



5. International World Energy Conference ABSTRACTS BOOK

EDITORS

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Şükrü Taner AZGIN

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INTERNATIONAL WORLD ENERGY CONFERENCE-V

December 12-13, 2025 / Kayseri, Türkiye



ABSTRACTS BOOK

EDITORS

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Assoc. Prof. Şükrü Taner AZGIN
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CONFERENCE ID

CONFERENCE TITLE

5th International World Energy Conference

DATE and PLACE

December 12-13, 2025 / Kayseri, Türkiye

ORGANIZATION

Erciyes University, Faculty of Engineering, Department of Energy Systems Engineering, Türkiye
IKSAD-Institute of Economic Development and Social Research, Türkiye
WEAR-Wind Engineering and Aerodynamics Research Group, Türkiye
MSG Teknoloji-Multi Science Gate, Türkiye
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NUMBER of REJECTED PAPERS-69

PARTICIPANTS COUNTRY

Albania, Algeria, Azerbaijan, Bangladesh, China, France, Georgia, India, Indonesia, Iran, Iraq, Italy, Kosovo, Lithuania, Malaysia, Morocco, Nigeria, Norway, Poland, Saudi Arabia, Somalia, Spain, Tunisia, Türkiye, UK, USA, Vietnam

PRESENTATION

Oral presentation

EVALUATION PROCESS

All applications have undergone a double-blind peer review process

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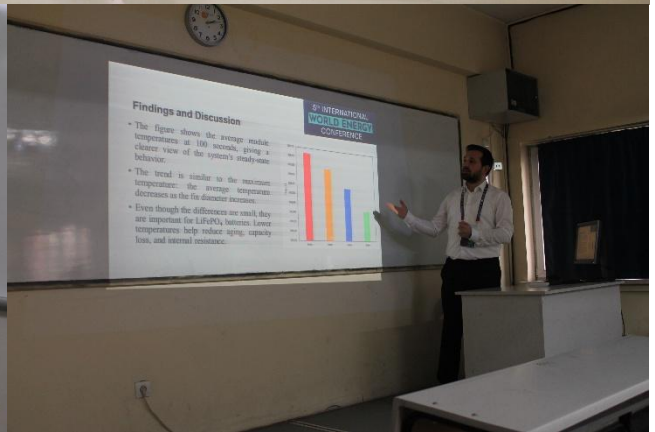
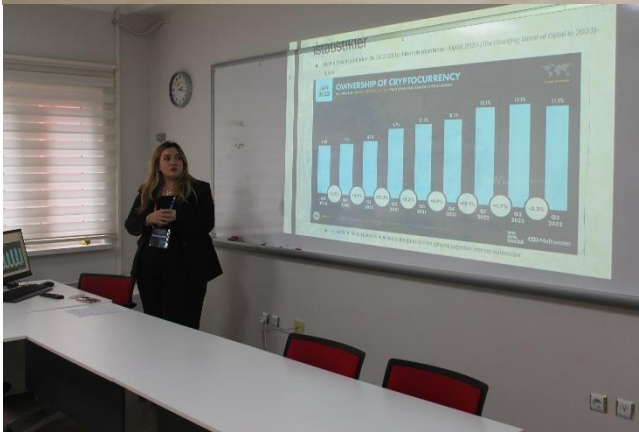
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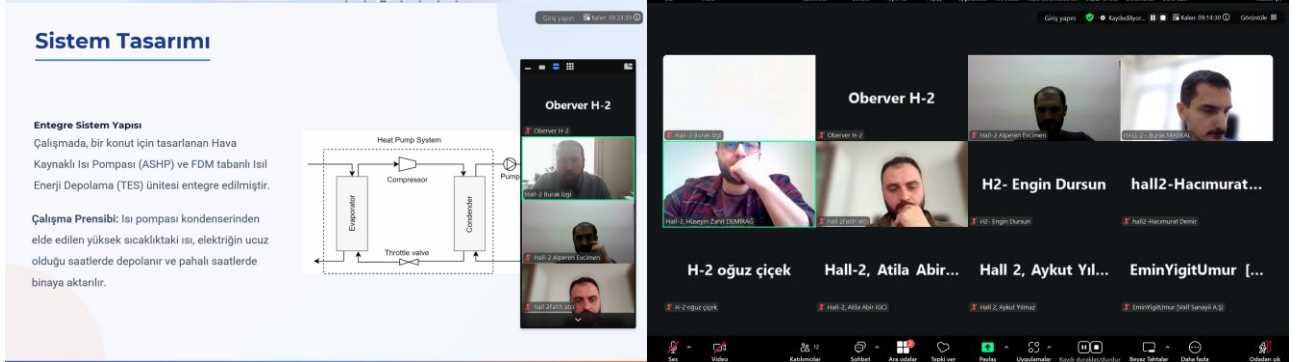
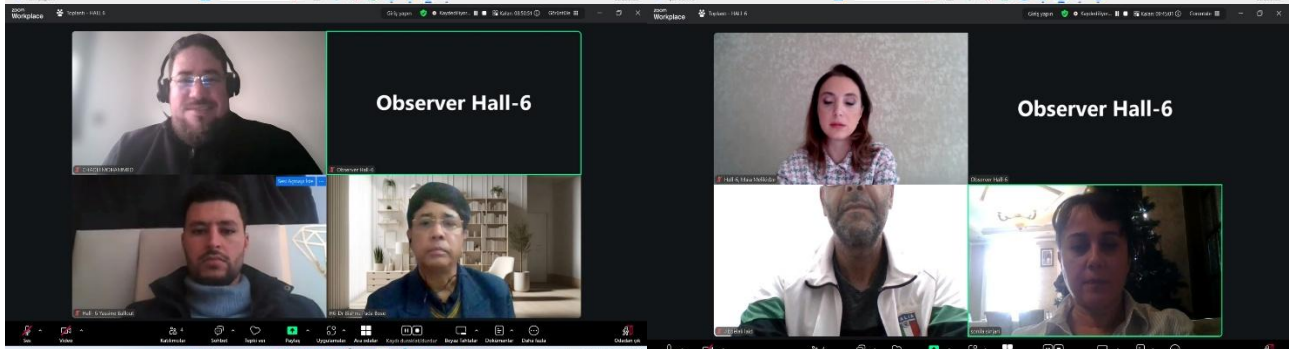
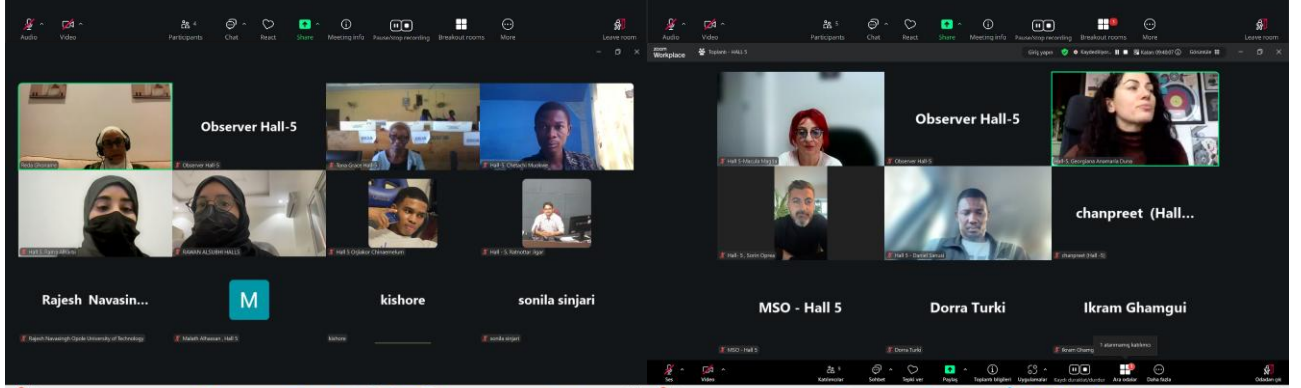
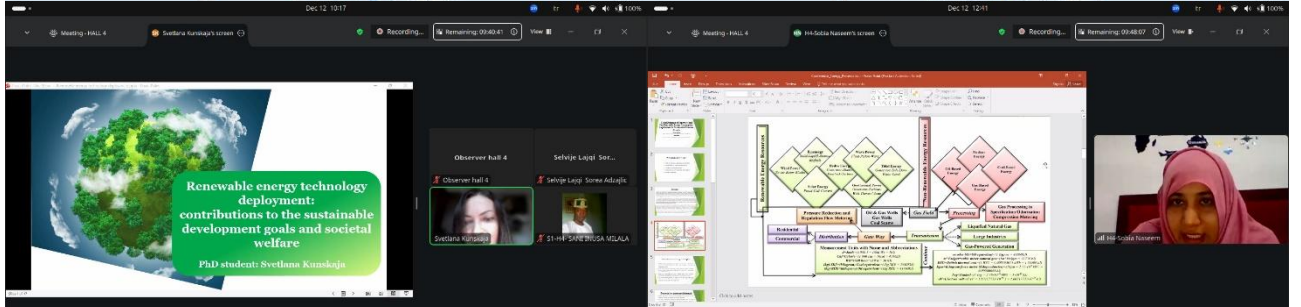
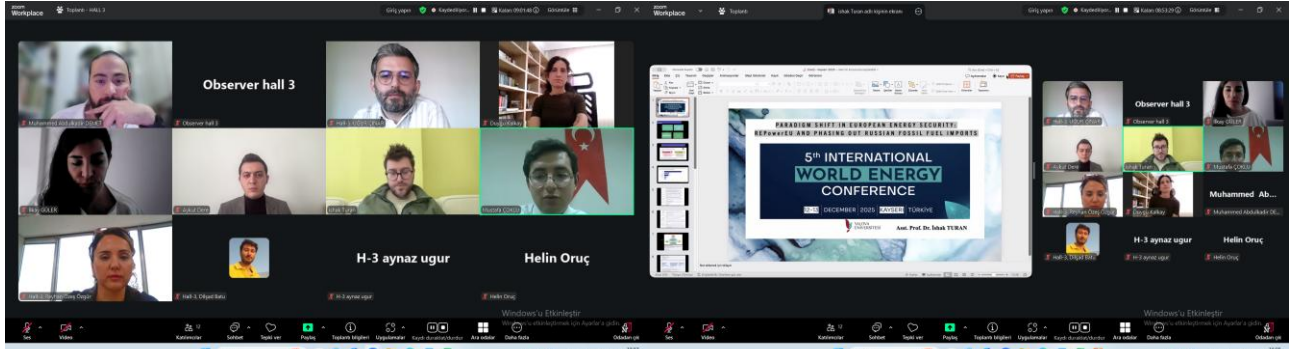












Energy and Performance Analysis According to Pressure Ratio

Case	PR	$\dot{m}_{air}$	$\dot{m}_{fuel}$	$\dot{m}_{air+fuel}$	$\dot{m}_{air+fuel+O_2}$	Thrust _{net}	TFC _{net}
Case 1	5	3677	17331	3916	13.92	28.28	
Case 2	5.5	4167	17626	4200	14.11	27.08	
Case 3	6	4339	18044	4484	14.28	27.22	
Case 4	6.5	4695	18470	4742	14.38	26.97	
Case 5	7	4957	18916	4986	14.46	26.84	
Case 6	7.5	5186	19304	5219	14.53	26.43	
Case 7	8	5385	19743	5440	14.58	26.44	
Case 8	8.5	5560	19921	5641	14.61	26.43	
Case 9	9	5705	19931	5854	14.64	24.26	
Case 10	9.5	5888	19188	6045	14.65	23.92	
Case 11	10	6173	16813	6236	14.65	23.61	

Compressor and Turbine Energy Analysis

Overall Performance Analysis

Participants: Observer H-2, Observer H-2, HANIL, NALKA KOTES, HANIL, YANNA KARAGEORGIOU, HANIL, Mehmet Ceylan.



YENİLENERİLİR ENERJİ SİSTEMLERİNDE EKLEME/İMALAT: 3B ÜRETİLMİŞ İSİ DEĞİSTİRİCİLER, SOĞUTMA YAPILARI VE ENERJİ VERİMLİLİĞİNE KATKILARI

Doç. Dr. Tuğçe Tazek, Prof. Dr. Volkan Kovan
Akdeniz Üniversitesi Mühendislik Fakültesi Makine Mühendisliği

Karbon Karnesi: CO₂ Emisyonları

- Genel Tablo:** 2020-2024 arası G20 toplam emisyonlarında ~%10 artış.
- En Yüksek Emisyon:** Çin (11.172 Mt - Artış sürüyor)
- Azalan Eğilim (Başarı Örnekleri):**
 - ABD:** 2021 zirvesinden sonra düşüş (4.619 Mt)
 - Avrupa (Almanya, İngiltere):** Dönüşüm politikalarıyla belirgin düşüş.
 - Artan Eğilim:** Hindistan, Endonezya, Rusya.

Entity	2020	2021	2022	2023	2024
USA	4460.4	4735.9	4801.0	4845.7	4815.5
China	11713.2	12654.8	12924.5	12924.5	12924.5
Japan	1192.1	1179.8	1191.8	1184.2	1177.1
Germany	176.4	160.3	178.0	170.3	178.3
UK	674.5	598.5	598.1	576.2	571.2
France	417.7	464.8	465.4	486.1	449.2
Canada	1006.7	1007.9	1004.5	1100.7	1110.0
Indonesia	1414.5	1505.4	1586.0	1695.5	1745.4
India	274.9	301.1	271.9	291.1	294.2
Russia	1611.0	1614.8	1574.5	1615.6	1622.0
Australia	600.4	623.2	614.4	607.4	591.3
South Korea	1247.7	1267.3	1265.4	1268.0	1259.4
Italy	244.7	241.5	241.5	244.7	244.4
Japan	1096.0	1099.3	1094.0	1072.0	1070.0
Canada	900.5	900.1	929.6	915.5	923.9
Ukraine	419.2	419.2	419.0	419.3	417.9
Russia	1401.9	1310.0	1387.1	1421.0	1461.1
South Korea	1217.6	1272.4	1269.5	1267.3	1260.4
Ukraine	484.6	430.7	425.1	414.8	412.9

Giriş

Giriş | Giriş | Giriş | Giriş | Giriş

Giriş

Günlümüz kentlerinde mimari çeşitlilik giderek artmakta, özellikle kent salınetine karakter kazandırarak anacıkla farklı geometrilere sahip bina tasarımları daha sık tercih edilmektedir.

Shanghai Tower, Şangay

app,uzunluluk, ekranınuz, paylaşımlar, paylaşımı

Yayımla

Gör

Oberver H-2

Oberver H-2

H2-2: Naciye OBERVER

H2-2: Naciye OBERVER

Kadir Özdemir

Kadir Özdemir

Giriş | Giriş | Giriş | Giriş | Giriş



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12-13 / DECEMBER / 2025 / KAYSERİ / TÜRKİYE

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-OPENING CEREMONY-

DATE: 12.12.2025 / TSI TIME-10⁰⁰ : 10³⁰
VENUE: FACULTY OF ENGINEERING, ERCIYES UNIVERSITY
(F BLOK KONFERANS SALONU)
Moderator: Assist. Prof. Saltuk Buğra SELÇUKLU

Prof. Dr. Mustafa Serdar GENÇ

Erciyes University, Faculty of Engineering, Department of Energy Systems Engineering
HEAD OF CONFERENCE

Serdal KARA

Deputy Chairman of the Kayseri Branch of the Chamber of Mechanical Engineers

Dr. Mustafa Latif EMEK

President of IKSAD Institute

Prof. Dr. Fatih ALTUN

Rector of Erciyes University

- PANEL SESSION-

DATE: 12.12.2025 / TSI TIME-10³⁰ : 12⁰⁰
VENUE: FACULTY OF ENGINEERING, ERCIYES UNIVERSITY
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Moderator: Prof. Dr. Gamze GENÇ

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"TENMAK ve Fırsatları"

Prof. Dr. Recep ULUCAK

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"İklim Değişikliğinin Ekonomik Etkileri"

Adem ÖZDEMİR

RHG Enertürk Enerji Mühendislik ve Teknik Destek Müdürü
"Net-Sıfır Yolculuğunda Sürdürülebilirlik Uygulamaları"

Participant Countries: Albania, Algeria, Azerbaijan, Bangladesh, China, France, Georgia, India, Indonesia, Iran, Iraq, Italy, Kosovo, Lithuania, Malaysia, Morocco, Nigeria, Norway, Poland, Saudi Arabia, Somalia, Spain, Tunisia, Türkiye, UK, USA, Vietnam

12.12.2025 / In-person Session-1 / TSI Time-14⁰⁰:16³⁰



Venue: Erciyes University, Faculty of Engineering



HEAD OF SESSION: Assist. Prof. Dr. Halil HAKAN AÇIKEL

Authors	Affiliation	Presentation title
Assist. Prof. Dr. Duygu Yiğit ÜNLÜ	Aksaray University, Türkiye	USE OF LED LIGHTING SYSTEMS IN CANNABIS CULTIVATION: AN ASSESSMENT OF SPECTRAL CHARACTERISTICS AND EFFICIENCY
Ahmet GÜL Ayşe SAYIN Hasip TUNA Mehmet SAĞER Özlem AYDOĞDU	Pamukkale University, Türkiye Lupamat Makina Sanayii A.Ş., Türkiye	ENERGY EFFICIENCY AND EMISSION PERFORMANCE OF SINGLE- AND TWO-STAGE INDUSTRIAL SCREW COMPRESSORS
Assoc. Prof. Dr. Ahmet AKSOZ Emrah BEYZO	Kayseri University, Türkiye	DESIGN OF A 48VDC AND ADJUSTABLE 105A BATTERY CHARGER USING A THREE-PHASE MAINS INPUT
Assoc. Prof. Dr. Ahmet AKSÖZ Bekir DURSUN	Kayseri University, Türkiye	ENERGY MANAGEMENT IN HYBRID AC/DC MICROGRIDS BASED ON PV, BATTERY, AND GENERATOR: EMS CONTROL ALGORITHM AND OPTIMIZATION
Mehtap ÖZTÜRK Osman Cudi ÇOŞKUN Melih KOYUNCU Salih Buğra ASLAN Assoc. Prof. Dr. Ahmet AKSÖZ	Kayseri University, Türkiye	DEVELOPING SUSTAINABLE E-MOBILITY INFRASTRUCTURE FOR DISABLED INDIVIDUALS WITH PIEZOELECTRIC-BASED ENERGY HARVESTING SYSTEMS

12.12.2025 / In-person Session-2 / TSI Time-14⁰⁰:16³⁰



Venue: Erciyes University, Faculty of Engineering



HEAD OF SESSION: Prof. Dr. Gamze GENÇ

Authors	Affiliation	Presentation title
M.Burak SERT Mert Osman HANİLCİ Bengisu YAVUZ İrem TEKDEN Prof. Dr. Mustafa Serdar GENÇ	Erciyes University, Türkiye	SIGNIFICANCE OF GEOGRAPHICAL CONDITIONS IN THE MICRO-SITING OF WIND ENERGY SYSTEMS
Res. Assist. Dr. Melih MANIR Prof. Dr. Gamze GENC Prof. Dr. Vagif NEVRUZOGLU Dr. Tugba BAYAZIT	Recep Tayyip Erdogan University, Türkiye Erciyes University, Türkiye	PRODUCTION AND INVESTIGATION OF CU AND Cu-Au PLASMONIC NANOPARTICLES WITH AN INNOVATIVE METHOD
Res. Assist. Dr. Melih MANIR Prof. Dr. Gamze GENC Yunus Emre KÖSE Prof. Dr. Vagif NEVRUZOGLU Dr. Tugba BAYAZIT Assist. Prof. Dr. Kemal KUVVET	Recep Tayyip Erdogan University, Türkiye Erciyes University, Türkiye	FABRICATION AND INVESTIGATION OF SURFACE PLASMON RESONANCE (SPR)-EFFECTIVE AuNp/n-Si/Al PHOTODEVICE USING CRYOGENIC TECHNIQUE
Assist. Prof. Dr. Muhammed Murat AKSOY Assoc. Prof. Dr. Tahir DURHASAN Assoc. Prof. Dr. Zehan KESILMIS Prof. Dr. Mustafa Serdar GENÇ	Osmaniye Korkut Ata University, Türkiye Adana Alparslan Turkes Science and Technology University, Türkiye Erciyes University, Türkiye	NANOSCALE ENERGY TRANSPORT IN BORON NITRIDE NANOTUBES FOR HYDROGEN STORAGE: FROM CRYOGENIC TO ELEVATED TEMPERATURES
Alparslan BOZKURT Prof. Dr. Mustafa Serdar GENÇ Assist. Prof. Dr. Sertaç Samed SEYİTOĞLU	Erciyes University, Türkiye Hitit University, Türkiye	OPTIMIZATION OF RENEWABLE ENERGY-BASED HYBRID ENERGY SYSTEMS FOR ELECTRIC VEHICLE CHARGING ON EDİRNE-ANKARA HIGHWAYS

12.12.2025 / In-person Session-3 / TSI Time-14⁰⁰:16³⁰



Venue: Erciyes University, Faculty of Engineering



HEAD OF SESSION: Assoc. Prof. Dr. Şükrü Taner AZGIN

Authors	Affiliation	Presentation title
Assoc. Prof. Dr. Asım Mustafa AYTEN Lect. Dr. İbrahim Hakan GÖVER	Abdullah Gül University, Türkiye	UNIVERSITY STUDENTS' ENVIRONMENTAL AWARENESS AND ENERGY-SAVING BEHAVIORS: AN ANALYSIS ON UN SDG-BASED COURSES
Assoc. Prof. Dr. Eyyüp Ensari ŞAHİN Assoc. Prof. Dr. Gürçem ÖZAYTÜRK Assist. Prof. Dr. Ayyüce MEMİŞ KARATAŞ	Niğde Ömer Halisdemir University, Türkiye	ENERGY PRICING PROJECTIONS WITH A HYBRID MODEL: ANALYSIS OF GLOBAL AND REGIONAL DYNAMICS
Assist. Prof. Dr. Feryade TOKAN ŞENOL Assoc. Prof. Dr. Seçil ÖZAY	Yeditepe University, Türkiye Marmara University, Türkiye	USE OF SOURCES AND FRAMING TENDENCIES IN ENERGY NEWS IN TURKEY
Dr. Serhat BİLGİN Dr. Ebubekir YAŞAR Dr. Mithat ŞİMŞEK Dr. Nurullah GÜLTEKİN	Tokat Gaziosmanpaşa University, Türkiye	BIOCHAR PRODUCTION FROM WASTE SLUDGE USING PYROLYSIS TECHNOLOGY: CARBON SEQUESTRATION, CERTIFICATION, AND MULTI-SECTOR APPLICATIONS
Res. Assist. Muhammed HATEM Prof. Dr. Mustafa Serdar GENÇ	Erciyes University, Türkiye	NUMERICAL INVESTIGATION OF AXIAL COMPRESSORS USED IN COMPRESSED AIR ENERGY STORAGE SYSTEMS
Prof. Dr. Arzu AL Dr. Mustafa Latif EMEK	Marmara University, Türkiye IKSAD Institute, Türkiye	THE ENERGY-DEVELOPMENT RELATIONSHIP POLICY SHIFTS AND GLOBAL IMPACT WITHIN THE FRAMEWORK OF THE FIRST TRUMP TERM (2017–2021)

12.12.2025 / In-person Session-4 / TSI Time-14⁰⁰:16³⁰



Venue: Erciyes University, Faculty of Engineering



HEAD OF SESSION: Prof. Dr. Mustafa Serdar GENÇ

Authors	Affiliation	Presentation title
Res. Assist. Oğuz Kaan ÇİNiCi Prof. Dr. Adem ACIR	Gazi University, Türkiye	NUMERICAL INVESTIGATION OF FIN DIAMETER EFFECT ON THERMAL-HYDRAULIC PERFORMANCE IN PRISMATIC LiFePO ₄ BATTERIES
Prof. Dr. Ercan KARAKÖSE Serhat AKKUŞ	Kayseri University, Türkiye	APPLICATION OF ZnO NANOSTRUCTURES IN AMMONIA (NH ₃) GAS SENSORS
Abdirisak Mohamed Abdillahi Assoc. Prof. Dr. Savaş BAYRAM	African Institute for Multidisciplinary Studies, Somalia Erciyes University, Türkiye	SPATIAL INEQUALITIES IN HOUSEHOLD ENERGY ACCESS ACROSS URBAN, RURAL, AND NOMADIC SETTLEMENTS IN SOMALILAND
Eren Anıl SEZER Eylül ÖNAL Prof. Dr. Mustafa Serdar GENÇ	Erciyes University, Türkiye	EFFECT OF THE LENGTH OF THE SETTLING CHAMBER ON FLOW QUALITY IN BLOWN TUNNEL DESIGN
Nazlı NUR Res. Assist. Sinem KESKİN Prof. Dr. Mustafa Serdar GENÇ	Erciyes University, Türkiye	BOUNDARY-LAYER AND VELOCITY PROFILE ANALYSIS ON A CAMBERED NACA AIRFOIL VIA HOT-WIRE MEASUREMENTS
Eda YILDIZ Res. Assist. Sinem KESKİN Prof. Dr. Mustafa Serdar GENÇ	Erciyes University, Türkiye	DETAILED INVESTIGATION OF THE SEPARATION BUBBLE OVER AIRFOILS WITH TIME-DEPENDENT PRESSURE DATA
Onur YILMAZ Prof. Dr. Mustafa Serdar GENÇ	Erciyes University, Türkiye	ENERGY QUALITY SOLUTION FOR VARIABLE FLOW HYDROELECTRIC POWER PLANTS WITH INTEGRATED CVT TRANSMISSION

12.12.2025 / In-person Session-5 / TSI Time-14⁰⁰:16³⁰



Venue: Erciyes University, Faculty of Engineering



HEAD OF SESSION: Assist. Prof. Saltuk Buğra SELÇUKLU

Authors	Affiliation	Presentation title
Edanur KILIÇ Assist. Prof. Dr. Erhan MUĞALOĞLU	Erciyes University, Türkiye	THE IMPACT OF CARBON PRICING ON ENERGY TRANSITION AND ECONOMIC ACTIVITY: FRANCE AND GERMANY
Dilay SAĞDIÇ	Turkish Electricity Transmission Corporation, Türkiye Ankara University, Türkiye	EVALUATION OF LEGAL CHALLENGES IN CRYPTO CURRENCY TRANSACTIONS IN THE CONTEXT OF ENERGY CONSUMPTION
Sevde ERTÜRK ÇETİNKAYA Assoc. Prof. Dr. Muhammet ÇELİK Prof. Dr. Gamze GENÇ	Erciyes University, Türkiye Aksaray University, Türkiye	COMPARATIVE ECONOMIC ANALYSIS OF OPERATIONAL STRATEGIES FOR BIOGAS-PV-WIND HYBRID SYSTEMS
Aiman Yousef Al Hard Res. Assist. Seda Nur BOZKURT Prof. Dr. Gamze GENÇ	Erciyes University, Türkiye	OPTIMIZING SOLAR ENERGY FORECASTING USING ADVANCED MACHINE LEARNING IN YEMEN
Assoc. Prof. Dr. Ebubekir İNAN Assoc. Prof. Dr. Ahmet AKSÖZ	Kayseri University, Türkiye	PROXIMITY-AWARE EXPLAINABILITY LAYER FOR ENERGY SYSTEM MODELS: A CONCEPTUAL FRAMEWORK
Assoc. Prof. Dr. Ebubekir İNAN Assoc. Prof. Dr. Ahmet AKSÖZ	Kayseri University, Türkiye	PROXIMITY-BASED RESILIENCE MAPPING FOR ENERGY INFRASTRUCTURES: A CONCEPTUAL FRAMEWORK
Yağmur ŞAN Prof. Dr. Ercan ŞENYİĞİT	Erciyes University, Türkiye	ANALYZING AND FORECASTING TURKEY'S RENEWABLE ENERGY EFFICIENCY IN THE WORLD VIA DBSCAN CLUSTERING AND FTS FORECASTING



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HEAD OF SESSION: Prof. Dr. Atılgan ATILGAN

Authors	Affiliation	Presentation title
Prof. Dr. Atılgan ATILGAN Lect. Leyla AKBULUT	Alanya Alaaddin Keykubat University, Türkiye	THE ROLE OF NATURE-BASED SOLUTIONS IN WATER, ENERGY AND ENVIROMENT: A REVIEW EXAMPLE
Prof. Dr. Sedat BOYACI Prof. Dr. Atılgan ATILGAN	Kırşehir Ahi Evran University, Türkiye Alanya Alaaddin Keykubat University, Türkiye	DETERMINATION OF HEATING BOILER CAPACITIES IN GREENHOUSES DEPEND ON ENERGY CONSERVATION
Prof. Dr. Sedat BOYACI Mısra SEZER Meryem Sümeyye EKİZ	Kırşehir Ahi Evran University, Türkiye	EVALUATION OF THE PERFORMANCE OF DIRECT EVAPORATIVE COOLER IN HIGH TUNNEL GREENHOUSE CONDITIONS
Assist. Prof. Dr. Ahmet ŞEKEROĞLU Res. Assist. Vesile ŞİMŞEKOĞLU	Amasya University, Türkiye Konya Technical University, Türkiye	BIOENERGY PRODUCTION BASED ON ENERGY CROPS IN MARGINAL AGRICULTURAL LANDS
Assoc. Prof. Dr. Sadettin ÇELİK	University of Bingol, Türkiye	MULCHING: AN INNOVATIVE APPROACH TO SOIL CONSERVATION AND COMBATING CLIMATE CHANGE
Assoc. Prof. Dr. Sadettin ÇELİK	University of Bingol, Türkiye	STRATEGIC IMPORTANCE OF DIRECT SEEDING AND ITS ROLE IN COMBATING CLIMATE CHANGE
Reyyan KOLCU Prof. Dr. Sevinç YEŞİLYURT	Tekirdağ Namık Kemal Türkiye	USE OF ALGAE IN AGRICULTURE AND CLIMATE CHANGE: NATURAL FERTILIZER, GROWTH REGULATOR, AND SOIL AMENDMENT
Asst. Prof. Dr. Mutlu BULUT	Niğde Ömer Halisdemir University, Türkiye	MODELLING AND FORECASTING ELECTRICITY DEMAND FOR AGRICULTURAL PRODUCTION IN TÜRKİYE USING ARIMA METHODS

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HEAD OF SESSION: Prof. Dr. Burak MARKAL

Authors	Affiliation	Presentation title
Res. Assist. Alperen EVCİMEN Prof. Dr. Burak MARKAL	Recep Tayyip Erdoğan University, Türkiye Karadeniz Technical University, Türkiye	INVESTIGATION OF LIQUID FILM AND VAPOR BUBBLE BEHAVIOUR AROUND A SQUARE PIN-FIN IN A MICRO DOMAIN
Assist. Prof. Dr. Burak İZGİ Assist. Prof. Dr. Hüseyin Zahit DEMİRAĞ Prof. Dr. Mevlüt ARSLAN	Yozgat Bozok University, Türkiye	TECHNO-ECONOMIC ANALYSIS OF HEAT PUMP AND PHASE CHANGE MATERIAL-BASED THERMAL ENERGY STORAGE INTEGRATION
Assist. Prof. Dr. Atila Abir İÇCİ Assist. Prof. Dr. Hüseyin Zahit DEMİRAĞ Assist. Prof. Dr. Burak İZGİ	Yozgat Bozok University, Türkiye	EFFECT OF TRAPEZOIDAL WINGLET TRAILING-EDGE HEIGHT REDUCTION ON HEAT TRANSFER ENHANCEMENT IN PERIODICALLY FULLY DEVELOPED CHANNEL FLOW
Res. Assist. Alperen EVCİMEN Prof. Dr. Burak MARKAL	Recep Tayyip Erdoğan University, Türkiye Karadeniz Technical University, Türkiye	A COMPREHENSIVE REVIEW ON THE PERFORMANCE CHARACTERISTICS OF PULSATING HEAT PIPES: A PARAMETRIC ANALYSIS
Lect. Fatih ATCI Prof. Dr. Burak MARKAL	Karadeniz Technical University, Türkiye	NUMERICAL ANALYSIS OF SINGLE-PHASE FLOW AND HEAT TRANSFER IN A WAVY MICROCHANNEL WITH A ROUGHENED BOTTOM SURFACE
Lect. Fatih ATCI Prof. Dr. Burak MARKAL	Karadeniz Technical University, Türkiye	A NUMERICAL STUDY OF FLOW AND HEAT TRANSFER IN MICROCHANEL HEAT SINK: EFFECT OF MICRO-PIN FIN ORIENTATION ANGLE
Engin DURSUN Emin Yiğit UMUR Oğuz ÇİÇEK	E.C.A Valf Sanayii Manisa, Türkiye	DEVELOPMENT OF A LOCAL AND ENERGY-EFFICIENT ELECTRONIC EXPANSION VALVE (EEV) DRIVER FOR REFRIGERATION SYSTEMS
Aykuş Alp YILMAZ Kader ORHAN Hüseyin GÜR	E.C.A Valf Sanayii Manisa, Türkiye	THERMOSTATIC MIX VALVE DESIGN AND MANUFACTURING

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HEAD OF SESSION: Assoc. Prof. Dr. Muhammet ÇELİK

Authors	Affiliation	Presentation title
Assist. Prof. Dr. Sezer ONBILGIN	Nigde Omer Halisdemir University, Türkiye	DEVELOPMENT OF A THREE-CELL MICROTUBULAR SOFC STACK PROTOTYPE FOR MOBILE APPLICATIONS
Assist. Prof. Dr. Vusala JAFAROVA Assist. Prof. Dr. Doğan ŞENGÜL	Turkic World Research Center, Azerbaijan İstanbul Sabahattin Zaim University, Türkiye	FROM HYDROCARBON CORRIDOR TO GREEN ENERGY CORRIDOR: A SWOT- AND RISK-BASED ASSESSMENT OF ENERGY AND TRANSPORTATION LOGISTICS IN THE TURKIC WORLD
Assist. Prof. Dr. Ceyda KÖK	İskenderun Technical University, Türkiye	THE EFFECT OF FUEL CELL MAXIMUM POWER ON PERFORMANCE IN A FUEL CELL HYBRID VEHICLE
Aytaç ŞANAL Assoc. Prof. Dr. Muhammet ÇELİK	Aksaray University, Türkiye	OPTIMIZATION OF PEM FUEL CELL PERFORMANCE USING ARTIFICIAL INTELLIGENCE METHODS
Bilal GÜLSEVEN Prof. Dr. Gökhan SÜRÜCÜ Prof. Dr. Özge SÜRÜCÜ Assoc. Prof. Dr. Ayşenur GENCER	Gazi University, Türkiye Ankara Yıldırım Beyazıt University, Türkiye Karamanoglu Mehmetbey University, Türkiye	DETERMINATION OF THE HYDROGEN STORAGE PROPERTIES OF Li DECORATED Ti2CF2 MXENES
Zeyad MANSOOR ALSADOON Prof. Dr. Gamze GENÇ	Erciyes University, Türkiye	MODELING AND SIMULATION OF A DIGITAL CONTROL SYSTEM FOR POWER QUALITY IMPROVEMENT USING STATIC VAR COMPENSATION
Chaymae DENDEN	Mohamed First University, Morocco	GLOBAL OPTIMIZATION OF HYDROGEN PRODUCTION SYSTEMS USING MACHINE LEARNING TECHNIQUES
Chaymae DENDEN	Mohamed First University, Morocco	SUSTAINABLE HYDROGEN PRODUCTION AND STORAGE FROM PHOTOVOLTAIC SYSTEMS IN SMART MICROGRIDS
Benlahreche Fatima Zohra Nouicer El amine Yahia Lazhar Hazmoune Hichem Nouicer abdelmadjid	Constantine 1 University, Algeria Batna 2 University, Algeria Oum el bouaghi University, Algeria	ADVANCED ELECTRODE MATERIALS AND NON-NOBLE METAL CATALYSTS FOR EFFICIENT GREEN HYDROGEN PRODUCTION VIA WATER ELECTROLYSIS

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HEAD OF SESSION: Selvije Lajqi

Authors	Affiliation	Presentation title
Abdulgaffar Muhammad	Ahmadu Bello University, Nigeria	MODELING THE CARBON-OIL-FISCAL TRILEMMA: A DERIVATIONAL FRAMEWORK FOR ENERGY JUSTICE AND EMISSION EFFICIENCY IN NIGERIA
Res. Assist. Francisco J. Rey	University of A Coruña, Spain	TECHNOLOGICAL INNOVATION AND SOCIAL ACCEPTANCE IN THE ENERGY TRANSITION: INSIGHTS FOR A RESPONSIBLE AND SUSTAINABLE AI FUTURE
Svetlana KUNSKAJA	Lithuanian Energy Institute, Lithuania	RENEWABLE ENERGY TECHNOLOGY DEPLOYMENT: CONTRIBUTIONS TO THE SUSTAINABLE DEVELOPMENT GOALS AND SOCIETAL WELFARE
Selvije Lajqi Soreja Adzajlic Kushtrim Agaj Venera Kelmendi Dielza Berisha	University "Haxhi Zeka"Pejë, Kosovo	CLEAN ENERGY FOR A SUSTAINABLE WORLD: TECHNOLOGY, POLICY, AND NEW PERSPECTIVES
Dr. Oheiku Aisha Avosuahi	University of Abuja, Nigeria	EVALUATING THE IMPACT OF RENEWABLE ENERGY SYSTEMS ON NURSING WORKFLOW EFFICIENCY AND PATIENT CARE IN RESOURCE-LIMITED SETTINGS: A SYSTEMATIC REVIEW
Artita Permanda Chrisstohfer SM Alif Prawira Basuki Ratna Septiyanti Mega Metalia	Perpajakan Universitas Lampung, Indonesia	ANALYSIS OF THE EQUITY AND EFFECTIVENESS OF THE LUXURY GOODS SALES TAX (PPNBM) EXEMPTION POLICY FOR ELECTRIC VEHICLES (EV) IN INDONESIA
Aminu Yakubu Boyi Sani Inusa Milala	Federal Polytechnic kaltungo, Nigeria Universiti Tun Hussein Onn Malaysia, Malaysia	BEYOND ESG REPORTING: ENERGY RESILIENCE AS A DRIVER FOR STRATEGIC ESTATE VALUATION AND PORTFOLIO REBALANCING
Najiba Mohammadi Prof. Samira Nasirzadeh	Allah Bayt International University, Iraq	THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENERGY DEMAND MANAGEMENT IN SMART CITIES
Moses Adeolu AGOI Yewande Adeyosola ODUNAYO Rasheed Olatunde AJETUNMOBI Akeem Ademola ADEDOKUN	Lagos State University of Education, Nigeria	BLOCKCHAIN TECHNOLOGY FOR PEER-TO-PEER RENEWABLE ENERGY TRADING

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HEAD OF SESSION: Mehedy Hasan Sabby

Authors	Affiliation	Presentation title
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Aymen BAMAAROUF	Hassan II University of Casablanca, Morocco	INTELLIGENT OPTIMIZATION OF ENERGY SHARING IN HYBRID WIND-BASED MICROGRIDS
Aymen BAMAAROUF	Hassan II University of Casablanca, Morocco	INTELLIGENT CONTROL OF ENERGY SHARING IN WIND BASED MICROGRIDS
Helal Uddin Nur Alam Mondal	Hajee Mohammad Danesh Science and Technology University, Bangladesh	MECHANICAL CAD DESIGN AND COMPUTATIONAL FLUID DYNAMICS STUDY OF AN ADVANCED HIGH-SPEED NASA PROPELLER
Drai Ismail Sahnoun Rachid Merouane Habib Yahiaoui Tayeb Slimani Rabeh	Mustapha Stambouli University of Mascara, Algeria	ADVANCED NUMERICAL ANALYSIS AND PERFORMANCE ENHANCEMENT OF DARRIEUS VERTICAL-AXIS WIND TURBINES
Chhavi Mukesh Kumar	Birla Institute of Technology and Science, Pilani- Dubai, United Arab Emirates University of Delhi, India	HYBRID WASTE HEAT RECOVERY FOR ENHANCED AUTOMOTIVE ENERGY EFFICIENCY
Nanda Aulia Rahma	State Islamic University K.H. Abdurrahman Wahid Pekalongan, Indonesia	WOOD BIOMASS GASIFICATION FOR RESOURCE CONSERVATION AND RENEWABLE ELECTRIC ENERGY
Nwaeze Quality Ebube T.O. Daniel	Alex Ekwueme Federal University, Nigeria	BIOENERGY: A SUSTAINABLE SOLUTION TO ENERGY DEMAND
Dr. Mohamad Nurul Azman Mohammad Taib	University of Malaya, Malaysia	RECENT DEVELOPMENT OF NANOCELLULOSE EXTRACTED FROM AGRICULTURAL WASTE FOR ENERGY STORAGE APPLICATIONS

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HEAD OF SESSION: Assist. Prof. Dr. S Suresh

Authors	Affiliation	Presentation title
Assist. Prof. Dr. S Suresh Assist. Prof. Dr. V Bharanigha Niranjana S Jai Akash S	B S Abdur Rahman Crescent Institute of Science and Technology, India	DESIGN AND SIMULATION ANALYSIS OF SOLAR PV-FED THREE-PHASE INTERLEAVED BOOST CONVERTER (SPVTPIBC) WITH MOTOR LOAD FOR E-MOBILITY APPLICATIONS
Adel DELIOU Takieddine Bouklia Samir DJIMLI Mohamed Kemiha Meriem DEHBI Sofiane BOULKROUNE Abdelkader FIDJAH	University of UMSB of Jijel, Algeria University of Djelfa, Algeria Center of Research in Mechanics (CRM), Algeria	STUDY OF THE PERFORMANCE OF A SYMMETRIC SOLAR STILL
Assoc. Prof. Dr. Sonila Sinjari Res. Assist. Klevis Turka Res. Assist. Oltion Pupi Assoc. Prof. Dr. Ferim Gashi	University of Tirana, Albania University of Prishtina, Kosovo	GEOSPATIAL MODELING FOR SOLAR ENERGY. CASE STUDY: HUDENISHT COMMUNE, ALBANIA
Abdelali Laid Abed Zoulikha	University Djillali Liabes of Sidi Bel Abbes, Algeria	MODELLING AND SIMULATION OF CIGS SOLAR CELLS ON THE PERFORMANCE OF ZINC SULFIDE INSULATION LAYER
El Mostafa Benharaf Ikram Mennas Zidane Zohra Abdelhakim Khourchech Ayoub Cherrat Abdellah Zeroual Mohammed El Idrissi	Sultan Moulay Slimane University, Morocco Mohammed V University in Rabat, Morocco	ENERGY-LEVEL ENGINEERING IN ORGANIC SOLAR CELLS: COMPUTATIONAL INSIGHTS INTO QUINOXALINE-BASED DONOR MATERIALS
Dr. Olaore, Kayode Olatunde Dr. Usman, Abdulkareem Dr.Sunday Abayomi John Abdulumuni Zakari	Kwara State Polytechnic, Nigeria	HARNESSING SOLAR ENERGY: AN INVESTIGATION INTO PARABOLIC SOLAR COOKING SYSTEMS FOR PARAFFIN WAX MELTING IN ILORIN KWARA STATE
Karima LAAROUSSI Abdellah EL AISSAOUI Assia HARKANI Saloua JEMJAMI	University Hassan 1st, Morocco National Institute of Agronomic Research, Morocco	LARGE-SCALE MAPPING OF PHOTOVOLTAIC PANELS USING K-MEANS CLUSTERING ON SATELLITE REMOTE SENSING DATA
Belarbi Faten Mohamed Adnane	University of Sciences and Technology Mohamed Boudiaf Oran, Algeria	THEORETICAL STUDY OF CZTS ECOFRIENDLY SOLAR CELL PERFORMANCE SCAPS-1D
Prof. Dr. Maia MELIKIDZE Garik TEYMURAZYAN Tamar TARKHNISHVILI	Business and Technology University, Georgia Georgian Renewable Energy Development Association (GREDA), Georgia Georgian Melioration, Georgia	PROSPECTS FOR THE INTEGRATION OF NET BILLING IN GEORGIA AND ITS IMPACT ON THE DEVELOPMENT OF RENEWABLE (SOLAR) ENERGY

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HEAD OF SESSION: Assoc. Prof. Dr. Aykut Fatih GÜVEN

Authors	Affiliation	Presentation title
Yaradana Çağrı GÖKTEPE Assoc. Prof. Dr. Aykut Fatih GÜVEN	Yalova University, Türkiye	OPTIMIZATION AND TECHNO-ECONOMIC ANALYSIS OF ELECTRIC VEHICLE CHARGING SYSTEMS IN RENEWABLE ENERGY-BASED MICROGRIDS ON UNIVERSITY CAMPUSES
Assoc. Prof. Dr. Aykut Fatih GÜVEN Elif ÇOKKIR Emine ÖNAL	Yalova University, Türkiye	AI-BASED PASSIVE CELL BALANCING IN LITHIUM-ION BATTERY PACKS: A SIMULATION-BASED COMPARISON OF PSO AND GWO ALGORITHMS
Res. Assist. Emine İŞİN Prof. Dr. Nurettin ÇETİNKAYA	Konya Technical University, Türkiye	BATTERY CAPACITY ESTIMATION IN GRID-CONNECTED ENERGY SYSTEMS AND MULTI-CRITERIA OPTIMIZATION APPROACH
Dr. A. Can DUMAN	Turkish-German University, Türkiye	COMPARING OVERNIGHT DEPOT AND OPPORTUNITY CHARGING STRATEGIES FOR BATTERY ELECTRIC BUSES
Res. Assist. Sebahat ALTUNDAG Prof. Dr. Fatih BULUT	Inonu University, Türkiye	SOC ESTIMATION OF LI-ION BATTERIES VIA LINEAR AND NONLINEAR EIS
Assist. Prof. Dr. Yusuf MURATOĞLU Prof. Dr. Alkan ALKAYA	Toros University, Türkiye Mersin University, Türkiye	PERFORMANCE AND STABILITY ANALYSIS OF LITHIUM TITANATE OXIDE BATTERIES IN ENERGY STORAGE SYSTEMS
Assoc. Prof. Dr. Haydar KEPEKCI Mehmet Emin AGCA	Istanbul Gelişim University, Türkiye Independent Researcher, Türkiye	CFD-BASED THERMAL ANALYSIS OF LI-ION BATTERY MODULE WITH DIFFERENT BAFFLE CONFIGURATIONS AND AIRFLOW CONDITIONS
Assoc. Prof. Dr. Şengül ŞANLIER UÇAK	Recep Tayyip Erdogan University, Türkiye	SAFETY AND RELIABILITY CHALLENGES IN SHORE ELECTRIFICATION: A RISK-ORIENTED EVALUATION FOR HYBRID AND ELECTRIC SHIPS

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HEAD OF SESSION: Prof. Dr. Nazan YALÇIN ERİK

Authors	Affiliation	Presentation title
Assoc. Prof. Dr. Okan KON	Balıkesir University, Türkiye	DEEP SEA TRANSPORT AND STORAGE OF CARBON DIOXIDE (CO ₂)
Prof. Dr. Nazan YALÇIN ERİK	Sivas Cumhuriyet University, Türkiye	THE PARADOXICAL ROLE OF COAL IN THE GLOBAL ENERGY SYSTEM: HISTORICAL LEGACY, CONTEMPORARY CRISIS, AND FUTURE PROJECTIONS
Res. Assist. Ömer ÖKSÜZ Prof. Dr. Burak MARKAL	Karadeniz Technical University, Türkiye	INVESTIGATION OF FLOW BOILING PERFORMANCE IN MICROCHANNELS FOR HYDROPHILIC, HYDROPHOBIC, AND HYBRID SURFACES: TECHNIQUES, MECHANISMS, AND APPLICATIONS
Res. Assist. Ömer ÖKSÜZ Prof. Dr. Burak MARKAL	Karadeniz Technical University, Türkiye	THERMAL MANAGEMENT SYSTEMS IN MICROGRAVITY ENVIRONMENTS: HEAT PIPE TECHNOLOGY
Assoc. Prof. Dr. Nazan GÖKŞEN TOSUN Prof. Dr. Cemil ALKAN Res. Assist. Erdinç Halis ALAKARA	Tokat Gaziosmanpaşa University, Türkiye	SYNTHESIS AND CHARACTERIZATION OF MULTIFUNCTIONAL N-DODECANOL@MFB@AG MICROCAPSULES FOR INDOOR THERMAL ENERGY STORAGE APPLICATIONS
Prof. Dr. Cemil ALKAN Assoc. Prof. Dr. Nazan GÖKŞEN TOSUN Res. Assist. Erdinç Halis ALAKARA	Tokat Gaziosmanpaşa University, Türkiye	HYBRID FLAME-RETARDANT MICROCAPSULES BASED ON N-OCTADECANE@MELAMINE-BORIC RESIN@AG FOR EFFICIENT THERMAL ENERGY MANAGEMENT

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HEAD OF SESSION: Prof. Dr. Hatice KANBUR ÇAVUŞ

Authors	Affiliation	Presentation title
Bourama DJONFAGA Prof. Dr. Gokhan SURUCU Assoc. Prof. Dr. Murat ŞAHİN Assist. Prof. Dr. Rıza Görkem OSKAY Prof. Dr. Ali İhsan KARAYİĞİT Assoc. Prof. Dr. Khairul Azlan MUSTAPHA Assist. Prof. Dr. Yakup ÇELİK	Gazi University, Türkiye National Defense University, Türkiye Hacettepe University, Türkiye University Malaya, Malaysia İstanbul University-Cerrahpaşa, Türkiye	A FIRST-PRINCIPLES INVESTIGATION OF THE STRUCTURAL, ELECTRONIC, AND OPTICAL PROPERTIES OF THE 2D SiCI MATERIAL PRELIMINARY EVALUATION OF SOURCE ROCK POTENTIAL USING ROCK-EVAL PYROLYSIS FROM THE MEZARDERE FORMATION SHALES OF LATE EOCENE-OLIGOCENE AGE (SW THRACE BASIN, NW TÜRKİYE)
Assist. Prof. Dr. Rıza Görkem OSKAY Prof. Dr. Ali İhsan KARAYİĞİT Assoc. Prof. Dr. Khairul Azlan MUSTAPHA Enver YILMAZ	Hacettepe University, Türkiye University Malaya, Malaysia İstanbul University-Cerrahpaşa, Türkiye Yılmaz Mining Industry and Trade, Türkiye	ROCK EVAL PYROLYSIS OF A LOW-RANK COAL: INSIGHTS INTO MIDDLE MIOCENE SEAM-II (ÇOMU-YANOĞLAN COALFIELD, İSKİLİP-ÇORUM, TÜRKİYE)
Prof. Dr. Hatice KANBUR ÇAVUŞ Prof. Dr. Berna YAVUZ PEHLİVANLI	Yozgat Bozok University, Türkiye	MORPHOLOGICAL AND STRUCTURAL IMPROVEMENT OF KÜTAHYA-OYSU AMORPHOUS GRAPHITE AFTER LEACHING AND HIGH-TEMPERATURE (1700 °C) TREATMENT: A COMPARATIVE ANALYSIS WITH SEM IMAGES
Prof. Dr. Hatice KANBUR ÇAVUŞ Prof. Dr. Berna YAVUZ PEHLİVANLI	Yozgat Bozok University, Türkiye	CHARACTERIZATION OF RAW GRAPHITE ORE FROM THE KAYSERİ DEPOSIT: MORPHOLOGICAL AND STRUCTURAL ANALYSIS VIA SEM AND XRD
Duriye KÖK	Yorglass Endüstriyel Cam Sanayi Ticaret A.Ş., Türkiye	MULTI-REGIME THERMAL ANALYSIS OF LOW-E GLASS CONFIGURATIONS FOR COMPLIANCE WITH NEXT-GENERATION ENERGY EFFICIENCY REGULATIONS
Ayşe ÜSTÜNEL ÇAVUŞ Assist. Prof. Dr. Raşit SEZER	Karadeniz Technical University, Türkiye	AN INNOVATIVE PROCESS FOR THE PREVENTION OF MERCURY EMISSIONS AND RECOVERY OF VALUABLE MATERIALS FROM WASTE FLUORESCENT LAMPS

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HEAD OF SESSION: Dr. Duong To Quoc Thai

Authors	Affiliation	Presentation title
Muhammad Mohsin Sobia Naseem	Hunan University of Humanities, China	GLOBAL DYNAMICS OF RENEWABLE AND NON- RENEWABLE ENERGY CONSUMPTION: IMPLICATIONS FOR SUSTAINABLE ECONOMIC GROWTH
Dr. Duong To Quoc Thai Dr. Nguyen Van Luan	Dong Thap University, Vietnam	THE ACTIVITIES OF THE BANQUE DE L'INDOCHINE IN THE COAL MINING INDUSTRY IN VIETNAM DURING THE FRENCH COLONIAL PERIOD (1875–1945)
Sonde, R. Dimeji	Olabisi Onabanjo University, Nigeria	ASSESSING THE IMPACT OF ENERGY TRANSITION ON ROAD TRANSPORT EFFICIENCY IN DEVELOPING ECONOMIES
Mihaela Vlădescu Mihaela Oprea	National Institute for Economic Research "Costin C. Kirițescu", Romania	ECONOMIC CAPACITY AND CLIMATE TRANSITION: THE REAL ROLE OF GDP
Ali Akbar Firoozi Ali Asghar Firoozi	University of Botswana, National University of Malaysia (UKM), Malaysia	SOLAR PV-BATTERY INTEGRATION WITH URBAN TRANSPORT CORRIDORS: CIVIL INFRASTRUCTURE DESIGN FOR LOW-CARBON MOBILITY
Ali Akbar Firoozi Ali Asghar Firoozi	University of Botswana, National University of Malaysia (UKM), Malaysia	IoT-ENABLED PUMPING AND DISTRIBUTION SYSTEMS FOR OPTIMIZING THE URBAN WATER-ENERGY NEXUS
Ali Akbar Firoozi Ali Asghar Firoozi	University of Botswana, National University of Malaysia (UKM), Malaysia	NANOMODIFIED AND BIO-BASED ASPHALT MIXTURES FOR ENERGY-EFFICIENT AND DURABLE PAVEMENTS
Ali Akbar Firoozi Ali Asghar Firoozi	University of Botswana, National University of Malaysia (UKM), Malaysia	MANAGING HAZARDOUS MATERIALS IN ENERGY- EFFICIENT BUILDING RETROFITS: A RISK-INFORMED CIVIL ENGINEERING APPROACH
Ali Akbar Firoozi Ali Asghar Firoozi	University of Botswana, National University of Malaysia (UKM), Malaysia	SITING UTILITY-SCALE RENEWABLE ENERGY FACILITIES ON MARGINAL AND BROWNFIELD LANDS: A MULTI-CRITERIA CIVIL ENGINEERING FRAMEWORK
Anna Piwowar Przemysław Jaszak Marcin Bieganski	Wroclaw University of Science and Technology, Poland	DESIGN OF GASKET SURFACES FOR IMPROVED SEALING PERFORMANCE

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HEAD OF SESSION: Prof. Dr. Reda Ghoname

Authors	Affiliation	Presentation title
Faiza Baghida	Moulay Ismail University, Morocco	THE STRUCTURAL, ELECTRONIC, AND THERMOELECTRIC CHARACTERISTICS OF Cu ₂ Se WERE EXAMINED THROUGH FIRST-PRINCIPLES CALCULATIONS BASED ON THE DFT-PBE METHOD
Prof. Dr. Reda Ghoname Rama Alharbi Rawan Alsubhi Malath Alhassan	King Abdulaziz University, Saudi Arabia	HYBRID ENERGY SYSTEM WITH A SMART GRID BY USING ARTIFICIAL INTELLIGENCE
Rajesh Jesudoss Hynes Navasingh Maciej Zdanowski	Opole University of Technology, Poland	SELF-HEALING INSULATING MATERIALS FOR HVDC POWER CABLES
Ratnottar Jigar Dr. Divyang Vyas	Atmiya University, India	AN INTEGRATED MACHINE LEARNING STRATEGY FOR ACCURATE SHORT-TERM HOUSEHOLD ELECTRICITY CONSUMPTION FORECASTING
Mounir BOUTARBOUCH Khadija El-Moustaqim Jamal MABROUKI	Mohammed V University of Rabat, Morocco Ibn Tofail University, Morocco	MECHANISTIC INSIGHTS AND CONTROL STRATEGIES FOR ELECTRODE PASSIVATION IN ELECTROCOAGULATION
Sheikh Tanvir Ahmed	Syracuse University, USA	SELF-RECONSTRUCTING HALIDE POLYMER INTERPHASES FOR DENDRITE-FREE SOLID-STATE LITHIUM-METAL BATTERIES
R. Kishore K. Vaishnavi S. Meenatchi V. Keerthana	Bharath institute of higher Education and research, India	ARTIFICIAL INTELLIGENCE IN ENERGY SYSTEM OPTIMIZATION
Orjiakor Chinaemelum Jude T.O. Daniel	Alex Ekwueme Federal University, Nigeria	RECENT ADVANCEMENTS IN SOLAR CELL TECHNOLOGIES
Chetachi Muokwe T.O. Daniel	Alex Ekwueme Federal University, Nigeria	ENERGY TRANSITION STRATEGIES: FROM FOSSIL FUELS TO RENEWABLES

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HEAD OF SESSION: Dr. Amoo Afeez Oladeji

Authors	Affiliation	Presentation title
Youssef Didi Zakaria El Fatouaki Rodouan Touti Rachid Ahfir Abdellah Tahiri Mohamed Naji Mohamed Idiri Abdelilah Rjeb	Mohamed Ben Abdellah University, Morocco Hassan II University, Morocco Mohammed VI Polytechnic University, Morocco	FIRST PRINCIPLES COMPUTATIONAL STUDY OF MgX_3H_8 ($X = V$ and Fe) FOR HYDROGEN STORAGE APPLICATIONS
Dr. Le Tran Thanh Liem Bui Thi Bich Lien	Can Tho University, Vietnam	HARNESSING AGRICULTURAL AND FORESTRY RESIDUES FOR BIOMASS-BASED ELECTRICITY: OPPORTUNITIES, CHALLENGES, AND POLICY PATHWAYS IN ASIA
S. Deepak A. Palanisamy S. Kalaivanan Lavanya Babu C. Ravi K. Dinesh rajan	Bharath Institute of Higher Education and Research, India	BIOFUEL CELLS FOR POWERING WEARABLE AND IMPLANTABLE MEDICAL DEVICES
Dr. Amoo Afeez Oladeji	Federal University Dutse, Nigeria	TEMPERATURE OPTIMIZATION FOR ENHANCED ANAEROBIC CO-DIGESTION OF VEGETABLE WASTE WITH CATTLE RUMEN CONTENT: MAXIMIZING BIOGAS YIELD
Abdul Waheed Abdullah Shah Hashmi	Bahauddin Zakariya University, Pakistan	ANIMAL DUNG AS ALTERNATIVE FORM OF SOURCE OF METHANE GAS FOR DOMESTIC ENERGY SOURCE
Mohanapriya P Assoc. Prof. Dr. Chamundeeswari M	St. Joseph's College of Engineering, India	BIOENERGY FROM NANOBIODEGRADATION OF DISPOSABLE FACE MASKS USING SOIL MICROBIOME- A BIOECONOMIC APPROACH
Drifa YALAOUI-GUELLAL Lila HADIDI Messaad MOUDACHE	University of Bouira, Algeria	HARNESSING MICROBIAL BIOTECHNOLOGY FOR SUSTAINABLE ENERGY DEVELOPMENT AND ENHANCED ENVIRONMENTAL SUSTAINABILITY
Lila HADIDI Drifa GUELLAL-YALAOUI	University of Bouira, Algeria	Quercus ilex FRUIT SHELLS AS A RENEWABLE BIOMASS FOR SUSTAINABLE ENERGY APPLICATIONS
Chaimae Lamiri Jamal Mabrouki Khadija El-Moustaqim Ayoub Ghailane Younes Abrouki	Mohammed V University in Rabat, Morocco Ibn Tofaïl University—KENITRA, Morocco	GREEN HYDROGEN, AN AFRICAN RESPONSE TO THE CHALLENGE OF CLIMATE CHANGE

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HEAD OF SESSION: Assist. Prof. Dr. Kadriye Filiz BALBAL

Authors	Affiliation	Presentation title
Alireza Esmaeili JOBANI Assist. Prof. Dr. Şükrü Mustafa KAYA	Istanbul Aydın University, Türkiye	INTELLIGENT ENERGY CONSUMPTION PREDICTION USING IoT DATA: COMPARISON OF LSTM AND ML ALGORITHMS
Samet ÖZKÖK Atakan ÇALIŞKAN Meriç ÖZKAYA Assist. Prof. Dr. Kadriye Filiz BALBAL	Dokuz Eylül University, Türkiye	PROJECTION OF ARTIFICIAL INTELLIGENCE-BASED RENEWABLE AND SUSTAINABLE ENERGY RESEARCH
Res. Assist. Dr. Mert ÖKTEN	Manisa Celal Bayar University, Türkiye	SIMULATION-BASED ASSESSMENT OF GASIFICATION PERFORMANCE OF TURKISH COAL TYPES USING MATLAB
Dr. Kaan DEVECİ	Turkish German University, Türkiye	SHORT-TERM MACHINE LEARNING-BASED POWER FORECASTING FOR AN ONSHORE WIND FARM IN TURKEY
Dr. Kaan DEVECİ	Turkish German University, Türkiye	LightGBM-BASED DAY-AHEAD PRICE FORECASTING FOR THE TURKISH DAY-AHEAD ELECTRICITY MARKET
Elif YÜCESOY Assist. Prof. Dr. Hakan IŞIKER Assist. Prof. Dr. Gökhan YÜKSEK	Mersin University, Türkiye Batman University, Türkiye	EVALUATING THE PREDICTIVE CAPABILITY OF BOOSTING ALGORITHMS FOR DATA-DRIVEN WIND TURBINE POWER MODELLING
Assist. Prof. Dr. Gökhan YÜKSEK	Batman University, Türkiye	ATMOSPHERIC INFLUENCES ON PHOTOVOLTAIC POWER OUTPUT: ANALYSIS OF PERFORMANCE DEVIATIONS AND ENERGY LOSSES

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HEAD OF SESSION: Assist. Prof. Dr. Haluk KELEŞ

Authors	Affiliation	Presentation title
Assist. Prof. Dr. Haluk KELEŞ Prof. Dr. Yücel ÖZMEN	Karadeniz Technical University, Türkiye	INVESTIGATION OF CONVECTION HEAT TRANSFER EFFECTS IN IMPINGING SWIRL JETS CONFINED BY PLATES WITH DIFFERENT INCLINATION ANGLES IN HIGH PLATE SPACING
Assist. Prof. Dr. Haluk KELEŞ	Karadeniz Technical University, Türkiye	AN INVESTIGATION ON THE USE OF NICKEL ALUMINUM BRONZE MATERIALS IN HYDRAULIC FLOW MACHINES AND SANITARY APPLICATIONS: THEIR CONTRIBUTION TO SERVICE LIFE
Ekin Can KAYAR Ali ABDEL JAWAD Prof. Dr. Ünal ÇAMDALI	Ankara Yıldırım Beyazıt University, Türkiye	ENERGY AND ENTROPY ANALYSIS FOR MATERIAL DEFORMATION PROCESSES
Assist. Prof. Dr. Emrehan GÜRSOY Assist. Prof. Dr. Kemal KUVVET Assoc. Prof. Dr. Mehmet GÜRDAL Prof. Dr. Engin GEDİK	Recep Tayyip Erdoğan University, Türkiye Kastamonu University, Türkiye Karabük University, Türkiye	ENTROPY GENERATION ANALYSIS OF VARIOUS METAL FOAM MATERIALS: A NUMERICAL ANALYSIS ON MATERIAL TYPE ORDER, POROSITY, AND PORE DENSITY
Fatma Nur HERGÜL Prof. Dr. Ünal ÇAMDALI	Ankara Yıldırım Beyazıt University, Türkiye	ENERGY AND EXERGY ANALYSIS FOR TURBOJET ENGINE PERFORMANCE
Assist. Prof. Dr. Mehmet DOYMUŞ	Dokuz Eylül University, Türkiye	BIOMETHANE AS AN ALTERNATIVE MARINE FUEL: POTENTIAL, BENEFIT, AND BARRIERS
Dr. Rıfki BAYRAM İrem ÜMİT	Metallurji İnşaat Taah. San. ve Tic.Ltd.Şti., Türkiye	WAVE ENERGY

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HEAD OF SESSION: Asst. Prof. Dr. Reyhan ÖZEŞ ÖZGÜR

Authors	Affiliation	Presentation title
Asst. Prof. Dr. Reyhan ÖZEŞ ÖZGÜR	Istanbul Gelisim University, Türkiye	THE MACROECONOMIC EFFECTS OF CARBON REDUCTION POLICIES: A STUDY ON SWEDEN
Assist. Prof. Dr. Aynaz UĞUR	Inonu University, Türkiye	THE PROTECTION OF ENERGY INVESTMENTS IN INTERNATIONAL INVESTMENT LAW
Assoc. Prof. Dr. Perihan Hazel KAYA Prof. Dr. Coşkun KUŞ Mustafa ÇOKLU Assoc. Prof. Dr. Mustafa Göktuğ KAYA	Selçuk University, Türkiye Ministry of Treasury and Finance, Türkiye	ENERGY CONSUMPTION, RENEWABLE ENERGY AND ECONOMIC GROWTH: THE BRICS COUNTRY EXAMPLE
Prof. Dr. Erdal ARSLAN Muhammed Abdulkadir DEMET	Selçuk University, Türkiye	THE RELATIONSHIP BETWEEN GREEN GROWTH AND SUSTAINABLE DEVELOPMENT IN TÜRKİYE
Assist. Prof. Dr. İshak TURAN	Yalova University, Türkiye	PARADIGM SHIFT IN EUROPEAN ENERGY SECURITY: REPowerEU AND PHASING OUT RUSSIAN FOSSIL FUEL IMPORTS
Aykuş DERE Assit. Prof. Dr. İlkey GÜLER	Ankara Hacı Bayram Veli University, Türkiye	ARE THE RENEWABLE ENERGY RESOURCES SOLUTIONS FOR CURRENT ACCOUNT DEFICIT? AN EVIDENCE FROM SELECTED E7 COUNTRIES
Assist. Prof. Dr. Mehmet Serdar ÇELİK Assist. Prof. Dr. Gökçe TUĞDEMİR KÖK Assist. Prof. Dr. Elif KOÇ Assist. Prof. Dr. Duygu KALKAY	Bandırma Onyeddi Eylül University, Türkiye Mersin University, Türkiye	FINANCIAL RISKS OF ENVIRONMENTAL SUSTAINABILITY IN PORT AND TERMINAL OPERATIONS: ANALYSIS OF ENERGY PRICE VOLATILITY WITH THE GARCH MODEL 2
Assoc. Prof. Dr. Altuğ KARABEY Dilşad BATU	Van Yüzüncü Yıl University, Türkiye	EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER USING SINGLE AND MULTIPLE AIR JETS IMPINGEMENT COOLING IN A FLAT PLATE
Prof. Dr. Seyfettin ERDOĞAN Prof. Dr. Durmuş Çağrı YILDIRIM Dr. Uğur ÇINAR	İstanbul Medeniyet University, Türkiye Tekirdağ Namık Kemal University, Türkiye	ENVIRONMENTAL DEGRADATION IMPLICATIONS OF PAKISTAN'S ENERGY PORTFOLIO: EVIDENCE FROM FOURIER APPROACHES

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HEAD OF SESSION: Assoc. Prof. Dr. Valbona Cinaj

Authors	Affiliation	Presentation title
Dr. Amirouche BOUAMER Res. Assist. Kamal SEDDA Res. Assist. Abdelkader SAFOU Dr. Faiza BENLAKHDAR	Research Centre in Industrial Technologies (CRTI), Algeria	STRUCTURAL, MORPHOLOGICAL, AND DIELECTRIC CHARACTERIZATION OF POLYVINYL ALCOHOL / CALCIUM TITANATE NANOCOMPOSITE
Faisal MUHAMMAD	University of Peshawar, Pakistan	KINETICS AND THERMO-CATALYTIC PYROLYSIS OF CITRUS WASTES IN PRESENCE AND ABSENCE OF NATURAL CATALYST PUMICE
Faisal Nazir	University of Agriculture, Pakistan	PRODUCTION AND CHARACTERIZATION OF CARBON NANOTUBES FROM BIOCHAR UNDER MICROWAVE IRRADIATION
Assoc. Prof. Dr. Valbona Cinaj Rebeka Ribaj	Albanian University, Albania	DEVELOPMENTS IN GREEN ENERGY: THE IMPACT ON THE DIGITALIZATION OF THE TRANSPORT SECTOR IN ALBANIA
Noshin Amina Rajsree Biswas Kaniz Fatema Bintey Patwary Shahid Ullah	International Islamic University Chittagong, Bangladesh	OPTIMIZING POWER GENERATION IN HYDROELECTRIC PLANTS USING AN IMPROVED HYDRAULIC TURBINE AND GOVERNOR MODEL
Mohammed Abdullah Ayoun Helena Khatoon	Chattogram Veterinary and Animal Sciences University, Bangladesh	INTEGRATED BIOPROCESS OPTIMIZATION FOR SUSTAINABLE BIOFUEL PRODUCTION FROM MICROALGAE
Ali Akbar Firoozi Ali Asghar Firoozi	University of Botswana, National University of Malaysia (UKM), Malaysia	AI-DRIVEN DIGITAL TWINS FOR ENERGY-EFFICIENT OPERATION OF CIVIL INFRASTRUCTURE CAMPUSES
Ali Akbar Firoozi Ali Asghar Firoozi	University of Botswana, National University of Malaysia (UKM), Malaysia	LIFE-CYCLE ENERGY AND CARBON ASSESSMENT OF LOW-CARBON CONCRETE MIXTURES FOR STRUCTURAL APPLICATIONS
Dr. Musa R. Titus	University of Jos, Nigeria	AI FOR CLIMATE CHANGE MODELLING AND RENEWABLE ENERGY DEVELOPMENT

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HEAD OF SESSION: Georgiana Anamaria DUNĂ

Authors	Affiliation	Presentation title
Georgiana Anamaria DUNĂ Sorin Alin OPREA Maria-Magdolna MACULA	National Institute for Economic Research "Costin C. Kirilăescu", Romania	SHAPING THE ECONOMY OF THE FUTURE: DIGITAL TRANSFORMATION, ENERGY TRANSITION AND REGIONAL CONVERGENCE
Daniel SANUSI Prof. Dr. James UHOMOIBHI	Veritas University, Nigeria Ulster University, UK	ARTIFICIAL INTELLIGENCE AS AN ACTUARIAL EQUALISER: ADVANCING ENERGY RISK ASSESSMENT AND EDUCATIONAL CAPACITY IN EMERGING ECONOMIES
Chanpreet Prof. Dr. Rajpal Singh Prof. Dr. Shalu Khanak Naiya	Maharshi Dayanand University, India	IMPACT OF GREEN MARKETING ON INVESTMENT IN RENEWABLE ENERGY FIRMS
F. N. Osuolale Prof. Dr. G. O. Tona Assoc. Prof. Dr. I. G. Adebayo Prof. Dr. O. O. Agbede	Ladoke Akintola University, Nigeria	INTEGRATING RENEWABLE ENERGY INTO NIGERIA'S ENERGY POLICY MIX – A REVIEW
Dr. Michael Sunday OLAYEMI Dr. Atabek MOVLYANOV Dr. Oluwamayowa Opeyimika OLAJIDE	Kogi State Polytechnic, Nigeria IKSAD Institute, Türkiye	ENERGY FINANCE SHOCKS AND CONDITIONAL VOLATILITY IN OIL-DEPENDENT ECONOMIES: A MULTIVARIATE DCC-GARCH ANALYSIS
Dr. Dorra TURKI	University of Sfax, Tunisia	ENERGY CONSUMPTION AND FISCAL–MONETARY INTERACTIONS IN TUNISIA
Dr. Ameni MTIBAA	University of Orléans, France	EXPLORING THE CO ₂ EMISSION EFFECTS OF FISCAL CONSOLIDATION: INSIGHTS FROM DEVELOPING COUNTRIES
Dr. Amir SAADAOU Dr. Ikram Ghamgui FRIKHA	University of Sfax, Tunisia	THE ROLE OF ESG PERFORMANCE IN SHAPING THE LINK BETWEEN CO ₂ EMISSIONS AND CREDIT RATING ANNOUNCEMENTS
Prof. Dr. Sunil Kumar Agrawal	People's University, India	A CASE STUDY ON THE EFFECTIVENESS OF THE FOSSIL FUEL INDUSTRY'S LOBBYING AND COMMUNICATION STRATEGIES
NOUI Abderrahmane GUESBAYA Zineb	Center for Scientific and Technical Research on Arid Regions CRSTRA – Biskra – Algeria University of Biskra, Algeria	ENVIRONMENTAL AND HEALTH IMPACTS OF FRENCH NUCLEAR TESTS IN ALGERIA ON GROUNDWATER

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HEAD OF SESSION: Prof. Dr. Skender DEMAKU

Authors	Affiliation	Presentation title
Prof. Dr. Skender DEMAKU Dr. Betim Ismajli Arbnorë Aliu Donika Sylejmani	University of Prishtina "Hasan Prishtina", Kosovo	DETERMINATION OF HEAVY METAL CONTAMINATION AND POLLUTION INDICES OF ATMOSPHERIC DUST IN TC "KOSOVA A&B", OBILIÇ-KOSOVO
Y. Ballout Y. El Miz H. El Harouachi D. Ahoudi M. Elgettafi R. Hakkou M. Loutou	University Mohammed first, Morocco Cadi Ayyad University (UCA), Morocco University Mohammed VI polytechnic (UM6P), Morocco	LOW CONSUMPTION ENERGY AND UNIFORM IRRADIATION THROUGH MICROWAVE CURING FOR THE SYNTHESIS OF IOT BASED GEOPOLYMERS
Yassine Ballout Mohammed Elgettafi Hanane El Harouachi Dounia Ahoudi Yassine El Miz Mohamed Loutou	Mohamed First University (UMP), Morocco Cadi Ayyad University (UCA), Morocco	FROM MINING TAILINGS TO ADVANCED MATERIALS: A REVIEW OF ACTIVATION TECHNIQUES AND GEOPOLYMER SYNTHESIS PATHWAYS
Prof. Assoc. Skender Demaku Muhamet Kiqina Arbnorë Aliu Donika Sylejmani	University of Prishtina "Hasan Prishtina", Kosovo	CHEMICAL ANALYSIS OF ATMOSPHERIC DUST AROUND THE KISHNICA AREA IN THE MUNICIPALITY OF GRACANICA
Rajaa Diany Mohammed Salah	Sultan Moulay Slimane University, Morocco Chouaib Doukkali University, Morocco	EXPLOITING SUNLIGHT WITH PORPHYRINS: A QUANTUM- CHEMICAL AND IMPEDANCE SPECTROSCOPY INVESTIGATION FOR DSSCs
A. Arif B. Boukili M. K. Atouailaa A. Aboulouard M. Boulghalat M. El idrissi	Sultan Moulay Slimane University, Morocco	QUANTUM-CHEMICAL INVESTIGATION OF NOVEL ORGANIC DYES FOR HIGH-EFFICIENCY DSSCs: A DFT/TD- DFT STUDY
Rajab Yahyazadeh Zahra Hashempour	Islamic Azad University, Iran	QUANTUM EFFICIENCY IN GaN/InGaN SOLAR CELLS UNDER HYDROSTATIC PRESSURE AND TEMPERATURE
Mohammed CHADLI Mohammed OUACHEKRADI Prof. Dr. Yasser KARZAZI	Mohamed 1st University, Morocco	DESIGNING HIGH-EFFICIENCY D-Π-A ORGANIC DYES FOR SOLAR CELLS: A DFT and TD-DFT INVESTIGATION OF ACCEPTOR VARIATIONS AND THEIR PHOTOVOLTAIC IMPACTS
Dr. Bishnu Pada Bose	Indian Institute of Technology Kharagpur, Kharagpur, India	INNOVATIVE PATHWAYS FOR CIRCULAR ECONOMY: REPURPOSING COAL MINE WASTE IN CONSTRUCTION MATERIALS

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HEAD OF SESSION: Assoc. Prof. Dr. Abdullah ÜZÜM

Authors	Affiliation	Presentation title
İlker Fatih GÜNGÖR Assoc. Prof. Dr. Abdullah ÜZÜM	Karadeniz Technical University, Türkiye	COMPARATIVE EVALUATION OF SINGLE AND DOUBLE HTL DESIGNS IN PEROVSKITE SOLAR CELLS
Sefer Altan ÇELTİK Assoc. Prof. Dr. Abdullah ÜZÜM	Karadeniz Technical University, Türkiye	PERFORMANCE ANALYSIS OF THINNER SILICON SOLAR CELLS FOR HIGH-EFFICIENCY PHOTOVOLTAICS
Dr. Ömer GÖNÜL	Turkish-German University, Türkiye	COMPARATIVE ANALYSIS OF MACHINE LEARNING AND DEEP LEARNING TECHNIQUES FOR SHORT-TERM SOLAR RADIATION PREDICTION
Mustafa Erkan GÖNÜL Prof. Dr. Engin KARATEPE	Ege University, Türkiye	VOLTAGE VARIATIONS IN DISTRIBUTION SYSTEMS CONSIDERING TIME-CORRELATED PHOTOVOLTAIC SYSTEM AND LOAD DYNAMICS
Assoc. Prof. Dr. Faruk UGRANLI Eşref DENİZ Kağan Berk TUNA Engin KARATEPE	İzmir Bakırçay University, Türkiye Entegro Enerji Sistemleri Ar-Ge Merkezi, Türkiye Ege University, Türkiye	GRID CODE COMPLIANCE OF PHOTOVOLTAIC POWER PLANTS CONSIDERING P-Q CAPABILITY CURVES
Assoc. Prof. Dr. Faruk UGRANLI Eşref DENİZ İsmail Eren DÖĞÜCÜ Engin KARATEPE	İzmir Bakırçay University, Türkiye Entegro Enerji Sistemleri Ar-Ge Merkezi, Türkiye Ege University, Türkiye	INFRARED THERMOGRAPHY BASED FAULT DETECTION IN PV POWER PLANTS: LIMITATIONS, TECHNOLOGICAL BOTTLENECKS, FUTURE RESEARCH PATHWAYS

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HEAD OF SESSION: Assoc. Prof. Dr. Veysel YILMAZ

Authors	Affiliation	Presentation title
Lect. Dr. Sinan GÜNEŞ Assist. Prof. Dr. Esra KESKİN	Ankara University, Türkiye	SUSTAINABLE FACILITY MANAGEMENT IN HIGHER EDUCATION: A SYSTEMATIC REVIEW OF RECENT ADVANCES AND FUTURE DIRECTIONS
Assist. Prof. Dr. Esra KESKİN Lect. Dr. Sinan GÜNEŞ	Ankara University, Türkiye	THE STRATEGIC ROLE OF FACILITY MANAGEMENT IN ACHIEVING SUSTAINABLE DEVELOPMENT GOALS
Assoc. Prof. Dr. Oğuzhan ERDOĞAN	Burdur Mehmet Akif Ersoy University, Türkiye	CLIMATE DIPLOMACY AND COP
Assoc. Prof. Dr. Veysel YILMAZ	Tokat Gaziosmanpasa University, Türkiye	TURNING POINT IN THE GLOBAL ENERGY TRANSITION: THE 2025 ENERGY REPORT CARD OF G20 COUNTRIES
Assoc. Prof. Dr. Veysel YILMAZ	Tokat Gaziosmanpasa University, Türkiye	TURKEY'S STRATEGIC RELATIONS WITH ITS NEIGHBORS IN ENERGY TRADE: IMPORTS AND EXPORTS DURING THE PERIOD 2016–2025
Dr. Ahmet SARNIÇ	Gendarmerie and Coast Guard Academy, Türkiye	INTER-INSTITUTIONAL COORDINATION IN THE PHYSICAL SECURITY OF NUCLEAR POWER PLANTS: A CRISIS AND RISK MANAGEMENT PERSPECTIVE
Asst. Prof. Dr. Burçin ULUĞ Hüseyin İNAL	Hasan Kalyoncu University, Türkiye	THE PROCESS OF EUROPEANISATION IN EUROPEAN UNION ENERGY POLICIES FOLLOWING THE RUSSIA-UKRAINE WAR: THE CASE OF GERMANY
Erol Emre SAYIL	Ankara Yıldırım Beyazıt University, Türkiye	REFLECTIONS OF THE 1973 OIL CRISIS IN CUMHURİYET NEWSPAPER

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HEAD OF SESSION: Assist. Prof. Dr. Mahmut TUĞLUER

Authors	Affiliation	Presentation title
Res. Assist. Ezgi AVCI Prof. Dr. Esmâ MIHLAYANLAR	Trakya University, Türkiye	INVESTIGATION OF INTEGRATION OF PHOTOBIOREACTOR (PBR) SYSTEMS TO BUILDING ENVELOPE
Assist. Prof. Dr. Olcay Türkan YURDUGÜZEL	Yozgat Bozok University, Türkiye	INNOVATIVE AND SUSTAINABLE HOUSING SOLUTIONS: ENERGY-EFFICIENT DESIGN APPROACHES FOR THE SOS 2024 COMPETITION
Assist. Prof. Dr. Mahmut TUĞLUER Assist. Prof. Dr. Mert ÇAKIR	Kahramanmaraş Sütçü İmam University, Türkiye	ASSESSMENT OF THE CURRENT STATUS OF URBAN GREEN SPACE AND CARBON STORAGE POTENTIAL IN TÜRKİYE
Assist. Prof. Dr. Mahmut TUĞLUER Assist. Prof. Dr. Sinan KORDON	Kahramanmaraş Sütçü İmam University, Türkiye	TÜRKİYE'S BLUE CARBON ECOSYSTEMS: ECOLOGICAL FUNCTIONS AND IMPORTANCE
Lect. Hülya ALGUR MARŞOĞLU Lect. Selin Rüya ÇAKIR	Istanbul Gelisim University, Türkiye	EVALUATION OF REFUNCTIONALIZED BUILDINGS IN TERMS OF SUSTAINABILITY AND ACCESSIBILITY: THE EXAMPLE OF RAMI LIBRARY
İsmail ÖZDEMİR Prof. Dr. Atilla BIYIKOĞLU	Gazi University, Türkiye	ENERGY OPTIMIZATION AND FEASIBILITY ANALYSIS OF CARBON CAPTURE AND STORAGE (CCS) SYSTEMS IN COAL-FIRED THERMAL POWER PLANTS UNDER CARBON PRICING SCENARIOS

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HEAD OF SESSION: Khadija MANHOU

Authors	Affiliation	Presentation title
Helal Uddin Touhidur Rahman Sajib Rasel Ahmed	Hajee Mohammad Danesh Science and Technology University, Bangladesh Multimedia University, Malaysia Rajshahi University of Engineering & Technology, Bangladesh	INTERNET OF VEHICLES (IOV)-BASED CYBERNETIC ROBOT OPERATION AND MONITORING SYSTEM ASSISTED BY RENEWABLE ENERGY
Helal Uddin Nur Alam Mondal	Hajee Mohammad Danesh Science and Technology University, Bangladesh	A BIM-CFD HYBRID WORKFLOW FOR COASTAL COMMUNITIES TO DESIGN WIND-RESILIENT ROOF STRUCTURES
Epheusus O. Fatunmbi	Federal Polytechnic, Nigeria	SIGNIFICANCE OF NONLINEAR THERMAL RADIATION AND ACTIVATION ENERGY ON FREE-CONVECTIVE MHD NANOFLUID FLOW OVER A STRETCHING DISK
Res. Assist. Bajram LEKA Prof. Dr. Astrit BARDHI Res. Assist. Ledio LUKU	Polytechnic University of Tirana, Albania	STUDY OF INSOLATED SYNCHRONOUS GENERATOR UNDER UNBALANCED LOAD CONDITIONS
Khadija MANHOU Houria DAKAK Rachid MOUSSADEK Abdelmjid ZOUAHRI Driss Hmouni	Ibn Tofail University, Morocco National Institute of Agricultural Research, Morocco International Center for Agricultural Research in Dry Areas (ICARDA), Morocco	ASSESSMENT OF SALINE IRRIGATION IMPACTS ON SOIL QUALITY AND DURUM WHEAT PRODUCTIVITY IN THE GHARB REGION: IMPLICATIONS FOR SUSTAINABLE WATER AND ENERGY MANAGEMENT
Shafiul Muznabin Al-Muttakin Suvo Rasidul Hassan Shikha Rani Shil	Pabna University of Science and Technology (PUST), Bangladesh	IMPACT OF CLEAN ENERGY POLICIES ON CO ₂ EMISSIONS: A COUNTRY-LEVEL REVIEW
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Dr. Vidya Sunil Kadam Dhanashri Nagappa Chandkoti Vaishnavi Manik Salgar	Rajarambapu Institute of Technology Rajaramnagar affiliated to Shivaji University Kolhapur, India	SOCIO-BEHAVIORAL DYNAMICS INFLUENCING SOLAR ENERGY ADOPTION IN THE RURAL CONTEXT OF WALWA TALUKA, SANGLI

