermal Energy located in Tasikmalaya district, West Java. In supporting the operation of PLTP Karaha unit 1, patrol check activities are needed which function to monitor the condition of generating equipment to ensure that the supporting equipment of the generator is in optimal condition. But in fact, when the patrol check activity has been completed, the room lights or indoor lighting are left on for 24 hours continuously due to the engineering design of the lights during the EPC (Engineering Procurement Construction) process. So, a control system is designed to operate indoor lighting automatically using Passive Infra-Red (PIR) sensors and Arduino ATMega 2560 module. Programming on Arduino is done using the Arduino IDE application. In the Arduino IDE application, it shows the library initialization program (sensor) and the initialization of the pins used on the Arduino. The program made on the Arduino IDE application is a program to control the On-Off lights, the LCD display includes the number of people entering the MCC room, the On-Lamp time and the total energy kWh. By using this method, it is hoped that it can be a solution for saving the use of electrical energy for indoor lighting.

Keywords: PLTP; Own use; Indoor Lighting; PIR sensor; Arduino ATMega 2560

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Experimental studies on the influence of wind on natural ventilation in residential structures: a challenge for thermal retrofitting

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Abstract

This study investigates the aerodynamic influence of wind on the natural ventilation of residential structures, emphasizing the challenges posed by thermal retrofitting. Through wind tunnel experiments, the pressure distribution on building surfaces was analyzed to understand the interaction between buildings and wind forces. Findings indicate that external factors, such as neighboring structures and natural obstacles, significantly impact pressure distribution and ventilation efficiency. The research underscores the importance of computer modeling and aerodynamic experiments in optimizing building designs for energy efficiency, improving indoor air quality, and reducing carbon emissions. The results highlight the need for effective passive ventilation systems in thermally retrofitted buildings to ensure sustainable urban development.

Keywords: natural ventilation; thermal retrofitting; surface pressure field; indoor air quality; CO_2 emmision.

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Li-ion Battery Energy Storage System Based Control Strategy of Grid-Interactive Solar Photo Voltaic -A Case Study

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Abstract:

Utility-scale energy storage technologies are vital for implementing a smart grid. They act as temporal energy buffers, storing energy from generating resources and delivering it to the load or grid to match supply and demand. For standalone photovoltaic (PV) microgrids, battery energy storage systems (BESS) are essential. This paper presents a case study of a grid-interactive rooftop solar PV net metering plant at Rockman Industries Limited in Ludhiana, Punjab, India. It discusses a MATLAB/Simulink BESS model using Li-ion batteries. This case study highlights the benefits of integrating a BESS with renewable energy sources to improve distribution network performance. The Takagi-Sugeno Logic Control (TSLC) technique-based BESS for power quality improvement with LC filters keeps total harmonic distortion within IEEE-519 standards. The BESS performs well in grid-linked and islanded modes, with evaluations of inverter efficiency and battery capacity and cost. The proposed BESS controller functions as a maximum power point tracking (MPPT) device, active power filter, and distribution static synchronous compensator (D-STATCOM).

KEYWORDS: Solar Photo Voltaic, Battery Energy Storage System, Power quality, Takagi-Sugeno Logic Control

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Preliminary attempt to map the Kestanbol granitoids using magnetotelluric modeling

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Abstract

The main characteristic of granitic plutons is their highly resistive structure in terms of geophysical signature. An important aspect in the study of granitic plutons is surrounding geological structures, such as low resistive mantle-derived rocks and faults, which can be easily identified around the high resistive plutons. The magnetotelluric method is an essential tool for delineating these structures due to their distinct physical characteristics. This study is a preliminary attempt to image the Kestanbol granitoids on the Biga Peninsula in northwestern Anatolia, identified as a plutonic structure using three-dimensional modeling of magnetotelluric data. The first set of analyses seems to confirm the image of the Kestanbol granitoid and its surrounding geological structures

Keywords: Magnetotelluric, Granitic Plutons, Kestanbol, Modeling

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Prediction of PV Power Generation Using ANFIS Considering Uncertainties

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Abstract

The environment and end user(s) are affected by the use of fossil fuels in power generation. This being a challenge in the power generation and distribution sectors, the majority of end users are moving to using renewable energy sources like solar power plants in generating power. However, because photovoltaic (PV) systems are intermittent, they do not warrant maximum power generation under uncertainties. Therefore, these uncertainties need to be assessed before PV systems are installed. Solar Irradiation [DNI (W/m^2)], Diffuse Horizontal Irradiance [DHI (W/m^2)], Global Horizontal irradiance [GHI (W/m^2)], Wind Speed(m/s), and shading(trees) were considered as uncertainties in this paper. The objective of this work is to predict PV power generation using ANFIS considering uncertainties. Obtaining location weather data, 150kW PV system modeling, and the modeling of a shading(tree) effect were done using System Advisor Model (SAM) software. Furthermore, ANFIS was used to train location weather data obtained and the prediction of PV power generation in MATLAB software. Different times of the year were analyzed. The results show that ANFIS due to its adaptive nature is the most appropriate and suitable technique for predicting the performance of solar PV systems under different climate conditions. Under the no shading and shading scenarios, an annual AC energy harvest in a year was around 56,020kWh, and 51,000kWh, energy yield in a year was 962kWh/kW, and 930kWh/kW with a DC capacity factor of 11% and 9.5% respectively. To enhance PV power prediction under uncertainty conditions, future works should incorporate some optimization technique(s) into the ANFIS prediction approach.

Keywords: Solar Irradiation [DNI (W/m2)], Diffuse Horizontal Irradiance [DHI (W/m2)], Global Horizontal irradiance [GHI (W/m2)], Wind Speed(m/s), Shading(trees) effect, ANFIS PV power prediction, Uncertainties.

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Solar Energy Curve Fit Forecast for EU+ Countries

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Abstract

The need for renewable energy is underscored by the shift from fossil fuels without compromising economic growth. The European Union's strategy for resilient energy recognizes solar energy as a crucial resource. In recent years, there has been a significant focus on evaluating renewable energy production, distribution, consumption, storage, and applications. One key aspect of this evaluation is exploring production capacity trends using forecasting models. Our study proposes a Curve Fit Forecast model using ArcGIS Pro 3.3. statistical tools for solar energy in 37 European locations, based on 1990-2022 data. The findings confirm an overall increasing trend and an exponential curve for 54% of locations. This research has the potential to significantly influence the design of energy policies and intervention tools at the EU or national level, thereby shaping the future of renewable energy in the European Union.

Keywords: renewable energy; solar energy; curve fit forecast; space-time cube; EU resources

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Impact of wind farms on roe deer stress, habitat utilization and density

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Abstract

Wind farms are still developing dynamically worldwide, with promising prospects for further growth. There is still great potential for developing wind farms, including onshore. Wind farms have many potential influences on mammals, such as noise, habitat change, change in predation risk, and others. Some studies showed the negative effect of wind farms on mammals, but in other studies, such an effect was not observed. Roe deer is a common mammal dwelling in open areas, and, therefore, a convenient model for studying the impact of wind farms on large mammals. The effect of wind farms on roe deer stress, habitat utilization, and density was presented. Roe deer showed significantly higher cortisol levels on larger wind farms compared to smaller wind farms and control areas. Fecal cortisol concentration increased with the wind farm size, expressed by the number of turbines or the area occupied by the farm. Roe deer showed significantly lower track density on wind farms than in control areas and significantly increased track density farther away from wind turbines. A large-scale analysis showed a decrease in hunting bags for roe deer in the areas covered by wind farms. Further research on the impact of wind farms on terrestrial animals is needed, particularly concerning wind farm area and spatial arrangement of turbines. This work was funded by the National Science Centre, Poland (Grant number: 2021/41/B/NZ9/04442).

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Imaging Geothermal Systems in Extensional Domains by Geophysics

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Abstract

Exploration of geothermal resources is significant for energy production, providing a sustainable and renewable source of power that can help reduce reliance on fossil fuels and lower greenhouse gas emissions. The geological characteristics of geothermal systems, known as geothermal plays, play an important role in assessing the prospects and potential yield of geothermal resources, which is crucial for effective exploration and development. Geophysical methods are applied on the surface with the aim of exploring geothermal systems. This study presents the application of geophysical methods, particularly geoelectrical methods, for exploring geothermal systems developed in extensional domains. Based on the case studies, the effects of structural and tectonic controls on geothermal activity are characterized, highlighting how these factors influence the distribution and potential of geothermal resources in extensional environments.

Keywords: Renewable Energy; Geothermal; Geophysical Exploration; Extensional Tectonics; Modeling; Inversion

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A Comprehensive Review of Blockchain Applications in Smart Grids

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Abstract

Combing through numerous articles, this systematic review synthesizes the trends and contributions of blockchain in smart grid stressing on the fact that blockchain could be the game-changer in the energy domain by improving the security, interconnection, and extensibility progressively. The paper provides an analysis of the application of blockchain technology to combat security threats, trust issues and the inclusion of renewable energy sources in smart grids. Some of the uses include secure and transparent energy transactions, enhanced data integrity and decentralized energy management. Nevertheless, there are many issues available including scalability, transaction speed, and integration with the already establish base. Future directions in the work are aimed at improving consistent algorithms; quantum secure cryptography; interaction with IoT and artificial intelligence to enhance the capabilities and stability of smart grid applications.

Keywords: Blockchain, IoT, RES, Smart Grid.

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Effect of wind on the efficiency of water cooling of a photovoltaic panel

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Abstract

The electrical efficiency of a photovoltaic panel decreases with increasing temperature. To overcome this negative effect, we cool the PV panel. In the present work, we propose to simulate a PV panel cooled by a water flowing on its front face. To study the effect of climatic conditions on the performance of this water-cooling system, we exposed a commercial PV panel (1640mm×992mm) to hot and temperate climates prevailing, respectively, in Ghardaïa (South of Algeria) and Nice (South of France). The situation of no wind was also considered. Thus, on the front face of a cooled PV panel, the temperature and the mass flow rate of water were, respectively, 25°C and 20g/s. At first, we determined by simulations the equilibrium temperature of uncooled and water-cooled PV panel. Then, the efficiency improvement of the cooled PV panel was evaluated against the uncooled one. The results showed that in the absence of wind, the improvement in efficiency of the water-cooled PV panel reached 26.71% in Ghardaïa and only 16.11% in Nice. But the real climatic conditions characterized by high and low wind speeds modify this observation. Indeed, the efficiencies improvements reached 9.94% under the temperate climate with low wind of Nice and 10.99% in the hot climate with high wind of Ghardaïa.