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Denisa KUKAJ Assoc. Prof. Dr. Sonila SINJARI Xhesian BALILI	University of Tirana, Albania	GEOSPATIAL MONITORING OF AIR QUALITY IN TIRANA
Asoc. Prof. Dr. Sonila Sinjari Res. Assist. Oltion Pupi Asoc. Prof. Dr. Ferim Gashi	University of Tirana, Albania University of Prishtina, Kosovo	LEVERAGING LOCAL SOLAR RESOURCES IN A HYDROPOWER-DOMINATED SYSTEM: POLICY AND PLANNING LESSONS FROM THE DURRËS REGION (ALBANIA)
Habib Olaniyi ALIU Rotimi Jamiu OLASINA	Federal Polytechnic Iloro, Nigeria	A STREAMLINED MACHINE LEARNING METHOD FOR PREDICTING URBAN HEAT ISLAND INTENSITY IN NIGERIAN CITIES USING ENVIRONMENTAL AND DEMOGRAPHIC FACTORS
Manika Chaudhary Abhishek Kumar Verma	Central University of Punjab, India	ENERGY-FOOD NEXUS IN EMPTYING HIMALAYAS: RENEWABLE ENERGY GOVERNANCE, NFSA IMPLEMENTATION, AND ENVIRONMENTAL VULNERABILITY IN UTTARAKHAND'S GHOST VILLAGES
Dr. Desi SIANIPAR Sozanolo TELAUMBANUA	Universitas Kristen Indonesia, Indonesia Sekolah Tinggi Teologi Setia, Indonesia	FORESTS AS PEDAGOGICAL SPACES FOR ENERGY RESILIENCE: CHRISTIAN RELIGIOUS EDUCATION AND ECOLOGICAL CURRICULUM DESIGN IN POST-DISASTER INDONESIA
Babita Gupta	Integral University, India	THE POLITICAL ECONOMY OF DECARBONIZATION: CHALLENGES AND PATHWAYS IN RENEWABLE ENERGY TRANSITIONS
Muhammad Aminu Musa Ishaku Gunda Abdullahi Muhammad Abdullahi Gambo Nurudeen Arigu Muhammad	Kampala International University, Uganda Ahmadu Bello University, Nigeria	EVALUATING THE INFLUENCE OF PCM IN VARIOUS PARTS OF BUILDING ENVELOPES FOR ENERGY SAVING IN THE HOT DRY CLIMATE OF NIGERIA
Dr. Jogendra Kumar	GBPIET Pauri Garhwal Uttarakhand, India	WASTE MANAGEMENT FOR SUSTAINABLE ENERGY
Anik Biswas	Trine University, USA	PERFORMANCE ANALYSIS OF SOLAR PANEL EFFICIENCY UNDER DIFFERENT WEATHER CONDITIONS

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HEAD OF SESSION: Maria HARJA

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Hannah Nathaniel Shamle Hulda Maxwell Davwet Asabe Edward Bash Clementina Hashimu Bulus	University of Jos, Nigeria	EFFECTS OF ENVIRONMENTAL EDUCATION ON THE USE OF ALTERNATIVE SOURCE OF ENERGY TO REDUCE THE DEPLETION OF ORGANIC MATTER IN PLATEAU STATE, NIGERIA
Lasha Kavelashvili Ketevan Gordeziani Zaal Tsinadze	Georgian Technical University, Georgia	WATER RESOURCES ENGINEERING AND MANAGEMENT IN GEORGIA
Piyush Kumar Mukesh Kumar	University of Delhi, India	HARVESTING POWER: NEXT-GENERATION TECHNOLOGIES FOR AUTOMOTIVE WASTE HEAT RECOVERY (WHR)
Lect. Muhammad Sajid Amin Assist. Prof. Dr. Muhammad Umer Quddoos Muhammad Akram Arslan Ahmad Siddiqi Assist. Prof. Dr. Muhammad Muzaffar Hameed	The Islamia University of Bahawalpur, Pakistan Bahauddin Zakariya University, Pakistan ConnecTech Private Limited, Pakistan	UNDERSTANDING THE DYNAMICS OF FINANCIAL AND ENVIRONMENTAL SUSTAINABILITY: A WAVELET EXPLORATION OF S&P 500 SUSTAINABILITY INDEX, DIGITAL CURRENCY BITCOIN, GOLD, AND CARBON EMISSIONS FUTURES
Masud Amran Sumel	Metropolitan University, Bangladesh	UNDERSTANDING THE ENVIRONMENTAL EFFECTS OF GLOBALIZATION: HOW TRADE AND INDUSTRY CONTRIBUTE TO CLIMATE CHANGE AND ECOSYSTEM LOSS
Diana HANGANU Diana HARJA Maria HARJA	Gheorghe Asachi Technical University of Iasi, Romania "Grigore T. Popa" University of Medicine and Pharmacy, Romania	OFLOXACIN PRESENCE IN THE ENVIRONMENT: TOXIC EFFECTS AND REMOVAL METHODS
Mihaela Fanache (Vasiliu) Alexandru Olaru Maria HARJA	Gheorghe Asachi Technical University of Iasi, Romania "Grigore T. Popa" University of Medicine and Pharmacy, Romania	VALORIZATION OF WASTE GLASS AS A STRATEGY FOR ENVIRONMENTAL PROTECTION AND THE PRODUCTION OF SUSTAINABLE COMPOSITE MATERIALS
Claudiu GOREA Maria HARJA	Gheorghe Asachi Technical University of Iasi, Romania	PHASE CHANGE MATERIALS: A SUSTAINABLE APPROACH TO ENERGY EFFICIENCY AND THERMAL ENERGY STORAGE
Loubna BELBEDJ Rachad MOUMNI Idriss BENLALLOUI Amor FEZZAN	University of Batna 2 Mostefa Benboulaid, Algeria University of Djelfa, Algeria Higher National School of Renewable Energies, Algeria	PI STRATEGY FOR STABLE OPERATION OF PV–WIND HYBRID SYSTEMS WITH DISO DC/DC CONVERTER

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HEAD OF SESSION: Assoc. Prof. Dr. Aysun ALTİKAT

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Assoc. Prof. Dr. Aysun ALTİKAT	Iğdır University, Türkiye	THE EFFECT OF HEMP-BASED MATERIALS ON CARBON FOOTPRINT: LIFE CYCLE ANALYSIS IN BIOCOMPOSITE AND CONSTRUCTION INDUSTRY
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Prof. Dr. Hüseyin TOPAL Nesrin DOĞAN	Gazi University, Türkiye	THERMOECONOMIC ANALYSIS OF APPLICATIONS TO REDUCE CARBON FOOTPRINT IN COAL-FIRED THERMAL POWER PLANTS
Assoc. Prof. Dr. Tuğçe TEZEL Prof. Dr. Volkan KOVAN	Akdeniz University, Türkiye	ENVIRONMENTAL IMPACT OF ADDITIVE MANUFACTURING: ENERGY USE AND CO ₂ EMISSIONS IN A LIFE CYCLE FRAMEWORK
Assoc. Prof. Dr. Tuğçe TEZEL Prof. Dr. Volkan KOVAN	Akdeniz University, Türkiye	ADDITIVE MANUFACTURING IN RENEWABLE ENERGY SYSTEMS: 3D-PRINTED HEAT EXCHANGERS, COOLING STRUCTURES AND THEIR CONTRIBUTION TO ENERGY EFFICIENCY

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İsmail Furkan DALDAL Assoc. Prof. Dr. Faruk UGRANLI	İzmir Bakırçay University, Türkiye	INVESTIGATION OF DC POWER FLOW MODELING UNDER HIGH WIND POWER PENETRATION
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Ahmet Özkan KIRLI Assoc. Prof. Dr. Barış GÜREL Assist. Prof. Dr. Kadir ÖZDEMİR	Süleyman Demirel University, Türkiye Istanbul Health and Technology University, Türkiye	NUMERICAL INVESTIGATION OF A SAVONIUS WIND TURBINE WITH DIFFERENT BLADE OVERLAP DISTANCES
Eren Berk SAÇ Assoc. Prof. Dr. Sercan DOĞAN	Konya Technical University, Türkiye	OpenFOAM-BASED INVESTIGATION OF CORNER RADIUS EFFECTS ON THE FLOW OVER A SURFACE-MOUNTED SQUARE
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Saikot Hasan Akhi Akther	Bangladesh Agricultural University, Bangladesh University of Rajshahi, Bangladesh	SMART GRID AND RENEWABLE INTEGRATION: A GLOBAL STUDY ON ENERGY EFFICIENCY, SUSTAINABILITY, AND FUTURE CHALLENGES
Amina Yahia	Oum el bouaghi University, Algeria	TOWARDS ENERGY SUSTAINABILITY IN ALGERIA: OPTIMIZATION OF HYBRID AND RENEWABLE ENERGY SYSTEMS USING GEOGRAPHIC INFORMATION SYSTEMS (GIS)
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Dr. Alok Kumar Shrivastav Dhruba Shil Arnab De Milan Sasmal Gargi Roy Deboduyti Upadhaya	JIS College of Engineering, India	HYBRID INDUCTIVE-CAPACITIVE LCLC- COMPENSATED WIRELESS POWER TRANSFER SYSTEM WITH ADAPTIVE IMPEDANCE AND ALIGNMENT CONTROL FOR HIGH- POWER ELECTRIC VEHICLE CHARGING
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Ana-Maria CIOBOTARU Marian MARIN Alexandru-Sabin NICULA Emanuela-Adina NICULA Radu- Daniel PINTILII	University of Bucharest, Romania "Gheorghe Balș" Technical College, Romania Romanian Academy, National Institute for Economic Research "Costin C. Kirilescu", Romania	ROMANIA'S PATH TO ONE-THIRD RENEWABLES: OPPORTUNITIES AND CHALLENGES
Prof. Dr. Laura DIACONU MAXIM Prof. Dr. Cristian C. POPESCU Prof. Dr. Mihai-Bogdan PETRIȘOR	"Alexandru Ioan Cuza" University of Iasi, Romania	COST-BENEFIT ANALYSIS OF ENERGY-EFFICIENT TECHNOLOGIES IN SUSTAINABLE BUILDING DESIGN

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Mohammed Ouachekradi Yasser Karzazi	Mohammed First University, Morocco	TERMINAL ACCEPTOR ENGINEERING IN D-A 1 -A 2 SMALL-MOLECULE DONORS TOWARD HIGH-EFFICIENCY ORGANIC SOLAR CELLS: INSIGHTS FROM DFT, TD-DFT, AND MOLECULAR DYNAMICS SIMULATIONS
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Saeeda Mubashra Tanzeela Riaz	Government College University Faisalabad, Pakistan	METAL SULFIDE PHOTOCATALYSTS: PROGRESS AND CHALLENGES IN SOLAR ENERGY CONVERSION
Abdelali Laid Abed Zoulikha	University Djillali Liabes of Sidi Bel Abbes, Algeria	ASSESSMENT OF THE ZINC SULFIDE INSULATION LAYER'S IMPACT ON CIGS SOLAR CELL EFFICIENCY
Belarbi Faten	Abdelhamid Ibn Badis University, Algeria	ENHANCING THIN-FILM PHOTOVOLTAIC SUSTAINABILITY USING SPRAY-DEPOSITED Cu_2SnS_3 ABSORBERS
Brahim AZZIMANI Yasser KARZAZI	Mohammed First University, Morocco	THEORETICAL STUDY OF NEW D- π -A ARCHITECTURE ORGANIC MATERIALS FOR APPLICATION IN DYE-SENSITIZED SOLAR CELLS
Mohd Kaif Abdul Rehman Bhavani Singh Abdul Hannan	Aligarh Muslim University, India	THE IMPACT OF SOLAR POWER SETUP IN RURAL AREAS OF RAJASTHAN: A SOCIAL DEVELOPMENT PERSPECTIVE
Youssef Ech-chine Mohammed Jami	Mohammed 1st University, Morocco	NUMERICAL INVESTIGATION OF THERMO-HYDRAULIC PERFORMANCE IN SOLAR AIR HEATER DUCT WITH NOVEL RIB ROUGHNESS GEOMETRY

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HEAD OF SESSION: Prof. Dr. Mustafa Serdar GENÇ

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Ikram Mennas Prof. Dr. Mohammed El Idrissi	Sultan Moulay Slimane University, Morocco	DFT/TD-DFT BASED COMPUTATIONAL STUDY OF NON- FULLERENE ACCEPTORS FOR ENHANCED ORGANIC SOLAR CELLS
Francisco J. Rey	Universidade da Coruña, Spain	PUBLIC PERCEPTIONS OF THE ENERGY TRANSITION IN THE CONTEXT OF TECHNOLOGICAL INNOVATION
Sneha Ghosh Dr. Subhasis Roy	University of Calcutta, India	Ag-Doped WO ₃ /TiO ₂ PHOTOELECTRODE FOR EFFICIENT GREEN HYDROGEN PRODUCTION VIA PEC WATER SPLITTING
Atreyee Hazra Dr. Subhasis Roy	University of Calcutta, India	HYDROGEN PRODUCTION VIA SEAWATER SPLITTING USING NaSiCon MEMBRANES: A SUSTAINABLE APPROACH
Burak AYDIN Prof. Dr. Mustafa Serdar GENÇ Prof. Dr. Gamze GENÇ	Erciyes University, Türkiye	RHEOLOGICAL EFFECTS OF MATERIAL SEQUENCING IN CATHODE SLUDGE FORMULATION FOR LITHIUM-ION BATTERIES
Jacopo C. Alberizzi Abdelaadim Khriss Aissa Kerkour Elmiad Mohammed Badaoui Massimiliano Renzi	Free University of Bozen - Bolzano, Italy Mohammed Premier University, Morocco	OPERATIONAL OPTIMIZATION OF BATTERY SWAPPING STATIONS WITH PHOTOVOLTAIC: A MILP-HEURISTIC COMPARISON
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Bouchra Bourhabi Latifa Mouhir	Hassan II University, Morocco	ECO-BRICKS FROM DAM SEDIMENTS: A CIRCULAR SOLUTION FOR SUSTAINABLE CONSTRUCTION
Ishaku Michael Christopher	Federal University of Technology Minna, Nigeria	GREEN AND RESILIENT INFRASTRUCTURE: LOW-CARBON DESIGN AND DAYLIGHTING AS A NATURE-BASED SOLUTION FOR SUSTAINABILITY OF CHURCH ARCHITECTURE IN ABUJA, NIGERIA

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SPEKTRAL ÖZELLİKLER VE VERİMLİLİK ÜZERİNE BİR DEĞERLENDİRME****Duygu Yiğit Ünlü**

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Özet

Bu çalışmada, kenevir (*Cannabis sativa* L.) yetiştiriciliğinde LED aydınlatma sistemlerinin spektral tasarımları ve enerji verimliliği odaklı kullanımı incelenmiştir. Işığın bitki fizyolojisi üzerindeki çok boyutlu etkileri; fotosentez, fotoperiyotizm ve fotomorfogenez ile birlikte değerlendirilmiş; kenevirin büyüme hızı, morfolojisi ve fitokimyasal içeriği özellikle kannabinoid ve terpen bileşenleri, ışık spektrumu, yoğunluğu (PPFD) ve fotoperiyod gibi çevresel faktörlere yüksek düzeyde duyarlılık gösterdiği ortaya konmuştur. Çalışmada ayrıca, LED teknolojilerinin sunduğu spektral özelleştirme imkânı, verim ve kalite artışı potansiyeli analiz edilmiştir.

Mavi (420–450 nm) ve kırmızı (600–700 nm) dalga boylarının fotosentetik aktivite ve morfolojik yapı üzerindeki etkileri incelenmiş; tam spektrum uygulamalarının monokromatik ışıklara kıyasla daha dengeli büyüme ve yüksek metabolit konsantrasyonu sağladığı belirlenmiştir. 800–1000 $\mu\text{mol m}^{-2}\text{s}^{-1}$ PPFD aralığında tam spektrum LED'lerin çiçeklenme evresinde verimi maksimize ettiği; 300–500 PPFD düzeyindeki düşük yoğunluklu uygulamaların ise köklendirme ve erken gelişim evrelerinde etkili olduğu görülmüştür. Mavi ışığın kompakt morfolojiyi ve terpen üretimini, kırmızı ışığın ise THC sentezini desteklediği saptanmıştır.

Enerji verimliliği açısından LED sistemlerinin, düşük ısı üretimi, uzun ömür ve spektral kontrol avantajlarıyla geleneksel HPS (High Pressure Sodium) sistemlerine kıyasla üstünlük sağladığı ortaya konmuştur. Ancak çalışmada, ışık optimizasyonunun CO₂ seviyesi, sıcaklık, nem ve mineral beslenme gibi çevresel faktörlerle birlikte değerlendirilmesi gerektiği de vurgulanmıştır. Çalışma, yapay zeka destekli spektrum ayarlamaları, bitki mimarisiyle uyumlu aydınlatma stratejileri ve sürdürülebilir enerji modelleri gibi geleceğe dönük araştırma alanlarını işaret ederek, kenevir üretiminde bilimsel ve ekonomik sürdürülebilirlik için yol gösterici bir çerçeve sunmuştur.

Anahtar kelimeler: *Cannabis sativa* L., LED aydınlatma, ışık spektrumu, ışık akışı yoğunluğu, kannabinoid üretimi, enerji verimliliği

**USE OF LED LIGHTING SYSTEMS IN CANNABIS CULTIVATION: AN ASSESSMENT OF
SPECTRAL CHARACTERISTICS AND EFFICIENCY****Abstract**

This study examined the spectral design and energy-efficient use of LED lighting systems in cannabis (*Cannabis sativa* L.) cultivation. The multifaceted effects of light on plant physiology were evaluated, including photosynthesis, photoperiodism, and photomorphogenesis. It was revealed that cannabis growth rate, morphology, and phytochemical content, particularly kannabinoid and terpene components, are highly sensitive to environmental factors such as light spectrum, intensity (PPFD), and photoperiod. The study also analyzed the spectral customization capabilities offered by LED technologies and the potential for yield and quality enhancement.

The effects of blue (420–450 nm) and red (600–700 nm) wavelengths on photosynthetic activity and morphological structure were investigated, and full-spectrum applications were found to provide more balanced growth and higher metabolite concentrations compared to monochromatic light. Full-spectrum LEDs in the 800–1000 $\mu\text{mol m}^{-2}\text{s}^{-1}$ PPFD range were found to maximize yield during the flowering phase, while lower-intensity applications of 300–500 PPFD were effective during rooting and early developmental stages.

Blue light was found to promote compact morphology and terpene production, while red light promoted THC synthesis.

In terms of energy efficiency, LED systems have been shown to offer advantages over traditional HPS (High Pressure Sodium) systems, thanks to their advantages of low heat generation, long lifespan, and spectral control. However, the study also emphasized that light optimization should be considered in conjunction with environmental factors such as CO₂ levels, temperature, humidity, and mineral nutrition. The study outlines future research areas such as AI-assisted spectrum adjustments, lighting strategies compatible with plant architecture, and sustainable energy models, providing a guiding framework for scientific and economic sustainability in cannabis production.

Keywords: Cannabis sativa L., LED lighting, light spectrum, light flux density, cannabinoid production, energy efficiency

ENERGY EFFICIENCY AND EMISSION PERFORMANCE OF SINGLE- AND TWO-STAGE INDUSTRIAL SCREW COMPRESSORS**Ahmet GÜL**

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Abstract

Compressed air systems used in industrial facilities are among the energy-intensive components of production processes and represent a significant share of both operating costs and environmental impacts. In this study, the energy efficiency and carbon emission performance of single-stage and two-stage screw compressors were comparatively investigated.

In single-stage compressors, the compression process takes place within a single rotor group, resulting in higher discharge temperatures, which in turn reduce the system's isentropic efficiency. In contrast, two-stage compressors, with their intercooler-supported dual rotor configuration, operate closer to ideal isothermal compression, thereby reducing energy consumption by approximately 15–25%. Calculations considering an annual operating time of 8,000 hours revealed that two-stage systems can achieve an annual reduction of approximately 476 tons of CO₂ emissions compared to single-stage systems. This difference stems from decreased energy consumption and contributes significantly to operational efficiency and long-term sustainable production goals.

Life cycle cost assessments indicated that energy expenditures account for more than 80% of the total cost of ownership. Although two-stage systems involve a higher initial investment, their lower specific energy consumption (kWh/m³) and higher isentropic efficiency result in a payback period of approximately 1.5–2 years. Furthermore, systems supported by variable speed drive (VSD) technology demonstrate additional efficiency gains under partial load conditions.

The results obtained clearly show that two-stage screw compressors present a technically, economically, and environmentally superior alternative in terms of reducing energy consumption and carbon emissions. These findings emphasize the strategic importance of two-stage compression technology in achieving sustainability goals in industrial applications.

Keywords: Screw Compressor, Single Stage, Two Stage, Energy Efficiency, Carbon Emission, Sustainability

ENDÜSTRİYEL VİDALI KOMPRESÖRLERDE TEK VE ÇİFT KADEME UYGULAMALARININ ENERJİ VERİMLİLİĞİ VE EMİSYON PERFORMANSLARI**Özet**

Endüstriyel tesislerde kullanılan basınçlı hava sistemleri, üretim süreçlerinin enerji yoğun bileşenleri arasında yer almakta olup, işletme maliyetleri ve çevresel etkiler açısından önemli bir paya sahiptir. Bu çalışmada, tek ve çift kademeli vidalı kompresörlerin enerji verimliliği ve karbon emisyon performansları karşılaştırmalı olarak incelenmiştir.

Tek kademeli kompresörlerde sıkıştırma işlemi tek bir rotor grubunda gerçekleştirildiği için sıkıştırma sonu sıcaklığı yükselmekte, bu durum da sistemin izentropik verimini düşürmektedir. Buna karşılık, çift kademeli

kompresörler ara soğutmalı iki aşamalı rotor grubu yapısı sayesinde ideal izotermal sıkıştırmaya daha yakın çalışmakta ve böylece enerji tüketimini yaklaşık %15–25 oranında azaltmaktadır. Yapılan hesaplamalar, yıllık 8.000 saatlik çalışma süresi dikkate alındığında, çift kademeli sistemlerin tek kademeli sistemlere kıyasla yılda yaklaşık 476 ton CO₂ emisyon azaltımı sağladığını ortaya koymaktadır. Bu fark, enerji tüketimindeki düşüşten kaynaklanmakta olup, uzun vadede işletme verimliliğine ve sürdürülebilir üretim hedeflerine önemli katkı sağlamaktadır.

Yaşam döngüsü maliyeti değerlendirmelerinde, enerji harcamalarının toplam sahip olma maliyetinin %80'inden fazlasını oluşturduğu belirlenmiştir. Çift kademeli sistemlerin daha yüksek ilk yatırım maliyetine karşın, düşük özgül enerji tüketimi (kWh/m³) ve yüksek izentropik verimlilik değerleri sayesinde yatırım geri dönüş süresi 1,5–2 yıl aralığında gerçekleşmektedir. Ayrıca, değişken hızlı sürücü (VSD) teknolojisi ile desteklenen sistemlerde kısmi yük koşullarında ek verimlilik artışı elde edilmektedir.

Elde edilen sonuçlar, çift kademeli vidalı kompresörlerin enerji tüketimini ve karbon emisyonlarını azaltma potansiyeli bakımından teknik, ekonomik ve çevresel açıdan üstün bir alternatif olduğunu ortaya koymaktadır. Bu bulgular, endüstriyel uygulamalarda sürdürülebilirlik hedeflerine ulaşmada çift kademeli sıkıştırma teknolojisinin stratejik önemini vurgulamaktadır.

Anahtar Kelimeler: Vidalı Kompresör, Tek Kademe, Çift Kademe, Enerji Verimliliği, Karbon Emisyonu, Sürdürülebilirlik

**DESIGN OF A 48VDC AND ADJUSTABLE 105A BATTERY CHARGER USING A THREE-PHASE MAINS INPUT****Ahmet AKSOZ**

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Abstract

This study aims to design and implement a high-power battery charging system powered by a three-phase mains supply, with a 48 V output and adjustable voltage between 0 and 105 A. Operating at a power level of approximately 5 kW, this system utilizes a 2 - Switch Forward topology as the isolated DC-DC converter structure. This topology offers significant advantages, particularly in industrial battery chargers, due to its lower switching voltage, simplified magnetic reset mechanism, and improved efficiency in high-power applications. The power conversion chain in this study consists of an input EMI filter, a rectifier and pre-charge circuit, a DC-link capacitor bank, an isolated converter, a synchronous rectifier stage, and a low-ripple output filter. The three-phase 400 V AC voltage received from the mains is rectified via a three-phase diode bridge and converted to a DC-link voltage of approximately 540 V. This high-voltage DC-link forms the input of the designed forward converter and determines the power flow of the system. GaN or SiC MOSFET switches for the converter are selected for the 650–800 V class, and the magnetic design, turns ratio, and core material are determined to provide optimal efficiency at 5 kW. The use of synchronous rectification in the output stage significantly reduces total power losses and increases system efficiency, particularly due to the low output voltage and high current requirements. A low-ESR filter is also used to reduce ripple. The CC-CV (constant current-constant voltage) method is used for charge control, and current and voltage feedback are continuously monitored with high-accuracy shunt and Hall-effect sensors. Protection mechanisms such as thermal management, EMI reduction, overcurrent, overvoltage, and short-circuit protection support system reliability. The results of this study will provide important engineering insights for the design of modular, high-performance, and cost-effective battery chargers for three-phase systems.

Keywords: Baattery Charger, 2 - Switch Forward, 3 Phase, 48VDC Output, High efficiency, High Current

3 FAZLI ŞEBEKE GİRİŞİ KULLANILARAK 48VDC VE AYARLI 105A BATARYA ŞARJ CİHAZI TASARIMI**Özet**

Bu çalışma, üç fazlı elektrik şebekesinden beslenen, 48V çıkışa sahip ve 0–105A arasında ayarlanabilir yüksek güçlü bir batarya şarj sisteminin tasarımını ve gerçekleştirilmesini amaçlamaktadır. Yaklaşık 5 kW güç seviyesinde çalışan bu sistemde, izolasyonlu DC-DC dönüştürücü yapısı olarak 2-switch forward topolojisi tercih edilmektedir. Bu topoloji, yüksek güç uygulamalarında daha düşük anahtar gerilim stresi, basitleştirilmiş manyetik reset mekanizması ve gelişmiş verimlilik sunması nedeniyle özellikle endüstriyel batarya şarj cihazlarında önemli avantajlar sağlamaktadır. Çalışmada, güç dönüştürme zinciri; giriş EMI filtresi, doğrultma ve pre-charge devresi, DC-link kapasitör bankı, izolasyonlu dönüştürücü, senkron doğrultma katı ve düşük dalgalanmalı çıkış filtresinden oluşmaktadır. Şebekeden alınan üç fazlı 400V AC gerilim, üç fazlı diyot köprüsü üzerinden doğrultularak yaklaşık 540V seviyesinde bir DC-link gerilimine dönüştürülmektedir. Bu yüksek gerilimli DC-link, tasarlanacak olan forward dönüştürücünün girişini oluşturmakta ve sistemin güç akışını belirlemektedir. Dönüştürücüde kullanılacak GaN veya SiC MOSFET anahtarlar 650–800V sınıfında seçilmekte; manyetik tasarım, dönüş oranı ve çekirdek malzemesi ise 5 kW seviyesinde optimal verim

sağlayacak şekilde belirlenmektedir. Çıkış katında senkron doğrultma yönteminin kullanılması, özellikle düşük çıkış gerilimi ve yüksek akım gereksinimi nedeniyle toplam güç kayıplarını önemli ölçüde azaltmakta ve sistem verimini artırmaktadır. Ayrıca ripple düşürme amacıyla düşük ESR'li filtre kullanılmıştır. Şarj kontrolünde CC-CV (sabit akım – sabit gerilim) yöntemi uygulanmakta; akım ve gerilim geri beslemeleri yüksek doğruluklu şönt ve hall-effect sensörlerle sürekli izlenmektedir. Termal yönetim, EMI azaltımı, aşırı akım, aşırı gerilim ve kısa devre gibi koruma mekanizmaları sistemin güvenilirliğini desteklemektedir. Bu çalışma ile elde edilecek sonuçlar, üç fazlı sistemler için modüler, yüksek performanslı ve maliyet etkin batarya şarj cihazlarının tasarımına yönelik önemli mühendislik çıktıları sunacaktır.

Anahtar Kelimeler: Batarya şarj cihazı, 2-Anahtarlı Forward, 3- fazlı, 48V DC çıkış, Yüksek verim, Yüksek Akım.

**ENERGY MANAGEMENT IN HYBRID AC/DC MICROGRIDS BASED ON PV, BATTERY, AND GENERATOR: EMS CONTROL ALGORITHM AND OPTIMIZATION****Ahmet AKSÖZ**

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Abstract

This study aims to design an Energy Management System (EMS) for hybrid AC/DC microgrids integrating photovoltaic (PV) systems, battery energy storage units, and generators, and to analyze it using a MATLAB-based optimization approach. The integration of both AC and DC buses within the same microgrid architecture is expected to enhance the efficiency of PV sources and reduce energy conversion losses.

Initially, a system comprising PV units, a battery, and AC loads will be designed. The proposed system will be tested under three distinct scenarios: high PV generation, low PV generation, and high load demand. Based on the obtained results, the battery system will operate efficiently within its state of charge (SoC) limits, and the microgrid will achieve optimal performance both technically and economically. Subsequently, in cases of high load demand, the operating periods and fuel costs of the integrated generator will be calculated.

According to the study findings, mathematical models of the PV, battery, and generator components will be developed, and power flow equations will be formulated to match the hybrid AC/DC architecture. An EMS control algorithm will be developed, considering PV generation, load profile, battery SoC, and generator operating constraints. To enhance the economic performance of the EMS, an optimization function incorporating generator fuel cost, battery degradation, and power flow constraints will be implemented in MATLAB.

In conclusion, this study contributes to the design of multi-source EMSs in hybrid microgrids and represents an engineering output that can be further improved through the integration of real-time control hardware and advanced artificial intelligence-based optimization methods.

Keywords: Hybrid Microgrid, Energy Management System, Photovoltaic, Energy Storage.

HİBRİT AC/DC MİKRO ŞEBEKELERDE PV, BATARYA VE JENERATÖR TABANLI ENERJİ YÖNETİMİ: EMS KONTROL ALGORİTMASI VE OPTİMİZASYONU**Özet**

Bu çalışmada, hibrit AC/DC mikro şebekelerde fotovoltaiik (PV) sistemler, batarya enerji depolama birimi ve jeneratörün birlikte kullanıldığı bir enerji yönetim sistemi (EMS) tasarlamak ve MATLAB tabanlı optimizasyon yaklaşımı ile analiz etmek hedeflenmiştir. Mikro şebekede hem AC hem DC baraların aynı yapı içerisinde bütünleşik olarak kullanılması, fotovoltaiik kaynakların daha verimli çalıştırılmasına ve enerji dönüştürme kayıplarının azaltılmasını sağlayacaktır.

Çalışmada öncelikli olarak PV, batarya ve AC yük bulunan sistem tasarlanacaktır. Tasarlanan sistem üç farklı senaryo altında test edilecektir: yüksek PV üretimi, düşük PV üretimi ve yüksek yük talebi durumları. Elde edilen verilere göre batarya sistemi şarj durumu (State of Charge – SoC) sınırları dahilinde yüksek verimle çalıştırılmış, mikro şebeke ise hem teknik hem de ekonomik açıdan optimum performansta işletilmiş olacaktır. Devamında yüksek yük talebi durumlarında sisteme entegre edilecek olan jeneratörün çalışma süreleri ve yakıt maliyeti hesaplanacaktır.

Çalışmaların sonuçlarına göre, PV, batarya ve jeneratör bileşenlerinin matematiksel modelleri oluşturulup; güç akış denklemleri hibrit AC/DC mimarisine uygun şekilde tanımlanacaktır. PV enerji üretimi, yük profili, batarya doluluk oranı (SOC) ve jeneratör çalışma kısıtlarını dikkate alan bir EMS kontrol algoritması geliştirilecektir. EMS'nin ekonomik performansını artırmak için jeneratör yakıt maliyeti, batarya degradasyonu ve güç akış sınırlarını içeren bir optimizasyon fonksiyonu MATLAB ortamında tasarlanacaktır.

Sonuç olarak bu çalışma, hibrit mikro şebekelerde çok kaynaklı EMS tasarımına katkı sunarak, gelecekte gerçek zamanlı kontrol donanımı ve gelişmiş yapay zekâ tabanlı optimizasyon yöntemlerinin eklenmesiyle daha da geliştirilebilir bir mühendislik çıktısı ortaya koyacaktır.

Anahtar Kelimeler: Hibrit Mikro Şebeke, Enerji Yönetim Sistemi, Fotovoltaik, Enerji Depolama

**PIEZOELEKTRİK TABANLI ENERJİ HASADI SİSTEMLERİYLE ENGELLİ BİREYLER İÇİN SÜRDÜRÜLEBİLİR E-MOBİLİTE ALTYAPISININ GELİŞTİRİLMESİ****Ahmet AKSÖZ**

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Özet

Bu projenin odak noktası, hastaneler gibi yoğun insan trafiğinin olduğu alanlarda yürüyüş hareketlerinden kaynaklanan atıl mekanik enerjiyi geri kazanmak amacıyla zemine entegre edilen piezoelektrik disklerden oluşan özel bir sistem tasarlamaktır. Basınç tipi mekanik yükleme ile adım kuvvetlerinden doğan mekanik gerilimler aracılığıyla elektrik enerjisi üretimi hedeflenirken, araştırmanın temel bilimsel yeniliği; elde edilen düşük ve değişken AC gerilimin, Tam Dalga Doğrultucu ve düşük güçlü enerji kaynakları için uygun Perturb & Observe (P&O) MPPT stratejili Buck Dönüştürücü içeren gelişmiş bir güç yönetim zinciri kullanılarak yüksek verimle kararlı DC gerilime dönüştürülmesine dayanmaktadır. Piezoelektrik kaynakların yüksek iç direncini dengelemek ve değişken adım kuvvetlerinden kaynaklanan dalgalanmaları filtrelemek amacıyla doğrultucu çıkışına uygun bir buffer kapasitör veya süperkapasitör eklenecektir. Elde edilen bu enerji, elektrikli tekerlekli sandalyelerde kullanılan 12V/24V batarya sisteminin tam şarjı yerine yardımcı enerji desteği olarak kullanılacaktır. Çalışmanın yöntemi; malzeme seçimi, piezo disklerin optimum konfigürasyon simülasyonu, prototip halı modülü üretimi, güç elektroniği entegrasyonu, MPPT uygulaması ve gerilim-akım-ısı verilerine dayalı tahmini bir model ile Batarya Yönetim Sistemi (BMS) tasarımını içermektedir. Son aşamada sistem, çıkış gücü, enerji dönüşüm verimi ve tepki süresi açısından titizlikle test edilecek ve elde edilen veriler, Batarya Doluluk Oranı (SoC) ve sistem davranışlarını izlemek amacıyla bulut tabanlı bir IoT altyapısında depolanarak izlenecektir. Bu araştırma, hem yenilenebilir enerji üretimine katkı sağlama hem de engelli bireylerin sürdürülebilir mobilitate gereksinimlerini destekleme potansiyeli yüksek, özgün ve uygulanabilir bir çözüm sunmayı amaçlamaktadır.

Anahtar Kelimeler: Piezoelektrik enerji hasadı, enerji dönüşümü, güç elektroniği, IoT, MPPT.

DEVELOPING SUSTAINABLE E-MOBILITY INFRASTRUCTURE FOR DISABLED INDIVIDUALS WITH PIEZOELECTRIC-BASED ENERGY HARVESTING SYSTEMS**Abstract**

The focus of this project is to design a special system consisting of piezoelectric discs integrated into the floor, with the aim of recovering the waste mechanical energy generated by walking movements in areas with high human traffic, such as hospitals. While the generation of electrical energy is targeted through mechanical stresses arising from step forces, based on pressure-type mechanical loading, the fundamental scientific innovation of the research is based on the development of an advanced power management chain that ensures the low and variable AC voltage obtained is converted to a stable DC voltage, required by the battery, with high efficiency, using a Full-Wave Rectifier and a Buck Converter with a Maximum Power Point Tracking (MPPT) strategy suitable for low-power energy sources, such as Perturb&Observe (P&O). A suitable buffer capacitor or supercapacitor will be added to the rectifier output to stabilize voltage fluctuations due to the high internal resistance of piezoelectric sources. The energy obtained will be used as auxiliary energy support for the battery system, rather than for direct full charging, of the 12V/24V battery systems commonly used in electric wheelchairs. The method of the study includes material selection, simulation of the optimum series/parallel connection configurations of the piezo discs, production of the prototype carpet module, power

electronics integration, implementation of the MPPT algorithm, and Battery Management System (BMS) design with a predictive model based on voltage-current-temperature data. In the final stage, the system will be meticulously tested in terms of output power, energy conversion efficiency, and response time to human step frequency, and the data obtained will be stored and monitored in a cloud-based IoT infrastructure to track Battery State of Charge (SoC) and system behavior. This research aims to present an original, applicable, and high social impact potential solution that contributes to both renewable energy generation and the support of the sustainable mobility requirements of individuals with disabilities.

Keywords: Piezoelectric Energy Harvesting, Energy Conversion, Power Electronics, IoT (Internet of Things), MPPT (Maximum Power Point Tracking)

SIGNIFICANCE OF GEOGRAPHICAL CONDITIONS IN THE MICRO-SITING OF WIND ENERGY SYSTEMS**M.Burak SERT**

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Abstract

The increasing global demand for clean and sustainable energy has elevated the importance of renewable energy systems, and land-based wind energy has become a key component for carbon reduction and energy security strategies. This importance highlights the need for careful planning and optimized site selection in wind energy projects. Consequently, micro-siting (the precise placement of individual turbines) plays a critical role in maximizing energy yield and minimizing wake losses and structural stresses. This study highlights the importance of geographical conditions in micro-siting land-based wind energy systems. Key parameters such as wind speed distribution, turbulence intensity, terrain roughness, elevation variations, and surface features are examined to understand their effects on local wind flow and turbine performance. Using high-resolution wind data and terrain modeling, the research demonstrates how these geographical factors affect the capacity factor and overall system efficiency. The narrative outlines the methodological approach, presents example assessments of terrain-wind interactions, and summarizes key findings supporting more accurate and sustainable micro-siting decisions for land-based wind energy projects.

Keywords: Micro-siting, Geographical Conditions, Land-Based Wind Energy, Wind Resource Assessment

PRODUCTION AND INVESTIGATION OF CU AND Cu-Au PLASMONIC NANOPARTICLES WITH AN INNOVATIVE METHOD**Melih MANIR**

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Abstract

In this study, Copper (Cu) nanoparticles were grown on glass substrates using the cryogenic technique in 50 K steps over a substrate temperature range of 100-300 K in a vacuum (4.5×10^{-6} Torr) environment. X-ray diffraction (XRD) patterns of the films revealed that all samples grew in a cubic structure along the (111) plane. Field Emission Scanning Electron Microscope (FESEM) images of Cu nanoparticles showed that the films produced at 200 K substrate temperature were spherical and consisted of equally sized clusters (10-12 nm). This result indicates that the soliton growth mechanism occurred at 200 K substrate temperature during the nanoparticle production process. Optical measurement results showed that Cu nanoparticles produced at all substrate temperatures exhibited surface plasmon resonance (SPR) at a wavelength of ~ 600 nm. In the next step of the study, a Cu/Au structure was produced using Au nanoparticles produced at 230 K substrate temperature. FESEM images of the produced structure revealed a grain size of approximately 23 nm. Atomic Force Microscope (AFM) images revealed an average roughness value (Ra) of 4.254 nm for the Cu/Au structure. Optical measurements revealed that the effective SPR event in the Cu/Au structure occurred at a wavelength of ~ 590 nm.

Keywords: Cu nanoparticle, Plasmonic, Soliton, Cryogenic technique.

**FABRICATION AND INVESTIGATION OF SURFACE PLASMON RESONANCE (SPR)-
EFFECTIVE AuNp/n-Si/Al PHOTODEVICE USING CRYOGENIC TECHNIQUE****Melih MANIR**

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Abstract

Plasmonic properties exhibited by some metallic particles at different wavelengths are being exploited. Metallic nanoparticles such as gold (Au), silver (Ag), and copper (Cu) exhibit surface plasmon resonance (SPR) at broad wavelengths (400-800 nm). Furthermore, metallic nanoclusters such as Ag, Au, and Cu, which exhibit SPR at wavelengths of 450 nm, 520 nm, and 650 nm, are used in photodevice construction. Today, metallic materials are produced as thin films using various methods (chemical and vacuum evaporation). These methods are called thermal methods, and the resulting crystal structure consists of clusters of different sizes. For an effective SPR event, metallic nanoparticles should have uniform nanosizes. In this study, Au layers were deposited in clusters of equal size on a cooled n-Si surface using cryogenic techniques at different substrate temperatures (300 K-100 K) to fabricate AuNp/n-Si/Al optoelectronic devices. Among the devices fabricated under different regimes, the best performance was achieved with the Au layer fabricated at 230 K substrate temperature.

Keywords: Cu nanoparticle, Plasmonic, Soliton, Cryogenic technique.

NANOSCALE ENERGY TRANSPORT IN BORON NITRIDE NANOTUBES FOR HYDROGEN STORAGE: FROM CRYOGENIC TO ELEVATED TEMPERATURES**Muhammed Murat AKSOY**

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Abstract

The objective of this study is to reveal that hydrogen as a clean energy carrier could be promising for nanoscale applications, yet its effective storage is a challenging concern. Boron nitride nanotubes (BNNTs) show unique characteristics for hydrogen storage due to the advantages of thermal stability and binding perspective. In this work, nanoscale energy transport phenomena in hydrogen-loaded BNNTs were investigated using molecular dynamics simulations across a wide temperature range from cryogenic (10 K) to elevated temperatures (500 K). A (7,7) armchair BNNT with approximately 5 nm length containing 560 atoms was modeled using the extended Tersoff potential for B-N interactions. Eight hydrogen molecules (H_2) were introduced into the nanotube, modeled using harmonic bond potentials, while H_2 -BNNT interactions were described by Lennard-Jones potentials combined with Coulombic interactions. Simulations were performed using LAMMPS with a 1 fs timestep under NVT ensemble conditions. The system was equilibrated through gradual temperature adjustments to examine hydrogen confinement, diffusion behavior, and thermal release mechanisms. The results demonstrate temperature dependence of hydrogen dynamics within the nanotube. At cryogenic temperatures (from 10 K to 50 K), hydrogen molecules remain confined in the nanotube cavity with negligible diffusion. As the temperature increases to the room temperature (300 K), enhanced molecular mobility is observed, and the mean square displacement was significantly increased. At elevated temperatures (500 K), complete hydrogen release occurs through thermal activation, while the BNNT structure maintains its mechanical integrity throughout all temperature regimes. These findings provide molecular-level insights into the energy transport mechanisms of hydrogen storage and release in BNNTs. The observed temperature-dependent behavior highlights the potential for controlled hydrogen release through thermal management, offering valuable guidance for the design of BNNT-based hydrogen storage systems for clean energy applications.

Keywords: Nanoscale energy transport, Molecular dynamics simulation, Boron nitride nanotubes, Hydrogen storage

OPTIMIZATION OF RENEWABLE ENERGY-BASED HYBRID ENERGY SYSTEMS FOR ELECTRIC VEHICLE CHARGING ON EDİRNE-ANKARA HIGHWAYS**Alparslan BOZKURT^a, Mustafa Serdar GENÇ^{a, b, *}, S. Samed SEYİTOĞLU^c**^a Wind Engineering and Aerodynamic Research Laboratory, Department of Energy Systems Engineering, Erciyes University, Kayseri, Turkey^b MSG Teknoloji Ltd. Sti, Erciyes Teknopark, Tekno-1 Binası, 61/20, 38039, Kayseri, Turkey^c Department of Mechanical Engineering, Hitit University, Çorum, Turkey.**Abstract**

The increasing number of electric vehicles (EVs) in recent years has naturally brought about the challenge of adequacy of charging infrastructure. With the increasing number of electric vehicles, infrastructure and energy demand have also increased proportionally. One of the most significant obstacles to electric vehicle adoption is user range anxiety. To address this issue, this study addressed the Edirne-Ankara Highway, Türkiye's longest highway at approximately 650 km, and developed the location and design of electric vehicle charging stations. EV charging stations were planned along the 650 km highway route, with stations spaced 45-65 km apart to ensure safe and uninterrupted driving. Thus, a vehicle consuming 20 kWh of energy per 100 km would pass two stations without recharging. This approach supports Türkiye's net-zero carbon policy and contributes to the development of national EV infrastructure and sustainable mobility. The technical, economic, and environmental feasibility of the proposed charging stations was evaluated using HOMER Pro optimization software under three different energy supply scenarios: grid-only, grid-connected renewable hybrid, and off-grid renewable hybrid systems. The results show that while grid-only systems have low initial investment costs, they suffer from high operating expenses and significant greenhouse gas emissions. Off-grid systems, despite being fully independent, require high PV and battery capacities, resulting in excessive investment costs. In contrast, the grid-connected hybrid system provided the best balance of performance in terms of cost, reliability, and sustainability.

Keywords: Renewable Energy, Hybrid System, Electric Vehicles, Highway, Off-Grid

UNIVERSITY STUDENTS' ENVIRONMENTAL AWARENESS AND ENERGY-SAVING BEHAVIORS: AN ANALYSIS ON UN SDG-BASED COURSES¹**Asım Mustafa AYTEN**

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Abstract

This study examines undergraduate students' environmental awareness and energy-saving behaviors through a secondary analysis of an existing dataset collected within the scope of UN SDG-based GLB courses at a Turkish public university. The research focuses on three questions: (1) Are engineering students more sensitive to energy and environmental issues compared to students from other disciplines? (2) To what extent do students prioritize energy crises and environmental problems among global issues? (3) Do GLB courses influence students' environmental and energy-saving behaviors in their daily lives? The dataset includes responses from 325 students across engineering, social sciences, and natural sciences, originally gathered with ethical approval and informed consent. The analysis uses descriptive statistics and comparative cross-tabulations to explore patterns across departments, demographic groups, and course-related behavioral changes.

Preliminary findings indicate that engineering students, particularly those studying electrical-electronics, mechanical, and civil engineering, report relatively higher sensitivity to environmental challenges and energy-related risks. Across the entire sample, environmental issues—including global warming, pollution, drought, water scarcity, and the energy crisis—emerge as the most frequently prioritized global problems. Moreover, students who stated that GLB courses affected their daily lives also reported substantial behavioral changes, especially in reducing waste, conserving water and energy, and avoiding environmental pollution. These results suggest that SDG-oriented courses can cultivate both awareness and practical energy-conscious behaviors among undergraduates.

Overall, the study highlights the educational value of integrating SDGs into university curricula, demonstrating measurable contributions to students' environmental responsibility and energy-saving habits. It offers insights for policymakers, curriculum designers, and sustainability educators seeking to strengthen the role of higher education in addressing global environmental challenges.

Keywords: UN SDGs, University Students, Sustainability, Energy Crisis, Environmental Awareness

¹ This paper is based on the secondary analysis of a dataset previously collected for a study that has been submitted to a peer-reviewed journal and is currently under editorial evaluation. The research questions, analytical scope, and findings in the present study are entirely distinct from those of the submitted manuscript. Ethical approval and informed consent were obtained during the original data collection.

**ENERGY PRICING PROJECTIONS WITH A HYBRID MODEL: ANALYSIS OF GLOBAL AND REGIONAL DYNAMICS****Eyyüp Ensari ŞAHİN**

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Abstract

This study proposes a two-layer hybrid model that integrates global energy market trends with domestic macroeconomic dynamics to forecast Türkiye's electricity prices in the short and medium term. The high volatility, abrupt price spikes, strong seasonality, and susceptibility to multiple external shocks inherent in electricity prices limit the capacity of single models to capture all structural components simultaneously. For this reason, the study adopts the hybrid approach introduced by Zhang (2003), which sequentially models linear and nonlinear components: the global trend is represented through a Seasonal ARIMA (SARIMA) specification, while regional market dynamics are modelled using a Random Forest regression framework. In the first layer of the model, a SARIMA structure is estimated for Brent crude oil prices covering the period 2014–2025, following the Box–Jenkins methodology. A SARIMA projection representing the long-run energy cycle is extracted. Stationarity is assessed using the Augmented Dickey–Fuller test, and parameter selection is optimized using the Akaike Information Criterion. In the second layer, the SARIMA-derived trend component is combined with nine Türkiye-specific variables and fed into a Random Forest model. Hyperparameters are optimized using Grid Search and five-fold cross-validation. Model performance is evaluated for the test period (2023–2025) using RMSE, MAE, and MAPE. The findings indicate that Türkiye's electricity prices are more strongly influenced by domestic supply conditions, seasonal demand variations, and renewable energy generation than by global energy trends. Variable importance analysis identifies renewable energy production, temperature, and SARIMA_Projection as the most influential predictors. Scenario analyses of exchange rates, natural gas prices, and industrial energy consumption reveal that the price formation mechanism shows limited but observable sensitivity to external shocks. The results provide a practical projection framework for policymakers and market actors in the energy sector.

Keywords: Energy pricing, Hybrid model, SARIMA, Random Forest, Electricity market, Machine Learning

HİBRİT MODEL İLE ENERJİ FİYATLANDIRMA PROJEKSİYONLARI: KÜRESEL VE BÖLGESEL DİNAMİKLERİN ANALİZİ**Özet**

Bu çalışma, Türkiye elektrik fiyatlarının kısa ve orta vadeli tahmininde küresel enerji piyasası eğilimleri ile yerel makroekonomik dinamikleri bütünleştiren iki katmanlı bir hibrit model önermektedir. Elektrik fiyatlarının yüksek volatilité, ani fiyat sıçramaları, güçlü mevsimsellik ve çoklu dışsal şoklara duyarlı yapısı, tekil modellerin bu dinamikleri aynı anda yakalamada sınırlı kaldığını göstermektedir. Bu nedenle çalışmada, Zhang'ın (2003) doğrusal ve doğrusal olmayan bileşenlerin ardışık biçimde modellenmesine dayanan hibrit yaklaşımı izlenmiş; küresel trend bileşeni mevsimsel ARIMA (SARIMA) ile, yerel piyasa dinamikleri ise Random Forest regresyonu ile temsil edilmiştir. Modelin birinci katmanında, 2014–2025 dönemine ait Brent petrol fiyatları üzerinden Box–Jenkins metodolojisi doğrultusunda SARIMA modeli kurulmuş ve küresel

enerji döngüsünü temsil eden bir trend serisi (SARIMA_Projection) elde edilmiştir. Durağanlık Augmented Dickey–Fuller testi ile değerlendirilmiş, parametrik seçim Akaike Bilgi Kriteri kullanılarak optimize edilmiştir. İkinci katmanda ise SARIMA çıktısı, Türkiye’ye özgü dokuz yerel değişken ile birlikte Random Forest modeline girdi olarak verilmiş; hiperparametre optimizasyonu Grid Search ve beş katlı çapraz doğrulama yöntemiyle gerçekleştirilmiştir. Model performansı test dönemi (2023–2025) için RMSE, MAE ve MAPE ölçütleri ile değerlendirilmiştir. Bulgular, Türkiye elektrik fiyatlarının küresel enerji trendinden ziyade yerel arz koşulları, mevsimsel talep değişimleri ve yenilenebilir enerji üretiminden daha güçlü biçimde etkilendiğini göstermektedir. Değişken önem analizi, yenilenebilir enerji üretimi, sıcaklık ve SARIMA_Projection’ın en belirleyici faktörler olduğunu ortaya koyarken döviz kuru, doğal gaz fiyatı ve sanayi tüketimi üzerine gerçekleştirilen senaryo analizleri, fiyat oluşumunun dışsal şoklara duyarlılığını sınırlı düzeyde koruduğunu göstermektedir. Bu çalışma, elektrik fiyat tahmininde küresel ve yerel bileşenlerin birlikte ele alınmasının önemini vurgulayarak hibrit modelleme literatürüne metodolojik katkı sunmakta; elde edilen bulgular enerji piyasası politika yapıcıları ve sektör paydaşları için kullanılabilir bir projeksiyon çerçevesi sağlamaktadır.

Anahtar Kelimeler: Enerji Fiyatlandırma, Hibrit Model, SARIMA, Random Forest, Elektrik Piyasası, Makine öğrenmesi.

USE OF SOURCES AND FRAMING TENDENCIES IN ENERGY NEWS IN TURKEY

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Abstract

The energy sector is a strategic field that directly affects many areas, ranging from economic development to international politics, and from environmental sustainability to societal welfare. Therefore, energy news not only provides a daily flow of information but also points to an issue that directly influences the public and constitutes an important component of political debates. Journalism literature indicates that, especially in fields requiring technical knowledge, ensuring diversity of sources, making expert opinions visible, and producing content based on verifiable data are essential for achieving high-quality journalism (Schudson, 2001; McNair, 2017). Communication and journalism studies emphasize that expert-based news production enhances the comprehensibility of complex issues, strengthens the reliability of information, and improves the quality of democratic discussion. However, the frequently observed tendency toward “dependence on official sources” (Hall et al., 1978) may deepen information asymmetries in energy journalism and narrow the boundaries of public debate. In Turkey, comprehensive quantitative research examining which sources energy journalism relies on, the extent to which experts and technical actors are visible in the media, and the frames through which news stories are constructed remains highly limited. Framing literature demonstrates that the media shape societal perceptions of complex energy issues by presenting them through specific discourse patterns, economic-pragmatic emphases, or narratives focused on national interest (Entman, 1993; Gamson & Modigliani, 1989). Yet, in the Turkish context, systematic empirical studies addressing source types, expert representation, and dominant interpretive frames in energy news are scarce. This study aims to objectively reveal existing discursive structures by examining energy-related coverage published in national daily newspapers through content analysis and framing analysis techniques. In doing so, it seeks to provide a critical evaluation of the quality of information-production processes in Turkish energy journalism.

Keywords: Energy Journalism, Source Use, Expert Visibility, Framing analysis.

**BIOCHAR PRODUCTION FROM WASTE SLUDGE USING PYROLYSIS TECHNOLOGY:
CARBON SEQUESTRATION, CERTIFICATION, AND MULTI-SECTOR APPLICATIONS****Serhat BİLGİN**

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Abstract

Global climate change has necessitated modifications to waste management systems and the linear economy model. The transition from a linear economy to a circular economy, along with the growing global interest in circular economy principles and carbon neutrality, has intensified the focus on transforming waste into valuable resources. This study presents a comprehensive analysis of biochar production from sewage sludge using advanced pyrolysis technology, emphasizing its carbon sequestration potential, carbon credit certification pathways, and multisectoral applications. Through controlled pyrolysis experiments conducted at temperatures ranging from 400°C to 800°C, we demonstrate that the biochar derived from sewage sludge exhibits exceptional properties for various applications, including industrial fuel supplementation, greywater filtration systems, and agricultural soil enhancement. Our findings show that the pyrolysis process provides a carbon conversion efficiency of 35–45% and that the resulting biochar demonstrates significant methane reduction potential (2.3–4.1 tCO₂eq/t biochar), making it eligible for carbon credit generation under established frameworks. It is known that carbon credit revenues provide a potential income of \$120–600 per ton of biochar at current market prices. The surface area of the biochar, ranging from 85–280 m²/g, and its high cation exchange capacity make it particularly effective for water treatment applications, providing removal efficiencies of 85–92% for common greywater pollutants. In agricultural applications, biochar amendment has improved soil carbon content by 15–25%, increased water retention capacity by 20–35%, and recorded yield increases of 8–15% in field trials (greenhouse–field). Economic analyses reveal that integrated carbon credit revenue streams can offset production costs by 40–60%, thereby demonstrating the economic feasibility of the technology. This research offers a pathway for sustainable waste management while contributing to climate change mitigation through carbon sequestration and circular resource utilization.

Keywords: biochar, pyrolysis, sewage sludge, carbon sequestration, carbon credits, circular economy, sustainability.

NUMERICAL INVESTIGATION OF AXIAL COMPRESSORS USED IN COMPRESSED AIR ENERGY STORAGE SYSTEMS**Muhammed HATEM**

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Abstract

Energy storage systems have become a popular method today, particularly for storing excess energy in scenarios where renewable energy production is intermittent or overproduction and the grid is not needed. Compressed air energy storage, one of the energy storage methods, is based on the principle of compressing excess energy with air by compressors, storing it in underground caverns or pressure tanks, and then passing through expansion turbines to make it reusable. In this method, compressors directly affect energy storage efficiency because they determine the pressure of the air sent to the turbines for expansion. Heat loss or aerodynamic instabilities in the compressor will reduce compression performance and storage efficiency. This paper examines the effects of these parameters on compression ratio and power requirements by conducting CFD analyses for axial compressors used in renewable energy-powered compressed air energy storage systems under different inlet and rpm conditions.

Keywords: energy storage, axial compressor, CFD

**THE ENERGY–DEVELOPMENT RELATIONSHIP WITHIN THE FRAMEWORK OF THE
FIRST TRUMP ADMINISTRATION’S POLICIES****Arzu AL**

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Abstract

Energy is one of the most essential inputs for modern economies in achieving sustainable development goals. However, energy policies are shaped according to the ideological approaches of governments and directly affect development models. This study aims to examine the impact of U.S. energy policies during Donald Trump’s first presidential term (2017–2021) on economic development and global energy balances within the framework of the energy dominance doctrine. The study analyzes the radical policy shifts in this period, such as the Trump administration’s withdrawal from the Paris Climate Agreement, the loosening of environmental regulations, and the encouragement of fossil fuel production. Using a qualitative research method and document analysis technique, the reflections of these policies on the U.S. gross domestic product, employment data, and energy trade balance are evaluated. The findings indicate that the protectionist and production-oriented policies implemented during the Trump era transformed the United States from a net energy importer into a net energy exporter and contributed positively to short-term economic growth indicators. However, the pressures created by this rapid development approach on long-term environmental sustainability and renewable energy investments present a controversial picture regarding the quality of development. In conclusion, the study argues that the energy-development relationship during the Trump period constitutes one of the most concrete examples of the tension between global climate objectives and national economic interests.

Keywords: Energy Policies, Economic Development, First Trump Administration, Energy Dominance, Fossil Fuels

NUMERICAL INVESTIGATION OF FIN DIAMETER EFFECT ON THERMAL-HYDRAULIC PERFORMANCE IN PRISMATIC LiFePO₄ BATTERIES**Oğuz Kaan ÇİNİCİ**

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Abstract

This study numerically investigates the influence of fin diameter on the thermal–hydraulic performance of an air-cooled prismatic LiFePO₄ battery module intended for stationary energy storage applications. A 4×4 battery pack configuration was modeled using ANSYS Fluent, where cylindrical fins of four diameters (3 mm, 4 mm, 5 mm and 6 mm) were mounted on the cell surfaces to enhance convective cooling. A constant air inlet velocity of 1 m/s was applied, and temperature, airflow resistance, heat transfer behavior and overall performance efficiency were evaluated comparatively. The simulation results show that increasing fin diameter improves heat dissipation capability and delays temperature escalation throughout the discharge period. At 100 s, the maximum battery temperature decreased from 312.67 K for 3 mm fins to 312.04 K for 4 mm, 311.89 K for 5 mm and reached the lowest value of 311.71 K with 6 mm fins, confirming a progressive enhancement in thermal control. However, this improvement was accompanied by a rise in pressure drop, which measured 69 Pa, 72 Pa, 75 Pa and 78 Pa for the respective diameters, indicating increased flow resistance due to reduced channel cross-sectional area. The thermal–hydraulic performance ratio demonstrated that the 3 mm fin exhibited the highest efficiency ($\Phi = 0.69$), while the 6 mm configuration achieved the strongest cooling effect but with reduced overall efficiency ($\Phi = 0.27$). Considering both thermal and hydraulic criteria together, the 5 mm fin configuration offers the most balanced solution, providing significant cooling capacity with moderate pressure penalties. These findings highlight fin geometry as a key design parameter for optimizing energy-efficient thermal management strategies in LiFePO₄-based battery storage systems.

Keywords: LiFePO₄ battery cooling, Fin diameter, Thermal–hydraulic performance.

APPLICATION OF ZnO NANOSTRUCTURES IN AMMONIA (NH₃) GAS SENSORS

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Abstract

Ammonia (NH₃) is a significant toxic gas originating from industrial processes, agricultural activities, and biological metabolism. In recent years, research has accelerated toward the development of sensors with low detection limits that operate rapidly, selectively, and at low temperatures. **Zinc oxide (ZnO)**, owing to its wide bandgap, high chemical stability, rich nanostructural diversity, and suitability for surface functionalization, has become one of the most extensively studied metal oxide semiconductors for NH₃ detection. This review comprehensively addresses performance-enhancing strategies reported over the past five years in ZnO-based NH₃ sensors, including nanostructure design, noble metal doping (Au, Ag, Pd), heterostructure formation, and integration with flexible platforms. The literature demonstrates that hydrothermally synthesized AuNP/ZnO and AgNP/ZnO composites exhibit extraordinary sensitivity ($S \approx 9000$) and low detection limits (LOD < 1 ppm) even at room temperature. Such superior performance is supported by both theoretical and experimental findings, which attribute it to the activation of oxygen species on the ZnO surface, modulation of the Fermi level, and enhancement of NH₃ adsorption energy by noble metal nanoparticles. The review also discusses current limitations, such as humidity-dependent response variations, insufficient long-term stability, and selectivity issues, while presenting future research directions including in-situ spectroscopy for mechanism validation, surface passivation, bimetallic core-shell nanostructures, and wearable sensor architectures. Overall, this study provides a comprehensive evaluation of the potential of ZnO-based NH₃ sensors in **environmental monitoring, biomedical breath analysis, and food spoilage detection** applications.

Keywords: ZnO, NH₃, sensor.

ZnO NANO YAPILARININ NH₃ GAZ SENSÖRLERİNDE KULLANIMI**Özet**

Amonyak (NH₃), endüstriyel süreçler, tarım uygulamaları ve biyolojik metabolizma kaynaklı önemli bir toksik gaz olup, düşük tespit limitine sahip hızlı, seçici ve düşük sıcaklıkta çalışan sensörlerin geliştirilmesine yönelik araştırmalar son yıllarda hız kazanmıştır. Çinko oksit (ZnO), geniş bant aralığı, yüksek kimyasal stabilitesi, zengin nanoyapısal çeşitliliği ve yüzey fonksiyonelleştirmeye uygunluğu sayesinde NH₃ algılamada en çok çalışılan metal oksit yarıiletkenlerden biridir. Bu derleme, ZnO tabanlı NH₃ sensörlerinde son beş yılda bildirilen nanoyapı tasarımı, değerli metal katkılama (Au, Ag, Pd), heteroyapı oluşturma ve esnek platform entegrasyonu gibi performans artırıcı stratejileri bütüncül biçimde ele almaktadır. Literatür, hidrotermal AuNP/ZnO ve AgNP/ZnO kompozitlerinin oda sıcaklığında dahi olağanüstü duyarlılık ($S \approx 9000$) ve düşük tespit limiti (LOD < 1 ppm) sergilediğini göstermektedir. Bu üstün performansın, değerli metal nanopartiküllerinin ZnO yüzeyindeki oksijen türlerini aktive etmesi, Fermi seviyesini modüle etmesi ve NH₃ adsorpsiyon enerjisini artırması ile ilişkili olduğu teorik ve deneysel bulgularla desteklenmektedir. Derleme ayrıca neme bağlı yanıt değişimi, uzun vadeli stabilite eksikliği ve seçicilik problemleri gibi mevcut sınırlamaları tartışarak, in-situ spektroskopi ile mekanizma doğrulama, yüzey pasifleştirme, bimetalik çekirdek-kabuk nanoyapıları ve giyilebilir sensör mimarileri gibi geleceğe yönelik araştırma önerileri

sunmaktadır. Bu çalışma, ZnO bazlı NH₃ sensörlerinin çevresel izleme, biyomedikal nefes analizi ve gıda bozulma tespiti gibi uygulamalardaki potansiyelini kapsamlı bir çerçevede değerlendirmektedir.

Anahtar Kelimeler: ZnO, NH₃, sensör.

SPATIAL INEQUALITIES IN HOUSEHOLD ENERGY ACCESS ACROSS URBAN, RURAL, AND NOMADIC SETTLEMENTS IN SOMALILAND

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Abstract

Unequal access to modern energy remains a central barrier to achieving Sustainable Development Goal 7 (SDG7-Affordable and Clean Energy) in low-income and fragile contexts. This study quantifies spatial and socioeconomic inequalities in household electricity and clean-cooking-fuel access across Somaliland's urban, rural, and nomadic settlements, using nationally representative microdata from the 2021 Demographic and Health Survey (n = 6,077 households). Weighted descriptive and inferential analyses were performed using DHS sampling weights. Electricity access rates were 80.7% in urban areas, 20.3% in rural areas, and 0.1% among nomadic households, while clean-fuel adoption remained negligible outside cities. Infrastructure quality (wall, roof, and floor materials) showed strong associations with electricity access (Cramér's $V > 0.6$), highlighting the interaction between built-environment conditions and energy inequality. Regional inequalities were evident: electricity access ranged from 25% in Sool and Sanaag to 71% in Marodijeh (Hargeisa). National inequality indices reveal severe concentration (Gini = 0.55 for electricity; 0.91 for clean fuels), reflecting both spatial and wealth-driven polarization.

Beyond Somaliland, similar urban–rural divides in energy access are evident across much of Sub-Saharan Africa, where electrification advances in cities while rural and mobile populations remain largely excluded. The findings provide comparative evidence supporting global efforts to design decentralized renewable systems and inclusive energy-finance mechanisms that can bridge persistent access gaps. By establishing a quantitative baseline for an Energy-Access Index (EAI) in a data-scarce setting, the study contributes to the comparative understanding of how geography and income jointly shape progress toward SDGs 7 and 11.

Keywords: Energy access; Inequality; Electricity; Clean cooking; Sustainable Development Goals.

EFFECT OF THE LENGTH OF THE SETTLING CHAMBER ON FLOW QUALITY IN BLOWN TUNNEL DESIGN**Eren Anıl SEZER**

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Abstract

In this study, numerical wind tunnel analyses were conducted to evaluate the effect of settling chamber length on flow quality and uniformity. To determine the optimum geometry for low-speed aerodynamic experiments, several test sections with different lengths were analyzed. The simulations were examined under various inlet velocities. In the numerical analyses, a hexahedral mesh structure was employed, and the $k-\epsilon$ turbulence model, known to provide more accurate results for internal flows, was used; all simulations were performed in ANSYS Fluent. For each analysis, flow uniformity, velocity distribution, turbulence intensity, and pressure characteristics were evaluated along the test section. The results demonstrate that the length has a measurable influence on velocity development and boundary-layer growth, and that an optimum length exists where flow uniformity is maximized while unnecessary domain extension is minimized. Within this context, it was observed that although a specific length range yields the highest uniformity, both excessively long and overly short test sections lead to flow distortions within the tunnel. This study presents findings that can guide future design efforts in wind tunnel test-section sizing and contribute to improving the accuracy of low-speed aerodynamic experiments.

Keywords: Wind tunnel, Test-section length, Internal flow, Numerical analysis

**BOUNDARY-LAYER AND VELOCITY PROFILE ANALYSIS ON A CAMBERED NACA AIRFOIL
VIA HOT-WIRE MEASUREMENTS****Nazlı NUR**

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Abstract

In this study, experimental measurements were conducted using a hot-wire anemometer to investigate the flow behavior over an aerodynamic surface. Time-dependent velocity data were analyzed, and the formation, development, and reattachment of the laminar separation bubble were examined. The influence of bubble size and duration on flow stability was identified, allowing the characteristics of the laminar separation bubble to be revealed through experimental results and providing key observations on the laminar–turbulent transition.

Keywords: Boundary Layer, Low Reynolds Number, Velocity measurement, Hot-Wire Anemometry

DETAILED INVESTIGATION OF THE SEPARATION BUBBLE OVER AIRFOILS WITH TIME-DEPENDENT PRESSURE DATA**Eda YILDIZ**

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Abstract

This study was conducted to investigate the flow behaviour of NACA0015 and NACA4415 airfoils at low Reynolds numbers under conditions of $Re = 1.5 \times 10^5$. The experiments were conducted to compare the performance of the profiles at 0° , 4° , and 8° angles of attack, specifically investigating the formation of Laminar Separation Bubbles (LSBs), which are frequently encountered in low-speed aerodynamics. The aim was to reveal the position, size and response to angle changes of the LSB on both profiles using both quantitative and qualitative methods. In this context, a pressure measurement experiment was first conducted, and pressure coefficient distributions were created using data obtained from pressure taps placed on the surface of the object. These distributions enabled the determination of where the separation began, how the transition region was formed, and where reattachment occurred. In addition, time-dependent pressure changes were examined to observe the unstable behaviour of the flow, and the fluctuating structure of the LSB over time was better understood. Furthermore, the surface flow structure was directly observed using an oil flow visualisation method. When the obtained data were evaluated together, it was observed that the NACA0015 profile formed a more pronounced and longer LSB due to its symmetrical structure. In contrast, the NACA4415 profile exhibited an earlier transition due to its curvature effect, creating a shorter bubble. An increase in the angle of attack contributed to the forward movement of the LSB in both profiles and, in general, to the formation of a more stable flow structure.

Keywords: Laminar Separation Bubble, Low Reynolds Number, Pressure Distribution, Oil Flow Visualisation

**THE IMPACT OF CARBON PRICING ON ENERGY TRANSITION AND ECONOMIC
ACTIVITY: FRANCE AND GERMANY****Edanur KILIÇ**

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Abstract

Carbon markets are the most important market-based policy tools that facilitate cost-effective emission reductions in line with low-carbon economy goals. Carbon pricing mechanisms are important stimulators that determine investment strategies and production decisions of each country, and influence technology choices in energy supply. This study examines the dynamic relationship between carbon prices and economic activity (industrial production), the share of renewable energy in electricity generation, and greenhouse gas emissions for Germany and France, countries covered by the EU ETS (European Union Emissions Trading System), over the period 2010-2021. The share of renewable energy in electricity generation is a proxy indicator of energy transition. The research uses Bayesian VAR (BVAR) models estimated separately for each country and investigate the short-term impacts of carbon price shocks using impulse response functions. The findings indicate that rising carbon prices generally increase the transition to renewable energy technologies and have an emission-reducing effect. However, the factors driving the energy transition differ between Germany and France. The study demonstrates that the ambitious carbon reduction and energy efficiency commitments adopted at COP28 and beyond require different policy levers depending on countries' existing installed energy capacity, energy structures, and economic conditions. In this context, carbon pricing is considerably more effective when combined with focused investment strategies, incentives for technological innovations, and country-specific regulatory frameworks to support the energy transition.

Keywords: Carbon markets, BVAR, energy transition, economic activity, EU ETS, greenhouse gas emissions.

**KARBON FİYATLANDIRMASININ ENERJİ DÖNÜŞÜMÜ VE EKONOMİK FAALİYET
ÜZERİNDEKİ ETKİSİ: FRANSA VE ALMANYA****Özet**

Karbon piyasaları emisyon azaltımının maliyet etkin şekilde gerçekleştirilmesini sağlayan, düşük karbonlu ekonomi hedefleri doğrultusunda, en önemli piyasa temelli politika araçlarından biri olarak tanımlanmaktadır. Karbon fiyatlandırma mekanizmaları, ülkelerin yatırım ve üretim kararlarını belirleyen önemli uyarıcı olmasıyla birlikte enerji arzındaki teknoloji tercihlerini de şekillendirmektedir. Bu çalışma 2010-2021 dönemi için EU ETS (Avrupa Birliği Emisyon Ticaret Sistemi) kapsamında olan Almanya ve Fransa ülkeleri için karbon fiyatlarının ekonomik faaliyet (sanayi üretimi), elektrik üretiminde yenilenebilir enerjinin payı ve sera gazı emisyonları arasındaki dinamik ilişkiyi incelemektedir. Elektrik üretiminde yenilenebilir enerji payı değişkeni enerji dönüşümünün göstergesi olarak analize dahil edilmiştir. Analizde, iki ülke için ayrı ayrı tahmin edilen Bayesyen VAR (BVAR) modelleri kullanılarak karbon fiyatı şoklarının kısa vadeli etkileri etki tepki fonksiyonları aracılığıyla değerlendirilmiştir. Elde edilen bulgular, karbon fiyatları artışının genel olarak yenilenebilir enerji teknolojilerine geçişi artırdığını ve emisyonları azaltıcı etkisinin olduğunu göstermektedir. Bununla birlikte enerji dönüşümünün itici gücünün Almanya ve Fransa için farklı olduğu gözlemlenmiştir. Genel olarak çalışma, COP28 ve sonrasında benimsenen iddialı karbon azaltım ve enerji verimliliği taahhütlerinin, ülkelerin mevcut kurulu enerji kapasiteleri, enerji yapıları, ekonomik koşullarına bağlı olarak farklı politika kaldıraçlarına ihtiyaç duyduğu sonucuna varmıştır. Bu bağlamda, karbon fiyatlandırmasının

etkinliđi, enerji dönüşümünü destekleyecek tamamlayıcı yatırım politikaları, teknoloji yenilikleri ve ülkeye özgü düzenleyici çerçevelerle güçlendirildiğinde önemli ölçüde artmaktadır.

Anahtar Kelimeler: Karbon piyasaları, BVAR, enerji dönüşümü, ekonomik faaliyet, EU ETS, sera gazı emisyonları.

**KRİPTO PARA İŞLEMLERİNDEKİ HUKUKİ ZORLUKLARIN ENERJİ TÜKETİMİ BAĞLAMINDA DEĞERLENDİRİLMESİ****Av. Dilay SAĞDIÇ**

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Özet

Kripto para teknolojileri, son yıllarda hem finansal sistemlerdeki dönüşüm hem de enerji tüketimi üzerindeki etkileriyle önemli bir tartışma alanı haline gelmiştir. Kripto paraların merkezi otoritesiz, aracısız yapıları ve konuyla ilgili denetim otoritelerinin bulunmaması; kripto paraların işleyişini hem pratik hem de hukuki açıdan karmaşık bir hâle getirmiştir. Bunun yanında, özellikle iş ispatı (proof-of-work) ve kişisel kripto varlıkları; yüksek enerji tüketimi, sürdürülebilirlik ve büyüme etkileri açısından ek bir tartışmayı da doğurmaktadır. Kripto paraların kullanımına ilişkin temel hukuki sorunlar; merkezi bir muhatap yokluğu, denetim güçlüğü, anonim kullanımın sözleşmelerdeki yeri gibi bağlantılar üzerinden ele alınmaktadır. Ayrıca özellikle PoW yöntemiyle kripto para madenciliğinin aşırı büyük veriler kullanarak gerçekleştirdiği karmaşık işlemlerin enerji tüketimi üzerindeki etkilerinin, Türkiye'deki sürdürülebilir enerji politikalarıyla birlikte değerlendirildiğinde kripto varlıklar ve bunların madenciliği noktasında ortaya çıkan sorunlara önerilecek çözümler önemini artırmaktadır.

Bu çalışmanın amacı, kripto para işlemlerindeki hukuki zorlukların enerji tüketimi bağlamında değerlendirilmesi yoluyla bu sorunlara ilişkin çözüm önerileri sunmaktır. Bu nedenle öncelikle kripto para kavramı ve kripto para kullanımındaki hukuki zorlukların sebepleri açıklanmıştır. Daha sonra kripto para teknolojisiyle ilgili güncel sorunlara yer verilmiş ve kripto para madenciliği ve iş ispatı gibi güvenlik yöntemlerinin madencilikteki yeri açıklanmıştır. Ardından kripto para madenciliğinin enerji tüketimi ve sürdürülebilirlik üzerindeki etkilerine ve bunların hukuki zeminine, Türkiye'deki sürdürülebilir enerji politikalarına da değinilerek yer verilmiştir. Son olarak mevcut mevzuatın söz konusu sorunları çözme konusunda yetersiz kaldığına dikkat çekilerek konunun özel bir hukuki düzenlemeye muhtaç olduğu hususlarına değinilip mevzuatı ve hukuki alt yapısı Türkiye'de yavaş yavaş şekillenmeye başlayan kripto paraların değerlendirilmesinde enerji tüketimi ve sürdürülebilirlik politikalarının önemini göz önünde bulundurulması çözüm önerisi olarak sunulmuştur.

Anahtar Kelimeler: Kripto Para, Dijital Enerji Politikaları, Hukuki Belirsizlik, Enerji Tüketimi, Blockchain, Proof-of-Work, Sürdürülebilirlik, Regülasyon.

EVALUATION OF LEGAL CHALLENGES IN CRYPTO CURRENCY TRANSACTIONS IN THE CONTEXT OF ENERGY CONSUMPTION**Abstract**

Cryptocurrency technologies have become a significant topic of discussion in recent years due to their impact on both the transformation of financial systems and energy consumption. The decentralized, intermediary nature of cryptocurrencies and the lack of regulatory authorities have complicated their operation from both a practical and legal perspective. Furthermore, proof-of-work and personal crypto assets, in particular, have generated additional debate regarding their high energy consumption, sustainability, and growth impacts. Fundamental legal issues related to the use of cryptocurrencies are addressed through connections such as the lack of a central interlocutor, the difficulty of oversight, and the role of anonymous use in contracts. Furthermore, when the complex transactions performed by cryptocurrency mining using extremely large data, particularly through the PoW method, are considered in conjunction with sustainable energy policies in Türkiye, the potential impact of proposed solutions to the problems arising from crypto assets and their mining increases the importance of these solutions.

The aim of this study is to evaluate the legal challenges in cryptocurrency transactions in the context of energy consumption and to propose solutions to these problems. Therefore, the concept of cryptocurrency and the reasons for the legal challenges in cryptocurrency use are first explained. Current issues related to cryptocurrency technology are then addressed, and the role of security methods such as cryptocurrency mining and proof-of-work in mining is explained. The study then examines the impacts of cryptocurrency mining on energy consumption and sustainability, their legal basis, and sustainable energy policies in Turkey, with a particular emphasis on the issue. Finally, the inadequacy of existing legislation to address these issues is highlighted, and the need for specific legal regulation is highlighted. A proposed solution is to consider the importance of energy consumption and sustainability policies in the evaluation of cryptocurrencies, whose legislation and legal infrastructure are slowly taking shape in Turkey.

Keywords: Cryptocurrency, Digital Energy Policies, Legal Uncertainty, Energy Consumption, Blockchain, Proof-of-Work, Sustainability, Regulation.

COMPARATIVE ECONOMIC ANALYSIS OF OPERATIONAL STRATEGIES FOR BIOGAS-PV-WIND HYBRID SYSTEMS**Sevde ERTÜRK ÇETİNKAYA¹**

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Abstract

Grid stability can only be ensured with a comprehensive solution that effectively combines highly variable renewable energy sources, such as solar PV systems and wind energy, with reliable and controllable sources of energy. In this context, biogas-fueled electricity generation emerges as a strategically important element, providing the baseload support necessary to stabilize the grid in the face of natural fluctuations associated with solar and wind energy sources. This study uses HOMER Pro to model the operation of a hybrid energy system comprising a biogas generator, wind energy, and solar energy in two different scenarios, highlighting the importance of biogas. The technical and economic performance of the hybrid energy system model is compared. In Scenario 1, the system, comprising a biogas generator, wind turbine, and solar energy sources, operates in conjunction, offering a cost-effective solution due to its high energy production and low fuel/maintenance costs. However, in Scenario 2, the biogas generator operates only at night, increasing the contribution of renewable energy sources to the system's energy balance and ensuring a balance between energy sources. While the Net Present Cost (NPC) is \$4,267,972.00 in Scenario 1, the NPC is calculated as \$2,045,770.00 in Scenario 2. As a result, it is observed that the unit energy, operating, and fuel consumption costs in Scenario 2 are reduced compared to Scenario 1, and the Levelized Cost of Energy (\$1.45) is almost halved.

Keywords: Biogas generator, Renewable energy, Economic analysis.

OPTIMIZING SOLAR ENERGY FORECASTING USING ADVANCED MACHINE LEARNING IN YEMEN**Aiman Yousef AL HARD**

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Abstract

The rapid global expansion of solar energy, driven by the installation of photovoltaic panels on homes and large-scale solar farms, necessitates highly accurate prediction models to enhance system optimization and support predictive maintenance of power plants. The increasing demand for sustainable energy sources has fuelled advancements in solar technology, making efficiency and cost-effectiveness paramount. Reducing reliance on non-renewable fossil fuels and mitigating climate change effects are primary goals supported by accurate energy forecasting. This comprehensive and comparative study addresses this need by evaluating six machine learning (ML) algorithms for predicting Daily Global Horizontal Irradiance (GHI) across four climatically diverse Yemeni cities: Sanaa (high-altitude plateau), El Hudaydah (hot Red Sea coast), Aden (port city), and Al Mukalla (southern coast). The models—Support Vector Regression (SVR), Artificial Neural Network (ANN), Decision Tree (DT), Random Forest (RF), Gradient Boosting (GB), and Extreme Gradient Boosting (XGBOOST)—were rigorously assessed. Input parameters included air Temperature and Humidity, supplemented by derived geographical and solar calculation features. Model performance was validated using key metrics: R^2 (Coefficient of Determination), RMSE (Root Mean Square Error), (MAPE) Mean absolute percentage error and MBE (Mean Bias Error). The results definitively identify the Artificial Neural Network (ANN) as the most effective predictive model. ANN consistently achieved the highest R^2 scores (between 0.9996 and 0.9999) and the lowest error values, validating its superiority over ensemble methods (GB, XGBoost, RF, SVR). The findings not only validate the ANN's effectiveness for GHI forecasting but also offer optimal parameter insights crucial for real-world integration, particularly for edge devices used in PV power plant predictive maintenance.

Keywords: Solar Irradiance (GHI), Artificial Neural Network (ANN), Predictive Maintenance, Regression Metrics (R^2 , RMSE, MBE), Yemen Climate, Photovoltaic Forecasting

PROXIMITY-AWARE EXPLAINABILITY LAYER FOR ENERGY SYSTEM MODELS: A CONCEPTUAL FRAMEWORK**Ebubekir İNAN**

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Abstract

Data-driven models based on machine learning and deep learning are now routinely employed in energy systems for grid state estimation, battery monitoring, load forecasting, and price formation. Their predictive performance can be very strong, yet the internal logic of these models often remains opaque; in particular, decisions taken under rare or stressed operating conditions can be difficult to interpret or to justify. Post-hoc explanation tools such as SHAP (SHapley Additive Explanations) and LIME go some way towards opening this black box, but they typically leave the geometric and proximity structure of the data space implicit. When operating regimes shift or when certain regions of the feature space are sparsely populated, this lack of an explicit proximity model may lead to explanations that fluctuate considerably from point to point.

In this work, we outline a proximity-aware explainability layer designed to sit on top of existing energy system models. In the proposed setting, an explanation module acts on an arbitrary predictor $f(x)$ and compares samples through descriptive proximity relations rather than relying solely on Euclidean distance. On the descriptor space we introduce fuzzy membership functions and proximity measures, denoted by μ and ν , and embed these weights into a SHAP-style attribution scheme. The resulting construction, referred to as PA-SHAP (Proximity-Aware SHAP), is intended to produce feature attributions that are sensitive to the underlying operating regimes and to local neighbourhood structure.

No real-world dataset is analysed in this study. Instead, we work with a deliberately simplified two-dimensional energy setting, in which temperature and load (or state-of-charge) serve as input variables, and use this setting to develop a sequence of illustrative, intuition-oriented scenarios. Within this framework, we examine how changes in the proximity radius and in the cluster structure of the data affect feature attributions across low-, medium-, and high-temperature regimes. We also indicate several application areas, battery SoC/SoH estimation, renewable generation forecasting, and grid anomaly detection, where a PA-SHAP layer could plausibly enhance the stability, interpretability, and practical usefulness of explanation tools that are already in use.

Keywords: Explainable AI, SHAP, proximity theory, energy modeling, PA-SHAP.

**PROXIMITY-BASED RESILIENCE MAPPING FOR ENERGY INFRASTRUCTURES: A CONCEPTUAL FRAMEWORK****Ebubekir İNAN**

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Özet

Elektrik iletim ve dağıtım şebekeleri, yenilenebilir enerji santralleri ve kritik tüketicilerden (hastaneler, veri merkezleri, okullar vb.) oluşan enerji altyapıları, iklim kaynaklı aşırı hava olayları, aşırı yüklenmeler ve siber-fiziksel saldırılar karşısında giderek daha kırılgan bir hâle gelmektedir. Dayanıklılık (resilience) kavramı bu bağlamda, arızaya karşı koyma kapasitesi ile birlikte bozulma, uyum sağlama ve toparlanma süreçlerinin tamamını içeren bir konsept sunmaktadır. Mevcut yaklaşımın önemli bir kısmı, N-1 güvenlik kriterleri, graf kuramına dayalı kırılganlık metrikleri ve senaryo tabanlı simülasyonlar üzerinden ilerlemektedir. Ancak bu yöntemler çoğu zaman, enerji varlıkları arasındaki tanımlayıcı (descriptive) ilişkileri ve yaklaşık komşuluk yapısını açık biçimde modellemediği için, riskin topolojik örgüsünü ve kritik bölgelerin birbirine nasıl “yakın” olduğunu sınırlı ölçüde görür kılmaktadır.

Bu çalışmada, enerji altyapıları için yakınlık-temelli dayanıklılık haritaları üretmeye yönelik kavramsal bir çerçeve sunulmaktadır. Bu çerçevede öncelikle trafo merkezleri, iletim ve dağıtım hatları, yenilenebilir üretim birimleri ve kritik tüketicilerden oluşan bir varlık kümesi X tanımlanmaktadır. Daha sonra her bir varlık için kurulu güç, yedeklilik seviyesi, kritik yük oranı, coğrafi bölge ve yenilenebilir üretim payı gibi bileşenlerden oluşan bir betimleyici vektör $\Phi(x)$ kullanılmaktadır. Bu betimleyiciler üzerinden, coğrafi yakınlık, fonksiyonel benzerlik ve operasyonel korelasyon gibi birden fazla descriptive proximity ilişkisi kurulmakta ve bunlar tek bir bileşik yakınlık yapısında birleştirilmektedir. Her kritik varlık için, bu yapı kullanılarak yaklaşık risk komşuluğu $N^*(x)$ tanımlanmaktadır. Böylece bir arıza veya hizmet kesintisi durumunda etki alanına girebilecek varlık kümeleri topolojik olarak ifade edilmektedir. Elde edilen yaklaşık komşuluklar, varlıkların kritiklik düzeyi ve yakınlık ağırlıklarıyla birlikte değerlendirilerek, zayıf yedekleme bölgelerini, risk birikiminin yoğunlaştığı alanları ve olası alternatif akış yollarını öne çıkaran bir dayanıklılık haritası oluşturulmaktadır.

Çalışma tamamen kuramsal niteliktedir. Herhangi bir gerçek şebeke verisi kullanılmamaktadır. Bunun yerine, küçük ölçekli bir şehir senaryosu üzerinden, kavramsal adımların (varlık kümesinin tanımlanması, betimleyici tasarımı, yakınlık ilişkilerinin kurulması, yaklaşık risk komşuluklarının hesaplanması ve haritalama katmanı) nasıl işletileceği gösterilmektedir. Gelecek çalışmalarda, önerilen yakınlık-temelli çerçevenin klasik N-1 analizleri ve graf tabanlı metriklerle bütünleştirilmesi, parametrelerinin gerçek şebeke verisi ile kalibre edilmesi ve farklı risk senaryoları (iklim etkileri, siber saldırılar, talep dalgalanmaları) altında karşılaştırmalı olarak sınanması hedeflenmektedir.

Anahtar Kelimeler: Enerji altyapıları, dayanıklılık haritaları, açıklanabilir risk analizi, yakınlık kuramı, kritik altyapı.

Abstract

Electricity transmission and distribution networks, renewable generation plants, and critical consumers such as hospitals, data centers, and schools form the backbone of modern energy infrastructures. These systems are increasingly exposed to climate-induced extreme weather events, sustained overloads, and cyber-physical attacks, which makes them more fragile over time. In this context, the notion of resilience goes beyond simple fault tolerance and covers the full cycle of degradation, adaptation, and recovery. A large part of the current

practice relies on N-1 security criteria, graph-theoretic vulnerability indices, and scenario-based simulations. While useful, these tools often leave the descriptive relations between assets and the structure of approximate neighbourhoods implicit. As a result, the topological fabric of risk, and the way in which critical regions are “near” to one another in an energy sense, can remain only partially visible.

This paper proposes a conceptual framework for building proximity-based resilience maps for energy infrastructures. The starting point is a set X of assets that includes substations, transmission and distribution lines, renewable generation units, and critical loads. Each asset $x \in X$ is represented by a descriptor vector $\Phi(x)$ composed of elements such as installed capacity, redundancy level, share of critical load, geographical region, and renewable generation share. Based on these descriptors, several descriptive proximity relations are introduced, for example geographical nearness, functional similarity, and operational correlation; these relations are then combined into a single composite proximity structure. For every critical asset, an approximate risk neighbourhood $N^*(x)$ is defined using this structure, capturing those assets that may be affected if x fails or is taken out of service. The resulting neighbourhoods are evaluated together with asset criticality scores and proximity weights to construct a resilience map that highlights weakly backed-up regions, areas where risk tends to concentrate, and potential alternative flow paths.

The study is entirely theoretical and does not use real network data. Instead, a small-scale city scenario is employed to show, at a conceptual level, how the main steps of the framework can be carried out: defining the asset set, designing descriptors, constructing proximity relations, computing approximate risk neighbourhoods, and forming the mapping layer. Future work will focus on integrating the proposed proximity-based framework with classical N-1 analyses and graph-based metrics, calibrating its parameters on real grid data, and testing its performance under different risk scenarios, including climate impacts, cyber attacks, and demand fluctuations.

Keywords: Energy infrastructures, resilience maps, explainable risk analysis, proximity theory, critical infrastructure.

ANALYZING AND FORECASTING TURKEY'S RENEWABLE ENERGY EFFICIENCY IN THE WORLD VIA DBSCAN CLUSTERING AND FTS FORECASTING**Yağmur ŞAN**

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Abstract

As in all areas around the world, the importance of sustainability in the field of energy is increasing, and for this reason, the transition to renewable energy is supported by all countries. Many factors such as the climate crisis, the inadequacy and depletion of resources, and the increase in the world population are further accelerating the transition to clean and renewable energy, that is, the green transformation process. All developed and developing countries that are trying to manage these processes in the best way possible include important targets and projects for the transition to renewable energy in their policies and development plans. Türkiye is a country with high geographical diversity and rich energy resources and all kinds of projects and breakthroughs in the field of renewable energy are being rapidly realized. The motivation of the study is to observe Türkiye's energy efficiency and development in the field of renewable energy in comparison with other countries. In this study, countries (a total of 203 countries) were grouped according to their similarities in terms of renewable energy efficiency and Türkiye's energy efficiency was evaluated comparatively. In the study, DBSCAN algorithm was used as a method in the grouping phase and parameters such as countries' renewable energy capacities, renewable energy production and consumption amounts, CO₂ emission amounts, energy import amounts and fossil energy production amounts were considered. In addition, by using the specified parameters, a future projection was drawn by making forecasting in terms of renewable energy efficiency for Türkiye with Fuzzy Time Series. The results obtained from the study provide realistic and important predictions for the future in terms of renewable energy efficiency for Türkiye.

Keywords: renewable energy, energy efficiency, DBSCAN (Density-Based Spatial Clustering of Applications with Noise), FTS (Fuzzy Time Series).

**SU, ENERJİ VE ÇEVRE KONULARINDA DOĞA TEMELLİ ÇÖZÜMLERİN ROLÜ: BİR DERLEME ÖRNEĞİ****Prof. Dr. Atılğan ATILGAN**

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Özet

Günümüzde artan nüfus, kentleşme ve iklim değişikliği gibi faktörler doğal kaynaklar üzerinde ciddi baskılar oluşturmaktadır. Bu baskılar özellikle su kaynaklarının sürdürülebilirliğini tehdit etmektedir. Su yönetiminde geleneksel yöntemlerin yetersiz kaldığı günümüzde, doğa temelli çözümler giderek daha fazla önem kazanmaktadır. Bu çalışmada, yağmur suyu hasadı ve yeşil çatı uygulamaları gibi alternatif sistemlerin suyun korunması, geri kazanımı ve yeniden kullanımı konularındaki etkileri ele alınmıştır. Literatür taramasına dayalı bu çalışma, 2020–2025 yılları arasında yayımlanmış 21 adet bilimsel yayını kapsamaktadır. Ulaşılan bulgular, söz konusu sistemlerin kentlerde su tasarrufu sağladığını, taşkın riskini azalttığını, binaların enerji performansını iyileştirdiğini ve ekosistem hizmetlerine katkı sunduğunu göstermektedir. Ayrıca, enerji verimliliği uzmanı bakış açısıyla değerlendirildiğinde bu sistemlerin hem elektrik tüketimini azaltma hem de bina düzeyinde sürdürülebilirliği artırma potansiyeline sahip olduğu görülmüştür.

Anahtar Kelimeler: Yağmur suyu hasadı, yeşil çatı sistemleri, sürdürülebilir su yönetimi, enerji verimliliği, doğa temelli çözümler

THE ROLE OF NATURE-BASED SOLUTIONS IN WATER, ENERGY AND ENVIROMENT: A REVIEW EXAMPLE**Abstract**

In today's world, a wide variety of natural resources are decreasing due to population growth and overconsumption. Water, being one of the most vital natural resources, is under significant threat. Therefore, it is essential to protect these resources and adopt sustainable water management practices. One of the effective strategies includes the development of new systems such as rainwater harvesting and green roof applications. These systems offer ecological and economic benefits by enhancing water conservation, promoting energy efficiency, and contributing to urban resilience. Especially in urban areas, where the negative impacts of rapid urbanization and climate change are more pronounced, the integration of green infrastructure plays a critical role. This paper aims to evaluate rainwater harvesting and green roof systems by reviewing recent literature from multiple disciplines. The findings highlight their importance in urban water recovery, energy use optimization, and sustainable development. Additionally, from the perspective of energy audits and building technologies, these systems demonstrate potential for reducing cooling loads, managing stormwater, and enhancing building-level sustainability.

Keywords: Rainwater harvesting, green roof systems, sustainable water management, energy efficiency, nature-based solutions

DETERMINATION OF HEATING BOILER CAPACITIES IN GREENHOUSES DEPEND ON ENERGY CONSERVATION**Sedat BOYACI**

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Abstract

Maximum heat power in greenhouses is needed for a very short time of year. Therefore, understanding the repeat of heat power throughout the year, as well as calculating greenhouse heat power, is important for sizing the heating system and reducing initial investment costs. In this study, heat power values and annual repeats were determined using hourly climate data for greenhouses of the same size, both with and without thermal curtains. The results showed that the thermal energy requirement for the greenhouse without thermal curtains was 408.8 kWh/m² and 318.0 kWh/m² for the greenhouse with thermal curtains. Accordingly, if the thermal curtain is used in the greenhouse and the sealing condition is good, the heat energy that can be saved will be 22.2% respectively. Additionally, if the temperature is maintained at 15°C/21°C night and day in a 5000 m² PE plastic greenhouse with thermal curtains, the required heat power is calculated as 1300 kW. However, if the primary heat energy required is met by a 500 kW heating system, 76% of the heat requirement can be met in a greenhouse without thermal curtains, while 81% can be met in a greenhouse with thermal curtains. A second 1300 kW boiler installed in the greenhouse operation will be activated in extreme weather conditions to meet the greenhouse's maximum heat energy needs. The study concluded that selecting two separate boilers instead of a single heating boiler in greenhouses will reduce the boiler size needed to meet the greenhouse's primary heat needs, thus saving on initial investment and heating costs.

Keywords: Greenhouse, heat requirement, heat power, boiler, boiler capacity

EVALUATION OF THE PERFORMANCE OF DIRECT EVAPORATIVE COOLER IN HIGH TUNNEL GREENHOUSE CONDITIONS**Sedat BOYACI**

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Abstract

The study was carried out to determine performance parameters (cooling efficiency, cooling capacity and water consumption amounts) of the direct cooler used to reduce the increasing indoor temperatures in the high tunnel greenhouse. For this objective, the necessity of evaporative cooling was determined by measuring indoor temperature and relative humidity values using the natural ventilation method. Accordingly, in the natural ventilation application, the highest temperature measured outdoors was 31.6 °C and the relative humidity was 32.5%. In the indoor environment, the highest temperature measured was 48.6 °C and the relative humidity was 15.9%. Due to the fact that these measured values were not suitable for optimal plant growth, evaporative cooling systems became necessary. During the hours when the direct evaporative cooler was operating, the outdoor temperature and relative humidity were 29.1°C and 36.5%, while the indoor temperature and relative humidity were 23.7°C and 68.7%. The average temperature inside the high tunnel greenhouse was 5.3°C lower than the outdoor temperature, and the relative humidity was 32.2% higher. Additionally, cooling efficiency was determined to be 47.8% on average, ranging from 34.3% to 64.2%. The system's cooling capacity was calculated as 2.5 kW, ranging from 1.6 to 3.8 kW, with a COP of 10.0 on average, ranging from 6.4 to 15.0 kW, and a water consumption of 41.1 L/day (4.57 L/h). The study concluded that evaporative cooling applications reduce indoor temperatures, but more research to determine different water flow rates and pad thicknesses on the cooling system's performance parameters and the greenhouse's indoor environment.

Keywords: Greenhouse, cooling efficiency, cooling capacity, water consumption

BIOENERGY PRODUCTION BASED ON ENERGY CROPS IN MARGINAL AGRICULTURAL LANDS**Ahmet ŞEKEROĞLU**

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Abstract

Fossil fuel-based greenhouse gas emissions, one of the main drivers of global climate change, have made the transition toward renewable energy sources an urgent necessity. Countries are increasingly adopting various agreements and plans to promote the widespread use of renewable energy. Among these sources, bioenergy has emerged as a significant potential in waste conversion and energy production derived from biomass. In recent years, the cultivation of energy crops on marginal lands has gained prominence as a stable means of ensuring biomass supply for bioenergy production. Particularly in marginal areas with low soil fertility, bioenergy production using energy crops offers important advantages in terms of both energy and land sustainability. The aim of this study is to identify suitable areas for bioenergy production based on energy crops in marginal agricultural lands with low soil fertility, using a multi-criteria and geographic information system (GIS)-based approach. Within this scope, considering the net-zero emission targets, spatial suitability assessment was conducted for Konya Province based on the Representative Concentration Pathway (RCP) scenarios (RCP4.5 and RCP8.5), utilizing the 2050 climate projections of the HadGEM2-ES model. The evaluation incorporated temperature and precipitation indicators derived from the RCP scenarios, along with soil pH, slope, elevation, and marginal land criteria. In this study, the suitability levels of the energy crops *Miscanthus × giganteus*, *Panicum virgatum*, and *Salix alba* were evaluated in terms of energy density and applicability using ArcGIS spatial analysis tools and the fuzzy AND operator, based on the determined criteria. The findings indicate that under the RCP4.5 scenario, approximately 5.21% (about 25,391 ha) of Konya Province is suitable for *Panicum virgatum*, and 0.31% (about 12,320 ha) for *Miscanthus × giganteus*. Under the RCP8.5 scenario, these ratios decrease to 4.85% and 0.18%, respectively. Although the suitability of *Salix alba* is very low, no suitable areas were identified under the RCP8.5 scenario. The results reveal that the western and southwestern districts of Konya Province, particularly for *Panicum virgatum*, possess significant potential for bioenergy production based on energy crops.

Keywords: bioenergy, energy crops, biomass, marginal land, climate scenarios

MARJİNAL TARIM ALANLARINDA ENERJİ BİTKİLERİNE DAYALI BİYOENERJİ ÜRETİMİ**Özet**

Küresel iklim değişikliğinin en önemli etkenlerinden fosil kaynaklara dayalı artan sera gazı emisyonları, yenilenebilir enerjiye yönelimi zorunlu hale getirmektedir. Ülkeler çeşitli sözleşme ve planlar ile yenilenebilir enerji kaynak kullanımını yaygınlaştırma eğilimindedir. Yenilenebilir enerji kaynaklarından birisi olan biyoenerji ise atık dönüşümü ve buna dayalı enerji üretiminde önemli bir potansiyel olarak ortaya çıkmaktadır. Son yıllarda biyoenerjiye yönelik biyokütle kaynaklarının enerji arzını istikrarlı bir şekilde sağlaması bakımından marjinal alanlarda enerji bitkilerine dayalı yaklaşımlar artmaktadır. Özellikle toprak verimliliğinin düşük olduğu marjinal alanlarda enerji bitkileri ile biyoenerji üretimi, enerji ve arazi sürdürülebilirliği açısından önemli avantajlar sağlamaktadır. Bu çalışmanın amacı toprak verimliliğinin düşük olduğu marjinal tarım alanlarında enerji bitkilerine dayalı biyoenerji üretimi için uygun alanları çok kriterli ve coğrafi bilgi sistemlerine dayalı yaklaşımla belirlemektir. Bu kapsamda net sıfır emisyon hedefleri de göz önüne alınarak

2050 yılı iklim projeksiyonları HadGEM2-ES modeli sonuçlarından yararlanılarak temsili konsantrasyon yolu senaryolarına dayalı (RCP4.5 ve RCP8.5) olarak Konya ilini kapsayacak şekilde mekânsal uygunluk değerlendirmesi gerçekleştirilmiştir. Değerlendirmelerde temsili konsantrasyon değerlendirmesindeki sıcaklık ve yağış göstergelerinin yanı sıra toprak pH değeri, eğim, yükseklik ve marjinal alan kriterleri göz önüne alınmıştır. Bu çalışmada, enerji yoğunluğu ve uygulanabilirlik açısından *Miscanthus × giganteus*, *Panicum virgatum* ve *Salix alba* türlerine ait enerji bitkilerinin uygunluk düzeyleri, ArcGIS yazılımında mekânsal analiz araçları ve bulanık AND operatörü kullanılarak, belirlenen kriterlere dayalı biçimde değerlendirilmiştir. Çalışma bulguları RCP4.5 senaryosuna göre Konya ili toplam alanının %5, 21'i *Panicum virgatum* (yaklaşık 25391 ha), %0, 31'i *Miscanthus × giganteus* (yaklaşık 12320 ha) enerji bitkileri için uygunluk göstermektedir. RCP8.5 senaryosuna göre ise bu oranlar sırasıyla %4,85 ve %0,18'e düşmektedir. *Salix alba* enerji bitkisi açısından uygunluk değeri çok düşük olmakla birlikte RCP8.5 senaryosunda uygunluk bulunmamaktadır. Sonuçlar Konya ilinin batı ve güney batı ilçelerinde *Panicum virgatum* başta olmak üzere enerji bitkilerine dayalı biyoenerji üretimi için önemli bir potansiyel olduğunu ortaya koymaktadır.

Anahtar Kelimeler: biyoenerji, enerji bitkileri, biyokütle, marjinal alan, iklim senaryoları

**MALÇLAMA: TOPRAĞI KORUMA VE KÜRESEL İKLİM DEĞİŞİKLİĞİ İLE MÜCADELDE İNOVATİF YAKLAŞIM****Assoc. Prof. Dr. Sadettin ÇELİK**

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Özet

Dünya nüfusunun hızla artması, ısınma ve diğer insani faaliyetleri için fosil yakıtları kullanması, ormansızlaştırma, sera gazı etkileri, tarımsal faaliyetler ve buzulların erimesi gibi olaylar, dünya çapında bir sıcaklık artışına yol açmakta ve bu da iklim değişikliğine sebebiyet vermektedir. Kuraklık, sera gazı etkisi, küresel iklim değişikliği, beraberinde getirdiği yağış rejimindeki değişiklikler, ekstrem sıcaklıklar ve soğukluklar, bitkilerin gelişimlerini olumsuz etkileyerek tarımsal üretimi sekteye uğratmaktadır. Doğa olaylarına kısa vadede müdahale etmenin mümkün olmadığı göz önünde bulundurulduğunda, sürdürülebilir tarımsal üretim için toprağın yüzeyini örten, buharlaşmayı önleyerek toprak neminin korunmasını sağlayan, verim, kalite arttıran, kök sistemini güçlendiren, yabancı ot kontrolünü sağlayan, herbisit kullanılmasının önüne geçerek hem çiftçi, hem çevre dostu, hem erkenci bir uygulama olan malçlamanın yapılması kaçınılmazdır. Doğada kendiliğinden olan malçların yanında, sentetik olan polietilen malç plastiklerin kullanılmasının daha etkili olduğunu, daha bol ve tedarikinin kolay olduğu görülmektedir. Sonuç olarak, toprağın yüzeyinin kaplanması, toprak neminin korunması, yabancı ot kontrolü, verim ve kaliteyi artırarak sürdürülebilir bir tarımsal üretimin en etkili yollarından birisidir. Sentetik polietilen malçlar, Pratik ve yaygın olmaları, tedarik kolaylığı ve etkinlikleri gibi özellikleri nedeniyle yaygın kullanımları ile ön plana çıkmaktadırlar.

Keywords: plastic malç, Polietilen malç (PE), malçlama, yabancı ot kontrolü,

MULCHING: AN INNOVATIVE APPROACH TO SOIL CONSERVATION AND COMBATING CLIMATE CHANGE**Abstract**

The rapid increase in the world's population, the use of fossil fuels for heating and other human activities, deforestation, greenhouse gas effects, agricultural activities and melting of glaciers lead to a worldwide increase in temperature, which in turn causes climate change. Drought, greenhouse gas effects, global climate change, the resulting changes in precipitation patterns, and extreme temperatures and cold snaps negatively impact plant development and disrupt agricultural production. Given the impossibility of short-term intervention in natural events, mulching is essential for sustainable agricultural production. It covers the soil surface, prevents evaporation, maintains soil moisture, increases yield and quality, strengthens the root system, provides weed control, and prevents the use of herbicides. Mulching is a practice that is both farmer-friendly and environmentally friendly, as well as an early-season solution. In addition to naturally occurring mulches, the use of synthetic polyethylene mulch is more effective, more plentiful, and easier to source. In conclusion, covering the soil surface is one of the most effective ways to achieve sustainable agricultural production by maintaining soil moisture, controlling weeds, and increasing yield and quality. Synthetic polyethylene mulches stand out for their widespread use due to their practicality, ease of supply, and effectiveness.

Keywords: Plastic mulch, Polyethylene mulch (PE), mulching

**DOĞRUDAN EKİMİN KÜRESEL İKLİM DEĞİŞİKLİĞİ İLE MÜCADELEDE STRATEJİK ÖNEMİ****Assoc. Prof. Dr. Sadettin ÇELİK**

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Özet

Doğrudan ekim, toprağın sürülmeden ve işlenmeden, bir önceki ürünün hasadından sonra doğrudan ekim makinesi ile tohumla ekim yapılması işlemidir. Bu yöntem, toprak yüzeyinin korunmasını sağlayarak organik madde birikimini artırmakta, besin maddelerinin döngüsünü iyileştirmekte ve topraktaki biyolojik çeşitlilik ile mikrobiyal faaliyeti artırmaktadır. Ayrıca, toprak erozyonunu önleyerek su ve rüzgar erozyonunu azaltır, toprak nemini korur ve karbonun toprakta tutulmasına katkı sağlar. Sıfır toprak işleme, yakıt tüketimini %40-50 oranında düşürmekte, zaman ve iş gücü tasarrufu sağlamaktadır. Bu avantajlar, özellikle geniş arazilerde sürdürülebilir tarımsal üretim ve düşük maliyetli ürün elde edilmesini mümkün kılmaktadır. Bununla birlikte, doğrudan ekimin bazı sınırlamaları da vardır. Toprak işlenmediği için kök gelişimi ve dağılışı yavaş olabilir; anız toprağın verimliliğini artırmada sınırlı kalır. Ayrıca, bitki artıkları patojen ve toprak kökenli hastalıkların yaşam alanı olabilir. Yeknesak gübre dağılımı sağlanamaz ve anızın güneş ışınlarını engellemesi nedeniyle toprak geç ısınabilir, bu da çimlenmeyi geciktirebilir. Ağır bünyeli topraklarda drenaj problemleri, asidik koşullar ve yüksek metal içerikleri de ekim başarısını sınırlayabilir. Sonuç olarak, doğrudan ekim hem çevresel hem de ekonomik açıdan avantajlar sağlayan doğa dostu bir tarım yöntemidir. Karbon tutulumunu artırması, erozyon ve sel kontrolüne katkısı ile küresel iklim değişikliği ile mücadelede önemli bir araç olarak öne çıkmaktadır. Bu nedenle, uygun önlemlerle uygulandığında dünya genelinde yaygınlaştırılması önerilmektedir

Keywords: Doğrudan ekim, sıfır toprak işleme, anıza ekim, korumalı toprak işleme, azaltılmış işleme

STRATEGIC IMPORTANCE OF DIRECT SEEDING AND ITS ROLE IN COMBATING CLIMATE CHANGE**Abstract**

Direct seeding is the process of planting seeds directly with a seed drill after the previous crop is harvested, without plowing or tilling the soil. This method protects the soil surface, increases organic matter accumulation, improves nutrient cycling, and enhances soil biodiversity and microbial activity. It also prevents soil erosion, reduces water and wind erosion, preserves soil moisture, and contributes to carbon sequestration. Zero tillage reduces fuel consumption by 40-50% and saves time and labor. These advantages enable sustainable agricultural production and low-cost crop yields, especially on large plots. However, direct seeding has some limitations. Because the soil is not tilled, root development and distribution can be slow; stubble is limited in its ability to increase soil fertility. Furthermore, crop residues can be a breeding ground for pathogens and soil-borne diseases. Uniform fertilizer distribution is not achieved, and stubble blocks sunlight, slowing soil warming, which can delay germination. Drainage problems, acidic conditions, and high metal content in heavy-textured soils can also limit planting success. Consequently, direct seeding is a nature-friendly agricultural method that offers both environmental and economic advantages. Its increased carbon sequestration and contribution to erosion and flood control make it a significant tool in combating global climate change. Therefore, its widespread adoption worldwide is recommended when implemented with appropriate measures.

Keywords: Direct seeding, zero tillage, conservation tillage

**TARIMDA ALG KULLANIMI VE İKLİM DEĞİŞİKLİĞİ: DOĞAL GÜBRE, BÜYÜME DÜZENLEYİCİ VE TOPRAK İYİLEŞTİRİCİ****Reyyan KOLCU**

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Özet

Algler, hızlı biyokütle üretimleri, yüksek besin ve biyolojik aktif bileşen içerikleri sayesinde sürdürülebilir tarımsal üretimde giderek daha fazla önem kazanan bir doğal kaynak haline gelmiştir. İklim değişikliğinin yol açtığı kuraklık, tuzluluk artışı, sıcaklık dalgalanmaları ve bitki besin maddesi kayıpları gibi stres faktörleri, tarımsal verimliliği ve toprak sağlığını ciddi biçimde tehdit etmektedir. Bu bağlamda, mikroalg ve makroalglerden elde edilen ekstraktların doğal gübre, büyüme düzenleyici ve toprak iyileştirici olarak kullanımı hem bitki fizyolojisini destekleyen hem de çevresel direnci artıran yenilikçi bir yaklaşım sunmaktadır. Alg kökenli ürünler; azot, fosfor, potasyum gibi temel makro besinlerin yanı sıra iz elementler, amino asitler, vitaminler, polisakkaritler ve bitki büyüme düzenleyicileri içermeleri nedeniyle bitkilerin stres koşullarında metabolik dengesini korumasına katkıda bulunmaktadır. Yapılan çalışmalar, alg uygulamalarının çimlenme oranını artırdığını, kök gelişimini teşvik ettiğini, fotosentetik etkinliği güçlendirdiğini ve buna bağlı olarak verim istikrarını sağladığını göstermektedir. İklim değişikliğinin toprak yapısı üzerindeki bozucu etkileri göz önünde bulundurulduğunda, alglerin organik madde birikimini artırması, su tutma kapasitesini iyileştirmesi ve toprak mikrobiyal aktivitesini desteklemesi büyük önem taşımaktadır. Bu özellikler, toprağın karbon depolama kapasitesini güçlendirerek hem ekosistem sağlığını korumakta hem de küresel karbon döngüsüne olumlu katkıda bulunmaktadır. Ayrıca alg bazlı gübrelerin kimyasal gübrelere olan bağımlılığı azaltması, sera gazı emisyonlarının düşürülmesine yönelik sürdürülebilir tarım hedefleriyle uyumludur. Bu derleme, alglerin tarımdaki çok yönlü işlevlerini ve iklim değişikliği bağlamındaki ekolojik önemini kapsamlı biçimde ele alarak, geleceğin dirençli ve çevre dostu tarım sistemleri için yetiştirici ortamın sağlıklı toprak için doğal gübre kaynağının sunduğu potansiyeli değerlendirmeyi amaçlamaktadır.

Anahtar Kelimeler: Alg, iklim değişikliği, toprak, gübre.

USE OF ALGAE IN AGRICULTURE AND CLIMATE CHANGE: NATURAL FERTILIZER, GROWTH REGULATOR, AND SOIL AMENDMENT**Abstract**

Algae have become an increasingly important natural resource in sustainable agricultural production due to their rapid biomass generation, high nutrient content, and rich composition of biologically active compounds. Stress factors associated with climate change—such as drought, increased salinity, temperature fluctuations, and nutrient depletion—pose significant threats to agricultural productivity and soil health. In this context, the use of extracts derived from microalgae and macroalgae as natural fertilizers, growth regulators, and soil amendments offers an innovative approach that supports plant physiology while enhancing environmental resilience. Algal products contain essential macronutrients such as nitrogen, phosphorus, and potassium, as well as trace elements, amino acids, vitamins, polysaccharides, and plant growth regulators, all of which help maintain the metabolic balance of plants under stress conditions. Studies indicate that algal applications increase germination rates, stimulate root development, enhance photosynthetic efficiency, and thereby contribute to yield stability. Considering the degrading effects of climate change on soil structure, the ability of algae to increase organic matter accumulation, improve water-holding capacity, and stimulate soil microbial

activity is of great importance. These properties strengthen the soil's carbon sequestration potential, contributing both to ecosystem health and to the global carbon cycle. Furthermore, the use of algae-based fertilizers reduces dependence on chemical fertilizers, aligning with sustainable agricultural goals focused on lowering greenhouse gas emissions. This review aims to comprehensively examine the multifaceted functions of algae in agriculture and their ecological significance in the context of climate change, and to evaluate the potential they offer as a natural fertilizer source that promotes healthy soils and resilient, environmentally friendly crop production systems of the future.

Key Words: Algae, Climate change, Soil, Fertilizer.

**TÜRKİYE’DE TARIMSAL ÜRETİME YÖNELİK ELEKTRİK TALEBİNİN MODELLENMESİ VE TAHMİN EDİLMESİ****Mutlu BULUT**

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Özet

Tarımsal üretim süreçleri, özellikle sulama, mekanizasyon ve işletme faaliyetlerinde kullanılan elektrik nedeniyle giderek daha fazla enerji bağımlı hale gelmektedir. Bu nedenle tarım sektörünün uzun dönemli elektrik tüketim davranışının anlaşılması, kaynak planlaması ve gelecekteki enerji gereksinimlerinin öngörülmesi açısından büyük önem taşımaktadır. Bu çalışmada Türkiye’de tarımsal elektrik tüketiminin zaman içindeki eğilimi incelenmiş ve geleceğe yönelik talep tahminleri ARIMA zaman serisi modeli kullanılarak değerlendirilmiştir. Araştırmada 2000–2023 dönemine ait yıllık tarımsal elektrik tüketim verileri kullanılmıştır. Serinin düzey halinde durağan olmadığı görülmüş, birinci fark işlemi sonrasında durağanlık sağlanmıştır. ACF ve PACF grafiklerinden elde edilen bulgular doğrultusunda ARIMA(1,1,1) modeli en uygun seçenek olarak belirlenmiştir. Model ile 2024–2030 dönemi için üretilen tahminler, tarımsal elektrik talebinin gelecek yıllarda düzenli bir artış göstereceğine işaret etmektedir. Bulgular, özellikle sulama amaçlı elektrik kullanımının tarımsal maliyetler içinde giderek daha kritik bir unsur haline geldiğini ortaya koymaktadır. Bu eğilim, iklim koşullarındaki değişim ve su kaynaklarının durumuna bağlı olarak daha da güçlenebilir. Çalışmanın sonuçları, tarımsal üretimde enerji verimliliğinin artırılması, yenilenebilir enerji kullanımının teşvik edilmesi ve tarım–enerji etkileşimini dikkate alan politikaların geliştirilmesi gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: Tarımsal elektrik tüketimi, Zaman serisi analizi, Sulama enerjisi, Tarım ekonomisi

MODELLING AND FORECASTING ELECTRICITY DEMAND FOR AGRICULTURAL PRODUCTION IN TÜRKİYE USING ARIMA METHODS**Abstract**

Agricultural production has become increasingly dependent on energy inputs, particularly electricity used for irrigation, mechanization, and farm operations. Understanding the long-term behavior of electricity consumption in agriculture is essential for planning sustainable resource use and anticipating future energy needs. This study aims to analyze the trend of agricultural electricity consumption in Türkiye and to forecast future demand using the ARIMA time series modelling approach. Annual agricultural electricity consumption data covering the period 2000–2023 were employed. The series was found to be non-stationary at levels, and stationarity was achieved after first differencing. Based on the ACF and PACF structures, the ARIMA(1,1,1) model was identified as the most suitable specification. Forecasts generated for 2024–2030 indicate a steady increase in agricultural electricity consumption, suggesting that energy used for irrigation will continue to be a significant cost driver for farmers. These findings are consistent with international studies highlighting the growing energy dependence of agriculture under changing climatic and hydrological conditions. The study underscores the importance of integrating energy considerations into agricultural policy, promoting energy-efficient irrigation technologies, and supporting renewable energy adoption in rural areas. The results provide valuable insights for policymakers, researchers, and energy planners by offering an evidence-based estimation of future agricultural electricity demand in Türkiye.

Keywords: Agricultural electricity consumption, Time series analysis, Irrigation energy, Agricultural economics

**MİKRO ÖLÇEKTE KARE KESİTLİ PİM TİPİ KANATÇIK ETRAFINDAKİ SIVI FİLM VE BUHAR KABARCIĞI DAVRANIŞININ İNCELENMESİ****Alperen EVCİMEN**

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Özet

Mikro ölçekli kanallarda kaynamalı akış, yüksek kompaktlık, düşük debide akışkan kullanımı ve neredeyse sabit yüzey sıcaklığı gibi özellikleri nedeniyle yüksek kapasiteli soğutma teknikleri arasında yer almaktadır. Pim tipi kanatçıklar, mikro kanallarda kaynamalı akış performansını iyileştirmek için etkili bir araç olarak kullanılabilir. Termo-akışkanların başarısının altında yatan mekanizma, pim tipi kanatçıkların etrafındaki sıvı-buhar dinamiği ile yakından ilgilidir. Pim tipi kanatçıkların neredeyse dikey kenarları, kabarcık oluşumu ve kılcallık ile sıvı filminin yönlendirilmesi için uygun ortamı yaratma potansiyeline sahiptir.

Bu çalışmada, belirli çalışma koşulları altında, yüksek hızlı görüntüleme kullanılarak, pim tipi kanatçıkların çevresindeki buhar-sıvı bileşenlerinin etkileşimi analiz edilmiştir. 2000 fps ile elde edilen görüntü kareleri, buhar kabarcıklarının ve sıvı filmlerin davranışını tespit etmek ve ifade etmek için kullanılmıştır. Sabit bir giriş sıcaklığı (71 °C) ve kütle akışıyla ($189 \text{ kg m}^{-2} \text{ s}^{-1}$) üç farklı ısı gücü (150 W, 200 W, 250 W) uygulanmıştır. Kabarcık popülasyonu ve çekirdeklenme özellikleri ile pim tipi kanatçıkların rolü, ısı yük değişimi temelinde raporlanmıştır.

Bu çalışma sonucunda elde edilen bulgular, gelecekteki pim tipi kanatçık tasarımları için yararlı bilgiler sağlamaktadır. Ayrıca, akış mekanizmalarının anlaşılmasında akış görselleştirmesinin önemi, yüksek çözünürlüklü görüntülerle vurgulanmıştır.

Keywords: iki fazlı akış, mikrokanal, pim tipi kanatçık, kaynamalı akış, akış görüntüleme

INVESTIGATION OF LIQUID FILM AND VAPOR BUBBLE BEHAVIOUR AROUND A SQUARE PIN-FIN IN A MICRO DOMAIN**Abstract**

Flow boiling in micro-scale structures is among the high-capacity cooling techniques due to its characteristics features such as high compactness, requiring low flow rates and nearly constant surface temperature. Pin-fins can be used as effective tools to improve flow boiling performance in microchannels. The underlying mechanism of the thermo-fluidic success is closely related to liquid-vapor dynamics around the pin-fins. Nearly vertical edges of the pin-fins have the potential to set the stage for nucleation and wicking of the thin liquid film.

In the present paper, for a given operational conditions, effectively using high-speed visualization, dynamics of vapor-liquid components around pin-fins were analysed. The milli-second intervals provided by 2000 fps were utilized to both detect and express the behaviour of vapor bubbles and liquid films. Three stages of heating powers (150 W, 200 W, 250 W) were applied for a constant inlet temperature (71 °C) and mass flux ($189 \text{ kg m}^{-2} \text{ s}^{-1}$). Bubble population and nucleation characteristics as well as pin-fin role were reported based on thermal load variation.

Outcomes of the present study provides helpful information for future designs of pin-fins. In addition, the importance of flow visualization on understanding of flow mechanisms was underlined via high-quality images.

Keywords: Two phase flow, microchannel, micro pin-fin, flow boiling, flow visualization

**TECHNO-ECONOMIC ANALYSIS OF HEAT PUMP AND PHASE CHANGE MATERIAL-BASED THERMAL ENERGY STORAGE INTEGRATION****Burak İZGİ**

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Abstract

The integration of latent heat thermal energy storage (LHTES) systems with air-source heat pumps offers significant potential for increasing energy efficiency and shifting peak loads in residences, particularly in regions with time-of-use tariffs. This strategy aims to reduce consumption during expensive peak hours. This study numerically investigates a system configuration where high-grade heat from the air-source heat pump's condenser is stored in a Phase Change Material (PCM) unit during low-demand off-peak hours, when electricity tariffs are cheap. This stored latent heat is subsequently discharged to meet the building's heating load during peak hours, when electricity cost is high, thereby significantly reducing the heat pump's concurrent electrical consumption. In this work, the techno-economic performance of this integrated system is evaluated via a developed quasi-steady-state simulation model. The system is analyzed according to a tariff-aware control logic, and its performance is compared against a conventional baseline system using only a heat pump. Key performance indicators considered in the analysis include the total amount of electrical load shifted from expensive peak hours to cheap off-peak hours, variations in the system's instantaneous coefficient of performance (COP), and the resulting daily operational cost savings. Simulation results reveal that the LHTES-integrated system, when managed by a smart control strategy, successfully transfers a significant portion of the electrical demand to off-peak hours. Thus, a marked reduction in daily energy costs is achieved, and the proposed integration is seen to offer a sustainable and economically viable solution for residential demand-side management.

Keywords: Heat Pump, Phase Change Material (PCM), Thermal Energy Storage, Techno-Economic Analysis, Peak Load Shifting, Affordable & Clean Energy.

ISI POMPASI VE FAZ DEĞİŞTİREN MALZEME ESASLI TERMAL ENERJİ DEPOLAMA ENTEGRASYONUNUN TEKNO-EKONOMİK ANALİZİ**Özet**

Gizli ısı temelli termal enerji depolama (LHTES) sistemlerinin hava kaynaklı ısı pompalarıyla entegrasyonu, özellikle zamana-bağlı-kullanım tarifelerinin geçerli olduğu bölgelerde, konutlarda enerji verimliliğini artırmak ve pik yüklerin kaydırılması açısından önemli bir potansiyel sunmaktadır. Bu strateji, pahalı pik saatlerdeki tüketimi azaltmayı hedefler. Bu çalışma, bir hava kaynaklı ısı pompasının kondenserinden elde edilen yüksek kaliteli ısı, elektrik tarifesinin ucuz olduğu talebin düşük olduğu saatlerde (pik-dışı) bir faz değiştiren malzemesi (FDM) ünitesinde depolandığı bir sistem konfigürasyonunu sayısal olarak incelemektedir. Depolanan bu gizli ısı, daha sonra elektrik maliyetinin yüksek olduğu pik saatlerde binanın ısıtma yükünü karşılamak üzere deşarj edilmekte ve bu sayede ısı pompasının o anki elektrik tüketimi önemli ölçüde azaltılmaktadır. Çalışmada, bu entegre sistemin tekno-ekonomik performansı, geliştirilen yarı-kararlı-durum (quasi-steady-state) bir simülasyon modeli aracılığıyla değerlendirilmiştir. Sistem, tarife-duyarlı bir

kontrol mantığına göre analiz edilmiş ve performansı, yalnızca ısı pompası kullanılan geleneksel bir temel sistemle karşılaştırılmıştır. Analiz kapsamında temel performans göstergeleri olarak, pahalı pik saatlerden ucuz pik-dışı saatlere kaydırılan toplam elektrik yükü miktarı, sistemin anlık enerji verimlilik katsayısı (COP) değişimleri ve buna bağlı olarak elde edilen günlük işletme maliyeti tasarrufları dikkate alınmıştır. Simülasyon sonuçları, LHTES ile entegre sistemin, akıllı bir kontrol stratejisi ile yönetildiğinde, elektrik talebinin anlamlı bir bölümünü yoğun olmayan saatlere başarılı bir şekilde aktardığını ortaya koymaktadır. Böylece, günlük enerji maliyetlerinde belirgin bir azalma sağlanmakta ve önerilen entegrasyonun konutlarda talep tarafı yönetimi açısından sürdürülebilir ve ekonomik olarak uygulanabilir bir çözüm sunduğu görülmektedir.

Anahtar Kelimeler: Isı Pompası, Faz Değiştiren Malzeme (FDM), Termal Enerji Depolama, Tekno-Ekonomik Analiz, Pik Yük Kaydırma, Erişilebilir ve Temiz Enerji.

**EFFECT OF TRAPEZOIDAL WINGLET TRAILING-EDGE HEIGHT REDUCTION ON HEAT TRANSFER ENHANCEMENT IN PERIODICALLY FULLY DEVELOPED CHANNEL FLOW****Atila Abir İĞCİ**

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Abstract

The passive enhancement of heat transfer in internal channel flows is vital for improving energy efficiency in various thermal management applications. This study numerically investigates the thermal and hydrodynamic performance of geometrically modified 60°-cut Trapezoidal Winglet Vortex Generators (*TWVGs*), type of longitudinal vortex generator. The core of the research involves progressively reducing the trailing-edge height (*b*) of *TWVG*. This modification is designed to strategically control the motion of generated longitudinal vortex, channelling it to the heated surface. The objective is to maximize boundary layer mixing and, consequently, the enhancement of heat transfer. A review of the literature indicates a gap in systematic studies focusing on modifying *TWVG* geometry specifically to direct vortices toward heated surface, establishing this work as an original contribution. Numerical analyses are conducted in a channel (200 mm×25 mm) with air as the fluid, entering as hydrodynamically fully developed. *TWVGs* are placed on heated surface in a stream-wise periodic pattern. Simulations are performed using ANSYS Fluent over a Reynolds number range of 5000 to 22500 under periodic boundary conditions. The parametric geometric study involves seven different a-b configurations (from a-b=1-1 to 1-0), while maintaining a constant relative height ($BR=a/H=0.48$) and angle of attack (30°). The numerical results clearly indicate a systematic enhancement in thermal performance as the height is gradually reduced, which is fully consistent with the primary objective of the study. Thermal Enhancement Factor (*TEF*) increased significantly from 1.711 for the unmodified a-b=1-1 geometry to a maximum of 2.090 for a-b=1-0 configuration at $Re=5000$. Similarly, *TEF* increased from 1.255 to 1.495 at $Re=22500$. The findings demonstrate that directing the longitudinal vortex toward the heated surface effectively maximizes heat transfer enhancement thereby providing critical data for the *TWVG* design of compact heat exchangers.

Keywords: Heat transfer enhancement, Longitudinal vortex generators, Thermal enhancement factor, Turbulent flow.

PERİYODİK OLARAK TAM GELİŞMİŞ KANAL AKIŞINDA TRAPEZ KANATÇIKLARIN ARKA KENAR YÜKSEKLİĞİNİN AZALTILMASININ ISI TRANSFERİNİN İYİLEŞTİRİLMESİNE ETKİSİ**Özet**

Kanal içi akışlarda pasif yöntemlerle ısı transferinin artırılması, çeşitli ısı yönetim uygulamalarında enerji verimliliğinin iyileştirilmesi açısından büyük önem taşımaktadır. Bu çalışma, uzunlamasına vorteks üretici türü olan geometrik olarak modifiye edilmiş 60°-kesimli Trapez Kanatçık Vorteks Üreticilerinin (*TKVÜ*) ısı ve hidrodinamik performansını sayısal olarak incelemektedir. Araştırmanın temelini, *TKVÜ*'nün arka kenar yüksekliğinin (*b*) kademeli olarak azaltılması oluşturmaktadır. Bu modifikasyon, üretilen uzunlamasına vorteksin hareketini stratejik olarak kontrol etmek ve onu ısıtılan yüzeye yönlendirmek için tasarlanmıştır.

Amaç, sınır tabaka karışımını ve dolayısıyla ısı transferi iyileştirerek maksimize etmektir. Literatür taraması, vorteksleri doğrudan ısıtılan yüzeye yönlendirmek amacıyla *TKVÜ* geometrisinin modifiye edilmesine odaklanan çalışmaların eksikliğini ortaya koymakta ve bu çalışmayı özgün bir katkı olarak konumlandırmaktadır. Sayısal analizler, akışkan olarak havanın kullanıldığı ve hidrodinamik olarak tam gelişmiş olduğu kabul edilen (200 mm x 25 mm) bir kanalda gerçekleştirilmiştir. *TKVÜ*'ler ısıtılan yüzeye akış doğrultusunda periyodik bir düzende yerleştirilmiştir. Sayısal çözümler, Reynolds sayısı 5000 ile 22500 aralığında, periyodik sınır koşulları altında, ANSYS Fluent kullanılarak gerçekleştirilmiştir. Geometrik parametre çalışması, yükseklik oranı ($BR=a/H=0.48$) ve hücum açısının (30°) sabit tutulduğu, yedi farklı $a-b$ konfigürasyonunu ($a-b=1-1$ 'den $1-0$ 'a) kapsamaktadır. Sayısal sonuçlar, arka yüksekliğin kademeli olarak azaltılmasıyla ısı performansında sistematik bir artış olduğunu açıkça göstermekte, bu bulgu, çalışmanın temel amacıyla tam bir uyum göstermektedir. Isıl İyileştirme Faktörü (*TEF*), $Re=5000$ 'de modifiye edilmemiş $a-b=1-1$ geometrisi için 1.711'den, $a-b=1-0$ konfigürasyonu için maksimum 2.090'a önemli ölçüde yükselmiştir. Benzer şekilde, $Re=22500$ 'de *TEF*, 1.255'ten 1.495'e artmıştır. Bulgular, uzunlamasına vorteksin ısıtılan yüzeye yönlendirilmesinin, ısı transferi iyileştirmesini etkin bir şekilde arttırdığını ve bu sayede kompakt ısı değiştiricilerin *TKVÜ* tasarımı için önemli veriler sunduğunu göstermektedir.

Anahtar Kelimeler: Isı transferi iyileştirme, Boyuna vorteks üreteçleri, Isıl iyileşme faktörü, Türbülanslı akışı.

**ATIMLI ISI BORULARININ PERFORMANS ÖZELLİKLERİNE İLİŞKİN KAPSAMLI BİR DERLEME: PARAMETRİK BİR ANALİZ****Alperen EVCİMEN**

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Özet

Elektronik bileşenlerin termal yönetimi için, yaygın olarak kullanılan ısı transferi cihazları arasında **atımlı ısı boruları (PHP'ler)** kritik bir öneme sahiptir. Basit tasarımları ve görece yüksek performanslarıyla öne çıkan bu sistemler pasif olarak çalışırlar. İşleyiş prensipleri, kılcal akış kanalları içinde bulunan sıvı ve buhar fazlarının karmaşık, salınımlı hareketine dayanır; bu nedenle verimleri çok sayıda parametreye bağlıdır. Bu çalışma, PHP performansını etkileyen temel parametreler üzerine kapsamlı bir literatür incelemesi sunmaktadır. Bulgular üç ana başlık altında sistematik biçimde sınıflandırılmış ve tartışılmıştır: (1) geometrik tasarım, (2) iş akışkanlarının özellikleri (saf maddeler, karışımlar ve nanoakışkanlar) ve (3) çeşitli operasyonel özellikler. Bu operasyonel özellikler arasında dolum oranı, eğim açısı, harici manyetik alanların etkisi ve farklı yerçekimi koşullarındaki performans yer almaktadır.

Çeşitli araştırmaların çıktılarını sunan bu derleme, alanın mevcut durumuna ilişkin kapsamlı ve yapılandırılmış bir genel bakış sağlamaktadır. Literatürdeki araştırma eğilimlerini öne çıkarmakta, kritik çalışma parametrelerini tanımlamakta ve mevcut çalışmalarda raporlanan sonuçları tartışmaktadır. Dolayısıyla bu çalışma, daha verimli atımlı ısı borularının tasarımına katkı sağlamayı ve bu teknolojiye yönelik gelecekteki araştırmalara yön göstermeyi amaçlayan mühendisler ve araştırmacılar için temel bir başvuru kaynağı olarak kullanılabilir.

Anahtar Kelimeler: Atımlı Isı Borusu (PHP), Salınımlı Akış, İki Fazlı Akış, Derleme, İş Akışkanı

A COMPREHENSIVE REVIEW ON THE PERFORMANCE CHARACTERISTICS OF PULSATING HEAT PIPES: A PARAMETRIC ANALYSIS**Abstract**

For thermal management of electronics, among the widely used heat transfer devices, the pulsating heat pipes (PHPs) have a critical importance. They are passive devices with simple design and relatively high performance. Their operation relies on the complex, oscillating motion of liquid and vapor inside a capillary flow passage, making their efficiency highly dependent on numerous factors. This paper provides a comprehensive literature review on the key parameters that influence PHP performance. The study systematically organizes and discusses findings related to three main areas: (1) geometric design, (2) the properties of working fluids (including pure substances, mixtures, and nanofluids), and (3) various operational characteristics. These characteristics include the filling ratio, inclination angle, the effects of external magnetic fields, and performance under different gravitational conditions.

Synthesizing a wide range of research, this review offers a structured overview of the current state of the field. It highlights established trends, identifies critical operational parameters, and discusses conflicting findings present in the literature. Therefore, this work serves as a foundational resource for engineers and researchers, aiming to support the design of more effective PHPs and guide future investigations into this promising technology.

Keywords: Pulsating Heat Pipe (PHP), Oscillating Flow, Two-Phase Flow, Review, Working Fluid

NUMERICAL ANALYSIS OF SINGLE-PHASE FLOW AND HEAT TRANSFER IN A WAVY MICROCHANNEL WITH A ROUGHENED BOTTOM SURFACE**Fatih ATCI**

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Abstract

Microchannel-based cooling systems play a critical role in the thermal management of electronic components due to their high heat transfer capacities and compact design advantages. The cooling performance of these systems is directly related not only to the channel geometry but also to the surface properties resulting from the manufacturing process. Micro-nano scale surface roughness arising during the manufacturing process can affect the flow structure, boundary layer development, and thus thermo-fluidic characteristics. Therefore, a detailed investigation of the effects of surface roughness in microchannels on flow and heat transfer is crucial for developing highly efficient and reliable cooling solutions.

In this study, the effect of surface roughness on flow and heat transfer in a wavy microchannel was investigated numerically. Three different channel geometries were evaluated: (i) a smooth straight microchannel, (ii) a smooth wavy microchannel, and (iii) a wavy microchannel with random roughness applied to its bottom surface. The random roughness structure was created using a three-dimensional Gaussian model. Numerical analyses were performed using ANSYS Fluent software employing the finite volume method. Water was used as the coolant. The analyses were performed under laminar flow conditions in the Reynolds number range of 250- 1000.

The numerical results show that the wavy microchannel provides higher average Nusselt numbers and pressure drops compared to the straight microchannel. Furthermore, adding random surface roughness to the wavy channel bottom resulted in a significant increase in the average Nusselt number compared to the smooth wavy configuration, while causing only a slight increase in pressure drop. The results indicate that wavy channel structure with rough surface can significantly enhance heat transfer in microchannel-based cooling systems.

Keywords: surface roughness, heat transfer, single-phase flow, microchannel.

**A NUMERICAL STUDY OF FLOW AND HEAT TRANSFER IN MICROCHANNEL HEAT SINK:
EFFECT OF MICRO-PIN FIN ORIENTATION ANGLE****Fatih ATCI**

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Abstract

Increasing power density of high-performance electronic systems has led to a significant rise in the heat flux that must be dissipated from a unit area. This has become a critical issue that can reduce overall system efficiency and cause permanent damage to electronic components. Therefore, the development of efficient and compact cooling technologies has become an important area of research. Among various approaches, microchannel heat sinks have attracted considerable attention due to their high heat transfer coefficients and compact structures. In particular, micro pin-fin-integrated microchannel designs offer superior thermal performance compared to conventional parallel microchannels, owing to their larger heat transfer surface area, improved mixing ability and generation of secondary flows. To further enhance the cooling efficiency, it is essential to explore new geometric configurations that can intensify mixing of the fluid and thus improve heat transfer within microchannels.

In this study, a numerical investigation was conducted to investigate the influence of orientation angle of micro pin-fins on flow and heat transfer characteristics within a microchannel. To systematically evaluate the effect of rotational orientation on the thermal-hydraulic performance, square pin-fins were rotated around their own axes from 0° to 45°, with increments of 15°. The simulations were performed under laminar single-phase flow condition using ANSYS Fluent, a three-dimensional finite volume-based CFD solver.

The results indicate that increasing the rotation angle of the pin-fins enhances fluid mixing and, consequently, leads to a notable improvement in heat transfer performance. However, this enhancement is accompanied by a rise in pressure drop. Among the examined configurations, the 15° rotation angle was found to provide the most favourable balance between heat transfer enhancement and pressure loss. Overall, results highlight that optimizing pin-fin orientation in microchannel heat sink design is a key parameter for improving thermal performance and energy efficiency in microscale cooling applications.

Keywords: micro pin-fin, heat transfer, single-phase flow, microchannel heat sinks.

**SOĞUTMA SİSTEMLERİ İÇİN YERLİ VE ENERJİ VERİMLİ ELEKTRONİK GENLEŞME VALFİ (EEV) SÜRÜCÜSÜ TASARIMI****Engin DURSUN**

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Özet

Bu proje, Türkiye’de soğutma ve iklimlendirme sektöründe enerji verimliliğini artırmak, ithal bağımlılığını azaltmak ve yerli teknolojik çözümler geliştirmek amacıyla tasarlanmıştır. Valf Sanayii A.Ş. tarafından yürütülecek olan çalışma, çoklu soğutkan desteğine sahip, PID tabanlı superheat kontrolü uygulayabilen, selenoid bobinli valflerle uyumlu ve RS485 Modbus haberleşmesini destekleyen bir Elektronik Genleşme Valfi (EEV) Sürücüsü geliştirilmesini hedeflemektedir.

Proje, mevcut ithal ürünlerin kapalı yazılım mimarileri ve sınırlı özelleştirilebilirlik sorunlarına karşı, açık kaynaklı ve esnek bir platform sunarak yerli üreticilere hem teknik hem de ekonomik avantaj sağlamayı amaçlamaktadır. Geliştirilecek ürün, enerji verimliliğinde %5–10 oranında iyileşme sağlayabilecek, [1] ithalatı azaltarak cari açığa olumlu katkıda bulunacaktır. Ayrıca, sistem güvenliğini artıracak alarm yönetimi, fail-safe modları ve gelişmiş sensör kalibrasyonu gibi yenilikçi özellikler içerecektir.

Bu proje sonucunda, Türkiye’de benzeri olmayan, enerji tasarrufu sağlayan, tamamen yerli bir EEV sürücüsü üretilecek; ülke sanayisine Ar-Ge kapasitesi, mühendislik uzmanlığı ve sürdürülebilirlik açısından önemli kazanımlar sunulacaktır.

Anahtar Kelimeler: Elektronik Genleşme Valfi, Superheat Kontrolü, PID Algoritması, Enerji Verimliliği, RS485 Modbus, Yerli Üretim, Soğutma Sistemleri, Gömülü Yazılım.

DEVELOPMENT OF A LOCAL AND ENERGY-EFFICIENT ELECTRONIC EXPANSION VALVE (EEV) DRIVER FOR REFRIGERATION SYSTEMS**Abstract**

The project aims to enhance energy efficiency, reduce import dependency, and develop innovative local technologies in Turkey’s refrigeration and HVAC industry. Led by Valf Sanayi A.Ş., it focuses on designing and developing a local Electronic Expansion Valve (EEV) Driver featuring multi-refrigerant compatibility, PID-based superheat control, solenoid valve drive capability, and RS485 Modbus communication.

Unlike existing imported alternatives with closed software architectures and limited customization options, the proposed driver will provide an open, configurable, and cost-effective platform. The system will dynamically optimize cooling performance, improving energy efficiency by 5–10% while lowering operational costs and contributing to national sustainability goals. [1] Advanced functions such as sensor calibration, fail-safe operation, and adaptive PID parameter tuning will ensure precise control and operational reliability.

This locally developed solution will fill a technological gap in the Turkish market by replacing foreign EEV drivers with a domestic, high-value product. The project will strengthen local R&D capacity, support skilled

employment, and promote sustainable industrial growth. Ultimately, it will position Turkey as a potential technology provider in energy-efficient refrigeration control systems.

Keywords: Electronic Expansion Valve Driver, Superheat Control, PID Algorithm, Energy Efficiency, RS485 Modbus, Local Manufacturing, Refrigeration Systems, Embedded Software.

**TERMOSTATİK MİX VANA TASARIMI VE İMALATI****Aykut Alp YILMAZ**

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Özet

Günümüzde enerji verimliliği, güvenlik ve kullanıcı konforu; özellikle banyo, lavabo ve duş gibi sıhhi tesisat uygulamalarında temel tasarım parametreleri arasında yer almaktadır. Sıcaklıkta meydana gelen ani değişimler, kullanıcı konforunu olumsuz etkilediği gibi ciddi güvenlik riskleri oluşturmakta ve sistemde gereksiz enerji kayıplarına yol açabilmektedir. Bu nedenle, sıcak ve soğuk suyu istenen sabit sıcaklıkta karıştırarak kontrol eden termostatik karıştırma vanaları, modern tesisat sistemlerinin vazgeçilmez bileşenleri hâline gelmiştir.

Termostatik karıştırma vanaları, sıcaklık algılayıcı termal elemanlar ve mekanik kontrol mekanizmaları yardımıyla giriş hattındaki sıcak ve soğuk su debilerini dinamik olarak düzenleyerek çıkış suyu sıcaklığını sabit bir değerde tutar. Bu özellikleri sayesinde konfor seviyesini arttırmakta, haşlanma riskini azaltmakta ve enerji kullanımının optimize edilmesine olanak sağlamaktadır. Bu tür sistemlerin otel, hastane, konut ve endüstriyel tesisler gibi geniş bir yelpazede giderek artan oranlarda kullanılmasının temel nedeni de bu üstün performans özellikleridir.

Bu tez çalışmasının amacı, boyler tankından sağlanan sıcak su ile şebekeden gelen soğuk suyu istenilen sıcaklıkta karıştırarak kullanıcıya güvenli ve konforlu bir şekilde sunabilecek, yerli ve özgün bir termostatik karıştırma vanasının tasarımı ve prototip üretimidir. Bu kapsamda vananın üç boyutlu modelleme ve montaj süreçleri SolidWorks yazılımı kullanılarak gerçekleştirilmiş; akış, sıcaklık ve yapısal davranışa ilişkin analizler ise ANSYS platformunda yürütülmüştür. Tasarım doğrulamasının ardından prototip imalatı yapılmış ve sistem performansı deneysel olarak değerlendirilmiştir.

Bu çalışma, yerli üretim kapasitesinin artırılmasına katkı sağlamayı ve sanayi uygulamalarında kullanılabilecek özgün bir termostatik karıştırma vanası çözümü sunarak sektöre değer kazandırmayı hedeflemektedir.

Anahtar Kelimeler: Termostatik mix vana, termal eleman, sıcaklık, debi, SolidWorks , ANSYS, prototip imalatı, sıcaklık kontrolü, akış analizi

THERMOSTATIC MIX VALVE DESIGN AND MANUFACTURING**Abstract**

In contemporary sanitary engineering applications, energy efficiency, operational safety, and user comfort constitute fundamental design priorities. These considerations are particularly critical in fixtures such as showers, washbasins, and bath installations. Sudden fluctuations in water temperature not only compromise user comfort but may also pose significant safety hazards and increase overall energy consumption. Consequently, thermostatic mixing valves—devices that blend hot and cold water to deliver a stable outlet temperature—have become integral components of modern plumbing systems.

Thermostatic mixing valves maintain a constant outlet temperature by means of thermally responsive elements and mechanically actuated flow-control mechanisms. Through continuous modulation of the hot- and cold-

water flow rates at the inlet, these valves ensure that the mixed water temperature remains within a predefined set point. Their deployment has expanded progressively in hotels, hospitals, residential complexes, and various industrial facilities due to their contribution to thermal stability, scald protection, and water-energy optimization.

The present thesis focuses on the design and prototype development of a domestically engineered thermostatic mixing valve capable of blending hot water supplied from a boiler tank with cold municipal water to achieve a predetermined and stable outlet temperature. Within this framework, the valve's three-dimensional geometric model and assembly configuration were developed using SolidWorks, followed by structural and thermal-fluid performance analyses executed in ANSYS. Based on the analytical outcomes, a prototype was manufactured, and its functional performance was experimentally evaluated.

This study aims to advance domestic technological capability by proposing a locally developed thermostatic mixing solution and to contribute to industrial applications through the design, analysis, and experimental validation of an original valve architecture.

Keywords: Thermostatic mixing valve, thermal element, temperature, flow rate, SolidWorks, ANSYS, prototype manufacturing, temperature control, flow analysis

DEVELOPMENT OF A THREE-CELL MICROTUBULAR SOFC STACK PROTOTYPE FOR MOBILE APPLICATIONS**Assist. Prof. Dr. Sezer ONBILGIN**

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Abstract

Microtubular solid oxide fuel cells (μ T-SOFCs), the subject of this study, are an ideal for mobile applications, like unmanned aerial vehicles and auxiliary power units, due to features such as rapid start-up and superior thermal cycling durability. However, since the power output of a single cell is insufficient to meet the energy demands of target applications, multiple cells must be connected in series or parallel to form a stack. This study aims to develop, fabricate, and characterize the performance of a μ T-SOFC stack prototype for portable systems. In this context, cells with an active area of 3 cm², consisting of a NiO-YSZ anode support, YSZ electrolyte, and LSM-YSZ cathode layers, were fabricated using extrusion and dip-coating methods. Subsequently, manifolds were manufactured from stainless steel for a three-cell stack prototype, and a parallel-connected stack was prepared. Electrochemical performance and impedance tests were conducted using hydrogen flow rates of 0.3 NL/min for the single cell and 0.9 NL/min for the three-cell stack prototype, both using an open-cathode design in a furnace environment at operating temperatures of 700, 750, and 800 °C. According to the test results, the single cell exhibited a maximum power of 560 mW (187 mW/cm²) at 800 °C, while the 3-cell stack produced a maximum power of 1195 mW (133 mW/cm²) at the same temperature. In the stack design, a power loss in the range of 29-33% was observed for different operating temperatures compared to single-cell performance. This performance degradation was attributed to the use of stainless steel interconnectors in the three cell-stack prototype, whereas Crofer22APU material, specially produced for KOYP as a stack element, was used in the single-cell anode current collection. According to impedance analyses, the approximately 100% increase in ohmic resistance of the three-cell stack prototype compared to a single cell confirms this situation.

Keywords: Microtubular solid oxide fuel cell, Electrochemical performance, Stack prototype.

FROM HYDROCARBON CORRIDOR TO GREEN ENERGY CORRIDOR: A SWOT- AND RISK-BASED ASSESSMENT OF ENERGY AND TRANSPORTATION LOGISTICS IN THE TURKIC WORLD

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Abstract

The Turkic World has been central to Eurasian geopolitics due to its geography for hydrocarbon transit. The region holds substantial proven oil and gas reserves and possesses some of the world's strongest solar and wind corridors (IEA, 2023). The Russia-Ukraine war and subsequent sanctions have accelerated a shift in Eurasian routing economics, making green interconnectors a strategic response to geopolitical instability. This shift does not represent a loss of the region's traditional advantages; rather, it transforms hydrocarbon corridors into low-carbon energy highways. The Azerbaijan-Georgia-Romania-Hungary Green Energy Corridor aims to deliver 3.9 GW of HVDC capacity by 2040, enabling exports of 30 TWh of renewable electricity and potentially 17 TWh of green hydrogen annually (CESI, 2025). Meanwhile, the Middle Corridor (TITR) continues to demonstrate strong growth. Between January and July 2025, the Port of Baku handled 60,429 TEU, a 54% year-on-year increase, placing the port on track to reach approximately 100,000 TEU by the end of the year. A SWOT analysis reveals that strengths include large-scale renewable energy potential and strategic geographic location, while weaknesses include slow grid transition and regulatory fragmentation. Opportunities exist in industrial clusters around ports such as Alat, Aktau, and Kuryk, while threats include sanctions, volatility, and great-power competition. These findings align with the OTS Vision 2040, which frames energy-transport coupling as a foundation for economic sovereignty. Integrated green corridors have the potential to significantly reduce transport-related emissions and support higher long-term growth in corridor economies (World Bank, 2023). The transition is not only technological; it represents a shift in the political economy of Eurasian influence.

Keywords: Energy Logistics, Risk Assessment, SWOT, Green Energy Corridor, Middle Corridor, Turkic World.

THE EFFECT OF FUEL CELL MAXIMUM POWER ON PERFORMANCE IN A FUEL CELL HYBRID VEHICLE**Ceyda KÖK**

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Abstract

Increasing air pollution and the gradual depletion of fossil fuel reserves are driving the shift toward alternative energy sources. In today's world, where transportation has become an indispensable part of our lives, internal combustion engines rely on fossil fuels. Therefore, fuel cell vehicles are being presented as an alternative to internal combustion engine vehicles. Fuel cells are preferred for long ranges due to their high specific energy. Fuel cells are used in conjunction with batteries or supercapacitors to provide additional power. In these topologies used in fuel cell vehicles, energy efficiency, fuel consumption, and the efficiency of the fuel cell and battery are very important. One of the important parameters affecting these is fuel cell power. Therefore, in this study, the fuel cell and battery topology was modeled, and the WLTP driving cycle was applied to this topology. To observe the effect of fuel cell power on energy efficiency, fuel consumption, and energy source efficiency, tests were conducted with fuel cell powers of 40 kW, 45 kW, and 50 kW. The results show that as fuel cell power increases, fuel consumption at the end of the driving cycle increases and overall energy efficiency decreases. At the same time, an increase in battery charge status at the end of the cycle was observed when fuel cell power increased. Based on these findings, fuel cell power should be designed within optimal power limits in fuel cell vehicle design.

Keywords: Fuel cell vehicle, battery, energy efficiency, fuel cell, hydrogen consumption

**PEM YAKIT HÜCRESİ PERFORMANSININ YAPAY ZEKA TABANLI YÖNTEMLER İLE OPTİMİZASYONU****Aytaç ŞANAL**

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Özet

Bu çalışma, polimer elektrolit membranlı yakıt hücrelerinin (PEMYH) performansını etkileyen temel girdilerin geniş bir literatür taramasıyla analiz edilip yapay zeka destekli algoritmalar değerlendirilerek hücre performansının optimize edilmesini amaçlamaktadır. Bu amaç doğrultusunda sıcaklık, basınç, nem oranı, platin yükleme ve membran tipi gibi temel parametrelerin yakıt hücresi verimini nasıl etkilediği ayrıntılı bir biçimde yapay zeka teknikleri ile değerlendirilmiştir. Her çalışmadan elde edilen akım–gerilim eğrileri bu parametrelerle karşılaştırılmış, elde edilen tüm veriler yapay zeka teknikleri aracılığıyla analiz edilmiştir. Bu model sayesinde girdilerin hücre performansı üzerindeki etkileri ile güç yoğunluğu, aktivasyon, ohmik ve konsantrasyon kayıplarına olan etkileri ortaya konularak yapay zeka analizleriyle maksimum güç yoğunluğuna ulaşma şartları değerlendirilmiştir. Elde edilen sonuçlar, literatürde yaygın olarak araştırma konusu olan PEM yakıt hücrelerinin araştırılmasına yönelik çalışmalar için katkı sunacaktır. Çalışmanın sonunda enerji verimliliğinin artırılması, hücre performansının iyileştirilmesi, maliyetlerin düşürülmesi ve sürdürülebilir PEM yakıt hücresi teknolojilerinin gelecekteki tasarımlarına katkılar sunulması hedeflenmektedir.

Anahtar Kelimeler: Hidrojen Enerjisi, Yakıt Hücresi, Sürdürülebilir Enerji, Yapay Zeka Teknikleri.

OPTIMIZATION OF PEM FUEL CELL PERFORMANCE USING ARTIFICIAL INTELLIGENCE METHODS**Abstract**

This study aims to optimize fuel cell performance by analyzing the key inputs affecting the performance of polymer electrolyte membrane fuel cells (PEMFCs) through an extensive literature review and evaluating artificial intelligence-supported algorithms. For this purpose, fundamental parameters such as temperature, pressure, humidity, platinum loading, and membrane type were comprehensively evaluated using artificial intelligence techniques to determine how they affect fuel cell efficiency. The current-voltage curves obtained from each study were compared with these parameters, and all data obtained were analyzed using artificial intelligence techniques. Thanks to this model, the effects of inputs on cell performance and their effects on power density, activation, ohmic and concentration losses were revealed, and the conditions for achieving maximum power density were evaluated using artificial intelligence analyses. The results obtained will contribute to studies investigating PEM fuel cells, which are a widely researched topic in the literature. The aim at the end of this study is to increase energy efficiency, improve cell performance, reduce costs, and contribute to the future designs of sustainable PEM fuel cell technologies.

Keywords: Hydrogen Energy, Fuel Cell, Sustainable Energy, Artificial Intelligence Methods

DETERMINATION OF THE HYDROGEN STORAGE PROPERTIES OF Li DECORATED Ti₂CF₂ MXenes**Bilal GÜLSEVEN**

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Abstract

This study addresses efficient hydrogen storage, a major challenge for clean energy technologies. We investigate the potential of the Ti₂CF₂ MXene material using Density Functional Theory (DFT) and Ab-initio Molecular Dynamics (AIMD) simulations. This non-clustering behavior is essential, as it directly contributes to the system's dynamic stability and ensures maximum hydrogen adsorption sites remain available. Specifically, they inherently offer significant advantages, including a high surface area, adjustable surface chemistry—which allows for precise functionalization like Li decoration—and good conductivity, all of which are favorable for robust storage performance. MXenes materials are regarded as one of the promising candidates for the future in hydrogen storage technologies due to their unique structural and electronic properties. Despite these significant inherent advantages, several critical practical challenges still need to be comprehensively addressed. These challenges include ensuring long-term material stability, reducing production costs to make the technology economically viable, and developing strategies for successful large-scale integration into commercial devices. Future research is expected to focus on the development of MXene-based composite systems and ensuring industrial-scale applicability. By continuing to advance both the fundamental understanding and practical engineering of these materials, the overall contribution of MXenes to the burgeoning hydrogen economy is strongly anticipated to increase substantially in the coming years.

Keywords: Hydrogen storage, MXenes, Ti₂CF₂, Density functional theory (DFT), AIMD simulations.

MODELING AND SIMULATION OF A DIGITAL CONTROL SYSTEM FOR POWER QUALITY IMPROVEMENT USING STATIC VAR COMPENSATION**Zeyad MANSOOR ALSADOON**

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Abstract

This paper presents a practical way of designing and evaluating a digital controller for power quality improvement in industrial electrical networks. The technique is based on a solar PV-integrated three-phase inverter with Static VAR Compensation (SVC) has been implemented and simulated using MATLAB/Simulink. We describe how control parameters are determined, PWM switching is controlled between phases and customized filtering strategies for voltage regulation, harmonic cancellation and reactive power compensation. The impact of practical issues in real world implementation, for example, sampling rates, quantization error and system response during load transients is also investigated through extensive simulations. This framework provides a structured and flexible path towards hardware deployment or real-time testing by tying together control strategy, power electronics behavior, and grid interaction.

Keywords: Power quality, digital control, FPGA implementation, three-phase inverter, Static VAR Compensation (SVC), PWM control, harmonic mitigation.

GLOBAL OPTIMIZATION OF HYDROGEN PRODUCTION SYSTEMS USING MACHINE LEARNING TECHNIQUES**Chaymae DENDEN**

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Abstract

The growing demand for sustainable and carbon-free energy has accelerated the global transition toward hydrogen-based technologies. However, optimizing hydrogen production from renewable sources remains a major challenge due to the nonlinear and dynamic nature of photovoltaic (PV) and electrolysis systems. This study explores the integration of Machine Learning (ML) algorithms as a powerful tool for global optimization and performance enhancement of hydrogen production systems. Various ML models, including Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Reinforcement Learning (RL), are investigated for predicting key operational parameters such as temperature, current density, and efficiency under variable environmental conditions. The proposed approach enables accurate modeling of system behavior, real-time optimization of operating points, and adaptive control to maximize hydrogen yield while minimizing energy losses. Furthermore, this research highlights the potential of ML-based hybrid models that combine data-driven prediction with physical modeling to achieve higher reliability and scalability. The results demonstrate that ML can play a decisive role in improving the efficiency, stability, and sustainability of renewable hydrogen systems, contributing significantly to the achievement of global clean energy goals.

Keywords: Machine Learning, Hydrogen Production, Optimization, Photovoltaic Systems, Sustainable Energy

SUSTAINABLE HYDROGEN PRODUCTION AND STORAGE FROM PHOTOVOLTAIC SYSTEMS IN SMART MICROGRIDS**Chaymae Denden**

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Abstract

The increasing global demand for sustainable energy has intensified research on hydrogen as a promising clean fuel for the future. Among the various renewable sources, photovoltaic (PV) systems represent an effective and eco-friendly solution for hydrogen generation through water electrolysis. However, the intermittent nature of solar energy poses challenges to the stability and efficiency of hydrogen production. This study explores the development of an optimized control strategy for a photovoltaic hydrogen production and storage system integrated within a smart microgrid. The proposed approach aims to enhance energy conversion efficiency, ensure system stability, and balance energy flows between PV generation, electrolyzer operation, and storage units. Furthermore, the integration of intelligent control methods and predictive algorithms is discussed to improve dynamic performance under variable solar irradiance conditions. The findings contribute to advancing sustainable hydrogen technologies and their practical application in future energy systems.

Keywords: Hydrogen production, photovoltaic energy, energy storage, microgrid, renewable energy control.

ADVANCED ELECTRODE MATERIALS AND NON-NOBLE METAL CATALYSTS FOR EFFICIENT GREEN HYDROGEN PRODUCTION VIA WATER ELECTROLYSIS**Benlahreche Fatima Zohra**

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Abstract

The transition toward sustainable energy systems increasingly relies on the large-scale deployment of green hydrogen, which can be efficiently produced through water electrolysis when powered by renewable energy sources. However, the widespread adoption of this technology remains limited by the cost and durability of conventional noble metal catalysts. This work investigates advanced electrode materials and non-noble metal catalysts designed to enhance the efficiency, stability, and overall performance of water electrolysis systems. Emphasis is placed on transition-metal-based compounds—such as oxides, phosphides, and sulfides—engineered to improve the kinetics of the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER). Structural, morphological, and electrochemical characterizations are employed to establish structure–activity relationships and to identify key factors influencing catalytic activity and long-term durability under operational conditions. The results highlight that tailored nanostructured surfaces, synergistic multi-metal compositions, and optimized electrode architectures significantly enhance catalytic efficiency while reducing material costs. This study contributes to the development of high-performance, low-cost electrocatalysts and electrode materials, offering promising pathways for scalable and economically viable green hydrogen production.

Keywords: Green Hydrogen, Water Electrolysis, Electrocatalysts, Hydrogen Evolution Reaction (HER), Nanostructured Materials.

MODELING THE CARBON–OIL–FISCAL TRILEMMA: A DERIVATIONAL FRAMEWORK FOR ENERGY JUSTICE AND EMISSION EFFICIENCY IN NIGERIA

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Abstract

This paper develops a quantitative and derivational framework for understanding Nigeria's carbon–oil–fiscal trilemma, where hydrocarbon dependence, emission efficiency, and fiscal stability interact. Using national data from 2000 to 2023, the study constructs a Carbon–Oil Decoupling Index (CODI) to evaluate whether growth in oil production has become delinked from CO₂ emissions. Building on this, a series of mathematical derivations formalize the emission–production relationship: discrete difference equations decompose emission change into production, intensity, and interaction effects; logarithmic elasticities define the condition for carbon decoupling; and an Integrated Decoupling Potential (IDP) measures long-term emission efficiency. A discrete optimal-control model further identifies the emission-minimizing path of carbon intensity, interpreting deviations as fiscal inefficiencies or forgone mitigation. By aligning these dynamics with fiscal dependence and environmental accountability, the framework treats energy justice as a balanced condition between revenue sustainability and ecological responsibility. The study contributes a unified, mathematically rigorous model linking fiscal structure, carbon cost, and emission control offering an analytical foundation for Nigeria's just and financially coherent energy transition.

Keywords: carbon–oil–fiscal trilemma; emission efficiency; decoupling index; optimal-intensity model; energy justice; Nigeria

TECHNOLOGICAL INNOVATION AND SOCIAL ACCEPTANCE IN THE ENERGY TRANSITION: INSIGHTS FOR A RESPONSIBLE AND SUSTAINABLE AI FUTURE

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Abstract

Public perceptions of the energy transition are strongly shaped by how technological innovation is understood, trusted, and integrated into everyday life. Current literature indicates that attitudes toward renewable energy technologies are influenced not only by environmental awareness but also by the perceived reliability, fairness, and long-term benefits of new systems. Social acceptance is influenced by expectations of technological progress, such as improvements in efficiency, smart infrastructures, or advanced storage solutions, which often generate optimism but also raise concerns related to transparency, equity, and potential local impacts. Research highlights that communities tend to support innovation when it is framed as accessible, safe, and aligned with socio-economic development. However, persistent gaps remain in how citizens evaluate the broader technological shift that accompanies decarbonisation, especially regarding trust in institutions, pace of change, and the perceived distribution of risks and benefits. This state-of-the-art synthesis highlights the need for approaches that integrate technological innovation with participatory strategies to establish legitimacy and promote sustained public support for the energy transition.

Keywords: energy transition, public perceptions, technological innovation, social acceptance, decarbonization, socio-technical change.

RENEWABLE ENERGY TECHNOLOGY DEPLOYMENT: CONTRIBUTIONS TO THE SUSTAINABLE DEVELOPMENT GOALS AND SOCIETAL WELFARE**Svetlana KUNSKAJA**

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Abstract

Renewable energy technology (RET) deployment is central to achieving the Sustainable Development Goals (SDGs), particularly SDG7 on affordable and clean energy and SDG13 on climate action. At the same time, RETs shape key dimensions of societal welfare by influencing decent work and economic growth (SDG8), industry, innovation and infrastructure (SDG9), sustainable cities and communities (SDG11), and responsible consumption and production (SDG12). Yet empirical evidence on how RET deployment contributes to – or challenges – these goals and broader societal welfare remains fragmented. This study aims to synthesize recent findings on the links between RET deployment, selected SDGs and societal welfare outcomes. Methods: A systematic literature review was conducted of peer-reviewed empirical studies indexed in Scopus and Web of Science between 2015 and 2025. Eligible articles analyzed RET deployment together with social, economic or environmental outcomes that could be linked to SDG7, SDG8, SDG9, SDG11, SDG12 or SDG13. Societal welfare was interpreted in a multidimensional way, including material living conditions, employment, local economic development, quality of life, social cohesion and environmental quality. Studies were identified using predefined keyword combinations, screened according to inclusion and exclusion criteria, and systematically analyzed by categorizing information on technology type, SDG linkages and reported welfare indicators in a structured extraction table. Results: The review shows that RET deployment supports multiple SDGs and enhances societal welfare through improved energy access, job creation, local economic development, technological innovation and reduced emissions. At the same time, important trade-offs emerge around land use, distributional equity, energy affordability and local acceptance, which may constrain welfare gains and hinder progress towards inclusive and sustainable communities. Conclusions: The findings underline the need for renewable energy policies and project designs that explicitly integrate SDG objectives and societal welfare considerations. Strengthening the alignment between RET deployment, welfare indicators and SDG targets can help maximize synergies, minimize trade-offs and ensure that the energy transition contributes to a more equitable and sustainable society.

Keywords: Renewable energy, sustainable development goals, SDG, societal welfare, energy transition.

CLEAN ENERGY FOR A SUSTAINABLE WORLD: TECHNOLOGY, POLICY, AND NEW PERSPECTIVES**MSc.Selvije Lajqi**

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Abstract

The transition to clean energy is a key component in addressing the challenges of climate change and achieving sustainable development. This paper examines the impact of renewable energy sources and the role of energy policies that support the transition to a clean economy. Energy sources such as solar, wind, and biomass have been identified as the most effective options to meet the demand for sustainable energy with a low environmental impact. The methodology used includes an in-depth analysis of national and international energy policies, as well as an evaluation of the efficiency of renewable resources through comparative studies. The findings show that supportive policies, such as fiscal incentives, technological innovation, and investments in infrastructure, can accelerate the transition to clean energy and contribute to achieving sustainable development goals. The study further highlights the role of private sector engagement, public-private partnerships, and international cooperation in fostering clean energy solutions. Additionally, it explores the potential of emerging technologies, such as energy storage and smart grids, to enhance energy system resilience. This study emphasizes that the integration of clean energy into global energy systems requires close international cooperation and sustained commitment at the political, technological, and institutional levels.

Keywords: Clean energy, sustainable development, renewable resources, energy policies, climate change, energy efficiency, international cooperation, energy storage, smart grids.

EVALUATING THE IMPACT OF RENEWABLE ENERGY SYSTEMS ON NURSING WORKFLOW EFFICIENCY AND PATIENT CARE IN RESOURCE-LIMITED SETTINGS: A SYSTEMATIC REVIEW

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Abstract

Reliable electricity is foundational to effective healthcare delivery, yet many health facilities in low- and middle-income countries (LMICs) continue to face persistent power shortages. Frequent outages disrupt nursing activities, hinder the performance of essential medical equipment, and compromise patient safety. Renewable energy systems (RES) particularly solar photovoltaic (PV) technologies supported by battery storage are increasingly being adopted to mitigate these challenges.

This systematic review consolidates current evidence (2018–2025) on the influence of RES on nursing workflow efficiency and patient care in resource-constrained environments. A comprehensive search of five major databases was conducted following PRISMA guidelines, yielding 27 eligible studies.

The findings consistently demonstrate improvements in lighting quality, equipment availability, vaccine cold-chain stability, and the continuity of emergency and maternal health services. Ten studies reported substantial enhancements in nursing workflow, including fewer disruptions, better timeliness of clinical tasks, and increased direct patient care. Thirteen studies documented improved patient outcomes, particularly in neonatal and maternal health. Despite these positive trends, there remains a significant gap in rigorous impact assessments and long-term evaluations. The review underscores the need for more robust research designs and continued policy support to expand renewable energy integration within healthcare systems across LMICs.

Keynotes: Renewable Energy Systems, Nursing Workflow Efficiency, Patient Care, Resource-Limited Setting, Solar Photovoltaic (PV)

ANALYSIS OF THE EQUITY AND EFFECTIVENESS OF THE LUXURY GOODS SALES TAX (PPNBM) EXEMPTION POLICY FOR ELECTRIC VEHICLES (EV) IN INDONESIA**Artita Permanda, Chrisstohfer SM, Alif Prawira Basuki, Ratna Septiyanti, Mega Metalia**

Perpajakan Universitas Lampung

Abstract

This study presents an in-depth analysis of the dual impacts of the Luxury Goods Sales Tax (PPnBM) exemption policy for Battery-Based Electric Motor Vehicles (KBLBB) in Indonesia. As a progressive fiscal instrument, this policy is designed to accelerate EV adoption to achieve the 2060 Net Zero Emission target. This study uses a descriptive qualitative method with a comprehensive literature review approach. The policy's effectiveness is analyzed quantitatively using vehicle sales trend data, while its equity aspect is examined through the lens of vertical equity theory, critiquing the allocation of incentive benefits. The results reveal a paradox: this policy has proven highly effective in stimulating market growth and consumer interest, marked by an exponential surge in sales. However, at the same time, this policy is inherently regressive. The benefits of this tax exemption disproportionately benefit high-income segments of society, creating distributive distortions and significant opportunity costs for the government. The study concludes that, despite its success as a market driver, this policy requires serious recalibration to align environmental objectives with principles of social justice, and recommends a more tiered and public-oriented incentive scheme.

Keywords: Fiscal Incentives, PPnBM, Electric Vehicles, Tax Fairness, Policy Effectiveness, Regressive Policy, Energy Transition.

BEYOND ESG REPORTING: ENERGY RESILIENCE AS A DRIVER FOR STRATEGIC ESTATE VALUATION AND PORTFOLIO REBALANCING**Aminu Yakubu Boyi**

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Abstract

The global real estate sector faces escalating pressure from climate-related physical risks, energy price volatility, and stringent decarbonization mandates. While Environmental, Social, and Governance (ESG) reporting has become standard, it often remains a backward-looking compliance exercise. This creates a critical gap: current valuation models and portfolio strategies largely fail to quantify how energy resilience an asset's ability to maintain operations during grid stress and transition to clean energy impacts long-term financial performance and strategic asset allocation. This study argues that energy resilience must transition from an ESG metric to a core financial driver in estate management. It aims to empirically investigate the relationship between measurable energy resilience features (e.g., on-site generation, storage, microgrid capability) and strategic outcomes in asset valuation and portfolio rebalancing decisions. The research employs a mixed-methods approach. First, a quantitative analysis of 150 commercial assets in the European market will be conducted, using hedonic pricing models to isolate the price premium or risk discount associated with verified resilience features. Second, semi-structured interviews with 20 senior portfolio managers and valuation experts will provide qualitative insights into how resilience is shifting strategic hold/sell/acquire decisions. Preliminary analysis of a 50-asset subset reveals a statistically significant 8-12% valuation premium for assets with certified resilience infrastructure, compared to peers without. Furthermore, 73% of interviewed executives confirmed that energy resilience is now a "high-priority" factor in portfolio rebalancing, directly influencing divestment from vulnerable assets and capital allocation for retrofits. The study concludes that energy resilience is a material, value-creating attribute that transcends traditional ESG reporting. For estate managers, proactively quantifying and investing in resilience is not merely a risk mitigation tactic but a strategic imperative for enhancing portfolio value and navigating the energy transition. It advocates for the integration of resilience metrics into mainstream investment appraisal frameworks.