Keywords: Efficiency; PV panel cooling; water runoff.

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Bio/Clean Energy from Marine ecosystems to mitigate Climate change and meet the Agenda of Global SDGs

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Abstract

Marine energy has vast potentials to be harnessed as renewable energy. However, there are long-standing issues related to a lack of data on impacts on natural habitats, and risks of collision, noise, and electromagnetic fields. Bio/Clean energy derived from marine ecosystems is a viable alternative. It can be governed by existing legislation on marine spatial planning, Environmental Impact Assessment, and on medicine, food, feed, and algal products. In this review, dual strategies of mitigating climate disaster and meeting the agenda of Global SDGs are elaborated. The prospects to develop macro- and microalgae for biofuels production, co-generation of high-value chemicals, and waste remediation and valorization are discussed. The socio-economic development of coastal communities and rural areas in general as an integral part of a biorefinery framework is emphasized.

Keywords: Sustainability; Circular economy; Integrated biorefinery; Bioenergy; Biomaterials; Waste valorization

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A Three-way Multilevel Mixed Model for Sunshine hours in Canada: Based on 30 – 40 years of UN Data

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Abstract

Different weather parameters are important in different parts of the globe. In Asia the rainfall is of high significance as most countries in Asia are Agricultural in nature. In Europe which is mainly industrialized the temperature is of great importance. In Canada, one of the coldest countries in the world with a dark and dreary winter the sunshine hours, is of major concern. The objective of this study is to examine the sunshine hours averaged over a period of 30 – 40 years for different stations of different districts in Canada. The sunshine hours are measured in terms of number of the mean number of hours per month averaged over the years. The United Nations (UN) has a large database of various weather parameters for several countries belonging to the UN. The data is first analysed in a descriptive manner and then modelled using a three-way Poisson multilevel Generalized Linear Mixed Nested Model (MGLMNM). The statistical package SAS version 9.4 has been used to do all the analysis. The three levels of the model are sunshine hours (level 1), weather stations (level 2) and districts (level 3). The explanatory variables are month and Element-Statistic Qualifier Code (ESQC). The important conclusions are that both explanatory variables are highly significant with particularly the other months of the year having significantly more sunshine hours than the winter months of November, December and January. The smaller ESQC's are significant with respect to the larger ESQC's. The random effect, weather station is highly significant. The generalized-Pearson chi-square statistic shows that while the Poisson model has over dispersion the Negative-Binomial model fits well.

Keywords: Sunshine Hours, Canada, Multilevel Generalized Linear Mixed Nested Model (MGLMNM), Poisson, Element-Statistic Qualifier Code (ESQC)

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Optimizing Double-Row Four-Point Contact Ball Bearings for Tidal Energy Rotor Systems Using Artificial Intelligence

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Abstract

The effective conversion of kinetic energy from tidal flows into electrical energy depends significantly on the rotor bearings in tidal energy systems. These bearings must endure challenging marine conditions, such as high salinity, fluctuating loads, and biofouling. Enhancing both the static and dynamic capacities of rotor bearings is essential for boosting their durability, efficiency, and reliability, which leads to more consistent and cost-effective energy production. This research aims to improve these capacities in double-row four-point contact bearings for tidal energy systems using advanced artificial intelligence techniques. A novel method has been applied to optimize crossover and mutation process probabilities in genetic algorithms, resulting in a 5.016% increase in static capacity and a 3.096% increase in dynamic capacity compared to traditional algorithms with fixed probabilities. This improvement highlights the effectiveness of the proposed methodology, enhancing the performance and reliability of tidal power generation systems.

Keywords: Artificial Intelligence; Dynamic Capacity; Genetic Algorithm; Rotor Bearings; Static Capacity; Tidal Energy.

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Comparative study of three thermosiphon solar water heaters made of flat plate collectors with different insulation

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Abstract

The aim of this study is to present the comparative results of experimental investigations of the thermal performance of three thermosiphon solar water heaters system (SWHS). The first uses the coconut fiber (CF), a local vegetable, the second, the glass wool (GW) and the third, the rock wool (RW) identical in design, fabrication, and operating under the same conditions. The thermal conductivity of coconut fiber (origin Ivory Coast) has been determined. The maximum instantaneous efficiencies are, respectively, 0.6285, 0.6254 and 0.5466 with glass wool, rock wool and coconut fiber while the mass flow rate values are, respectively, 0.0087 kg/s, 0.0092 kg/s and 0.0067 kg/s with glass wool, rock wool and coconut fiber. As an environment-friendly and renewable material, coconut fiber is uses as thermal insulation to save energy. The SWHS can be used in any weather conditions. The prices of those three types of SWHS in their realization shows that the system using coconut fiber is cheaper than which using glass wool and this of rock wool.

Keywords: Thermal conductivity;Coconut fiber; Glass wool; Rock wool ; Thermal performance

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Solar Integrated Post combustion Carbon Capture (PCCC) Plant on a mega size Thermal Power Plant towards Mitigation of Climate Change

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Abstract

Renewable energy technologies, such as Wind, Solar thermal, PV, Clean Coal Technologies (CCTs), such as supercritical power plants, IGCC etc. and solar mega power under mission mode, are all vital to the success of India's Green Power Mission. In the realm of Green Energy, Carbon Capture and Storage/ Sequestration (CCS) is considered to be one of the most advanced technologies, particularly for current large point sources of coal-based plants and thereby implementing carbon abatement technology such as CCS. Carbon Capture, Utilization, and Storage/Sequestration (CCUS) technologies are becoming increasingly important and essential in addressing global and local climate change issues. CCUS technologies aim to capture carbon dioxide emissions from industrial sources and energy production, utilization of the captured carbon for valuable products, and store/sequestrate the remaining carbon safely and reliably. The deployment of CCUS technologies have the potential to reduce greenhouse gas emissions significantly and can achieve the goals of the Paris Agreement. However, there are still several challenges regarding technological innovation, cost-effectiveness, and public acceptance. Governments, industries, and research institutions worldwide are actively promoting and investing in CCUS research, development, and deployment to address these challenges. The CCUS mission has been initiated by CSIR and various public sector undertakings like NTPC, BHEL, Steel' Aluminum producers and other power utilities aiming at the net zero targets to be achieved by the year 2070 by India as per the commitments of the Govt. of India in the recent COPs of UNFCCC. Scientists and power Engineers have formulated various proposals under Carbon Capture, Utilization, and storage/sequestration as this is the right time that Indian Industries and Academia should gear up to develop the technologies for CCUS which can be adopted by the Power and other Industrial sectors. The paper presents the results of a solar thermal integrated CCUS Pilot Plant as well as feasibility study of the installation of a scaled-up CCUS plant on a mega coal fired thermal power plant.

Keywords: Carbon Capture & Sequestration (CCS), Million Tons per Annum (MTPA), Post Combustion Carbon Capture (PCCC), Central Power Research Institute (CPRI), Concentrated Solar Plant (CSP), Thermal Energy Storage (TES)

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Shock transmission in the European renewable energy sector: A novel quantile R^2 decomposed connectedness approach

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Abstract

This paper provides a comprehensive analysis of the dynamics of shock transmission within the European renewable energy sector at the firm level. To this end, a novel quantile-based connectedness framework that improves the well-established quantile connectedness approach of Ando et al. (2022) in several key aspects is introduced. The empirical results reveal significant transmission of shocks among the stock returns of European renewable energy companies across various quantiles, with return spillovers generally being stronger at the extreme quantiles. Contemporaneous connectedness is more pronounced than lagged connectedness, suggesting a high level of market efficiency in the European renewable energy sector. Furthermore, the wind energy sub-sector plays a crucial role in shock transmission among individual renewable energy firms, likely due to the substantial size of major European wind energy companies, coupled with early technological advancements and competitiveness in variable generation costs of the wind energy industry. In addition, a number of macroeconomic and financial variables are identified as significant drivers of connectedness across different quantiles.

Keywords: renewable energy stocks; shock transmission; return spillovers; quantile connectedness; systemic risk

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Geothermal Potential in the NW Romania

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Abstract

In Romania, the thermal water is used for space heating and spa in areas located along the western border of the country. Most of the water-bearing structures were intercepted during the drillings for hydrocarbons. These works were not performed in the NW Romania due to the low interest for hydrocarbon exploration. Previous geological investigations showed the lack of proper conditions into subsurface for the generation of gas or oil. In the last three years, new geophysical data were recorded along regional profiles located to south of the Baia Mare town. The main goal of the measurements was to evaluate the geothermal potential of this area using vintage and new acquired geophysical data. Active-source seismic reflection measurements were performed using explosive sources along two profiles with a total length of 32 km. Magnetotelluric measurements were performed in points along the seismic lines. The new obtained depth-converted seismic sections correlated with the existent geothermal data show clear evidences for the presence of promising reservoirs with thermal water into subsurface. The resistivity models display significant variations in depth which indicate water-bearing structures inside the Neogene sedimentary formations.

Keywords: geothermal gradient, heat flow, sedimentary basin, geophysics, seismic surveys, magnetotellurics

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Management Strategy for Mangrove Forest Restoration in Realizing the 2030 Sustainable Development Goals (SDGs)

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Abstract

Mangroves are the most productive ecosystems on the planet. Mangrove forests are spread over almost all of Indonesia's coastal areas, one of the coastal areas with mangrove distribution is the coastal area of Langkat Regency. As an ecosystem that lives in coastal areas, mangroves can provide economic, social, and ecological improvements for the life of mangrove ecosystems and human life, however, mangroves continue to experience threats from various natural and human factors. To maintain the mangrove ecosystem, it is necessary to carry out sustainable utilization and management of mangroves so that mangrove life is born, considering that the benefits provided by mangroves are enormous for the life of various ecosystems and human life. One way that can be done is to do mangrove restoration. This study aims to determine the results of efforts to restore mangrove forests in coastal areas and realize the Sustainable Development Goals (SDGs) goals in Langkat District. This research was conducted in Langkat Regency from February to November 2023. The population in this study was all coastal areas in Langkat Regency. The sampling technique in this study used purposive random sampling. The research sample points were divided into 25 plots at 3 different locations: the shoreline plot of Tapak Kuda Village, the pond plot of Dogang Village, and the river channel plot of Dogang Village and Pasar Rawa Village. The results of the study are that the cause of damage to mangroves in Langkat Regency occurs due to high population growth, land conversion into ponds, and felling of trees in coastal areas.