Keywords: Energy Resilience, Strategic Valuation, Portfolio Rebalancing, ESG Integration, Real Estate Investment

THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENERGY DEMAND MANAGEMENT IN SMART CITIES**Najiba Mohammadi**

Student of AllahBayt International University

Hajer Ehsani

student of AllahBayt International University

Samira Nasirzadeh

Professor Advisor of AllahBayt International University

Abstract

Sustainable energy management is one of the central challenges in smart cities, and the application of artificial intelligence (AI) has emerged as an effective approach for optimizing consumption patterns, forecasting energy demand, and enhancing the efficiency of urban infrastructure. This study aims to analyze the role of AI in managing energy demand in smart cities and to identify major research trends in this field. To this end, previous scholarly studies on AI, urban planning, and energy management were systematically reviewed, and a scientometric analysis was conducted using VOSviewer to examine the knowledge structure of related research through co-occurrence mapping. The findings indicate a substantial growth in AI-related studies in smart cities in recent years, with a shift in focus from conceptual investigations toward practical applications that address real urban challenges, particularly in energy management. The knowledge map reveals that emerging concepts such as sustainable development, net-zero carbon, resilience, circular economy, and energy efficiency have become central themes in contemporary research on smart cities and energy systems. Case study evidence further demonstrates that employing machine learning algorithms for load forecasting, monitoring temporal consumption patterns, and enabling autonomous appliance control can reduce energy use by 25% in lighting systems, 15% in socket-based systems, and approximately 40% in heating and cooling systems without compromising occupant comfort. Moreover, integrating renewable energy sources—such as residential solar panels—into smart grid systems and leveraging data-driven models for supply–demand management contributes approximately 9 kWh of clean energy daily to smart buildings. Overall, the results highlight that AI, through automated decision-making, infrastructure optimization, error reduction, and improved energy efficiency, plays a foundational role in advancing smart urban systems and achieving sustainability goals. Consequently, the future development of smart cities requires stronger data infrastructures, ethical frameworks, and institutional capacity to ensure the effective and responsible deployment of AI technologies in energy demand management.

Keywords: Artificial Intelligence; Smart Cities; Energy Demand Management; Machine Learning; Sustainable Urban Systems

BLOCKCHAIN TECHNOLOGY FOR PEER-TO-PEER RENEWABLE ENERGY TRADING**Moses Adeolu AGOI**Lagos State University of Education, Lagos Nigeria.
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Abstract

This paper investigates the transformative potential of blockchain technology as a foundational infrastructure for enabling Peer-to-Peer (P2P) renewable energy trading. In contrast to the traditional centralized energy distribution model; where utilities act as the sole intermediaries controlling pricing, metering, and distribution, blockchain introduces a decentralized paradigm that empowers energy consumers to become prosumers: simultaneously producing, consuming, and trading renewable electricity at the community level. By eliminating the need for third-party gatekeepers, blockchain is positioned to foster transparent, secure, and tamper-proof energy transactions that operate in near real time. The research provides a comprehensive review of the major architectural components and operational mechanisms that underpin blockchain-based P2P energy markets. Specific attention is given to the role of smart contracts in automated settlement, market-clearing algorithms that balance supply and demand efficiently, and scalability strategies required to support a growing number of participants without compromising system performance. Furthermore, the study contributes three major innovations: (1) a rigorous synthesis of cutting-edge P2P energy trading frameworks proposed in recent academic and industry literature; (2) the design of a hybrid market mechanism that integrates features of auction-based pricing with coalition-based trading structures to ensure both fairness and efficiency; and (3) an empirical evaluation of market performance using simulated trading environments and microgrid testbeds. Results demonstrate that blockchain-enabled P2P trading can substantially enhance producer surplus, boosting seller profits by up to approximately 88% compared to conventional billing approaches, while also maintaining acceptable cost levels for buyers. The decentralized framework promotes market fairness, incentivizes increased renewable adoption, and reduces dependence on heavily centralized grid infrastructure. However, notable barriers remain, including regulatory ambiguity, technical limitations related to network congestion and transaction latency, and the need for standardized interoperability frameworks across regions. The study concludes by outlining targeted future research pathways aimed at developing scalable, secure, and socially equitable P2P renewable energy markets that can support widespread green energy transitions globally.

Keywords: Blockchain, Peer-to-Peer Energy Trading, Smart Contracts.

BEM-BASED QBlade ANALYSIS OF SINGLE VS MULTI-AIRFOIL ROTOR CONFIGURATIONS FOR A 5 MW WIND TURBINE**MD MEHEDY HASAN SABBY**

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BANDHON SAHA BIJOY

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Abstract

This study investigates an aerodynamic analysis and performance assessment of a 5 MW horizontal-axis wind turbine utilizing several airfoil shapes. The inquiry was conducted via QBlade software grounded in Blade Element Momentum (BEM) theory. Four blade configurations were analyzed: single-airfoil blades (SG6051 and S1221) and two hybrid designs (SG6050–SG6043–S1221 and SG6050–SG6040–SG6043). Critical aerodynamic metrics, including lift, drag, lift-to-drag ratio, power coefficient, power curve, torque, and thrust, were examined over a spectrum of wind velocities. The findings demonstrate that whereas single-airfoil designs ensure stable and reliable operation, hybrid arrangements attain superior aerodynamic efficiency and enhanced thrust performance. The SG6050–SG6040–SG6043 combination exhibited the best power coefficient ($C_p = 0.64$) and highest power ($2.92 \times 10^5 \text{W}$), signifying exceptional power extraction efficiency. The SG6050–SG6043–S1221 arrangement exhibited superior thrust control and aerodynamic stability. The simulation suggests that multi-airfoil blades provide superior energy capture, more uniform load distribution, and greater efficiency relative to single-airfoil designs, rendering them ideal for next-generation large-scale wind turbines.

Keywords: Blade Element Momentum (BEM) theory; aerodynamic performance; multi-airfoil rotor; horizontal-axis wind turbine; power coefficient; thrust efficiency.

INTELLIGENT OPTIMIZATION OF ENERGY SHARING IN HYBRID WIND-BASED MICROGRIDS**Aymen Bamaarouf**

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Abstract

The global energy transition promotes the development of microgrids integrating renewable sources such as wind energy. However, the intermittency of these sources creates challenges in terms of stability, synchronization, and optimal energy flow management. This research proposes an artificial intelligence-based approach to optimize control, synchronization, and energy sharing among distributed units within a microgrid connected to the national grid. The methodology relies on reinforcement learning algorithms and neural networks to dynamically adjust control parameters according to load conditions and generation fluctuations. Preliminary simulation results show a significant improvement in system stability and a reduction in energy losses. These findings highlight the potential of intelligent control strategies for enhancing the integration of renewable sources in modern smart grids.

Keywords: microgrid, wind energy, optimization, intelligent control, synchronization, energy sharing

INTELLIGENT CONTROL OF ENERGY SHARING IN WIND BASED MICROGRIDS**Aymen Bamaarouf**

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Abstract

The global energy transition promotes the development of microgrids integrating renewable sources such as wind energy. However, the intermittency of these sources creates challenges in terms of stability, synchronization, and optimal energy flow management. This research proposes an artificial intelligence-based approach to optimize control, synchronization, and energy sharing among distributed units within a microgrid connected to the national grid. The methodology relies on reinforcement learning algorithms and neural networks to dynamically adjust control parameters according to load conditions and generation fluctuations. Preliminary simulation results show a significant improvement in system stability and a reduction in energy losses. Furthermore, the proposed model can be adapted to different configurations of distributed generation systems, ensuring flexibility and scalability for real applications. Future work will focus on experimental validation through a laboratory-scale microgrid platform integrating real-time data acquisition and hardware-in-the-loop simulation. This step aims to confirm the robustness and adaptability of the proposed intelligent control under realistic operating conditions, paving the way toward autonomous and resilient smart energy systems. So it's mandatory to take in consideration many external conditions which influence the stability of these microgrids .

These findings highlight the potential of intelligent control strategies for enhancing the integration of renewable sources in modern smart grids.

Keywords: Microgrid, wind energy, optimization, synchronization, energy sharing, Machine Learning;

MECHANICAL CAD DESIGN AND COMPUTATIONAL FLUID DYNAMICS STUDY OF AN ADVANCED HIGH-SPEED NASA PROPELLER**Helal Uddin**

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Abstract

Advanced open-rotor designs are receiving more attention as the aviation industry continuously looks for propulsion systems that combine the high cruising speeds of turbofans with the fuel economy of turboprops. However, using propellers at transonic speeds involves important compressibility effects, such as drag divergence and shock wave production, which are difficult to simulate structurally and computationally. This is a project concerning a parametric mechanical design and a high precision aerodynamic analysis of a NASA type super-accurate high-speed propeller to test its performance at transonic cruise speeds. Our project is a parametric CAD super twisted, swept scimitar geometry with NASA SR -series coordinates and geometry. I then modeled the flow with Shear Stress Transport (SST) $k-\omega$ turbulence model to obtain the detailed physics of the complex flow at the cruise Mach number 0.8. The findings indicated the higher propulsive efficiency of 82.30 at the design advance ratio. Flow visualization is used to effectively study the conditions of the shock waves at the blade tips and confirmed the distribution of pressure in comparison with the historical wind tunnel results. This paper ends by determining that the suggested swept-blade geometry is an efficient way to delay the divergence of drag justifying the integrated CAD and CFD workflow used to optimize high speed propulsion systems in the next generation.

Keywords: Advanced Open Rotor; Computational Fluid Dynamics (CFD); Parametric CAD Modeling; Propulsive Efficiency; Compressibility Effects.

ADVANCED NUMERICAL ANALYSIS AND PERFORMANCE ENHANCEMENT OF DARRIEUS VERTICAL-AXIS WIND TURBINES**Drai Ismail^{1,2}**

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Abstract

The vertical-axis wind turbine (VAWT), serves to convert the kinetic energy of the wind into electrical power. The main configurations of VAWTs include the Darrieus turbine, the Savonius turbine, hybrid designs, and lift-type turbines. In this paper, an in-depth aerodynamic analysis was performed by conducting a numerical investigation on a two-bladed Darrieus turbine. For this purpose, a two-dimensional cross-sectional computational model was built using structured meshing techniques in order to analyze the behavior of the airflow and the resultant aerodynamic forces acting on the blades. Numerical results were compared with those presented by Lanville's reference study, showing a very good level of agreement and confirming the validity of the adopted methodology. Based on the experience obtained from the two-blade configuration, an innovative four-blade turbine model was proposed by enlarging the aerodynamic profiles, aimed at increasing the wind-capture capability and improving the performance of the turbine. Finally, an extended performance comparison was carried out for the two configurations to compare operational efficiency, aerodynamic behavior, and possible performance improvements. This study provides an in-depth insight into VAWT aerodynamic mechanisms, underlining the key design issues for performance optimization. In this respect, the findings herein reported will also be of practical importance for future work dealing with wind turbines, thus offering valuable contributions to the current efforts devoted to increasingly efficient, clean, and renewable energy—a key ingredient of the global energy transition.

Keywords: Vertical-Axis Wind Turbine (VAWT), Darrieus Turbine, Aerodynamic Performance, Computational Fluid Dynamics (CFD).

HYBRID WASTE HEAT RECOVERY FOR ENHANCED AUTOMOTIVE ENERGY EFFICIENCY**Chhavi**

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Orchid ID - 0000-0003-2570-1535**Abstract**

The study highlights the importance of Advanced Automotive Waste Heat Recovery Systems (WHRS) in addressing the energy inefficiency of modern Internal Combustion Engine (ICE) vehicles. Approximately 60–70% of fuel combustion energy is lost as waste heat through exhaust gases and engine coolant, which significantly reduces fuel economy and increases CO₂ emissions.

This research focuses on next-generation WHRS architectures that convert thermal losses into mechanical or electrical power. Two major technologies are emphasized: the Organic Rankine Cycle (ORC), which converts exhaust heat into usable power, and Thermoelectric Generators (TEG) that use the Seebeck effect to directly convert temperature gradients into electricity. The study also examines novel thermal energy storage and conversion methods and analyzes the thermodynamic performance of these integrated systems, including net power output, conversion efficiency, system size, and complexity, under varying transient driving conditions.

Overall, the work demonstrates that advanced WHRS can enhance vehicle efficiency by 5–10%, thereby improving fuel economy and reducing the carbon footprint of ICE automobiles.

Keywords: Waste Heat Recovery, Internal Combustion Engine, Organic Rankine Cycle (ORC), Thermoelectric Generator (TEG), Thermal Efficiency, Fuel Economy, Exhaust Energy.

WOOD BIOMASS GASIFICATION FOR RESOURCE CONSERVATION AND RENEWABLE ELECTRIC ENERGY**Nanda Aulia Rahma**

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Abstract

This study examines the significance of wood biomass gasification in supporting resource conservation and the generation of renewable electric energy, employing a qualitative literature review within the scope of Environmental Studies. The analysis brings together findings from recent academic publications that focus on the utilisation of wood waste, the environmental performance of biomass-based systems, and the technical behaviour of gasification technologies in sustainable energy applications. Synthesized literature indicates that converting wood biomass into syngas through gasification helps reduce the exploitation of natural resources while increasing the beneficial use of wood residues that would otherwise be discarded or burned conventionally. Several studies highlight that downdraft gasifiers can deliver relatively stable syngas for decentralized power generation, making the technology suitable for small-scale and community-based renewable energy systems. In addition, research consistently reports noticeable reductions in emissions and ecological footprint when gasification is adopted instead of traditional combustion or waste disposal methods. These findings reinforce the view that wood biomass gasification offers a practical, environmentally responsible, and resource-efficient pathway for expanding renewable electricity and promoting broader sustainability goals. Overall, this study contributes to a deeper understanding of how wood-based biomass resources can be integrated into cleaner energy strategies while supporting environmental conservation efforts.

Keywords: Wood Biomass, Gasification, Environmental Studies, Resource Conservation, Renewable Energy

BIOENERGY: A SUSTAINABLE SOLUTION TO ENERGY DEMAND**Nwaeze Quality Ebube**

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Abstract

Bioenergy offers a sustainable and renewable solution to the growing global energy demand, providing an environmentally friendly alternative to fossil fuels. Derived from organic materials such as biomass, agricultural residues, and organic waste, bioenergy encompasses various forms including bioethanol, biodiesel, and biogas. These biofuels play a crucial role in energy diversification, rural electrification, and the development of carbon-neutral fuel systems. Advanced technologies in biochemical and thermochemical conversion have enhanced the efficiency of bioenergy production, enabling its integration into modern energy infrastructures. Despite its potential, the bioenergy sector faces several challenges, including high production costs, technological limitations, and inconsistent policy support. However, ongoing research, innovation, and global policy initiatives continue to strengthen its prospects. Bioenergy remains central to the transition towards a cleaner, more resilient, and sustainable global energy system. Furthermore, bioenergy contributes significantly to waste management by converting agricultural and municipal waste into usable energy, thereby reducing environmental pollution. It also creates employment opportunities across the energy value chain, particularly in rural communities where biomass resources are abundant. Bioenergy systems are scalable and can be tailored for off-grid applications or large-scale power generation. Life-cycle assessments reveal that, when sustainably managed, bioenergy systems emit considerably less greenhouse gases compared to fossil-based energy sources. Additionally, co-products such as biochar and digestate enhance soil fertility, supporting circular economy models. Continued investment in feedstock optimization, conversion technologies, and supportive policies will be critical to overcoming current barriers. In summary, bioenergy represents a multifaceted and vital component of the global shift towards energy security, climate change mitigation, and sustainable development.

Keywords: Bioenergy, Renewable energy, Biofuels, Biomass conversion, and Sustainable energy systems

RECENT DEVELOPMENT OF NANOCELLULOSE EXTRACTED FROM AGRICULTURAL WASTE FOR ENERGY STORAGE APPLICATIONS

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Abstract

This review was conducted to assess the viability of nanocellulose for energy storage applications. Nanocellulose has emerged as a very promising and sustainable nanomaterial owing to its distinctive architectures, remarkable characteristics, and natural abundance. This paper examines current research efforts aimed at utilizing nanocellulose for enhanced energy storage applications. We start by providing a concise overview of the structural characteristics of cellulose nanofibers present in the cell walls of cellulose resources. then we examine diverse methodologies that have been studied for employing cellulose in energy storage applications. Unlike conventional binders, we prioritize the use of solid electrolytes and 3D printing methodologies. Furthermore, we investigate various application domains, encompassing supercapacitors, lithium-ion batteries, and zinc-ion batteries. This section primarily focuses on the integration of nanocellulose with other active materials to create flexible substrates, including films and aerogels. Finally, we offer our insights on many critical domains that necessitate more investigation in this evolving study field moving forward.

Keywords: nanocellulose; agricultural waste; energy storage; aerogel; composite

DESIGN AND SIMULATION ANALYSIS OF SOLAR PV-FED THREE-PHASE INTERLEAVED BOOST CONVERTER (SPVTPIBC) WITH MOTOR LOAD FOR E-MOBILITY APPLICATIONS**Dr S Suresh**

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Abstract

Connecting solar PV power-producing systems to the load is done using the three-phase interleaved boost converter (TPIBC). To maximize power extraction from the source, TPIBC circuits employ Maximum Power Point Tracking (MPPT) controllers. This study uses the perturb and observe (P&O) MPPT algorithm to simulate a solar PV-fed TPIBC (SPVTPIBC) for electric vehicle applications. Using a solar PV device with different irradiances, the temperature is kept constant at 25°C. The PWM technique is used by the IBC's MOSFET to produce pulses. The conventional boost converter (BC) is unreliable in high-power applications. To reduce switch stress, three-stage 120° phase shifting techniques have been used. The IBC technique should be used for high-power applications in order to increase efficiency. analysis of the complete simulation with a switching frequency of 31 kHz. Overall losses have been eliminated by the employment of the phase-shifting technique. MATLAB/Simulink software was used to simulate the full simulation, and the overall efficiency of this SPVTPIBC with motor load technique was 91.40%.

Keywords: Maximum Power Point Tracking, Boost Converter, Interleaved Boost Converter.

STUDY OF THE PERFORMANCE OF A SYMMETRIC SOLAR STILL**Adel DELIOU**

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Abstract

Our work consists in studying experimentally and theoretically a chapel-type solar still. Distilled water production tests were carried out using well water with a conductivity . The numerical study of the system by the application of the finite difference method, allowed us to better see the temporal evolution of the temperatures, the variation of the operating characteristics of the distiller such as the internal efficiency, the global efficiency, yield and performance factor.

The program developed was validated by the comparative study of theoretical and experimental results taken under the same conditions. The measurements made by our program under the same conditions with respect to temperatures, solar flux have been verified by measurements made experimentally on a distiller made at the laboratory level with an absorption surface of 1.2 m² in aluminium and an angle of inclination of the glazing of 15°, under the climatic conditions of the town of Tipasa.

The day of July 15 was chosen for the calculation, the daily productivity in distilled water. During this day the production reached 5.2 liters; under a radiance of 1015.75 w/m² inducing an ambient temperature of 37.5°C with brine reaching 70.9°C, the rated internal efficiency is 35.23% with an overall efficiency of 53.42% and a performance factor of 2.33.10⁻⁴ l/kJ.

Keywords: Solar distillation, Finite differences, Efficiencies, Temperatures.

GEOSPATIAL MODELING FOR SOLAR ENERGY. CASE STUDY: HUDENISHT COMMUNE, ALBANIA**Prof. Asoc. Dr., Sonila Sinjari**

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Abstract

The potential of geospatial technologies in the energy sector is considerable and continuously expanding. Geographic Information Systems (GIS) and Remote Sensing (RS) play a crucial role in the renewable energy domain, particularly for identifying solar energy potential, prioritizing high-yield areas, determining optimal zones for transmission and distribution infrastructure, and enhancing spatial and operational decision-making processes.

This study aims to emphasize the role of GIS and RS in modelling renewable energy potential and identifying suitable locations for optimal installation of solar photovoltaic systems. To conduct this micro-thesis, research methods were employed to collect theoretical data and geospatial information, primarily sourced through Remote Sensing technology. Additionally, spatial, geostatistical, and geo-visual analyses were performed using GIS, including 2D and 3D environmental modelling.

Albania is considered to have a favourable solar energy regime and high potential in terms of solar radiation, thanks to its climatic conditions, the intensity and duration of solar exposure, which together provide above-average solar energy opportunities. Lin Village, located in the Hudenisht Commune in Southeastern Albania, on the western shore of Lake Ohrid and characterized by a favourable geographic position for tourism development, was selected as the case study area. One of the principal outcomes of this research is the mapping and identification of suitable residential buildings that could benefit from the installation of photovoltaic systems, supporting community needs and local socio-economic activities, particularly tourism-related ventures. Findings indicate that the majority of households demonstrate viable potential for solar panel installation, as no area falls below the minimum economic feasibility threshold.

Based on these results, it is recommended that local authorities and community stakeholders integrate geospatial analyses into future renewable energy planning initiatives. Furthermore, pilot implementation and incentive-based programs should be considered to accelerate the adoption of photovoltaic systems and sustainable energy practices in the region.

Keywords: GIS; Remote Sensing; Geospatial Modelling, Solar Energy, Photovoltaic Systems etc.

MODELLING AND SIMULATION OF CIGS SOLAR CELLS ON THE PERFORMANCE OF ZINC SULFIDE INSULATION LAYER**Abdelali Laid, Abed zoulikha**

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Abstract

In this paper, we present a simulation of a CIGS solar cell with a ZnS buffer layer, performed using the Silvaco-Atlas simulator. However, we obtained an efficiency of 24.13%, short-circuit current of 37.81 mA/cm², an open circuit voltage of 740 mV, and a fill factor of 78.78% at E_g was around 1.41 eV, corresponding to an x ratio of 0.5 for the CIGS solar cell using a ZnS buffer layer. We optimized the performance of the ZnS/CIGS solar cell with the improved effects of layer parameters such as thickness and acceptor densities ZnS buffer layers.

Keywords: Buffer layer (ZnS), CIGS, Solar cell, Optimization, Silvaco-Atlas

ENERGY-LEVEL ENGINEERING IN ORGANIC SOLAR CELLS: COMPUTATIONAL INSIGHTS INTO QUINOXALINE-BASED DONOR MATERIALS

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Abstract

This theoretical study investigates four quinoxaline-based derivatives (M1–M4) as potential electron donors for organic solar cells (OSCs), with a particular focus on their energy-related optoelectronic properties using DFT/TD-DFT calculations. The analysis examines frontier orbital energy levels, energy band gaps, and excitation energies derived from their absorption spectra. Among the studied dyes, M3 emerges as the most promising candidate due to its lowest energy gap, broad absorption profile, and high chemical softness—features that enhance light-harvesting efficiency and energy-driven charge transport. Although M1 and M2 possess deeper HOMO energy levels that could improve open-circuit voltage, their wider energy gaps reduce their light absorption capability. Overall, the results demonstrate how molecular engineering can effectively tune the energy characteristics of quinoxaline derivatives to achieve high-performance organic photovoltaic materials.

Keywords: Quinoxaline derivatives, Organic solar, TD-DFT, photovoltaic applications, Charge transport, Energy bandgap

HARNESSING SOLAR ENERGY: AN INVESTIGATION INTO PARABOLIC SOLAR COOKING SYSTEMS FOR PARAFFIN WAX MELTING IN ILORIN KWARA STATE**Dr. Olaore, Kayode Olatunde¹****ORCID- 0009-0002-2517-339X*****Dr. Usman, Abdulkareem²******Dr. Sunday Abayomi John³******and Abdulmumini Zakari⁴*****Department of Science Laboratory Technology (Physics
/ Electronics Unit), Kwara State Polytechnic, Ilorin, Nigeria .^{1,2,3AND 4}****Abstract**

A solar cooking system uses solar energies to heat and melt various substances, including paraffin. The solar cooker is a simple device that uses sunlight to cook food. The concept of solar cooking was introduced since in ancient times. Industrial heating and melting are an indispensable process in the manufacture of various organic products and household cooking. In order to provide a reliable method of heating and melting which is not hazardous to health and environment unlike the conventional sources, an alternative renewable energy was studied in this work which could also be used for industrial application. The aim of this work is to use parabolic solar cooking system to harness and focus solar radiation for heating and melting paraffin wax to prepare a solution for skin treatment under Kwara state metrological condition and also to measure various temperature parameters. The parabolic solar cooker was used in heating and melting paraffin wax with mineral oil as a lubricant. In the result obtained, the highest solar radiation was 1216.7w/m², the highest ambient temperature was 48.7°C, the highest fluid temperature was 49.6°C, the highest temperature of the cover was 59.6°C, the highest side temperature was 56.4°C, the highest absorber plate temperature was 94.6°C and highest temperature of the air gap was 70.4°C. The parabolic solar cooker was able to melt paraffin wax for 1hour, and the thermal performances in term of average cooking power, standard cooking power and cooker efficiency was evaluated.

Key Words: Parabolic Solar cookers, Paraffin Wax, Solar Radiation, Fluid.

LARGE-SCALE MAPPING OF PHOTOVOLTAIC PANELS USING K-MEANS CLUSTERING ON SATELLITE REMOTE SENSING DATA

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Abstract

Climate change, coupled with population growth and evolving lifestyles, is driving a sharp rise in energy demand while fossil fuel reserves continue to decline. In this context, photovoltaic energy stands out as a major renewable source and an effective environmental solution, though assessing its large-scale deployment remains challenging. Remote sensing and Geographic Information Systems (GIS) provide powerful tools to address these issues.

This study introduces an unsupervised machine learning approach for the automatic detection of solar panels using Sentinel-2 multispectral imagery and RGB images. The K-Means clustering algorithm was employed to segment the images, identify areas with photovoltaic installations, and minimize noise. The results demonstrate that integrating remote sensing, GIS, and machine learning enables reliable, efficient, and scalable detection of solar panel installations across diverse data types and observational contexts.

Keywords: Photovoltaic detection, Unsupervised learning, K-Means, Sentinel-2, Remote sensing, GIS, photovoltaic energy

THEORETICAL STUDY OF CZTS ECOFRIENDLY SOLAR CELL PERFORMANCE SCAPS-1D**Belarbi Faten¹ and Mohamed Adnane²**

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Abstract

Due to its high efficiency, cheap cost, non-radioactive, and environmentally benign behavior, Cu₂ZnSnS₄ (CZTS) absorber layer research demonstrates comprehensive influential aspects to replace expensive Cu(In,Ga)Se₂ (CIGS) absorber layer. We investigated the effect of various factors on the heterojunction solar cell (n-ZnO / n-CdS / p-CZTS / p-MoS₂) in thin films, where the absorber is the p-type Cu₂ZnSnS₄ (CZTS) semiconductor. We will investigate the effects of various parameters such as doping density, absorber layer thickness, and working temperature on conversion efficiency ($\eta\%$), because each parameter has an impact on cell performance.

Keywords: CZTS, Thin-film solar cell, SCAPS-1D simulation, Absorber layer optimization, Conversion efficiency.

**PROSPECTS FOR THE INTEGRATION OF NET BILLING IN GEORGIA AND ITS IMPACT ON
THE DEVELOPMENT OF RENEWABLE (SOLAR) ENERGY**

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Abstract

Currently, in Georgia, the primary challenges are ensuring energy security and effectively utilising solar energy. The net billing system is in its early stages of development, despite having high solar potential and interest from investors. The paper discusses the prospects for integrating net billing in Georgia. It analyses its potential impact on the development of solar energy, strengthening energy independence, and promoting consumer involvement in the transformation towards renewable energy. The study is one of the first attempts in Georgia to examine the issue of net billing from not only a technical and economic perspective, but also a social and political context, thereby contributing to the development of a discourse on renewable energy. The study's findings can be utilised by policymakers, the private sector, and civil society to promote renewable energy and inform appropriate strategic frameworks. The research was carried out in two stages. First, a literature review was conducted, within the framework of which the theoretical basis of the net billing model and international practice were analysed. The second stage of the research employed a qualitative method, including in-depth interviews at the regulatory authority, private sector, and consumer levels. The results showed that, despite an upbeat assessment of the system, there are serious barriers: an imperfect legal framework, the absence of smart metering, and a low level of consumer awareness.

Keywords: net billing in Georgia; solar energy; renewable energy.

OPTIMIZATION AND TECHNO-ECONOMIC ANALYSIS OF ELECTRIC VEHICLE CHARGING SYSTEMS IN RENEWABLE ENERGY-BASED MICROGRIDS ON UNIVERSITY CAMPUSES**Yaradana Çağrı GÖKTEPE**

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Abstract

This study presents a comprehensive optimization and techno-economic analysis of electric vehicle (EV) charging systems integrated into renewable energy-based microgrids within university campuses. Using the HOMER Grid software, hybrid configurations combining photovoltaic (PV) panels, wind turbines, diesel generators, and battery storage systems were simulated under 8760-hour real meteorological and load data for the Yalova University campus. Five distinct EV charging scenarios—Highway Charger (Level 3, On-Demand), Multifamily Residential Charger (Level 2, On-Demand), Office Charger (Level 2, Deferrable), Public On-Demand Charger, and Overnight Fleet Charger (Level 3, Deferrable)—were evaluated under nine system configurations (S1–S9) to determine the optimal design balancing cost, energy independence, and environmental impact.

Among the simulated cases, Scenario S2 (Solar + Storage + Grid) achieved the best overall performance, with a net present cost of \$860,470, LCOE of \$0.0452/kWh, and an internal rate of return (IRR) of 85%. The system demonstrated a 99% renewable fraction, reducing annual CO₂ emissions by over 60% compared with the base grid-dependent configuration. Economic assessments revealed substantial operational savings, including annual utility bill reductions exceeding \$53,000 and a simple payback period of approximately 1.2 years.

The Highway Charger (Level 3) exhibited the highest annual energy savings and confirmed the feasibility of renewable-based fast-charging solutions, while Level 2 chargers achieved moderate investment returns with payback periods below five years. The integration of PV and battery systems effectively minimized grid imports during high-tariff hours, optimized load matching, and stabilized the microgrid's energy flow under varying seasonal conditions.

The findings confirm that renewable-integrated hybrid microgrids can provide technically reliable, economically viable, and environmentally sustainable solutions for electric mobility infrastructures in academic environments. Furthermore, the study highlights the strategic potential of energy storage and smart control systems in achieving decarbonized, cost-efficient, and resilient campus-scale EV charging networks.

Keywords: Renewable Energy-Based Microgrid, Electric Vehicle Charging Systems, Optimization, Techno-Economic Analysis, HOMER Grid.

**AI-BASED PASSIVE CELL BALANCING IN LITHIUM-ION BATTERY PACKS: A
SIMULATION-BASED COMPARISON OF PSO AND GWO ALGORITHMS****Aykut Fatih GÜVEN**

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Abstract

With the rapid growth of electric vehicles, the efficiency and safety of Battery Management Systems (BMS) have become increasingly critical. One of the most common issues in battery packs is the voltage imbalance among series-connected lithium-ion cells, which can degrade system performance, reduce battery lifespan, and increase safety risks. This paper focuses on minimizing voltage discrepancies among three lithium-ion cells using a passive balancing method enhanced with intelligent optimization techniques.

A real-time monitoring and control model was developed in MATLAB/Simulink to observe and regulate cell voltages dynamically. Instead of relying on fixed threshold values, the proposed system employs Particle Swarm Optimization (PSO) and Grey Wolf Optimization (GWO) algorithms to identify cells requiring balancing adaptively. This adaptive control structure enables the system to respond flexibly to varying operating conditions.

Simulation results demonstrate that both algorithms effectively reduce inter-cell voltage differences while maintaining overall system stability. Moreover, findings indicate that the PSO-based controller provides slightly higher energy efficiency compared to the GWO-based approach. Nevertheless, both algorithms deliver reliable and robust performance under passive balancing scenarios, confirming their suitability for advanced BMS applications.

Keywords: Lithium-Ion Battery, Passive Balancing, PSO, GWO, Simulink, Battery Management System.

**BATTERY CAPACITY ESTIMATION IN GRID-CONNECTED ENERGY SYSTEMS AND
MULTI-CRITERION OPTIMIZATION APPROACH****Emine İŞİN**

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Abstract

The increasing integration of renewable energy sources, such as solar and wind, is significantly transforming the dynamics of energy grids. The variable and intermittent nature of these sources necessitates the incorporation of Battery Energy Storage Systems (BESS) to maintain energy security and grid stability. However, the high installation costs and operational complexities of BESSs present substantial engineering challenges for their integration into Hybrid Energy Systems (HES). This study demonstrates the application of artificial intelligence (AI)-based methods for both the design and real-time management of BESS. Initially, Artificial Neural Network (ANN) and Long Short-Term Memory (LSTM) architectures were employed to estimate BESS capacity, with model performance evaluated using statistical metrics such as MSE, MAE, and R^2 . The ANN model achieved high accuracy (MSE: 0.0001, R^2 : 0.9900), whereas the LSTM model exhibited relatively lower performance (MSE: 0.1781, R^2 : 0.8507). Both models produced battery capacity estimates (ANN: 9.41 kWh, LSTM: 8.08 kWh) that closely matched the reference capacity of 9.51 kWh, determined from peak-load requirements and renewable-energy variability analysis. Subsequently, multi-criteria optimization algorithms, including Genetic Algorithm (GA), Particle Swarm Optimization (PSO), and NSGA-II, were utilized to balance cost and energy independence. All algorithms recommended an approximate capacity of 5.85 kWh; NSGA-II resulted in the lowest annual cost (3097.6 TL, approximately 90 USD), while PSO achieved the highest energy independence (10.16%). These findings indicate that integrating AI-based prediction and optimization methods can enhance the flexibility, reliability, and sustainability of grid-connected energy systems.

Keywords: battery energy storage systems (BESS), hybrid energy systems (HES), optimization, energy management systems (EMS), renewable energy, smart grids

COMPARING OVERNIGHT DEPOT AND OPPORTUNITY CHARGING STRATEGIES FOR BATTERY ELECTRIC BUSES**A. Can DUMAN**

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Abstract

Battery electric buses (BEBs) have become a leading alternative to conventional diesel buses, offering zero tailpipe emissions, reduced noise pollution, and lower operating costs. Despite these advantages, large-scale BEB deployment poses operational and economic challenges due to trade-offs between battery size, charging infrastructure, and fleet efficiency. Because the charging strategy determines both system flexibility and long-term cost, selecting an appropriate approach is a key decision for transit agencies. This study compares two dominant charging strategies (1) overnight depot charging and (2) opportunity (flash) charging along bus routes, in terms of infrastructure requirements, operational implications, and techno-economic performance. A comparative analysis is conducted using realistic operational inputs, including route length, daily duty cycles, and energy consumption per kilometer. Each charging approach is evaluated under different electricity pricing schemes, such as flat tariffs and time-of-use (TOU) rates, using simulation-based assessments to estimate required battery capacity, charger utilization, and total energy cost. The findings reveal clear trade-offs between the two methods. Depot charging is operationally simple and requires minimal public infrastructure but depends on larger, more expensive battery packs. Opportunity charging allows significantly smaller batteries and higher fleet utilization but requires strategically located high-power chargers, increasing upfront infrastructure costs. Under TOU tariffs, depot charging benefits from lower off-peak prices, whereas opportunity charging distributes charging events throughout the day, reducing peak load stress. Overall, both strategies can be viable depending on local route characteristics, electricity pricing structures, and infrastructure budgets. Cities with compact routes and high passenger turnover may benefit more from opportunity charging, while cities with longer routes or limited infrastructure funding may prefer depot charging. The study concludes that a hybrid charging strategy, combining depot and on-route charging, can offer an optimal balance of cost, operational reliability, and energy efficiency for future BEB fleet deployments.

Keywords: Battery electric buses (BEBs), Overnight depot charging, Opportunity charging, Urban public transport, Charging infrastructure

DOĞRUSAL VE DOĞRUSAL OLMAYAN EIS YÖNTEMİ İLE Li-iyon PİLLERDE SOC TAHMİNİ**Sebahat ALTUNDAĞ**

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Özet

Son yıllarda elektrikli araçların kullanımının artmasıyla birlikte lityum-iyon pillere olan ilgi de hızla artmaktadır. Elektrikli araçlar ve diğer taşınabilir elektronik cihazlarda bataryanın sağlığını korumak ve enerji verimliliğini artırmak için pilin durumunun doğru bir şekilde belirlenmesi, özellikle şarj durumu (SOC) ve sağlık durumu (SOH) tahmini oldukça önemlidir. Doğru bir SOC tahmini hem menzil hesaplamasının doğruluğunu artırmakta hem de aşırı şarj/deşarj gibi batarya ömrünü kısaltan durumların önüne geçmektedir. SOC tahmini için birçok yöntem kullanılmaktadır. Bu yöntemlerden bir tanesi de elektrokimyasal empedans spektrum (EIS) yöntemidir. Klasik EIS yöntemi doğrusal bir modele dayansa da lityum iyon piller doğası gereği doğrusal olmayan bir elektro-kimyasal davranış sergilemektedir. Bu nedenle doğrusal EIS ile elde edilen birinci harmonik verilerin yanı sıra, doğrusal olmayan EIS (NLEIS) yöntemi ile elde edilen ikinci harmonik bileşiklerin analizi, pilin elektrokimyasal süreçleri hakkında daha fazla bilgi vermektedir. NLEIS özellikle SEI tabakasındaki değişimi, reaksiyon asimetrisi, yük transferindeki doğrusal olmayan davranış ve difüzyon sınırlarının belirlenmesinde yüksek duyarlılıktadır. Bu nedenle SOC/SOH tahmin modellerinde klasik EIS'in sağlayamadığı ek bilgiler vererek daha doğru ve kararlı tahminler yapılmasına sağlamaktadır.

Yapılan çalışmada, Power-xtra ve Aspilsan marka ticari lityum-iyon piller 1 A ve 3 A akımlar altında 1000 döngü boyunca yaşlandırılmış ve ardından EIS ile NLEIS analizleri gerçekleştirilmiştir. EIS ve NLEIS sonuçları kullanılarak ayrı ayrı SOC tahmin modelleri oluşturulmuştur.

Anahtar Kelimeler: Li-iyon, EIS, NLEIS

Teşekkür: FDK-2024-3686 numaralı proje ile İnönü Üniversitesi BAP birimine maddi desteklerinden dolayı teşekkür ederim.

SOC ESTIMATION OF Li-ion BATTERIES VIA LINEAR AND NONLINEAR EIS**Abstract**

In recent years, the increasing adoption of electric vehicles has significantly boosted the interest in lithium-ion batteries. For electric vehicles and various portable electronic devices, accurately determining the battery state particularly the State of Charge (SOC) and State of Health (SOH) is essential for ensuring battery safety, longevity, and efficient energy utilization. Accurate State-of-Charge (SOC) estimation not only improves the precision of range prediction but also prevents conditions such as over-charging and over-discharging, which significantly shorten battery lifetime. Various methods have been proposed for SOC estimation, and one of the prominent approaches is Electrochemical Impedance Spectroscopy (EIS). Although the classical EIS technique relies on a linear system assumption, lithium-ion batteries inherently exhibit nonlinear electrochemical behavior. Therefore, in addition to the first-harmonic components obtained from linear EIS, the analysis of second-harmonic components derived from nonlinear EIS (NLEIS) provides deeper insight into the underlying electrochemical processes of the battery. NLEIS is particularly sensitive to variations in the SEI layer, reaction asymmetry, nonlinear charge-transfer behavior, and diffusion limitations. Therefore, it provides additional information that conventional EIS cannot capture, enabling more accurate and robust SOC/SOH estimation models.

In this study, commercial Power-xtra and Aspilsan lithium-ion cells were aged for 1000 cycles under 1 A and 3 A current loads, and their EIS and NLEIS characteristics were analyzed. Based on the obtained EIS and NLEIS data, separate SOC estimation models were developed.

Keywords: Li-ion, EIS, NLEIS

Acknowledgment: I would like to thank the Scientific Research Projects Coordination Unit (BAP) of İnönü University for their financial support under Project No. FDK-2024-3686.

PERFORMANCE AND STABILITY ANALYSIS OF LITHIUM TITANATE OXIDE BATTERIES IN ENERGY STORAGE SYSTEMS**Yusuf MURATOĞLU**

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Abstract

Energy storage systems play a crucial role in an efficient and secure future. They have become an indispensable part of our lives today in grid systems, electronic devices, and the transportation sector. In these systems, energy is stored using rechargeable battery technologies. Energy and power density, capacity, and cycle life are key parameters in battery technologies. In addition to these parameters, other parameters such as cycle stability, safety, and ion transport kinetics also gain importance when choosing a battery technology, depending on the intended use and needs. Lithium-ion batteries surpass other battery technologies in these parameters. Lithium Titanate Oxide batteries have higher cycle life, safety, and ion transport kinetics than other lithium-based batteries. Their high-ion transport kinetics safely support rapid charge/discharge rates. Other key advantages of Lithium Titanate Oxide batteries include their wide operating temperature range and low solid electrolyte interface. They can perform well between -30°C and +60°C. The solid electrolyte interface is constantly increasing in other batteries. This leads to increased internal resistance and reduces capacity. Solid electrolyte interface formation is almost non-existent in Lithium Titanate Oxide batteries. This study presents a comparison of Lithium Titanate Oxide batteries with other battery technologies and their analysis under different operating conditions. Constant current tests were conducted at different operating currents: 0.1C (4A), 0.2C (8A), 0.3C (12A), 0.4C (16A), 0.5C (20A), 0.6C (24A), and 0.7C (28A) using the established experimental setup.

Keywords: Lithium Titanate Oxide (LTO) Batteries, Energy Storage Systems, C-Rate Testing, Experimental Analysis

CFD-BASED THERMAL ANALYSIS OF LI-ION BATTERY MODULE WITH DIFFERENT BAFFLE CONFIGURATIONS AND AIRFLOW CONDITIONS**Haydar KEPEKCI**

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Abstract

In this study, to improve the thermal management performance of a lithium-ion battery module, the effects of baffle placement orientation and airflow velocity on cooling efficiency have been investigated using three-dimensional Computational Fluid Dynamics. Numerical analyses have been conducted under the SST $k-\omega$ turbulence model and steady-state conditions. Air has been used as the coolant, and two different thermal scenarios have been defined for ambient temperatures of 25 °C and 30 °C. In the baffle-free configuration, the maximum cell temperature was 71.8 °C, indicating that critical temperature limits have been exceeded due to insufficient heat transfer. The temperature decreased to 31.15 °C with a horizontal baffle, while in the vertical baffle configuration, it was 35.88 °C. When the air velocity has been increased from 2 m/s to 4 m/s, the maximum temperature decreased from 37.15 °C to 26.84 °C in the horizontal baffle design and from 39.05 °C to 31.00 °C in the vertical baffle design. Furthermore, an increase in ambient temperature from 25 °C to 30 °C increased the average temperature by approximately 6–8% in both configurations. The results revealed that baffle orientation and air velocity are decisive factors in the battery module's turbulence development and heat transport. The horizontal baffle structure reduced thermal gradients by allowing airflow to be distributed more homogeneously across the cell surfaces, providing the highest cooling performance. The findings demonstrate that passive cooling-based air direction strategies effectively improve thermal balance in lithium-ion batteries.

Keywords: Lithium-ion battery, Baffle orientation, Thermal management, Air cooling, CFD.

SAFETY AND RELIABILITY CHALLENGES IN SHORE ELECTRIFICATION: A RISK-ORIENTED EVALUATION FOR HYBRID AND ELECTRIC SHIPS**Şengül ŞANLIER UÇAK**

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Abstract

The European Green Deal and the IMO's medium and long-term strategies for the reduction of greenhouse gas (GHG) emissions have stimulated the development and implementation of technical solutions aimed at mitigating emissions originating from maritime transport. In line with the net-zero carbon emission targets in the maritime sector, the use of hybrid and fully electric ship technologies has been rapidly increasing. Within this context, Shore-Side Electricity (SSE) and Shore-Side Battery Charging (SBC) systems have become increasingly prevalent as key components of sustainable energy management frameworks designed to eliminate greenhouse gas and air pollutant emissions in port operations.

This study investigates the main failure modes and safety requirements associated with shore-based charging systems for hybrid and fully electric ships through a risk-based assessment approach. The evaluation encompasses cable and connector systems, grounding and insulation, energy management, thermal control, communication infrastructure, human factors, and fire and gas-related hazards. The findings indicate that the primary risk areas with high likelihood-high impact combinations include voltage fluctuations, grounding and insulation failures, overcurrent, cable and connector damage, and ship-to-shore communication disruptions. Such conditions may lead to electrical fires and explosions, electric shock and arc flash injuries for personnel, as well as energy interruptions on board or at the port during the charging process. The results reveal that ensuring safe and uninterrupted operation in shore electrification applications requires appropriate system design, well-defined operational procedures, comprehensive personnel training, and effective ship-shore coordination mechanisms. The study contributes to the development of safety-oriented policies and practices for port authorities, ship operators, and engineering stakeholders in the implementation of shore power supply systems.

Keywords: Maritime decarbonization, Electric-hybrid vessels, Shore-Side Electricity (SSE), Shore-Side Battery Charging (SBC), Risk assessment.

**KARBONDİOKSİTİN (CO₂) DERİN DENİZLERE TAŞINMASI VE DEPOLANMASI****Okan KON**

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Özet

Küresel karbondioksit (CO₂) emisyonlarının yaklaşık %75'ini ana kaynakları arasında en büyüğü elektrik üretimidir. Literatürde dünya elektrik üretimindeki artışın yaklaşık %87 olacağı öngörülmektedir. Karbona bağlı emisyonlarını önemli ölçüde azaltmanın en önemli uygulamalardan birisi de Karbon Yakalama ve Depolamadır (CCS). Karbon yakalama ve depolama teknolojileri, karbondioksitin büyük endüstriyel tesisler ve güç santralinden toplanmasını, uygun depolama alanına taşınmasını ve ardından jeolojik oluşumlara veya okyanusta uzun süre depolanmasını kapsar. Boru hatları, gemiler, trenler ve tankerler dahil olmak üzere çeşitli karbondioksitin (CO₂) taşınma yöntemleri mevcuttur, boru hatları ve gemiler en yaygın kullanılanlarıdır. Karbondioksitin (CO₂) depolanması ve taşınması için hem boru hatları hem de gemiler her ikisi birden kullanılarak uygun çözümler sunabilir. Gemi taşımacılığında, boru hatlarından daha esneklik sağlar, ancak limanlarda çeşitli ekipman ve prosesler gerektirir. Diğer yandan boru hatları ile taşıma gemilere göre daha az lojistik gerektirir ve sürekli bir akış sağlar. Hem boru hattı hem de gemilerle taşındıktan sonra, CO₂'yi 3.000 metreden daha derinlerdeki okyanuslara ve denizlere doğrudan enjekte etmek daha ekonomik ve uygulanabilir olduğu literatürde belirtilmiştir. Okyanusun depolama kapasitesinin yaklaşık 1.000 ile 10.000 Gt olduğu tahmin edilmektedir. Okyanus veya derin denizlerdeki su sıcaklık ve basıncının değeri değişmektedir. Buna bağlı olarak karbondioksitin su altında hem taşınması hem de depolanması sırasındaki özellikleri çok önemlidir. Karbondioksit gaz, sıvı veya süperkritik halde bulunabilir. Gaz fazında taşıma, düşük yoğunluğu nedeniyle ekonomik değildir; bu da büyük çaplı borular gerektirir ve yüksek basınç düşüşleri anlamına gelir. Boru hatlarında CO₂'yi taşınmanın en iyi yolu sıvı haldedir. Hem borular hem de gemiler ile taşınan karbondioksitin (CO₂) depolanan okyanus veya derin deniz dip toprak özellikleri de etkili parametredir. Ülkemiz üç tarafı denizlerle çevrilidir. Akdeniz gibi geniş alana sahip denize kıyısı bulunmaktadır. Literatürde Akdeniz, sıcak ve yüksek tuzlu, derin sulara sahip geniş ve kapalı bir havza olması sebebiyle CO₂ tutulması için çok uygundur. Bu çalışmada, karbondioksitin hem borular ile hem de gemiler ile taşınarak okyanus veya derin denizlere depo edilmesinde gerekli ekipman ve prosesler tanımlanmıştır. Dünyadaki örnek uygulamalar verilmiştir.

Anahtar Kelimeler: Karbondioksit yakalama ve depolama (CCS), boruyla taşıma, gemiyle taşıma, derin denize depolama

DEEP SEA TRANSPORT AND STORAGE OF CARBON DIOXIDE (CO₂)**Abstract**

Electricity generation is the largest contributor to carbon dioxide (CO₂) emissions, accounting for approximately 75% of global CO₂ output. According to projections in the literature, global electricity production is expected to increase by nearly 87% in the coming decades. Among the most effective strategies for mitigating carbon-related emissions is Carbon Capture and Storage (CCS). CCS technologies involve capturing CO₂ from major emission sources—such as large industrial facilities and power plants—transporting it to appropriate storage sites and subsequently storing it in geological formations or oceanic environments for extended periods. Several methods are available for CO₂ transportation, including pipelines, ships, trains, and tankers; however, pipelines and ships are the most commonly employed. While pipelines are preferable for continuous, large-scale transfer due to reduced logistical requirements. Both options provide viable solutions for the transport and storage of CO₂. Shipping offers greater flexibility but necessitates additional infrastructure and processing systems at port facilities. Literature indicates that following transportation by pipeline or ship, direct injection of CO₂ into deep oceanic or marine environments typically at depths exceeding 3,000 meters

is both economically and technically feasible. The estimated CO₂ storage capacity of the oceans ranges from 1,000 to 10,000 Gt. As temperature and pressure conditions vary with ocean depth, the thermophysical properties of CO₂ during underwater transport and storage become critical considerations. Depending on these conditions, CO₂ may exist in gaseous, liquid, or supercritical states. Transporting CO₂ in its gaseous form is generally inefficient due to its low density, which requires large-diameter pipelines and results in high pressure losses. Therefore, the liquid phase is considered the most practical state for pipeline transport. The physicochemical properties of the seafloor or deep-sea environment designated for CO₂ storage also play a significant role, regardless of whether the CO₂ is delivered by pipeline or ship. Turkey, surrounded by seas on three sides and possessing extensive coastlines along large bodies of water such as the Mediterranean Sea, presents favourable conditions for potential CO₂ storage. The Mediterranean is characterized in the literature as a large, semi-enclosed basin with warm, saline, and deep waters, features that make it particularly suitable for CO₂ sequestration. This study presents the equipment, infrastructure, and operational processes required for the transportation of CO₂ via both pipelines and ships to oceanic and deep-sea storage sites and provides examples of relevant global applications.

Keywords: Carbon Capture and Storage (CCS), pipeline transport, ship transport, deep-sea storage.

THE PARADOXICAL ROLE OF COAL IN THE GLOBAL ENERGY SYSTEM: HISTORICAL LEGACY, CONTEMPORARY CRISIS, AND FUTURE PROJECTIONS**Nazan YALÇIN ERİK**

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Abstract

For centuries, coal has been at the center of industrialization as a primary energy source, driving economic growth, technological progress, and societal transformation. However, in the 21st century, the global implications of climate change and international targets for reducing greenhouse gas emissions have necessitated a redefinition of coal's role within energy systems. Today, many countries are developing policies aimed at reducing carbon emissions while maintaining energy supply security, thereby reassessing the future of coal. In this context, low-carbon solutions such as carbon capture, utilization, and storage (CCUS) technologies and coal gasification are gaining increasing importance due to their potential to mitigate the environmental impacts of coal. Nevertheless, rising energy demand and the costs associated with technological transitions make the complete phase-out of coal in the short term challenging. This situation demonstrates that the energy transition is not a linear process but rather a multidimensional transformation, dependent on regional conditions. Consequently, coal is positioned not as a fully excluded resource in the future global energy system, but as a technologically transformed “bridge energy source” in the transition toward sustainable energy. The future role of coal will thus be shaped by the capacity of policies and technologies to balance energy security with environmental sustainability.

Keywords: Coal, Energy Transition, Energy Security, Climate Policies, IEA, Turkey Energy Strategy

INVESTIGATION OF FLOW BOILING PERFORMANCE IN MICROCHANNELS FOR HYDROPHILIC, HYDROPHOBIC, AND HYBRID SURFACES: TECHNIQUES, MECHANISMS, AND APPLICATIONS**Ömer ÖKSÜZ**

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Abstract

When considered together with flow boiling, microchannel heat sinks offer innovative solutions for the thermal management of advanced electronic systems that dissipate high heat fluxes. The performance of such heat sinks is strongly influenced by the interaction between the working fluid and the microchannel surface. The surface wettability characteristics have a direct impact on the onset of boiling, bubble dynamics, and consequently, the overall heat transfer performance. Optimizing flow boiling performance by altering the wettability properties of microchannel surfaces has emerged as a key strategy to meet the cooling requirements of modern compact and high-power electronic devices. In this context, a systematic investigation of the effects of different surface wettabilities on the heat transfer mechanisms under flow boiling conditions is of great importance.

In this study, surface modification strategies employed to enhance flow boiling performance in microchannels are comprehensively reviewed under three main categories: hydrophilic, hydrophobic, and hybrid surfaces. Based on the existing literature, each surface modification technique and variations in contact angle (CA) were examined in detail with respect to their effects on nucleation-site density and the heat transfer coefficient (HTC).

This review highlights the roles of hydrophilic, hydrophobic, and hybrid surface modifications on the flow boiling performance in microchannels. The performance evaluation is carried out based on heat transfer and pressure drop characteristics. The study systematically demonstrates how contact angle optimization affects key parameters such as bubble dynamics, HTC, and critical heat flux (CHF). Consequently, controlling surface wettability emerges as a pivotal technology for the design of future high-efficiency microchannel and boiling-based cooling systems.

Keywords: Control of surface wettability, Surface modifications, Flow boiling, Microchannel.

THERMAL MANAGEMENT SYSTEMS IN MICROGRAVITY ENVIRONMENTS: HEAT PIPE TECHNOLOGY**Ömer ÖKSÜZ**

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Abstract

Thermal management of systems used in space differs from their terrestrial counterparts due to microgravity conditions. Conventional systems such as forced air circulation, impinging air, or water jets cannot be employed. In this context, heat pipes have emerged as a significant alternative for thermal management in space applications. This study provides a comprehensive overview of recent research on heat pipe performance and design applications for thermal management in microgravity environments.

The choice of working fluid, wick structure, channel geometry, and material properties influence the capillary pumping pressure and thereby alter the heat transfer capability. Experimental studies involving parabolic flights, drop towers, sounding rockets, and orbital missions have revealed the differences observed between ground-based and various reduced-gravity environments. The present study discusses the scope of these experiments and elaborates on findings regarding the behavior, startup characteristics, and flow patterns of heat pipes in microgravity conditions.

Furthermore, numerical and analytical models developed to simulate two-phase flow behavior in heat pipes under microgravity have been reviewed, examining their roles in predicting dry-out limits, temperature distribution, and transient performance. In the final section, the study addresses possible wick deformations, variations in wicking capability, and potential cycle numbers. In addition, recommendations for advanced microgravity-compatible heat pipes, including loop and pulsating heat pipe configurations, are presented.

Keywords: Microgravity, Heat Pipe, Two-Phase Flow, Thermal Management.

**SYNTHESIS AND CHARACTERIZATION OF MULTIFUNCTIONAL N-
DODECANOL@MFB@AG MICROCAPSULES FOR INDOOR THERMAL ENERGY STORAGE
APPLICATIONS**

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Abstract

Recent advances in energy storage technologies demonstrate the potential for managing energy between production and demand. Among storage systems used for the efficient use of thermal energy, PCM-based storage systems offer the widest range of applications and span a broad range of research and application areas. Today's PCMs are expected not only to provide energy efficiency but also to exhibit various inner and outer scope multifunctional properties. One of the most effective approaches to impart functional properties is microencapsulation, wherein the PCM core is coated with a shell material that introduces additional features.

In this study, n-dodecanol, a suitable fatty alcohol PCM for indoor applications, was encapsulated to enhance its thermal stability through polycondensation of melamine-formaldehyde-boric acid (MFB). Furthermore, to impart antimicrobial activity to the microparticles (n-dodecanol@MFB), Ag was deposited, and n-dodecanol@MFB@Ag microcapsules were produced.

The chemical characterization of the produced n-dodecanol@MFB@Ag microcapsules was determined by Fourier Transform Infrared (FT-IR) spectroscopy. The thermal energy storage properties of the n-dodecanol@MFB@Ag microcapsules were revealed by Differential Scanning Calorimetry (DSC) analysis. In addition, the particle size distribution of n-dodecanol@MFB@Ag microcapsules was measured, and the surface morphologies of the microcapsules were determined using Scanning Electron Microscopy (SEM) and Scanning Transmission Electron Microscopy (STEM) methods. FT-IR results confirmed successful polycondensation and encapsulation of n-dodecanol through the formation of B–O–C and B–O–N cross-links. The microcapsules successfully retained more than half of the latent heat of the core phase change material. At the same time, the microparticles had a smooth surface morphology, were homogeneous and spherical, with a size distribution ranging from approximately 60 to 280 µm. In general, the system's shell is flame-retardant, and the addition of boron enhances this property. Besides, Ag imparts thermal conductivity, energy-harvesting properties, and antibacterial properties to microparticles. In conclusion, the resultant material is a potential material for building energy comfort applications.

Keywords: n-dodecanol, PCMs, microcapsule, thermal energy storage, Ag, antimicrobial

HYBRID FLAME-RETARDANT MICROCAPSULES BASED ON N-OCTADECANE@MELAMINE-BORIC RESIN@AG FOR EFFICIENT THERMAL ENERGY MANAGEMENT

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ABSTRACT

The depletion of natural resources and the ever-increasing need for renewable energy make storable renewable energy sources increasingly attractive. In recent years, the production of new phase change materials (PCMs) has not been solely meaningful; the PCMs produced must have applications and serve a multidisciplinary field. In this regard, the developed PCMs are expected not only to possess high thermal energy storage capacities but also to contribute to energy production and exterior functionality. In this context, microencapsulated PCMs stand out among approaches that impart hybrid properties to materials with different shell and core contents.

In this study, n-octadecane, an organic paraffin-based PCM, is widely used to reduce indoor temperature fluctuations and forms the core material of the produced microcapsules. To impart hybrid properties to this microcapsule, a melamine-formaldehyde resin (MFB) with boric acid, which has flame-retardant properties, was chosen as the shell material. After microencapsulating n-octadecane with a melamine-formaldehyde resin containing boric acid, Ag was deposited on the surface of the microencapsulated phase change material (n-octadecane@MFB@Ag), aiming to increase the heat transfer rate of the n-octadecane@MFB@Ag microcapsules and achieve a more efficient heat storage-release cycle.

The chemical characterization of the n-octadecane@MFB@Ag microcapsules was determined by FT-IR spectroscopy, while DSC was used to determine their thermal energy storage properties. The surface morphology of the n-octadecane@MFB@Ag microcapsules was determined by SEM and STEM methods. Thermal conductivity data were recorded following the Ag coating process of n-octadecane@MFB@Ag microcapsules. The results indicate that n-octadecane was successfully encapsulated in a melamine-formaldehyde resin with boric acid. These microcapsules retained more than 50% of the core's latent heat capacity, and the microparticles were uniform, and monodisperse, with particle size distributions ranging from 50 to 250 µm in diameter. In conclusion, the n-octadecane-loaded microcapsules produced in this study are potential candidates for thermal energy management applications for buildings.

Keywords: n-octadecane, microcapsule, PCMs, thermal energy storage, Ag

**İKİ BOYUTLU SiCl MALZEMESİNİN YAPISAL, ELEKTRONİK VE OPTİK ÖZELLİKLERİNİN
İLK İLKELER ESASLI BİR İNCELEMESİ****Bourama DJONFAGA**

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Özet

Bu çalışma, iki boyutlu SiCl tek katmanının doğasında bulunan yapısal, elektronik ve optik özellikleri aydınlatmak için ilk prensip metodolojilerine dayalı kapsamlı bir teorik inceleme sunmaktadır. Çalışma, malzemenin gelişmiş optoelektronik ve fotokatalitik alanlardaki potansiyel uygulanabilirliğini saptamak için sistematik bir Yoğunluk Fonksiyonel Teorisi (DFT) iş akışı kullanmaktadır. Yapısal optimizasyon, $a = b = 3.979 \text{ Å}$ ve $\gamma = 120^\circ$, parametrelerine sahip izotropik bir altıgen Bravais örgüsünü doğrulamakta ve bu sonuçlar literatürle uyum göstermektedir. Malzemenin termodinamik kararlılığının doğrulanması büyük önem taşımaktadır. Sonlu sıcaklık dinamiklerini değerlendirmek için, makine öğrenimi kuvvet alanlarının (MLFF) uygulanmasıyla hesaplamalı olarak güçlendirilmiş, ab initio moleküler dinamik (AIMD) simülasyonları yürütülmüştür. Bu simülasyonlar, tek katmanın ortam sıcaklığında (300 K) sağlam yapısal bütünlüğünü koruduğunu göstermektedir. Gelişmiş doğruluk için ileri düzey hibrit fonksiyoneli (HSE06) kullanan kapsamlı bir elektronik özellik analizi, 2.12 eV'luk bir bant aralığı (E_g) değerini belirlemiştir. Bu değer, SiCl'i, etkin güneş enerjisi eldesi için temel bir ön koşul olan görünür ışık spektrumunun önemli bir bölümünü soğurmak için optimal bir konumda bulunan bir yarı iletken olarak konumlandırmaktadır. Bu potansiyel, görünür bölge elektromanyetik spektrumu kapsayan kayda değer soğurma katsayıları ve güçlü ışık-madde etkileşimi ortaya koyan optik özelliklerin incelenmesiyle daha da doğrulanmakta; bu durum, elektron-deşik çiftlerinin etkin üretimi için doğasında var olan bir kapasiteyi göstermektedir. Doğrulanmış termal kararlılık, elverişli elektronik bant aralığı ve güçlü optik soğurma özellikleri arasında sergilenen sinerji, SiCl'i sürdürülebilir enerji uygulamaları için üstün bir aday malzeme olarak belirlemektedir. Bu bulgular toplu olarak, malzemenin yeni nesil fotokatalitik sistemlere, güneş enerjisi dönüşüm cihazlarına ve gelişmiş görünür ışık optoelektroniklerine entegrasyonu için güçlü potansiyelinin altını çizmektedir.

Anahtar kelimeler: SiCl, Yoğunluk Fonksiyonel Teorisi, Örgü Dinamik Özellikleri

**A FIRST-PRINCIPLES INVESTIGATION OF THE STRUCTURAL, ELECTRONIC, AND
OPTICAL PROPERTIES OF THE 2D SiCl MATERIAL****Abstract**

This investigation undertakes a comprehensive theoretical examination of the two-dimensional SiCl monolayer, predicated on first-principles methodologies, to elucidate its inherent structural, electronic, and optical characteristics. The study utilizes a systematic Density Functional Theory (DFT) workflow to ascertain the material's potential applicability within advanced optoelectronic and photocatalytic domains.

Structural optimization confirms an isotropic hexagonal Bravais lattice with parameters $a = b = 3.979 \text{ Å}$ and $\gamma = 120^\circ$, exhibiting congruence with established antecedent literature. Of considerable significance is the confirmation of the material's thermodynamic stability. Ab initio molecular dynamics (AIMD) simulations,

computationally augmented by the implementation of machine learning force fields (MLFF), were executed to assess finite-temperature dynamics. These simulations demonstrate that the monolayer maintains robust structural integrity at ambient temperature (300 K). An exhaustive analysis of the electronic properties, utilizing the advanced hybrid functional (HSE06) for enhanced accuracy, quantifies a band gap (E_g) of 2.12 eV. This value positions SiCl as a semiconductor optimally situated for the absorption of a considerable portion of the visible region light spectrum, a primary prerequisite for efficacious solar energy harvesting. This potentiality is further corroborated by an examination of the optical properties, which reveals substantial absorption coefficients and potent light-matter interaction spanning the visible electromagnetic spectrum, indicating an intrinsic capacity for the effective generation of electron-hole pairs.

The demonstrated synergy between confirmed thermal stability, a favorable electronic band gap, and strong optical absorption characteristics establishes SiCl as a superlative candidate material for sustainable energy applications. These findings collectively underscore its strong potential for integration into next-generation photocatalytic systems, solar energy conversion devices, and advanced visible-light optoelectronics.

Keywords: SiCl, Density Functional Theory, Lattice Dynamic Properties

**PRELIMINARY EVALUATION OF SOURCE ROCK POTENTIAL USING ROCK-EVAL
PYROLYSIS FROM THE MEZARDERE FORMATION SHALES OF LATE EOCENE-
OLIGOCENE AGE (SW THRACE BASIN, NW TÜRKİYE)**

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Abstract

The Thrace Basin is one of the important coal, natural gas and oil production areas in Türkiye. The sedimentary infillings of this basin host several Cenozoic formations, which have different geological characteristics in hydrocarbon generation. The Late Eocene-Early Oligocene Mezardere Formation in the basin is considered being a source rock for several natural gas fields. This formation reaches up to thermal maturity within the oil window in the central parts, where it has deeper burial depths than other parts of the basin, while it is considered as gas-prone in the north-eastern parts of the basin. This difference is mainly related to the different burial depths and heat flow within this basin. In this study, a total of twenty shale and calcareous samples, which were obtained from the measured cross-section in the south-western parts of the basin, were investigated using Rock-Eval pyrolysis analysis to check their hydrocarbon generation potential. The S₁, S₂, and S₃ peaks of the samples display wide ranges, and ranging from 0.01-0.04 mg HC/g rock, 0.15-0.47 mg HC/g rock, and 0.14-0.32 mg CO₂/g rock, respectively. T_{max}, HI, and OI values vary from 427-436°C, 43-67 mg HC/g TOC and 33-65 mg HC/g CO₂, respectively. These values are close to those reported for the Mezardere Formation in the natural gas exploration wells in the south-western parts of the basin. This implies that the heat flow in this part of the basin is presumably lower than other parts of the basin. Furthermore, the relatively low TOC values suggest that the accumulation of organic matter was lower in this part of the basin. Overall, the studied samples were mostly immature and had limited gas-generation potential; nevertheless, further sampling and analysis from the Mezardere Formation shales representing the whole-basin should be done for a better understanding of hydrocarbon generation potential in the Thrace basin.

Keywords: Thrace Basin, Mezardere Formation, Rock-Eval, Thermal maturity, Nature gas.

A part of this study for the first author have been conducted within the Post-Doctoral Research Fellowship scheme of the University of Malaya

ROCK EVAL PYROLYSIS OF A LOW-RANK COAL: INSIGHTS INTO MIDDLE MIOCENE SEAM-II (ÇOMU-YANOĞLAN COALFIELD, İSKİLİP-ÇORUM, TÜRKİYE)**Rıza Görkem OSKAY**

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Abstract

As a conventional fossil fuel, coal can reach sufficient thermal maturity to become gas- and/or oil-prone. Nevertheless, recent studies also imply that traditional Rock-Eval pyrolysis data should be evaluated with caution and correlated with the maceral and mineralogical compositions of coal. The Çankırı-Çorum Basin is an important basin in northern Central Anatolia that hosts Eocene and Middle Miocene coal seams and bituminous shale beds. Previous studies in the basin have mostly focused on the hydrocarbon generation potential of bituminous shales within the Middle Miocene Hançili Formation; however, the Rock-Eval pyrolysis of coal seams in this formation has not been investigated in detail to date. In this study, eight samples (six coal, one bituminous shale, and one mudstone) from the Middle Miocene Seam-II in the Çomu-Yanoğlan coalfield were investigated to determine the influence of coal features on Rock-Eval pyrolysis. As expected, the TOC values of the samples display wide ranges (3.7-55.0%) owing to the variable ash yields (10.2-88.8%, on a dry basis) and total C contents (1.9-64.8%, on a dry basis) of the samples. The roof rock (bituminous shale) samples display relatively higher HI (343 mg/HC g TOC) and T_{max} (426°C) values than the coal samples (97-142 mg/HC g TOC and 413-416 °C). Such differences are expected since liptinite (alginite and sporinite) macerals are more common in the bituminous shale sample than in the coal samples. In contrast, the S_3 peak (11.1-15.0 mg CO₂/g rock) of the coal samples were higher than those of the inorganic samples (0.7-4.2 mg CO₂/g rock) because of the release of CO_x from the breakdown of carboxyl and hydroxyl groups in the telohuminite macerals and carbonate minerals during pyrolysis. Overall, the studied Seam-II has only limited gas generation potential and that bituminous shale has not reached sufficient thermal maturity to produce liquid hydrocarbons.

Keywords: Çankırı-Çorum Basin, Rock-Eval pyrolysis, Miocene, Hançili Formation, Buddingtonite, Subbituminous coal.

A part of this study for the first author have been conducted within the Post-Doctoral Research Fellowship scheme of the University of Malaya

MORPHOLOGICAL AND STRUCTURAL IMPROVEMENT OF KÜTAHYA-OYSU AMORPHOUS GRAPHITE AFTER LEACHING AND HIGH-TEMPERATURE (1700 °C) TREATMENT: A COMPARATIVE ANALYSIS WITH SEM IMAGES

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Abstract

This study morphologically investigates the purification and structural improvement processes of raw amorphous graphite obtained from the Kütahya–Oysu deposit in Turkey. The purity of the natural graphite in this deposit generally varies between 70% and 90%. Therefore, processing of the raw material is required to achieve Industrial Grade Graphite standards (85–95% carbon) or to reach higher purity levels. For this purpose, the raw graphite sample was subjected to chemical leaching to remove mineral impurities, followed by heat treatment at 1700 °C in a nitrogen (N₂) atmosphere to improve the crystal structure and eliminate remaining volatile components.

The surface and internal morphologies of the raw and treated samples were compared in detail using Scanning Electron Microscopy (SEM). SEM images of the raw graphite revealed the irregular surface morphology characteristic of an amorphous structure, along with distinct silicate/mineral impurities. While leaching successfully removed a large proportion of the surface impurities, the subsequent 1700 °C heat treatment promoted the transformation of the amorphous graphite mineralization toward a more crystalline structure due to the high-temperature effect. As a result, the surface smoothness significantly increased, and the flakes acquired a sharper, well-graphitized appearance. These findings demonstrate that amorphous graphite from the Kütahya–Oysu deposit can be rendered suitable for high-purity and advanced morphology requirements in high-technology applications through optimized leaching and high-temperature treatment.

Keywords: Kütahya–Oysu, Amorphous Graphite, Leaching, High-Temperature Treatment, SEM.

**CHARACTERIZATION OF RAW GRAPHITE ORE FROM THE KAYSERI DEPOSIT:
MORPHOLOGICAL AND STRUCTURAL ANALYSIS VIA SEM AND XRD****Hatice KANBUR ÇAVUŞ**

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Abstract

This study aims to determine the fundamental morphological and crystallographic properties of raw graphite ore obtained from the Kayseri deposit, one of Turkey's significant graphite potential areas. Detailed characterization is mandatory for evaluating the industrial suitability of natural ores, which often contain a high proportion of mineral impurities. The surface morphology and general texture of the raw ore sample were examined using Scanning Electron Microscopy (SEM), while the crystal structure, phase composition, and degree of graphitization were determined by X-ray Diffraction (XRD) analysis. Using the XRD data, the characteristic (002) peak of graphite was utilized, and critical structural parameters, such as the average crystallite size along the c-axis (L_c) and the interlayer distance (d_{002}), were calculated using the Debye-Scherrer method. SEM images revealed the irregularity of the graphite flakes and the distribution of silicate/quartz-based gangue minerals within the matrix. The XRD analysis showed that the graphite (002) peak was low in intensity and broad. The resulting calculation of a small crystallite size (L_c) and a large d_{002} value (deviating from the ideal value of 0.3354 nm) scientifically proved that the raw graphite possesses a low degree of crystallinity and an amorphous structure. The findings indicate that the Kayseri graphite ore must be subjected to an effective purification and thermal refinement process to achieve the high purity and crystal quality required for advanced technological applications.

Keywords: Kayseri Graphite Deposit, Raw Graphite Ore, XRD, SEM, Debye-Scherrer Method.

MULTI-REGIME THERMAL ANALYSIS OF LOW-E GLASS CONFIGURATIONS FOR COMPLIANCE WITH NEXT-GENERATION ENERGY EFFICIENCY REGULATIONS**Duriye KÖK**YORGLASS ENDÜSTRİYEL CAM SANAYİ TİCARET A.Ş., Bolu-Türkiye
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Growing global energy-efficiency requirements have made the thermal performance of oven door glazing a critical design parameter, particularly as next-generation regulations impose stricter limits on maximum allowable surface temperatures to ensure user safety. Low-emissivity (Low-E) coated glass has consequently gained prominence due to its ability to reflect infrared radiation and suppress radiative heat transfer, thereby functioning as an effective thermal barrier. Previous studies in the literature demonstrate that emissivity-controlled coatings significantly influence infrared reflectivity, conductive and convective heat-transfer pathways, and thermo-mechanical stability under high-temperature exposure. During pyrolytic self-cleaning cycles, internal oven temperatures may exceed 350–500 °C, generating substantial thermal gradients across glass–coating interfaces. These gradients intensify localized thermal stresses; in single-sided coatings, they further induce asymmetric heat distribution. Reported failure mechanisms include bowing deformation, localized loss of temper (de-tempering), optical distortion, and reductions in mechanical integrity. This study provides a comprehensive experimental assessment of Low-E glass configurations used in pyrolytic, static, and convection ovens. The investigation focuses on four main aspects: (1) the influence of coating orientation on external door-surface temperature, (2) the thermo-mechanical response of single- and multi-layer glazing systems, (3) deformation behaviour (bowing) under prolonged thermal cycling, and (4) the suitability of various Low-E configurations for compliance with emerging energy-efficiency regulations. Findings highlight that coating orientation (facing the oven cavity or the exterior) plays a determinative role in both thermal management and mechanical stability. The results further indicate that optimal glass configurations must balance emissivity-driven heat-reflection performance with resistance to thermal stress-induced deformation. Overall, this work offers a scientifically grounded framework for developing glazing systems capable of meeting next-generation regulatory requirements while maintaining structural integrity under high thermal loads.

Keywords: Low-E glass performance, Heat transfer reduction

**ATIK FLORESAN LAMBALARDAN CIVA KIRLİLİĞİNİN ÖNLENMESİ VE EKONOMİK DEĞER KAZANIMI İÇİN YENİ BİR PROSES YAKLAŞIMI****Ayşe ÜSTÜNEL ÇAVUŞ**

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Özet

Bu çalışma, atık floresan lambalarda bulunan çevresel açıdan riskli bileşenlerin geri kazanımına yönelik bütüncül ve yenilikçi bir proses geliştirmeyi amaçlamaktadır. Floresan lambalar, toksik etkisi iyi bilinen cıva (Hg) içermesinin yanı sıra, fosfor tozunda stratejik öneme sahip nadir toprak elementleri ile geri dönüştürülebilir cam ve metal bileşenleri barındırmaktadır. Türkiye'deki mevcut geri dönüşüm uygulamaları genellikle yalnızca gaz fazındaki cıvanın geri kazanılmasına odaklanmakta; ancak literatür verileri ve deneysel bulgular, cıvanın %75'ten fazlasının cam, metal ve özellikle fosfor tozu gibi katı bileşenlere kontamine olduğunu göstermektedir. Bu durum, mevcut yöntemlerin çevreye cıva salınımını önlemede yetersiz kaldığını ortaya koymaktadır. Bu çalışmada, cıvanın hem gaz fazındaki hem de katı bileşenlere bağlı formunun tamamen geri kazanılmasına olanak sağlayan yeni bir proses geliştirilmiştir. Çalışma kapsamında farklı liç çözeltileri (kral suyu, NaOCl, KI/I ve NaOCl/NaCl karışımları) kullanılarak yüksek çözünme ve geri kazanım verimleri elde edilmiştir. Ayrıca fosfor tozu etkin bir şekilde ayrıştırılarak nadir toprak elementlerinin geri kazanımı için uygun hale getirilmiş; cam ve metal fraksiyonları ise yeniden kullanılabilir formda elde edilmiştir. Elde edilen sonuçlar, geliştirilen yöntemin hem çevresel kirliliğin azaltılmasına hem de ekonomik değeri yüksek materyallerin sürdürülebilir biçimde geri kazanımına katkı sağladığını ortaya koymakta olup, çalışma bu yönüyle atık floresan lambaların yönetiminde çevre dostu ve uygulanabilir bir alternatif sunmaktadır.

Anahtar kelimeler: Atık floresan lambalar, cıva geri kazanımı, nadir toprak elementleri, liç prosesi, çevresel sürdürülebilirlik, geri dönüşüm teknolojisi.

AN INNOVATIVE PROCESS FOR THE PREVENTION OF MERCURY EMISSIONS AND RECOVERY OF VALUABLE MATERIALS FROM WASTE FLUORESCENT LAMPS**Abstract**

This study aims to develop an integrated and innovative process for the recovery of environmentally hazardous components present in waste fluorescent lamps. Fluorescent lamps contain mercury (Hg), a well-known toxic element, as well as phosphor powders rich in strategically important rare earth elements (REEs), along with recyclable glass and metal components. Current recycling practices in Türkiye mostly focus on recovering mercury in its gaseous phase; however, both literature data and experimental findings indicate that more than 75% of the mercury in fluorescent lamps is actually bound to solid components such as glass, metal, and particularly phosphor powder. This demonstrates that existing methods are insufficient to prevent mercury release into the environment. In this research, a novel process has been developed to enable the complete recovery of mercury from both gaseous and solid-contaminated phases. Various leaching solutions (aqua regia, NaOCl, KI/I, and NaOCl/NaCl mixtures) were evaluated to achieve high dissolution and recovery efficiencies. Furthermore, phosphor powder was effectively separated and processed to recover rare earth oxides, while glass and metal fractions were regenerated into reusable forms. The results clearly show that the proposed method not only contributes to the reduction of environmental pollution but also promotes the sustainable

recovery of high-value materials. Therefore, this study presents an environmentally friendly and practical alternative for the management and recycling of waste fluorescent lamps.

Keywords: Waste fluorescent lamps, mercury recovery, rare earth elements, leaching process, environmental sustainability, recycling technology

**GLOBAL DYNAMICS OF RENEWABLE AND NON-RENEWABLE ENERGY CONSUMPTION:
IMPLICATIONS FOR SUSTAINABLE ECONOMIC GROWTH****Muhammad Mohsin**

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Abstract

The global economy is undergoing a profound transformation as nations confront the dual challenge of meeting rising energy demand while mitigating environmental degradation. This study investigates the worldwide impact of both non-renewable and renewable energy resources on economic growth, highlighting how different energy structures shape development trajectories across advanced, emerging, and low-income economies. Non-renewable resources—such as coal, oil, and natural gas—continue to dominate global energy consumption, contributing significantly to short-term economic expansion but also driving carbon emissions, resource depletion, and climate vulnerabilities. In contrast, renewable energy sources—including solar, wind, hydro, biomass, and geothermal—have demonstrated strong potential to support long-term, sustainable growth, with global renewable energy capacity increasing by more than 9% annually over the past decade. Drawing on recent empirical findings, cross-country data, and sustainability frameworks, this study evaluates the comparative effects of energy types on productivity, environmental performance, and economic resilience. The results underscore that economies with higher shares of renewable energy experience improved energy security, lower ecological footprints, and enhanced innovation capacity, while continued reliance on non-renewable energy is associated with increased carbon intensity and economic volatility. The study contributes to global policy debates by proposing an integrated pathway for transitioning toward low-carbon growth, emphasizing investment in clean technologies, diversification of energy portfolios, and strengthening institutional frameworks. The innovation of this research lies in its comprehensive global perspective that simultaneously examines economic, environmental, and structural implications of the energy transition. This work offers valuable insights for policymakers, researchers, and practitioners seeking balanced strategies for achieving sustainable economic growth in an increasingly energy-constrained world.

Keywords: Energy Resources; Renewable Energy, Non-Renewable Energy; Economic Growth

THE ACTIVITIES OF THE BANQUE DE L'INDOCHINE IN THE COAL MINING INDUSTRY IN VIETNAM DURING THE FRENCH COLONIAL PERIOD (1875–1945)**Dr. Duong To Quoc Thai**Dong Thap University, Vietnam <https://orcid.org/0009-0008-1929-3751>**Dr. Nguyen Van Luan**

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Abstract

Following the completion of the French conquest of Vietnam, the colonial administration immediately commenced the economic exploitation of the colony. Within the sphere of mining operations, specifically the coal mines in Tonkin (present-day Northern Vietnam), the government of the French Indochinese Union granted numerous concessions to French joint-stock companies. Consequently, the prospecting and exploitation activities in Tonkin's coal sector became exceptionally vigorous. The substantial profits generated from coal exports allowed these French capitalist joint-stock companies to accumulate increasing wealth.

Recognizing the lucrative potential of coal exploitation in Tonkin, the Banque de l'Indochine promptly injected capital into the sector through various mechanisms, including: extending mortgage-backed credit, discounting bills of exchange and trade bills, participating in stock issuance, and even engaging in direct financial participation to become a major founding shareholder of the operating companies.

These extensive credit operations not only stimulated the rapid growth of Vietnam's coal mining industry under French rule but also enabled the Bank of Indochine to effectively control the entire sector, thereby securing immense profits and greatly enriching French finance capitalism.

Therefore, research into the “*The Activities of the Banque de l'Indochine in the Coal Mining Industry in Vietnam during the French Colonial Period (1875–1945)*” is highly essential for the study of modern Vietnamese history and further contributes to the multifaceted narrative of 20th-century world history.

Keywords: Banque de l'Indochine (Indochina Bank); coal mining; joint stock company; Tonkin; French colonialism.

ASSESSING THE IMPACT OF ENERGY TRANSITION ON ROAD TRANSPORT EFFICIENCY IN NIGERIA

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Abstract

This study investigates the impact of energy transition on road transport efficiency in developing economies, where heavy reliance on fossil fuels continues to hinder sustainable mobility and increase operational costs. The problem arises from slow adoption of clean energy technologies, inadequate infrastructure, and limited policy support, which collectively constrain transport performance. The objective is to examine how emerging energy alternatives influence cost efficiency, reliability, and operational effectiveness within the road transport sector. A sample size of 250 respondents, comprising commercial drivers, fleet managers, and transport officials, was selected using a stratified sampling technique. Purposive sampling technique was used to administer data to the respondents. Data were analyzed using descriptive statistics and regression analysis to determine the relationship between energy transition indicators and transport efficiency measures. Findings show that gradual adoption of alternative fuels and energy-efficient technologies leads to measurable reductions in fuel expenditure, improved vehicle performance, and enhanced service reliability, although infrastructural deficits and awareness gaps remain significant challenges. The study concludes that energy transition positively contributes to transport efficiency but requires coordinated policy and investment efforts. It recommends expanding clean-energy infrastructure, offering incentives for low-carbon transport technologies.

Keywords: Energy Transition, Road Transport Efficiency, Developing Economies, Alternative Fuels, Sustainable Mobility

ECONOMIC CAPACITY AND CLIMATE TRANSITION: THE REAL ROLE OF GDP**Mihaela Vlădescu^{1,2}, Mihaela Oprea²**

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Abstract

The transition toward climate neutrality represents one of the most complex economic, technological, and social transformations of the 21st century, involving massive investments in energy infrastructure, profound industrial restructuring, and significant institutional adjustments at both national and international levels. In this context, Gross Domestic Product (GDP) is frequently invoked as a key indicator of a state's financial and administrative capacity to support decarbonization efforts. This study examines the relationship between the level of GDP and the pace at which a country advances toward the net-zero emissions target, highlighting both the advantages of a solid economic base such as access to capital, funding for research and innovation, the development of green infrastructure, and the support of social protection measures and the limitations of these advantages in the absence of coherent public policies. The comparative analysis shows that a high GDP does not automatically guarantee climate performance, as demonstrated by the cases of developed economies such as Luxembourg or Germany, where high levels of consumption, industrial structure, and partial dependence on fossil fuels continue to generate significant emissions. On the other hand, countries with a relatively lower level of GDP, such as Romania, record lower CO₂ emission levels, not necessarily as a result of proactive climate policies, but mainly due to a lower degree of industrialization and consumption. The results support the hypothesis that, alongside factors such as the stability of the legislative framework, economic structure, and institutional capacity to implement climate policies, GDP primarily acts as a facilitating factor of the transition, rather than as its determining driver.

Keywords: climate neutrality, GDP, economic, transition, disparities.

SOLAR PV-BATTERY INTEGRATION WITH URBAN TRANSPORT CORRIDORS: CIVIL INFRASTRUCTURE DESIGN FOR LOW-CARBON MOBILITY**Ali Akbar Firoozi^{a,*} & Ali Asghar Firoozi^b**^aDepartment of Civil Engineering, Faculty of Engineering & Technology, University of Botswana, Gaborone, Botswana.^bDepartment of Civil Engineering, Faculty of Engineering, National University of Malaysia (UKM), Selangor, Malaysia**Abstract**

Urban transport corridors concentrate both energy demand and civil infrastructure investment, offering a unique platform for integrated decarbonization strategies. This paper explores the potential of integrating solar photovoltaic (PV) canopies, battery energy storage, and charging infrastructure into road and rail corridors from a civil engineering standpoint. The proposed concept treats bridges, noise barriers, station roofs, and parking structures as structural hosts for PV arrays and energy storage enclosures. Structural loading, wind uplift, and durability considerations are discussed alongside electrical and energy management aspects. A simplified techno-economic and energy model is outlined for a hypothetical urban rail corridor, estimating annual PV generation, self-consumption through traction loads and electric vehicle charging, and impacts on peak demand. Civil engineering considerations such as foundation design, maintenance access, drainage, and safety clearances are integrated into the assessment to ensure constructability and long-term performance. The study argues that transport corridors can evolve from passive energy consumers into active low-carbon energy corridors when civil infrastructure is deliberately designed as energy-generating and energy-buffering assets. This integrated view supports cities aiming to couple sustainable mobility objectives with distributed renewable energy deployment.

Keywords: Solar photovoltaic, transport infrastructure, battery storage, urban corridors, structural integration, low-carbon mobility.

IoT-ENABLED PUMPING AND DISTRIBUTION SYSTEMS FOR OPTIMIZING THE URBAN WATER-ENERGY NEXUS**Ali Akbar Firoozi^{a,*} & Ali Asghar Firoozi^b**^aDepartment of Civil Engineering, Faculty of Engineering & Technology, University of Botswana, Gaborone, Botswana.^bDepartment of Civil Engineering, Faculty of Engineering, National University of Malaysia (UKM), Selangor, Malaysia**Abstract**

Urban water supply systems are major electricity consumers, particularly in regions where groundwater abstraction, long-distance conveyance, or high pumping heads are required. This paper proposes an IoT-enabled control framework for water distribution networks that explicitly targets energy optimization while safeguarding hydraulic performance and infrastructure reliability. Smart flow meters, pressure sensors, and pump status monitors are deployed at critical nodes and integrated into a cloud-based supervisory control platform. Hydraulic and energy models are coupled to estimate real-time energy intensity per cubic metre delivered, identify avoidable pressure zones, and detect leakage patterns. A rule-based and model-predictive control (MPC) strategy is outlined to shift pumping to off-peak tariff periods, flatten demand, and minimize excessive pressures that accelerate pipe deterioration. The approach is illustrated conceptually for a medium-sized city network, showing how civil and hydraulic engineers can embed energy-aware thinking into traditional design criteria such as minimum pressure and service level. The study emphasizes practical issues of retrofitting existing systems, data reliability, and cybersecurity, and positions urban water systems as strategic entry points for water-energy-carbon co-optimization in civil infrastructure planning.

Keywords: Water-energy nexus, pumping systems, IoT sensing, model predictive control, urban water distribution, civil infrastructure.

NANOMODIFIED AND BIO-BASED ASPHALT MIXTURES FOR ENERGY-EFFICIENT AND DURABLE PAVEMENTS**Ali Akbar Firoozi^{a,*} & Ali Asghar Firoozi^b**^aDepartment of Civil Engineering, Faculty of Engineering & Technology, University of Botswana, Gaborone, Botswana.^bDepartment of Civil Engineering, Faculty of Engineering, National University of Malaysia (UKM), Selangor, Malaysia**Abstract**

Road pavements are central elements of civil infrastructure that influence not only durability and maintenance energy but also vehicle fuel consumption through surface characteristics. This study examines the potential of nanomodified and bio-based asphalt binders and mixtures to enhance pavement performance while contributing indirectly to energy efficiency and emission reduction in road transport. The paper conceptually compares conventional hot-mix asphalt with mixtures incorporating nano-clays, nano-silica, bio-binders, and recycled materials. Key engineering properties such as stiffness, rutting resistance, fatigue life, and skid resistance are linked to energy-related indicators, including rolling resistance and maintenance frequency over the pavement lifecycle. A framework is proposed for integrating laboratory test data, mechanistic–empirical pavement design, and simple fuel-consumption models to estimate life-cycle energy implications of different mixture families. Environmental co-benefits, such as reduced production temperatures and lower binder contents, are considered alongside potential concerns around nanoparticle release and end-of-life management. The study aims to equip civil and transportation engineers with structured criteria for selecting advanced asphalt technologies that align with national energy and climate targets while remaining compatible with existing design codes and construction practices.

Keywords: Asphalt mixtures, nanomaterials, bio-binders, pavement performance, rolling resistance, energy-efficient roads.

MANAGING HAZARDOUS MATERIALS IN ENERGY-EFFICIENT BUILDING RETROFITS: A RISK-INFORMED CIVIL ENGINEERING APPROACH**Ali Akbar Firoozi^{a,*} & Ali Asghar Firoozi^b**^aDepartment of Civil Engineering, Faculty of Engineering & Technology, University of Botswana, Gaborone, Botswana.^bDepartment of Civil Engineering, Faculty of Engineering, National University of Malaysia (UKM), Selangor, Malaysia**Abstract**

The drive toward energy-efficient building retrofits has accelerated interventions such as deep insulation upgrades, window replacement, and HVAC modernization in aging building stocks. Many of these structures contain legacy hazardous materials, including asbestos, lead-based paints, polychlorinated biphenyls (PCBs), and contaminated dust, which complicate retrofit strategies and can generate new health risks if not managed systematically. This paper presents a risk-informed civil engineering framework for integrating hazardous materials assessment into energy retrofit planning and design. The framework combines building diagnostics, materials sampling, and simple exposure assessment with retrofit design options such as façade over-cladding, roofing replacement, and boiler room upgrades. Decision pathways are outlined to classify building zones into “remove,” “encapsulate,” or “avoid disturbance” categories while still achieving thermal and energy performance targets. The study emphasizes coordination between civil engineers, environmental consultants, and contractors, and recommends documentation practices to support future deconstruction and circular-material strategies. By embedding hazardous material considerations explicitly into energy retrofit workflows, the proposed approach protects occupants and workers, avoids regulatory non-compliance, and supports truly sustainable building transformation rather than purely energy-focused interventions.

Keywords: Energy retrofit, hazardous materials, asbestos, risk assessment, building rehabilitation, sustainable design.

SITING UTILITY-SCALE RENEWABLE ENERGY FACILITIES ON MARGINAL AND BROWNFIELD LANDS: A MULTI-CRITERIA CIVIL ENGINEERING FRAMEWORK**Ali Akbar Firoozi^{a,*} & Ali Asghar Firoozi^b**^aDepartment of Civil Engineering, Faculty of Engineering & Technology, University of Botswana, Gaborone, Botswana.^bDepartment of Civil Engineering, Faculty of Engineering, National University of Malaysia (UKM), Selangor, Malaysia**Abstract**

The rapid expansion of utility-scale solar and wind projects raises complex land-use, geotechnical, and environmental questions, particularly in regions with competing demands on high-quality land. This paper proposes a civil-engineering-oriented multi-criteria framework for siting renewable energy facilities on marginal lands, including brownfields, degraded industrial sites, and reclaimed quarries. The framework integrates geotechnical stability, foundation design, contamination status, access and drainage constraints, grid connection options, and visual-social impacts with traditional energy yield assessments. A screening methodology is described that uses GIS-based layers to identify candidate sites, followed by a more detailed ranking using analytic hierarchy process (AHP) or similar decision-support tools. Particular attention is given to the interaction between contamination management (e.g., capping, shallow excavation, or in-situ stabilization) and foundation solutions for PV tables or wind turbine towers. The study positions civil engineers as central actors in transforming problematic lands into productive low-carbon assets, while reducing pressure on agricultural and ecologically sensitive zones. The framework is intended as a practical tool for municipalities, developers, and engineering consultants engaged in sustainable regional energy planning.

Keywords: Renewable energy siting, brownfields, marginal land, geotechnical assessment, multi-criteria decision-making, civil infrastructure planning.

DESIGN OF GASKET SURFACES FOR IMPROVED SEALING PERFORMANCE

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Abstract

Reliable sealing in static joints is a critical requirement in many industrial systems, particularly where the control of fluid leakage directly affects safety, efficiency, and environmental protection. Conventional gasket design typically focuses on material selection and surface finish; however, the functional role of deliberately engineered surface textures remains insufficiently explored.

This paper investigates the influence of a controlled surface microstructure of gasket interfaces on the sealing behavior as a function of joint clamping. Instead of solely relying on material deformation mechanisms, the proposed concept utilizes geometric surface features to modify the local flow conditions within potential leakage paths.

The experimental program involved comparative leakage tests conducted on gasket specimens with two distinct surface states: a geometrically textured surface and a quasi-smooth surface. The results reveal that the introduction of surface microstructure alters the leakage characteristics of the joint, leading to measurable improvements in sealing performance within a specific loading range.

To support the experimental findings, numerical flow simulations were used to examine the distribution of pressure and velocity fields in the contact zone between the gasket and the mating surface. The simulations indicate that surface texturing can promote flow phenomena that contribute to an increase in flow resistance along leakage paths.

The outcomes of this study highlight the potential of surface texture engineering as a complementary approach to conventional gasket design and provide a basis for further optimization.

Keywords: flange-bolted joint; gasket; tightness improvement; CFD

THE STRUCTURAL, ELECTRONIC, AND THERMOELECTRIC CHARACTERISTICS OF Cu_2Se WERE EXAMINED THROUGH FIRST-PRINCIPLES CALCULATIONS BASED ON THE DFT-PBE METHOD

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Abstract

The copper selenide is now being looked at as a possible way to meet the energy needs. Therefore, in this study, the structural and thermoelectric properties of Cu_2Se were investigated using both density functional and classical Boltzmann transport models. The structural. The Perdew-Burke-Ernzerhof (PBE) was utilised to determine the band gaps. We demonstrate a prototype thermal evolution path for liquid thermal conductivity in solids. Thermal evolution of b- Cu_2Se shows large interstitial displacement of constituent atoms marked by glass-like transitions and an asymptotic liquid thermal transport. Using ab initio molecular dynamics (AIMD), we identify these transitions, and confirm them with in situ transmission electron microscopy and electron energy loss spectroscopy. The thermal disorder of the Cu^+ ions forms homopolar Cu–Cu bonds under a rigid Se framework, and at yet higher temperatures the Se framework undergoes thermal distortion. The non-equilibrium AIMD prediction of lattice thermal conductivity shows significant suppression of the phonon transport, in agreement with experiments and molecular behavior.

Keywords: DFT, Thermoelectric properties, Electronic properties.

HYBRID ENERGY SYSTEM WITH A SMART GRID BY USING ARTIFICIAL INTELLIGENCE**Prof. Dr. Reda Ghoname**

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ABSTRACT

The rise of global demand for sustainable energy has highlighted the importance of hybrid renewable systems that contain multiple power sources for reliability and efficiency. This project aims to develop a hybrid wind and solar energy system able to supply a smart grid and a DC load. The solar panel captures the solar energy, and the wind turbine converts the wind energy to electrical power. The problem mentioned is intermittency, as each source requires certain weather conditions. The solar panels need sunlight; therefore, their efficiency decreases in cloudy weather, and the wind turbine demands wind to work. Thus, this intermittency problem is mitigated by integrating both renewable energy sources into a hybrid renewable system. This ensures continuous and efficient energy generation within the system and to the load. The objectives of this project are to develop and design a hybrid solar-wind renewable energy system that generates a minimum of 5W to the load and implement Artificial intelligence to integrate solar panel tracking for maximum solar energy harvesting. Also, demonstrate smart grid functions to monitor all voltage, current, and temperature values in real-time. Provide a fast protection response time for faults. Balance the supply-demand energy through the battery to control the DC bus voltage to maintain voltage stability. The battery charges when generation exceeds load demand and discharges when generation is insufficient. Furthermore, to transmit and monitor the power to the load. Several alternative designs were considered, including different types of wind turbines. The optimum chosen solution integrates the two renewable energy sources, wind and solar, both connected through a maximum power point tracking charge controller and battery storage. The solar panel pitch is controlled by motors linked to Artificial intelligence.

Keywords: Hybrid renewable energy, solar-wind system, smart grid, artificial intelligence (AI), maximum power point tracking (MPPT), battery storage, energy efficiency, microcontroller control.

SELF-HEALING INSULATING MATERIALS FOR HVDC POWER CABLES**Rajesh Jesudoss Hynes Navasingh, Maciej Zdanowski**

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Abstract

Electrical treeing is the chief reason for breakdown of polymer insulation materials in high voltage direct current cables. Self-Healing Insulating Materials can defects caused by electrical treeing damages and increase the service life of power cables up to 50%. Thermal, mechanical, environmental, electrical stresses lead to breakdown, partial discharge, tracking, degradation of power cables. Though self-healing materials are used the mechanism of self-healing is least understood. In the present work, the mechanism of self-healing material is explored in detail and the corresponding change in its properties as assessed. Extrinsic method of self-healing is studied in detail with its implications. Self-healing insulation materials release microcapsules as healing agents at the location of the defects and restore the cables from damage. During damage of the cables, rupture of microcapsules takes place and it releases healing agent. When it is exposed to atmospheric air polymerization is initiated and cracks are filled because of solidification. Finally, the insulation material is restored and damage is prevented. Implementation of Self-Healing Insulating Materials can save money on repairs, and reduce risk of catastrophic failures for Power companies.

Keywords: self-healing materials, high-voltage insulation, power cables, Cybersecurity, Electrical treeing

AN INTEGRATED MACHINE LEARNING STRATEGY FOR ACCURATE SHORT-TERM HOUSEHOLD ELECTRICITY CONSUMPTION FORECASTING

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Abstract

Strategies to foster equitable growth in developing countries depend on understanding how households responds to energy access. This study proposes a system that uses machine learning strategies to precisely forecast the electricity usage of household appliances in sustainable dwellings. The primary purpose is to make actionable recommendations for optimizing energy use by identifying and modelling controllable factors. The primary objective is to reduce electricity bills while minimizing environmental effect through increased energy efficiency. The proposed approach is based on a comprehensive data collection and analysis structure. The methodology integrates a variety of publicly available statistics, including: a) appliance usage patterns, b) local weather conditions, and c) other environmental elements that have a substantial impact on energy consumption. Intelligent machine learning algorithms will be trained on this multivariate data to identify complicated trends, correlations, and consumption patterns unique to low-energy dwelling environments. The outcomes of the prediction models will serve as the foundation for delivering particular, individualized recommendations for homeowners. These data-driven recommendations focus on maximizing the advantages of on-site green power sources, analysing the adoption of more energy-efficient appliance technology, and optimizing the schedule of appliance consumption. This approach aims to allow homeowners to achieve substantial energy savings and contribute to a cleaner energy environment by converting basic information into useful, accessible findings.

Keywords: smart grid, energy management system, sustainable energy, green ecology, machine learning, home energy management system

MECHANISTIC INSIGHTS AND CONTROL STRATEGIES FOR ELECTRODE PASSIVATION IN ELECTROCOAGULATION

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Abstract

Electrocoagulation (EC) is a green electrochemical process that is rapidly gaining popularity for treating water. Nevertheless, the large scale application of EC technology continues to be hampered by the corrosion and passivation of the electrodes. This phenomenon decreases the dissolution of metal, prevents the generation of flocculants and increases energy consumption. This review combines present know-how on EC mechanics. In particular, on the formation of anodic damage and cathodic passivation layers rich in metal oxides and hydroxides and their influence. Recent advances in passivation detection, including surface characterization (SEM, EDS, XRD, XPS, ToF-SIMS), electrochemical analyses (Tafel curves, cyclic voltammetry, EIS), and real time monitoring techniques such as UTDR, are critically examined. The review further analyzes key operational factors influencing passivation current density, pH, electrode spacing, ionic composition, and hydrodynamic conditions. A comprehensive assessment of passivation mitigation strategies is provided, including current-mode modification (polarity reversal, pulsed currents), innovative electrode designs (cylindrical, perforated, rotating), reactor-level optimizations, chloride introduction for controlled pitting, and auxiliary methods such as ultrasound, mechanical cleaning, and hypergravity. Coupled and hybrid EC configurations, as well as the emerging integration of machine learning for predictive control and energy optimization, are also discussed. Overall, this review identifies critical challenges and highlights promising pathways for achieving stable, efficient, and scalable EC systems.

Keywords: Electrocoagulation; Electrode corrosion; Electrode passivation; Electrochemical analysis; Machine learning; Water treatment.

SELF-RECONSTRUCTING HALIDE POLYMER INTERPHASES FOR DENDRITE-FREE SOLID-STATE LITHIUM-METAL BATTERIES**Sheikh Tanvir Ahmed**

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Abstract

Solid-state lithium-metal batteries promise high energy density but continue to face critical interfacial challenges, including void formation, crack development, and dendrite penetration at the Li|solid-electrolyte junction. Conventional ceramic and polymer interlayers struggle to maintain interfacial integrity due to their mechanical rigidity or limited ionic transport. Halide-rich interphases containing MCl_6 ($M = \text{Ti, Zr, In}$) nanoclusters embedded within dynamic polymer networks offer a potential pathway to combine fast Li-ion conduction with mechanical adaptability. The halide domains can support stable Li-Cl interphase chemistry, while the polymer matrix accommodates local stress and mitigates microstructural defects. Together, these characteristics may enable smoother lithium deposition, suppress dendrite initiation, and improve long-term interfacial stability in solid-state cells. Such an approach could open new directions for engineering robust interfaces in next-generation lithium-metal batteries.

ARTIFICIAL INTELLIGENCE IN ENERGY SYSTEM OPTIMIZATION

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Abstract

Artificial intelligence (AI) has emerged as a transformative tool for optimizing modern energy systems by enhancing efficiency, reliability, and sustainability. With the global shift toward renewable and decentralized energy generation, traditional energy management approaches are no longer adequate to handle increasing system complexity. AI-based techniques—including machine learning, deep learning, and reinforcement learning—enable real-time forecasting of energy demand, renewable energy output, and grid behavior. These predictive capabilities support intelligent scheduling of power generation, load balancing, and fault detection, significantly improving grid stability. AI-driven optimization also enhances the performance of energy storage systems by predicting charge–discharge cycles and extending battery lifespan. In smart grids, AI facilitates automated decision-making through advanced data analytics, enabling demand response management, decentralized energy trading, and efficient integration of distributed energy resources (DERs). Furthermore, AI algorithms play a crucial role in reducing transmission losses, minimizing operational costs, and supporting carbon reduction goals. Despite its potential, challenges such as data security, algorithm transparency, and infrastructure requirements must be addressed to ensure large-scale adoption. Overall, AI offers a powerful pathway to build intelligent, resilient, and sustainable energy systems capable of meeting future energy demands.

Keywords: Artificial intelligence (AI), Machine learning, Deep learning, Reinforce learning, smart grid, Energy management, Energy forcecasting

RECENT ADVANCEMENTS IN SOLAR CELL TECHNOLOGIES

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Abstract

The growing global demand for clean and sustainable energy is driving fast improvements in solar cell technologies. This work gives an overview of recent progress in photovoltaic systems, focusing on new materials, better device designs, and broader applications. Perovskite solar cells lead the way with their high power conversion efficiencies, adjustable bandgaps, and low production costs. However, there are still challenges related to long-term stability and lead content. Tandem solar cells, particularly the combinations of perovskite and silicon, have surpassed traditional efficiency limits by capturing more of the solar spectrum with multiple absorber layers. Dye-sensitized and organic solar cells provide advantages like flexibility, semi-transparency, and low production costs, making them ideal for uses such as smart windows and indoor energy harvesting. Progress in thin-film technologies and roll-to-roll manufacturing has led to the development of lightweight, flexible panels for portable and off-grid applications. Combining solar systems with advanced energy storage solutions, including lithium-ion and next-generation batteries, increases system reliability and promotes energy independence. While issues like material toxicity, environmental harm, manufacturing scalability, and recycling are still present, ongoing research and policy efforts are tackling these problems. Solar technologies are set to play a key role in meeting global climate goals and boosting the use of renewable energy.

Key words: Solar cell technologies, Perovskite solar cells, Tandem solar cells, Photovoltaic Systems, Thin-film technologies, Sustainability

ENERGY TRANSITION STRATEGIES: FROM FOSSIL FUELS TO RENEWABLES**Chetachi Muokwe**

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ABSTRACT

The pressing necessity of switching from fossil fuels to renewable energy sources is highlighted by the growing global energy demand, which is being driven by industrialization and population growth. Greenhouse gas emissions from conventional energy systems that depend on coal, natural gas, and oil greatly exacerbate environmental deterioration and climate change. Sustainable and more environmentally friendly options are provided by renewable energy sources like biomass, solar, wind, and hydro.

Biomass energy has now been accepted as having the potential of providing major part of the renewable energy projection provisions of the future as biofuels in the form of gas, liquid or solid fuels. In providing these biofuels, three main pathways are followed: thermal conversion, biological conversion, and physical thermochemical conversion processes for higher efficiencies, greater versatility, and lower costs in providing fuel, chemical options, and wide range of energy.

Noteworthy also is the abundance and adaptability of solar energy for industrial, heating, and electricity generation applications. Despite the tremendous advancements in renewable technologies, issues with system integration, storage, and efficiency still exist.

These obstacles are being addressed by recent developments in energy storage, materials science, and smart grid technologies, which will increase the scalability and dependability of renewable energy systems. Global sustainability goals are further supported by incorporating renewable energy sources into contemporary infrastructure, such as smart devices and off-grid applications.

Keywords: Renewable energy, Biomass, Biofuels, Sustainable energy, and Solar energy.

FIRST PRINCIPLES COMPUTATIONAL STUDY OF MgX_3H_8 ($X = V$ and Fe) FOR HYDROGEN STORAGE APPLICATIONS

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Abstract

The current environmental and energy crisis highlights the urgent need for alternative energy sources. Hydrogen is a promising option because of its abundance, cost-effectiveness, and eco-friendliness, yet its large-scale application requires advancements in storage and transportation technologies. This article discusses the significant potential of solid hydrogen storage systems using metal hydrides, which offer advantages in safety and volumetric density. Magnesium-based materials, specifically MgV_3H_8 and $MgFe_3H_8$, are explored through Density Functional Theory (DFT) to evaluate their structural, electronic, thermodynamic, and mechanical properties, as well as their hydrogen storage capabilities. The results indicate that these compounds exhibit negative formation enthalpy -0.86eV/atom for MgV_3H_8 and -0.81eV/atom for $MgFe_3H_8$, suggesting their stability and feasibility for synthesis. Phonon calculations revealed no imaginary frequencies, confirming their dynamic stability. The mechanical stability of MgV_3H_8 and $MgFe_3H_8$ was verified through the compliance of their elastic constants with Born stability criteria. The electronic band structure analysis indicates that these metal hydrides exhibit metallic behavior. The evaluation of Poisson's ratio (ν) and Pugh's ratio (B/G) for MgV_3H_8 and $MgFe_3H_8$ suggests ductile mechanical behavior, with anisotropic characteristics observed in both materials. Furthermore, the promising gravimetric hydrogen storage capacities ($C_{wt}\%$) of 4.14 wt% for MgV_3H_8 and 3.84 wt% for $MgFe_3H_8$, along with desorption temperatures (T_{des}) of 636.38 K and 599.47 K, respectively, highlight their potential for practical applications. Additionally, the study reveals that hydrogen diffusion within these materials occurs primarily through multiple diffusion pathways. Notably, hydrogen migration in the (a , b) plane is rapid in the $MgFe_3H_8$ structure due to a low energy barrier of 0.14 eV. Overall, this research highlights the potential of these materials in advancing hydrogen storage solutions.

Keywords: Hydrogen storage; Hydrogen Diffusion; Barrier Energy; DFT; Magnesium; Mechanical properties

HARNESSING AGRICULTURAL AND FORESTRY RESIDUES FOR BIOMASS-BASED ELECTRICITY: OPPORTUNITIES, CHALLENGES, AND POLICY PATHWAYS IN ASIA

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Abstract

As Asia grapples with the dual imperatives of meeting rising energy demand and achieving decarbonization targets, the utilization of agricultural and forestry residues for electricity generation has emerged as a critical strategic pathway. This study evaluates the status, technological maturity, supply chain dynamics, and policy landscapes of biomass power in Asia from 2015 to 2025. The review identifies that while Southeast Asia and India possess immense theoretical potential—with over 500 million tons of biomass available annually—the conversion to commercial energy is hindered by supply chain fragmentation, moisture content issues, and competitive markets for export. The results highlight a technological bifurcation: mature direct combustion technologies like Circulating Fluidized Bed (CFB) boilers are gaining traction for handling heterogeneous fuels, whereas small-scale gasification projects frequently face operational failures due to tar issues and lack of technical expertise. Policy analysis reveals a distinct divergence between import-dependent nations (Japan, South Korea) that use Feed in Tariffs (FIT) and Renewable Portfolio Standards (RPS) to drive demand, and resource-rich nations (Vietnam, Indonesia) that struggle to balance domestic utilization with lucrative export markets for wood pellets. The study concludes that sustainable governance models must shift from capital subsidies to operational support (supply chain financing) and harmonize regional sustainability standards to mitigate deforestation risks. Future research should focus on the socio-economic impacts of bio-energy hubs and the life cycle assessment of cross-border biomass trade.

Keywords: Biomass electricity, Agricultural residues, Bioenergy policy, Supply chain logistics, Asia energy transition.

BIOFUEL CELLS FOR POWERING WEARABLE AND IMPLANTABLE MEDICAL DEVICES**S. Deepak, A. Palanisamy, S. Kalaivanan, Lavanya Babu, C.Ravi, K. Dinesh rajan**

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Abstract

The use of biochemical energy from the human body, specifically biofuel cells (BFCs), has become a revolutionary power source for wearable and implantable medical devices. A diverse array of studies, encompassing in vivo experiments in rodents, glucose-fueled implantable prototypes and wearable devices powered by sweat, demonstrate that BFCs can maintain low-power electronics without external charging. LEDs, temperature sensors, and pacemaker-like circuits have all been powered by glucose biofuel cells implanted in rats, indicating their potential as long-term internal energy sources. Typically, these systems use immobilized enzymatic catalysts like glucose-oxide or dehydrogenases on nanoengineered electrodes to improve catalytic efficiency and power density. The use of wearable BFCs made from textile substrates and flexible nanocomposites has potential applications in biosignal monitoring, fitness tracking, and self-powered diagnostic patches. These technologies are highly versatile. Carbon nanotube fiber electrodes or gold-coated foams are used to manufacture sweat-based BFCs, which offer high mechanical flexibility and stable output under bending conditions. Artificial vessel-based BFCs and implantable carbon-foam systems exhibit superior biocompatibility and stability in physiological settings. Additionally, they are more stable under normal conditions....

However, many obstacles still remain so that medical implants can use BFCs as a replacement for traditional batteries. Long-term stability is compromised by enzyme degradation, and performance may be reduced by biofouling and immune responses after implantation. Although the use of nanomaterials and hybrid designs has resulted in significant increase in power output, higher energy demands necessitate further optimization. To overcome these limitations, active attempts are being made to develop nanoengineered electrodes, enzyme stabilization strategies and oxygen-independent cathodes or hybrid BFC–supercapacitor power modules. Overall, growing body of research shows that biofuel cells provide a miniaturized and biocompatible power solution for next generation medical electronics. Why? The future self-powered pacemakers, glucose monitors, neural implants, and wearable health systems are likely to benefit from ongoing improvements in materials, enzymatic engineering, or device integration.

Keywords: Biofuel cells, Implantable devices, Wearable electronics, Glucose energy harvesting, Enzymatic electrodes, Self-powered biomedical systems, Nanomaterial-based bioelectrodes

TEMPERATURE OPTIMIZATION FOR ENHANCED ANAEROBIC CO-DIGESTION OF VEGETABLE WASTE WITH CATTLE RUMEN CONTENT: MAXIMIZING BIOGAS YIELD**Amoo Afeez Oladeji**

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Abstract

The global challenge of managing organic waste sustainably continues to intensify, with vegetable waste (VW) and livestock-derived materials representing major contributors to environmental degradation and energy resource depletion. This study maximized the influence of temperature on the biogas yield, the proportion of methane, and the dynamics of the volatile fatty acid (VFA) of VW-CRC co-digestion at both mesophilic (35-48 °C) and thermophilic (50-60 °C) temperature conditions. The batch digesters included 5L capacity and operated on substrate mixtures in 70:30 and 50:50 ratios (VW: CRC) at substrate loading rates (OLR) of 2-4 kg VS/m³/d with 40 days retention times maintained at pH 6.8-7.2. The results finding indicated best biogas yield of 0.62 L/g VS containing 62 % methane at 42 °C was obtained with the 70:30 ratio, which was 38 and 18 percent higher than mono-digestion and thermophilic operation processes, respectively. Optimization of temperature lowered lag phase time by half, increased volatile solids (VS) reduction to 65, and decreased VFA accumulation (450 mg/L vs. >2200 mg/L at extremes of temperature). Kinetic modeling of temperature-optimum revealed the rates of hydrolysis rate constant ($\frac{ds}{dt} = -k_{hyd} \cdot S$) and methanogenesis ($\frac{dM}{dt} = k_{met} \cdot P$) of 0.12 d⁻¹ and 0.08 d⁻¹, respectively, confirming first-order degradation. ASPEN Plus simulation: 178 m³ of cumulative biogas production with sustained 60 % methane purity of 1.1 L of petrol energy per m³ was predicted at 90 days. The evidence suggests that biogas can be scaled in Nigeria and sub-Saharan Africa, where abundant VW and CRC from markets/farm and slaughterhouses remain underutilized, offering solutions for rural energy access, waste management, and greenhouse gas mitigation.

Keywords: Anaerobic co-digestion, Vegetable waste, cattle rumen content, temperature optimization, methane production, kinetic modeling.

ANIMAL DUNG AS ALTERNATIVE FORM OF SOURCE OF METHANE GAS FOR DOMESTIC ENERGY SOURCE**Abdul Waheed, Abdullah Shah Hashmi**

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Abstract

Pakistan's economy is rich in livestock resources (n=237.3 million excluding poultry) consisting of buffalo, cattle, camel, equines, sheep, goat, and poultry that yield a lot of fecal material that is capable of enhancing energy production from digested and decomposed biomaterials. In vivo and in vitro methane gas production is dependent of several factors. However, the dung obtained from these livestock is a useful energy source in the form of dung cakes, dung wood and biogas production using biogas plants. Direct collection of methane has been experimented using gas chambers/balloons. It is suggested that this huge amount of livestock could be harnessed for methane gas production as alternative sources of fuel by providing sufficient training and other facilities like provision of dung wood machines and biogas production plants to farmers as incentive or credit forms. This would enhance energy production from natural livestock sources.

Keywords: Livestock feces, dung wood, biogas plants, gas chambers

BIOENERGY FROM NANOBIODEGRADATION OF DISPOSABLE FACE MASKS USING SOIL MICROBIOME- A BIOECONOMIC APPROACH**Mohanapriya P^{1*}, Chamundeeswari M²**¹Research Fellow, Department of Biotechnology, St. Joseph's College of Engineering, India² Associate Professor, Department of Biotechnology, St. Joseph's College of Engineering, India**Abstract**

Disposable polypropylene (PP) face masks pose substantial ecological risks due to their persistence and contribution to microplastic pollution. This study investigates a novel approach to accelerate PP biodegradation by combining soil-isolated plastic-degrading microorganisms with green-synthesized iron nanoparticles (FeNPs) as degradation enhancers. The FeNPs were synthesized via a green chemistry approach, using agro-friendly plant *Sesbania bispinosa* aqueous extract to control nanoparticle size through optimized parameters. The researchers have demonstrated that such biosynthesized FeNPs stimulate bacterial proliferation, organic matter mineralization, humidification, and compost maturation. Plastic-degrading strains were isolated from agricultural soil and screened for degradation activity. Laboratory-scale biodegradation assays were conducted using face mask films, degradation efficiency was quantified based on weight loss, and molecular changes were confirmed by FTIR, which revealed emergence of acetaldehyde and carbonyl peaks compared to untreated films. Biofilm formation by the microbial strains on the mask surfaces confirmed microbial colonization and attachment. The results indicate that the synergistic application of isolated soil microorganisms and green-synthesized FeNPs markedly improves the biodegradation of PP masks. This integrated strategy shows strong potential as an environmentally sustainable method for managing PP waste and simultaneous CO₂ capture technology paves way to next generation bioenergy development.

Key Words: Microplastics, soil microorganisms, biodegradation, Sustainability approach, Face mask

HARNESSING MICROBIAL BIOTECHNOLOGY FOR SUSTAINABLE ENERGY DEVELOPMENT AND ENHANCED ENVIRONMENTAL SUSTAINABILITY

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Abstract

Biotechnologies are vital instruments for advancing environmental sustainability and creating renewable energy sources. The growth of renewable energy sources and environmental sustainability depend heavily on biotechnologies, particularly microbial biotechnology as Methanization. this later, also known as anaerobic digestion, is the fermentation process that uses (bio)methane as the final electron acceptor to break down putrescible materials in the absence of air. The result of this anaerobic breakdown of organic materials is a gaseous mixture known as biogas or biomethane, which is mostly made up of carbon dioxide and methane. Hydrolysis (hydrolytic bacteria), acidogenesis (*Bacteroides*, *Bacillus*, *Pelobacter*, *Acetobacterium*, *Enterobacteriaceae*), acetogenesis (homoacetogenic bacteria), and methanogenesis (archaea) are the four fundamental stages of this bacterial breakdown. A certain set of bacteria is involved in each phase. This biotechnological method makes it possible to turn agricultural waste and residues into biogas and digestate, providing an environmentally friendly, economical, and flexible means of converting organic waste into renewable energy and making a substantial contribution to the circular bioeconomy and efforts to slow down climate change.

Keywords: Environmental sustainability; renewable energy; Methanization, Organic waste, biogas.

Quercus ilex* FRUIT SHELLS AS A RENEWABLE BIOMASS FOR SUSTAINABLE ENERGY APPLICATIONS*Lila HADIDI ¹, Drifa GUELLAL-YALAOUI¹**¹Faculty of natural and life sciences and earth sciences, university of bouira, 10000 bouira, Algeria.**Abstract**

Forestry and agricultural residues represent an abundant renewable biomass that remains largely underutilized in many mediterranean regions. In this context, the fruit shells of *Quercus ilex* offer promising potential for integration within sustainable energy and environmental systems. This study investigates the phytochemical composition of *Q. ilex* shells (rich in phenolic and flavonoid compounds) and evaluates their strong antioxidant activity ($IC_{50} = 18.51-42.25 \mu\text{g/ml}$ for DPPH and NO, respectively). Beyond their bioactivity, the lignocellulosic structure and biodegradability of these residues position them as valuable feedstock for pre-treatment steps in bioenergy production, low-energy bioremediation processes, and circular bioeconomy strategies. Their capacity to adsorb pollutants and enhance oxidative stability suggests possible roles in improving the efficiency of biomass conversion systems and supporting eco-friendly energy pathways. Overall, *Q. ilex* fruit waste represents a multifunctional renewable resource linking waste valorization, environmental remediation, and sustainable energy systems.

Keywords: *Quercus ilex*, bioactive compounds, renewable biomass, waste valorization, sustainable energy.

GREEN HYDROGEN, AN AFRICAN RESPONSE TO THE CHALLENGE OF CLIMATE CHANGE**Chaimae Lamiri¹, Jamal Mabrouki¹, Khadija El-Moustaqim², Ayoub Ghailane¹ and Younes Abrouki¹**

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Abstract

The continent is rich in renewable energy resources that can help meet its electricity demand, thereby promoting economic growth and contributing to global CO₂ emission reduction targets. Green hydrogen is considered one of the most promising technologies for energy production, transport, and storage. Climate change is one of the greatest challenges of the 21st century. According to climatologists around the world, energy-related CO₂ emissions account for approximately 76% of global greenhouse gas emissions, which are responsible for climate change that threatens the Earth's viability for humanity. Today, electricity generation relies mainly on fossil fuels or nuclear power plants fueled by natural gas or coal; however, the future lies in clean electricity. The world needs a sustainable solution, known as “sector coupling,” to enable the transfer of renewable energy to energy-consuming sectors of the global economy and to ensure the storage and transportation of energy produced from renewable sources. This chapter examines the potential for green hydrogen production in Africa, as well as its future applications. It also provides an overview of the benefits of transitioning to this technology. Current African infrastructure and policies are assessed in terms of their suitability for this transition. This project examines the potential for green hydrogen production in Africa, as well as its future applications. It also provides an overview of the benefits associated with the transition to this technology. Current African infrastructure and policies are assessed in relation to future objectives. Finally, the study offers a detailed theoretical, environmental, technological, and economic analysis, taking into account local energy needs.

Keyword: Renewable energy, Climate change, Green hydrogen, electricity generation

**INTELLIGENT ENERGY CONSUMPTION PREDICTION USING IoT DATA: COMPARISON OF LSTM AND ML ALGORITHMS****Alireza Esmacili JOBANI**

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Abstract

The integration of the Internet of Things (IoT) into energy systems has profoundly transformed energy management applications by enabling real-time data collection and intelligent decision-making processes. This study aims to develop and compare IoT-based Artificial Intelligence (AI) models for predicting energy consumption within the framework of smart energy management. By utilizing time-series data obtained from distributed IoT sensors that monitor energy usage, it is anticipated that the most effective algorithms for optimal energy consumption prediction can be identified. The study plans to compare a Long Short-Term Memory (LSTM) neural network with conventional Machine Learning (ML) algorithms such as Random Forest and Support Vector Regression (SVR). The performance of the models will be evaluated using metrics including Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and R^2 score to measure prediction accuracy and generalization capability. Experimental results will be assessed to observe that the LSTM model achieves higher accuracy by capturing temporal dependencies in fluctuating consumption patterns, while ML models offer advantages in terms of computational efficiency and training speed. The comparative findings will provide insight into the potential of deep learning for demand-side management, energy optimization, and sustainability within IoT-based infrastructures. This study contributes to the field of smart energy management by emphasizing the role of hybrid AI-IoT architectures in building data-driven, scalable, and efficient energy systems.

Keywords: IoT, Artificial Intelligence, Energy Management, LSTM, ML, Predictive Analysis.

IoT VERİLERİNİ KULLANARAK AKILLI ENERJİ TÜKETİMİ TAHMİNİ: LSTM VE ML ALGORİTMALARININ KARŞILAŞTIRILMASI**Özet**

Nesnelerin İnternet'inin (IoT) enerji sistemlerine entegrasyonu, gerçek zamanlı veri toplama ve akıllı karar verme süreçlerini mümkün kılarak enerji yönetimi uygulamalarını köklü biçimde dönüştürmektedir. Bu çalışma, akıllı enerji yönetimi bağlamında enerji tüketimini tahmin etmeye yönelik IoT tabanlı Yapay Zekâ (YZ) modellerini geliştirmeyi ve karşılaştırmayı amaçlamaktadır. Enerji kullanımını izleyen dağıtık IoT sensörlerinden elde edilen zaman serisi verileri kullanılarak farklı yöntemler içerisinde optimum enerji tüketim tahminlerinin yapan algoritmaların tespit edilebileceği ön görülmektedir: Uzun Kısa Süreli Bellek (LSTM) sinir ağı ve Random Forest ile Destek Vektör Regresyonu (SVR) gibi geleneksel Makine Öğrenmesi (ML) algoritmalarının karşılaştırılması planlanmaktadır. Modellerin performansı, tahmin doğruluğunu ve genelleme yeteneğini ölçmek amacıyla Ortalama Mutlak Hata (MAE), Kök Ortalama Kare Hatası (RMSE) ve R^2 skor metrikleri incelenecektir. Deneyisel sonuçlar değerlendirilecek ve LSTM modelinin özellikle dalgalı tüketim desenlerinde zamansal bağımlılıklarını yakalayarak doğruluk oranları ve ML modellerinin karmaşıklığı ve hızı ile eğitim avantajı gözlemlenecektir. Karşılaştırmalı bulgular, IoT tabanlı altyapılarda talep tarafı yönetimi, enerji optimizasyonu ve sürdürülebilirlik açısından derin öğrenmenin potansiyelinin tespit etme imkânı sunmaktadır. Bu çalışma, veriye dayalı, ölçeklenebilir ve verimli enerji sistemlerinin

oluřturulmasında hibrit YZ–IoT mimarilerinin rolünü vurgulayarak akıllı enerji yönetimi alanına katkı sağlamaktadır.

Anahtar Kelimeler: IoT, Yapay Zekâ, Enerji Yönetimi, LSTM, ML, Tahmine Dayalı Analiz.

PROJECTION OF ARTIFICIAL INTELLIGENCE-BASED RENEWABLE AND SUSTAINABLE ENERGY RESEARCH**Samet ÖZKÖK**

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Abstract

The rapid development of technology and science is increasing energy demand. Meeting this rapidly growing energy demand while ensuring its sustainability is considered one of the significant challenges of the modern age. Therefore, the use of renewable and sustainable energy sources plays a critical role in the world's future. In this vital area, it is inevitable that artificial intelligence, which has been applied in various fields in recent years, will also find its applications. Indeed, it has been observed that an increasing number of researchers are employing multiple artificial intelligence techniques to address problems in the field of renewable and sustainable energy. This study presents a bibliometric evaluation of AI-based research in renewable and sustainable energy. The dataset was obtained from the Web of Science (WoS) database. Research articles published in SCI-EXPANDED, SSCI, and ESCI-indexed journals in WoS were filtered using the keywords "renewable energy," "sustainable energy," "machine learning," and "AI." The data collection process was limited to articles published between 2015 and 2025, resulting in a total of 7,914 articles. The VOSviewer program was used to visualize the bibliometric analysis of the resulting dataset. According to the analysis results, the countries that contributed the most to the literature are China, India, and the United States. The keyword network map indicates that the literature is structured around the keywords "renewable energy," "machine learning," "artificial intelligence," "energy management," and "deep learning." As demonstrated by the network map, which is colored by year, the literature has focused on the keywords "artificial intelligence," "energy efficiency," and "real-time systems" since the second half of 2023. The analysis results presented in this study are intended to support researchers working in or aspiring to work in the field of artificial intelligence-based renewable and sustainable energy.

Keywords: Artificial Intelligence, Renewable Energy, Sustainable Energy, Bibliometric Analysis.

**YAPAY ZEKA TABANLI YENİLENEBİLİR VE SÜRDÜRÜLEBİLİR ENERJİ
ARAŞTIRMALARININ PROJEKSİYONU****Özet**

Teknoloji ve bilimin hızla gelişmesi enerji talebini artırmaktadır. Hızla artan bu enerji talebini sürdürülebilirliğini sağlayarak karşılamak, modern çağın önemli zorluklarından biri olarak kabul edilmektedir. Bu nedenle, yenilenebilir ve sürdürülebilir enerji kaynaklarının kullanımı dünyanın geleceğinde kritik bir rol oynamaktadır. Bu hayati alanda, son yıllarda çeşitli alanlarda uygulanan yapay zekânın da uygulama alanları bulması kaçınılmazdır. Nitekim, giderek artan sayıda araştırmacının yenilenebilir ve sürdürülebilir enerji

alanındaki sorunları ele almak için birden fazla yapay zekâ tekniği kullandığı görülmektedir. Bu çalışmada, yapay zeka tabanlı yenilenebilir ve sürdürülebilir enerji araştırmalarının bibliyometrik bir değerlendirmesi sunulmaktadır. Veri seti, Web of Science (WoS) veri tabanından elde edilmiştir. WoS'ta yer alan SCI-EXPANDED, SSCI ve ESCI indeksli dergilerde yayımlanmış araştırma makaleleri, “renewable energy”, “sustainable energy”, “machine learning” ve “AI” anahtar kelimeleri kullanılarak filtrelenmiştir. 2015-2025 yılları arasında yayımlanan makalelerle sınırlandırılan veri toplama işlemi sonucunda, toplam 7914 makaleye ulaşılmıştır. Elde edilen veri setinin bibliyometrik analizini görselleştirmek için VOSviewer programından yararlanılmıştır. Analiz sonuçlarına göre literatüre en çok katkıda bulunan ülkeler Çin, Hindistan ve Amerika olarak öne çıkmaktadır. Anahtar kelime ağ haritası literatürün “renewable energy”, “machine learning”, “artificial intelligence”, “energy management”, “deep learning” anahtar kelimeleri etrafında yapılandığını göstermektedir. Yıllara göre renklendirilmiş ağ haritasına göre ise 2023 yılının ikinci yarısından itibaren literatür “artificial intelligence”, “energy efficiency”, “real-time systems” anahtar kelimelerine odaklanmaktadır. Bu çalışma kapsamında gerçekleştirilen analiz sonuçlarının, yapay zeka tabanlı yenilenebilir ve sürdürülebilir enerji alanında çalışan veya çalışmak isteyen araştırmacılara yardımcı olması hedeflenmektedir.

Anahtar Kelimeler: Yapay Zeka, Yenilenebilir Enerji, Sürdürülebilir Enerji, Bibliyometrik analiz.

SIMULATION-BASED ASSESSMENT OF GASIFICATION PERFORMANCE OF TURKISH COAL TYPES USING MATLAB**Mert ÖKTEN**

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Abstract

This study investigates the gasification performance of different coal types commonly found in Türkiye through a MATLAB-based simulation model. The model evaluates both the energy production potential and the CO₂ emissions under varying temperature conditions in the 800–1200 °C range. Results reveal that high-grade coals such as anthracite and bituminous coal exhibit superior energy outputs across all temperatures compared to lignite and sub-lignite, a trend directly linked to their higher lower heating values (LHV) and carbon contents. Increasing temperature enhances syngas quality by elevating CO and H₂ fractions, thereby improving energy recovery efficiency. Meanwhile, CO₂ emissions display a decreasing trend at higher temperatures, which can be attributed to the prevalence of reduction reactions, particularly the Boudouard reaction, that convert CO₂ into CO. Moreover, coals with higher carbon ratios generate higher emissions than low-grade coals, highlighting the dual influence of fuel quality and operating conditions. These findings underscore the environmental and energetic advantages of high-temperature gasification. Beyond technical insights, the study emphasizes the strategic importance of coal gasification in enhancing Türkiye's energy security, reducing dependency on imported fuels, and supporting the production of value-added chemical feedstocks. In conclusion, coal gasification emerges as a promising pathway that combines efficiency and sustainability, positioning it as a key contributor to the country's long-term energy and industrial strategies.

Keywords: Coal gasification, CO₂ emissions, Energy efficiency, Syngas, MATLAB simulation.

**SHORT-TERM MACHINE LEARNING-BASED POWER FORECASTING FOR A SINGLE
ONSHORE WIND FARM IN TURKEY****Kaan DEVECİ**

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Abstract

This study proposes a machine learning-based framework for short-term wind power forecasting for a single onshore wind farm in Turkey. The study investigates the feasibility of short-term wind power forecasting based solely on open-access reanalysis data and historical power generation records, without the use of on-site meteorological measurements. To this end, ERA5 data are combined with historical generation data obtained from the EPIAŞ Transparency Platform. A compact and physically informed feature set is constructed, including cyclic temporal variables, meteorological variables at multiple heights, derived physical quantities, and autoregressive power lags selected to preserve the day-ahead forecasting structure while preventing data leakage. The forecasting model is developed using the light gradient boosting machine, with hyperparameters optimized through Bayesian optimization. Model performance is evaluated using the mean absolute error over normalized power outputs and compared against a naïve persistence benchmark. The proposed approach achieves an MAE of 0.133, corresponding to an improvement of approximately 46% over the baseline model. The results demonstrate that use of reanalysis-based meteorological data, when combined with appropriate feature engineering and machine learning techniques, can provide acceptable short-term wind power forecasts for market-oriented applications.

Keywords: Machine learning, forecasting, wind energy production.

LIGHTGBM-BASED MARKET CLEARING PRICE FORECASTING FOR THE TURKISH DAY-AHEAD ELECTRICITY MARKET

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Abstract

Accurate forecasting of electricity prices is essential for market participants to manage risks and optimize bidding strategies in deregulated energy markets. This study addresses the day-ahead price forecasting problem within the context of the Turkish day-ahead market, which is characterized by high volatility and dynamic consumption patterns. The study employs the Light Gradient Boosting Machine algorithm, utilizing a dataset that includes historical prices, load forecasts, and calendar-based features. A specific focus is placed on the comparative analysis of two training window strategies: the rolling window approach, which utilizes a fixed-size recent dataset, and the expanding window approach, which incorporates the entire available historical data. The experimental results indicate that the rolling window strategy provides better predictive performance compared to the expanding window method. The proposed model achieved a mean absolute error of 6.92 USD/MWh on the test set, demonstrating a 14.15% improvement over the Naive baseline model, which assumes that the price at a given hour is equal to the price at the same hour of the previous day.

Keywords: Machine learning, forecasting, market clearing price.

EVALUATING THE PREDICTIVE CAPABILITY OF BOOSTING ALGORITHMS FOR DATA-DRIVEN WIND TURBINE POWER MODELLING**Elif YÜCESOY**

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Abstract

Wind power forecasting plays a vital role in modern power system operation, supporting secure grid management, reserve planning, and the efficient integration of renewable energy. The nonlinear interactions between atmospheric variables and turbine aerodynamics require learning algorithms capable of capturing complex multi-factor relationships with high predictive accuracy. This study presents a comprehensive comparison of five boosting-based shallow learning models—Gradient Boosting Regression (GBR), Extreme Gradient Boosting (XGBoost), LightGBM, CatBoost, and AdaBoost—for short-term wind power prediction. The analysis is based on an hourly dataset collected from a Nordex N117/3600 wind turbine in Yalova, Turkey, combined with meteorological variables obtained from reanalysis sources, resulting in an 8,760-point time series representing diverse atmospheric conditions and seasonal variability. All models were trained within a unified workflow in which hyperparameters were optimized using Grid Search combined with five-fold time-aware cross-validation to ensure chronologically consistent performance evaluation. Model accuracy was assessed using R^2 , RMSE, and MAE metrics. The results indicate that XGBoost and CatBoost achieve the highest predictive accuracy after hyperparameter tuning, followed by LightGBM and GBR, which also demonstrate competitive performance. AdaBoost, on the other hand, exhibits relatively weaker results due to its sensitivity to noisy and correlated features, yet provides a useful baseline that highlights the limitations of classical boosting in modelling complex atmospheric–mechanical interactions. The comparison demonstrates that boosting-based shallow learners, when successfully optimized, offer an accurate, efficient, and robust framework for short-term wind power prediction. These findings contribute to improved forecasting strategies that support grid operators, energy planners, and renewable integration processes in modern power systems.

Keywords: Wind power prediction; Boosting methods; Gradient boosting; XGBoost; LightGBM; Machine learning

ATMOSPHERIC INFLUENCES ON PHOTOVOLTAIC POWER OUTPUT: ANALYSIS OF PERFORMANCE DEVIATIONS AND ENERGY LOSSES**Gökhan YÜKSEK**

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Abstract

Photovoltaic (PV) power output is highly sensitive to changes in atmospheric conditions, and understanding these effects is essential for evaluating real-world system behaviour. In this study, operational measurements from a PV installation are examined together with solar irradiation, ambient temperature, cloud cover, and wind-related variables to reveal how environmental fluctuations shape the system's short-term and aggregate energy performance. Expected power is derived using irradiation-based reference values informed by panel characteristics, enabling a clear distinction between normal production behaviour and periods in which the system departs from its typical operating response. Instances of reduced output are classified as power anomalies, and their contribution to energy yield reduction is quantified by analysing the temporal accumulation of these deviations. The results illustrate the extent to which rapid atmospheric transitions and temperature-driven changes influence PV generation, highlighting the need for continuous environmental monitoring to obtain a more accurate picture of operational efficiency and to better interpret performance deviations in practical PV applications.

Keywords: Photovoltaic performance, Atmospheric effects, Irradiance variability, Power deviation analysis, Energy yield losses, PV anomaly characterization

**YÜKSEK LEVHALAR ARASI AÇIKLIKTA FARKLI EĞİM AÇILI LEVHALARLA
SINIRLANDIRILMIŞ ÇARPAN DÖNMELİ JETLERDE TAŞINIMLA ISI TRANSFERİ
ETKİLERİNİN İNCELENMESİ****Haluk KELEŞ**

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Özet

Bu çalışmada, düz bir yüzeye çarpan ve farklı eğim açlarına sahip levhalar ($\theta = 0^\circ, 15^\circ$ ve 30°) ile sınırlandırılmış türbülanslı dönmeli hava jetlerinde çarpma yüzeyindeki ısı transferi etkileri, yüksek levhalar arası açıklıkta ($H/D = 6$) deneysel olarak kapsamlı bir şekilde incelenmiştir. Deneylerde, Reynolds sayıları $Re = 20.000$ ve 30.000 değerleri ile boyutsuz dönme sayıları $S = 0.125, 0.26$ ve 0.52 aralığında seçilmiş olup, çarpma levhası yüzeylerinde sıcaklık dağılımları yüksek çözünürlüklü termal kamera kullanılarak ölçülmüştür. Elde edilen sıcaklık verileri, çarpma levhasındaki Nusselt sayısı dağılımlarının Reynolds sayısı, sınırlayıcı levha eğim açısı ve boyutsuz dönme sayısı gibi parametrelerden nasıl etkilendiğini detaylı biçimde incelemek için analiz edilmiştir. Tüm akış alanlarında gözlemlendiği üzere, çarpma levhası üzerindeki Nusselt değerleri Reynolds sayısı arttıkça yükselmekte, sınırlayıcı levha eğim açısı arttıkça ise azalmaktadır. Ayrıca, boyutsuz dönme sayısının artmasıyla birlikte çarpma levhasındaki Nusselt dağılımları daha homojen ve üniform bir görünüm kazanmaktadır. Özellikle $\theta = 15^\circ$ ve $S = 0.26$ koşullarında çarpma levhası üzerinde en yakın üniform Nusselt dağılımı elde edilmiştir. Elde edilen deneysel bulgular, farklı sınırlayıcı levha eğimlerinin ve dönme etkisinin, türbülanslı çarpan jetlerde ısı transferi performansını belirgin şekilde değiştirdiğini göstermektedir. Bu sonuçlar, ısı transferi optimizasyonu ve endüstriyel uygulamalarda daha etkin soğutma tasarımları geliştirilmesi açısından değerli ve yol gösterici veriler sunmaktadır.

Anahtar Kelimeler: Çarpan dönmeli jet, Sınırlayıcı levha, Nusselt dağılımı.

**INVESTIGATION OF CONVECTION HEAT TRANSFER EFFECTS IN IMPINGING SWIRL JETS
CONFINED BY PLATES WITH DIFFERENT INCLINATION ANGLES IN HIGH PLATE
SPACING****Abstract**

In this study, the effects of heat transfer on impingement surfaces were experimentally investigated in turbulent swirling air jets impinging on a flat plate confined by plates with different inclination angles ($\theta = 0^\circ, 15^\circ$, and 30°) at a high inter-plate spacing ($H/D = 6$). In the experiments, Reynolds numbers of $Re = 20,000$ and $30,000$ and dimensionless swirl numbers of $S = 0.125, 0.26$, and 0.52 were selected, and the temperature distributions on the impingement surface were measured using a high-resolution infrared thermal camera. The obtained temperature data were analyzed in detail to examine how the Nusselt number distributions over the impingement surface were influenced by Reynolds number, the inclination angle of the confining plates, and the dimensionless swirl number. In all investigated flow fields, it was observed that the Nusselt numbers on the impingement surface increased with increasing Reynolds number, while they decreased as the inclination angle of the confining plates increased. Moreover, as the dimensionless swirl number increased, the Nusselt distributions on the impingement surface became more uniform. The most uniform Nusselt distribution on the impingement surface was obtained at $\theta = 15^\circ$ and $S = 0.26$. The experimental findings demonstrate that variations in the confining plate inclination and the swirl intensity significantly affect the heat transfer performance in turbulent impinging jets. These results provide valuable and practical insights for the

optimization of convective heat transfer and the development of more effective cooling designs in industrial applications.

Keywords: Impinging swirl jet, Confining plate, Nusselt distributions.

**NİKEL ALÜMİNYUM BRONZ MALZEMELERİN HİDROLİK AKIM MAKİNALARINDA VE SİHHİ TESİSAT UYGULAMALARINDA KULLANIMI: HİZMET ÖMRÜNE KATKISI ÜZERİNE BİR İNCELEME****Haluk KELEŞ**

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Özet

Nikel Alüminyum Bronz (NAB) alaşımları, yüksek korozyon direnci, üstün mekanik dayanımı, mükemmel aşınma özellikleri, iyi döküm kabiliyeti ve deniz suyuna karşı olağanüstü dayanıklılığı sayesinde denizcilik, enerji sistemleri, kimya endüstrisi ve sıhhi tesisat uygulamaları için en uygun metalik malzeme gruplarından biri olarak kabul edilmektedir. Bu çalışmada, NAB alaşımlarının pompa gövdeleri, pervaneler, vana bileşenleri ve diğer hidrolik akım elemanlarında kullanımına yönelik malzeme davranışları detaylı olarak incelenmiştir. Özellikle tatlı su, deniz suyu ve klorlanmış su gibi farklı kimyasal ortamlarda meydana gelen korozyon mekanizmaları deneysel verilerle desteklenerek analiz edilmiştir. Ayrıca galvanik çiftler içerisindeki potansiyel farkların yanı sıra sıcaklığın ve akış hızının NAB malzemelerinin korozyon hızına etkisi değerlendirilmiştir. Yapılan incelemeler, NAB alaşımlarının galvanik korozyona karşı yüksek direnç gösterdiğini; aynı zamanda kavitezyon, erozyon ve kimyasal aşınma türlerine karşı da klasik bronz ve pirinç alaşımlarına göre çok daha uzun hizmet ömrü sunduğunu ortaya koymuştur. Çalışmada ayrıca malzemenin mikro yapı özelliklerinin, faz dağılımının, tane boyutunun ve uygulanan ısıtma işlem koşullarının servis ömrü üzerindeki etkileri ayrıntılı olarak değerlendirilmiştir. Sonuç olarak, NAB alaşımlarının hidrolik akım makinalarında kullanımının; bakım aralıklarının uzaması, enerji verimliliğinin artması, arıza oranlarının azalması ve işletme maliyetlerinin düşürülmesi gibi önemli avantajlar sağladığı görülmüştür. Bu üstün özellikler, NAB malzemelerini modern su teknolojilerinde sürdürülebilir, çevre dostu ve güvenilir bir çözüm haline getirmektedir.

Anahtar Kelimeler: Hidrolik akım makinaları, Sıhhi tesisat, Hizmet ömrü, Nikel alüminyum bronz.

AN INVESTIGATION ON THE USE OF NICKEL ALUMINUM BRONZE MATERIALS IN HYDRAULIC FLOW MACHINES AND SANITARY APPLICATIONS: THEIR CONTRIBUTION TO SERVICE LIFE**Abstract**

Nickel Aluminum Bronze (NAB) alloys are recognized as one of the most suitable groups of metallic materials for marine engineering, energy systems, chemical industry, and sanitary applications due to their high corrosion resistance, superior mechanical strength, excellent wear properties, good castability, and outstanding durability against seawater. In this study, the material behavior of NAB alloys used in pump casings, propellers, valve components, and other hydraulic flow elements has been examined in detail. In particular, corrosion mechanisms occurring in various chemical environments such as freshwater, seawater, and chlorinated water have been analyzed and supported by experimental data. In addition, the effects of potential differences within galvanic couples, as well as temperature and flow velocity, on the corrosion rate of NAB materials have been evaluated. The investigations revealed that NAB alloys exhibit high resistance to galvanic corrosion and provide a significantly longer service life against cavitation, erosion, and chemical wear compared to conventional bronze and brass alloys. The study also comprehensively assessed the effects of microstructural characteristics, phase distribution, grain size, and applied heat treatment conditions on the service life of the material. As a result, the use of NAB alloys in hydraulic flow machines was found to provide important advantages such as extended maintenance intervals, increased energy efficiency, reduced failure rates, and lower operating costs. These superior properties make NAB materials a sustainable, environmentally friendly, and reliable solution for modern water technologies.

Keywords: Hydraulic flow machines, Plumbing systems, Service life, Nickel aluminium bronze.

ENERGY AND ENTROPY ANALYSIS FOR MATERIAL DEFORMATION PROCESSES

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Abstract

Understanding how materials interact with external effects such as force, temperature and time is essential for achieving efficient, reliable and energy-aware engineering design. The response of materials to deformation involves fundamental energy processes, including mechanical energy storage, dissipation and irreversible energy conversion. Accurate modeling of elastic, viscous, plastic and anelastic deformation mechanisms enables the prediction of energy loss, deformation limits and overall structural performance. In this study, the thermomechanical and energy-related behavior of materials is examined using rheological systems composed of idealized mechanical elements: the elastic spring, viscous dashpot and friction element. These elements represent recoverable energy storage, rate-dependent energy dissipation and irreversible energy loss mechanisms within the material. The deformation response of the system is investigated under steady, unsteady and load-reversal conditions, emphasizing how mechanical energy is partitioned into stored, recoverable and dissipated components.

Elastic deformation allows full recovery of stored mechanical energy, whereas viscous and frictional mechanisms convert a portion of the external work into irreversible energy losses. Only the reversible part of the mechanical energy contributes to the thermodynamic state, while the irreversible part appears as dissipated energy. Using the mechanical energy balance combined with the Clausius–Duhem inequality, expressions for entropy generation are derived in direct relation to these energy-conversion processes. During mechanical hysteresis cycles, non-coinciding loading and unloading curves quantify the irreversible energy loss, which transforms into heat and increases the entropy of the surroundings. The results demonstrate that rheological systems provide a robust framework for analyzing energy conversion mechanisms, irreversible deformation behavior and entropy generation in thermomechanical materials, making the approach relevant for energy-focused engineering applications.

Keywords: Energy Dissipation, Thermomechanical Behavior, Material Deformation, Entropy Generation, Energy Conversion.

ENTROPY GENERATION ANALYSIS OF VARIOUS METAL FOAM MATERIALS: A NUMERICAL ANALYSIS ON MATERIAL TYPE ORDER, POROSITY, AND PORE DENSITY**Emrehan GÜRSOY**

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Abstract

In this study, the effects of the proximity to the heat source, porosity of $\varepsilon = 0.90$ and 0.95 , and pore densities of $\omega = 10$ and 20 PPI of two different metal foam (MF) materials (copper and aluminium) with identical width and length conditions of the phase change material (PCM) in a vertical rectangular cavity latent heat thermal energy storage system (LHTES) were investigated. The analyses were carried out by using the Finite Volume Method, and the enthalpy-porosity method was used during the melting of PCM. The flow characteristics within the MF were solved using Brinkman-Forchheimer extended Darcy model. The local thermal equilibrium model was applied in the analyses. The results show that the thermal ($\dot{S}_{gen,thermal}$) and frictional ($\dot{S}_{gen,frictional}$) entropy generation analyses for Cu MF, whose variable is only close to the heat source, are 5.6% and 14.6% lower compared to the Al MF. The MF porosity configuration of $\varepsilon = 0.90 \rightarrow 0.95$, located closer to the heat source, exhibited 14.1% and 72.9% lower $\dot{S}_{gen,thermal}$ and $\dot{S}_{gen,frictional}$, respectively, compared to $\varepsilon = 0.95 \rightarrow 0.90$. Furthermore, it was determined that variations in pore density in the LHTES did not have a significant effect on $\dot{S}_{gen,thermal}$, while increasing pore density also had a decreasing effect on $\dot{S}_{gen,frictional}$. Using 20 PPI MF instead of 10 PPI reduced $\dot{S}_{gen,frictional}$ by up to half. Finally, the common result obtained in all the variables examined is that $\dot{S}_{gen,thermal}$ is more dominant than $\dot{S}_{gen,frictional}$, and the $\dot{S}_{gen,total}$ exhibits almost the same trend as thermal.

Keywords: Energy storage; Entropy generation; Metal foam; Phase change material; Pore density effect; Porosity effect.

ENERGY AND EXERGY ANALYSIS FOR TURBOJET ENGINE PERFORMANCE**Fatma Nur HERGÜL**

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Abstract

Turbojet engines in modern aviation industry require more detailed thermodynamic analyses due to the increasing demands for higher speed, longer range, lower fuel consumption, and greater efficiency. Turbojet engines are complex thermodynamic systems in which compression, combustion, and expansion in the turbine processes occur sequentially, with energy transformations taking place at each stage. While conventional energy analysis provides information about the overall efficiency of the engine, exergy analysis plays a crucial role in identifying the sources of losses and irreversibilities within the system.

In this study, pressure, temperature, and isentropic efficiency data of a GE J85-13 turbojet engine were obtained using the GasTurb program. These data were then incorporated into Brayton cycle-based energy and exergy equations and analyzed using the EES (Engineering Equation Solver). The results indicate that the lowest exergy efficiency occurs in the combustion chamber, with a value of 60.15%.

Parametric analyses conducted in EES show that increasing the compressor pressure ratio (PR) from 5 to 10 raises the compressor outlet enthalpy, thereby reducing combustion chamber irreversibilities. As a result, the overall exergy efficiency increases from 58.86% to 61.58%, while the TSFC (thrust specific fuel consumption) decreases from 28.88 g/kN·s to 23.61 g/kN·s, improving engine economy. Conversely, increasing the altitude from 0 to 10,000 m significantly reduces the engine mass flow rate and thrust (from 14.45 kN to 5.43 kN) due to lower atmospheric density, leading to a slight increase in TSFC from 26.11 g/kN·s to 27.03 g/kN·s. However, the reduction in ambient temperature at higher altitudes enhances the overall exergy efficiency of the system.

The results of the energy and exergy analyses demonstrate that compressor pressure ratio, altitude, ambient conditions, and combustion chamber design are the dominant parameters affecting turbojet engine performance. Consequently, the findings of this study contribute to improving turbojet engine performance and provide valuable insights for future design and optimization studies.

Keywords: Turbojet Engine, Energy Analysis, Exergy Analysis, Thermodynamic Performance

BIOMETHANE AS AN ALTERNATIVE MARINE FUEL: POTENTIAL, BENEFIT, AND BARRIERS**Mehmet DOYMUŞ**

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Abstract

The Maritime Industry is struggling to find the optimum solution to reach out to IMO's 2050 targets. Biomethane derived from upgraded biogas is emerging as a viable alternative marine fuel. In line with the reduction of greenhouse gas (GHG) emissions and global regulatory targets, the use of this fuel in both new and existing vessels is being investigated. A systematic literature review was conducted in the Web of Science database to analyze biomethane as an alternative marine fuel. The literature is evaluated under three contexts: effectiveness and environmental impact, technical and economic challenges, including storage and infrastructure, and application pathways, including liquefied biomethane and compressed biomethane. The results show that biomethane offers significant environmental advantages as a marine fuel for shipping by reducing greenhouse gas emissions up to 59% compared to marine diesel fuel. However, high costs, infrastructure requirements, and supply chain limitations constrain the extensive adoption of biomethane. This situation requires the implementation of new incentives, policy updates, and technological developments to fully utilize biomethane's potential in decarbonizing maritime transport.

Keywords: Biomethane, Maritime Transport, Decarbonization

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Özet

Dünyada artan enerji talebi ve fosil yakıt kullanımının çevresel etkileri, yenilenebilir enerji kaynaklarının önemini her geçen gün daha da artırmaktadır. Bu bağlamda deniz ve okyanuslardan elde edilen dalga enerjisi, sürdürülebilir enerji üretiminde öne çıkan alternatiflerden biri olarak değerlendirilmektedir. Dalgaların taşıdığı mekanik enerjinin elektrik enerjisine dönüştürülmesine dayanan bu teknoloji, yüksek enerji yoğunluğu ve öngörülebilir üretim karakteri sayesinde literatürde giderek daha fazla incelenmektedir. Özellikle geniş kıyı şeritlerine sahip ülkelerde, dalga enerjisi potansiyeli hem teknik hem de ekonomik açıdan önemli bir fırsat yaratmaktadır. Dalga enerjisinin diğer yenilenebilir kaynaklara göre en belirgin avantajı, yıl boyunca daha kararlı ve süreklilik gösteren bir üretim profiline sahip olmasıdır. Rüzgâr ve güneşten farklı olarak dalga hareketi, atmosferik değişimlerden daha az etkilenmekte ve bu durum enerji üretimindeki dalgalanmaların (intermittency) azaltılmasına katkı sağlamaktadır. Ayrıca dalga enerji sistemlerinin kıyıya yakın bölgelerde konumlandırılabilmesi, enerji iletim kayıplarını ve altyapı maliyetlerini sınırlamaktadır. Bununla birlikte, zorlu deniz koşullarına dayanabilecek teknolojilerin geliştirilmesi, bakım maliyetlerinin azaltılması ve çevresel etkilerin doğru şekilde analiz edilmesi, dalga enerjisinin yaygınlaşması için çözülmesi gereken temel konular arasında yer almaktadır. Bu çalışma, dalga enerjisinin teknik prensiplerini, mevcut dönüştürücü teknolojilerini, potansiyel uygulama alanlarını ve karşılaşılan mühendislik sorunlarını kapsamlı bir şekilde incelemeyi amaçlamaktadır. Ayrıca dalga enerjisinin enerji sistemlerine entegrasyonunun gerektirdiği tasarım, verimlilik ve ekonomik analizler değerlendirilerek, bu kaynağın sürdürülebilir enerji portföyündeki yeri bilimsel bir çerçevede ele alınacaktır.

Anahtar kelime: Dalga, enerji, dünya

WAVE ENERGY**Abstract**

The increasing global demand for energy and the environmental impacts of fossil fuel consumption have heightened the importance of renewable energy sources. In this context, wave energy derived from seas and oceans is considered one of the most promising alternatives for sustainable power generation. This technology, which is based on converting the mechanical energy of waves into electrical energy, has attracted growing attention in the literature due to its high energy density and predictable production characteristics. Especially in countries with extensive coastlines, the potential of wave energy presents significant technical and economic opportunities. A major advantage of wave energy compared to other renewable sources is its relatively stable and continuous generation profile throughout the year. Unlike wind and solar energy, wave motion is less affected by atmospheric fluctuations, contributing to reduced intermittency in energy production. Additionally, the ability to install wave energy systems near coastal areas helps minimize transmission losses and infrastructure costs. However, the development of technologies capable of withstanding harsh marine conditions, reducing maintenance expenses, and accurately assessing environmental impacts remains a critical challenge for the widespread adoption of wave energy. This study aims to provide a comprehensive examination of the technical principles of wave energy, current converter technologies, potential application areas, and the engineering challenges encountered in practice. Furthermore, the integration of wave energy

into existing power systems is evaluated through design, efficiency, and economic analyses, offering a scientific perspective on the role of this resource within a sustainable energy portfolio.

Keyword: Wave, energy, world

**KARBON AZALTIM POLİTİKALARININ MAKROEKONOMİK ETKİLERİ: İSVEÇ ÜZERİNE BİR İNCELEME****Reyhan Özeş Özgür**

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Özet

Bu çalışmanın temel amacı, İsveç'in 2040 yılı sera gazı emisyon azaltım hedefi çerçevesinde gerçekleştirilecek enerji dönüşümünün ekonomik, çevresel ve dış ticaret etkilerini incelemektir. İsveç, güçlü iklim politikaları ve yenilenebilir enerji altyapısı ile Avrupa'da düşük karbonlu dönüşüm konusunda öncü ülkeler arasında yer almaktadır. Ülke, hidroelektrik, rüzgar ve biyokütle enerjisi gibi temiz enerji kaynaklarını yoğun şekilde kullanmakta ve enerji ikamesinde yenilenebilir enerji kaynaklarına öncelik vermektedir. İsveç'in yüksek hedefleri ve güçlü politik altyapısı, Türkiye gibi gelişmekte olan ülkeler veya Avrupa'nın genel ortalamasıyla karşılaştırma yapmak için bir ideal senaryo örneği sunmaktadır.

Bu araştırmada, İsveç'te sera gazı emisyonlarının 1990 yılı seviyelerine göre %75 oranında azaltılması öngörülerek, bu azaltımın hem sektörel hem de genel ekonomi üzerindeki etkileri ortaya konulmaktadır. Araştırmanın temel metodolojisinde 2018 yılı girdi-çıktı tablosu kullanılmakta girdi-çıktı modeli ile değerlendirilmektedir.

Analiz, İsveç'in resmi emisyon hedefleri ve güçlü yenilenebilir enerji altyapısı dikkate alınarak, enerji dönüşümünün maliyetleri ve karbon azaltım potansiyelini ortaya koymaktadır. Sonuçlar, diğer ülkeler için de düşük karbonlu enerji politikalarının tasarlanmasında yol gösterici nitelikte olmakla birlikte enerji ikamesi stratejilerinin ekonomik ve çevresel etkilerini öngörmek açısından önemli çıkarımlar sunmaktadır.

Elde edilen bulgular, yenilenebilir enerji kaynakları ikamesinin, bazı sektörlerde yarattığı ekonomik daralmaya rağmen, ekonomi genelinde sınırlı da olsa bir pozitif büyüme etkisi yarattığını göstermektedir. Sera gazı emisyonu açısından ise, yine bazı sektörlerde bir emisyon azalışı gözlenmekle birlikte, ekonomi geneli sınırlı bir emisyon artışı ortaya çıkmaktadır.

Anahtar kelimeler: enerji dönüşümü, 2040 emisyon hedefi, karbon nötr ekonomi, yenilenebilir enerji

**Bu çalışma TÜBİTAK tarafından desteklenen 223K299 numaralı proje kapsamında gerçekleştirilmiştir.*

THE MACROECONOMIC EFFECTS OF CARBON REDUCTION POLICIES: A STUDY ON SWEDEN**Abstract**

The primary objective of this study is to examine the economic, environmental and foreign trade impacts of the energy transition to be implemented within the framework of Sweden's 2040 greenhouse gas emission reduction target. Sweden is among the leading countries in Europe in terms of low-carbon transition, with its strong climate policies and renewable energy infrastructure. The country makes intensive use of clean energy sources such as hydroelectric, wind and biomass energy and prioritises renewable energy sources in energy substitution. Sweden's ambitious targets and strong policy infrastructure provide an ideal scenario for comparison with developing countries such as Turkey or the European average.

This study projects a 75% reduction in greenhouse gas emissions in Sweden compared to 1990 levels and reveals the effects of this reduction on both the sectoral and overall economy. The study's basic methodology uses the 2018 input-output table and is evaluated using the input-output model.

The analysis highlights the costs of energy transition and the potential for carbon reduction, taking into account Sweden's official emission targets and robust renewable energy infrastructure. The findings are instructive for

other countries in designing low-carbon energy policies, while also offering important insights into the economic and environmental impacts of energy substitution strategies.

The findings show that the substitution of renewable energy sources creates a limited positive growth effect on the economy as a whole, despite the economic contraction it causes in some sectors. In terms of greenhouse gas emissions, while a decrease in emissions is observed in some sectors, there is a limited increase in emissions across the economy as a whole.

Keywords: energy transition, 2040 emissions target, carbon-neutral economy, renewable energy

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**MİLLETLERARASI YATIRIM HUKUKUNDA ENERJİ YATIRIMLARININ KORUNMASI****Aynaz UĞUR**

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Özet

Milletlerarası yatırım hukukunda yatırımcının korunması büyük önem arz eder. Yatırım anlaşmaları iki ya da çok taraflı olarak devletlerarasında imzalanmaktayken, yatırım sözleşmeleri yatırımcı ile devlet ya da devlet kuruluşları arasında imzalanmaktadır. Uyuşmazlık halinde tarafların taleplerinin hangi sözleşme kapsamında olduğunun tespiti milletlerarası yatırım hukuku bakımından önem taşır. Yatırımcı ve ev sahibi devlet arasında müzakerelerle somut yatırıma göre şekillendirilen sözleşmeler, yatırım anlaşmalarıyla temin edilemeyen hukuki güvenliği ve istikrarı sağlamaktadır.

Enerji yatırımlarını yatırım anlaşmaları ve enerji yatırım sözleşmeleriyle korumanın farklı mekanizmaları geliştirilmiştir: Bunlar şemsiye klorlar, istikrar klorları, yeniden müzakere kaydı, hukuk seçimi şartı olarak karşımıza çıkabilmektedir. Bunun yanı sıra hükümetler arası anlaşmalar ile ev sahibi hükümet anlaşmalarının da bu anlamdaki işlevleri unutulmamalıdır. Yine yatırım anlaşmalarının maddi hükümlerinde en önemlisi olarak yer alan adil ve eşit davranma yükümlülüğünün yanı sıra bulunan ayırım yapmama, kamulaştırma yasağı vb. yükümlülükler de aynı amaca hizmet etmektedir.

Enerji yatırım sözleşmelerinde ilk kayıtlar, petrol arama ve üretimine dayalı imtiyaz sözleşmelerinde yer bulmuştur. Bu hususta “Enerji Şartı Konferansı” ve “Enerji Şartı Anlaşmasının (EŞA)” yapılması da süreci hızlandıran girişimler olarak tespit edilmektedir. Yine “Washington Sözleşmesi” ile “Dünya Bankası (DB)” bünyesinde kurulan “ICSID (International Center for Settlement of Investment Disputes)” ve bu kurumun yayımladığı “Uluslararası Yatırım Uyuşmazlıklarının çözümüne ilişkin ICSID Konvansiyonu” da, ev sahibi devlet ile yabancı yatırımcı arasında çıkması muhtemel uyuşmazlıklar bakımından uluslararası yatırım tahkimi imkanının önünü açarak, yabancı yatırımcıyı milli devlet mahkemelerinde yargılanma baskısından ve dava açma mecburiyetinden kurtarmıştır.

Yatırım sözleşmeleri yapıldıktan sonra, yatırımcı için en önemli risk, ev sahibi ülkede ortaya çıkabilecek hukuki ve ekonomik değişikliklerdir. Bu nedenle yatırımcıyı sonradan ortaya çıkan değişikliklerden muaf tutmayı sağlayan istikrar klorları gibi düzenlemeler özellikle önem taşımaktadır. Bu bağlamda çalışmamız bu kurumların enerji yatırımlarının özgün yapısına uyarlanması üzerinde yoğunlaşacaktır.

Anahtar Kelimeler: Enerji, Yatırım, Tahkim, Sözleşme, Hukuk Seçimi.

THE PROTECTION OF ENERGY INVESTMENTS IN INTERNATIONAL INVESTMENT LAW**Abstract**

The protection of foreign investor in international investment law takes a great importance. While investment agreements are signed between states bilaterally or multilaterally, investment contracts are signed between the investor and the state or state institutions. In the event of a dispute, determining which agreement governs the parties' claims is important in terms of international investment law. Contracts provide legal security and stability that cannot be guaranteed by investment agreements.

The protection mechanisms have been developed like this: These may include umbrella clauses, stability clauses, renegotiation clauses, and choice of law clauses. In addition, the role of intergovernmental agreements and host government agreements in this regard should not be overlooked. Furthermore, alongside the most important obligation to treat fairly and equally and obligations such as non-discrimination and prohibition of expropriation also serve the same purpose.

The first registrations in energy investment contracts were found in concession contracts based on oil exploration and production. In this regard, the Energy Charter Conference and the conclusion of the Energy Charter Treaty are also identified as initiatives that accelerated the process. Similarly, the Washington Convention and the ICSID Convention on the Settlement of International Investment Disputes, published by the ICSID established within the World Bank, have opened the way for international arbitration in the event of potential disputes between the host state and foreign investors, freeing foreign investors from the pressure of being tried in national courts and the obligation to file lawsuits.

The most significant risk for investors is the possibility of legal and economic changes occurring in the host country. Therefore, clauses like stability clauses provides a significant importance. In this context, our study will focus on adapting these institutions to the unique structure of energy investments.

Keywords: Energy, Investment, Arbitration, Contract, Choice of Law.

**ENERJİ TÜKETİMİ, YENİLENEBİLİR ENERJİ VE EKONOMİK BÜYÜME: BRICS ÜLKELERİ ÖRNEĞİ****Perihan Hazel KAYA**

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Özet

Günümüzde enerji, ekonomik büyümenin temel dinamiklerinden biri olarak kabul edilmektedir. Özellikle çevresel kaygıların artmasıyla birlikte, yenilenebilir enerji kaynaklarına yönelim giderek önem kazanmıştır. Bu çalışmada, enerji tüketimi, yenilenebilir enerji kullanımı ve ekonomik büyüme arasındaki ilişki, BRICS ülkeleri (Brezilya, Rusya, Hindistan, Çin ve Güney Afrika Cumhuriyeti) örneğinde ele alınmıştır. 2000-2023 yıllarını kapsayan panel veri seti kullanılarak yapılan analizde, kişi başına düşen Gayri Safi Yurtiçi Hasıla (GSYH), toplam enerji tüketimi ve yenilenebilir enerji üretimi gibi değişkenler dikkate alınmıştır. Uygulanan panel birim kök testleri, eşbütünleşme analizleri ve Granger nedensellik testleri sonucunda, enerji tüketimi ile ekonomik büyüme arasında pozitif ve anlamlı bir ilişki olduğu ortaya konmuştur. Yenilenebilir enerji kullanımı ile ekonomik büyüme arasındaki ilişki ise daha sınırlı olmakla birlikte pozitif yöndedir. Ayrıca, enerji tüketiminin ekonomik büyümeyi tek yönlü olarak etkilediği, yenilenebilir enerji kullanımı ile ekonomik büyüme arasında ise çift yönlü bir nedensellik ilişkisi bulunduğu belirlenmiştir.

Bu bulgular, BRICS ülkelerinde sürdürülebilir büyüme hedeflerine ulaşmak için enerji verimliliğinin artırılması ve yenilenebilir enerji yatırımlarının teşvik edilmesi gerektiğine işaret etmektedir. Politika yapıcılar açısından, enerji kaynaklarının çeşitlendirilmesi ve çevre dostu stratejilerin benimsenmesi hem ekonomik büyümenin sürekliliği hem de çevresel sürdürülebilirlik açısından önem arz etmektedir.

Anahtar Kelimeler: Enerji Tüketimi, Yenilenebilir Enerji, Ekonomik Büyüme, Panel Veri Analizi, BRICS Ülkeleri

ENERGY CONSUMPTION, RENEWABLE ENERGY AND ECONOMIC GROWTH: THE BRICS COUNTRY EXAMPLE**Abstract**

Today, energy is considered one of the fundamental dynamics of economic growth. Especially with the increase in environmental concerns, the orientation towards renewable energy sources has become increasingly important. This paper examines the relationship between energy consumption, renewable energy use, and economic growth, using the example of the BRICS countries (Brazil, Russia, India, China, and South Africa). In the analysis conducted using the panel data set covering the years 2000-2023, variables such as Gross Domestic Product (GDP) per capita, total energy consumption and renewable energy production were taken into account. As a result of the applied panel unit root tests, cointegration analyses and Granger causality tests, it was revealed that there is a positive and significant relationship between energy consumption and economic

growth. The relationship between renewable energy use and economic growth is more limited but positive. In addition, it was determined that energy consumption affects economic growth unidirectionally, while there is a bidirectional causality relationship between renewable energy use and economic growth.

These findings indicate that energy efficiency should be increased and renewable energy investments should be encouraged in order to achieve sustainable growth targets in BRICS countries. For policy makers, diversifying energy sources and adopting environmentally friendly strategies are important for both the continuity of economic growth and environmental sustainability.

Keywords: Energy Consumption, Renewable Energy, Economic Growth, Panel Data Analysis, BRICS Countries

**TÜRKİYE'DE YEŞİL BÜYÜME VE SÜRDÜRÜLEBİLİR KALKINMA İLİŞKİSİ****Erdal ARSLAN**

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Özet

Bu çalışma, Türkiye'de yeşil büyüme ve sürdürülebilir kalkınma kavramları arasındaki ilişkiyi incelemeyi amaçlamaktadır. Araştırmada nitel araştırma yöntemi benimsenmiş olup sistematik literatür taraması ve doküman analizi teknikleri kullanılmıştır. Çalışmada öncelikle sürdürülebilir kalkınma ve yeşil büyüme kavramlarının teorik çerçevesi ortaya konulmuş, ardından bu iki kavram arasındaki ilişki kapsamlı bir şekilde analiz edilmiştir. Sürdürülebilir kalkınma, 1987 yılında Birleşmiş Milletler Dünya Çevre ve Kalkınma Komisyonu tarafından yayımlanan Brundtland Raporu ile gündeme gelen ve ekonomik büyüme, çevresel koruma ve sosyal kalkınma arasında denge kurmayı hedefleyen bütüncül bir yaklaşım olarak tanımlanmaktadır. Yeşil büyüme ise Ekonomik Kalkınma ve İşbirliği Örgütü tarafından geliştirilen ve ekonomik büyümenin çevresel sürdürülebilirlik ile uyumlu hale getirilmesini öngören bir strateji olarak öne çıkmaktadır. Araştırma bulgularına göre, Türkiye'nin yeşil büyüme politikaları uluslararası gelişmelerden önemli ölçüde etkilenmektedir. Avrupa Birliği'nin Sınırdaki Karbon Düzenleme Mekanizması ve Paris İklim Anlaşması bu süreçte belirleyici rol oynamaktadır. Türkiye, 2053 yılı için net sıfır emisyon hedefi belirlemiş olup yenilenebilir enerji alanında kayda değer bir potansiyele sahip bulunmaktadır. Ülkenin elektrik kurulu gücünün yarısından fazlası hidroelektrik, rüzgar, güneş, jeotermal ve biyokütle gibi yenilenebilir enerji kaynaklarından oluşmaktadır. Ülkede yeşil ekonomi ve istihdam ilişkisi de akademik çalışmalarda ele alınan önemli konular arasında yer almaktadır. Sonuç olarak, yeşil büyüme ve sürdürülebilir kalkınma kavramları birbirini tamamlayan yaklaşımlar olarak değerlendirilmektedir. Türkiye'nin bu alandaki politikalarının geliştirilmesi ve güçlendirilmesi, hem ulusal kalkınma hedeflerinin gerçekleştirilmesi hem de uluslararası taahhütlerin yerine getirilmesi açısından büyük önem taşımaktadır.