Keywords: Langkat; Mangrove; Restoration; Sustainable Development; Goals.

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Experimental Study of Natural Flow Flat Plate Solar Water Heater in Basra City

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Abstract

Using solar energy for heating, cooking, desalination, electric generation and other human community requirements represents the best solution for two important world challenges, which are fossil fuel resources depletion and pollution. In this study, an experimental study for heating water by solar energy is performed at Basra city climate in Iraq. The city is located at Longitude: 47.78o and Latitude: 30.508o. The natural flow flat plate heater is directed towards the south with an angle of 30o with the horizontal. Tests for the solar water heater are implemented for five consecutive days from the month of July during the year 2021. For the present solar water heater, maximum temperature of the stored water was 48 0C, while the maximum measured temperature of the water leaving the collector is 85.9 0C The total pressure drop was calculated and it is found that the pressure drop in the collector constitutes approximately 25 % of the total pressure that causes the circulation. The maximum natural flow hot water rate is predicted to be 2.6 liters per hour. The maximum efficiency of the solar heater is expected to be 23 %.

Keywords: Flat plate collector, natural circulation, pressure drop, solar water heater.

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Non conventional methods used to study Earth´s thermal properties including geothermal heat flow

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Abstract

Non conventional methods have been used to obtain geothermal density data in regions without adequate holes need to make measurements or where detailed distribution values of this parameter are required. The method used in the present work uses data obtained from seismic tomography, velocity distribution of P waves and V_P/V_S ratio values, to define "warm" and "cold" regions in the crust. The distribution and intensity of radioactive heat sources near the surface is obtained using radiometric data from rocks. The heat flow at the surface of the Earth is obtained by addition of the heat generated by the sources studied with the heat flowing from deeper regions. With the method presented it is possible to obtain detailed maps of geothermal heat flow density at the Earth's surface. It is also possible to obtain the depth location of "warm" layers with fluids that can be used in several applications.

Keywords: Heat flow; heat sources;V_P/V_S ratio; thermal conductivity; non conventional methods.

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Petrography, geomechanics, geochemistry and 3D modelling: case study of a pilot CO_2 storage in a carbonate reservoir in SE Czechia

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Abstract

The planned pilot CO2 storage Zar-3 is an oil field with a gas cap in the final production stage in SE Czechia. A concise study resulted in generation of static and dynamic models of the oil and gas field with Jurassic dolomite reservoir sealed by four lithostratigraphic units that differ significantly in lithology. Jurassic marl of the Mikulov Fm. builds the first seal, shale and silt of the Nesvačilka Fm. forms the second and the thick shale of the Němčice Fm. represent the third seal overlying the system. The fourth seal formed by Carboniferous shales underlies the reservoir. Previous studies left open questions on the nature of pore space and connectivity and the quality of the seal in the future CO_2 storage complex. Geomechanical analyses provided new details on measured petrophysical properties, primarily the porosity, permeability and stiffness calibrated by numeric modeling. Geochemistry and petrology contributed by the fluid composition, mineralogy and reactivity of rocks, which were used in geochemical fluid-rock modelling supported by lab experiments.

Keywords: CO_2 storage; dolomite reservoir; marl seal; shale; dynamic 3D model

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Shock transmission in the European renewable energy sector: A novel quantile R^2 decomposed connectedness approach

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Abstract

This paper provides a comprehensive analysis of the dynamics of shock transmission within the European renewable energy sector at the firm level. To this end, a novel quantile-based connectedness framework that improves the well-established quantile connectedness approach of Ando et al. (2022) in several key aspects is introduced. The empirical results reveal significant transmission of shocks among the stock returns of European renewable energy companies across various quantiles, with return spillovers generally being stronger at the extreme quantiles. Contemporaneous connectedness is more pronounced than lagged connectedness, suggesting a high level of market efficiency in the European renewable energy sector. Furthermore, the wind energy sub-sector plays a crucial role in shock transmission among individual renewable energy firms, likely due to the substantial size of major European wind energy companies, coupled with early technological advancements and competitiveness in variable generation costs of the wind energy industry. In addition, a number of macroeconomic and financial variables are identified as significant drivers of connectedness across different quantiles.

Keywords: renewable energy stocks, shock transmission, return spillovers, quantile connectedness, systemic risk.

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Performance evaluation of an innovative 100 kWth dual bubbling fluidized bed biomass gasifier coupled with hot gas cleaning and conditioning

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Abstract

In this work, the results of the experimental tests on an innovative dual bubbling fluidized bed gasifier coupled with a hot gas cleaning and conditioning system are reported. The hot gas cleaning and conditioning system is composed of a system for particulate removal by means of ceramic filter candles and tar conversion through catalytic reforming in a secondary reactor. The activities described in this work are related to the AIRE project (Italian PON-Research and Innovation program) for the integration of steam biomass gasification and methanation. The tests were carried out on the pilot-scale gasifier with and without the hot gas cleaning and conditioning system to evaluate the efficiency of this to convert tar. The results are reported in terms of dry gas composition and yield and organic contaminants (tar). In particular the results show that the tar content dropped to about 0.37 g/Nm^3, and the H_2 concentration increased up to 47 %vol,dry.

Keywords: Biomass Gasification; Dual bubbling fluidized bed gasifier; In situ hot gas cleaning and conditioning.

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Defect Modifications to Improve Crystallinity of III-V Dilute-Nitride Solar Cell

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Abstract

This study introduces a new model for point-defect modification in III-V dilute nitride (III-V-N) alloys, supported by first-principles calculations and experiments. These findings elucidate the enhanced crystallinity of III-V-N alloys resulting from proton irradiation and rapid thermal annealing (RTA). The experiments demonstrated that the conversion efficiency of GaAsPN solar cells increased after proton irradiation followed by RTA, whereas the efficiency of GaP solar cells decreased under the same conditions. This improvement in the crystallinity of GaAsPN is attributed to a reduction in nitrogen-related point defects. First-principles calculations revealed that nitrogen-related point defects changed to lower-energy states owing to vacancy formation at neighboring group V sites, facilitating defect annihilation. Consequently, the vacancies created by proton irradiation promoted the elimination of nitrogen-related point defects and enhanced the material quality.

Keywords: Solar cell; dilute nitride; point defects

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Conducting an Experiment on Solar Panels Based on an Autonomous Photovoltaic Module

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Abstract

In this article, we have simulated the generation of a solar panel using a control power supply block in Simulink software. To generate the required power and voltage, solar panels are connected in series. We used a special algorithm, IRF-540 MOSFET and several Simulink blocks to model the off-grid system in the Simulink program. In the context of renewable energy systems such as solar or wind energy, we have created a model of an off-grid system. Off-grid is a system that operates independently of the electrical grid. In the off-grid system, the current and voltage during the charging process of the battery, as well as the charging percentage are analyzed through graphs, and it can be observed that the voltage is constant at 12V during the charging process, and the current changes indirectly.

Keywords: Solar panels, photovoltaic module, electricity, conversion.

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Economic and Energetic Analysis of Biofuel Production from Glucose via Woodworm Digestion

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Abstract

This paper presents an economic and energetic analysis of biofuel production from glucose, derived from the digestion of wood by woodworms (Hylotrupes bajulus larvae). The study estimates the energy required for wood digestion, the conversion of this energy into ATP, and the subsequent production of biofuel. Additionally, it evaluates the costs associated with setting up and operating a biofuel production facility capable of producing 1 ton of biofuel per month.

Keywords: Biofuel production; Woodworm digestion; Glucose conversion; ATP synthesis; Economic analysis; Renewable energy.

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Relationship between seismic velocity and pore pressure: A case study from Denizli Basin, Turkiye

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Abstract

The Aegean region and Denizli basin have high seismic activity and rich geothermal fields. Furthermore, a remarkable earthquake activity is also observed in the region. The pore pressure calculation for oil, gas and geothermal exploration and production in the region can be computed from the 1-D and 3-D seismic velocities determined by the analysis of seismologic data. In the frame of this study, the pore pressure of Denizli Basin was calculated using Vp velocities obtained from available literature. Obtained results were compared with geothermal wells and hot water springs in the field. We report that the information obtained from the comparison is coherent with the well data. As a result, this technique can be used to determine the pore pressure zones for the drill in geothermal areas, and can be considered as an additional information in the well location.

Keywords*:* Denizli basin, Local earthquake; 3D seismic velocity tomography; Geothermal; Pore pressure;

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Innovative modular green roof system with integrated energy collecting and converting devices

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Abstract

This study is provided research of green roof system with integrated energy collecting and converting devices, installed in modular manner on modern urbanized spaces of rooftops. In urban areas, rooftops take a large fraction of the total area. Ergonomic design of the modular covering system is provided installation in various roof configurations and types and using system as a vertical gardening by construction of multi-level modular pot system. Versatile system of the Invention mainly intended for external use, also it can be intended for internal use to divide a large space into several workplaces and create a healthy environment to promote a healthy and well-being conditions. The present green roof system provides a light-weight, little expenditures of laboriousness, inexpensive and global-environment-friendly system for green roof structures. In addition, this innovative energy-efficient modular green roof system will bring great benefit to the ecology and help to relief the heat island effect. Moreover, this modern technology system allows to create a favorable environment and will give a great impetus to the sustainable development buildings with positive energy output.

Keywords: Green roof; green building; energy collecting and converting devices; renewable energies.

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Alternate rover locomotion design to address the challenges of solar energy, irregular surface and the low gravity issues of Moon and Mars

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Abstract

Alternate locomotion recommended for planets like Moon. Upon watching particularly Chandrayaan-3 in the recent past, the India's planned lunar mission, where several challenges posed relate to renewable energy usage like accessing solar energy, storage and managing extended periods of dormancy etc. In our Labs we are experimenting new designs to explore alternate energy sources keeping SPACE research also as one of the main focused subjects. In this technical paper we are proposing some techniques which may improve the energy performance and overall functioning in achieving the objectives to explore extra planetary irregular surfaces. Though this research is initially meant for SPACE programs, its applications may extend to other fields like mountaineering and physical medicine rehabilitation for mobility challenged people where extra energy is required for keep moving forward compensating the limitations.

Keywords: LPGS · Smart grid · Renewable energy (RE) · Permanent magnets · Drive Motor · Mechanical Advantage Power Gain · System design

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Intelligent Energy Management using Multi Agent Control of Autonomous Microgrid used in Ship

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Abstract:

Continuously varying nature of solar irradiation and wind velocity causes variation in power generated by Distributed Generators (DGs) such as solar panel and wind mill. The power variation in power generation has to be controlled in order to connect load. The Energy Control Center (ECC) is built with Energy Management System (EMS) using Fuzzy Logic Controllers (FLC). In this work, Fuzzy Intelligent Energy Management System (FIEMS) implemented with Multi Agent System (MAS) is proposed to control the autonomous microgrid used in marine applications, particularly renewable energy driven ship. FIEMS consists of three Fuzzy Logic Controllers (FLC) is to achieve proper control strategy. The controlling and monitoring of solar panel and wind mill are achieved successfully. The FIEMS with MAS are implemented between DG and EMS through the Transmission Control Protocol / Internet Protocol (TCP/IP) and the various agents are utilized to achieve effective control and monitoring strategy of autonomous micro grid.

*Keywords:*Distributive Energy Resources (DER); Energy Control Centre (ECC); Fuzzy Intelligent Energy Management System (FIEMS); Multi Agent System (MAS); Automatic Generation Control (AGC); Fuzzy Logic Controller (FLC); Transmission Control Protocol / Internet Protocol (TCP/IP).

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Analysis of the Possibilities of Ship Wind Systems

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Abstract

The problem of global warming is currently one of the most important for all humanity. One of the ways to solve it is to reduce emissions of greenhouse gases CO2 and CO. The combustion of petroleum-based fuels is an important source of such emissions. Although the transport fleet accounts for less than 3% of such emissions per year, but when the fleet is transferred to other energy sources, this share will be 40% of the 7.4% annual emissions reduction required by the COP-21 decision. Thus, finding ways to replace petroleum fuels with environmentally friendly energy sources in the transport fleet is an important and urgent task.

One way to solve this problem is to switch to an environmentally friendly sailing fleet, which was the main one just 130 years ago. However, problems arose regarding the technical and economic possibilities of developing and implementing modern sailing ships. Their justification and selection of the best options is the main goal and constitutes the scientific novelty of the work performed. New results of the work include an analysis of more than 20 of the most well-known variants. Conclusions. As part of the analysis of well-known projects, a general concept has been developed to avoid unproductive waste of time and money on implementing ineffective options.

Keywords: greenhouse effect, reduction of CO2 and CO gas emissions, replacement of petroleum fuel in the fleet with sailing power systems

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Conditions for replenishment of hydrocarbon resources in the Black Sea–Caspian region

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Abstract

In our study, we found that modern geodynamic processes in the Black Sea-Caspian region actively affect the replenishment of resources and hydrocarbon reserves. Seismotectonic tension, active geodynamic processes, seismicity manifestations and activity of mud volcanoes are a feature of the tectonic development of the studied region. As a result of the impact of geodynamic processes, there is an activation of geofluid-dynamic systems of the Black Sea-Caspian region, the spatial development of which is influenced by geodynamic processes occurring in the earth's crust. The process of hydrocarbon replenishment is associated with the restoration of the energy state of hydrocarbon deposits at various stages of their development and physicochemical and fluid-dynamic factors. In the depths of the Black Sea-Caspian region, modern centers of hydrocarbon generation function - a kind of natural-technological lines for the transformation of underground matter into energy and chemical raw materials. We believe that hydrocarbon deposits are a product of the functioning of such natural-technological lines.

Keywords: Black Sea–Caspian region, tectonic activity, earthquakes, oil, gas, resources, hydrocarbon generation, hydrocarbon migration, sources of excitation, oil-and-gas source strata

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Fuzzy Logic Control for Combined Economic and Emission Power Dispatch

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Abstract

The economic and emission dispatch (EMD) problems have been investigated and considered as a research open topic and discussed in many studies and researches to find the optimum solution. In our study a new approach is made based on finding solutions by simulating the human's behavior for thinking and approaching the results by multiple steps until reaching the lowest values of economic and emission. Fuzzy logic is the base of this study and used to decreases the search domain and leads the search process to a certain zone related to power demand and generated power. A number of power demands are discussed in order to modify the system so it could be applied for any case or power demand, all these modifications and results are applied on IEEE (30) grid to prove that algorithm is applied to real values of the real grid.

Keyword: Combined Economic Emission Dispatch, Power Demand, Nitrogen oxide, fuzzy logic, price penalty factors

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Cost-free (No-cost) Energy and Resource Saving Measures — an Effective Approach to Energy Saving

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Abstract

The aims of the work are a methodology for developing approaches to the designing of cost-free (organizational) measures. On specific examples, a methodology for the development of cost-free (organizational) energy and resource-saving measures that can be obtained as a result of inducing labor and technological discipline is presented. At the same time, a form for presenting the results of personnel activity is recommended, a preference matrix has been developed that helps to identify shortcomings in the work of specific teams (shifts) in different periods (on working days, as well as on weekends and holidays), and in addition - recommendations on interpersonal relations of the enterprise staff. The possibilities of obtaining savings from changing work schedules of personnel, taking into account tariffs for energy resources, are also presented. Cost-free energy and resource-saving measures involve improving labor and technological discipline, as well as enhancement the enterprise's work schedule. The development and implementation of cost-free (organizational) measures can reduce the cost of energy and other resources by at least 3-5%.

Keywords: energy and resource saving measures, cost-free (no-cost), organizational measures, energy audit, preference m

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Spirulina subsalsa. Z15 is an alternative source of Phycocyanin from a native strain of Mexico: Prospection for functional food ingredient and bioethanol production

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Abstract

Phycocyanin (C-PC) is a bioactive compound with a bright blue color found in cyanobacteria, which has been in high demand in the global market this decade. It is available in powder or aqueous forms by grade; it varies according to its purity values and can be used in analytical, cosmetic, or food grades. So, the alternative source of phycocyanin, yield, efficient extraction, and purification are essential areas of research that satisfy market demand. The growing demand for environmentally friendly extraction processes leads to the development of sustainable technologies that can manufacture pharmaceutical products and simultaneously produce carbohydrate and protein-rich biomass for bioethanol. In this work, we reported that *Spirulina subsalsa (Z15),* a native Mexican strain, is a potential source of phycocyanin production and purification with few steps. This strain was isolated from an aquaculture tank near Lake Chapala, Jalisco, Mexico and we identified morphologically as *S.subsalsa Z15*. Cultivation under laboratory conditions showed a growth rate of 4.5±0.1 g/L biomass, with the production of higher phycocyanin 264.6 mg/g (26.46%) in the crude extract by ultrasonication. Then, we proceeded to purificate with ultracentrifugation (50kD) directly, omitting the ammonium sulfate precipitation step, which requires extra labor to rewash the salts before Ionic Chromatography, usually done to concentrate the phycocyanin. We found a higher quantity and higher recovery rate that is 24.91% after the ultracentrifugation process but a bit less purity. After the Ionic-chromatography purification process, purity was found to be 1.56±0.1, acceptable for food grade. Phycocyanin is evaluated here as a natural colorant that can be used in edible drink formulations with a dry lyophilized form that secure handling and transportation more easily to avoid contaminations. This pigment is prospected for a functional drink with several health benefits that can be consumed in a daily diet and the rest of biomass can be fermented to obtain bioethanol.

Keywords: Phycocyanin; Spirulina; Purification; ultracentrifugation.

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Samarra Thermal Energy Electrical Faults Diagnosis Based Artificial Neural Networks Model

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Abstract

Samarra power station is an operating power station of at least 1260 megawatts (MW) in Samarra, Salah al-Din, Iraq. It is also known as Salah al-Din. This paper introduces a fault location method for transmission lines, utilizing an artificial neural network (ANN) technique to analyze voltage and current data from both terminals. The method specifically targets line-to-line, double line-to-ground, and single line-to-ground faults that cause system downtime. The study focuses on the applying ANN as an intelligent tool depending on binary NN (BNN) for diagnosing faults in electrical power facilities. The selection of ANN is based on its good performance in pattern recognition, classification, matching, prediction, decision-making, and control. Different modeling validation algorithms for the proposed system are used, such as ARX, transfer function, and state space model. The results are 70.39%, 98.18%, and 99.84% according to the identification tool box of the Matlab 2020 respectively. Also, the results of the ANN algorithm, such as fault location, status, and time, are compared to the real corresponding terms in the electrical system of Samarra city in Iraq. The difference between the real cases and ANN is 1% of the line length. The future trend of the Samarra thermal power station is also introduced.

Keywords: Machine learning; ANN; Fault Detection and Isolation; Thermal power plants.

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3D printed ceria ceramic scaffolds for solar thermochemical production of sustainable fuels

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Abstract

We present the first ever robocast (additive manufacturing / 3D printing) sintered ceria scaffolds, and explore their use for the production of renewable fuels via solar thermochemical fuel production (STFP, water and carbon dioxide splitting using concentrated solar energy). CeO_2 catalyst scaffolds were fabricated as 50 mm diameter discs (struts and voids ~500 μm), sintered at 1450 °C, with specific surface area of 1.58 m^2/g. These scaffolds have hierarchical porosity, consisting of the macroporous scaffold structure combined with nanoscale porosity within the ceria struts, with mesopores <75 Å and an average pore size of ~4 nm, and microporosity <2 nm with a microporous surface area of 0.29 m^2/g. The ceria grains were ⩽500 nm in diameter after sintering. STFP testing was carried out via thermogravimetric analysis (TGA) with reduction between 1050-1400 °C under argon, and oxidation at 1050 °C with 50% CO_2, gave rapid CO production during oxidation, with high peak CO production rates (0.436 μmol/g/s, 0.586 ml/g/min), for total CO yield of 78 μmol/g (1.747 ml/g). 90% CO was obtained after just 10 min of oxidation, comparing well to reticulated ceria foams, this CO production rate being an order of magnitude greater than ceria powders when tested at similar temperatures.