Keywords: Yeşil Büyüme, Sürdürülebilir Kalkınma, Yenilenebilir Enerji, İklim Politikası, Paris İklim Anlaşması

**THE RELATIONSHIP BETWEEN GREEN GROWTH AND SUSTAINABLE DEVELOPMENT IN
TÜRKİYE****Abstract**

This study aims to examine the relationship between the concepts of green growth and sustainable development in Türkiye. A qualitative research methodology was adopted, utilizing systematic literature review and document analysis techniques. The study first establishes the theoretical framework of sustainable development and green growth concepts, then comprehensively analyzes the relationship between these two concepts. Sustainable development, which emerged with the Brundtland Report published by the United Nations World Commission on Environment and Development in 1987, is defined as a holistic approach aiming to establish a balance between economic growth, environmental protection, and social development. Green growth, developed by the Organisation for Economic Co-operation and Development, emerges as a strategy that envisages aligning economic growth with environmental sustainability. According to the research findings, Türkiye's green growth policies are significantly influenced by international developments. The European Union's Carbon Border Adjustment Mechanism and the Paris Climate Agreement play a determining role in this process. Türkiye has set a net-zero emission target for 2053 and possesses considerable potential

in the field of renewable energy. More than half of the country's installed electricity capacity consists of renewable energy sources such as hydroelectric, wind, solar, geothermal, and biomass. The relationship between green economy and employment in the country is also among the important topics addressed in academic studies. In conclusion, green growth and sustainable development concepts are considered as complementary approaches. The development and strengthening of Türkiye's policies in this field is of great importance both for achieving national development goals and fulfilling international commitments.

Keywords: Green Growth, Sustainable Development, Renewable Energy, Climate Policy, Paris Climate Agreement

PARADIGM SHIFT IN EUROPEAN ENERGY SECURITY: REPowerEU AND PHASING OUT RUSSIAN FOSSIL FUEL IMPORTS**İshak TURAN**

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Abstract

In line with climate change, the EU, which implemented its first energy action plan in 2007, took radical decisions in 2022 following Russia's invasion of Ukraine, despite having made significant progress in renewable energy and energy efficiency. In this regard, with the REPowerEU Plan adopted in May 2022, the EU aims to gradually reduce its energy dependence on Russia to zero. This paper aims to reveal the extent to which the REPowerEU plan has been effectively implemented in its first three years and how it led to a change in the European energy security approach. Although the EU has managed to officially reduce Russian oil imports to 3% by 2025 since the start of the war, it is understandable that this percentage is not actually known for certain due to shadow fleets. The EU's dependence on Russian imports and the subsequent increase in energy costs due to the sanctions imposed on Russia after the war, which are detrimental to sustainable economic development, have accelerated investments in energy efficiency, renewable energy and LNG terminal construction, all which require substantial budgets. The paper reveals that, compared to the pre-war period, the EU has limited Russian gas imports between 2021 and 2025 solely to the pipeline coming through Turkey. To replace Russian gas, it doubled its gas imports within 3 years from other countries, primarily the US and Norway thanks to the rapid implementation of FSRUs and LNG terminals in that time. In pipeline gas imports, there has also been an increase in Turkish, Azerbaijani or Russian gas passing through Turkey. It is also evident that, within the framework of REPowerEU's clean energy plan, the EU has accelerated its renewable energy investments, which had declined in 2021, increasing them from 21% to 24%. It has also been concluded that the transition to clean energy production initiated by the REPowerEU plan is gradually increasing the EU's dependence on rare elements and necessitates that this plan be implemented in parallel with RESourceEU to be sustainable.

Keywords: REPowerEU, Energy Security, RESourceEU, Net-zero Emission, Ukraine-Russia War, Renewable Sources

**ARE THE RENEWABLE ENERGY RESOURCES SOLUTIONS FOR CURRENT ACCOUNT DEFICIT? AN EVIDENCE FROM SELECTED E7 COUNTRIES****Aykut DERE**

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Abstract

The current account is one of the most important components of the balance of payments. The current account consists of the total external economic relations of a country, covering trade in goods and services, as well as income items derived from primary and secondary investments. Following the financial liberalization seen in the 1980s in developing countries and after the 2008 global crisis in developed countries, the current account deficit has come to the fore as a factor of fragility. Studies investigating factors aimed at reducing the current account deficit have been conducted in macroeconomic literature. Energy imports are among the main causes of the current account deficit as they disrupt countries' foreign trade balance. Therefore, increasing renewable energy investments to reduce energy imports is of great importance. In this study, current account data for the period 1992-2023 was used as the dependent variable, while data on electricity generated from renewable energy was used as the independent variable. The E7 countries, referred to as the 7 emerging economies, were considered as sample countries. These countries are India, China, Indonesia, Brazil, Russia, Mexico, and Turkey. Russia was not included in the analysis because it is a net energy exporter. Most studies in the literature suggest that as renewable energy consumption increases, energy imports decrease, thereby eliminating the current account deficit. However, an examination of the latest data for the countries included in the study reveals the opposite of what is suggested in the literature. In this regard, comprehensive econometric analyses are required. The ARDL (Autoregressive Distributed Lag) bounds test approach was applied in the study to determine the existence of a long-term cointegration relationship between the series. The results of the analysis revealed a long-term cointegration relationship for Mexico, Brazil, and Turkey, while no long-term cointegration relationship was found for Indonesia, China, and India.

Keywords: Current Account Deficit, Renewable Energy, Development Economics, Energy Economics

YENİLENEBİLİR ENERJİ KAYNAKLARI, CARİ AÇIK İÇİN ÇÖZÜM OLABİLİR Mİ? SEÇİLMİŞ E7 ÜLKELERİNDEN KANITLAR**Özet**

Cari işlemler hesabı, ödemeler dengesinin en önemli kalemlerinden biridir. Cari işlemler hesabı, bir ülkenin mal ve hizmet ticareti, birincil ve ikincil yatırım kaynaklı gelir kalemlerini kapsayan dış ekonomik ilişkilerinin toplamından meydana gelmektedir. 1980'lerde görülen finansal liberalleşmenin ardından gelişmekte olan ülkelerde, 2008 küresel krizinin ardından ise gelişmiş ülkelerde, cari açık, kırılganlık faktörü olarak ön planda yer almıştır. Makro iktisat literatüründe cari açığı azaltmaya yönelik faktörlerin araştırıldığı çalışmalar yer almıştır. Enerji ithalatı, ülkelerin dış ticaret dengesini bozduğu için cari açığın temel nedenlerinin başında gelmektedir. Bu nedenle yenilenebilir enerji yatırımlarının artırılarak enerji ithalatının azaltılması büyük önem taşımaktadır. Çalışmada, 1992-2023 yıllarını kapsayan dönemin cari işlemler hesabı verileri bağımlı değişken olarak, yenilenebilir enerjiden üretilen elektrik verileri ise bağımsız değişken olarak kullanılmıştır. Bu çalışmanın örneklemini, E7 ülkeleri olarak adlandırılan gelişmekte olan; Çin, Endonezya, Hindistan, Rusya, Brezilya, Meksika ve Türkiye oluşturmaktadır. Rusya net enerji ihracatçısı olduğu için analize dahil edilmemiştir. Literatürde yer alan çalışmaların çoğunda elde edilen sonuç yenilenebilir enerji tüketimi arttıkça

enerji ithalatının azalacağı, böylece cari açığın olmayacağı yönündedir. Fakat çalışmanın yapıldığı ülkelerin mevcut verileri incelendiğinde çalışmanın yapıldığı ülkelerde literatürün aksi durum gözlenmektedir. Bu doğrultuda kapsamlı ekonometrik analizler yapılması gerekmektedir. Çalışmada seriler arasındaki uzun dönemli eşbütünleşme ilişkisinin varlığını tespit etmek amacıyla ARDL sınır testi yaklaşımı uygulanmıştır. Yapılan analizler sonucunda Brezilya, Meksika ve Türkiye için uzun dönemli eşbütünleşme ilişkisi tespit edilirken Çin, Endonezya ve Hindistan için uzun dönemli eşbütünleşme ilişkisi tespit edilememiştir.

Anahtar Sözcükler: Cari Bütçe Açığı, Yenilenebilir Enerji, Gelişme Ekonomisi, Enerji Ekonomisi

LİMAN VE TERMİNAL İŞLETMELERİNDE ÇEVRESEL SÜRDÜRÜLEBİLİRLİĞİN FİNANSAL RİSKLERİ: ENERJİ FİYAT VOLATİLİTESİNİN GARCH MODELİ İLE ANALİZİ ¹**Mehmet Serdar ÇELİK**Dr.Öğr. Üyesi, Bandırma Onyediy Eylül Üniversitesi, Denizcilik Fakültesi, orcid.org/0000-0001-5971-9405**Gökçe TUĞDEMİR KÖK**Dr.Öğr. Üyesi, Mersin Üniversitesi, Denizcilik Fakültesi, orcid.org/0000-0002-9642-3985**Elif KOÇ**Dr. Öğr. Üyesi, Bandırma Onyediy Eylül Üniversitesi, Ömer Seyfettin Uygulamalı Bilimler Fakültesi, orcid.org/0000-0002-0235-086X**Duygu KALKAY** (sorumlu yazar)Dr. Öğr. Üyesi, Bandırma Onyediy Eylül Üniversitesi, İktisat Fakültesi, orcid.org/0000-0002-8729-9177**Özet**

Enerji maliyetleri birçok sektörde olduğu gibi liman ve denizcilik alanında da önemli bir yer kaplamaktadır. Çevresel sürdürülebilirlik açısından da enerji fiyatlarındaki belirsizlik sektörün geleceği için önemli bir risk oluşturur. Bu nedenle petrol fiyatlarındaki volatilité çevresel stratejide bir yol haritası oluşturmaktadır. Finansal belirsizlik ortamlarında çevresel yatırımlar sektöre uğramaktadır. Bu çalışmada temel olarak enerji piyasalarındaki ani dalgalanmaların, sektörün finansal dengesini bozarak uzun vadede çevre yönetim planlarını sektöre uğratıp uğratmayacağı hakkında bir yol haritası oluşturmaktır. Bu kapsamda çalışmada Türkiye için 2018-2025 yılları arasındaki günlük veriler kullanılarak enerji fiyatlarındaki dalgalanmaların BİST Ulaştırma ve Liman sektörü endeksi üzerindeki etkisi GARCH (Genelleştirilmiş Otoregresif Koşullu Değişen Varyans) modeli ile analiz edilmiştir. Çalışma sonucunda, enerji fiyatlarında yaşanan dalgalanmaların ve belirsizliğin, BİST Ulaştırma Endeksi'nin volatilitésini artırdığı sonucuna ulaşılmıştır.

Anahtar Kelime: Liman İşletmeciliği, Çevresel Sürdürülebilirlik, Finansal İstikrar, Ulaştırma endeksi

FINANCIAL RISKS OF ENVIRONMENTAL SUSTAINABILITY IN PORT AND TERMINAL OPERATIONS: ANALYSIS OF ENERGY PRICE VOLATILITY WITH THE GARCH MODEL**Abstract**

Energy costs play a significant role in the port and maritime sector, as they do in many other sectors. From an environmental sustainability perspective, uncertainty in energy prices also poses a significant risk to the sector's future. Therefore, volatility in oil prices is shaping the roadmap for environmental strategy. Environmental investments are being disrupted in times of financial uncertainty. This study primarily aims to create a roadmap regarding whether sudden fluctuations in energy markets will disrupt the sector's financial balance and, in the long term, hinder environmental management plans. Within this scope, the study analyzed the impact of energy price fluctuations on the BIST Transportation and Ports sector index using daily data for Turkey between 2018 and 2025, employing the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model. The study concluded that fluctuations and uncertainty in energy prices increased the volatility of the BIST Transportation Index.

Keyword: Port Management, Environmental Sustainability, Financial Stability, Transportation Index

¹ Bu çalışma "Türkiye'deki Liman Sektörünün Çevresel Önceliklerinin Belirlenmesi: Delphi, DAMATEL, ANP ve GARCH Yöntemleri ile Sistematik Bir İnceleme" isimli TÜBİTAK 1002 Hızlı Destek Programı kapsamında kabul edilen 424K105 nolu proje tarafından desteklenmiştir

**EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER USING SINGLE AND MULTIPLE AIR JETS IMPINGEMENT COOLING IN A FLAT PLATE****Altuğ KARABEY**

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Abstract

High heat fluxes, which arise during industrial operation and result from various irreversibility processes, are among the most important parameters that negatively affect the operating performance and economic life of systems. Various cooling methods, such as impinging air jets, water jets, microchannels, and spray cooling, are used in the literature to remove high heat fluxes. Impinging air jet cooling, which achieves high heat transfer performance with low refrigerant flow rates, is widely used in drying applications for removing high heat fluxes, in microelectronic chips and circuit components with high heat flux densities, in gas turbines, and in the textile and paper manufacturing industries. In this study, heat and flow parameters were investigated in heat transfer with single and multiple impinging air jets on a flat plate. Experiments using a flat plate were conducted at constant heat flux, a 40 mm nozzle diameter, three different jet heights, and five different jet velocities between 5 and 9 m/s. Experiments investigated the effects of single and multiple air jets, dimensionless distance, and jet velocity on heat transfer characteristics. The results are presented as Nusselt Number-Reynolds Number plots. It was concluded that the Nusselt number increases with increasing Reynolds number, and that the Nusselt number decreases with increasing distance between the nozzle and the heat sink. The results are consistent with experimental studies conducted with single and multiple air jets in the literature.

Keywords: Impingement jet cooling, Heat sink, Heat transfer enhancement.

DÜZ LEVHAYA ÇARPAN TEKLİ ve ÇOKLU HAVA JETLERİYLE SOĞUTMADA ISI TRANSFERİNİN DENEYSEL İNCELENMESİ**Özet**

Endüstride işletme sırasında ortaya çıkan ve birtakım tersinmezlikler sonucu oluşan yüksek ısı akıları sistemlerin çalışma performanslarını ve ekonomik ömürlerini olumsuz etkileyen en önemli parametrelerden birisidir. Yüksek ısı akılarının uzaklaştırılmasında literatürde çarpan hava jeti, su jeti, mikro kanallar, sprey soğutma vb. birçok soğutma metodu kullanılmaktadır. Düşük soğutucu akışkan debisi ile yüksek ısı transfer performansı elde edebilmek için kullanılan çarpan hava jeti ile soğutma, yüksek ısı akılarının uzaklaştırılması için kurutma uygulamalarında, yüksek ısı akısı yoğunluklarına sahip mikro-elektronik çipler ve devre elemanlarında, gaz türbinlerinde, tekstil ve kâğıt üretim endüstrisi gibi uygulama alanlarında oldukça yaygın olarak kullanılmaktadır. Bu çalışmada, düz levha üzerinde tekli ve çoklu çarpan hava jetleriyle ısı transferinde ısı ve akış parametreleri incelenmiştir. Düz levha kullanılarak yapılan deneyler; sabit ısı akısında, 40 mm lüle çapında, üç farklı jet yüksekliğinde ve 5-9 m/s aralığında beş farklı jet hızı değerinde gerçekleştirilmiştir. Deneyler sonucunda, tekli ve çoklu hava jeti kullanımının, boyutsuz mesafenin ve jet hızının ısı transferi karakteristikleri üzerindeki etkileri araştırılmıştır. Sonuçlar Nusselt Sayısı-Reynolds Sayısı grafikleri olarak sunulmuştur. Nusselt sayısının artan Reynolds sayısı ile arttığı ve Nusselt sayısının lüle ile ısı alıcı arasındaki mesafe arttıkça azaldığı sonucuna ulaşılmıştır. Elde edilen sonuçların literatürde ayrı ayrı bulunan tekli ve çoklu hava jeti ile yapılan deneysel çalışmalarla uyumlu olduğu gözlenmiştir.

Anahtar Kelimeler: Çarpan jetle soğutma, Isı alıcı, Isı transferinin iyileştirilmesi.

**PAKISTAN ENERJİ PORTFÖYÜNÜN ÇEVRESEL TAHRİBATA YANSIMALARI: FOURIER YAKLAŞIMLARINDAN BULGULAR****Seyfettin Erdoğan**

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Özet

Çevresel sürdürülebilirlik, ekonomik faaliyetlerin ekosistem üzerindeki baskıyı artırmadan sürdürülmesini ve uzun vadeli çevresel dengenin korunmasını gerekli kılan temel bir kalkınma unsurudur. Sera gazı yoğun ekonomik yapıların dönüştürülmesi ve çevresel tahribatın sınırlandırılması bu hedefin kritik bileşenleri arasında yer alırken, enerji tüketiminin daha temiz bileşenlerle çeşitlendirilmesi karbon yoğun enerji kullanımının yol açtığı çevresel baskıların azaltılmasında belirleyici bir rol oynamaktadır.

Bu doğrultuda, bu çalışmada Asya bölgesinin yüksek karbon salınımına sahip ülkelerinden biri olan Pakistan için nükleer enerji, yenilenebilir enerji ve fosil enerji tüketimlerinin CO₂ emisyonları üzerindeki etkisi 1990–2023 dönemi kapsamında incelenmektedir. Analizlerde Kesirli Frekanslı Fourier ADL (FFF-ADL) testi kullanılarak enerji türleri ile karbon emisyonu arasında uzun dönemli bir eşbütünleşme ilişkisinin bulunduğu ortaya konulmaktadır. Devamında DOLS tahmincisi ile elde edilen uzun dönem katsayıları, nükleer enerji ve yenilenebilir enerji tüketiminin karbon salınımını azalttığını; buna karşılık fosil enerji tüketiminin emisyonları artırdığını göstermektedir. Ayrıca wavelet dönüşümlü Kesirli Frekanslı Fourier Toda–Yamamoto (FFF-TY) nedensellik testi uygulanarak nükleer enerji, yenilenebilir enerji ve fosil enerji tüketimi ile CO₂ emisyonu arasında uzun dönemde çift yönlü nedensellik ilişkilerinin bulunduğu tespit edilmiştir.

Elde edilen bulgular, Pakistan’ın enerji portföyünün çevresel tahribat üzerindeki belirleyici etkisini ortaya koymakta ve düşük karbonlu enerji kaynaklarına yönelimin politika tasarımı merkezli bir önem taşıdığını göstermektedir.

Anahtar Kelimeler: Pakistan, Çevresel tahribat, Fourier yaklaşımları, Wavelet dönüşümü

ENVIRONMENTAL DEGRADATION IMPLICATIONS OF PAKISTAN’S ENERGY PORTFOLIO: EVIDENCE FROM FOURIER APPROACHES**Abstract**

Environmental sustainability requires that economic activities be carried out without increasing ecological pressure and that long-term environmental balance be maintained. Transforming greenhouse gas-intensive economic structures and limiting environmental degradation constitute critical components of this objective, while diversifying energy consumption toward cleaner sources plays a decisive role in mitigating the environmental pressures arising from carbon-intensive energy use.

In this context, this study examines the impact of nuclear, renewable, and fossil energy consumption on CO₂ emissions for Pakistan—one of the high-emission countries in the Asian region—over the period 1990–2023. The analysis employs the Fractional Frequency Fourier ADL (FFF-ADL) cointegration test, which confirms the presence of a long-run equilibrium relationship between energy types and carbon emissions. Subsequently, long-run coefficients obtained from the DOLS estimator indicate that nuclear energy and renewable energy

consumption reduce carbon emissions, whereas fossil energy consumption increases them. Furthermore, the wavelet-based Fractional Frequency Fourier Toda–Yamamoto (FFF-TY) causality test reveals the existence of bidirectional long-run causality between nuclear, renewable, and fossil energy consumption and CO₂ emissions.

Overall, the findings demonstrate the decisive influence of Pakistan’s energy portfolio on environmental degradation and highlight the central importance of transitioning toward low-carbon energy sources in the country’s policy framework.

Keywords: Pakistan, Environmental degradation, Fourier approaches, Wavelet transform

**STRUCTURAL, MORPHOLOGICAL, AND DIELECTRIC CHARACTERIZATION OF
POLYVINYL ALCOHOL / CALCIUM TITANATE NANOCOMPOSITE****Amirouche BOUAMER**

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Abstract

The purpose of this study was to add calcium titanate (CaTiO_3) fillers to a polymer (PVA) matrix in order to enhance its dielectric behavior. The solution casting technique was used to elaborate thin films of polyvinyl alcohol (PVA) and PVA/ CaTiO_3 nanocomposites. SEM images showed that nanoparticles are uniformly dispersed in the PVA matrix. A successful of the PVA/ CaTiO_3 nanocomposite formation was confirmed by X-ray diffraction analysis, which showed the appearance of diffraction peaks of the crystalline phases of CaTiO_3 in the pattern of the nanocomposite, indicated that the nanoparticles were integrated into the polymer network. Dielectric measurements show that the real part (ϵ') of the permittivity, and the AC conductivity vary significantly with the presence of CaTiO_3 fillers in the PVA matrix. The nanocomposite exhibits highly improved electrical properties where the dielectric constant (ϵ') increased from 23.19 to 32.8 at 1 KHz, and the AC conductivity (σ_{ac}) is raised from $1.56 \times 10^{-7} \text{ S}\cdot\text{m}^{-1}$ to $1.21 \times 10^{-4} \text{ S}\cdot\text{m}^{-1}$ at 1 MHz. Thus improvements are due to interfacial polarization, space-charge accumulation, and increased mobility of charge carriers at the PVA– CaTiO_3 interfaces. The results show that nanocomposites can be used as a flexible electronic component and a capacitive device due to their exceptional dielectric and structural properties.

Keywords: Polyvinyl alcohol (PVA), Calcium titanate (CaTiO_3), Nanocomposite films, Dielectric properties, AC conductivity.

Title: KINETICS AND THERMO-CATALYTIC PYROLYSIS OF CITRUS WASTES IN PRESENCE AND ABSENCE OF NATURAL CATALYST PUMICE

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Abstract

In this study, our focus was on utilizing juice-squeezed citrus wastes, specifically peel and pulp, to produce valuable components through an environmentally friendly approach. Thermogravimetric profile (TG/DTG) exhibited a four-step weight loss, attributed to the evaporation of water and the degradation of hemicellulose, cellulose, and lignin. To further investigate the effects of catalysts, we also subjected pure citrus wastes and citrus wastes loaded with natural catalyst pumice to thermogravimetric analysis (TGA). Heating rates of 15, 20, 25, and 30 °C/min were employed within the temperature range of 25-800 °C. Using the Kissinger method, we determined the kinetic parameters for both the absence and presence of pumice as a natural catalyst based on the thermogravimetric data. The oils obtained from the catalyzed and uncatalyzed reactions were subsequently analyzed using gas chromatography mass spectrometry (GC-MS). The results led to the conclusion that the use of natural catalyst pumice not only reduced the activation energy but also improved the quality of the produced oil. With further upgrading, the obtained oil holds promising potential for applications across various industries.

PRODUCTION AND CHARACTERIZATION OF CARBON NANOTUBES FROM BIOCHAR UNDER MICROWAVE IRRADIATION**Faisal Nazir**

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Abstract

Carbon nanotubes (CNTs) are widely used in a variety of fields to produce a diversity of products, including hydrogen storage systems, and field emitters. In the proposed study, CNTs synthesized via biochar under the microwave irradiation method. In this method, the combination of charcoal and ferrocene are used to synthesize CNTs from the biochar approach. Biochar samples for CNTs synthesis are made from pyrolyzed agro-industrial waste such as rapeseed cake, hazelnut hulls, wheat straw, and oat hulls at different temperatures. The biochar was produced from agro-industrial biomass. During experiments, 100g of biomass was placed in a microwave reactor. The samples were pyrolyzed at 400 °C to 600°C. SEM analysis was used to confirm the morphology of CNTs. SEM micrographs revealed the perfect structure of multiwall carbon nanotubes, while interlayers spacing was changed due to variation of catalysts and measured about 0.34nm. Further, the optical properties were examined by UV-visible spectroscopy. In the UV, one band is clear at 240 nm region due to resonance of nanotubes $\pi(\pi)$ electrons of carbon nanotubes. XRD was used to analyze the glassy structure of prepared CNTs under microwave revealed that the creation and growth of CNTs were mostly influenced by microwave irradiation and the ferrocene catalyst. The structure of CNTs was developed under microwave heating and in the presence of ferrocene catalyst. To research how nitrogen impurities adhere to CNTs, FTIR experiments were conducted in the 400–4000 cm^{-1} range. The sample's FTIR spectra exhibit prominent peaks that correspond to C-H and C=C, respectively.

**DEVELOPMENTS IN GREEN ENERGY: THE IMPACT ON THE DIGITALIZATION OF THE
TRANSPORT SECTOR IN ALBANIA****Associate Professor Valbona Cinaj**

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Abstract

This paper examines the latest developments in green energy and their influence on the digitalization of the transport sector in Albania and the Balkan region. It specifically investigates the expansion of renewable energy capacities, including solar and wind power, alongside the adoption of advanced digital technologies for traffic management, energy monitoring, and electric vehicle integration. A regional comparative analysis indicates that more developed countries such as Bulgaria and North Macedonia benefit from substantial funding and progressive policy frameworks, whereas Albania is progressively advancing in this domain. Key challenges identified include limited sustainable financing, incomplete infrastructure, and inadequate public awareness and technical expertise. The paper argues that strategic investments, innovative policy measures, and international cooperation are crucial for accelerating this transition, thereby fostering sustainable and integrated regional development.

Keywords: Green Energy, Digitalization of Transport, Renewable Energy Development, Sustainable Mobility.

OPTIMIZING POWER GENERATION IN HYDROELECTRIC PLANTS USING AN IMPROVED HYDRAULIC TURBINE AND GOVERNOR MODEL**Noshin Amina**

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Abstract

This research represents a redesigned hydraulic turbine and governor model aimed at improving power generation efficiency in hydroelectric power plants. Hydropower remains a vital renewable energy resource, especially for countries like Bangladesh, where water-based energy production plays a significant role. The proposed model focuses on optimizing the turbine's performance by analysing the influence of net head variations on generator output. Using MATLAB Simulink, a detailed simulation model was developed, incorporating a nonlinear hydraulic turbine, a PID-based governor, a synchronous generator, and a step-up transformer connected to an existing grid. The system parameters were carefully selected to enhance output stability and efficiency. Simulation results demonstrate that output voltage, current, and apparent power increase proportionally with net head values up to an optimal point, after which performance gradually decreases. The highest output, approximately 2.08 MVA, was achieved at a net head value of 1. Also, fault analysis using line-to-line, line-to-ground, and three-phase faults was conducted to evaluate system robustness. The model successfully returned to steady-state conditions within a few seconds after each disturbance. These findings highlight the effectiveness of the improved turbine design and offer a promising approach for enhancing hydropower generation in modern renewable energy systems.

Keywords: Hydropower, Hydraulic Turbine, Governor System, MATLAB Simulink, Net Head, Renewable Energy, Synchronous Generator, Fault Analysis, Power Optimization

**INTEGRATED BIOPROCESS OPTIMIZATION FOR SUSTAINABLE BIOFUEL PRODUCTION
FROM MICROALGAE****Mohammed Abdullah Ayoun**

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Abstract

The high cost of synthetic algal media is a major obstacle to the commercial development of biofuels from microalgae. this research investigates the use of cow-dung based media as a low-cost alternative to conventional conway media for the development of biofuel from the marine microalga *gonyostomum* sp. with high lipid productivities. preliminary data indicate that the cow-dung based medium enhances the growth of algae and lipid content. the lipid extraction methods used were: hexane-methanol extraction (solvent-based) and soxhlet extraction of the microalgal biomass produced under both conway and cow-dung based media conditions. the lipid extracts obtained were then transesterified into fatty acid methyl esters (fames) using two different processes; one being a two-stage base-acid catalysis process and the other an acid catalysis process. major fames identified by gas chromatography were: palmitic acid (c16:0); oleic acid (c18:1); and linoleic acid (c18:2); all of which are suitable for biofuel application. additionally, the properties of the biofuel produced using the best treatment conditions (cetane number = 58; lcsf = 0.869; kinematic viscosity = 4.8 mm²/s) meet or exceed the requirements of international biodiesel standards (astm d6751 and en 14214). these results support a sustainable method for the development of microalgal biofuels particularly in resource-poor environments, as they demonstrate that the use of cow-dung based media can reduce the costs associated with cultivation while maintaining the quality of the biofuel produced.

Keywords: Microalgae, *Gonyostomum* sp., Cow dung media, Lipid yield, FAME conversion, Fatty acid profile, Biodiesel, Circular bioeconomy

AI-DRIVEN DIGITAL TWINS FOR ENERGY-EFFICIENT OPERATION OF CIVIL INFRASTRUCTURE CAMPUSES**Ali Akbar Firoozi^{a,*} & Ali Asghar Firoozi^b**^aDepartment of Civil Engineering, Faculty of Engineering & Technology, University of Botswana, Gaborone, Botswana.^bDepartment of Civil Engineering, Faculty of Engineering, National University of Malaysia (UKM), Selangor, Malaysia**Abstract**

Large civil infrastructure campuses such as universities, hospitals, and industrial parks are increasingly intensive energy consumers, yet their operation is still managed with limited integration between structural, mechanical, and energy systems. This study proposes an AI-driven digital twin framework that couples Building Information Modelling (BIM), real-time IoT sensing, and predictive analytics to optimize energy performance while respecting structural and operational constraints. The digital twin integrates HVAC, lighting, and envelope performance with occupancy patterns, weather data, and structural health monitoring indicators. Machine learning models are trained to forecast hourly energy demand and detect anomalous consumption linked to system faults or degradation. A multi-objective optimization module then recommends control strategies that balance energy use, indoor comfort, and safety margins for critical structural elements. The framework is demonstrated conceptually for a mixed-use academic campus, with scenario analyses comparing baseline rule-based control with digital-twin-assisted operation. Preliminary simulations indicate substantial potential for peak-load reduction and improved reliability of critical systems. The study highlights how civil engineers can reposition digital twins from purely structural monitoring tools to holistic cyber-physical platforms that simultaneously support energy efficiency, resilience, and lifecycle asset management.

Keywords: Digital twin, BIM, energy efficiency, smart infrastructure, civil engineering, AI analytics.

LIFE-CYCLE ENERGY AND CARBON ASSESSMENT OF LOW-CARBON CONCRETE MIXTURES FOR STRUCTURAL APPLICATIONS**Ali Akbar Firoozi^{a,*} & Ali Asghar Firoozi^b**^aDepartment of Civil Engineering, Faculty of Engineering & Technology, University of Botswana, Gaborone, Botswana.^bDepartment of Civil Engineering, Faculty of Engineering, National University of Malaysia (UKM), Selangor, Malaysia**Abstract**

Concrete remains the backbone of civil infrastructure, yet it is responsible for a high share of embodied energy and CO₂ emissions in the built environment. This study develops a comparative life-cycle assessment (LCA) of conventional Portland cement concrete versus low-carbon mixtures incorporating supplementary cementitious materials (SCMs) such as fly ash, slag, and calcined clays, as well as alkali-activated binders. A cradle-to-grave system boundary is adopted, including raw material production, transport, batching, construction, service life, and end-of-life scenarios. Structural performance requirements are preserved by considering strength class, durability exposure class, and cover thickness within standard design codes. Inventory data are combined with regional electricity mixes and transport distances representative of African and Middle Eastern contexts. Energy use and greenhouse gas emissions are quantified per cubic metre and per functional unit of “50-year service life of a typical structural element.” Sensitivity analyses explore the influence of SCM replacement levels, curing regimes, and service-life extension due to improved durability. The study provides design-oriented LCA indicators and simple selection charts that help civil and structural engineers choose concrete technologies that minimize energy and carbon without compromising safety. The findings support the integration of LCA-based criteria into structural design practice and public procurement for sustainable infrastructure.

Keywords: Low-carbon concrete, supplementary cementitious materials, alkali-activated binders, life-cycle assessment, embodied energy, structural engineering.

AI FOR CLIMATE CHANGE MODELLING AND RENEWABLE ENERGY DEVELOPMENT

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Abstract

The fast-growing consequences of climate change necessitate innovative approaches to understanding, mitigating, and adapting to its effects. Artificial intelligence (AI) has emerged as a powerful tool in this endeavor because to its advanced abilities to analyze complex data, predict climate events, and support sustainable practices. This study explores the ways in which artificial intelligence (AI) can transform the modeling of climate change and the advancement of renewable energy. The study examines papers about modeling climate change, developing renewable energy, and using AI-powered tools for resource management and environmental preservation. Predicting the climate is an important topic of research. Combining AI with sensor data, satellite imaging, and historical climate records can lead to significant advancements in areas such as deforestation monitoring, sustainable agriculture, and biodiversity preservation. The study also examines the ethical concerns and limitations related to AI use, including bias, data privacy, and equitable access to technology. Artificial intelligence (AI) can be a crucial component of global strategies to combat climate change, enhance ecological resilience, and advance sustainable development by addressing these problems. This study adds to the expanding corpus of research on the nexus between artificial intelligence (AI) and environmental science by emphasizing AI's capacity to bring about profound change and advance a sustainable future for both people and the environment.

Keywords: AI, climate change modelling, renewable energy development

SHAPING THE ECONOMY OF THE FUTURE: DIGITAL TRANSFORMATION, ENERGY TRANSITION AND REGIONAL CONVERGENCE**Georgiana Anamaria DUNĂ**

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Abstract

The accelerated pace of digital transformation and the ongoing energy transition are continuously redefining economic development models across Europe. The availability of clean, accessible, and secure energy, as reflected in Sustainable Development Goal 7 (SDG 7), is important for sustainable growth and the reduction of territorial imbalances. In this context, eliminating regional disparities has become a priority for ensuring social cohesion and long-term resilience. Romania, as an emerging EU economy, continues to face persistent disparities in socio-economic development, digital integration, and renewable energy implementation. This paper examines how digital transformation and the adoption of renewable energy can strengthen regional convergence and contribute to the economy of the future.

The aim of this study is to assess the relationship between progress in sustainability—measured by SDG 3 (Health and well-being), SDG 4 (Quality Education), SDG 7 (Affordable and Clean Energy), and SDG 10 (Reduced Inequalities)—and the digital and energy transition in Romania, compared to the European Union average.

Two research hypotheses guide the analysis: H1: Indicators associated with SDG 3, SDG 4, SDG 7, and SDG 10 have a major influence on socio-economic development and the reduction of regional disparities in Romania and the EU; H2: There is a direct correlation between the degree of digital transformation and the capacity to mitigate regional inequalities related to SDG 3, SDG 4, SDG 7, and SDG 10.

The methodology combines a descriptive statistical analysis with a qualitative assessment of Romanian and EU policies that promote digitalization and renewable energy integration.

Results indicate that advancements in digital skills, e-health, e-learning, and renewable energy penetration are associated with reduced socio-economic disparities, although Romania remains below the EU average on most SDG indicators. The study concludes that shaping the economy of the future requires synchronized progress in innovation, sustainability, and social inclusion to ensure equitable development and enable regional convergence across the European Union.

Keywords: digital transformation, energy transition, regional disparities, sustainable developments goals, regional convergence

ARTIFICIAL INTELLIGENCE AS AN ACTUARIAL EQUALISER: ADVANCING ENERGY RISK ASSESSMENT AND EDUCATIONAL CAPACITY IN EMERGING ECONOMIES**Daniel SANUSI**

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Abstract

Artificial intelligence (AI) is revolutionising actuarial science and energy risk assessment by introducing new skills that address long-standing structural imbalances in emerging nations. This paper investigates AI as an actuarial equaliser, demonstrating how sophisticated machine learning approaches improve risk modelling, forecasting accuracy, and decision-making in energy systems with uncertainty, data scarcity, and infrastructure restrictions. It combines data from actuarial practice, climate risk analytics, and energy systems engineering to demonstrate how AI facilitates the move from reactive to predictive risk management, resulting in more robust and efficient energy planning in emerging environments. Beyond efficiency enhancements, the study investigates AI's function in boosting literacy rates in regions with limited resources. The research shows how AI-powered personalised learning systems, teacher support platforms, and offline digital tools can help close long-running divides in career development, data proficiency, and technological expertise. The study presents a cohesive conceptual framework for illustrating how AI can simultaneously enhance actuarial dependability, energy-industry robustness, and talent development by combining concepts from sectoral procedures, scholarly research, and policy papers. The results show that, while AI has innovative benefits, its implementation in poor economies is impeded by regulatory ambiguity, data-quality constraints, infrastructure deficiencies, and governance concerns. The study concludes that accomplishing AI's equitable function would need focused policies, funding in digital structures, open data control, and cross-sector collaborations that integrate cutting-edge technology with skill-development measures.

Keywords: AI, Actuarial Science, Energy Risk Assessment, Machine Learning, Emerging Economies, Educational Capability, Climate and Energy Systems.

IMPACT OF GREEN MARKETING ON INVESTMENT IN RENEWABLE ENERGY FIRMS

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Abstract

This review paper examines the impact of green marketing on investment in renewable energy firms, emphasizing how sustainability-focused communication shapes investor trust, perceived firm value, and financial decision-making. As global awareness of climate change grows, renewable energy companies increasingly rely on green marketing tools—such as eco-labeling, environmental reporting, and digital sustainability campaigns—to differentiate themselves in a competitive market. This review synthesizes insights from recent academic literature, industry analyses, and corporate sustainability disclosures to evaluate how these communication strategies influence investor behavior and capital allocation. The findings reveal that transparent, verifiable, and consistent green marketing initiatives significantly enhance a firm's reputation by signaling strong environmental commitment and long-term stability. Such signals reduce information asymmetry, allowing investors to better assess risk and potential returns, which ultimately contributes to increased capital inflows and improved market valuation. However, the analysis also highlights the challenges associated with greenwashing, as exaggerated or unsupported sustainability claims can lead to investor skepticism and reputational damage. Therefore, authenticity and measurable environmental performance are crucial for the effectiveness of green marketing efforts. The paper concludes that aligning green marketing with robust sustainability practices is essential for attracting long-term investment in the renewable energy sector. It further recommends future research focusing on data-driven marketing methods, the role of digital analytics, and comparative studies across different markets to better understand global investor responses to green marketing strategies.

Keywords: green marketing, renewable energy, investor behavior, sustainability communication, investment inflow, firm valuation

INTEGRATING RENEWABLE ENERGY INTO NIGERIA'S ENERGY POLICY MIX – A REVIEW**F. N. Osuolale**

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Abstract

The energy sector in Nigeria is a great concern that seems to have defied all intervention by successive governments in the country. Nigeria is the largest producer of crude oil in Africa, but this has not translated to wealth and energy supply for its teeming populace. The high growth in population and increasing living standards, coupled with continuous industrial growth has resulted into high energy demand in the country. There had been numerous promises made to the populace and several steps taken, however, it is as if each successive government leaves the country worse than previously. Nigeria however is abundantly blessed with energy resources in different forms.

This paper presents a viable and workable intervention for the nation's energy sector from the angle of renewable energy. An estimate of about 2,500,000 GW of renewable energy could be available in a year if judiciously harnessed from potential energy sources. The wind speed average for the country is 3.88 m/s to 9.39 m/s in the North-West, 1.77 m/s to 4.5 m/s in the South-West, 2.46 m/s to 5.36 m/s in the North-Central, 3.30 m/s to 4.65 m/s in the South-South. Energy from agricultural and livestock residues is estimated to be 710, 000,000 MW, while the solar radiation energy could be as much as 1,500,000 GW. Hydro energy presently utilized in the country is a meagre amount of 1, 930 MW, though the country has higher potential of about 6,396,390 MW.

Projected amount of energy demand of the nation by 2030 is 45 GW. The value of renewable energy left unexploited shall be more than enough to meet the energy demands of the country. It is hoped that the government could appropriate some of the suggestions outlined in this research paper to bring about an overhauling of the energy sector policy in Nigeria.

Keywords: Nigeria, Policy, Renewable energy

ENERGY FINANCE SHOCKS AND CONDITIONAL VOLATILITY IN OIL-DEPENDENT ECONOMIES: A MULTIVARIATE DCC-GARCH ANALYSIS**Dr. Michael Sunday OLAYEMI**

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Abstract

Oil-dependent economies are highly vulnerable to global energy-market shocks, yet the impact of energy-finance shocks on volatility remains underexplored. While prior studies focus on oil-price fluctuations and geopolitical risks, limited attention has been given to how variations in financing—such as foreign direct investment, sovereign loans, domestic credit to energy firms, and green-energy capital—affect oil-market dynamics. This study investigates the effect of energy-finance shocks on conditional volatility in five oil-dependent economies: Nigeria, Angola, Saudi Arabia, Algeria, and Venezuela, over 1995–2022. A multivariate Dynamic Conditional Correlation GARCH (DCC-GARCH) model is employed to capture time-varying volatility and correlations between oil returns and energy-finance shocks. All series are transformed into log-returns to ensure stationarity, with univariate GARCH(1,1) models estimating conditional variances and the DCC process capturing evolving correlations. Results show significant volatility clustering in both oil returns and energy-finance shocks, with $\alpha + \beta$ coefficients exceeding 0.85. Energy-finance shocks produce larger volatility responses than oil returns in Nigeria and Venezuela. DCC estimates reveal persistent correlations ($a = 0.069$, $b = 0.917$), with peaks exceeding 0.70 during major crises, including 1998, 2008, 2014, and 2020, indicating strong co-movement and systemic risk. The study highlights the role of financial flows in propagating oil-market volatility and provides actionable policy recommendations, including diversification of energy-finance sources, strengthened financial resilience, adoption of hedging instruments, and investment in energy infrastructure, to enhance stability and sustainability in oil-dependent economies.

Keywords: Energy Finance, Oil Market Volatility, DCC-GARCH, Conditional Correlation, Oil-Dependent Economies

ENERGY CONSUMPTION AND FISCAL–MONETARY INTERACTIONS IN TUNISIA**Dorra TURKI**

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Abstract

Energy consumption and environmental degradation have become major challenges for developing economies, particularly Tunisia, which is subject to significant environmental pressures, notably rising CO₂ emissions and its structural energy dependence. In this context, we examine the interactions between fiscal and monetary policies, energy consumption, and CO₂ emissions in Tunisia over the period 1980–2022. The objective of this study is to determine the environmental effects of positive and negative fiscal and monetary policy responses, taking into account energy consumption and economic activity in an emerging economy.

To this end, the study relies on a nonlinear autoregressive model with staggered lags (NARDL), which allows for different levels of integration and accounts for asymmetric adjustments. The model incorporates the positive and negative partial sums of fiscal and monetary shocks to account for potential short- and long-term asymmetries.

By analyzing the interaction between macroeconomic policies and energy consumption within a non-linear framework, this research leads to a better understanding of the macroeconomic factors driving environmental pressures in an emerging economy, contributing to the literature in two main ways. First, it introduces a non-linear and interactive perspective into the discourse on energy and the environment in Tunisia, a context where fiscal and monetary policies can have heterogeneous environmental impacts. Second, it offers an empirical framework that better accounts for the complexity of macroeconomic dynamics in an emerging economy. The results should inform policymakers about the importance of coordinating macroeconomic actions to maintain environmental sustainability.

Keywords: Energy consumption, Environmental economics, Monetary policy, Fiscal policy

EXPLORING THE CO₂ EMISSION EFFECTS OF FISCAL CONSOLIDATION: INSIGHTS FROM DEVELOPING COUNTRIES**Ameni MTIBAA**

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ABSTRACT

Environmental sustainability has become a central policy concern, motivating closer examination of how fiscal actions influence CO₂ emissions. The present research investigates the nonlinear effect of fiscal consolidation on CO₂ emissions for 17 OECD countries over 1978–2020. Using a panel Quantile Autoregressive Distributed Lag (QARDL) model, the analysis explores both short- and long-run dynamics across the emissions distribution. The findings indicate that fiscal consolidation reduces CO₂ emissions in the short run across almost all quantiles. In the long run, however, its impact becomes heterogeneous: consolidation increases emissions at lower quantiles but decreases them at higher quantiles. Overall, the results support a non-Keynesian view, suggesting that well-designed consolidation policies can enhance economic performance while contributing to short-term environmental improvements. The mixed long-run effects emphasize the need for sustained and efficient consolidation strategies to achieve lasting emission reductions and support the transition toward cleaner energy.

Keywords: fiscal policy; fiscal consolidation; OECD countries; carbon emissions.

THE ROLE OF ESG PERFORMANCE IN SHAPING THE LINK BETWEEN CO₂ EMISSIONS AND CREDIT RATING ANNOUNCEMENTS

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Abstract

Growing global concerns about sustainability have intensified interest in understanding how ESG performance influences the relationship between environmental emissions and credit rating assessments. This study provides an empirical investigation of this interaction by examining a panel of G20 countries from 2010 to 2024. Using advanced panel econometric techniques, we assess whether stronger ESG profiles can mitigate the adverse effects of CO₂ and greenhouse gas emissions on credit rating announcements. The results reveal that economies with higher ESG scores tend to record significantly lower emissions, suggesting that sustainability-oriented policies reduce environmental vulnerabilities. Moreover, enhanced ESG performance appears to serve as a positive signal for rating agencies, strengthening confidence in sovereign creditworthiness. Theoretically, this research highlights ESG as a moderating mechanism capable of reshaping the environmental–financial risk nexus. Empirically, it offers new insights into how non-financial indicators influence rating dynamics. Managerially, the findings underscore the importance for governments and firms to embed ESG principles in their strategic frameworks to improve both environmental outcomes and external evaluations. Overall, the study demonstrates the growing relevance of ESG factors in shaping the relationship between environmental performance and credit rating decisions in major global economies.

Keywords: Environmental, Social, and Governance (ESG), Carbon emissions, Greenhouse gas intensity, Sustainable finance, Emerging and advanced economies

A CASE STUDY ON THE EFFECTIVENESS OF THE FOSSIL FUEL INDUSTRY'S LOBBYING AND COMMUNICATION STRATEGIES

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Abstract

This research paper examines the effectiveness of lobbying and communication strategies employed by the fossil fuel industry to influence public opinion, regulatory frameworks, and energy policy decisions. Through the lens of qualitative case study analysis, the paper evaluates the tactics used by major fossil fuel corporations, industry associations, and allied political actors. The study focuses on messaging themes, lobbying expenditures, political alliances, media campaigns, and digital communication approaches. Findings indicate that the industry has effectively shaped energy policy debates, delayed climate legislation, and maintained a favourable regulatory environment through targeted lobbying and persuasive communication. However, growing public awareness, climate activism, and regulatory scrutiny have begun to challenge the long-term sustainability of these strategies. The paper concludes with implications for policymaking and recommendations for increasing transparency in corporate influence.

Keywords: Fossil fuel industry, lobbying, communication strategies, climate policy, public opinion, corporate influence, energy politics, case study.

DETERMINATION OF HEAVY METAL CONTAMINATION AND POLLUTION INDICES OF ATMOSPHERIC DUST IN TC**Prof. Dr. Skender DEMAKU****Dr. Sc. Betim Ismajli****MSc. Arbnorë Aliu****MSc. Donika Sylejmani**

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Abstract

This study looks at the levels, spread, and ecological risks of heavy metals in dust from the Kosova A and Kosova B thermal power plants in Obiliç. Researchers collected dust samples between October and December 2024 and tested them for As, Pb, Cd, Fe, Cu, Ni, Co, Mn, Zn, and Cr using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). They assessed pollution using the geoaccumulation index (I_{geo}), contamination factor (CF), pollution load index (PLI), and potential ecological risk index (PERI). The results showed that the dust was highly contaminated, especially with As, Cd, and Pb, which were the most enriched. Levels of As, Cd, Pb, Mn, Co, and Zn varied widely in both power plant areas ($CV > 35\%$), suggesting strong human impact. CF values for As, Cd, Pb, Co, Mn, and Zn in both plants were above the very high pollution threshold ($CF > 3$). The I_{geo} results showed that dust near Kosova A was heavily polluted by As, Cd, and Pb ($3 < I_{geo} \leq 4$). The ecological risk assessment found As, Cd, and Pb to be the main contaminants with the highest environmental and health risks. When compared to WHO and US-EPA air quality guidelines, the measured concentrations were higher than recommended. This could increase public health risks because heavy metals remain and build up in the environment. This research offers important evidence for environmental monitoring and highlights the need for better pollution control and management in Obiliç.

Keywords: Heavy metals; Atmospheric dust; Kosova A & B; Ecological risk; ICP-OES.

LOW CONSUMPTION ENERGY AND UNIFORM IRRADIATION THROUGH MICROWAVE CURING FOR THE SYNTHESIS OF IOT BASED GEOPOLYMERS

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Abstract

This study presents a rapid and innovative approach for synthesizing iron ore tailings (IOT)-based geopolymers using acidic activation coupled with volumetric microwave irradiation, applied for the first time to enhance geopolymerization and significantly reduce synthesis time. The raw IOT, composed of 16 wt.% SiO₂, 5 wt.% Al₂O₃ (SiO₂/Al₂O₃ 3.6), and 50 wt.% Fe₂O₃, proved to be a suitable aluminosilicate precursor. Comprehensive characterization (CS, SEM-EDX, ATR-FTIR, ATD-ATG, XRD) revealed that optimal conditions (14 M H₃PO₄, 700 W, 10 min) induced strong structural densification and the formation of Al–O–Si, Al–O–P, and mixed Al–O–Si–O–P linkages corresponding to AlPO₄, Al(PO₃)₃, Al(H₂PO₄)₃, and AlSi₂(PO₄)₃ crystalline phases. Mechanical performance improved markedly, with compressive strength rising from 4 to 32 MPa with increased acid concentration, from 6 to 45 MPa under higher microwave power, and from 5 to 23 MPa with irradiation time up to 10 min before declining due to overexposure. The resulting geopolymers also exhibited excellent resistance to aggressive environments, confirming this method as a sustainable, energy-efficient alternative to conventional geopolymer curing processes.

Keywords: IOT-based geopolymer, phosphoric acid activation, Microwave irradiation, High performance geopolymers

FROM MINING TAILINGS TO ADVANCED MATERIALS: A REVIEW OF ACTIVATION TECHNIQUES AND GEOPOLYMER SYNTHESIS PATHWAYS

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Abstract

The mining industry plays a pivotal role in the global economy, yet it generates vast amounts of solid and liquid byproducts during mineral extraction and processing. Among these, mine tailings represent one of the most significant sources of environmental pollution, contributing to acidification, heavy metal contamination, and challenges related to accumulation and surface storage. Recycling tailings within the framework of the green circular economy offers a dual benefit: reducing the ecological footprint of mining activities while providing alternative raw materials to industries, thereby strengthening national and global economic resilience.

Recent research has highlighted diverse valorization pathways, including the production of bricks, construction materials, ceramic membranes, and geopolymer composites. These approaches not only mitigate waste management issues but also advance sustainable material innovation. This paper presents a critical and up-to-date review of the literature on mine tailing recycling, with particular emphasis on geopolymer synthesis technologies, activation techniques, and their potential for sustainable applications.

Keywords: mining tailings based geopolymer, alkaline activation, phosphoric acid activation, green circular economy, High performance geopolymers

CHEMICAL ANALYSIS OF ATMOSPHERIC DUST AROUND THE KISHNICA AREA IN THE MUNICIPALITY OF GRACANICA**Prof. Assoc. Skender Demaku****Msc. Muhamet Kiqina****Msc. Arbnorë Aliu****Msc. Donika Sylejmani**

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Abstract

Kosovo is a very specific country, geographically, surrounded by all sides with the range, which is fundamentally protected, however, from The influence of the global climate, but in fact, how can this be defined when in many cases we encounter Pristina, as a city that has the primate. In the world, of the day-to-day pollution of the environment, what is it that causes all this contamination, with a weak economy, why all this contamination, we have them, they are too weak filters (or have not installed them at all), then old vehicles, forest cutting, lakes contamination, Above all, our awareness of a clean environment is lacking, almost `will be ours. Therefore, in this project, we will present our findings, based on Chemical analysis, in the cities; Prishtina, Gracanica, the cities considered as the most polluted, therefore, the impact on the health of residents and many other environmental impacts, in the areas analyzed will bring a realistic picture of environmental pollution, a perimeter of approximately 30km, including a triangle of the three cities analyzed.

Keywords: Heavy metals; Air, Cars, Households, Thermal power plants

EXPLOITING SUNLIGHT WITH PORPHYRINS: A QUANTUM-CHEMICAL AND IMPEDANCE SPECTROSCOPY INVESTIGATION FOR DSSCs**Rajaa Diany^a, Mohammed Salah^b**

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Abstract

This work explores the photovoltaic potential of 10 dye-sensitized organic structures (DSSCs) based on modified porphyrins aiming to increase their efficiency. One of these modifications is adding groups for donors and acceptors. The objective of this work is to evaluate optical, electrical, geometric, and photovoltaic properties of altered compounds. Finding the key variables open-circuit voltage, energy gap (band gap), and maximum absorption wave length that influence how effectively these redesigned structures might operate in solar cells is the primary objective. The study aims to find whether adopting these changed structures in the field of photovoltaics is viable using knowledge of computations and analyses. Together with a careful application of quantum chemistry, the inclusion of donor and acceptor groups into dye-sensitized organic structures based on porphyrins enables a more deep awareness of the effect of these changes on the photovoltaic efficiency of materials. In essence, the work aims to identify and characterize structures showing enhanced photovoltaic efficiency, therefore furthering the development of suitable solar materials. In this work, the geometric, electrical, photovoltaic, and optical properties of modified porphyrin-based dye-sensitized organic structures were evaluated utilizing quantum chemistry approaches based on Density Functional Theory (DFT) and Time-Dependent Density Functional Theory (TD-DFT). More specifically, electronic transitions and optical properties were computed exactly using TD-DFT-B3LYP/6-31g(d,p) and TD-CAM-B3LYP/6-31g(d,p). Furthermore, as a vital method, impedance spectroscopy (IS) was applied to characterize, examine, and diagnostic the several structures in this work.

Keywords: Porphyrin DFT, TD-DFT, Solarcells, Impedances pectroscopy, Gap energy Donor-Acceptor

QUANTUM-CHEMICAL INVESTIGATION OF NOVEL ORGANIC DYES FOR HIGH-EFFICIENCY DSSCs: A DFT/TD-DFT STUDY

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Abstract

This investigation focuses on the computational design and analysis of novel organic electron-donor molecules for dye-sensitized solar cells (DSSCs), utilizing density functional theory (DFT) and time-dependent (TD-DFT) with B3LYP. Advanced photovoltaic technologies hold significant promise for generating electricity directly from sunlight, driving interest in developing high-performance DSSCs. In this study, we investigated the structure, optics, electronics, reorganization energy, and photovoltaic characteristics of newly designed dyes (MC28, MC20, MZ173, MZ175, MK162). The analyses include global reactivity descriptors, density of states, molecular electrostatic potential (MEP), charge mobility, and optical properties. Additionally, we examined their nonlinear optical (NLO) properties, Mulliken atomic charges, and optimized geometries. Molecular modeling identified materials suitable for efficient DSSC assembly, optimizing components such as dye sensitizers, semiconductors, and electrolytes. Machine learning models further guided the selection of parameters critical for cell design. The results highlight that the designed molecules exhibit low band gaps, excellent optical properties, and high photovoltaic potential, paving the way for the fabrication of high-efficiency DSSCs with minimal need for extensive laboratory experiments. [1,2].

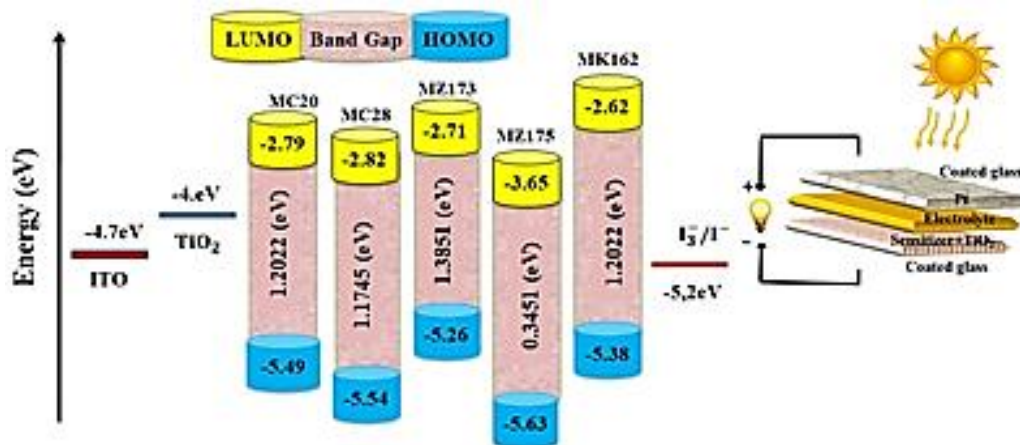


Fig. 1. Energy level of the studied compounds.

Keywords: Photovoltaics, TD-DFT, dye-sensitized solar cells, Reorganization Energy, Non-linear Optical Properties (NLO)

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QUANTUM EFFICIENCY IN GaN/InGaN SOLAR CELLS UNDER HYDROSTATIC PRESSURE AND TEMPERATURE

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Abstract

This study used a numerical model to investigate the quantum efficiency in InGaN/GaN multiple-quantum-well solar cells (MQWSC) under hydrostatic pressures. Finite difference techniques were employed to acquire band energy and their corresponding eigenfunctions of InGaN/GaN MQWLED, and the hole eigenstates were calculated via a k.p method (Fig.1). Our calculations demonstrated that a temperature change could decrease the electron and hole capture coefficients. Based on these results, radiative [1] and non-radiative recombination (i.e., Auger [2] and Shockley-Read-Hall [3]) and carrier leakage current decrease with increasing pressure and increase with increasing temperature. Increasing pressure by 10 GPa increases the quantum efficiency. Comparing this model with other models and experimental data demonstrates the good validity of this model, particularly in light of the multiphonon model. Overall, solar cells showed better performance compared to when the Shockley-Read-Hall current is lower, suggesting that temperature and hydrostatic pressure have both negative and positive impacts on the performance of these solar cells.

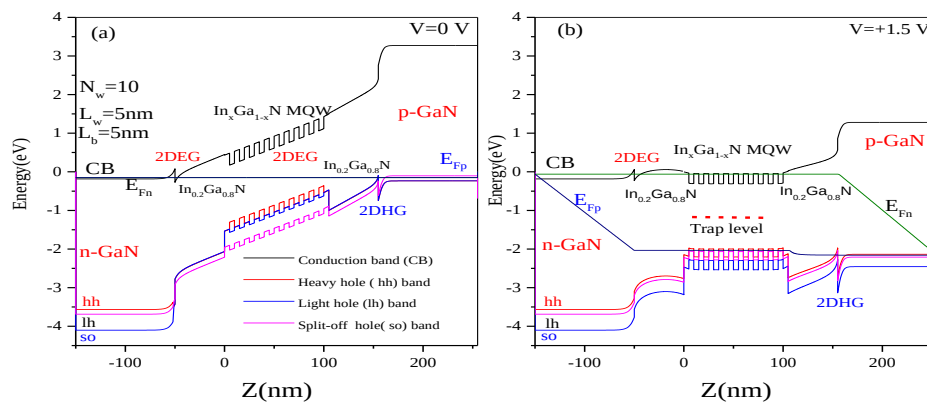


Fig. 1 The conduction (C.B.) and valence (V.B.) band energy of InGaN/GaN BVLs as a function of the distance for (a) $V=0V$ and (b) $V=1.5V$

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DESIGNING HIGH-EFFICIENCY D- π -A ORGANIC DYES FOR SOLAR CELLS: A DFT and TD-DFT INVESTIGATION OF ACCEPTOR VARIATIONS AND THEIR PHOTOVOLTAIC IMPACTS**Mohammed CHADLI**

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Abstract

The energy industry is focusing its development efforts on photovoltaic technologies, particularly dye-sensitized solar cells (DSSC) and organic solar cells (OSC). These technologies are less expensive than conventional silicon photovoltaic cells, mainly due to less complex manufacturing processes and the use of less expensive materials. Our study focuses on the design and study of new organic materials, characterized by specific molecular structures, to optimize photovoltaic performance in the last two generations of DSSC and OSC solar cells using different molecular modeling methods.

This study focuses on the computational analysis (using Gaussian 09) of new D- π -A dyes obtained from triphenylamine while replacing the original molecule M1 with different acceptors denoted Ai (i=2-7). The geometric, electrical, and optical properties of these dyes were calculated using density functional theory (DFT) and time-dependent DFT, using the B3LYP/6-31 G (d,p) model.

The factors considered in this study are light-harvesting efficiency (LHE), open-circuit photovoltage (V_{OC}), electron injection driving force (ΔG_{inj}), dye regeneration driving force (ΔG_{reg}), excited-state lifetime (τ), and reorganization energy (λ_{total}). The latter shows a strong correlation with the short-circuit photocurrent density (J_{SC}) and the overall efficiency of DSSCs. This scientific approach contributes to the design of dyes most capable of improving DSSC efficiency.

Keywords: Renewable energy, Solar cell, DSSC, Molecular Modeling, DFT, TD-DFT.

INNOVATIVE PATHWAYS FOR CIRCULAR ECONOMY: REPURPOSING COAL MINE WASTE IN CONSTRUCTION MATERIALS**Dr Bishnu Pada Bose**

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Abstract

With the rapid growth of population and urbanization, waste accumulation has been rising at an exponential rate. The biosphere has already exceeded its natural carrying and regenerative capacity due to the prevailing linear consumption model, which follows the “take–make–use–dispose” approach. To counter this unsustainable trend, it is imperative to embrace the philosophy of the circular economy, emphasizing reduction, reuse, and recycling. The primary objective of this study is to identify waste materials that are both environmentally harmful and abundantly available, while also being readily accessible for potential applications in civil engineering. Based on a comprehensive analysis of various waste streams and in alignment with our objectives, coalmine overburden has been selected for detailed experimental investigation. An experimental study in this study has demonstrated that all the components of the coal mine waste material can be put to valuable use. After pulverization of the large stones and separating the silt and coal particles, all the stones can be used as large and small aggregates for making concrete, bricks, and mortar. Silt can be mixed with ordinary clay to make fired clay bricks and energy can be harvested out of the coal particles. Mechanical properties of concrete, bricks, and mortar made out of mine stones are similar to their standard counterparts. The outcomes of this study highlight the immense potential of transforming waste materials into valuable resources, thereby mitigating their damaging impact on the environment. Through recycling, waste is granted a “second life,” effectively extending its end-of-life cycle and preventing indiscriminate dumping into the environment. In the context of the construction industry, this approach not only curbs waste generation but also partially replenishes the rapidly depleting reserves of essential natural resources. This practice is firmly aligned with the 3R principles of waste management “Reduce, Reuse, and Recycle” while also extending them to include Replenish (restoring scarce resources) and Release land (freeing up land previously occupied by waste). In this sense, the process adds a new dimension to the circular economy, evolving beyond the conventional “make–use–dispose” model into a more regenerative cycle of make–use–recycle–replenish. By replenishing natural resources, even to a modest extent, this model not only reduces environmental degradation but also alleviates the mounting pressure on ecosystems. Additionally, the release of vast land areas previously burdened by waste deposits opens opportunities for more productive and sustainable uses. Altogether, the process represents a significant step toward operationalizing the circular economy philosophy, where waste becomes a resource, resource scarcity is mitigated, and environmental sustainability is reinforced. Entrepreneurship driven by the adoption of process technologies developed in this research carries significant social and environmental value, strongly aligned with the principles of the Circular Economy. By transforming polluting waste materials into usable resources, entrepreneurs will not only eliminate environmental hazards but also close the loop of waste generation. This approach directly addresses the contamination of water, air, and soil, gradually restoring ecological balance and improving public health. Moreover, the reduction of heavy metal accumulation in nearby soils will enhance agricultural productivity, thereby strengthening the local economy. In addition, the reclamation of land currently burdened with waste deposits will open opportunities for productive and sustainable uses, further reinforcing the vision of a regenerative, resource-efficient Circular Economy.

Keyword: Circular economy, Waste, Mine waste, Waste recycling, Construction materials

COMPARATIVE EVALUATION OF SINGLE AND DOUBLE HTL DESIGNS IN PEROVSKITE SOLAR CELLS**İlker Fatih GÜNGÖR**

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Abstract

Perovskite solar cells are one of the emerging solar cell technologies for post silicon solar cells. This study focuses on performance analysis of MAPbI₃ based perovskite solar cells with a single- or double- hole transfer layer (HTL) architectures, by a variety of HTL materials. In the first stage, solar cells with a single-HTL were examined. The thickness of the absorber layer varied between 100 - 1500 nm, and the optimum thickness was determined based on the resulting data. Then, defect density analyses were conducted, and the effects of different defect density levels on the open-circuit voltage (V_{oc}), short-circuit current density (J_{sc}), fill factor (FF) and power conversion efficiency were determined. Different HTL materials were employed for the solar cell with single- and double-HTL structure. Among the materials employed as HTLs, the highest power conversion efficiencies were achieved with CNTS, MoO₃, CuSbS₂ and NiO, exhibiting values of 22.00%, 21.96%, 21.93%, and 21.88%, respectively. In the analyses conducted through energy band diagrams, the influence of the valence band offset (VBO) at the absorber/HTL interface was evaluated. In the second stage of the study, the double-HTL configuration was examined. For this structure, additional HTL materials were incorporated on the NiO and Spiro-OMeTAD layers, and the resulting changes in the solar cell parameters, energy band alignment, and recombination characteristics were investigated in detail. Improvements with double-HTL structure were observed depending on the material. All simulations in this study were performed using the SCAPS-1D software, and the electrical, optical, and interfacial properties of each layer were comprehensively evaluated. The findings demonstrate the impact of material selection in both single and double-HTL configurations and contribute to a deeper understanding of HTL behavior under distinct structural arrangements. In this context, the results are expected to support the future development of perovskite-based solar cells.

Keywords: perovskite solar cells, double-HTL, SCAPS-1D

PERFORMANCE ANALYSIS OF THINNER SILICON SOLAR CELLS FOR HIGH-EFFICIENCY PHOTOVOLTAICS**Sefer Altan ÇELTİK**Karadeniz Technical University, Department of Electrical and Electronics Engineering, Trabzon-Türkiye
ORCID: 0009-0009-8380-4250**Abdullah ÜZÜM***Karadeniz Technical University, Department of Electrical and Electronics Engineering, Trabzon-Türkiye
(Responsible author) ORCID: 0000-0001-5324-8892**Abstract**

Silicon-based solar cells continue to be the dominant photovoltaic technology in the market. Industrial trends are increasingly focusing on thinning silicon wafers, aiming to achieve high efficiency with thinner silicon bulk while reducing costs. However, this structural transition introduces severe optoelectronic limitations and recombination losses due to insufficient optical path lengths and an increased surface-to-volume ratio. To address these specific trade-offs and overcome efficiency limits in thin structures, this study presents a comprehensive performance analysis of thin silicon based solar cells. In this study, the absorber layer thickness varied across the 10-300 μm range for optimization purposes and a 150 μm bulk thickness was selected as considering both optical saturation data and accessibility within current industrial production standards. The spectral effects of emitter thickness were investigated within the range of 0.1-1.0 μm , and 0.7 μm thickness was determined as the optimum operating point to minimize shunting risks associated with industrial metallization processes. Bulk and emitter layer thicknesses, surface recombination velocity (SRV) and temperature effects on such thin structures were analyzed in detail. As a solution for the surface recombination drawback caused by the thick emitter cases, for example, adjustments should be carried out at the interface to reduce the SRV. This phenomenon is simulated by varying the front SRV in a wide range from 10^5 cm/s to 150 cm/s. To investigate the effect of the ambient temperature on such thin solar cells, temperature varied between -20°C and +80°C and results were analyzed. All simulations in this study were performed using the SCAPS-1D software, and the electrical, optical, and interfacial properties were evaluated. Applied thin solar cell design achieved a 20.84% conversion efficiency outlining a high-performance pathway for thinner silicon solar cell technology.

Keywords: Solar cell, Thin c-Si, Surface passivation, Photovoltaic, SCAPS-1D.

**COMPARATIVE ANALYSIS OF MACHINE LEARNING AND DEEP LEARNING TECHNIQUES
FOR SHORT-TERM SOLAR RADIATION PREDICTION****Ömer GÖNÜL**Turkish-German University, Department of Energy Science and Technology, Beykoz/İstanbul, Türkiye
ORCID: 0000-0003-4091-3376**Abstract**

Accurate prediction of solar radiation plays a critical role in the efficient operation and planning of photovoltaic (PV) power systems, energy management, and smart grid integration. In this study, a comparative analysis of two advanced machine learning and deep learning approaches which are Extreme Gradient Boosting (XGBoost) and Long Short-Term Memory (LSTM) neural networks for short-term global horizontal irradiance (GHI) prediction using high-resolution time series data. In the simulations, the solar radiation dataset of Bursa province with a 10-min time resolution and a four-year time span is used. 80% and 20% of the data is allocated for training and testing, respectively. Both models are optimized via grid search to obtain the best hyperparameter configuration. As performance parameters, Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Bias Error (MBE), and the coefficient of determination (R^2) are evaluated. Moreover, computation time is also taken to measure the model speed. The results showed that both models perform superior performance, and the XGBoost model provides slightly higher accuracy than LSTM. The XGBoost model yields 0.980 R^2 , while the LSTM model has 0.977 R^2 . Moreover, the RMSE values for XGBoost and LSTM are 39.602 and 42.984 W/m², respectively. For the computation time, XGBoost model present remarkable lower time, which 13.64 s for XGBoost and 173.54 s for LSTM model. Therefore, this highlights the practical applicability of XGBoost. In general, this study emphasizes the potential of machine learning and deep learning techniques for short-term solar radiation prediction and contributes to the improvement of renewable energy operations.

Keywords: solar radiation, prediction, machine learning, deep learning, photovoltaic system, smart grid.

**ZAMANSAL KORELASYONLU FOTOVOLTAİK SİSTEM VE YÜK DİNAMİKLERİ DİKKATE ALINARAK DAĞITIM SİSTEMLERİNDE GERİLİM DEĞİŞİMLERİ****Mustafa Erkan GÖNÜL**

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Özet

Yenilenebilir enerji teknolojilerinin hızla yaygınlaşmasıyla birlikte, dağıtım seviyesinden entegre edilen fotovoltaik (PV) sistemlerin şebeke işletme koşulları üzerindeki etkileri önemli bir araştırma konusu olmuştur. PV güç üretimi güneş ışınımı, sıcaklık ve bulutluluk gibi çevresel faktörlere bağlı olarak zamansal değişkenlik gösterirken, yük talebi de kullanıcı davranışlarına ve günün saatine bağlı olarak değişebilmektedir. PV güç üretiminin hava koşullarına duyarlılığı, üretim ve tüketim arasındaki eşzamanlılığın belirsizleşmesine neden olur. Düşük yük koşullarında yüksek PV üretimi, ters güç akışı ve yükselen gerilim seviyelerine neden olabilir. Bu nedenle, olası durumların dikkate alınarak belirsizliklerin özellikle gerilim seviyeleri açısından nicel olarak değerlendirilmesi, dağıtım sistemlerindeki gerilim değişimlerinin analizinde büyük önem taşımaktadır. Bu çalışmada, farklı PV katılım seviyeleri altında olasılıksal güç akışı analizleri, Matlab/Matpower kullanılarak IEEE 33 baralı radyal dağıtım hattı üzerinde gerçekleştirilmiştir. Güneş ışınımındaki olasılıksal değişimler, Beta dağılımını takip eden Monte Carlo Simülasyonları kullanılarak üretilmiştir. Yük değişimleri ise konut, ticari ve sanayi tüketicilerine ait zaman serisi profilleri üzerinden temsil edilmiştir, ayrıca gerilime bağlı yük karakteristikleri de dikkate alınmıştır. Her baradaki kurulu PV gücü, baranın temel yüküne orantılı olarak belirlenmiş ve farklı yük senaryoları altında %0, %20, %50, %80, %100 ve %120 PV katılım seviyeleri için gerilim değişimleri gözlemlenmiştir. Elde edilen sonuçlar, PV entegrasyonu ve yük profilinin etkileşiminin belirli bir katılım seviyesine kadar gerilim profilinde iyileşme sağlayabileceğini, ancak PV katılım oranı arttıkça bu etkinin tersine dönerek sistem genelinde kademeli bir gerilim artışı eğilimini ortaya çıkarabileceğini göstermektedir. Bu durum, yüksek PV katılım senaryolarında etkin gerilim düzenleme mekanizmalarının gerekliliğini vurgulamakta ve PV entegrasyonunun dağıtım şebekesi üzerindeki etkilerinin yalnızca katılım seviyesiyle değil, aynı zamanda yük profili ve normal koşullar için seçilen işletme gerilimiyle birlikte değerlendirilmesi gerektiğini ortaya koymaktadır.

Anahtar Kelimeler: Olasılıksal güç akışı, fotovoltaik katılım oranı, Monte Carlo Simülasyon, dağıtım şebekeleri, gerilim değişimi, yük belirsizliği.

VOLTAGE VARIATIONS IN DISTRIBUTION SYSTEMS CONSIDERING TIME-CORRELATED PHOTOVOLTAIC SYSTEM AND LOAD DYNAMICS**Abstract**

With the increasing penetration of renewable energy technologies, the effects of photovoltaic (PV) systems integrated at distribution level on grid operating conditions have become an important research topic. PV power generation exhibits temporal variability depending on environmental factors such as solar irradiance, temperature, and cloud cover, while load demand also varies with user behaviour and time of day. The dependency of PV power generation on weather conditions introduces uncertainty in the coincidence between generation and consumption. High PV generation under low load conditions can lead to reverse power flow and rising voltage levels. Therefore, quantitative assessment of uncertainties, particularly regarding voltage levels under possible scenarios, is essential for analyzing voltage changes in distribution systems. In this study, probabilistic power flow analyses under different PV penetration levels are performed on IEEE 33-bus radial

distribution system using Matlab/Matpower. Probabilistic variations in solar irradiance are generated through Monte Carlo Simulations following Beta probability distributions. Load changes are represented using time series profiles for residential, commercial, and industrial consumers, and voltage-dependent load characteristics are also considered. Installed PV power at each bus is set proportionally to the bus baseload, and voltage changes are observed for PV penetration levels of 0%, 20%, 50%, 80%, 100%, and 120% under different load scenarios. The results indicate that interaction between PV integration and load profile can improve voltage profile up to a certain penetration level, but as PV penetration increases, this effect can reverse, revealing a gradual voltage rise across the system. This highlights the necessity of effective voltage regulation mechanisms in high PV penetration scenarios and shows that the impacts of PV integration on distribution networks must be evaluated not only by penetration level but also considering load profile and chosen operating voltage under normal conditions.

Keywords: Probabilistic power flow, photovoltaic penetration ratio, Monte Carlo Simulation, distribution networks, voltage variations, load uncertainty.

GRID CODE COMPLIANCE OF PHOTOVOLTAIC POWER PLANTS CONSIDERING P-Q CAPABILITY CURVES**Faruk UGRANLI**

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Abstract

The increasing deployment of photovoltaic (PV) power plants in today's electrical grids is reducing system inertia, thereby making grid code compliance more important. As PV plants are connected to the grid via power electronics inverters, their ability to meet active and reactive power support requirements specified in grid regulations depends on the development of detailed inverter- and plant-level models. Comprehensive testing of the static and dynamic behaviour of PV plants under possible operating conditions is therefore necessary. In this framework, the capability curves of inverters and the dependence of PV plant output on irradiance and temperature play a key role in determining operational strategies. In this study, a grid-connected PV plant is modelled in Matlab and its response under various scenarios is evaluated for grid code compliance. Both the inverter P-Q capability curve and varying irradiance profiles are embedded directly into the model, enabling static and dynamic analyses of reactive-power support during LVRT and normal operation. In addition, the analysis explicitly incorporates the total reactance at the PV plant's point of interconnection, including transformer and inverter-filter reactances together with bus-voltage and power-angle, which jointly enter the formulation through the coupled active and reactive power-flow equations, while the inverter's characteristic P-Q capability curve is consistently enforced within this unified framework. The results show that the P-Q capability must be examined alongside the available power of PV arrays dependent on irradiance, since this interaction becomes critical during clipping events. When reactive-power setpoints are evaluated jointly with P-Q limitations, appropriate selection of the operating point on PV array power-voltage curve can maintain required grid support while reducing active-power clipping losses. Another important point to note is that, besides the inverter's P-Q capability limits, dc-ac ratio in PV plant design will grow in significance for effectively utilizing available power in future high-PV-penetration grids.

Keywords: Grid code, PV power plant, PQ capability curve, LVRT, reactive power, dc-ac ratio.

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**INFRARED THERMOGRAPHY BASED FAULT DETECTION IN PV POWER PLANTS:
LIMITATIONS, TECHNOLOGICAL BOTTLENECKS, FUTURE RESEARCH PATHWAYS****Faruk UGRANLI**

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Abstract

Thermal imaging has emerged as one of the most effective and non-intrusive methods for fault detection, performance assessment, and maintenance optimization in photovoltaic (PV) systems. Its ability to rapidly map infrared-based temperature distributions has made thermography an essential component of both manual and drone-assisted inspections in large-scale PV plants. Although the studies provide detailed descriptions of thermal signatures associated with hotspots, bypass-diode failures, delamination, soiling, cell cracks, and PID-related degradation, most existing studies remain largely qualitative. This limitation highlights notable research gaps in automated fault classification, quantitative power-loss estimation, and mitigation of environmental effects. Several notable shortcomings are evident in existing studies. Automation frameworks capable of processing high-resolution drone-based thermal data in real time remain limited, as current systems struggle with data volume and computational burden, making immediate decision-making difficult. Another challenge is the strong similarity between the thermal patterns of different faults can produce nearly indistinguishable temperature signatures, which leads to misclassification and unnecessary maintenance interventions. Additionally, thermal measurements are highly sensitive to irradiance, wind, ambient temperature, and humidity, reducing the comparability of datasets obtained under different conditions. The studies consistently highlight the absence of dynamic correction models capable of normalizing environmental effects to standard reference conditions. This study addresses these gaps within a unified framework and identifies several development directions. First, more generalizable deep-learning-based classifiers are needed to enable real-time processing of thermal imagery. Second, hybrid data-fusion approaches combining thermal images with electrical measurements and meteorological information represent a promising strategy for achieving more consistent power-loss estimation. Additionally, the development of physics-based or machine-learning-supported dynamic correction models capable of translating thermal data into standardized conditions is a critical need. The observations obtained indicate that these research directions could substantially strengthen fault detection and performance-monitoring practices in PV plants, complementing current operational methods.

Keywords: PV power plants, thermal imaging, fault detection, maintenance optimization

SUSTAINABLE FACILITY MANAGEMENT IN HIGHER EDUCATION: A SYSTEMATIC REVIEW OF RECENT ADVANCES AND FUTURE DIRECTIONS**Sinan GÜNEŞ**

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Abstract

Sustainable facility management in higher education institutions has undergone a profound transformation between 2020 and 2025, driven by climate urgency, digital innovation, and post-pandemic operational changes. This systematic review synthesises findings from Web of Science-indexed journals to examine recent advances in campus sustainability across five critical dimensions: governance evolution, green building strategies, energy efficiency technologies, social sustainability, and climate action. Analysis of over 80 peer-reviewed articles reveals a shift in paradigm from isolated environmental initiatives to integrated, strategically governed sustainability frameworks. Key findings demonstrate that IoT-enabled smart campus systems achieve energy reductions of 34-70% in HVAC, while carbon neutrality commitments have accelerated dramatically, with 85% of publications emerging after 2019. However, critical gaps persist between technical building performance and occupant satisfaction, with studies showing that green-certified buildings often fail to guarantee user comfort. The review identifies persistent challenges in quantifying Scope 3 emissions, climate adaptation planning, and integrating social dimensions into facility management practices. Post-pandemic disruptions revealed building flexibility deficits while accelerating the adoption of hybrid operational models and predictive control systems. The synthesis concludes that successful sustainable facility management requires synchronised advancement across technical infrastructure, stakeholder engagement, governance structures, and behavioural dimensions. Future research priorities include standardised benchmarking methodologies, longitudinal performance tracking, climate adaptation strategies, and integration of occupant well-being metrics into sustainability frameworks. This review provides actionable insights for campus facility managers, policymakers, and researchers advancing the energy transition in educational built environments.

Keywords: sustainable facility management, green campus, energy efficiency, indoor environmental quality, higher education, climate action

THE STRATEGIC ROLE OF FACILITY MANAGEMENT IN ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

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Abstract

The discipline of facility management has evolved from being merely a support function executing operational processes to becoming a strategic governance mechanism in the implementation of sustainable development policies. While the existing literature predominantly addresses facility management from an operational efficiency perspective, there exists a conceptual gap regarding its strategic integration with global governance frameworks such as the United Nations Sustainable Development Goals (SDGs). Given the critical importance of the operational phase of the built environment in the context of the climate crisis, there emerges a necessity to reconceptualize the strategic role of facility management within the sustainability agenda. In this context, facility management is positioned as a multidimensional interface facilitating interaction among building stock performance, energy efficiency, carbon emissions, user satisfaction, and corporate governance processes. The primary objective of this study is to develop an integrative conceptual framework demonstrating how facility management can strategically contribute to SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Based on a literature review and comparative analysis of international best practice examples, the study demonstrates that facility management delivers measurable sustainability outcomes in the areas of energy efficiency, waste management, renewable energy utilization, carbon reduction, stakeholder engagement, and social responsibility. The study conceptually defines three strategic levels at which facility management can operate: operational level (performance optimization), tactical level (stakeholder management and governance mechanisms), and strategic level (integration of long-term sustainability objectives into corporate strategies). The proposed framework systematically addresses the integration of technologies such as BIM, IoT, and digital twins into sustainability objectives and data-driven decision-making processes. Furthermore, it reveals that integrating SDG-oriented performance indicators into facility management strategies enhances corporate accountability and governance transparency, thereby strengthening institutional resilience against environmental risks. Based on the findings, facility management should be conceptualized as a strategic governance instrument that transforms sustainability objectives into corporate performance. This repositioning contributes both theoretical insights to the academic literature and provides an applicable framework for policymakers. Recognition of the strategic role of facility management is critically important in achieving global commitments such as the Paris Climate Agreement and the European Green Deal.

Keywords: facility management, sustainable development goals, energy efficiency, resource management, sustainable governance

**İKLİM DİPLOMASİSİ VE COP****Oğuzhan ERDOĞAN**

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Özet

İklim diplomasisi, küresel iklim değişikliğiyle mücadelede devletler, uluslararası örgütler, sivil toplum kuruluşları ve özel sektörün iş birliğine dayalı çok taraflı müzakere süreçlerini kapsayan stratejik bir alandır. Bu çerçevede Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi (BMİDÇS) kapsamında düzenlenen Taraflar Konferansı (Conference of Parties COP) toplantıları, küresel iklim yönetişiminin en önemli platformu olarak uluslararası iklim politikalarının şekillendiği, bağlayıcı ve yönlendirici kararların alındığı diplomatik bir zemindir. Kyoto Protokolü (COP3), Paris Anlaşması (COP21) ve Glasgow İklim Paketi (COP26), iklim diplomasisinin dönüştürücü gücünü ortaya koyan temel dönüm noktalarıdır. Bu süreçler, emisyon azaltım taahhütleri, uyum politikaları, finansman mekanizmaları ve kayıp-zarar fonu gibi kritik konuların uluslararası gündeme taşınmasını sağlamıştır. İklim diplomasisi, sadece çevresel bir mesele olmayıp aynı zamanda ekonomik, politik, güvenlik ve etik boyutları olan bütüncül bir küresel yönetim sorunu olarak değerlendirilmektedir. COP zirveleri, gelişmiş ve gelişmekte olan ülkeler arasındaki iklim adaleti, ortak fakat farklılaştırılmış sorumluluklar ve finansman yükümlülükleri gibi tartışmalı konulara çözüm üretme kapasitesine sahiptir.

Bu makalede, iklim diplomasisinin teorik temelleri, COP süreçlerinin tarihsel dönüşümü, aktörlerin rolü ve karar mekanizmalarının işleyişi incelenmektedir. Ayrıca, COP toplantılarının iklim diplomasisine katkıları, küresel iklim yönetişimi açısından etkinliği ve gelecekteki politika perspektifleri değerlendirilmektedir. Elde edilen bulgular, iklim diplomasisinin, sürdürülebilir kalkınma hedefleriyle uyumlu, kapsayıcı ve adil bir küresel iklim rejimi inşasında kritik bir araç olduğunu ortaya koymaktadır.

Anahtar Kelimeler: İklim, İklim Diplomasisi, Taraflar Sözleşmesi, COP.