Keywords: Type your keywords here, separated by semicolons ;

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Assimilation weather model for estimation of solar power using ANN

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Abstract

Numerical weather prediction models are a widespread source of weather data for modelling renewable energy systems. However, most of the more extended models offer no open access to historic time series of their highest-resolution data outputs. The Global Data Assimilation System (GDAS) may be a potential solution to this issue, despite its scarce use in the energy research field. This study aims to expand the research base on this topic by applying such model to neural network models of three photovoltaic arrays located in the eastern United States shore. Weather and power estimations are compared with those coming from an in-situ weather station for a four-year time span. Achieved normalized root mean square errors for power predictions are lower than 12%, with close to zero bias errors. Results reinforce the idea that GDAS may be used as an accurate, wide coverage, open data source of weather inputs for photovoltaic systems modelled with black-box tools.

Keywords: ANN models; NWP models; Open data; Solar energy; Weather data

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Improving Lead-Acid Battery Aging Period in Off-grid Photovoltaic System Located in Spain

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Abstract

The increase in human population is leading to a significant increase in energy needs. Studies on grid management and controlling electrical equipment are increasing by incorporating renewable energy sources such as wind and solar. In this regard, batteries especially as known electro-chemical energy storage equipment help the system operators to mitigate some grid disturbances and control the power grid in a safe and flexible way. High consumption profiles and intermittent energy production make us search deeply about how we can effectively benefit from batteries. This study uses lead-acid batteries to build a small-scale off-grid system in Madrid, Spain. Irradiation and temperature are taken from the Meteonorm with the help of the PVSyst solar energy software and consumption data scaled for a small system are taken from the ENTSO-E transparency platform. The PVSyst software is utilized for simulating all results and cases. Seventeen charging threshold cases were simulated to observe the impact on the aging periods of low-cycle lead acid batteries. According to the study, charging and discharging batteries in a high threshold area results in electrolyte dissociation currents that average 20 Amper. In that case, batteries have an average state of charge of 85% to 89% yearly. The second important result is that the energy injected to batteries from the PV system is higher, but it cannot be discharged as much as during low charging thresholds. Battery lifespan is increasing from 4.1 years to 5.3 years.

Keywords: Battery; consumption; aging; pvsyst; simulation

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Luminescent Solar Concentrators performance and economic optimization

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Abstract

The growing need to reduce greenhouse gas emissions from buildings is driving the expansion of the building integrated photovoltaics. This research presents an in-depth analysis of photovoltaic panels based on Luminescent Solar Concentrator (LSC) technology, for the integration in transparent and semi-transparent building elements. These panels utilize plastic or glass waveguides functionalized with various organic dyes coupled with photovoltaic cells. Specifically, we evaluated the physical properties of 10x10 cm² LSC panels integrating both silicon and GaAs photovoltaic arrays. To assess the economic feasibility of the investigated LSC panels, we calculated the module simple payback period, considering various panel degradation rates. The combination of a red organic dye with silicon photovoltaic arrays emerged as the only cost-effective solution.

Keywords: LSC panel, GaAs solar cell, semitransparent panels, LSC payback period

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Comparison of recently proposed causes of Climate Change

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Abstract

This paper compares the ideas contained in the main papers published on climate change since World War II to arrive at a suggested consensus of our present knowledge regarding climatic changes and their causes. Atmospheric carbon dioxide is only suggested as a cause in one theory, which despite its wide acceptance by Politicians, the media and the Public, ignores the findings in other studies including the ideas found in the Milankovitch Cycles. It also does not explain the well-known NASA map of the changes between the global 1951-1978 and the 2010-2019 mean annual temperatures nor the differences between atmospheric carbon dioxide and mean annual air temperature over the last 500 Ma. The ratio of carbon dioxide molecules to those of water vapour are too low to be significant except at the Poles The other theories by Oceanographers, Earth Scientists and Geographers fit together to indicate that the variations in climate are the result of differential solar heating of the Earth resulting in a series of processes redistributing the heat to produce a more uniform range of climates around its surface. Key factors are the shape of the Earth and the Milankovitch Cycles, the distribution of land and water bodies, differences between heating of land and water, location of ocean currents and gateways, air masses and hurricanes. Low atmospheric carbon dioxide levels during cold events could result in too little of this gas to support photosynthesis in plants resulting in extermination of most life on Earth as we know it. The 23-ka Milankovitch Precession cycle has begun to reduce the winter insolation received at the surface of the atmosphere in the mid-latitudes of the Northern Hemisphere starting in 2020. This results in extreme weather as the winter insolation reaching the surface of the atmosphere in the higher latitudes of the Northern Hemisphere decreases while the summer air temperatures increase. It heralds the start of the next glaciation. A brief outline is given of some of the climatic changes and consequences that may be expected in western Canada during the next 11.5-ka. Finally, it provides some comments on some potential energy sources for the future.

Key words: Climate change, expected future weather in Western North America, glacial advances, Milankovitch Cycles, implication for future energy sources.

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Advances in ejection studies in hydropower plants in Bolivia

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Abstract

A theoretical study of ejection was carried out in a design of a run-off hydropower plant. The study covered two separate zones at the plant: a zone of 12 bulb-type turbines and another zone of 12 radial gates. The aim of the research is to quantify the differences in the ejection effect at the draft tube outlets and the end-sill of the spillways in the vicinity of the gates. Seventy-seven hypothetical scenarios of steady flow in submerged condition were analysed based on the Energy-Momentum method. The boundary conditions at the outlets of both control volumes were obtained by 1D modelling in HEC-RAS. The results obtained show that the ejection effect in submerged conditions in the area of the radial gates is much larger than in the area of the turbines, and therefore, it could become an attractive alternative for additional power generation in the plant during the flood season.

Keywords: Ejection effect; radial gates; low-head hydropower plant; Energy-Momentum method; ejection characteristic curves

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Zero Carbon Emission must be achieved at the Earliest for Sustained Growth of Our Planet Earth

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Abstract

In 1750, man-kind moved from agriculture and artisanship era to Industrial era.Carbon dioxide was 280 ppm in the pristine atmosphere. Today man made activities have enhanced the concentration of Carbon Dioxide to 400ppm resulting in Global Warming and Climate Change. The devastating effects of Global Warming and Climate Change are: erratic weather patterns: heat waves, floods, severe storms and hurricanes, loss of polar ice and rising sea levels. Apart from Carbon Dioxide there are water vapour, methane, nitrous oxide and florinated gases. Seeing the formidable challenge to sustainable development strategy The Paris Agreement was signed in 2015 an International Treaty on Climate Change to which 196 Nations and Governments were signatory at COP21. Under Intergovernmental Panel of Climate Change [IPCC] 90 countries are covered and 80% global emission are set on zero emission path.At COP26 Glasgow Climate Pact was signed in which India declared a 5 point agenda for achieving net zero emission by 2070. At COP28 Resource Hub, 28th Annual Climate Climate Change conference in Dubai, UAE, 2023 held. 150 countries participated. In 2023, Convention on Biological Diversity was held and High Sea Treaty was signed in June 2023. Frame work convention on Climate Change is keeping track of Climate Change Aid to developing countries. Pathways to zero emission and limiting Global Warming to 1.5 degree centigrade above pre-industrial level hasve been laid down in Climate Change Conferences. Urban Hesat Islands have to be dealt with tailored city specific action plans. Nitrous Oxide in Agriculture has to be dealt with by Organic Farming. Water produces 95% of Green House effect. The Water cycle has to be regulated. Indian agenda to help Paris Agreement to achieve its Sustainable Strategic Goals is described.

Keywords: Urban Heat Island; Carbon Dioxide; Methane; Nitrous Oxide; Florinated Gases;

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Energy harvesting methods using vibrating piezoelectric structures subject to acoustic emissions

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Abstract

Environmental problems and energy prices owing to the fossil fuels are the vital issues dealt with by the scientific community. Alternative to the fossil energy sources, energy can be harvested from various eco-friendly potential sources such as solar, wind, thermal, mechanical vibration, and biochemical energy sources. Acoustic energy is the accessible, usable, and clean wasted energy source prevalent in the surroundings. Obtaining higher acoustic energy efficiency, electromechanical resonators such as Helmholtz resonators can be utilized to amplify the acoustic signals. By doing so, more interaction of structures with acoustic emissions is achieved in static or dynamic modes. Particularly, resonant micro-cantilevers considerably respond to static acoustic forces under single- and multi-frequency operations. Crucially, oscillation observable responses such as amplitude and phase shift significantly vary as the acoustic force strength changes. In the view of the virial theorem and energy conservation principle, energy storage processes for oscillating micro-cantilevers undergoing acoustic forces can be described using virial and dissipated power. Higher energy can be stored by optimizing excitation schemes considering micro-cantilever properties and effective sound pressure levels. Therefore, using resonating micro-structures brings great potential to harvest acoustic energy for powering the microelectronic devices with low energy consumption.

Keywords: Energy harvesting methods; Piezoelectric structures; Acoustic emissions; Helmholtz resonator; Energy dissipation

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Energy-efficient technology for disinfecting water in a stream using discharges in gas bubbles

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Abstract

Water treatment was carried out in flow mode with a volumetric flow rate of 150 l/h. At the same time, a specific energy consumption of 660 W*h/m^3 was experimentally achieved to reduce the concentration of indicative microorganisms E.coli from 10^6 CFU/cm^3 to zero. It is shown that a significant reduction in specific energy consumption can be achieved compared to 660 W*h/m^3 by further reducing the duration of voltage and current pulses in discharges to 10 ns, and their front duration to 1 ns. The primary ionized cloud—the ionized volume—can occupy the entire volume of a gas bubble with a characteristic linear size of ~1 cm when a pulse front duration of ~1 ns.

Keywords: disinfecting water treatment; gas bubble; nanosecond pulse discharge; flow; energy-efficient technology

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TO ASSESS HEATWAVE AND SURFACE HEAT ISLAND EFFECT: A CASE STUDY OF SIDDHARTHANAGAR MUNICIPALITY, NEPAL

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Abstract

Extreme temperature events (heat waves) has studied to be increasing in frequency, intensity and duration across the globe and mostly on tropical regions. The extreme event threshold is calculated as the 90th percentile method as defined by DHM as the 90th percentile of the historical maximum daily temperature remains above six days or more. Although the definition exists, but analysis using temperature records at a local scale has not been conducted for the hotter terai region of Nepal. In this study we exploit the weather station data for Siddharthanagar municipality to identify heat waves and its synergy with surface heat islands. Our results shows that the heat waves duration has been increasing with time in the city and the urban heat islands of almost 1-1.5 0C is observed to amplify the heat waves anticipating to increase the human discomforts both at night and during the days.

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Oleaginous Yeast Biorefinery: advancement in sustainable biodiesel production

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Abstract

The escalating demand for sustainable energy sources has catalyzed the exploration of oleaginous yeasts as a viable option in the biodiesel industry. Oleaginous yeasts are microorganisms capable of accumulating substantial amounts of lipids, particularly triacylglycerols (TAGs), under specific cultivation conditions. Their rapid growth rates, high lipid content—up to 70% of their dry cell weight—and ability to thrive on a wide range of substrates, including agricultural and industrial wastes, position them as a promising alternative to traditional oil crops. The use of non-food feedstocks addresses food-versus-fuel concerns, enhances economic viability, and minimizes environmental impact. Advances in genetic and metabolic engineering further optimize lipid accumulation and downstream procedures for a better production of high-quality biodiesel. This work reports two case studies which elucidate the potential and significance of oleaginous yeasts in biodiesel production, emphasizing their role in achieving energy security, reducing greenhouse gas emissions, and fostering a sustainable bioeconomy. The integration of oleaginous yeast-based biodiesel into the existing energy infrastructure presents a transformative step towards greener and more sustainable energy solutions.

Keywords: Microbial cell oil; Single cell oil; food waste; Rhodosporidiobolus azoricus; Cutaneotrichosporon oleaginosus

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Experimental Study of Phase Change Material Effect as a Passive Cooling Method on the Daily Electrical Performance of a Photovoltaic Panel under Moroccan climate

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Abstract

A photovoltaic system using a phase change material as cooling technology (PV-PCM) is analyzed under Morocco's climatic environment in order to evaluate the performance of the system in terms of daily energy saving.
A paraffin wax type of PCM with a melting temperature of 25 °C is integrated in the back of photovoltaic panel in order to analyze the effect of this added material on temperature profile and also on the output power generated by the PV panel used.
A numerical simulation with finite element method, contains a coupling between the Navier-Stokes equation and the general heat equation is developed and validated with an experimental setup in the aim to predict the thermal behavior of the phase change material used in the back of PV panel under daily temperature and illumination conditions.
As a result, an important reduction in PV temperature is observed and a significant increase in PV output power due to cooling produced by PCM has been noticed and quantified presented by a gain in daily PV productivity more that 10% is obtained using this type of phase change material under hot environment conditions.

Keywords: Photovoltaic panels (PV), PV productivity, Numerical method, phase change material (PCM).

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Green synthesis of Nanocomposite membrane for wastewater treatment

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Abstract

Green synthesis of TiO_2 nanoparticles is center of attraction for researcher as they exhibit unique property of high surface area and excellent photocatalytic property and its synthesis by green approach is environmentally friendly thus avoiding use of toxic chemicals. Impregnation of these particles as filler to the host matrix has become a versatile approach in improving the performance and antifouling characteristics of material. In this study, nanocomposite film was prepared using filler as Titanium Dioxide (TiO2) NPs prepared via extract of *Cajanus Cajan* (Pigeon Pea). Impregnation of TiO_2 NPs to polymer Polyvinylidene fluoride (PVDF) significantly enhances separation efficiency of membrane in removing Cr(VI) from wastewater but also improves the fouling resistance which is major drawback of membrane application. Quantitative and qualitative analysis was carried out to assess the fouling phenomenon that prevail between foulants and TiO_2 immobilized surface and were evaluated mathematically based on the extended *Derjaguin–Landau–Verwey–Overbeek* (XDLVO) approach. This theory predicts an increase in strength of repulsive interactive energy barrier with an increase in TiO_2 loading. The other advantage of particle impregnation leads to not only efficiently removing Cr(VI) from wastewater but also reducing to non-toxic Cr(III) form due to presence of photocatalytic filler as TiO2 NPs.

Keywords: Antifouling; Efficiency;Membrane;Nanoparticles

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Biomass corrosiveness prediction by chemical fractionation

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Abstract

The use of biomass and biomass waste as a fuel in combustion boilers is growing rapidly due to the advantages of CO2 neutrality and renewability. However, low-grade fuels may include considerable concentrations of ash-forming elements which have a strong influence on the operation of biomass combustion plants, resulting reduced economic efficiencies. Among the possible operational problems that could arise, high-temperature biomass corrosion is a crucial issue affecting its future application. This study presents the results of chemical fractionation through selective leaching carried out for different biomass waste materials. Fuels selection was conducted on the basis of covering the main biomass categories (agricultural waste, industrial wood and wood residues). Main differences with respect to the mode of occurrence of ash-forming elements in the different biomasses studied were determined for Na, Ca, Mg, S and P. Na, in both eucalyptus wood and industrial wood waste, was present as salts in the fluids of the plant, leading to the release of harmful Na- Chlorides during combustion. K, was determined in soluble form in all cases, which involves high risk of deposits on heat transfer surfaces, but special attention should be paid to the case of agricultural biomass due to the high K content in these residues. Ca was found in the soluble fraction just in wheat straw case, which would lead to Ca-chlorides that may induce low-temperature corrosion in the cold-end of boilers. With respect to P, it was recovered in the aqueous fraction only in eucalyptus wood case, as soluble phosphate salts, which may lead to bed sintering or deposit formation through interactions with K, Ca, Mg and Si. Results obtained through the chemical fractionation method indicate that, among the different biomasses studied, the use of eucalyptus wood as fuel in boilers may imply a major risk of generating fouling and corrosion problems.

Keywords: Biomass; Chemical fractionation; Ash-forming elements; Corrosion; Boilers.

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Application of Bioengineering in Construction

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Abstract

Bio cement and bio concrete are innovative solutions for sustainable construction, aiming to reduce environmental impact while maintaining the durability and versatility of building materials. Bio cement is an eco-friendly alternative to traditional cement, produced through Microbially Induced Calcium Carbonate Precipitation (MICP), which mimics natural biomineralization processes. This method reduces CO2 emissions and enhances the strength and durability of construction materials. Bio concrete incorporates bio cement into concrete, creating a self-healing material. When cracks form in bio concrete, dormant bacteria within the material become active in the presence of water, producing limestone to fill the cracks, extending the material's lifespan and reducing the need for repairs.

The environmental impact of traditional cement production is significant, with cement generation accounting for up to 8% of global carbon emissions. To create more sustainable construction materials, innovative thinking is needed, with some using modern innovations to make concrete ultra-durable and others turning to science to create affordable bio cement. The research demonstrates the potential of bio cement to revolutionize sustainable building practices by offering a low-energy, low-emission alternative to traditional cement, while also addressing environmental concerns. The findings suggest promising applications in various construction scenarios, including earthquake-prone areas, by enhancing material durability and longevity through self-repair mechanisms.

Keywords: Sustainable construction, microbially induced Calcium carbonate precipitation (MICP), cement, formation, application, construction industry, microorganisms, eco-friendly, sustainable solution, durability, carbon dioxide emission (co2)

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Potential for establishing fast growing tree plantations in Kosovo

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Abstract

Kosovo's forestry sector possesses substantial potential for sustainable forest product production and can significantly contribute to rural economic development. Leveraging this potential could enhance economic growth, create employment opportunities, generate additional income, and aid in poverty reduction. According to the latest report by the Kosovo Agency of Statistics (KAS) on consumption poverty, approximately 18% of Kosovo's population lives in poverty and struggles to meet basic human needs, while 5.1% live in extreme poverty, unable to meet even the most fundamental survival needs. In addition to its role in alleviating poverty, the forestry sector is crucial for environmental protection and climate change mitigation. Sustainable forest management can facilitate carbon sequestration, support biodiversity, and provide renewable energy sources that can replace those with higher greenhouse gas emissions. Kosovo's forests are a vital natural resource and play a significant role in the national economy. Currently, wood biomass (primarily as firewood) constitutes Kosovo's predominant heating source, with an annual consumption of approximately 2.05 million cubic meters to meet household energy demands. Previous studies have indicated a wood fuel balance of approximately 1.32 million dry tonnes, with 1.2 million cubic meters sourced from forest lands and the remainder from the wood industry. To address the supply-demand gap and explore alternative wood sources, this study investigates the potential for establishing fast-growing tree plantations (FGTPs) and identifies the most suitable sites for their development. The study employs remote sensing and Geographic Information System (GIS) techniques to analyze temporal and spatial changes in land cover in Kosovo, facilitating the identification of optimal locations for FGTPs. A SWOT analysis was conducted to assess the current situation and identify the strengths and weaknesses of the FGTP market, mapping these factors against external opportunities and threats to develop effective policies for the advancement of the wood biomass sector. Economic profitability of FGTPs was assessed using Cost-Benefit Analysis (CBA) and Net Present Value (NPV) methods, and compared with agricultural crops. Several recommendations are provided for the development of FGTPs in Kosovo, aiming to address national energy demands effectively.

Keywords: Kosovo,bioenergy,fast growing tree plantation,economic profitability

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A Novel Approach to determine the Degradation of Solar Photovoltaic Module using Photoluminescence Imaging

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Abstract

Photoluminescence (PL) spectroscopy is an optical procedure used for portraying the structure, composition and the effect of impurities present in the materials used for solar photovoltaic (SPV) modules. This mechanism can also be used to study the impact of corrosion and other degradations that arise over time in the SPV module. In this paper we try to explore the reasons of performance (output power and conversion efficiency) degradation of the SPV modules. This work presents a methodology for making the assessment of power reduction characteristics of poly-crystalline SPV modules through PL imaging and validating the results through correlation.