CLIMATE DIPLOMACY AND COP**Abstract**

Climate diplomacy is a strategic field that encompasses multilateral negotiation processes based on cooperation between states, international organizations, civil society organizations, and the private sector in the fight against global climate change. In this context, the Conference of Parties (COP) meetings organized under the United Nations Framework Convention on Climate Change (UNFCCC) are the most important platform for global climate governance, where international climate policies are shaped. The COP meetings are the most important platform for global climate governance, where international climate policies are shaped. The COP meetings are the most important platform for global climate governance, where international climate policies are shaped. Framework Convention on Climate Change (UNFCCC) (Conference of Parties - COP) meetings are the most important platform for global climate governance, a diplomatic arena where international climate policies are shaped and binding and guiding decisions are made. The Kyoto Protocol (COP3), the Paris Agreement (COP21), and the Glasgow Climate Pact (COP26) are fundamental milestones that demonstrate the transformative power of climate diplomacy. These processes have ensured that critical issues such as emission reduction commitments, adaptation policies, financing mechanisms, and loss and damage funds are brought to the international agenda. Climate diplomacy is not only an environmental issue but also a holistic global governance issue with economic, political, security, and ethical dimensions. COP summits have the capacity to produce solutions to controversial issues such as climate justice between developed and developing countries, common but differentiated responsibilities, and financing obligations.

This article examines the theoretical foundations of climate diplomacy, the historical transformation of the COP processes, the role of actors, and the functioning of decision-making mechanisms. Furthermore, the contributions of COP meetings to climate diplomacy are evaluated in terms of their effectiveness in global climate governance and future policy perspectives. The findings reveal that climate diplomacy has been effective in Furthermore, the contributions of COP meetings to climate diplomacy, their effectiveness in terms of global climate governance, and future policy perspectives are evaluated. The findings reveal that climate diplomacy is a critical tool in building an inclusive and equitable global climate regime that is consistent with sustainable development goals.

Key Words: Climate, Climate Diplomacy, Parties Convention, COP.

**TURNING POINT IN THE GLOBAL ENERGY TRANSITION: THE 2025 ENERGY REPORT
CARD OF G20 COUNTRIES****Veysel YILMAZ**

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Abstract

This study examines the energy transition performance of G20 countries as of 2025, drawing on data from the Energy Institute database. The primary objective of the research is to present the current status of the world's largest economies in terms of total energy supply, diversity of fuel sources, per capita energy consumption, and energy-related carbon dioxide (CO₂) emissions, and to comparatively assess their progress in alignment with global climate targets.

The analysis of the 2020–2024 period reveals that China and the United States remain dominant actors in global energy supply. However, their energy profiles diverge significantly. Despite investments in renewable energy, China continues to pursue a coal-intensive growth model, whereas the United States maintains a diversified structure by balancing fossil fuels and renewable sources. In advanced economies such as Germany, the United Kingdom, and Japan, declining carbon emissions have been observed as a result of energy efficiency measures and transition policies. Conversely, in emerging economies such as India, Indonesia, and Russia, rising energy demand and dependence on fossil fuels have led to continued increases in emissions. From the perspective of energy security, resource-rich countries such as Saudi Arabia and Canada rank among the highest in per capita energy supply. In energy-importing countries such as Turkey, growing demand and reliance on fossil fuels have heightened vulnerability risks.

Since the period under review coincides with the Covid-19 pandemic, temporary fluctuations in energy demand and consumption dynamics were observed. In conclusion, the study points to a critical turning point in the global energy transition. Achieving energy security and decarbonization targets simultaneously requires stronger international cooperation and technology transfer within the framework of the theme “Solidarity, Equity, and Sustainability.”

Keywords: G20, Energy Transition, Fossil Fuels, Renewable Energy, CO₂ Emissions.

**KÜRESEL ENERJİ DÖNÜŞÜMÜNDE KIRILMA NOKTASI: G20 ÜLKELERİNİN 2025 ENERJİ
KARNESİ****Özet**

Bu çalışma, Enerji Enstitüsü veri tabanından elde edilen verileri kullanarak, G20 ülkelerinin 2025 yılı itibarıyla enerji geçiş performansını incelemektedir. Araştırmanın temel amacı, dünyanın en büyük ekonomilerinin toplam enerji arzı, yakıt kaynaklarının çeşitliliği, kişi başına düşen enerji tüketimi ve enerji kaynaklı karbondioksit (CO₂) emisyonları açısından mevcut durumlarının ortaya konulması ve küresel iklim hedefleri doğrultusunda kaydettikleri ilerlemeyi karşılaştırmalı olarak değerlendirmektir.

2020–2024 dönemi için yapılan analiz sonuçlarında elde edilen bulgularda Çin ve Amerika Birleşik Devletleri küresel enerji arzında baskın aktörler olmaya devam etmektedirler. Bununla birlikte bu ülkelerin de enerji profillerinin belirgin şekilde ayrıştığı görülmektedir. Çin, yenilenebilir enerji yatırımlarına rağmen kömür yoğun bir büyüme modeli sürdürmekte iken ABD fosil yakıtlar ve yenilenebilir kaynaklarını dengeli kullanarak çeşitlendirmiş bir durumdadır. Almanya, Birleşik Krallık ve Japonya gibi gelişmiş ekonomilerde enerji verimliliği ve dönüşüm politikaları sayesinde karbon emisyonlarında düşüş eğilimi gözlemlenmiştir. Hindistan, Endonezya ve Rusya gibi yükselen ekonomilerde ise artan enerji talebi ve fosil yakıt bağımlılığı nedeniyle emisyonların yükselmeye devam ettiği tespit edilmiştir. Enerji güvenliği açısından Suudi Arabistan

ve Kanada gibi rezerv zengini ülkeler kişi başına düşen enerji arzında üst sıralarda yer almıştır. Türkiye gibi enerji ithalatçısı ülkelerde artan talep ve fosil yakıt bağımlılığı kırılganlık riskini artırmaktadır.

İncelenen dönem Covid-19 pandemisiyle çakışan bir dönem olduğundan enerji talebi ile tüketim dinamiklerinde geçici dalgalanmalara yol açmıştır. Sonuç olarak, çalışma küresel enerji dönüşümünde kritik bir kırılma noktasına işaret etmektedir. Enerji güvenliği ile dekarbonizasyon hedeflerinin eş zamanlı başarılabilmesi için “Dayanışma, Eşitlik ve Sürdürülebilirlik” teması çerçevesinde daha güçlü uluslararası işbirliği ve teknoloji transferi gerekliliğine vurgu yapılmalıdır.

Anahtar Kelimeler: G20, Enerji Dönüşümü, Fosil Yakıtlar, Yenilenebilir Enerji, CO₂ Emisyonları.

**TURKEY'S STRATEGIC RELATIONS WITH ITS NEIGHBORS IN ENERGY TRADE: IMPORTS AND EXPORTS DURING THE PERIOD 2016–2025****Veysel YILMAZ**

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Abstract

Turkey's unique geopolitical position renders energy security and foreign trade strategies one of the fundamental pillars of the country's macroeconomic stability. In particular, its critical role within the Eurasian energy corridor necessitates a detailed analysis of trade dynamics with neighboring states. This study examines the structure of Turkey's energy trade and the degree of sectoral specialization with its ten bordering countries (Russia, Azerbaijan, Iran, Iraq, Georgia, Bulgaria, Greece, Syria, Ukraine, and the Turkish Republic of Northern Cyprus) by employing the Trade Balance Index (TBI) methodology. Drawing upon data from the Turkish Statistical Institute (TURKSTAT) for the period 2016–2025, the analysis focuses on four major energy categories: coal, crude oil and petroleum products, natural gas, and electricity. The findings reveal structural asymmetries in Turkey's energy trade across partner countries. In the case of hydrocarbon-rich states such as Russia, Iran, and Iraq, TBI values consistently approach -1, indicating Turkey's position as a strong "net importer" and confirming its high external dependency on primary energy resources. Conversely, trade relations with the Turkish Republic of Northern Cyprus exhibit a constant TBI value of +1, signifying Turkey's status as a "fully specialized net exporter" in this market. Another noteworthy outcome is observed along the western corridor. In trade with Bulgaria and Greece, particularly in electricity and refined petroleum products, TBI values fluctuate across years, with Turkey periodically assuming the role of a net exporter. In conclusion, the study demonstrates that Turkey continues to maintain its dependency on external sources for raw energy inputs, while simultaneously strengthening its potential to act as a regional supply hub in electricity and processed petroleum products.

Keywords: Turkey, Energy Trade, Trade Balance Index, Energy Security

**TÜRKİYE'NİN ENERJİ TİCARETİNDE KOMŞULARIYLA OLAN STRATEJİK İLİŞKİLERİ:
2016-2025 DÖNEMİ İHRACAT VE İTHALATI****Özet**

Türkiye'nin sahip olduğu özgün jeopolitik konum, enerji arz güvenliği ve dış ticaret stratejilerini ülkenin makroekonomik istikrarının en temel bileşenlerinden biri haline getirmektedir. Özellikle Avrasya enerji koridorundaki kritik rolü, sınır komşularıyla olan ticari dinamiklerin analizini zorunlu kılmaktadır. Bu çalışma, Türkiye'nin on sınır komşusu (Rusya, Azerbaycan, İran, Irak, Gürcistan, Bulgaristan, Yunanistan, Suriye, Ukrayna ve KKTC) ile yürüttüğü enerji ticaretinin yapısını ve sektörel uzmanlaşma düzeylerini Ticaret Dengesi Endeksi (TBI) yöntemiyle incelemektedir. Araştırmada, Türkiye İstatistik Kurumu (TÜİK) veri tabanından elde edilen 2016–2025 dönemi verileri kullanılarak; taş kömürü, ham petrol ve petrol ürünleri, doğal gaz ve elektrik enerjisi olmak üzere dört temel enerji kalemi detaylı şekilde analiz edilmiştir. Elde edilen bulgular, Türkiye'nin enerji ticaretinde partner ülkelere göre yapısal asimetrisi barındırdığını göstermektedir. Hidrokarbon rezervleri açısından zengin olan Rusya, İran ve Irak ile yürütülen ticarete TBI değerlerinin istikrarlı bir şekilde -1'e yaklaştığı tespit edilmiştir. Bu durum, Türkiye'nin birincil enerji kaynaklarında güçlü bir "net ithalatçı" olduğunu ve yüksek dışa bağımlılığını teyit etmektedir. Buna karşın, Kuzey Kıbrıs Türk Cumhuriyeti ile olan ticari ilişkilerde TBI değeri sürekli +1 seviyesinde gerçekleşmiş ve Türkiye'nin bu pazarda "tam uzmanlaşmış net ihracatçı" olduğu belirlenmiştir. Çalışmanın dikkat çekici bir diğer sonucu ise batı hattında gözlemlenmiştir. Bulgaristan ve Yunanistan ile gerçekleştirilen elektrik enerjisi ve rafine petrol ürünleri ticaretinde endeks değerleri yıllara göre dalgalanma göstermekte olup, Türkiye'nin bu kalemlerde dönemsel olarak net ihracatçı konuma geçtiği görülmüştür. Sonuç olarak çalışma, Türkiye'nin ham madde

tedarikinde dışa bağımlı yapısını koruduğunu, ancak elektrik ticareti ve işlenmiş petrol ürünlerinde bölgesel bir tedarik merkezi olma potansiyelini güçlendirdiğini ortaya koymaktadır.

Anahtar Kelimeler: Türkiye, Enerji Ticareti, Ticaret Dengesi Endeksi, Enerji Arz Güvenliği

**NÜKLEER GÜÇ SANTRALLERİNİN FİZİKİ GÜVENLİĞİNDE KURUMLAR ARASI
KOORDİNASYON: KRİZ VE RİSK YÖNETİMİ PERSPEKTİFİ****Dr. Ahmet SARNIÇ**

Jandarma ve Sahil Güvenlik Akademisi

Özet

Nükleer güç santralleri, enerji arz güvenliği, ekonomik sürdürülebilirlik ve ulusal savunma kapasitesi açısından stratejik öneme sahip kritik altyapılardır. Bu tesislerin fiziki korunması yalnızca teknik güvenlik önlemlerine dayanmaz; çok paydaşlı bir yönetim modeli, kurumlar arası koordinasyon ve etkin kriz yönetimi süreçlerinin bütünselik biçimde işletilmesini gerektirir. Bu çalışma, nükleer güç santrallerinin fiziki korunmasında yer alan temel aktörler (Tesis İşletmesi, Nükleer Düzenleme Kurumu, Jandarma Genel Komutanlığı, AFAD, Emniyet, yerel otoriteler ve destek birimleri) arasındaki iş birliği mekanizmalarını kriz yönetimi döngüsü çerçevesinde incelemektedir.

Çalışmada öncelikle nükleer fiziki koruma sisteminin katmanlı mimarisi açıklanmış; tehdit tipleri (sabotaj, siber saldırı, drone/İHA ihlalleri, iç tehdit, yetkisiz giriş vb.) yönetsel bir risk perspektifiyle değerlendirilmiştir. Ardından hazırlık, müdahale ve iyileştirme aşamalarını kapsayan kriz yönetimi döngüsü doğrultusunda kurumlar arası komuta-kontrol yapılarına, bilgi ve istihbarat paylaşımına, ortak tatbikatlara, koordinasyon toplantılarına ve karar alma süreçlerine odaklanılmıştır. Bulgular, nükleer güvenliğin yalnızca teknik bir mesele olmadığını; kurumlar arası senkronizasyon, örgütsel dayanıklılık, rol-netliği, ortak operasyon kültürü ve sürekli iletişim gibi yönetim–organizasyon bileşenlerinin kritik önemde olduğunu göstermektedir.

Sonuç olarak çalışma, Türkiye’nin nükleer güvenlik kapasitesini güçlendirmek adına çok paydaşlı yönetim modelinin kurumsallaştırılmasını, düzenli tatbikatların standardize edilmesini, ortak risk değerlendirme sistemlerinin geliştirilmesini ve kriz yönetimi protokollerinin ulusal düzeyde uyumlaştırılmasını önermektedir. Bu yönüyle araştırma, hem enerji güvenliği literatürüne hem de kritik altyapı yönetimi uygulamalarına akademik bir katkı sunmaktadır.

Anahtar Kelimeler: Nükleer güç santrali, fiziki koruma, kurumlar arası iş birliği, kriz yönetimi, Risk yönetimi güvenliği,

**INTER-INSTITUTIONAL COORDINATION IN THE PHYSICAL SECURITY OF NUCLEAR
POWER PLANTS: A CRISIS AND RISK MANAGEMENT PERSPECTIVE****Abstract**

Nuclear power plants are among the most critical infrastructures in terms of energy supply security, economic sustainability, and national defense capacity. The physical protection of these facilities does not solely depend on technical safeguards but requires a comprehensive governance approach involving multi-agency coordination and an integrated crisis management framework. This study examines the cooperation mechanisms among key actors involved in the physical protection of nuclear power plants—Plant Operators, the Nuclear Regulatory Authority, the Gendarmerie General Command, AFAD, Police, local authorities, and supporting units—through the lens of the crisis management cycle.

The study first outlines the layered structure of nuclear physical protection systems and evaluates major threat categories (sabotage, cyberattacks, drone/UAV incursions, insider threats, unauthorized access) from a managerial risk perspective. It then analyzes command-and-control arrangements, information and intelligence sharing, joint exercises, coordination meetings, and decision-making processes within the stages of crisis management: preparedness, response, and recovery. Findings show that nuclear security is not merely a technical challenge; it fundamentally depends on organizational factors such as interagency synchronization, role clarity, organizational resilience, collaborative operational culture, and continuous communication.

The study concludes by proposing the institutionalization of a multi-stakeholder governance model, the standardization of regular joint exercises, the development of integrated risk assessment systems, and the harmonization of national crisis management protocols to strengthen nuclear security capacity. In this respect, the research contributes to both the energy security literature and practical approaches to critical infrastructure protection.

Keywords: Nuclear power plant, physical protection, interagency cooperation, crisis management, Risk management,

**THE PROCESS OF EUROPEANISATION IN EUROPEAN UNION ENERGY POLICIES
FOLLOWING THE RUSSIA-UKRAINE WAR: THE CASE OF GERMANY****Asst. Prof. Dr. Burçin ULUĞ**

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Abstract

The Russia-Ukraine war has triggered a profound transformation process in the European Union's energy policies, leading to a redefinition of the concepts of energy supply security, sustainability, and strategic autonomy. This paper aims to analyse the changing EU energy strategies post-war through the example of Germany within the framework of the Europeanisation theory. The Europeanisation approach is a multi-layered theoretical model that explains how policies, norms and institutional structures developed at the EU level are reflected in the national policies of member states. In this context, the study aims to assess how Germany's energy policies interact with structural transformation in Europe.

Within the scope of the research, the impact of policy frameworks such as the REPowerEU Plan, the European Green Deal, the European Energy Union strategy and sustainable development goals on Germany's national energy vision will be examined. The alignment of Germany's energy security policies with the normative targets set at European level will be investigated. Furthermore, the importance of renewable energy investments and alternative supply networks in the process of reducing energy dependence on Russia will be assessed.

The study will emphasise that the European Union's energy policies must be addressed not only in economic terms but also in terms of their normative, environmental and strategic dimensions. The findings are expected to clarify Germany's decisive role in European energy policies and how the Europeanisation process works in the field of energy security. In this respect, the research aims to bring a new analytical perspective to the literature on energy policies and European integration.

Keywords: European Union, Energy Policies, Germany, Europeanisation, Energy Security.

**1973 PETROL KRİZİ’NİN CUMHURİYET GAZETESİ’NE YANSIMALARI****Erol Emre SAYIL**

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Özet

Bu çalışma, 1973 Petrol Krizi’nin Cumhuriyet Gazetesi’ne yansımalarını kapsamlı bir biçimde incelemektedir. Çalışmanın ana problemi, küresel ölçekte ekonomik ve siyasal dengeleri sarsan bu kriz sürecinin Türkiye’de nasıl algılandığı, medya söylemine nasıl aktarıldığı ve Cumhuriyet Gazetesi’nin haberler, köşe yazıları, yorumlar ve analizlerinde hangi temalar üzerinden temsil edildiğidir. Araştırmanın amacı, dönemin medya dilini ve kriz karşısındaki toplumsal algıyı tarihsel bağlamda çözümleyerek, basının ekonomik ve siyasal krizleri çerçeveleme ve kamuoyuna aktarma biçimlerini ortaya koymaktır. Yöntem olarak nitel araştırma yöntemlerinden tarama-derleme yöntemi ile içerik analizi yöntemi kullanılmıştır. Bu kapsamda 1973–1974 yıllarını kapsayan dönemde Cumhuriyet Gazetesi’nin ekonomi, dış haberler, enerji, iç siyaset ve toplumsal haber sayfalarından seçilen haberler, başyazılar ve yorum yazıları tematik kategoriler hâlinde detaylı olarak analiz edilmiştir. Analizler, petrol kıtlığı, fiyat artışları, enerji politikaları, toplumsal endişe, hükümet uygulamaları, uluslararası diplomasi, enerji güvenliği ve kriz karşısındaki kamuoyu tepkisi gibi başlıkların, gazetenin kriz söyleminde merkezi bir rol oynadığını göstermektedir. Ayrıca gazetede kullanılan dilin tonu, hükümet politikalarının ele alınış biçimi, önerilen ekonomik ve sosyal önlemler ve halkın bilgilendirilme biçimi de değerlendirilmiştir. Çalışma, 1973 Petrol Krizi’nin Türkiye’de ve dünyada gündelik yaşamdan devlet politikalarına kadar uzanan geniş, çok boyutlu etkilerini ve Cumhuriyet Gazetesi’nin bu süreci kamuoyuna aktarmadaki belirleyici rolünü ortaya koymaktadır. Bu yönüyle araştırma, basın tarihine ve Türkiye’nin 1970’ler siyasi-ekonomik atmosferine ışık tutmayı da amaçlamaktadır.

Anahtar Kelimeler: 1973 Petrol Krizi, Enerji Krizi, Cumhuriyet Gazetesi, Basın, Türkiye

REFLECTIONS OF THE 1973 OIL CRISIS IN CUMHURİYET NEWSPAPER**Abstract**

This study comprehensively examines the reflections of the 1973 Oil Crisis in Cumhuriyet newspaper. The main research problem concerns how this crisis, which disrupted global economic and political balances, was perceived in Turkey, how it was conveyed through media discourse, and through which themes it was represented in *Cumhuriyet*’s news reports, opinion columns, commentaries, and analyses. The aim of the study is to analyze the media language of the period and societal perceptions of the crisis within their historical context, thereby revealing the ways in which the press framed economic and political crises and communicated them to the public. Methodologically, the study employs qualitative research methods, specifically the literature review (survey–compilation) method and content analysis. Within this framework, news items, editorials, and commentary articles selected from the economy, foreign affairs, energy, domestic politics, and social news pages of *Cumhuriyet* during the 1973–1974 period were examined in detail under thematic categories. The analyses demonstrate that themes such as oil shortages, price increases, energy policies, social anxiety, government practices, international diplomacy, energy security, and public reactions to the crisis played a central role in the newspaper’s crisis discourse. In addition, the tone of the language used in the newspaper, the manner in which government policies were addressed, the economic and social measures proposed, and the ways in which the public was informed were also evaluated. The study reveals the broad and multidimensional impacts of the 1973 Oil Crisis in Turkey and worldwide, ranging from everyday life to state policies, as well as the decisive role of *Cumhuriyet* in conveying this process to the public; in this respect, the research also aims to shed light on press history and Turkey’s political and economic atmosphere of the 1970s.

Keywords: 1973 Oil Crisis, Energy Crisis, Cumhuriyet Newspaper, Press, Turkey

INVESTIGATION OF INTEGRATION OF PHOTOBIOREACTOR (PBR) SYSTEMS TO BUILDING ENVELOPE**Ezgi AVCI**

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Abstract

Energy plays a crucial role in the building sector throughout all phases of a building's life cycle, from construction to demolition, with the highest level of consumption generally occurring during the operational phase. In recent years, limiting the use of fossil fuels and expanding the adoption of renewable energy sources have become primary objectives, while the European Union has aimed to ensure that new buildings have been designed as nearly zero-energy buildings since 2021 and to achieve carbon neutrality by 2050. Within this framework, increasing energy efficiency in buildings and integrating renewable energy technologies are of critical importance. Among renewable energy sources such as solar and wind, biomass energy is considered a sustainable and effective alternative for meeting building energy demands. Biomass energy, derived from plant- and animal-based resources, is an environmentally friendly energy source and has gained widespread application through its use in biofuel production as well as electricity generation and heating. In buildings, energy supply is provided through pellet stoves, biomass boilers, and cogeneration systems; in recent years, however, the integration of photobioreactors into the building envelope has emerged as an innovative approach. The performance of these systems varies depending on factors such as the building's geographical location, solar exposure duration, and climatic characteristics, which are regarded as important parameters influencing implementation costs. This study addresses the current state of biomass energy utilization in building envelopes and examines the technical characteristics and implementation processes of the system in detail. The findings indicate that photobioreactors contribute to meeting energy requirements, reducing noise levels, and minimizing environmental impacts. In the context of climate change and the objectives of the Paris Agreement, the importance of building-integrated systems based on renewable energy sources is increasing. This study demonstrates that biomass-based photobioreactors offer contributions to building applications from theoretical and practical perspectives overall.

Keywords: Energy, renewable energy, biomass energy, photobioreactor (PBR), building envelope.

FOTOBİYOREAKTÖR (FBR) SİSTEMLERİN BİNA KABUĞUNA BÜTÜNLEŞTİRİLMESİNİN İNCELENMESİ**Özet**

Enerji, bina sektöründe yapıların inşasından yıkımına kadar geçen tüm aşamalarda önemli bir rol oynamakta olup, en yüksek tüketim genellikle işletme sürecinde gerçekleşmektedir. Günümüzde fosil yakıt kullanımının sınırlandırılması ve yenilenebilir enerji kaynaklarının yaygınlaştırılması öncelikli hedefler arasında yer almakta, Avrupa Birliği ise 2021'den itibaren yeni yapıların neredeyse sıfır enerjili tasarlanmasını ve 2050 yılına kadar karbon nötre ulaşılmasını amaçlamaktadır. Bu çerçevede, binalarda enerji verimliliğinin artırılması ve yenilenebilir enerji teknolojilerinin entegrasyonu kritik öneme sahiptir. Biyokütle enerjisi, güneş ve rüzgar gibi yenilenebilir kaynakların yanında, bina enerji ihtiyacının karşılanmasında sürdürülebilir ve etkin bir alternatif olarak değerlendirilmektedir. Biyokütle enerjisi, bitkisel ve hayvansal kaynaklardan elde edilen çevre dostu bir enerji türü olup, biyoyakıt üretimi, elektrik ve ısıtma amaçlı kullanım alanlarıyla günümüzde

yaygınlık kazanmıştır. Binalarda pelet soba, biyokütle kazanı ve kojenerasyon sistemler aracılığıyla enerji temini sağlanmakta, son yıllarda ise fotobiyoreaktörlerin bina kabuğuna entegrasyonu yenilikçi bir yaklaşım olarak öne çıkmaktadır. Bu sistemlerin performansı; binanın coğrafi konumu, güneşlenme süresi ve iklim özelliklerine bağlı olarak değişmekte, bu da uygulama maliyetlerini etkileyen önemli bir unsur olarak görülmektedir. Bu çalışmada, biyokütle enerjisinin bina kabuğunda kullanımının mevcut durumu ele alınmış, sistemin teknik özellikleri ve uygulama süreçleri detaylı biçimde incelenmiştir. Bulgular, fotobiyoreaktörlerin; enerji gereksinimlerinin karşılanmasında, gürültü azaltımında ve çevresel etkilerin minimize edilmesinde önemli katkılar sağladığını göstermektedir. Küresel iklim değişikliği bağlamında ve Paris Anlaşması hedeflerine ulaşılabilmesi amacıyla, yenilenebilir enerji kaynaklarına dayalı bina entegrasyon sistemlerinin önemi giderek artmaktadır. Bu çalışma, biyokütle temelli fotobiyoreaktörlerin bina uygulamalarında hem teorik hem de pratik açıdan katkı sunabileceğini ortaya koymaktadır.

Keywords: Enerji, yenilenebilir enerji, biyokütle enerjisi, fotobiyoreaktör (PBR), bina kabuğu.

**INNOVATIVE AND SUSTAINABLE HOUSING SOLUTIONS: ENERGY-EFFICIENT DESIGN
APPROACHES FOR THE SOS 2024 COMPETITION****Olcay Türkan YURDUGÜZEL**

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Abstract

It is necessary to develop proposals to address the negative consequences of earthquakes that have occurred in our country at different times, resulting in significant loss of life and property. This study aims to present the architectural project design prepared for the Temporary Shelter Scenarios competition, announced under this theme and initiated by ISMD in 2024. By explaining the decision-making processes of the user-oriented design, which introduces a new interpretation of the concept of shelter, the study seeks to highlight its innovative aspects. Although the primary focus of the competition is earthquakes, decisions regarding energy conservation were also incorporated into the proposed design. Ensuring energy conservation in the design, implementation, and usage phases of the proposed project, as well as completing the design process with environmentally friendly decisions through the use of renewable energy sources, has been prioritized.

In the design, which operates with the potential to respond to various variables, user-centered determinants such as changes in the number of occupants, demographic diversity, neighborhood relations, and socialization were considered, while façade articulation and aesthetics were also included as key concepts in the process. In accordance with the competition specifications, the decisions made aim to ensure that the structure is long-lasting and responsive to user needs, while offering diverse usage possibilities, maintaining harmony with the environment, and incorporating aesthetic considerations that guide the design. The model proposal derived from the design process is presented by emphasizing the guiding role of flexibility and sustainability in shaping the design. The study also discusses the pursuit of new materials that contribute to the project's originality and distinctiveness, evaluating their potential role in the construction process. The proposed project offers rapid production, flexibility, adaptability to various user types, the ability to add or remove units based on the number of users, the use of renewable energy sources, and the incorporation of an innovative fiber material that provides economic advantages during the production process. In the proposal, which is considered to have high implementation potential, design decisions were made and presented within the framework of sustainability to prevent damage to energy resources.

Keywords: Earthquake, Housing, Flexibility, Sustainability, Innovative Fiber Material, Energy Conservation.

ASSESSMENT OF THE CURRENT STATUS OF URBAN GREEN SPACE AND CARBON STORAGE POTENTIAL IN TÜRKİYE**Mahmut TUĞLUER**

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Mert ÇAKIR

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Abstract

Climate change directly impacts the environmental structure and the use of natural resources in cities. Urban green spaces play a crucial role in this process due to their carbon storage capacity and environmental functions. This study compared the current amount of urban green spaces in Turkey and their carbon storage potential with international data.

The urban green space standards used in the study were based on planning approaches in different countries and recommendations from globally recognized official institutions and organizations. These standards were used as a reference for comparing Turkey's current situation. While the amount of green space per capita in Turkey is generally above the lower limit, it remains below ideal levels. This average value across Turkey varies significantly among cities. While the amount of green space remains quite low in some cities, others exhibit values closer to planning targets.

Data on carbon storage potential in Turkey is still limited, and studies are largely localized and limited to specific sample areas. Current findings indicate that carbon storage levels vary depending on tree density, age structure, and the location of green spaces. The location, continuity, and distribution of green spaces within cities directly impact carbon sequestration.

In conclusion, while the average amount of green space in Turkey meets basic requirements, imbalances between cities, the spatial location of green spaces, and limited carbon sequestration data highlight the need for more comprehensive studies in this area.

Keywords: Green spaces; Carbon stock; Green space standards; Ecosystem services; Türkiye

TÜRKİYE'S BLUE CARBON ECOSYSTEMS: ECOLOGICAL FUNCTIONS AND IMPORTANCE**Mahmut TUĞLUER**

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Abstract

Blue carbon ecosystems, which include seagrass meadows, salt marshes and mangrove-like coastal plant communities, play an important role in global climate regulation by capturing atmospheric carbon and storing it within sediment layers for long periods. Türkiye has diverse coastal environments along the Mediterranean, Aegean, Marmara and Black Seas that support habitats with significant blue carbon potential. However, studies assessing these ecosystems at a national scale are still limited. This study compiles current scientific information to identify the main blue carbon ecosystems in Türkiye, describe their carbon sequestration processes, and evaluate their ecological value within the context of conservation.

Seagrass meadows in the Mediterranean and Aegean regions, especially areas dominated by *Posidonia oceanica* and *Cymodocea nodosa*, store carbon effectively through dense rhizome structures and their ability to stabilize sediments. Salt marshes in the Gediz, Göksu, Kızılırmak, and Çukurova deltas contribute to long-term carbon storage through high biomass production and slow decomposition under oxygen-poor conditions. Although Türkiye does not contain true mangrove forests, reed and halophytic shrub communities in lagoon environments perform similar functions related to sediment trapping and carbon accumulation.

Human activities such as coastal development, drainage, pollution, and intense marine traffic continue to degrade these ecosystems and reduce their carbon storage capacity. Establishing a national blue carbon inventory, improving long-term monitoring efforts, expanding protection measures, and restoring damaged areas are essential steps for strengthening Türkiye's climate mitigation strategies.

Keywords: Blue carbon ecosystems; Seagrass meadows; Coastal carbon sequestration; Salt marshes; Climate change mitigation

**EVALUATION OF REFUNCTIONALIZED BUILDINGS IN TERMS OF SUSTAINABILITY AND ACCESSIBILITY: THE EXAMPLE OF RAMI LIBRARY****Hülya ALGUR MARŞOĞLU**

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Abstract

It's not always possible for buildings to maintain their original designed functions throughout their physical lifespan. By preserving and repurposing the building stock, a building can preserve its identity while also acquiring a new role within the city. This repurposing process contributes to the preservation of cultural heritage and significantly supports the concept of sustainability. While repurposing buildings, it's crucial to make them accessible to all. Furthermore, accessibility ensures the functional continuity of buildings, ensuring the most efficient use of existing building stock. This, in turn, serves the criteria of sustainable architecture. In addition to functional continuity, minimizing buildings' carbon footprint and the environmental burden they impose also forms the basis of sustainability. In this context, the conversion and repurposing of the Rami Library in Istanbul from a barracks to a library was examined in terms of sustainability and accessibility. In this context, sustainability and accessibility were addressed by considering material use, waste management, energy efficiency, accessibility for all disability types, and universal design principles, and criteria were determined for the evaluation of the building. These criteria were then assessed on a Likert scale, revealing the criteria considered during this process. By jointly considering sustainability and accessibility criteria in repurposed buildings, this study aims to serve as a model for future studies and highlight their value in repurposing.

Keywords: Sustainability, accessibility, Rami Library, refunctionalized buildings

YENİDEN İŞLEVLENDİRİLMİŞ YAPILARIN SÜRDÜRÜLEBİLİRLİK VE ERİŞİLEBİLİRLİK AÇISINDAN DEĞERLENDİRİLMESİ: RAMİ KÜTÜPHANESİ ÖRNEĞİ**Özet**

Yapıların fiziksel ömürleri boyunca tasarlandıkları özgün işlevleriyle devam etmeleri her zaman mümkün değildir. Yapı stoğunun korunup yeniden işlevlendirilmesi ile yapının kimliğini koruyarak kent içerisinde yeni bir rol kazanması sağlanabilir. Bu yeniden işlevlendirilme süreci, kültürel mirasın korunmasına katkı sağlarken aynı zamanda da sürdürülebilirlik kavramına önemli şekilde destek olmaktadır. Yapılara yeni bir işlev kazandırılırken aynı zamanda yapıların herkes için erişilebilir kılınması büyük önem arz etmektedir. Bununla birlikte erişilebilirlik, yapıların işlevsel sürekliliğini güvence altına alarak, mevcut yapı stoğunun en verimli şekilde kullanılmasını sağlamaktadır. Bu durum da sürdürülebilir mimarlık kriterlerine hizmet etmektedir. İşlevsel sürekliliğin yanı sıra, yapıların karbon ayak izinin ve doğaya getirdikleri yükün minimize edilmesi de sürdürülebilirlik anlayışının temelini oluşturmaktadır. Bu bağlamda İstanbul'da yer alan Rami Kütüphanesi'nin kıışladan kütüphaneye dönüşümü ve yeniden işlevlendirilmesi, sürdürülebilirlik ve erişilebilirlik açısından incelenmiştir. Bu kapsamda sürdürülebilirlik ve erişilebilirlik; malzeme kullanımı, atık yönetimi, enerji verimliliği, engel türlerine uygun erişilebilirlik ve evrensel tasarım ilkeleri göz önünde bulundurularak ele alınmış ve yapının değerlendirilmesi için kıstaslar belirlenmiştir. Bu kıstaslar Likert ölçeğine oturtularak yapının sürdürülebilirlik ve erişilebilirlik açısından durum değerlendirilmesi yapılarak bu süreçte hangi kıstaslara dikkat edildiği ortaya konulmuştur. Bu çalışmanın yeniden işlevlendirilen yapılarda

sürdürülebilirlik ve erişilebilirlik kriterlerinin birlikte ele alınmasıyla bu açıdan ileride yapılacak çalışmalar için bir örnek teşkil etmesi ve yeniden işlevlendirmedeki değerlerinin ortaya konulması hedeflenmektedir.

Anahtar Kelimeler: Sürdürülebilirlik, erişilebilirlik, Rami Kütüphanesi, yeniden işlevlendirilmiş yapılar

**KÖMÜR YAKITLI TERMİK SANTRALLERDE KARBON YAKALAMA VE DEPOLAMA
(KYKD) SİSTEMLERİNİN ENERJİ OPTİMİZASYONU VE KARBON FİYATLAMA
SENARYOLARI ALTINDA FİZİBİLİTE ANALİZİ****İsmail ÖZDEMİR**

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Özet

Küresel enerji talebini karşılamak üzere fosil yakıtların kullanımının artması, atmosferdeki CO₂ konsantrasyonunu yükselterek iklim değişikliği ve küresel ısınma gibi ciddi çevresel riskleri oluşturmaktadır. Bu problemlere yanıt olarak, ulusal ve uluslararası karbonsuzlaşma hedeflerine ulaşmada Karbon Yakalama ve Depolama (KYKD) teknolojisi kritik bir çözüm olarak öne çıkmaktadır. Bu çalışma, KYKD sistemlerinin termik santrallere entegrasyonundan kaynaklanan verim kayıplarının optimizasyonunu ve bu sistemlerin karbon fiyatlama mekanizmaları altındaki finansal fizibilitesi üzerine odaklanmaktadır. Bu çalışmada, mevcut kömür yakıtlı termik santrallerde yanma sonrası karbon yakalama teknolojilerinden kimyasal çözücü (MEA) ile yakalama işlemi üzerine odaklanılmıştır. Santralin proses parametreleri Chemcad programı kullanılarak modellenmiş ve simüle edilmiştir. KYKD sistemlerinin bir enerji santraline entegrasyonu, termodinamik açıdan ciddi dezavantajlar oluşturur. Bunun sebebi, yakalanan CO₂'nin zengin çözeltiden ayrılması için tasarlanan yenileyici (regenerator) ünitelerinin gerektirdiği yüksek ısı enerjisidir. Bu ısı yükü genellikle 100-120 °C aralığındadır. Santralin ana buhar türbininden buhar çekilerek karşılanmak zorunda kalır. Bu zorunlu buhar çekimi, santralin net elektrik veriminde doğrudan bir düşüşe neden olur. Yapılan simülasyonlar, bu verim kaybının yaklaşık %10 düzeyinde olduğunu göstermekle birlikte, ileri proses entegrasyonu ve atık ısı geri kazanımı gibi termodinamik iyileştirme stratejileri sayesinde bu kaybın önemli bir bölümünün telafi edilebileceği de kanıtlanmıştır. Ayrıca, 2025–2050 yılları arasındaki fosil yakıtlardan kaynaklı CO₂ emisyonlarının yakalanması, depolanması ve satışı üzerine karbon vergisi uygulaması öngörülerek bir fizibilite çalışması yapılmıştır. Fizibilite çalışmasında, KYKD santrallerinin yüksek sermaye maliyetleri nedeniyle, özellikle düşük karbon vergisi uygulamasında geri dönüş sürelerinin çok uzun olduğu görülmüştür. Ancak çevre politikaları kapsamında uygulamaya konulacak orta ve yüksek seviye karbon vergisi senaryoları ve ilave karbondioksit satışları ile bu geri dönüş sürelerinin kısaldığı sonucuna varılmıştır. Sonuç olarak, KYKD teknolojisinin termik santrallerin karbonsuzlaşma hedefine ulaşması için kritik öneme sahip olduğu; ancak finansal sürdürülebilirliğin güçlü ve kararlı karbon fiyatlama araçlarının varlığına bağlı olduğu net bir şekilde ortaya konmuştur.

Anahtar Sözcükler: Karbon Yakalama ve Depolama Teknolojileri, Termik Santrallerde Karbon Yakalama ve Depolama, Karbon Vergisi, Enerji Optimizasyonu

**ENERGY OPTIMIZATION AND FEASIBILITY ANALYSIS OF CARBON CAPTURE AND
STORAGE (CCS) SYSTEMS IN COAL-FIRED THERMAL POWER PLANTS UNDER CARBON
PRICING SCENARIOS****Abstract**

The increasing use of fossil fuels to meet global energy demand is elevating CO₂ concentrations in the atmosphere, posing serious environmental risks such as climate change and global warming. In response to these problems, Carbon Capture and Storage (CCS) technology is emerging as a critical solution for achieving national and international decarbonization goals. This study focuses on the optimization of efficiency losses arising from the integration of CCS systems into thermal power plants and their financial feasibility under carbon pricing mechanisms. This work specifically focuses on the post-combustion carbon capture process

using a chemical solvent (MEA) in existing coal-fired thermal power plants. The plant's process parameters were modeled and simulated using the Chemcad program. The integration of CCS systems into a power plant creates significant thermodynamic disadvantages. This is due to the high heat energy required by the regenerator units, which are designed to separate the captured CO₂ from the rich solvent. This heat load, typically in the range of 100-120 °C must be supplied by extracting steam from the plant's main steam turbine. This mandatory steam extraction directly causes a reduction in the plant's net electrical efficiency. Simulations conducted have shown that this efficiency loss is approximately 10%. However, it has also been demonstrated that a significant portion of this loss can be compensated through thermodynamic improvement strategies such as advanced process integration and waste heat recovery. Furthermore, a feasibility study was carried out, projecting the application of a carbon tax on the capture, storage, and sale of CO₂ emissions from fossil fuels between 2025 and 2050. The feasibility study revealed that due to the high capital costs of CCS plants, the payback periods are very long, especially under a low carbon tax application. However, it was concluded that these payback periods are shortened with the implementation of medium and high-level carbon tax scenarios within the scope of environmental policies and through additional carbon dioxide sales. In conclusion, it has been clearly established that CCS technology is critical for thermal power plants to achieve their decarbonization goals, but its financial sustainability depends on the existence of strong and stable carbon pricing instruments.

Keywords: Carbon Capture and Storage Technologies, Carbon Capture and Storage in Thermal Power Plants, Carbon Tax, Energy Optimization.

INTERNET OF VEHICLES (IoV)-BASED CYBERNETIC ROBOT OPERATION AND MONITORING SYSTEM ASSISTED BY RENEWABLE ENERGY**Helal Uddin**

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Abstract

In the field of mobile robotics, quadruped robots are essential platforms because they provide better stability and mobility over complicated and uneven terrain, where conventional wheeled robots frequently falter. Research on legged locomotion is still scarce in Bangladesh, despite its great suitability for industrial uses, military operations, and disaster relief. The mechanical optimization needed for cost-effective deployment in local contexts is frequently absent from current solutions. The goal of this project is to create an 8-degree-of-freedom (8-DoF) quadruped robot with an emphasis on improving gait generation, joint torque distribution, and mechanical architecture. The operational framework included thorough torque analysis and gait simulation after integrating 3D modeling to guarantee ideal weight distribution. The kinematic requirements of the 8-DoF system were managed through the implementation of a uniform actuator control scheme. The developed modular prototype showed adaptable locomotion modes and stable balancing in a variety of indoor environments. The combination of mechanical optimization and intelligent path-planning resulted in a dependable system that could adjust to changing operational requirements, according to experimental results. The resulting robotic platform demonstrates its suitability for tasks like search and rescue operations by providing a flexible and stable solution for critical environments.

Keywords- 8-Degree-of-Freedom (8-DoF); Quadruped Robot; Gait Design; Mechanical Architecture; Joint Torque Optimization; Mobile Robotics

A BIM-CFD HYBRID WORKFLOW FOR COASTAL COMMUNITIES TO DESIGN WIND-RESILIENT ROOF STRUCTURES**Helal Uddin**

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Abstract

Extreme cyclonic events, which frequently cause catastrophic damage to the built environment and local livelihoods, are particularly common in Bangladesh's southwest coastal region. The structural integrity of residential housing has emerged as a crucial issue for disaster risk reduction as climate change increases the frequency of these storms. Conventional roof geometries frequently experience structural uplifts and failure due to their inability to sustain high wind loads. Despite this vulnerability, there aren't many climate-resilient, optimized housing designs that are aerodynamically validated for the wind speeds found in this deltaic area. The goal of this study was to create a climate-resilient housing model by evaluating and optimizing roof resilience against high-velocity cyclone winds using Building Information Modeling (BIM) and Computational Fluid Dynamics (CFD). Revit 2024 was used to create roof models, which were then put through CFD simulations at a typical cyclone wind speed of 240.5 km/h. By contrasting a suggested octagonal roof design with a typical hip roof, performance was assessed. To determine drag and suction forces, these simulations were verified through laboratory wind tunnel testing. The hip roof underwent unstable flow separation at the eaves and ridgelines with high suction forces, according to simulation results. The octagonal roof, on the other hand, showed 31% less suction and a more even pressure distribution. The hip roof's leeward suction force was 39% greater than the octagonal roof's, according to laboratory validation. The octagonal roof geometry provides better aerodynamic stability than conventional designs, as confirmed by the integration of BIM and CFD analysis. In coastal Bangladesh, this model offers a workable, robust way to lessen housing damage caused by cyclones.

Keywords: Aerodynamic; CFD Simulations; BIM; Wind Tunnel; Coastal; Mechanical Design

SIGNIFICANCE OF NONLINEAR THERMAL RADIATION AND ACTIVATION ENERGY ON FREE-CONVECTIVE MHD NANOFLUID FLOW OVER A STRETCHING DISK**Ephesus O. Fatunmbi**

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Abstract

Free-convective magnetohydrodynamic nanofluid flow over stretching surfaces plays a vital role in many modern engineering operations where enhanced heat and mass transfer is required. Typical applications include polymer sheet extrusion, thermal coating and drying, thin-film fabrication, solar energy collectors, cooling of rotating machinery, and catalytic chemical reactors using nanoparticle suspensions. This study therefore analyzes the combined effects of nonlinear thermal radiation and activation energy on free-convective MHD nanofluid flow over a stretching disk. The mathematical model accounts for Brownian motion, thermophoresis, buoyancy forces, and chemical reactions to provide a realistic description of high-temperature processes. Nonlinear Rosseland radiation is incorporated to represent strong radiative heat flux variations, while the Arrhenius activation energy term captures the energy threshold required for reactive nanofluid species. Similarity transformations reduce the governing equations to nonlinear ordinary differential equations, which are solved numerically. Results indicate that nonlinear radiation substantially elevates temperature distribution and thickens the thermal boundary layer, whereas activation energy enhances concentration gradients and improves nanoparticle stability by moderating reaction rates. The magnetic parameter suppresses radial velocity but strengthens thermal profiles through Lorentz-force heating. These findings offer useful guidance for optimizing thermal management and chemical processing in systems involving stretching surfaces and reactive nanofluids.

Keywords: Activation energy; Free convective flow; Stretching Disk; Nonlinear thermal radiation;

STUDY OF INSOLATED SYNCHRONOUS GENERATOR UNDER UNBALANCED LOAD CONDITIONS**Bajram LEKA**

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Abstract

This study aims to analyse the efficiency of isolated synchronous generators in unbalanced load conditions. During this laboratory experiment, will be analysed synchronous generator performance as an isolated unit from the grid. This kind of experiment is really important to define the stability, power quality, and efficiency of synchronous generators in such applications as standalone generating systems. Will also be analysed due to unbalanced load the output voltage, frequency, torque oscillations, efficiency, etc, using advanced measurement devices and techniques to understand the importance of unbalanced load impact and what is more important, to evaluate any possibility for performance improvement. Asymmetry created during laboratory experiments will be valued from 10% up to 50% and also for different types of loads, a comparison will be done between unbalanced and balanced loads in terms of efficiency. The experimental data shown the torque oscillations that impact in the generator himself also the torque ripple, increase in power losses proportional to unbalance so decrease in efficiency and impact on electricity parameters. The results from this experiment will provide useful information on unbalanced load effects and to proper management of energy systems because of this condition and take additional restrictions to improve this negative effect in the practical use of synchronous generators as a standalone generating unit.

Keywords: synchronous generator, unbalanced load, efficiency, torque oscillations, isolated grid.

ASSESSMENT OF SALINE IRRIGATION IMPACTS ON SOIL QUALITY AND DURUM WHEAT PRODUCTIVITY IN THE GHARB REGION: IMPLICATIONS FOR SUSTAINABLE WATER AND ENERGY MANAGEMENT

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Abstract

In the arid and semi-arid regions of Morocco, the progressive degradation of arable lands has been attributed to salt accumulation resulting from low precipitation, insufficient drainage, inadequate irrigation management, and prolonged drought periods. This study aims to assess the impact of saline irrigation on the physicochemical properties of soil and wheat yield in a controlled greenhouse environment. A randomized block design was employed, with NaCl concentrations of 0.3 g/L (control), 2.56 g/L, 5.12 g/L, 7.68 g/L, and 10.24 g/L. The physicochemical parameters of the soil evaluated include granulometry, pH, electrical conductivity (EC), as well as concentrations of Na, K, Mg, Ca, and Cl. The results demonstrated that elevated NaCl concentrations significantly affected these parameters. At the control concentration of 0.3 g/L, the pH was 7.20 ± 0.14 , EC was 1.28 ± 0.74 dS/m, and the concentrations of Na, K, Mg, Ca, and Cl were 2.85 ± 1.04 mg/kg, 0.45 ± 0.08 dS/m, 4.79 ± 0.75 dS/m, 6.86 ± 0.59 dS/m, and 12.45 ± 1.93 dS/m, respectively. At the highest NaCl concentration of 10.24 g/L, EC increased to 11.09 ± 5.16 dS/m, pH rose to 8.33 ± 0.35 , and the concentrations of Na and Cl increased to 5.50 ± 1.30 mg/kg and 16.45 ± 1.23 dS/m, respectively, while the levels of K, Mg, and Ca decreased. Regarding yield, a significant reduction was observed with increasing NaCl concentrations. At 0.3 g/L, grain yield was 1.12 t/ha, while at 10.24 g/L, it decreased to 0.16 t/ha. The weight of 200 grains also decreased, from 67 g to 11.6 g between these two concentrations. Similarly, biomass significantly declined with higher salinity levels. In conclusion, saline irrigation adversely affects soil physicochemical properties and significantly reduces durum wheat yield. These results highlight the importance of adopting effective salinity management strategies to sustain agricultural productivity in saline-affected regions.

Keywords: Salinity stress, Irrigation, Soil properties, Durum wheat, Soil fertility

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IMPACT OF CLEAN ENERGY POLICIES ON CO₂ EMISSIONS: A COUNTRY-LEVEL REVIEW

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Abstract

The implementation of clean energy policies has become a central strategy for countries aiming to reduce CO₂ emissions and achieve long-term climate goals. This study investigates the effectiveness of these policies using **secondary data** from globally recognized sources, including the International Energy Agency (IEA), World Bank, UNFCCC, and OECD. A comparative analysis of selected developed and developing nations from **2010 to 2024** reveals that countries adopting integrated energy frameworks—combining renewable energy incentives, carbon pricing, efficiency standards, and regulatory enforcement—demonstrated substantial reductions in carbon intensity and total emissions (IEA, 2023; OECD, 2023). Conversely, nations with inconsistent or short-term policy commitments showed minimal gains despite increased renewable capacity (UNFCCC, 2023; REN21, 2023). Data trends also show that stable policy environments attract higher clean-energy investments, which strongly correlate with emission reductions (World Bank, 2024; IRENA, 2023). Overall, the findings highlight the importance of policy stability, financial incentives, and long-term planning in achieving meaningful decarbonization. This research contributes valuable evidence for policymakers and stakeholders involved in global sustainability transitions.

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A STUDY OF BIOCOAL PRODUCTION FROM CO-RESIDUES OF COCOA (*Theobroma cacao*) AND KOLANUT (*Cola nitida*) AS A SUSTAINABLE RENEWABLE ENERGY**T. B. Onifade**

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Abstract

Nigeria possesses abundant agricultural resources with significant potential for renewable energy generation from biomass residues. Large quantities of Cocoa Pod Husks (CPH) and Kolanut Pod Husks (KPH) are residues that remain underutilized despite their high bioenergy value. Therefore, this study aims at converting these residues into sustainable biofuel briquettes. Uniform cylindrical briquettes were produced from the mixture of CPH and KPH, with cassava starch (binder) at varying proportions (30–70 g CPH, 15–55 g KPH, and 5–25 g cassava starch). CPH and KPH were milled, sieved to particle sizes below 7 mm and dried at temperatures ranging from 140°C to 220°C. Physical properties: Bulk Density (BD), Shatter Index (SI), Fracture Resistance (FR), Final Weights, and Crushed Weights were evaluated. Statistical analysis was done to compare the physico-mechanical performance of the briquettes under different production parameters.

Bulk density, shatter index, final weights, crushed weights and fracture resistance values ranged from $3.43\text{--}6.46 \times 10^2 \text{ g/cm}^3$, 72.4–91.3 %, 72.5–91.3 %, 7.24–16.27 g and 6.28–11.43 g, respectively. The bulk density value was 0.00646 g/cm³ at 6 mm mould thickness, the shatter index was 91.3 % and fracture resistance of 91.3 % was obtained at 5 g binder weight and 220 °C drying temperature. The value of stress at peak was 159.31 N/mm² with a standard deviation of 1.62, ranging from 155.18 to 160.54 N/mm². The values of deformation and force at peak were 8.285 mm and 5018.2 N, respectively. The values of strain and energy at peak were 414.2 % and 12.159 N. The values of Skewness ranged from -1.48 to 1.32, and kurtosis from 0.22 to 1.14.

Statistical analysis indicated that mould height, binder proportion, and drying temperature had significant effects ($p < 0.05$) on briquette density and durability.

The study has shown that CPH and KPH residues produced durable, high-quality briquettes with the highest mechanical stability at 4 mm mould height, 5 % binder concentration, and CPH-KPH of 30–40 g. The findings have practical applications in promoting renewable energy alternatives and improving dependence on sustainable biocoal in homes and industries.

Keywords: Biocoal, Briquetting, Cocoa pod husk, Kolanut pod husk, Renewable energy

GEOHERMAL ENERGY: ENGINEERING SUSTAINABILITY AND THE ENVIRONMENT**Helal Uddin^{1(a)}, Touhidur Rahman Sajib^{2(b)} and Md. Rasel Ahmed^{3(c)}**¹Department of Mechanical Engineering, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh.²Department of Management, Multimedia University, Malay, Malaysia³Department of Mechanical Engineering, Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh.**Abstract**

Geothermal energy is acknowledged as a fundamental renewable energy source that offers dependable, low-emission baseload heating and power. Even if it has a negligible environmental impact by nature, its acceptance necessitates precise procedures for handling any possible consequences. If fluid extraction surpasses natural recharge, geothermal reservoirs will eventually run out of resources. Additionally, operations must rigorously reduce possible dangers, such as induced seismicity, non-condensable gas (NCG) emissions, and trace heavy metal pollution. The essential technical and management procedures needed to guarantee the reservoir's long-term viability and attain complete environmental compliance across geothermal projects are described in this study. The concept of sustainability always boils down to refilling the reservoir with chilled fluids in a systematic manner. That maintains the pressure and prevents the contamination of the groundwater. On the compliance side we are continuously injecting and retracting NCGs so as to minimize the quantity that gets into the atmosphere, not to mention the fact that the temperature of whatever we inject is controlled such that any induced seismic risk that may arise can be kept at bay. These best practices are data-driven and offensive in nature, which ensures the resources last longer and reduces our environmental footprint, ensuring that we can comply with the requirements of Good International Practice and with any regulatory monitoring. When sustainable applications of geothermal power are upheld and enhanced by stringent reservoir engineering and environmental management, it is a seriously feasible and sustainable foundation to the global renewable energy funnel.

Keywords: Geothermal Energy; Sustainability; Reservoir Management; Reinjection; Induced Seismicity

SOCIO-BEHAVIORAL DYNAMICS INFLUENCING SOLAR ENERGY ADOPTION IN THE RURAL CONTEXT OF WALWA TALUKA, SANGLI**Dr. Vidya Sunil Kadam**

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Abstract

As the world shifts toward renewable energy, it becomes essential to understand the human side of this transition — how people’s thoughts, behaviors, and social surroundings shape their choices. This study looks into the socio-behavioral factors that influence how rural households in Walwa Taluka, Sangli district, accept and use solar energy.

Although solar technology is becoming more accessible, its adoption in rural areas is still low. Factors such as limited awareness, financial constraints, community influence, and personal perceptions often affect the decision to go solar. To explore this, the research uses a mix of surveys and interviews to understand how education, social norms, and attitudes play a role in energy-related decisions.

The findings highlight what truly motivates or discourages people from adopting solar energy. These insights can help policymakers, local authorities, and renewable energy developers design more people-centered strategies. The study aims to support a smoother and more inclusive shift toward sustainable energy in rural communities.

Keywords: Solar Energy Adoption, Socio-Behavioral Factors, Rural Communities, Walwa Taluka, Awareness and Perception

GIS-BASED ANALYSIS OF SPATIAL PATTERNS OF ACOUSTIC POLLUTION IN THE MUNICIPALITY OF TIRANA, ALBANIA**Xhulia BYGJYMI**

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Abstract

This study investigates the spatial patterns of acoustic pollution in the Municipality of Tirana by integrating in situ acoustic measurements with Geographic Information Systems (GIS). Rapid urbanization, intensified traffic flows, and continuous expansion of residential and commercial infrastructure have contributed to rising acoustic levels in Tirana, posing significant environmental and public-health challenges. To assess the spatial distribution and intensity of acoustic exposure, 150 georeferenced point measurements were collected using the NoiseCapture mobile application, which records LAeq and related acoustic indicators through standardized smartphone-based protocols. These measurements were imported into a GIS environment and interpolated using the Inverse Distance Weighting (IDW) method to generate a continuous surface representing intra-urban acoustic variability across 14 administrative units. Results reveal pronounced acoustic gradients shaped by the configuration of the urban road network, land-use typologies, and population density. Central units—particularly Units 7, 8, 9, and 10—exhibit the highest noise levels (often exceeding WHO daytime thresholds), primarily due to dense traffic, commercial concentration, and limited green buffering. Conversely, peripheral units display lower acoustic intensities, reflecting reduced traffic volumes and more dispersed settlement structures. The spatial patterns correspond closely with the classification presented in the accompanying bar graph, which quantifies unit-level differences and highlights road-proximity effects as the dominant factor influencing acoustic propagation. The analysis underscores that Tirana's acoustic environment is predominantly transport-driven, with noise exposure decreasing as a function of distance from major arterial corridors. The findings emphasize the need for targeted interventions, including official noise mapping, traffic-calming measures, improved façade insulation, and strategic placement of green buffers. Integrating spatial analyses with urban-planning approaches offers a critical foundation for designing evidence-based policies aimed at reducing acoustic pollution, safeguarding public health, and promoting sustainable urban development in an increasingly dynamic metropolitan context.

Keywords: acoustic pollution, urban area, spatial patterns, GIS

GEOSPATIAL MONITORING OF AIR QUALITY IN TIRANA**Denisa KUKAJ**

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Abstract

This study describes the use of geospatial technologies in assessing, visualizing and understanding air quality dynamics in Albania's largest metropolitan center, Tirana, which is experiencing rapid urban growth, increased traffic density and expanding construction activity.

Air quality monitoring was conducted in accordance with the National Standards on Technical Specifications for Geospatial Information in Albania, under the topic "Infrastructure for environmental monitoring", approved by the Decision of the Council of Ministers No. 210, dated 13.04.2023. These standards define unified requirements for the collection, processing and dissemination of geospatial data, ensuring methodological coherence and consistent quality in air pollution measurements. The implementation of this standardized framework improves data reliability and enables comparisons over time and across different areas of the city.

Data collected from direct measurements show that concentrations of atmospheric pollutants PM_{2.5}, PM₁₀, NO₂ and O₃ often exceed the limits recommended by international organizations, especially in areas with high traffic density and intense urban activity.

By mapping the spatial distribution of atmospheric pollutants, we have identified pollution hotspots - usually near major road corridors, industrial areas and densely populated neighborhoods.

Through the analysis of time series and Remote Sensing data, air quality patterns have been discovered in relation to meteorological conditions, traffic flow and heating practices. On this basis, policies that enable the reduction of atmospheric pollution levels such as traffic restrictions, expansion of green spaces, etc. can be designed.

Keywords: Air Pollution, Air Quality, Geoinformation, Pollution Management

**LEVERAGING LOCAL SOLAR RESOURCES IN A HYDROPOWER-DOMINATED SYSTEM:
POLICY AND PLANNING LESSONS FROM THE DURRËS REGION (ALBANIA)****Prof. Asoc. Dr. Sonila Sinjari**

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Abstract

Albania's power system remains heavily dominated by large hydropower, making the country highly sensitive to hydrological variability and market price shocks. At the same time, western coastal regions such as Durrës benefit from high solar irradiation and dense urban–industrial fabrics that are well suited for distributed photovoltaic (PV) deployment. This paper uses the Durrës Region as a strategic case to examine how local solar development can enhance energy security, decarbonization and climate resilience in hydropower-dependent systems, and how these insights can inform global renewable energy pathways.

The analysis combines existing spatial assessments of solar potential with a review of recent Albanian and European policy and planning reforms. Particular attention is given to three types of “anchor sites” for solar deployment: (i) public buildings and social infrastructure, (ii) port and logistics facilities, and (iii) industrial zones and brownfields within the wider urban region. For each category, the paper discusses regulatory, financial and institutional conditions that can unlock bankable PV projects, including prosumer rules, public–private partnership models and the integration of solar targets into urban and port-development strategies.

The findings show that even a relatively small coastal city–region can play a disproportionate role in national and regional energy transitions if local solar investments are prioritized in a limited number of high-impact sites and supported by clear multi-level governance frameworks. The paper concludes with policy recommendations that are transferable to other hydropower-reliant and emerging economies, arguing that locally grounded solar programs in port and industrial regions can make a tangible contribution to strengthening global renewable energy pathways.

Keywords: Solar energy; hydropower-dominated systems; renewable energy policy; energy security; urban and port planning; South-East Europe; Albania.

A STREAMLINED MACHINE LEARNING METHOD FOR PREDICTING URBAN HEAT ISLAND INTENSITY IN NIGERIAN CITIES USING ENVIRONMENTAL AND DEMOGRAPHIC FACTORS

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Abstract

The impact of Urban Heat Island (UHI) has taken a more critical turn in the fast-urbanizing areas, particularly during the hot season every year in Nigeria. The growing temperatures, perception of green cover, and growing resistant surfaces have increased the exposure to heat for millions of urban dwellers, thereby increasing health risks and electricity use and generally diminishing comfort in cities. This analysis reports a simplified, and efficient machine learning framework to predict the intensity of UHI based on the easily accessible environmental and demographic data. The aim is to create a modeling pipeline to be implemented in order to make data-driven heat mitigation decisions based on the major cities in Nigeria. To achieve the objectives, a synthetic dataset of 100,000 samples was created, with the variables of land surface temperature, vegetation index (NDVI), impervious surface fraction, population density, humidity, wind speed, elevation, and nighttime lights. The target variable was UHI intensity, calculated as the result of the interactions between these predictors. Three machine learning models, including linear regression, random forest, and XGBoost, were trained and assessed based on RMSE, MAE, and R^2 . This model choice provides a compromise between being simple, interpretable, and predictive. The importance of feature analysis was also done to determine the important drivers of UHI formation. Findings indicate that Random Forest and XGBoost are much better compared to linear regression, as they are able to effectively capture nonlinear environmental demographic interaction affecting the UHI intensity. Impervious surface fraction, land surface temperature, NDVI, and nighttime lights were found to be the most predictive variables. The modeling pipeline can be run with few computational resources, and it does not involve elaborate geospatial processing; thus, it can be deployed by urban planners, environmental researchers, and climate adaptation agencies in Nigeria in a short time.

Keywords: Environmental Data, Hot Season, Machine Learning, Urban Heat Island (UHI)

ENERGY–FOOD NEXUS IN EMPTYING HIMALAYAS: RENEWABLE ENERGY GOVERNANCE, NFSA IMPLEMENTATION, AND ENVIRONMENTAL VULNERABILITY IN UTTARAKHAND’S GHOST VILLAGES

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Abstract

On the one hand, rural depopulation in Uttarakhand, which has now become characterized by almost 1,800 so-called ghost villages, has instigated a cascading failure in the environmental governance, traditional ecological knowledge, and even simple service delivery systems. Another aspect of this crisis that has been overlooked is the energy-food security nexus: the erosion of the local energy systems, collapsing community institutions, and deserted landscapes of the National Food Security Act (NFSA), 2013, in remote Himalayan settlements, in particular. This paper analyses that depopulation interferes with NFSA delivery mechanisms such as PDS functioning, delivery of necessary commodities, grain storage, identification of beneficiaries, and community monitoring, and also cause energy deficits, which impact on cooking, food utilisation, and access to calories based on livelihood. Through the lens of the doctrinal legal approach, the paper examines inconsistencies in NFSA requirements and the environmental legal frameworks (BDA, FRA, EPA) and the facts of the shrinking hill community with diminishing local governmental resource base. It posits that in the case of depopulated areas, renewable and decentralised energy systems such as micro-hydro, solar village grids, clean cooking solutions and biomass-based community energy could also act as stabilising points in ecological governance as well as in the application of NFSA. By combining energy access and food distribution, transport vulnerabilities are diminished, storage conditions are improved, local agriculture based nutrition is promoted and community institutions like Gram Sabhas, Van Panchayats and Biodiversity Management Committees are rejuvenated. The article offers a proposal of a regenerative energy-food governance model in the Himalayas: the considerations of ghost villages as the priority spaces, where the implementation of renewable energy, ecological rehabilitation, and the NFSA food rights are collectively pursued to strengthen the resilience of the land, reduce the pressure of migration, and promote the rights-based approach to food security in weak mountain ecosystems. This would incorporate SDG 2, SDG 7, SDG 13, and SDG 15 as one and the same Himalayan governance strategy.

Keywords: Energy–food nexus; NFSA 2013; rural depopulation; ghost villages; Himalayan governance; renewable energy; environmental law; food security delivery; traditional ecological knowledge; decentralised energy systems.

**FORESTS AS PEDAGOGICAL SPACES FOR ENERGY RESILIENCE: ECOLOGICAL BASED
CHRISTIAN RELIGIOUS EDUCATION CURRICULUM DESIGN IN POST-DISASTER
INDONESIA****Desi SIANIPAR**

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Abstract

Indonesia faces a high level of ecological vulnerability due to deforestation, climate change, and weak natural resource governance, resulting in increased flooding and landslides as well as declining energy resilience. These challenges are not merely technical–environmental issues but also reflect a broader social, moral, and pedagogical crisis, including low levels of ecological literacy within society. In this context, Christian Religious Education (CRE) holds strategic potential to cultivate ecological awareness and faith-based responsibility for the care of creation. This study aims to formulate an ecology-based CRE curriculum design that utilizes forests as pedagogical spaces to strengthen energy resilience in post-disaster contexts in Indonesia. The research employs a qualitative method with a literature review approach, involving thematic analysis of Scopus-indexed scholarly publications alongside official government and reputable institutional sources. The findings indicate that deforestation significantly contributes to ecosystem degradation, disruption of hydrological and natural energy cycles, and heightened disaster risks. Post-disaster forests can function as transformative pedagogical spaces through action-based learning practices such as reforestation, field observation, and theological–ecological reflection. In conclusion, an ecology-based CRE curriculum that integrates creation theology, contextual pedagogy, and energy resilience issues has strong potential to enhance the role of Christian religious education in ecological recovery, disaster risk mitigation, and the formation of post-disaster recovery agents oriented toward human flourishing or *shalom*.

Keywords: Christian Religious Education; forest as pedagogical space; ecological curriculum design; reforestation; energy resilience

THE POLITICAL ECONOMY OF DECARBONIZATION: CHALLENGES AND PATHWAYS IN RENEWABLE ENERGY TRANSITIONS**Babita Gupta**

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Abstract

Existing patterns of production, employment, and accumulation have grown to be a major issue of public policy when it comes to the energy transition. Many people agree that high-carbon energy systems must change in response to climate change. During the last 20 years, several legislative efforts have been launched to increase the use of renewable energy sources. Technology costs and deployment rates, implied in experience curves, are usually considered as the primary variables in the global clean energy transition from fossil fuels towards low-carbon energy sources. Since politics affects both deployment and prices, we argue that it is the hidden factor of technology experience curves. It offers a critical examination of how state institutions, global organizations, private industry, and civil society shape energy policy priorities, focusing on key factors such as financial incentives, regulatory frameworks, and the distribution of energy resources.

Technology prices and deployment rates, as indicated by experience curves, are widely regarded as the main factors influencing the worldwide clean energy transition from fossil fuels to low-carbon sources. We propose that politics is the hidden factor of technological experience curves, influencing both costs and implementation. The article explores the role of politics in shaping energy agendas, focusing on subsidies, regulatory systems, and resource access. It highlights the political economics of decarbonisation, highlighting the challenges and approaches involved in renewable energy transitions. The article also explores the complex interaction of political power, economic interests, social dynamics, and institutional frameworks driving the transition from fossil fuels to renewable energy sources. The study examines major obstacles to decarbonization, including industry opposition, financing and investment complexity, and the necessity for stable policies.

**EVALUATING THE INFLUENCE OF PCM IN VARIOUS PARTS OF BUILDING ENVELOPES
FOR ENERGY SAVING IN THE HOT DRY CLIMATE OF NIGERIA**

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Abstract

Buildings require a lot of energy worldwide; in Nigeria, the residential sector alone uses almost 65% of the country's energy. In tropical regions, the building envelope accounts for 50–60% of heat exchange, making it an important factor in this consumption. Using the Federal Secretariat in Maiduguri as a template, this study assesses the effect of Phase Change Materials (PCMs) on energy savings in Nigeria's hot, dry environment. Eight building layouts with PCMs applied to various envelope components were examined through simulation-based experimental research utilizing Google SketchUp Pro and OpenStudio. The findings show that energy performance depends on the strategic positioning of PCMs. The greatest sensible cooling load reduction of 22.3% was attained by configurations with PCMs in the walls and roofs, compared to 21.9% for walls and windows. Significant variations in cooling loads across configurations were verified by statistical analysis ($df(7, 88) = 4.461, p = .000$). Crucially, the use of PCM in flooring increased cooling demands by as much as 10.8%. This result emphasizes that the precise location of PCM within the building envelope is crucial to its performance. According to the study's findings, incorporating PCMs into walls and roofs optimizes energy savings, while using them in floors should be avoided to avoid raising cooling requirements in hot, dry areas.

Keywords: Building Envelope, Energy, Federal Secretariat, Hot Dry Climate, PCM

WASTE MANAGEMENT FOR SUSTAINABLE ENERGY

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Abstract

Waste management is part and parcel of the development of environmentally friendly energy solutions, especially concerning the issues of environmental concerns, lack of resources, and global warming. Reusing waste to produce energy using techniques such as waste-to-energy (Waste management), biomass into energy, and anaerobic digestion is a potential approach to minimizing the environmental impact of waste disposal and at the same time helping to generate renewable energy. The paper examines the importance of waste management towards the achievement of sustainability objectives, such as how waste-to-energy technologies can help decrease fossil fuel consumption and shift to a circular economy. It identifies environmental, economic and social benefits of combining waste management processes with energy production, including the minimization of greenhouse gas emissions, creation of the green employment, and increased energy security. Moreover, the paper reviews issues comprising of technological constraints, regulatory obstacles and financial constraints and gives policy suggestions to aid in the development of waste-to-energy systems. The approach offers a ground-breaking chance at realizing a more sustainable future of energy generation because of the connection created between waste management and sustainable energy production.

Keywords: Waste Management, Sustainable Energy, Waste-to-Energy, Biomass Conversion, Anaerobic Digestion, Circular Economy, Renewable Energy.

PERFORMANCE ANALYSIS OF SOLAR PANEL EFFICIENCY UNDER DIFFERENT WEATHER CONDITIONS**Anik Biswas**

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Abstract

Solar energy is one of the most widely used renewable energy sources, but the performance of photovoltaic (PV) panels is significantly affected by environmental conditions. Variations in sunlight intensity, temperature, humidity, and cloud coverage directly influence the electrical output and overall efficiency of solar panels. Understanding these effects is essential for optimizing energy production and designing more reliable renewable power systems.

This study analyzes the performance of solar panels under different weather conditions using data collected from publicly available meteorological datasets. The evaluation considers key parameters such as solar irradiance, ambient temperature, panel surface temperature, and relative humidity. A comparative analysis was conducted across clear, cloudy, and partially cloudy days to understand the fluctuations in output efficiency.

The results show that maximum panel efficiency occurs during high-irradiance conditions with moderate temperature levels. Efficiency decreases significantly on cloudy days due to reduced sunlight exposure, while extreme heat also negatively impacts performance by increasing panel temperature. The study confirms that both irradiance and temperature play critical roles in determining the electrical output of PV systems.

These findings support improved planning and optimization strategies for solar energy deployment, especially in regions with variable climatic conditions. The study offers valuable insights for engineers, energy planners, and researchers working on sustainable and environmentally friendly power solutions.

Keywords: Solar Energy, Renewable Energy, Efficiency Analysis, Weather Conditions, Photovoltaic Systems, Environmental Engineering

ENERGY PATHWAYS TOWARD DECARBONIZATION: UPGRADING GAS TURBINES FROM E-CLASS TO F-CLASS AND INTEGRATING HYDROGEN AS A CLEAN FUEL**Seyed Milad Mostafavi^{1*}, Zahra Ebrahimi²**

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Abstract

Electricity generation is a critical issue worldwide and is still largely based on fossil fuels, making it a major contributor to pollution and greenhouse gas emissions. There is an urgent need to mitigate the severe environmental impacts of climate change, which necessitates a transition toward a low-carbon energy infrastructure. This study investigates two complementary pathways for cleaner gas-fired power production. The first involves upgrading existing E-class gas turbines to F-class units, resulting in improved efficiency and reduced CO₂ emissions. The second explores integrating hydrogen as a clean fuel blended with natural gas, highlighting its potential to lower carbon intensity without compromising turbine performance. Together, these approaches provide practical and viable solutions for advancing the energy transition.

The results indicate that upgrading gas turbines, with efficiencies of approximately 35% and 39.5%, can achieve up to a 12% reduction in both CO₂ emissions and fuel consumption, along with associated cost savings when operating on 100% CH₄. Additionally, blending hydrogen up to 40% by volume with CH₄ in F-class turbines can lead to up to a 27% reduction in CO₂ emissions compared to E-class turbines operating on 100% CH₄, and up to a 17% reduction compared to F-class turbines running on 100% CH₄ alone.

Keywords: Clean Energy, Decarbonization, Gas Turbine Upgrade, Hydrogen, Low-Carbon Power Generation

EFFECTS OF ENVIRONMENTAL EDUCATION ON THE USE OF ALTERNATIVE SOURCE OF ENERGY TO REDUCE THE DEPLETION OF ORGANIC MATTER IN PLATEAU STATE, NIGERIA

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Abstract

The study determined the impact of Environmental Education (EE) on the attitude of secondary students towards alternative source of energy in Plateau State, Nigeria. To guide the conduct of the study, two objectives were stated, two research questions were answered and two hypotheses were tested. The study adopted the quasi experimental design, particularly, pre-test-post-test control group design without randomization. The population of the study comprised all secondary school I (SSI) students in Plateau State and the sample was made up of SSI students from two selected secondary schools in the study area. Environmental Education Attitude Questionnaires for Students was the instrument used for the study. The construct validity of the instrument was established using factor analysis while the Cronbach alpha method of internal consistency was used to ensure the reliability of the instrument where a coefficient of 0.94 was obtained. The data collected for answering the research questions was analyzed using simple percentages while the hypotheses were tested with analysis of covariance (ANCOVA) and the computation was carried out with SPSS. The result showed that the students in both groups were neutral in their attitude towards alternative source of energy before the experiment. After the intervention, the result revealed a positive impact of Environmental Education on the attitude of students towards alternative source of energy in Plateau State in favour of those in the experimental group. While the students in the control group, who were not exposed to Environmental Education remain neutral in their attitude towards alternative source of energy. On comparison of the attitude of male and female students in the experimental group, after the intervention, the result indicated that more than 80% of the male students were positive in their attitude while only about 60% of the female counterparts had positive attitude towards alternative source of energy. The study recommended that the federal government through the Nigerian Educational Research and Development Council in conjunction with the curriculum planners, should include Environmental Education as a compulsory course to be studied at the secondary level of education in Nigeria. Seminars and workshops are to be organized on regular bases on the use of alternative source of energy such as agricultural residues.

Key Words: Environmental Education, Energy, Depletion, Organic Matter

WATER RESOURCES ENGINEERING AND MANAGEMENT IN GEORGIA**PhD Student Lasha Kavelashvili**

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Abstract

Water resources engineering and management in Georgia are essential for the country's sustainable development, given its rich hydrological resources and growing energy, agricultural, and industrial demands. The country's hydropower potential, supported by numerous rivers and mountainous terrain, has been harnessed for energy production, making hydropower a cornerstone of Georgia's energy infrastructure. However, despite these advancements, Georgia faces several challenges in water management. These include fragmented legislation, environmental impacts from large-scale hydropower projects, water pollution, and the uncertainties introduced by climate change. The lack of comprehensive legal frameworks has hindered the effective integration of water resources management (IWRM) principles, leading to inefficient governance, competing demands, and environmental degradation. Furthermore, hydropower developments, while vital for energy production, have raised concerns regarding ecological disruption and the displacement of local communities. Water quality is also under threat due to pollution from industrial waste, agricultural runoff, and inadequate wastewater treatment systems. Climate change further exacerbates water scarcity, altering rainfall patterns and increasing the frequency of extreme weather events.

To address these challenges, Georgia must prioritize the reform of its water management legislation, promote sustainable hydropower development, improve water quality through better pollution control and wastewater treatment, and adapt water management practices to climate change. Strengthening institutional frameworks, fostering stakeholder engagement, and investing in education and research will be crucial for building a resilient water management system. With these measures, Georgia can ensure the sustainable and equitable management of its water resources, supporting continued economic growth and environmental sustainability.

Keywords: Water Resources, Renewable, Challenges

HARVESTING POWER: NEXT-GENERATION TECHNOLOGIES FOR AUTOMOTIVE WASTE HEAT RECOVERY (WHR)**Piyush Kumar¹, Mukesh Kumar²**¹Department of Physics, Swami Sharaddhanad College, University of Delhi, Alipur, Delhi 110036**Abstract**

The automotive sector faces mounting pressure to enhance fuel economy and minimize emissions. A significant amount of fuel energy in internal combustion engines is wasted as heat, with only 25–30% converted into useful mechanical work. Approximately 40% is lost through high-temperature exhaust gases (around 600 °C), while another 30% is dissipated via engine coolant (approximately 90–100 °C). Utilizing even a minor portion of this untapped thermal energy presents considerable opportunities for improving vehicle efficiency. This review assesses recent advancements in Automotive Waste Heat Recovery (WHR) technologies focused on converting exhaust and coolant heat into usable power. It examines systems including Thermoelectric Generators (TEGs), which utilize the Seebeck effect to produce 1–5 kW of electrical output; Organic Rankine Cycle (ORC) systems that can achieve 10–20% thermal-to-power conversion efficiency; turbo-compounding units that recover kinetic energy through an additional turbine connected to the engine; and sophisticated heat-exchanger designs that facilitate integrated hybrid recovery systems. Comparative studies demonstrate that WHR technologies can enhance overall fuel efficiency by approximately 5–15%, contingent upon system design and vehicle application, such as heavy-duty trucks, hybrid powertrains, and performance engines. Challenges including low thermoelectric efficiency (<10%), increased exhaust backpressure, system cost, and integration complexity persist. However, innovations such as tubular TEG modules, nanostructured thermoelectric materials, flexible device designs, and hybrid ORC–TEG systems demonstrate significant potential for future development and commercial application. Automotive waste heat recovery is a crucial strategy for achieving sustainable mobility, as it decreases fuel consumption, reduces emissions, and enhances overall energy efficiency.

Keywords: Waste heat recovery; W2E technologies; thermoelectric generators (TEGs), fuel-efficiency improvement; heat exchangers; hybrid vehicles.

**UNDERSTANDING THE DYNAMICS OF FINANCIAL AND ENVIRONMENTAL
SUSTAINABILITY: A WAVELET EXPLORATION OF S&P 500 SUSTAINABILITY INDEX,
DIGITAL CURRENCY BITCOIN, GOLD, AND CARBON EMISSIONS FUTURES**

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Abstract

An important field of research now centers on how financial markets and environmental sustainability interact. Therefore, our empirical study aims to explore the intricate relationships between financial markets and environmental sustainability in the contemporary global landscape. We employ different wavelet techniques to investigate the relationships among the S&P 500 sustainability screened index, Bitcoin, gold commodity futures, and carbon emissions futures for the period ranging from September 30, 2013, to October 13, 2023. Our objective is to unleash significant relationships among the variables across the sampled period and frequencies. We find distinct patterns and significant relationships corresponding to different frequency bands throughout the sample period, ranging from short, medium, and long run. We find that carbon emissions have medium- and long-run relationships with the common effects of the S&P 500 sustainability-screened index, Bitcoin, and gold commodity futures, and vice versa. The study's findings have meaningful implications for various stakeholders, such as ESG investors and policymakers managing digital asset regulations. Its guidance on green investing, hedging strategies, and blockchain sustainability is empirically grounded and applicable to real-world investment and policy decisions. Furthermore, our study offers insights into the dynamic relationships within the modern digital landscape, informing eco-friendly investments and sustainable policies.

Keywords: S&P 500; Sustainability Screened Index; Bitcoin; Futures; Carbon Emissions; Wavelet Estimations

UNDERSTANDING THE ENVIRONMENTAL EFFECTS OF GLOBALIZATION: HOW TRADE AND INDUSTRY CONTRIBUTE TO CLIMATE CHANGE AND ECOSYSTEM LOSS**Masud Amran Sumel**

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Abstract

Globalization has connected economies, increased trade, and fueled industrial growth, but its environmental impacts have become a major concern. This research explores how global trade and industrialization contribute to climate change and the degradation of ecosystems, particularly in developing countries. As demand for cheap goods increases, industries expand rapidly, often without adequate environmental regulations, leading to pollution, deforestation, and rising carbon emissions. While many studies have examined globalization's broader environmental effects, there is a lack of focus on the specific ways trade and industrial growth drive climate change and ecosystem loss. This study aims to fill this gap by investigating the direct links between these factors, specifically examining the role of multinational corporations and trade policies. Furthermore, it will propose practical solutions for minimizing environmental harm through sustainable trade policies, cleaner technologies, and green business practices. By focusing on the interconnectedness of trade, industry, and environmental sustainability, this research will offer actionable recommendations to mitigate the negative effects of globalization. The findings will provide valuable insights for policymakers, industry leaders, and environmental organizations looking to balance economic growth with environmental protection in the age of globalization.

Keywords: Globalization, Environmental Impact, Climate Change, Trade, Ecosystem Loss

OFLOXACIN PRESENCE IN THE ENVIRONMENT: TOXIC EFFECTS AND REMOVAL METHODS**Diana HANGANU, Diana HARJA, Maria HARJA**

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Abstract

In recent years, infections have become increasingly common in hospital pathologies. A widely prescribed fluoroquinolone antibiotic in hospital treatments is ofloxacin, which targets topoisomerase II and inhibits bacterial DNA synthesis. Its consistent use in treating pulmonary, gastrointestinal, and ENT infections results in higher concentrations of ofloxacin in the environment through direct disposal or after elimination, with over 80% excreted unmetabolized from the human body. The presence of ofloxacin in aquatic environments causes toxic effects on aquatic life, including hepatotoxicity, genotoxicity, gastrotoxicity, teratogenicity, and, most concerning, antibiotic resistance, which complicates future infection treatments. Its environmental impact, combined with the limited ability of wastewater treatment plants to remove it, underscores the need for a targeted approach to its elimination from water. This paper aims to provide a comprehensive view of ofloxacin's role in patient treatment, its environmental toxicity, and to provide an insight into its removal methods, focusing on adsorption and photocatalysis. Adsorption materials such as activated carbon, N-doped activated carbon, chitosan, molecularly imprinted geopolymers, nanocomposites, and lignin-based adsorbents can achieve over 90% removal efficiency. High-degradation-efficiency photocatalysts like Ag/ZnNb₂O₆@SC₃N₄, ZnO/ZnS, and ZnFe₂O₄@TiO₂ are discussed. Both adsorption and photocatalysis are influenced by various experimental parameters, including pH, material dosage, pollutant concentration, and experimental duration. This study aims to evaluate the benefits of ofloxacin treatment, its classification as an antibiotic with specific mechanisms of action, and its toxic effects due to environmental persistence. It also offers a brief review of the effectiveness of adsorption and photocatalysis as potential removal methods, along with their main advantages and disadvantages.

Keywords: Adsorption, antibiotic, environment, photocatalysis

VALORIZATION OF WASTE GLASS AS A STRATEGY FOR ENVIRONMENTAL PROTECTION AND THE PRODUCTION OF SUSTAINABLE COMPOSITE MATERIALS**Mihaela Fanache (Vasiliu)¹, Alexandru Olaru², Maria Harja^{3*}**

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Abstract

Waste glass pollution degrades the environment by contaminating soil, water, and air, thereby adversely affecting people, wildlife, disrupting ecosystems, and exacerbating climate change. By ingest or bioaccumulation by plants, hazardous substances can accumulate throughout the food chain. Improperly managed waste glass can pose several risks to human health. Sharp glass fragments may cause physical injuries, while fine glass particles can become airborne and be inhaled, potentially irritating the respiratory system. In addition, waste glass that accumulates in open environments can attract pests, contribute to unsafe living conditions, and indirectly affect community well-being. In this paper is proposed a strategy for capitalization of waste glass with obtaining sustainable cementitious composite materials. The composites were characterized by: consistency, density, porosity, water absorption and mechanical properties, in order to establishing the impact of waste glass (WG) dosage. Waste glasses were used for partial replacement of aggregates. The wastes were prepared to become comparable with natural aggregates. The prepared composites contained 2, 4, and 10 %wt. WG. The densities were reached from 2336 to 2385 kg/m³, smaller than composites without wastes. The samples containing 10% WG obtained the lowest value for properties. The results indicate that adding waste has a negative effect on its mechanical properties, but the values are superior standard requirements. Regarding durability, the presence of waste glasses favorized the resistance in chemical reagents. The best results were obtained for 10% WG, for these samples losses in mass were with 20% smaller as in reference sample. Other important benefit over environment is reserve the resources (river aggregate) and protection ecosystems. This study demonstrated that using WG as aggregate determine the obtaining a sustainable-materials. Waste-glass valorization creates opportunities for cost-effective production of secondary raw materials. It supports the development of recycling industries and circular-economy approach.