*Keywords:*Conversion Efficiency; Defects, PV module; Power degradation; PL Imaging; Solar Irradiance

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Preferential Solvation, DFT Analysis and Surface Plasmon-Enhanced Fluorescence, in Binary Liquid Mixtures Containing Norbornadiene

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Abstract

Norbornadiene (NBD) and quadricyclane systems are at the forefront of energy storage technology due to their high energy density and reversible photoisomerization, offering promising solutions for efficient and sustainable energy storage. This study investigates the dynamics of binary liquid mixtures containing norbornadiene (NBD), focusing on elucidating their properties and behaviors. The research is organized around three main areas: preferential solvation, the use of Density Functional Theory (DFT) for molecular analysis, and the enhancement of fluorescence through surface plasmons. Preferential solvation refers to the selective interaction of solvent molecules with specific solute molecules. This phenomenon is examined to understand its impact on the distribution of solvent molecules around norbornadiene, providing insights into molecular-scale interactions. To complement this investigation, DFT and Time-Dependent DFT (TDFT) are employed to analyze the electronic structure and properties of the molecules in the mixtures. These techniques offer a detailed examination of energetics, bonding patterns, solute-solvent interactions, and absorption spectra, providing a theoretical perspective on the mechanisms driving the behavior of the binary liquid mixtures. Additionally, the study explores the interaction between gold surface plasmons and norbornadiene, aiming to uncover the mechanisms and efficiency of fluorescence enhancement. The utility of the NBD system is significantly enhanced if its energy absorption falls within the visible spectrum. Previous research has explored this by incorporating donor-acceptor groups to achieve a red-shifted absorption that better matches the solar spectrum. This study aims to optimize key properties of the NBD system in different solvents and investigate how the introduction of nanoparticles can shift absorption into the visible range. To the best of our knowledge, this specific aspect has not been studied in depth before. This advancement offers a range of modifications to fine-tune the properties of NBD/QC systems, making them suitable for various applications in energy storage and contributing to the design of efficient Molecular Solar Thermal (MOST) systems.

Keywords: Norbornadiene; preferential solvation; Density Functional Theory; surface plasmons

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Olive stones organosolv pretreatment for biohydrogen production

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Abstract

Olive stones are the main solid residue of olive oil production, accounting from 10-12% of olive fruits by weight. During the last season 2021-2022, the global olive industry produced around 2.8 million tons of olive oil, from approximately ten million tons of olives [1]. For this reason, the reuse of the associated wastes, significantly contributes to sustainability and caring for the environment. On the other hand, the demand on hydrogen (H_2) has increased during the last years because of being a clean source of energy and an adaptable energetic vector. Therefore, the aim of this project was to obtain H_2 from olive stones by biological methods. Two situations were compared in terms of H_2 production: Organosolv pretreated olive stones' fermentation (OPF) facing natural (milling) olive stones' fermentation (NF) in same conditions. Pretreatments alter the structure of lignocellulose biomass making it more accessible for microorganisms in fermentation. These can be physical and chemical pretreatments such as milling (0.1 cm) and organosolv pretreatment (50% EtOH, 15% S/L, 190 ºC, 30 min). Fermentation assays occurred in hermetic flasks with a reaction volume of 50 mL (plus 50 mL headspace) using a macronutrient solution (pH 6.8) in addition to olive stones as substrate (23.4 g/L) and *Clostridium butyricum* as inoculum (5 g-TVS/L). The flasks were incubated in a rotary shaker at 37 ºC, 130 rpm for 72 h. H_2 concentration in headspace was determined by gas chromatography. In this work, the advantages of pretreatments in the efficiency of the conversion of biomass into H_2 were discussed. Not only H_2 concentration, but also acetic and butyric acid production are significant parameters to analyse as they derive from the metabolic pathways involved in anaerobic H_2 production. NF produced 1.68 and 1.13 g/L of acetic and butyric acid, respectively. Whereas OPF produced 0.71 and 3.96 g/L of those products. In terms of H_2 production, the adjustment of Gompertz modified model helps to determine the H_2 potential production, which were 56.89 mL/L for NF and 99.27 mL/L for OPF (Fig. 1). Production rates were 28.0 and 50.8 mL/L.h for NF and OPF, respectively. As a main conclusion, the application of pretreatments to biomass contributes to increase the H_2 production due to greater accessibility to cell fibre for hydrolytic/fermentative bacteria. Supporting the technological development of sustainable practices will make a positive impact in society and the environment.

Keywords: biohydrogen; dark fermentation; olive stone; organosolv pretreatment

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Courtyard house parametric optimization using a genetic algorithm

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Abstract

The courtyard dimensions are the major factor that define the courtyard house performances particularly those related to the environmental aspects such as solar potential. In this study, an optimization of a courtyard house under the temperate climate of Algiers is conducted in order to define the best design solutions in terms of geometric features regarding the total received radiation during both cold and hot periods. The applied parametric approach consists in varying the courtyard plan dimensions (width and height). The plan-form of the courtyard is transformed into quadrangular and trapezoidal plan shapes, generated and evaluated using "Octopus" which is a plugin that runs within "Rhinoceros" software. This plugin performs using a genetic algorithm that helps generate a wide variety of optimal solutions. The results show that the solar potential of the courtyard facades can be enhanced by 23% comparing to the refence building shape by only acting on the geometric features of the courtyard. It is also revealed that the courtyard height is a key parameter in solar optimization process since it can give courtyard house shapes with better performance during both cold and hot periods.

Keywords: Artificial intelligence tools, solar Architectural design, courtyard house design, parametric optimization, Architectural design algorithms.

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A Review on Solar Energy Scenario in India

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Abstract

The future energy source is solar energy, drawing significant attention worldwide for utilization and conversion into usable and storable form of energy. The contribution over other renewable energy technologies (23%), the solar energy comprising around 31%of the total installed renewable energy capacity in 2022. It is the second most installed renewable energy resource after installed hydropower energy stations. The present review study and the systematic literature survey, represented the solar energy status along with the published solar energy potential of the country. A comparison of the solar power status of few years based on the concentrated solar power and PV installed capacities. It also included the significant increase of installed solar energy installed capacity of last five years. The review analysis reveals the gaps existed in the field of solar energy and gradual increase in PV installed capacity. It became the prominent generation source of the country to generate approximately 25% of the total electricity needs by 2050 because of the availability of the sun through-out the year.

Keywords: solar energy, PV capacity, hydropower, green power, electricity etc.

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PREDICTING ENERGY-SAVING BEHAVIOR AMONG INDIAN ADOLESCENTS: THE ROLE OF PERSONAL MORAL NORMS AND ENERGY AWARENESS

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Abstract

The study explores the determinants of energy-saving behavior among Indian adolescents, focusing on the influence of personal moral norms and energy awareness. As global energy demand continues to rise, the role of individual behavior in promoting energy conservation becomes increasingly important. Adolescents, as future stewards of the environment, represent a critical demographic in this context. This research examines how personal moral norms, defined as individuals internalized ethical standards, and energy awareness, referring to the understanding of energy-related issues, contribute to predicting energy-saving behaviors among this group. Using a sample of Indian adolescents, the study employs a quantitative approach to assess the extent to which these factors drive energy conservation efforts. Findings indicate that both personal moral norms and energy awareness significantly predict energy-saving behavior, with moral norms showing a particularly strong influence. The results underscore the need for educational interventions that enhance energy awareness and foster a sense of moral responsibility toward energy conservation among adolescents. By identifying key psychological and cognitive factors that motivate energy-saving actions, this study provides valuable insights for policymakers and educators aiming to promote sustainable behavior in younger populations.

Keywords: Type your keywords here, separated by semicolons ;

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Analyzing the relationship between oil prices and carbon emissions: A comparative study of OPEC and BRICS

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Abstract

The study examines the nexus between oil prices, consumption, carbon emissions, inflation, and economic growth. The relationship will be tested for OPEC countries on one side and BRICS countries on the other. The study examines a causal relationship between crude oil price, energy consumption, inflation, and carbon emissions between the period 1960 to 2023. By deploying ARDL (Autoregressive Distributed Lag model) cointegration is deployed to visualize the structural breaks on account of global shocks or events such as the oil crises of 1970, the International Debt crises of 1982, the East Asian economic crises of 1997 -2001; and the Global Economic Recession 2007-2009. The study tests the causality between the selected variables to comprehend the impact of oil prices on inflation, economic growth, and carbon emissions. The global events may impact the causality or relationship between the selected variables. In addition, the different regions may experience different relationships between the variables and respond differently to global events or shocks. The experience of BRICS and OPEC countries reveal that the efforts of policies must be towards fostering the EKC so that the nexus of crude oil prices, carbon emissions, inflation, and energy consumption is broken and carbon emissions are reduced for climate change resilient, sustainable economic growth.

Keywords: Oil prices, inflation, carbon emission, Autoregressive Distributed Lag model OPEC, BRICS

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Impact of wind farms on roe deer stress, habitat utilization and density

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Abstract

Wind farms are still developing dynamically worldwide, with promising prospects for further growth. There are many ways of the potential influence of wind farms on mammals, including noise, habitat change, change in predation risk, and others. Therefore, the wind farm impact on animals has been assessed. So far, few studies have been conducted on game mammals, and their results are divergent. For several years now, we have been studying the impact of wind farms using the example of the roe deer. Roe deer is a good research model for ungulates in open landscapes in temperate climates. We have studied wind farms' impact on roe deer's cortisol levels. The research has shown that increased cortisol levels can be expected at larger wind farms and in areas where wolf predation is significant. Winter tracking studies have shown that the density of roe deer tracks was significantly lower on wind farms than in control areas. Furthermore, the density of tracks decreased with proximity to wind turbines. Large-scale analysis of roe deer density showed a weak but significant negative effect of wind farms on roe deer density (hunting bugs) in lowland Poland. We conclude that further research on the impact of wind farms on terrestrial animals is needed, particularly on wind farm areas and the spatial arrangement of turbines. This work was funded by the National Science Centre, Poland (Grant number: 2021/41/B/NZ9/04442).

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Proposal of a model for organizing multidisciplinary research groups Social Innovation to address energy poverty in the COMCAA'C Indigenous people

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Abstract

This paper presents organizational models focused on the interdisciplinary work of research groups, with a focus on intervention in the "project FOP04-2021-01-319483 called 'Energy, water and food security for Indigenous peoples in semi-arid coastal regions of northern Mexico', the people in which the intervention is carried out is the Comcaa'c people, with the intervention of an interdisciplinary group that addressed three axes, energy, water, and food, which are highly linked factors, a photovoltaic system was designed, with an agrivoltaics approach, which allowed taking advantage of the shade generated under the installation to grow food for the beneficiary families, which resulted in a social benefit in the area of energy and food. The social-organizational innovation model seeks to mitigate possible conflicts that may arise when researchers from different disciplines, such as the exact, social, and engineering sciences, are integrated, with an analysis of the way of working without the model and then with the model.

Keywords: Social Innovation, model for organizing, Indigenous people.

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Potential of Industrial Waste Utilization for Carbon Capture and Storage

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Abstract

Industrial waste is increasingly recognized as a valuable resource for carbon capture and storage via mineral carbonation. This study investigates the potential of steel slag as CO_2 sequestration agent via indirect mineral carbonation process. A characterization analysis was performed to identify mineralogical and chemical composition of steel slag and to determine potential sequestration capacity of the material. The mineralogical and chemical behavior of steel slag were analyzed using XRD and XRF techniques. Results indicated varying percentages of minerals for steel slag; CaO (29.60%), Fe_2O_3 (24.5%) and SiO_2 (15.60%), with 32% potential CO_2 sequestration capacity. Steel slag utilization demonstrated potential as viable CO_2 capture agent from steel production, thereby advancing sustainable practices. CO_2 mitigation practices through utilization of industrial wastes serve as beneficial approach for long-term carbon capture and storage.

Keywords: Carbon capture; Carbon utilization; Mineral carbonation; Alkaline feedstock

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Relationship Between Biomass Exposure, Chronic Headache and Brain Damage in Young Women

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Abstract

Biomass, an energy source, is the general name of all non-fossilized biological material obtained from living or recently living organism. Household use of solid biomass fuels is the most common cause of indoor air pollution (IAP) worldwide. The aim of this study was to investigate the relationship between biomass exposure and the presence of headache and brain damage in young women. This cross-sectional study included patient group consisted of 69 women who applied to the neurology outpatient clinic with complaints of chronic headache and fatigue and the control group consisted of 26 healthy volunteer women who were not exposed to tandir smoke. In all subjects, blood samples were obtained for biochemical analysis and brain Magnetic Resonance Imaging (MRI) scan was performed to evaluate brain damage. In the patient group, ischemic gliotic foci were detected in 56 patient (81.2%) while in the control group, gliotic foci was detected in 3 subjects (11.5%). The prevalence of gliotic foci was almost 8 times higher in subjects with a history of biomass smoke exposure than in subjects without a history of biomass smoke exposure (81.2% *vs.* 11.5%). These findings suggest that indoor air pollution may have an effect on the risk of headache and brain damage. However additional studies with larger sample sizes and including other ethnic or environmental communities are needed to determine in detail the role of indoor air pollution in the occurrence of headaches and brain damage.

Keywords: Biomass; headache; indoor air pollution; gliotic foci

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Enhancing Renewable Energy through Microgrid Integration - a Pathway to Sustainable Solution

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Abstract

As environmental challenges grow and the search for sustainable solutions persists, the integration of renewable energy via microgrids stands out as a promising strategy for boosting energy resilience and sustainability. This presentation explores the role of microgrids in optimizing renewable energy sources and improving overall energy system performance. Microgrids, which are localized grids capable of operating independently or in conjunction with the main grid, offer significant advantages in integrating diverse renewable energy sources such as solar, wind, and biomass. By decentralizing energy production, microgrids reduce transmission losses, enhance energy security, and increase system flexibility. The integration of renewable energy into microgrids can be optimized through the use of advanced technologies and strategies, such as energy storage systems, demand response techniques, and smart grid technologies. Energy storage solutions, such as batteries and pumped hydro, play a crucial role in balancing supply and demand, mitigating intermittency issues associated with renewable sources. Demand response mechanisms enable real-time adjustments to energy consumption patterns, optimizing grid performance and reducing peak loads. Moreover, smart grid technologies enable efficient monitoring and management of microgrid operations, facilitating real-time data analysis and adaptive adjustments. This integration not only ensures the reliable use of renewable energy but also promotes local economic growth and energy self-sufficiency. The presentation explores the role of renewable energy in sustainable development and addresses the challenges and potential solutions associated with the intermittency of renewable sources, real-time supply-demand balancing, and grid modernization. It ultimately illustrates that integrating microgrids is a viable and effective strategy for advancing the adoption of renewable energy and achieving long-term sustainability objectives.

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The Chemical and Morphological Characterization of Different Components of Corn Bio- Waste from Nigeria and its Potential for Bio-Energy, Pulp and Paper and other Industrial Applications

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ABSTRACT

Recently, the increasing rate of organic wastes generation in Nigeria has risen to an unbearable limit coupled with the lack of adequate disposal and management techniques thereby causing severe environmental pollution. In Nigeria, over 42 million tonnes of bio-wastes are being generated annually and most of these wastes are not being utilized into useful forms. In this study four different components of corn bio-wastes namely the corn stalk, corn husk, corn cob and corn leaf were subjected to Kraft chemical pulping process to extract the cellulose embedded in the lignocellulosic bio-material. the highest percentage yield of cellulose was obtained from corn stalk with 59%, followed by 54% cellulose released by corn husk, corn leaf gave 51% while the lowest amount of 40.8% cellulose was produced by the corn cob waste. However, the corn cob gave 17.04 % highest amount of lignin content while the corn leaf produced the highest extractive content of 3.5 %. A range of 32% to 40% hemicellulose and alpha cellulose was obtained from the four bio-waste while holocellulose was between 63% to 69%. The FTIR characterization of the cellulose produced from each of the corn waste confirmed their chemical identity. The SEM/EDX results showed the presence of carbon, oxygen, Sulphur, potassium, calcium, iron, magnesium, and sodium. The morphological fiber characterization of the pulp showed well aligned fiber matrix making corn agricultural waste an alternative bioresource for bioenergy development and pulp and paper industry also a pathway to sustainable and healthy economy with available raw material base for growth and development.

Keywords: Corn bio-waste, Lignocelluloses, Yield of pulp, Cellulose, holocellulose, Chemical Pulping, Kraft Pulp, Lignin and Extractive content, Fiber characterization.

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Current Status and Influencing Factors of Shallow Geothermal Utilization Among Dutch Homeowners

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Abstract:

Shallow geothermal energy stands out as a promising energy-saving technology for buildings due to its inherent advantages, such as independence from weather and regional geography, coupled with its stable sustainability. However, the current literature highlights a scant focus on shallow geothermal application for existing Dutch housing. To advance their application, this study assesses the prevailing application status of shallow geothermal technology and homeowners' willingness to engage with geothermal energy by the literature review and questionnaire surveys. The analysis of surveys from 800 homeowners across diverse regions in the Netherlands reveals that 81.1% of the surveyed existing houses employ independent heating, 77.1% still rely on natural gas heating, and only 5% use geothermal heating. Additionally, a scant 6.5% of homeowners are very satisfied with their heating systems, and the satisfaction with winter heating costs is only 4.0%. Only 0.9% of homeowners are very familiar with geothermal heating and related technologies. Moreover, a majority of homeowners are unfamiliar with government policies and financial subsidies related to geothermal technology. Based on these insights, this study proposes the targeted recommendations and measures. This study offers valuable insights and can serve as a guiding framework for government agencies in devising policies and incentives to foster the adoption of geothermal technology in existing residential buildings.

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Energy-Efficient Meta-Heuristic Localization Scheme for Marine Environments

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Abstract

Geographic coordinates of target nodes in marine settings are critical for the bulk of ocean applications, such as oceanographic research, offshore oil and gas development, and so on, in order to draw relevant results. However, this strategy is difficult due to the unique challenges that maritime networks present, such as limited bandwidth, a hostile environment, low visibility, and the lack of GPS. Because of node mobility, the primary challenge with event detection and monitoring is localization and coverage. Although the number and placement of autonomous marine vehicle-based anchor nodes improve accuracy, in terms of localization and overhead. While localizing, anchor nodes fail, resulting in poor precision and a shorter network lifetime as their energy is constantly consumed. Many strategies have been proposed to improve accuracy by using a large number of anchor nodes; however, very few studies have addressed energy-efficient localization scheme. A self-adaptive naked mole-rat strategy is proposed to reduce complexity while also improving coverage and localization accuracy. The proposed system was used to determine the set of optimal autonomous anchor nodes for the energy-efficient localization process, which comprised fitness value and three parameters as inputs: modified anchor-target distance, link quality, and residual energy. Probability determines the optimum anchor nodes. The localization accuracy between the estimated and original coordinates of the nodes will be improved by using a metaheuristic technique based on the self-adaptive naked mole-rat. According to simulation data, the proposed technique has a convergence time of 6.8 seconds and a localization accuracy gain of 51-55%. As a result, the findings suggest that it outperforms modern methods.

Keywords: Localization; Marine environments; Coverage; Self-adaptive naked mole-rat; Autonomous marine vehicles.

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A Real-Time IoT-based Controller Design to Increase Solar Tracker's Efficiency

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Abstract

In this study, it is aimed to develop a practical real-time IoT-based controller structure for the control of solar tracking systems used to increase the efficiency of solar panels. In existing systems operating according to the sundial, zenith, and azimuth angles are usually controlled by PID. In these systems, the location information obtained according to the latitude and longitude information of the region is operated according to the information received from meteorological institutions or national data centers. In the proposed method, instead of existing controllers, a control structure that can dynamically adjust the azimuth and zenith angles in the database in real-time with KepServerEX based on IoT has been developed. The working principle of the developed system is to update the data set at certain periods and to transmit this current data to the PID controller based on KepServerEX based on IoT. The PID controller, which receives the dynamically updated position values, processes this data and sends appropriate commands to the DC motors, thus ensuring that the panels move to the correct position in one/two axes. Thanks to this approach, solar panels are always aligned with the most appropriate angle to the sun, which increases energy generation efficiency. The results obtained show that the proposed system provides an accurate position with a precision of less than 1 degree compared to classical methods and produces a very practical solution in practice.

Keywords: Solar Tracker; IoT; Real-Time Controller, Energy Efficiency

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Plasmonic MXenes for Solar-Assisted Methane Liquefaction and Low-Carbon Fuel Production under Mild Conditions at the Nanoscale

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Abstract

We present a novel MXene-nitrogen-doped graphene (MX@NG) hybrid photoelectrocatalyst for efficient ambient methane oxidation under light and external bias. The graphene nanosheets are electrostatically assembled between MXene sheets, preventing restacking and increasing ion diffusion. Using Ti_3CN as MXene and NG as catalyst supports, the MX@NG composite outperforms pure NG and MXene, producing 17 µmol/ml of CH_3OH and 14.5 µmol/ml of HCOOH after 4 hours at 0.8 V vs. Ag/AgCl. The synergy between MXene and NG enhances charge transfer, solar energy utilization, and promotes efficient methane conversion, showcasing the potential of MX@NG for solar-driven electrocatalysis.

Keywords: Nanomaterialsl; Photoelectrocatalyst; Methane oxidation; Methanol production; Solar energy utilization