Key words: glass waste, composite materials, properties, sustainability

PHASE CHANGE MATERIALS: A SUSTAINABLE APPROACH TO ENERGY EFFICIENCY AND THERMAL ENERGY STORAGE**Claudiu GOREA¹, Maria HARJA^{2*}**

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Abstract

Phase Change Materials (PCMs) represent compounds that are capable of storing and releasing thermal energy during phase transitions, most commonly between the liquid and solid states. The integration of phase change materials (PCMs) into building envelopes or thermal storage systems contributes to pollution reduction by stabilizing indoor temperatures, decreasing reliance on heating and cooling equipment, improving energy efficiency, and consequently lowering the emissions of greenhouse gases and other pollutants associated with conventional energy production. Their ability to maintain a practically constant temperature during the phase shift is based on the absorption and release of latent heat during processes. This characteristic gives them high potential in applications focused at increasing energy efficiency and sustainable thermal resources. There are three main PCM categories: organic, inorganic and eutectic. The durability and absence of corrosion of organic materials, such as paraffins or fatty acids, set them apart; but their heat conductivity is minimal. Inorganic PCMs, especially hydrated salts, offer high energy storage capacity and good conductivity. Unfortunately, they can suffer from phase separation or corrosion. Eutectic materials combine the advantages of both categories, offering specific melting points and increased thermal stability.

Applications for PCMs are numerous and include the construction industry, where they are utilized to save energy use and regulate indoor temperatures passively. They can also be utilized in solar energy storage systems, which enable thermal energy to build up during the day and be released at night.

In this paper are discussed an comparison between inorganic hydrates salts, such as: calcium chloride hexahydrate ($\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$); sodium sulfate decahydrate ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$), magnesium nitrate hexahydrate ($\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$), sodium acetate trihydrate ($\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$), lithium nitrate trihydrate ($\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$), magnesium chloride hexahydrate ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$), calcium nitrate tetrahydrate ($\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$) and their eutectics.

The incorporation of phase change materials (PCMs) into building systems can reduce pollution by lowering energy consumption and associated greenhouse gas emissions.

Keywords: phase change materials, inorganic salts, energy storage

PI STRATEGY FOR STABLE OPERATION OF PV–WIND HYBRID SYSTEMS WITH DISO DC/DC CONVERTER**Loubna BELBEDJ.¹**

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Abstract

In the context of rising global concerns about climate change, environmental degradation, and the depletion of fossil fuels-alongside increasing energy demand driven by population growth, industrial expansion, and improved living standards-renewable energy has become a crucial alternative. Consequently, the concept of sustainable development now plays a central role in guiding industrial and economic progress worldwide.

The traditional energy system is undergoing significant transformation with the integration of renewable energy sources and energy storage technologies, enabling greater flexibility, reliability, and sustainability. Renewable energy systems (RES), such as solar and wind, provide clean, efficient, and low-maintenance power generation without greenhouse gas emissions. Together, these sources ensure a stable energy supply in remote or off-grid areas, with excess energy stored for use during periods of low generation.

Significant advancements in power electronics have driven the widespread adoption of power converters in various energy applications. Given the critical role of power converters in ensuring the reliable operation of energy production systems, a high level of reliability is imperative. These converters are essential to the overall performance and safety of energy systems. Consequently, any failure within the power conversion stage can lead to severe malfunctions or complete system shutdowns if fault-tolerant mechanisms are not implemented. This research aims at improving the overall performance and reliability of energy systems.

To further enhance the reliability and efficiency of renewable systems, researchers are focusing on advanced power conversion technologies. The Dual Input Single Output (DISO) converter offers an effective solution for integrating multiple energy sources while minimizing cost, size, and losses. In this study, a PI controller technique is proposed to provide a continuous power supply to an autonomous resistive load. Improving the converter's dynamic performance and ensure stable operation under varying input conditions. Simulation results obtained using MATLAB/Simulink confirm the efficiency and stability of the proposed converter approach, demonstrating its suitability for hybrid photovoltaic–wind energy systems.

Keywords: Renewable energy systems (RES) , (DISO) DC-DC converter, PI control, Hybrid PV-Wind system.

**ATIKLARDAN HİDROJEN ENERJİSİ ÜRETİMİ: SÜRDÜRÜLEBİLİR ENERJİ DÖNÜŞÜMÜNE
ENTEĞRE YAKLAŞIMLAR****Aysun ALTIKAT**

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Özet

Hidrojen enerjisi, yüksek enerji yoğunluğu, temiz yanma ürünü olarak yalnızca su buharı ortaya çıkarması ve farklı sektörlerde kullanılabilmesi nedeniyle geleceğin sürdürülebilir enerji kaynakları arasında stratejik bir konuma sahiptir. Hidrojen; elektroliz, doğal gaz reformasyonu, biyokimyasal süreçler ve termokimyasal dönüşüm gibi çeşitli yöntemlerle üretilebilmekte olup son yıllarda özellikle atık kökenli üretim teknolojileri dikkat çekmektedir. Atıklardan elde edilen hidrojen enerjisi hem enerji ihtiyacının karşılanmasına hem de çevresel problemlerin azaltılmasına katkı sağlayarak döngüsel ekonomi yaklaşımını güçlendirmektedir.

Organik atıklar, tarımsal artıklar, belediye katı atıkları, endüstriyel atık sular ve plastik içerikli atıklar hidrojen üretimi için önemli birer hammadde niteliğindedir. Bu kapsamda biyokimyasal yöntemler (karanlık fermantasyon, fotobiyolojik süreçler) özellikle organik atıklardan düşük maliyetli hidrojen elde edilmesini mümkün kılmaktadır. Termokimyasal yöntemler olan piroliz, gazlaştırma ve süperkritik su gazlaştırması ise hem karbon bazlı atıkların değerlendirilmesi hem de yüksek verimli hidrojen üretimi bakımından öne çıkmaktadır. Bunun yanında gelişmiş katalizör teknolojileri, reaktör tasarımları ve hibrit prosesler sayesinde atık bazlı hidrojen üretiminin ekonomik uygulanabilirliği giderek artmaktadır.

Elde edilen hidrojen; yakıt hücrelerinde elektrik üretimi, endüstriyel proseslerde enerji kaynağı, hidrojenli ulaşım sistemleri, kimyasal sentez süreçleri ve ısıtma uygulamaları gibi geniş bir kullanım yelpazesine sahiptir. Atıklardan hidrojen üretiminin yaygınlaşması hem enerji bağımlılığının azaltılması hem de atık miktarının minimize edilmesi açısından önemli fırsatlar sunmaktadır.

Bu çalışma, hidrojen enerjisini tanımlayarak üretim yöntemlerini açıklamakta; ardından atık kökenli hidrojen üretim teknolojilerini teknik ve çevresel boyutlarıyla ele alarak sürdürülebilir enerji sistemlerine katkılarını tartışmaktadır.

Anahtar Kelimeler: Hidrojen Enerjisi, Atık Dönüşümü, Gazlaştırma, Biyohidrojen Üretimi, Döngüsel Ekonomi.

**HYDROGEN ENERGY PRODUCTION FROM WASTE: INTEGRATED APPROACHES TO
SUSTAINABLE ENERGY TRANSFORMATION****Abstract**

Hydrogen energy holds a strategic position among the sustainable energy sources of the future due to its high energy density, clean combustion, and ability to be used in various sectors. Hydrogen can be produced through various methods, such as electrolysis, natural gas reforming, biochemical processes, and thermochemical conversion. In recent years, waste-based production technologies have attracted particular attention. Hydrogen energy generated from waste contributes to both meeting energy needs and reducing environmental problems, strengthening the circular economy approach.

Organic waste, agricultural residues, municipal solid waste, industrial wastewater, and plastic-containing waste are important raw materials for hydrogen production. In this context, biochemical methods (dark fermentation, photobiological processes) enable the low-cost production of hydrogen, particularly from organic waste. Thermochemical methods such as pyrolysis, gasification, and supercritical water gasification stand out for both the utilization of carbon-based wastes and the production of high-efficiency hydrogen. Furthermore, thanks to

advanced catalyst technologies, reactor designs, and hybrid processes, the economic viability of waste-based hydrogen production is gradually increasing.

The resulting hydrogen has a wide range of uses, including electricity generation in fuel cells, energy sources in industrial processes, hydrogen-powered transportation systems, chemical synthesis processes, and heating applications. The widespread use of hydrogen production from waste offers significant opportunities for both reducing energy dependency and minimizing waste.

This study defines hydrogen energy and explains its production methods. It then examines the technical and environmental aspects of waste-based hydrogen production technologies and discusses their contributions to sustainable energy systems.

Keywords: Hydrogen Energy, Waste Conversion, Gasification, Biohydrogen Production, Circular Economy.

**KENEVİR ESASLI MALZEMELERİN KARBON AYAK İZİNE ETKİSİ: BİYOKOMPOZİT VE İNŞAAT SEKTÖRÜNDE YAŞAM DÖNGÜSÜ ANALİZİ****Aysun ALTIKAT**

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Özet

Küresel ısınma ve iklim değişikliğine bağlı olarak artan karbon emisyonları, yapı malzemeleri ve endüstriyel üretim süreçlerinde çevresel sürdürülebilirliğin önemini ön plana çıkarmıştır. Bu bağlamda, doğal lifler arasında yüksek biyokütle verimi, hızlı büyüme potansiyeli ve düşük çevresel etkileriyle öne çıkan *Cannabis sativa L.* (kenevir) esaslı malzemeler, son yıllarda yenilenebilir kaynak temelli üretim stratejilerinde dikkat çekici bir alternatif olarak değerlendirilmektedir. Bu derlemede, kenevir lifleri ve atıklarının biyokompozit, yalıtım, panel ve yapı malzemesi üretiminde kullanımının karbon ayak izi üzerindeki etkileri yaşam döngüsü analizi (LCA) yaklaşımıyla incelenmiştir.

Kenevirin fotosentetik kapasitesi sayesinde atmosferden yüksek miktarda CO₂ sekestre etmesi (yakalama-depolama), üretim aşamasındaki karbon salımlarını dengeleyebilmekte; ayrıca kenevir esaslı kompozitlerin üretiminde kullanılan düşük enerji girdisi, geleneksel petrokimyasal malzemelere kıyasla %40–70 oranında karbon emisyonu azaltımı sağlamaktadır. İnşaat sektöründe kenevir beton (“hemcrete”) ve kenevir lif takviyeli beton gibi uygulamalar, malzemenin ısı yalıtım, nem düzenleme ve karbon depolama kapasitesi açısından üstün performans sergilediğini göstermektedir. Yaşam döngüsü analizleri, kenevir esaslı malzemelerin üretimden bertarafa kadar olan süreçte net karbon negatif etki oluşturabileceğini ortaya koymaktadır.

Sonuç olarak, kenevir temelli malzemelerin yaygın kullanımı, inşaat ve kompozit endüstrilerinde karbon nötr hatta karbon negatif üretim hedeflerine ulaşmada stratejik bir potansiyel sunmaktadır. Bu çalışma, kenevirin sürdürülebilir malzeme teknolojilerindeki rolünü çevresel, ekonomik ve teknik açılardan bütüncül biçimde değerlendirmektedir.

Anahtar Kelimeler: Kenevir, Karbon ayak izi, Yaşam döngüsü analizi, Biyokompozit, Sürdürülebilir inşaat, Karbon sekestrasyonu.

THE EFFECT OF HEMP-BASED MATERIALS ON CARBON FOOTPRINT: LIFE CYCLE ANALYSIS IN BIOCOMPOSITE AND CONSTRUCTION INDUSTRY**Abstract**

Increasing carbon emissions due to global warming and climate change have highlighted the importance of environmental sustainability in building materials and industrial production processes. In this context, *Cannabis sativa L.* (hemp)-based materials, which stand out among natural fibers with their high biomass yield, rapid growth potential, and low environmental impact, have recently been considered a remarkable alternative in renewable resource-based production strategies. This review examines the carbon footprint impacts of using hemp fibers and waste in the production of biocomposites, insulation, panels, and building materials using a life cycle analysis (LCA) approach.

Hemp's photosynthetic capacity allows it to sequester high amounts of CO₂ from the atmosphere (capture and storage), offsetting carbon emissions during production. Furthermore, the low energy input used in the production of hemp-based composites provides a 40–70% reduction in carbon emissions compared to traditional petrochemical materials. Applications such as hemp concrete (hemcrete) and hemp fiber-reinforced concrete in the construction industry demonstrate the material's superior performance in terms of thermal insulation, moisture management, and carbon storage capacity. Life cycle analyses reveal that hemp-based materials can have a net carbon negative impact from production to disposal.

Consequently, the widespread use of hemp-based materials offers strategic potential for achieving carbon-neutral or even carbon-negative production goals in the construction and composites industries. This study holistically assesses the role of hemp in sustainable material technologies from environmental, economic, and technical perspectives.

Keywords: Hemp, Carbon footprint, Life cycle analysis, Biocomposite, Sustainable construction, Carbon sequestration.

**ANALYSIS OF STRATEGIES TO REDUCE THE CARBON FOOTPRINT WITHIN THE SCOPE OF WASTE MANAGEMENT IN KAYSERİ USING THE WASTE REDUCTION MODEL (WARM)****Derya ÖZCAN**

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Abstract

This study examines the impact of municipal solid waste generated in Kayseri on climate change through a comprehensive life cycle–based assessment. The city’s heavy reliance on landfilling, particularly the anaerobic decomposition of the organic fraction, leads to significant methane generation and markedly increases the overall carbon footprint of the system. Using the U.S. Environmental Protection Agency’s WARM model, the annual greenhouse gas emissions of the current waste management structure were calculated, and five alternative scenarios—enhanced recycling, composting, anaerobic digestion, source reduction, and a hybrid model integrating all options—were comparatively evaluated. The model results indicate that the landfill-dominated structure produces the highest emission load, while recycling and biological treatment methods reduce both upstream production emissions and the amount of waste sent to landfills, yielding substantial MTCO₂E savings. When all scenarios are considered together, the highest reduction potential emerges in the hybrid model that simultaneously incorporates recycling, compost, biogas production, and source reduction practices. Overall, the findings demonstrate that Kayseri has strong potential to transition toward a low-carbon, circular, and sustainable waste management system, providing a scientific foundation for local decision-makers in developing effective emission-reduction strategies.

Keywords: Municipal Solid Waste Management, Carbon Footprint, WARM Model, Source Reduction, Circular Economy, Kayseri.

KAYSERİ İLİ İÇİN ATIK YÖNETİMİ KAPSAMINDA KARBON AYAK İZİNİ AZALTMAYA YÖNELİK STRATEJİLERİN ATIK AZALTIM MODELİ (WARM) İLE İNCELENMESİ**Özet**

Bu çalışma, Kayseri ilinde oluşan kentsel katı atıkların iklim değişikliği üzerindeki etkilerini yaşam döngüsü bakış açısına dayalı bütüncül bir analizle incelemektedir. Kentte belediye atıklarının büyük bölümünün düzenli depolamaya yönlendirilmesi, özellikle organik fraksiyonun anaerobik ayrışması sonucu yüksek düzeyde metan oluşumuna neden olmakta; bu durum sistemin toplam karbon ayak izini belirgin biçimde artırmaktadır. Çalışmada ABD Çevre Koruma Ajansı tarafından geliştirilen WARM modeli kullanılarak mevcut sistemin yıllık sera gazı emisyonu hesaplanmış; geri dönüşüm, kompostlama, anaerobik çürütme, kaynağında azaltım ve bu seçenekleri bir araya getiren hibrit yapı olmak üzere beş farklı senaryo yaratılarak karşılaştırmalı değerlendirmeler yapılmıştır. Model sonuçları, düzenli depolama odaklı mevcut yapının en yüksek emisyon yükünü oluşturduğunu; geri dönüşüm ve biyolojik işleme yöntemlerinin ise hem üretim aşamasındaki yukarı akış emisyonlarını azalttığını hem de depolama sahalarına giden atık miktarını düşürerek önemli düzeyde MTCO₂E kazanımı sağladığını ortaya koymuştur. Tüm senaryolar birlikte ele alındığında, en yüksek toplam azaltımın geri dönüşüm, kompost, biyogaz ve kaynakta azaltım uygulamalarının entegre biçimde yürütüldüğü hibrit modelde ortaya çıktığı görülmüştür. Elde edilen bulgular, Kayseri'nin döngüsel ekonomi ilkeleriyle uyumlu, düşük karbonlu ve sürdürülebilir bir atık yönetimi yapısına geçiş kapasitesine sahip olduğunu göstermekte; yerel yönetimler için emisyon azaltımına dayalı karar süreçlerinde kullanılabilecek bilimsel bir temel sunmaktadır.

Anahtar Kelimeler: Kentsel Katı Atık, Karbon Ayak İzi, WARM Modeli, Kaynağında Azaltım, Döngüsel Ekonomi, Kayseri.

**TÜRKİYE'DE KARBON STOĞUNUN ZAMANSAL DEĞİŞİMİNE İLİŞKİN YAPILAN ÇALIŞMALARIN İNCELENMESİ****Fadime SAĞLAM**

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Özet

Yeryüzündeki en önemli karbon havuzlarından biri olan ormanlar, küresel ısınmanın olumsuz etkilerini azaltmada kritik bir rol oynamaktadırlar. Ormanlar bu önemli rolü ile hem bölgesel hem de küresel iklim istikrarını korumaya büyük katkı sağlamaktadır. Orman alanlarının artırılması, atmosferdeki karbondioksit konsantrasyonlarını düşürmek için basit fakat oldukça etkili bir strateji olarak kabul edilmektedir. Son yıllarda, karbon stoklarının farklı konumsal ölçeklerde nasıl değiştiğini ve zaman içinde nasıl farklılaştığını anlamak, sürdürülebilir orman yönetimi, iklim politikaları ve ekosistem koruma stratejileri için giderek daha da büyük bir önem kazanmıştır. Bu nedenle, bu çalışma, orman ekosistemlerindeki karbon depolanmasının zamansal ve konumsal değişimi ile ilgili mevcut araştırmaları incelemeyi amaçlamaktadır. Genel olarak, elde edilen bulgular, küresel iklim değişikliğinin etkilerini azaltmak üzere gerekli stratejileri güçlendirmek ve sürdürülebilir orman yönetimi planlamasını desteklemek amacıyla orman kaynaklarının korunmasının ve genişletilmesinin önemini bir kez daha vurgulamaktadır.

Anahtar kelimeler: Biyokütle, küresel ısınma, meşcere biyokütlesi, meşcere karbonu.

A REVIEW OF STUDIES ON THE TEMPORAL CHANGE OF CARBON STOCKS IN TURKIYE**Abstract**

Forests, as one of the most important carbon pools on Earth, play a critical role in mitigating the adverse effects of global warming. Through this essential function, forests make substantial contributions to maintaining both regional and global climate stability. Expanding forested areas is widely regarded as a simple yet highly effective strategy for reducing atmospheric carbon dioxide concentrations. In recent years, gaining an understanding of how carbon stocks vary across different spatial scales and change over time has become increasingly important for sustainable forest management, climate policy formulation, and ecosystem conservation strategies. Accordingly, this study aims to review existing research on the temporal and spatial variability of carbon storage in forest ecosystems. Overall, the findings emphasize once again the importance of conserving and expanding forest resources to strengthen strategies for mitigating the impacts of global climate change and to support sustainable forest management planning.

Keywords: Biomass, global warming, stand biomass, stand carbon.

COMPARISON OF ABOVE-GROUND BIOMASS ALLOCATION IN SCOTS PINE STANDS ACCORDING TO VARIOUS ALLOMETRIC EQUATIONS: A CASE STUDY OF KASTAMONU FOREST ENTERPRISE

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Abstract

Forest ecosystems play a pivotal role in mitigating global climate change by serving as the largest terrestrial carbon sinks. Accurate quantification of carbon stored in forest biomass is a prerequisite for developing sustainable forestry strategies and meeting international climate goals. While the use of allometric equations is the standard approach for estimating forest carbon stocks, the allocation of biomass among different tree components (Such as stem wood, bark, branches, and needles) can vary significantly depending on the model applied. This study investigates the consistency of biomass allocation predictions in pure and natural Scots pine (*Pinus sylvestris* L.) stands within the Kastamonu Forest Enterprise. Data were derived from field measurements taken at 92 sample plots. To evaluate model consistency, the proportional distribution of stem wood, bark, branch, and needle biomass within the above-ground total biomass was estimated using a reference method based on equations explicitly developed for the study area. These findings were subsequently compared with results derived from three alternative model sets representing different distribution regions of Scots pine. The study aims to highlight the discrepancies between different allometric approaches and provide insights into the reliability of component-based biomass estimation for regional carbon inventories.

Keywords: Climate change, Biomass proportion, *Pinus sylvestris*.

**KÖMÜR YAKITLI TERMİK SANTRALLERDE KARBON AYAK İZİNİ AZALTMAYA
YÖNELİK UYGULAMALARIN TERMOEKONOMİK ANALİZİ****Hüseyin TOPAL**

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Özet

Kömür yakıtlı termik santraller, yüksek sera gazı emisyonları nedeniyle İklim değişikliğiyle mücadelede öncelikli dönüşüm gerektiren enerji üretim tesisleridir. Bu çalışmanın amacı, Türkiye’de faaliyet gösteren bir kömür yakıtlı termik santralin karbon ayak izini TS EN ISO 14064-1 standardı doğrultusunda hesaplamak ve farklı karbon azaltım senaryolarının çevresel ve ekonomik uygulanabilirliğini değerlendirmektir.

Santralin doğrudan ve dolaylı emisyonları sera gazı envanteri yaklaşımıyla belirlenmiştir. Emisyonların azaltılmasına yönelik üç senaryo geliştirilmiştir. Biyokütle ile birlikte yakma, Güneş enerjisi entegrasyonu ile hibrit üretim modeli ve Karbon yakalama, kullanma ve depolama (CCUS) teknolojilerinin uygulanabilirliği. Senaryolar; emisyon azaltım potansiyeli, sistem verimindeki değişim ve ekonomik etkiler kapsamında karşılaştırmalı olarak analiz edilmiştir.

Ön değerlendirmelere göre, biyokütle ile birlikte yakma senaryosu karbon ayak izinde önemli bir azalma sağlayabilmektedir. Güneş enerjisi entegrasyonu ise fosil yakıt tüketimini azaltarak santral performansının iyileşmesine katkı sunmaktadır. CCUS teknolojileri yüksek yatırımlar gerektirmesine karşın, uzun vadede çevresel açıdan güçlü bir alternatif olarak değerlendirilmektedir. Elde edilen bulgular doğrultusunda, kömür yakıtlı santrallerde düşük karbonlu dönüşümün çok boyutlu stratejilerle mümkün olabileceği ve sürdürülebilir enerji üretimi için teknik ve ekonomik kriterlerin birlikte ele alınmasının kritik olduğu ortaya koyulmuştur.

Anahtar Kelimeler: Kömür, karbon ayakizi, termik santraller

**THERMOECONOMIC ANALYSIS OF APPLICATIONS TO REDUCE CARBON FOOTPRINT IN
COAL-FIRED THERMAL POWER PLANTS****Abstract**

Coal-fired power plants are major contributors to greenhouse gas emissions and require transformational strategies to align with global climate change mitigation goals. This study aims to quantify the carbon footprint of a coal-fired power plant in Türkiye based on ISO 14064-1 and evaluate the environmental and economic feasibility of different carbon reduction scenarios.

Direct and indirect emissions of the plant were determined through a greenhouse gas inventory approach. Three mitigation scenarios were developed. Biomass cofiring, Integration of photovoltaic systems for hybrid power generation, Implementation feasibility of carbon capture, utilization, and storage (CCUS). These scenarios were comparatively assessed in terms of emission reduction potential, changes in thermodynamic performance, and economic impacts.

Preliminary findings indicate that biomass cofiring can significantly reduce the plant’s carbon footprint. Solar hybridization contributes to improved operational efficiency by reducing fossil fuel consumption. Although CCUS technologies involve high initial investment costs, they remain a strong long-term option for substantial emission reduction. The study highlights that low-carbon transition in coal-based power systems requires a

multidimensional approach in which environmental, technical, and economic considerations must be jointly evaluated to ensure sustainable energy production.

Key Words: Coal, Carbon footprint, coal-fired thermal power plants

**ENVIRONMENTAL IMPACT OF ADDITIVE MANUFACTURING: ENERGY USE AND CO₂ EMISSIONS IN A LIFE CYCLE FRAMEWORK****Tuğçe TEZEL**

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Abstract

Additive manufacturing (AM) is widely promoted as a key enabler of sustainable production due to its material efficiency and design freedom. However, when process parameters, idle times and powder recycling strategies are not carefully managed, the energy demand and associated CO₂ emissions of AM can exceed those of conventional manufacturing. In this study, the environmental impacts of AM are examined from a life cycle perspective, with a focus on where energy use and emissions originate and how they can be reduced.

First, process-level energy and emission profiles are summarized for major AM technologies, including laser powder bed fusion (LPBF/SLM), electron beam melting (EBM), fused deposition modelling (FDM), directed energy deposition (DED/WAAM), binder jetting and emerging ceramic AM routes. Particular emphasis is placed on metal powder bed fusion, where electricity consumption dominates the global warming potential and powder recycling practices strongly influence the overall carbon footprint.

Subsequently, the influence of layer thickness, build orientation, infill density and preheating/idle phases on energy consumption is discussed, together with their interaction with mechanical performance targets. For FDM, the use of machine-learning-based models for predicting CO₂ emissions is highlighted as a promising route towards real-time, energy-aware process optimization. Finally, hybrid AM-machining chains and AM-produced ceramic heat exchangers are evaluated using life cycle assessment (LCA) to separate energy- and material-related emissions, and practical recommendations for reducing CO₂ emissions in AM process selection and parameter tuning are outlined.

Keywords: Additive manufacturing; Energy consumption; CO₂ emissions; Life cycle assessment; Sustainable manufacturing

EKLEMELİ İMALATIN ÇEVRESEL ETKİLERİ: YAŞAM DÖNGÜSÜ TEMELLİ ENERJİ TÜKETİMİ VE CO₂ EMİSYONLARININ ANALİZİ**Özet**

Ekl emeli imalat, karmaşık geometrilerin üretilebilmesi, malzeme israfının azaltılması ve üretim süreçlerinde esneklik sunması nedeniyle sürdürülebilir üretim modelleri içinde önemli bir yer edinmektedir. Bununla birlikte, süreç koşullarının uygun şekilde yönetilmediği durumlarda enerji tüketimi ve CO₂ emisyonları beklenenden yüksek seviyelere çıkabilmektedir. Özellikle metal **eklemeli imalat** süreçlerinde kullanılan lazer ve elektron ışını kaynakları, inert gaz sirkülasyonu, uzun ön ısıtma süreleri ve son işlem aşamaları toplam çevresel etkiyi belirleyen başlıca faktörlerdir.

Bu çalışmada, ekl emeli imalat teknolojilerinin çevresel etkileri yaşam döngüsü yaklaşımıyla kapsamlı biçimde ele alınmış; LPBF/SLM, EBM, DED/WAAM, FDM, binder jetting ve seramik **eklemeli imalat** süreçlerinin enerji profilleri karşılaştırılmıştır. Katman kalınlığı, parça yönelimi, platform doluluğu, baskı süresi, ön ısıtma ve boşta bekleme gibi parametrelerin enerji tüketimine etkileri değerlendirilmiş; makine öğrenimi tabanlı enerji/emisyon tahmin araçlarının süreç optimizasyonuna katkıları incelenmiştir.

Sonuçlar, eklemeli imalatta sürdürülebilirlik hedeflerine ulaşmak için parametre optimizasyonu, çevrim dışı enerji tüketiminin azaltılması, dögüsel ekonomi uygulamaları, malzeme geri kazanımı, makine öğrenimi destekli üretim planlaması ve entegre LCA yaklaşımlarının birlikte ele alınmasının önemli olduğunu göstermektedir.

Anahtar Kelimeler: Eklemeli imalat, enerji tüketimi, CO₂ emisyonları, yaşam döngüsü değerdendirmesi, sürdürülebilir üretim

**ADDITIVE MANUFACTURING IN RENEWABLE ENERGY SYSTEMS: 3D-PRINTED HEAT EXCHANGERS, COOLING STRUCTURES AND THEIR CONTRIBUTION TO ENERGY EFFICIENCY****Tuğçe TEZEL**

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Abstract

Additive manufacturing (AM) offers significant design freedom for thermal components used in renewable energy systems, particularly heat exchangers and cooling structures. By enabling complex internal channels, lattice architectures and multi-material layouts, AM allows thermal behaviour to be tailored beyond the limits of conventional manufacturing. This study reviews recent AM-based advances in thermal management for solar, wind, geothermal and waste-heat recovery applications.

Reported improvements include enhanced convective performance in TPMS-based heat exchangers, increased thermal storage through integrated phase-change materials, and more efficient cooling strategies for photovoltaic modules, electrical machines and power-electronics assemblies.

Remaining challenges involve surface roughness, process-induced defects, material qualification and long-term durability under outdoor conditions. Future progress is expected from AI-assisted optimization, hybrid material systems and advanced surface-finishing approaches that reduce hydraulic losses. Overall, AM-enabled thermal components show strong potential to support energy-efficiency goals across modern renewable-energy systems.

Keywords: Additive manufacturing; 3D-printed heat exchangers; Cooling structures; Thermal management; Energy efficiency; Renewable energy systems

YENİLENEBİLİR ENERJİ SİSTEMLERİNDE EKLEMELİ İMALAT: 3B ÜRETİLMİŞ ISI DEĞİŞTİRİCİLER, SOĞUTMA YAPILARI VE ENERJİ VERİMLİLİĞİNE KATKILARI**Özet**

Eklemeli imalat, yenilenebilir enerji sistemlerinde kullanılan ısıl bileşenler için tasarım özgürlüğünü önemli ölçüde artırmakta; özellikle ısı değiştiriciler ve soğutma yapılarında karmaşık iç kanallar, kafes mimarileri ve çok malzemeli düzeneklerin üretimini mümkün kılmaktadır. Bu sayede, ısıl davranış konvansiyonel imalat yöntemlerinin sınırlarını aşacak şekilde uyarlanabilmektedir. Bu çalışma, eklemeli imalat temelli ısıl yönetim yaklaşımlarındaki güncel gelişmeleri; güneş enerjisi, rüzgâr türbinleri, jeotermal sistemler ve atık ısı geri kazanım uygulamaları kapsamında incelemektedir.

Literatürde, TPMS tabanlı ısı değiştiricilerde konvektif performansta belirgin artışlar, faz değişim malzemesi entegrasyonu ile artırılmış ısı depolama kapasitesi ve fotovoltaiik modüller, elektrik makineleri ile güç elektroniği düzenekleri için daha etkin soğutma stratejileri raporlanmıştır. Buna karşın yüzey pürüzlülüğü, süreç kaynaklı kusurlar, malzeme yeterliliği ve dış ortam koşulları altında uzun dönem dayanımı gibi sorunlar halen çözülmesi gereken önemli başlıklardır.

Yapay zekâ destekli optimizasyon, hibrit malzeme sistemleri ve hidrolik kayıpları azaltan gelişmiş yüzey işleme yöntemlerinin, eklemeli imalat tabanlı ısıl bileşenlerin performansını daha da ileri taşıması

beklenmektedir. Genel olarak, eklemeli imalatla üretilmiş ısıl bileşenler, modern yenilenebilir enerji teknolojilerinde enerji verimliliği hedeflerini desteklemek için güçlü bir potansiyele sahiptir.

Keywords: Additive manufacturing; 3D-printed heat exchangers; Cooling structures; Thermal management; Energy efficiency; Renewable energy systems

INVESTIGATION OF DC POWER FLOW MODELING UNDER HIGH WIND POWER PENETRATION**İsmail Furkan DALDAL**İzmir Bakırçay University, Electrical and Electronics Engineering, İzmir-Türkiye
ORCID: 0009-0002-3031-5241**Faruk UGRANLI**İzmir Bakırçay University, Electrical and Electronics Engineering, İzmir- Türkiye,
ORCID: 0000-0003-0092-3318**Abstract**

The integration of wind power plants (WPPs) into electrical grids is increasing day by day, which further increases the need for power flow analysis to ensure the efficient operation of systems and reliable future planning. DC power flow analyses are widely preferred, especially in long-term planning studies, due to their computational efficiency and modelling simplicity. This study examines the effects of WPP integration into power grids on the accuracy and validity limits of DC power flow models. To this end, phase angle differences, bus voltages, and line active power flows are analysed on the IEEE 30-bus test system, and the accuracy of DC power flow under different scenarios is evaluated by comparing it with the AC power flow results as a reference. In particular, the effects of increased WPP penetration levels, load changes, and differences in line lengths on the accuracy of the DC power flow model are examined based on analyses of four scenarios: (i) reference base operating condition, (ii) changing the maximum WPP generation capacity, (iii) changing the total load of the system, and (iv) changing the distances of transmission lines. The findings reveal that as the penetration level of WPP increases, the accuracy of DC power flow results decreases, and the power flow directions even change in some lines. Similarly, as the total load level of the system increases, the differences between AC and DC power flow results in terms of active power flows in transmission lines increase. Consequently, under the influence of high WPP penetration and grid conditions, it has been determined that the accuracy of results obtained from DC power flow analyses depends on both the WPP penetration level and the system's operating conditions. Therefore, these effects must be taken into account to achieve high accuracy, particularly in long-term planning studies.

Keywords: DC power flow, WPP integration, AC power flow, Line distances.

LAMINAR SEPARATION BUBBLE FORMATION ON FINITE AND INFINITE WINGS FOR VERTICAL AXIS WIND TURBINES**Sefa ŞAHİN**

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Abstract

The aerodynamic performance of Vertical Axis Wind Turbines (VAWTs) is significantly affected by flow separations and instabilities, particularly at low Reynolds numbers. In this study, the formation and behavior of the Laminar Separation Bubble (LSB) on finite and infinite wing models possessing the NACA 4415 airfoil and wing were investigated experimentally. The primary objective of this research is to elucidate the aerodynamic differences between the finite wing, where three-dimensional flow effects are present, and the infinite wing, representing idealized two-dimensional flow, through the LSB mechanism.

Experimental tests were conducted at three different Reynolds numbers (75,000, 100,000, and 150,000) within an angle of attack range of 0 to 16 degrees. The surface oil flow visualization technique was utilized to observe the flow structure on the wing surfaces. The acquired visual data were analyzed using Python-based image processing algorithms to detect flow separation and reattachment points, enabling quantitative assessment. The results reveal that the LSB effect is particularly distinct at a Reynolds number of 150,000. While early stall is observed at lower Reynolds numbers, the behavior of the LSB changes significantly at higher Reynolds numbers. Specifically, at $Re=150,000$, it was observed that the LSB progressively moves towards the leading edge and diminishes in size up to an angle of attack of 12 degrees. Beyond 12 degrees, the bubble completely disappears. These findings corroborate the critical role of Reynolds number and wing finiteness in the design of vertical axis wind turbines.

Keywords: Vertical Axis Wind Turbine, Laminar Separation Bubble, Oil Flow Visualization, Finite and Infinite Wing, Reynolds Number, Image Processing.

**FARKLI GEOMETRİLERDE MANSARD ÇATILARA SAHİP BİNA MODELLERİ
ETRAFINDAKİ AKIŞIN SAYISAL İNCELENMESİ****Kerim SÖNMEZ**

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Özet

Mimari tasarımda estetik ve işlevsel kaygılarla tercih edilen farklı çatı geometrileri, yapıların rüzgâr etkisi altındaki aerodinamik davranışlarını önemli ölçüde değiştirmektedir. Mansard tipi çatılardaki geometrik farklılıklar da çatıların yüzeylerindeki akış karakteristiklerini belirgin biçimde etkilemektedir. Bu çalışmada, düz, iç bükey, dış bükey ve S formu şeklinde dört farklı mansard çatı tipine sahip bina modelleri etrafındaki akış alanları zaman bağımsız üç boyutlu sayısal çözümlerle incelenmiştir. Akış alanına uygun ağ yapısı ICEM CFD 18.0 programında oluşturulmuş ve çözümler ANSYS-FLUENT paket programı kullanılarak gerçekleştirilmiştir. SST k- ω türbülans modeli ile farklı mansard çatı tiplerine sahip bina modelleri etrafındaki akış alanı yapıları ve model yüzeylerindeki basınç dağılımları ayrıntılı biçimde hesaplanmıştır. Elde edilen sonuçlar, model yüzeylerindeki basınç katsayısı dağılımlarının çatı geometrisinden doğrudan etkilendiğini ve en kritik basınç katsayısı değerlerinin dış bükey mansard çatı tipinde, özellikle çatı sırt yüzeyinde meydana geldiğini göstermektedir.

Anahtar Kelime: Mansard çatı, Hesaplamalı Akışkanlar Dinamiği (HAD), Basınç katsayısı, Akış dağılımı.

**NUMERICAL INVESTIGATION OF FLOW AROUND BUILDING MODELS WITH MANSARD
ROOFS OF DIFFERENT GEOMETRIES****Abstract**

Different roof geometries chosen for aesthetic and functional reasons in architectural design significantly alter the aerodynamic behavior of structures under wind loads. Geometric differences in mansard roofs also markedly affect the flow characteristics on roof surfaces. In this study, flow fields around building models with four different mansard roof types (flat, concave, convex, and S-shaped) were investigated using time-independent three-dimensional numerical solutions. A computational mesh suitable for the flow domain was generated using ICEM CFD 18.0, and numerical simulations were conducted using the ANSYS-FLUENT software package. The flow field structures around building models with different mansard roof types and the pressure distributions on the model surfaces were calculated in detail using the SST k- ω turbulence model. The results obtained show that the pressure coefficient distributions on the model surfaces are directly affected by the roof geometry and that the most critical pressure coefficient values occur in the convex mansard roof type, particularly on the roof ridge surface.

Keywords: Mansard roof, Computational Fluid Dynamics (CFD), Pressure distribution, Flow Distribution

**KARE VE DAİRESEL KESİTLİ BİNA MODELLERİ ETRAFINDAKİ RÜZGAR ETKİLERİNİN SAYISAL OLARAK İNCELENMESİ****Tekmile CÜREBAL**

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Özet

Modern şehirlerde mimari yapıların yalnızca işlevsel olmaktan çıkıp kentsel estetiğin temel bileşenleri haline gelmesi, farklı geometrilere sahip yüksek binaların giderek yaygınlaşmasına neden olmaktadır. Bu durum, kare, dairesel veya daha farklı kesitlerdeki yüksek binaların aerodinamik davranışlarının incelenmesini gerekli kılmaktadır. Bu çalışmada, farklı geometrilere sahip yüksek binaların aerodinamik davranışlarını karşılaştırmalı olarak değerlendirmek amacıyla kare ve dairesel kesitli iki bina modeli etrafındaki rüzgâr etkileri üç boyutlu, zaman bağımsız sayısal analizlerle incelenmiştir. Bina modelleri, kare ve dairesel kesitli iki yapının 1/240 ölçeğinde küçültülmesiyle oluşturulmuş olup, kare kesitli bina 100 mm genişliğe ve 150 mm yüksekliğe, dairesel kesitli bina ise 100 mm çapa ve 150 mm yüksekliğe sahiptir. Akış alanındaki ağ yapıları ICEM CFD 18.0 programı ile oluşturulmuş, sayısal çözümler ise ANSYS-FLUENT 18.0 yazılımı kullanılarak Realizable k-ε türbülans modeli ile gerçekleştirilmiştir. Analizlerde bina modelleri yüzeylerindeki ortalama basınç dağılımları ve bina modelleri etrafındaki akış alanı yapıları Reynolds sayısının 1.5×10^5 değeri için ayrıntılı olarak elde edilmiştir. Elde edilen sonuçlar, dairesel kesitli bina modelinin çatısı ve yan yüzeyleri üzerindeki ortalama basınç katsayısı değerlerinin kare kesitli modele kıyasla daha kritik olduğunu göstermektedir. Ayrıca bina modelinin yakın çevresindeki alan ağırlıklı ortalama rüzgâr hızı oranlarının dairesel model etrafında belirgin şekilde daha yüksek olduğu belirlenmiştir. Bu durum, bina geometrisinin hem yüzey basıncı hem de çevresel rüzgâr alanı üzerinde önemli bir etkiye sahip olduğunu ortaya koymakta ve modern şehirlerdeki aerodinamik tasarım yaklaşımlarına önemli katkılar sağlamaktadır.

Anahtar Kelimeler: Hesaplamalı Akışkanlar Dinamiği (HAD), Basınç katsayısı, Türbülanslı akış, Kare kesitli bina, Dairesel kesitli bina.

NUMERICAL INVESTIGATION OF WIND EFFECTS AROUND SQUARE AND CIRCULAR CROSS-SECTION BUILDING MODELS**Abstract**

In modern cities, architectural structures have evolved beyond mere functionality to become fundamental components of urban aesthetics, leading to the increasing prevalence of tall buildings with diverse geometries. This situation necessitates the investigation of the aerodynamic behavior of tall buildings with square, circular, or other distinct cross-sections. In this study, wind effects around two building models with square and circular cross sections were investigated using three dimensional, time-independent numerical analyses to comparatively evaluate the aerodynamic behaviour of tall buildings with different geometries. The building models were generated by scaling down two structures with square and circular cross-sections at a scale of 1:240. The square-cross-section model has a width of 100 mm and a height of 150 mm, while the circular-cross-section model has a diameter of 100 mm and a height of 150 mm. The mesh structures in the flow field were created using the ICEM CFD 18.0 program, and the numerical solutions were performed using the ANSYS-FLUENT 18.0 software with the Realizable k-ε turbulence model. The mean pressure distributions on the surfaces of the building models and the flow field structures around the models were obtained in detail for a Reynolds number of 1.5×10^5 . The results obtained show that the average pressure coefficient values on

the roof and side surfaces of the circular cross section building model are more critical compared to the square cross section model. Furthermore, it was determined that the area weighted average wind speed ratios in the immediate vicinity of the building model are significantly higher around the circular model. These findings reveal that building geometry has a significant impact on both surface pressure and the surrounding wind field, contributing significantly to aerodynamic design approaches in modern cities.

Keywords: Computational Fluid Dynamics (CFD), Pressure coefficient, Turbulent flow, Square cross-section building, Circular cross-section building.

**FANLI KARAYOLU TÜNELLERİNDE DİFÜZÖR KANAT AÇISININ TAŞITLARDAN YAYILAN KARBONDİOKSİT DAĞILIMLARI ÜZERİNDEKİ ETKİSİNİN SAYISAL İNCELENMESİ****Kerim SÖZMEZ**

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Özet

Bu çalışmada, karayolları tünellerinde biriken karbondioksitin fan etkisiyle dağılımında, fan önüne yerleştirilen difüzörün kanat açısının etkisi sayısal olarak incelenmiştir. 500 m uzunluğunda iki şeritli düz bir tünel içerisinde taşıtların olmadığı ve tünel girişinden 100 m ileride tünel tavanına yakın bir konuma yerleştirilmiş 950 N itme kuvvetine sahip fanın önüne üç farklı kanat açısına sahip ($\alpha=10^\circ$, 20° ve 30°) difüzör yerleştirilerek oluşturulan üç boyutlu akış alanları zaman bağımlı olarak Standart k- ϵ türbülans modeli ile çözülmüştür. Tünel içerisindeki karbondioksit düzeylerinin çalışan fan ve difüzör etkisiyle zamana göre değişimlerinin incelendiği çalışmada, difüzör kanat açısının tünel içerisindeki karbondioksit dağılımları üzerindeki etkisi değerlendirilmiştir. Başlangıçtaki karbondioksit seviyesi 25000 ppm olarak dikkate alınmıştır. Zaman adımı 1 dakika seçilerek 60 dakikalık çözümler gerçekleştirilmiştir. 60 dakikalık fan çalışma süresinin sonunda tünel içerisindeki karbondioksit değerleri elde edilmiştir. Tünel hacmi içerisinde karbondioksit seviyesindeki azalmada difüzör kullanımının dezavantajlı olduğu görülmüştür.

Anahtar Kelimeler: Karayolu tüneli, Fan itme kuvveti, Difüzör kanat açısı, Karbondioksit dağılımı, Standart k- ϵ türbülans modeli

NUMERICAL INVESTIGATION OF THE EFFECT OF DIFFUSER BLADE ANGLE ON CARBON DIOXIDE DISPERSION FROM VEHICLES IN VENTILATED ROAD TUNNELS**Abstract**

In this study, the effect of the blade angle of the diffuser placed in front of the fan on the distribution of carbon dioxide accumulated in road tunnels by the fan effect was investigated numerically. The three-dimensional flow fields created by placing a diffuser with three different blade angles ($\alpha=10^\circ$, 20° and 30°) in front of a fan with a thrust force of 950 N, located 100 m from the tunnel entrance and close to the tunnel ceiling, were solved over time using the Standard k- ϵ turbulence model. In the study, which examined the change in carbon dioxide levels inside the tunnel over time due to the effect of the operating fan and diffuser, the effect of the diffuser blade angle on the distribution of carbon dioxide inside the tunnel was evaluated. The initial carbon dioxide level was considered to be 25,000 ppm. Time steps of 1 minute were selected, and 60-minute solutions were performed. At the end of the 60-minute fan operating time, the carbon dioxide values inside the tunnel were obtained. It has been observed that the use of diffusers is disadvantageous in reducing carbon dioxide levels within the tunnel volume.

Keywords: Road tunnel, Fan thrust force, Diffuser blade angle, Carbon dioxide distribution, Standard k- ϵ turbulence model

NUMERICAL INVESTIGATION OF A SAVONIUS WIND TURBINE WITH DIFFERENT BLADE OVERLAP DISTANCES**Ahmet Özkan KIRLI**

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Abstract

This study examines the aerodynamic efficiency of a Savonius-type vertical-axis wind turbine with various blade gap configurations at different wind speeds through numerical methods. Blade gaps of 10 mm and 20 mm were examined at constant inlet wind velocities of 3, 7, and 11 m/s using two-dimensional transient Computational Fluid Dynamics (CFD) models. The numerical studies utilised the standard $k-\epsilon$ turbulence model to minimise computational expenses, employing a time step of 0.002 seconds across a total simulation period of 15 seconds. The findings indicate that the 10 mm blade gap consistently surpasses the 20 mm arrangement across all wind speed conditions. The findings demonstrate that a diminished blade gap markedly enhances flow organisation, torque stability, and energy conversion efficiency, underscoring the promise of optimised Savonius rotor geometries for small-scale and low-wind renewable energy applications.

Keywords: Wind turbine, Savonius wind turbine, CFD analysis, wind turbine performance.

OpenFOAM-BASED INVESTIGATION OF CORNER RADIUS EFFECTS ON THE FLOW OVER A SURFACE-MOUNTED SQUARE**Eren Berk SAÇ**

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Abstract

This study utilizes fully open-source computational tools to investigate the influence of surface-mounted square geometry for steady-state flow. Three geometries were analyzed: a sharp-cornered square ($r = 0$), a square with partially rounded edges ($r = 0.25D$), and a square with fully rounded edges ($r = 0.5D$). The simulations were conducted using OpenFOAM with simpleFoam as the steady-state solver and blockMesh for meshing. Flow visualization and post-processing were conducted in ParaView.

The findings indicate that the corner radius exerts a substantial influence on the flow field. In the absence of curvature in the square, the formation of recirculation zones becomes evident at the corners, leading to an increase in vorticity and a corresponding elongation in the vortex reattachment length. Increasing the corner radius has been demonstrated to reduce sharp recirculation regions and promote smoother, more uniform flow, as evidenced by the velocity contours. The drag coefficient obtained from the simulations demonstrates reasonable agreement with values reported in the extant literature, thereby substantiating the reliability of the numerical setup.

The results of this study indicate that the reduction in reattachment length due to rounding sharp corners is approximately 35%. This reduction signifies a more rapid pressure recovery, as the separated flow reattaches over a shorter distance. This modification resulted in a reduction of the drag coefficient from 1.84 to 0.89, which corresponds to a decrease of approximately 52%. This phenomenon results in enhanced flow stability and diminished low-pressure regions. This work underscores the capability of free and open-source tools to efficiently analyze complex flow behavior.

Keywords: CFD, Corner Radius, OpenFOAM, Open-Source CFD, Turbulent Flow

SYSTEM-LEVEL REVIEW AND PROTOTYPE CONCEPT FOR PASSIVE URBAN COOLING BY WIND CATCHERS, BERNOULLI SUCTION, AND EVAPORATIVE FLOW**Mehmet Efe GÖKTÜRK**

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Abstract

Urban heat island effects and the increasing energy demand are humanity's modern crisis. The need for new passive ventilation strategies in urban environments increased due to traditional inefficient and noisy mechanical cooling. Traditional windcatcher systems which dates back thousand years ago, provide energyless ventilation yet generally suffer due to variable wind directions and complex urban flow conditions. This reduces their effectiveness. This study proposes a fully passive ventilation system combining a rotational windcatcher. It uses an embedded Bernoulli principle based Venturi channel. It enhances airflow reliability and magnitude without adding mechanical or electrical assistance. The system includes a freely rotating intake head which continuously rotates towards the incoming wind direction. It minimizes hesitation and directional losses. It generates additional low pressure within the vertical duct accelerating airflow through the Venturi effect by a geometrically designed and curved channel at the upper section.

The principles of proposed system are studied using analytical airflow modeling. A model is developed by using continuity relations, and Bernoulli's equation. Wind generated pressure difference is considered. The fundamental mechanisms are evaluated as a combined system. The proposed design creates stable ventilation performance especially under changing wind conditions. Better modularity, lower construction costs and adaptation to new buildings and installation to existing ones are emphasized in our design. Initial analysis suggest that the combined rotational movement and Venturi upward acceleration can improve airflow performance significantly. The difference will be critical with respect to traditional fixed type windcatchers.

The design creates a scalable and energy free solution for passive urban cooling. This includes street level air circulation. Due to reflective nature of ground level structures, concrete and asphalt covered ground, and hot sides of cooling systems, removing excess heat from the street level shows significance. Potential applications are possible in residential buildings, courtyards and street level installations providing cleaner and cooler quality and fresh air. The system positively contributes to urban climate strategies and reduces cooling related energy consumption by enhancing natural ventilation without increasing electrical energy demand. Future work can focus on computational fluid dynamics study, simulations and experimental validation by quantifying airflow enhancement and thermal performance under typical urban wind conditions.

Keywords: Windcatcher; Passive cooling; Bernoulli effect; Venturi channel; Natural ventilation; Urban heat island.

ANALYSIS OF A NACA 0015 FLEXIBLE AIRFOIL**Muhammed Ali Taş**

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Abstract

This study investigates the aerodynamic behavior and structural deformation characteristics of a flexible NACA 0015 airfoil using numerical simulations performed in ANSYS. The airfoil model was designed with material properties representative of a compliant wing structure, and fluid–structure interaction (FSI) principles were applied to capture the coupled behavior between aerodynamic loads and elastic deformation. A steady-state CFD analysis was conducted to evaluate pressure distribution, lift and drag coefficients, and flow separation tendencies under varying angle-of-attack conditions. Structural deformation and stress fields were obtained through finite element analysis, and mesh sensitivity studies were performed to ensure result accuracy. The simulations demonstrate that airfoil flexibility significantly influences aerodynamic performance, causing measurable shape deflection that alters pressure gradients and overall lift production. The results highlight the importance of incorporating elastic behavior into aerodynamic design processes, especially for modern UAV and morphing-wing application

Keywords: Flexible airfoil, fluid-structure interaction (FSI), aerodynamic performance

DEVELOPMENT OF SELF-HEALING HYDROGEL ELECTROLYTES FOR FLEXIBLE ENERGY STORAGE SYSTEMS**Merve Ünal**

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Abstract

In recent years, interest in flexible energy storage systems has grown rapidly; however, these devices are prone to severe structural damage, including cracks, tears, and interfacial degradation, resulting from cyclic mechanical deformation and electrochemical depletion processes. This situation significantly limits device life by leading to performance losses and safety risks. To overcome these challenges, self-healing materials inspired by biology offer a promising solution. In this study, a polyvinyl alcohol (PVA)-based gel electrolyte with high-efficiency self-healing properties, based on dynamic boronate ester bonds, was successfully synthesized to facilitate rapid post-damage repair. This developed gel electrolyte can physically repair damaged areas and maintain stable contact at the electrode/electrolyte interface. The ability of this developed gel electrolyte to physically repair damaged areas and maintain stable contact at the electrode/electrolyte interface was conclusively confirmed by detailed electrochemical characterization tests. Functional evaluations conducted in an activated carbon-based supercapacitor device revealed that the synthesized material exhibits promising electrochemical performance. Functional evaluations conducted in an activated carbon-based supercapacitor device revealed that the synthesized material exhibited promising electrochemical performance. The findings clearly demonstrate that self-healing gel electrolytes based on boronate ester chemistry, with their repair capability, high energy density potential, and low-cost advantage, could be a critical component for durable and flexible energy storage devices of the future.

Acknowledgement: This project has been funded by The Bursa Uludağ University Research Fund. (Project No: FOA-2022-1146).

Keywords: energy storage, supercapacitor, electrolyte

ESNEK ENERJİ DEPOLAMA SİSTEMLERİ İÇİN KENDİ KENDİNE İYİLEŞEBİLEN HİDROJEL ELEKTROLİT GELİŞTİRİLMESİ**Özet**

Son yıllarda esnek enerji depolama sistemlerine olan ilgi hızla artmakla birlikte, bu cihazlar döngüsel mekanik deformasyon ve elektrokimyasal tükenme süreçleri nedeniyle çatlak, yarık ve arayüzey bozulması gibi ciddi yapısal hasarlara maruz kalmaktadır. Bu durum, performans kayıplarına ve güvenlik risklerine yol açarak cihaz ömrünü önemli ölçüde kısıtlamaktadır. Bu zorlukların üstesinden gelmek için, biyolojiden ilham alan kendi kendini iyileştiren malzemeler umut verici bir çözüm sunmaktadır. Bu çalışmada, hasar sonrası hızlı onarım sağlamak amacıyla dinamik boronat ester bağlarına dayalı, yüksek verimli kendi kendini iyileştirme özelliğine sahip polivinil alkol (PVA) esaslı bir jel elektrolit başarıyla sentezlenmiştir. Geliştirilen bu jel elektrolitin, hasarlı bölgeleri fiziksel olarak onarabilme ve elektrot/elektrolit arayüzeyinde kararlı bir temas sürdürebilme yeteneği, detaylı elektrokimyasal karakterizasyon testleri ile kesin olarak doğrulanmıştır. Aktif karbon esaslı bir süperkapasitör cihazında yapılan işlevsel değerlendirmeler, sentezlenen malzemenin umut verici elektrokimyasal performans sergilediğini ortaya koymuştur. Elde edilen bulgular, boronat ester kimyasına dayanan bu kendi kendini iyileştiren jel elektrolitlerin, sahip olduğu onarım yeteneği, yüksek enerji yoğunluğu

potansiyeli ve düşük maliyet avantajı ile geleceğin dayanıklı ve esnek enerji depolama cihazları için kritik bir bileşen olabileceğini açıkça göstermektedir.

Teşekkür: Bu proje Bursa Uludağ Üniversitesi Araştırma Fonu tarafından finanse edilmiştir. (Proje No: FOA-2022-1146).

Anahtar Kelimeler: enerji depolama, süperkapasitör, elektrolit

A SYNERGISTIC TERNARY NANOCOMPOSITE ELECTRODE FOR NEXT GENERATION SUPERCAPACITOR**Merve Ünal**

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Abstract

In recent years, with globalization spreading worldwide, there has been a growing need for robust, affordable, and compact high-performance energy storage devices. Supercapacitors, a type of energy storage device, emerge as alternative power sources for various devices and applications, including portable electronic products, implantable devices, electric vehicles, and renewable energy storage. The development of high-performance, binder-free supercapacitor electrodes is an essential strategy for advancing next-generation energy storage systems. In this study, a composite electrode comprising reduced graphene oxide (rGO), polyaniline (PANI), and manganese dioxide (MnO₂) nanostructures was fabricated without the use of polymeric binders or conductive additives. The synergistic integration of rGO's high electrical conductivity, PANI's pseudocapacitive behavior, and MnO₂'s high theoretical capacitance has led to improved electrochemical performance. The rGO network provided a flexible and conductive skeleton for the uniform deposition of PANI and MnO₂ nanostructures, supporting efficient electron and ion transport pathways. Structural and morphological analyses have confirmed the formation of a porous architecture that facilitates the homogeneous distribution of active materials and promotes electrolyte penetration. Electrochemical measurements performed on the electrode have yielded high specific capacitance, excellent rate capability, and remarkable cycle stability. These results highlight the potential of rGO–PANI–MnO₂ composites as promising binder-free electrode materials for flexible and high-energy supercapacitor applications.

Acknowledgement: This project has been funded by The Bursa Uludağ University Research Fund. (Project No: FOA-2022-1146).

Keywords: supercapacitor, nanocomposite, energy storage.

YENİ NESİL SÜPERKAPASİTÖR İÇİN SİNERJİK BİR ÜÇ BİLEŞENLİ NANOKOMPOZİT ELEKTROT**ÖZET**

Son yıllarda, dünya çapında meydana gelen küreselleşme ile sağlam, uygun fiyatlı ve kompakt boyutlara sahip, yüksek performanslı enerji depolama cihazlarına olan ihtiyaç artmaktadır. Enerji depolama cihazlarından biri olan süperkapasitörler, taşınabilir elektronik ürünler, implante edilebilir cihazlar, elektrikli araçlar ve yenilenebilir enerji depolama gibi çeşitli cihazlar ve uygulamalar için ortaya çıkan alternatif güç kaynaklarıdır. Yüksek performanslı, bağlayıcı içermeyen süperkapasitör elektrotların geliştirilmesi, yeni nesil enerji depolama sistemlerini ilerletmek için önemli bir stratejidir. Bu çalışmada, polimerik bağlayıcılar veya iletken katkı maddeleri kullanılmadan, indirgenmiş grafen oksit (rGO), polianilin (PANI) ve manganez dioksit (MnO₂) nanoyapılarından oluşan bir kompozit elektrot üretilmiştir. rGO'nun yüksek elektrik iletkenliği, PANI'nin psödokapasitif davranışı ve MnO₂'nin yüksek teorik kapasitansının sinerjik entegrasyonu, elektrokimyasal performansın artmasına neden olmuştur. rGO ağı, PANI ve MnO₂ nanoyapılarının düzgün bir şekilde birikmesi için esnek ve iletken bir iskelet sağlayarak verimli elektron ve iyon taşıma yollarını desteklemiştir. Yapısal ve morfolojik analizler, aktif malzemelerin homojen dağılımını ve elektrolit penetrasyonu için faydalı olan gözenekli bir mimarinin oluşumunu doğrulamıştır. Elektrot üzerinde

gerçekleştirilen elektrokimyasal ölçümlerde yüksek özgül kapasitans, mükemmel hız kapasitesi ve dikkat çekici döngü stabilitesi elde edilmiştir. Bu sonuçlar, rGO–PANI–MnO₂ kompozitlerinin esnek ve yüksek enerjili süperkapasitör uygulamaları için umut verici bağlayıcı içermeyen elektrot malzemeleri olarak potansiyelini vurgulamaktadır.

Teşekkür: Bu proje Bursa Uludağ Üniversitesi Araştırma Fonu tarafından finanse edilmiştir. (Proje No: FOA-2022-1146).

Anahtar Kelimeler: süperkapasitör, nanokompozit, enerji depolama.

EXPERIMENTAL EVALUATION OF THE PERFORMANCE OF CONSERVATION VOLTAGE REDUCTION (CVR) ON RESIDENTIAL LOADS AT VARIABLE VOLTAGE**Metin TÜYSÜZ**

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Abstract

Conservation Voltage Reduction (CVR) is a widely adopted, low-cost demand-side management strategy that aims to reduce peak demand and overall energy consumption in distribution systems by intentionally lowering the supply voltage. CVR is particularly effective for voltage-dependent residential loads; however, the degree of impact varies considerably depending on appliance characteristics. To better understand these variations, this study experimentally examines the electrical behavior of common household appliances subjected to controlled voltage changes. Measurements were performed at eight voltage levels between 180 V and 250 V, during which a comprehensive set of electrical parameters was recorded with one-second resolution. The results reveal that voltage variations influence appliances in markedly different ways. Resistive heater-based loads, such as air fryers and toasters, exhibited substantial increases in active power under higher voltage conditions—rising from 701 W to 839 W in the air fryer and by more than 70% in the toaster. These appliances therefore offer considerable potential for energy savings through CVR. Lighting devices also demonstrated distinct behaviors: compact fluorescent lamps (CFLs) displayed strong voltage dependency, with active power increasing by approximately 33% as voltage rose, whereas LED lamps maintained nearly constant power consumption thanks to their electronic driver circuits. Conversely, appliances with constant-power characteristics tended to increase current draw at lower voltages, potentially limiting CVR effectiveness. Overall, the findings highlight that CVR impact is highly load-dependent and that uniform energy-saving expectations across all appliance types are unrealistic. Considering load composition during voltage optimization is essential for achieving more accurate energy-saving estimates and for designing effective, region-specific CVR applications that maintain consumer comfort while reducing peak demand.

Keywords: Conservation Voltage Reduction, Peak Demand, Voltage Control Method, Consumer Comfort, Voltage Regulation

EXPERIMENTAL IDENTIFICATION OF ZIP MODELS FOR RESIDENTIAL LOADS USING HIGH-RESOLUTION MEASUREMENTS**Metin TÜYSÜZ**

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Abstract

In this study, a comprehensive investigation was carried out on ZIP models to represent the voltage-dependent behavior of residential electrical loads. To accurately capture the intrinsic dynamic responses of the selected appliances, a measurement-driven methodology was implemented, enabling a more precise and reliable characterization of their load behavior. The ZIP framework, widely employed for estimating the active and reactive power drawn by loads under varying voltage conditions, constitutes a fundamental modeling approach grounded in the physical representation of the power–voltage relationship. As part of this study, six commonly used household appliances were experimentally examined in the Electrical Laboratory of Karadeniz Technical University, Trabzon Vocational School. The appliances were tested across a voltage range of 180 V to 250 V in 10V increments. At each voltage level, a high-resolution set of electrical parameters was recorded with a temporal resolution of one second. The acquired dataset was subsequently processed in MATLAB using the least-squares estimation technique, through which the ZIP coefficients for each appliance were derived. In the final stage of this study, the power values predicted by the obtained ZIP models were compared with their measured counterparts. This comparison enabled a rigorous evaluation of the accuracy and representational capability of the models in describing the voltage-dependent power behavior of residential loads.

Keywords: Load modeling, ZIP model, Residential appliances, Parameter estimation

DETECTION AND CLASSIFICATION OF SPIKE EVENT WITH ARTIFICIAL GORILLA TROOPS OPTIMIZER ALGORITHM**Cagri Altintasi**

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Abstract

In this study, the detection of spike events, which are among the most frequent and short-duration power quality disturbances, is investigated using the Artificial Gorilla Troops Optimization (AGTO) algorithm, a recently developed meta-heuristic inspired by the collective intelligence and social behavior of gorillas. According to the IEEE Std-1159 standard, the mathematical model of a spike event is formulated, and this model is employed as the objective function within the optimization framework. By minimizing the root-mean-square error between the real and reconstructed signals, the proposed method not only detects the presence of spike events but also estimates their parameters such as amplitude, duration, and occurrence time. To validate the effectiveness of the approach, 300 synthetic spike events with different magnitudes and durations are randomly generated in a MATLAB-based simulation environment. The obtained results demonstrate that the proposed AGTO-based method can successfully detect spike events with an accurate rate of 95% under noiseless conditions while providing reliable parameter estimations. Furthermore, the approach exhibits high stability, fast convergence, and low computational complexity. These findings indicate that the proposed method provides an effective and efficient tool for the automatic detection and characterization of power quality disturbances.

Keywords - Power quality disturbances, Spike event detection, Artificial gorilla troops optimization (AGTO), Parameter estimation, IEEE Std – 1159..

THE IMPACT OF INSTALLING A NEW POWER TRANSMISSION LINE IN THE DISTRIBUTION AREAS WITH HIGH VARIABLE RENEWABLE ENERGY**Andi HIDA**

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Abstract

In recent years, increased interest in renewable energy sources (RESs) in Albania has led to a rise in the cumulative installed capacity. However, they are not evenly distributed throughout the country. For example, hydroelectric power plants (HPPs) are often located in remote areas with abundant water resources. Meanwhile, in these areas, the load is smaller than the generation, resulting in surplus energy. This difference, especially during the winter season, would overload the transmission lines. For this reason, the need arises to reinforce the power system.

In this context, this paper analyses the impact of installing a new 220 kV line in a distribution area with high-generation energy from HPPs, with a total installed capacity of 275 MW. Furthermore, based on measured data, different generation and load scenarios (min, average, max) have been considered. Thus, various performance parameters of 110 kV lines have been analysed and compared, such as voltage profile, load reduction, total power losses, and voltage profile index (VPI). The results show a significant improvement in the voltage level after the installation of the 220 kV line. In the same vein, a reduction in power losses is seen, as well as a decrease in the 110 kV lines loading. However, the differences vary between the selected scenarios. In addition, these results may be important for system operators managing such regions with high generation and low load.

Keywords: transmission line, high generation, distribution area, loading, power losses.

CFD ANALYSIS OF FLOW STRUCTURE AROUND NACA 0018 AIRFOIL IN A VERTICAL AXIS WIND TURBINE**Mikail KOÇYİĞİT**

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Abstract

In this study, the airflow structure around a NACA 0018 airfoil used in vertical axis wind turbines (VAWT) is analyzed using Computational Fluid Dynamics (CFD) in ANSYS Fluent. Two different rotational velocity conditions ($\omega = 12.5$ rad/s and $\omega = 18.75$ rad/s) are considered. The effects of angular velocity on velocity contours, pressure distribution, and flow patterns are examined in detail. A structured mesh was generated with high density near the blade surface, and SST k- ω turbulence model was employed. Results show significant flow separation, vortex formation, and pressure variations, which directly affect the aerodynamic performance of the turbine.

Keywords: NACA 0018, VAWT, CFD, Flow Structure, Pressure Contour, Velocity Contour

BIOMASS ENERGY FOR SUSTAINABLE AGRICULTURE: CURRENT STATUS AND PERSPECTIVES**GHAILANE Ayoub**

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Abstract

The growing need for renewable energy sources and sustainable agricultural practices has driven interest in biomass as a key resource. Biomass energy, derived from organic materials such as agricultural residues, dedicated energy crops, and animal waste, offers a dual benefit: it provides a renewable energy source while contributing to sustainable agricultural practices. Converting biomass into energy through processes like combustion, anaerobic digestion, pyrolysis, and gasification can generate electricity, heat, or biofuels. This integration of agriculture and biomass energy production not only reduces dependence on fossil fuels but also addresses waste management challenges by utilizing agricultural by-products efficiently.

Anaerobic digestion of crop residues and livestock manure produces biogas, a versatile energy source, and nutrient-rich digestate that can be used as organic fertilizer. Similarly, biochar, a by-product of pyrolysis, can improve soil health by enhancing nutrient retention, reducing erosion, and sequestering carbon. However, several challenges limit the large-scale adoption of biomass energy in agriculture. These include logistical issues related to biomass collection and transport, land-use competition between energy crops and food production, and variability in biomass quality. Technological advancements in biomass conversion processes and improved agricultural practices are essential to overcoming these barriers.

This paper explores the synergies between biomass energy production and sustainable agriculture, focusing on recent innovations, environmental impacts, and economic feasibility. It highlights the potential of biomass to improve farm resilience through energy self-sufficiency and soil enhancement. With careful management, biomass energy systems can play a vital role in achieving sustainable agriculture, reducing carbon footprints, and advancing rural development.

Keywords: Biomass, Renewable Energy, Agriculture, Sustainable Development.

THE LEGAL AND REGULATORY FRAMEWORK FOR RENEWABLE ENERGY: THE CASE OF ALBANIA

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Abstract

Albania ranks among the countries with the highest share of renewable energy in the Balkan region, primarily due to the dominance of hydropower in its energy mix. However, this dependence exposes the energy sector to climate-related vulnerabilities, while significant solar and wind potential remains underutilized. This paper analyzes the legal and regulatory framework governing renewable energy sources in Albania, evaluates existing challenges to diversification, and proposes policy and legal reforms to support a more resilient and sustainable energy transition.

Introduction and Purpose: The purpose of this study is to examine the current situation of renewable energy development in Albania, with a focus on the legal, regulatory, and policy frameworks that shape the sector. Although Albania benefits from abundant hydropower resources, its overreliance on hydro makes the system vulnerable to hydrological variability. At the same time, the country possesses strong technical potential for solar and wind energy, which remains insufficiently exploited.

The study aims to (1) assess the alignment of Albania's renewable energy policies with EU standards, (2) identify regulatory gaps that hinder diversification, and (3) provide recommendations for strengthening the legislative environment and improving energy security.

Materials and Methods: This research is based on qualitative analysis of national legislation, secondary legislation, policy documents, international reports (IRENA, EU energy directives), and sectoral evaluations. Comparative review methods are used to assess harmonization with European Union requirements, while analytical methods are applied to identify administrative barriers, infrastructural limitations, and investment challenges. Statistical data on installed capacities and renewable energy shares are incorporated to contextualize the legislative analysis.

Discussion and Conclusion: Findings indicate that Albania's renewable energy sector benefits from strong natural potential but remains heavily dominated by hydropower. Gaps in regulatory clarity, licensing procedures, grid integration, and investor incentives slow down diversification efforts. Strengthening the legal framework, simplifying administrative processes, expanding support schemes for solar and wind energy, and promoting decentralized models such as prosumers and community energy are essential steps. A more diversified renewable energy mix would enhance energy security, reduce climate-related risks, and support Albania's long-term sustainable development and EU integration objectives.

Keywords: Renewable energy; Albania; legal framework; energy policy; hydropower; solar energy; wind energy; energy security; diversification; EU harmonization.

SMART GRID AND RENEWABLE INTEGRATION: A GLOBAL STUDY ON ENERGY EFFICIENCY, SUSTAINABILITY, AND FUTURE CHALLENGES**Md. Saikot Hasan**

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Abstract

The global shift towards sustainable energy has heightened the necessity for effective integration of renewable sources, especially solar and wind, into current power systems. The variable and intermittent characteristics of renewable energy sources present considerable challenges for grid stability, load balancing, and long-term energy planning. Smart Grid technologies, enhanced by artificial intelligence (AI), the Internet of Things (IoT), advanced metering infrastructure, and real-time monitoring systems, provide a significant solution to these limitations. This study assesses the global advancement of Smart Grid and renewable integration, emphasizing improvements in energy efficiency, reductions in system losses, and the enhancement of overall sustainability. The research utilizes international evidence from Europe, North America, and Asia to demonstrate how digitalized grid infrastructures enhance demand-response mechanisms, optimize energy distribution, and improve reliability during peak load conditions. This analysis examines the functions of battery energy storage systems, distributed generation, and predictive analytics in addressing the variable nature of renewable energy. This analysis examines key policy frameworks, investment priorities, and cybersecurity considerations that are essential for the deployment of large-scale Smart Grids. Research demonstrates that nations enhancing their grid infrastructure achieve greater renewable energy integration, lower carbon emissions, and increased operational stability. Additionally, smart technologies substantially reduce outage durations and facilitate more robust responses to climate-related disruptions. The study concludes that the acceleration of Smart Grid development is essential for meeting global decarbonization objectives, securing energy supply, and creating a sustainable, future-oriented energy system.

Keywords: Smart grid, Renewable energy integration, Energy efficiency, Artificial Intelligence (AI), Internet of Things (IoT), Grid stability.

TOWARDS ENERGY SUSTAINABILITY IN ALGERIA: OPTIMIZATION OF HYBRID AND RENEWABLE ENERGY SYSTEMS USING GEOGRAPHIC INFORMATION SYSTEMS (GIS)

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Summary:

Algeria, with its immense renewable energy potential thanks to its solar, wind and geothermal resources, is facing major strategic challenges to achieve its energy transition. This study proposes an integrated approach to optimizing hybrid energy systems, combining local renewable sources, intelligent technologies and .(geographic information systems (GIS

The use of GIS makes it possible to identify and map the most suitable areas for the deployment of hybrid infrastructures, taking into account the climatic, topographical and socio-economic conditions specific to each region. Hybrid systems are modelled using spatial data and multi-criteria analysis tools to optimize the distribution of energy resources between Saharan areas with high solar potential and coastal regions favorable to wind power.

Intelligent technologies, such as artificial intelligence and IoT systems, are being mobilized to improve the management of energy flows, anticipate resource variability and increase storage efficiency. At the same time, a socio-economic analysis highlights the positive spin-offs of decentralized models for rural and .isolated areas, where access to energy remains limited

This integrated approach demonstrates that the combination of GIS, renewable energies and smart technologies is an effective way of reducing greenhouse gas emissions, enhancing national energy security .and stimulating sustainable local development

Keywords: Hybrid energy systems, Renewable energies in Algeria, Energy optimisation, Geographic Information Systems (GIS), Energy transition, Sustainable development, Decentralized management.

ENERGY EFFICIENCY AND CARBON REDUCTION STRATEGIES IN FOOD COLD CHAIN SYSTEMS: IMPACTS ON SUSTAINABILITY**Mir-Hassan Moosavy**

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Abstract

Cold chain systems play a crucial role in ensuring the quality and shelf life of perishable food products, yet they are among the most energy-intensive components of the entire food supply chain. High electricity demand, reliance on conventional cooling technologies, and the growing need for continuous temperature control contribute significantly to greenhouse gas emissions and environmental burdens. This study presents a focused review of energy-efficiency measures and carbon-reduction strategies applicable to food cold chain operations, highlighting their potential to enhance sustainability while maintaining product safety and reducing losses.

The review examines the main sources of energy consumption in cold storage, refrigerated transport, and retail cooling, and summarizes state-of-the-art approaches such as high-efficiency compressors, improved insulation materials, smart monitoring systems, and demand-side energy-management technologies. The potential of integrating renewable-energy sources, particularly solar-powered refrigeration and hybrid systems, is also explored, emphasizing their role in reducing dependence on fossil fuels and mitigating carbon emissions.

Findings indicate that combining energy-efficient technologies with renewable-energy integration can reduce operating costs, enhance system resilience, and support global sustainability targets. However, challenges such as initial investment requirements, technical limitations in retrofitting older facilities, and the need for trained personnel remain important considerations. Overall, this review underscores that advancing energy-efficient and low-carbon strategies in the food cold chain is a key opportunity to strengthen environmental sustainability while safeguarding food quality and security.

Keywords: Cold chain; energy efficiency; carbon reduction; renewable energy; sustainability.

HYBRID INDUCTIVE–CAPACITIVE LCLC-COMPENSATED WIRELESS POWER TRANSFER SYSTEM WITH ADAPTIVE IMPEDANCE AND ALIGNMENT CONTROL FOR HIGH-POWER ELECTRIC VEHICLE CHARGING**Alok Kumar Shrivastav**Department of Electrical
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of Engineering, India**Abstract**

This paper presents a novel hybrid inductive–capacitive wireless power transfer (HIC-WPT) system incorporating an improved LCLC-compensated topology and adaptive impedance control to enhance power transmission capability for high-power electric vehicle (EV) charging. The proposed configuration synergistically integrates inductive power transfer (IPT) and capacitive power transfer (CPT) mechanisms to achieve high efficiency under wide air-gap and misalignment conditions. An adaptive impedance matching network and frequency-tracking control are introduced to dynamically regulate the resonant frequency, reducing reactive losses and maintaining soft-switching operation across variable load and coupling scenarios. Finite element and circuit co-simulations are employed to optimize coupling geometry, plate dimensions, and dielectric parameters of the capacitive structure. A 100 kW prototype is modeled with 500 mm × 500 mm couplers, evaluated over air gaps from 150 mm to 750 mm. The combined IPT–CPT approach yields a maximum output power of 96.2 kW with an efficiency of 96.1% at a switching frequency below 1 MHz. Comparative results confirm improved electromagnetic coupling stability and robustness to lateral misalignment relative to conventional IPT systems. Environmental stress tests, including temperature, moisture, and dust exposure, demonstrate minimal degradation in power-transfer performance. The proposed HIC-WPT system enables efficient, reliable, and scalable wireless charging for next-generation electric mobility applications.

Keywords- Hybrid power transfer; wireless EV charging; LCLC compensation; adaptive impedance control; inductive and capacitive coupling; misalignment tolerance; resonant converter; frequency tracking.

THE POTENTIAL OF SMALL AND MEDIUM HYDROPOWER PLANTS FOR REGIONAL DEVELOPMENT**Ana Tsulaia**

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Abstract

Small and medium hydropower plants (S/M HPPs) play a crucial role in supporting sustainable regional development, particularly in countries with diverse hydrological resources. Their impact extends beyond renewable energy generation, influencing economic growth, infrastructure modernization, environmental management, and social well-being.

By providing stable, locally generated electricity, S/M HPPs strengthen energy security in remote regions and create favorable conditions for the development of local businesses, public services, and community livelihoods. Their construction and operation stimulate regional economies through job creation, increased demand for local services, and long-term investment opportunities. Additionally, hydropower projects often drive improvements in transportation networks and communication infrastructure, enhancing regional connectivity and competitiveness. When properly planned, these plants also support sustainable water management and have relatively low ecological impact compared to large hydropower facilities.

International examples—from Norway’s fjord communities to Austria’s Alpine regions—illustrate the transformative potential of small hydropower for local development. The Georgian case of hydropower development in Racha further demonstrates how such projects can open isolated areas to tourism, create new jobs, strengthen electricity supply, and elevate local living standards. Overall, small and medium hydropower plants serve as powerful catalysts for balanced, resilient, and environmentally responsible regional growth.

Key Words: Regional Development, Renewable Energy, Infrastructure Modernization, Local Economy, Sustainable Water Management, Rural Electrification, Energy Security, Environmental Sustainability.

FROM METHANE EMISSIONS MONITORING TO RENEWABLE ENERGY CONVERSION IN ALGERIA'S MAJOR LANDFILLS**Abdelli Islam Safia*, Toumi Meriem, Attouti Salima,**

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Abstract

Rapid demographic and urban growth in Algeria has led to a significant increase in municipal solid waste generation, more than 80% of which is disposed of in landfills. These sites represent major sources of atmospheric pollution, primarily through methane (CH₄) emissions a potent greenhouse gas with a global warming potential 21 times higher than CO₂.

This study assesses methane generation in five major Algerian cities (Algiers, Oran, Blida, Batna, and Sétif) using a multi-model approach based on IPCC, LandGEM, and MTM methodologies.

Results show that between 2010 and 2021, over 1,124 Gg of CH₄ were emitted from these landfills. Projections indicate emission peaks of 105 Gg/year in Algiers by 2041, 75 Gg/year in Sétif by 2046, and 45 Gg/year in Oran by 2047. The associated energy potential is substantial: up to 1.48 TWh in Algiers and 1.01 TWh in Sétif, with annual electricity generation capacities exceeding 300 GWh in the most active sites.

Methane-to-energy conversion represents a strategic pathway to simultaneously reduce greenhouse gas emissions, mitigate ecotoxicological impacts of landfills, and contribute to Algeria's sustainable development and energy transition. This approach provides an effective tool for biomonitoring and environmental remediation while supporting the emergence of a low-carbon circular economy.

Keywords: Municipal solid waste; Methane; Greenhouse gases; Biomonitoring; Energy recovery; Sustainable development; Circular economy.

ROMANIA'S PATH TO ONE-THIRD RENEWABLES: OPPORTUNITIES AND CHALLENGES

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Abstract

Nowadays, humanity is turning to alternative, renewable energy sources to reduce greenhouse gas emissions, improve energy security, and support economic and social development, as fossil fuels are running out. In this paper, we focus on renewable energy sources in Romania. Romania's EU target is to reach at least one-third renewables in gross final energy consumption by 2030, requiring roughly 7 GW of new renewable capacity, more than half of which will be solar.

Romania is a relatively "green" country, with hydro, nuclear, wind, and solar energy, and is planning a significant expansion of renewable energy by 2030. Hydropower remains the primary renewable source, but it depends on the hydrological conditions. Wind power has become a pillar of the energy system, with about 3 GW installed and frequent days when wind is the leading single source of electricity.

Also, solar capacity is growing, and the Dobrogea region could become a pioneer in energy transmission efficiency through an 850 km underground HVDC (High Voltage Direct Current) line. The use of wind and solar energy will reduce greenhouse gas emissions while providing clean energy for domestic consumption and export.

Advanced monitoring and integration of innovative grid technologies optimise energy production, transmission, and consumption patterns, and improve environmental performance.

COST–BENEFIT ANALYSIS OF ENERGY-EFFICIENT TECHNOLOGIES IN SUSTAINABLE BUILDING DESIGN**Laura DIACONU MAXIM**

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Abstract

Improving energy performance through high-efficiency buildings, which could include advanced heating, ventilation and air conditioning systems, especially from renewable generation, has been widely recognized as a cost-effective pathway to reduce energy demand. However, despite all these energy savings, the economic justification for adopting these technologies remains a major barrier for developers and policymakers. Considering these aspects, the purpose of the study is to quantify the economic viability of integrating the energy-efficient components into new or existing buildings and to identify which combinations offer the highest return on investment. Our major objectives are focused on both direct benefits, such as reduced energy use and operational costs, and indirect benefits, which refer to the reduced environmental externalities. Our results indicate that several energy-efficient technologies could generate strong economic returns within typical building lifetimes. Smart building energy management systems, though requiring lower capital investment, generate high benefit-cost ratios by optimizing real-time consumption and improving the overall system's efficiency. Renewable energy integration, especially the rooftop photovoltaics, becomes increasingly cost-effective under scenarios with moderate energy price increase and supportive incentives. All in all, we can argue that our findings highlight that energy-efficient technologies can provide significant long-term economic benefits, especially when evaluated through a life-cycle perspective.

Keywords: energy efficiency, sustainable building, cost-benefit analysis.

STUDY OF RADIATIVE HEAT TRANSFER ON CNT-WATER MHD NANOFLUID FLOW THROUGH A STRETCHING SURFACE: AN APPLICATIONS TO SOLAR ENERGY**Prashanta Kumar Mandal**

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Rajapriya E.

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Abstract

A numerical analysis for unsteady magnetohydrodynamic (MHD) flow of CNT-water nanofluid with non-linear thermal radiation is investigated. The Buongiorno's nanofluid model is assumed with single and multi-walled carbon nanotubes (SWCNTs and MWCNTs). The convective condition and zero nanoparticles mass flux condition are applied on the boundary. Mathematical model has been developed with the help of momentum, temperature as well as nanoparticles concentration equations. The resulting differential systems are highly nonlinear which are solved numerically with the help of shooting technique along with Runge-Kutta-Fehlberg method. The graphs are depicted for velocity, temperature and nanoparticle concentration whereas numerical computations for skin friction, Nusselt number as well as Sherwood number are recorded in tabular form. It is found that the temperature is increasing functions of the radiation parameter whereas the rate of heat transfer increases with the improvement of temperature ratio parameter.

Keywords: Unsteady flow, Nanofluid, MHD, Non-linear radiation, Convective condition, CNT.

Title: DEVELOPMENT OF TIN OXIDE THIN FILMS DEPOSITED BY ULTRASONIC SPRAY PYROLYSIS FOR ENHANCED PHOTOVOLTAIC APPLICATIONS**Sabrina Roguai**

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Abstract

SnO₂ thin films were successfully deposited using the ultrasonic spray pyrolysis (USP) technique at a substrate temperature of 450°C. The structural, vibrational, and optical properties of the films were thoroughly characterized using X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, and ultraviolet–visible (UV–Vis) spectroscopy. XRD analysis confirmed the formation of a tetragonal rutile-type structure with a well-defined crystalline quality and an average crystallite size of approximately 35 nm. The films exhibited a preferred orientation along the (101) plane, indicating good crystallinity.

FTIR spectroscopy revealed the presence of two distinct absorption bands: one corresponding to Sn-O-Sn deformation vibrations, and the other associated with O-Sn stretching modes, confirming the bonding characteristics of the SnO₂ matrix. The optical properties were further investigated using UV–Vis spectroscopy, where the optical transmittance of the films was recorded over a wide wavelength range. The band gap energy was calculated using the Wemple-DiDomenico single-oscillator model, yielding a direct band gap value, which is crucial for photovoltaic applications due to its influence on light absorption efficiency.

These findings suggest that SnO₂ thin films produced by USP exhibit suitable structural and optical properties for potential use in photovoltaic devices, offering a promising approach for improving energy conversion efficiency.

Keywords: Thin films, X-ray diffraction, FTIR spectroscopy, Optical properties.

TERMINAL ACCEPTOR ENGINEERING IN D–A₁–A₂ SMALL-MOLECULE DONORS TOWARD HIGH-EFFICIENCY ORGANIC SOLAR CELLS: INSIGHTS FROM DFT, TD-DFT, AND MOLECULAR DYNAMICS SIMULATIONS**Mohammed Ouachekradi, Yasser Karzazi**

Laboratory of Applied Chemistry and Environment, Faculty of Sciences, University Mohammed I, BP 4808, 60046 Oujda, Morocco

Abstract

In this study, a series of small-molecule donors for organic solar cells were rationally designed and evaluated using density functional theory (DFT), time-dependent DFT (TD-DFT), and molecular dynamics (MD) simulations. The molecular design strategy focused on tuning the terminal acceptor group within a D–A₁–A₂ framework. The reference compound (D1) incorporated the conventional malononitrile unit, whereas the newly designed small-molecule donors (D2–D6) were obtained by substituting this group with engineered acceptors derived from fragments commonly employed in state-of-the-art non-fullerene acceptors (NFAs). The results revealed that terminal acceptor engineering effectively improved the electronic structure by narrowing the HOMO–LUMO energy gap and strengthening the intramolecular charge transfer (ICT). Optical investigations showed red-shifted absorption bands, higher oscillator strengths (f), and enhanced light-harvesting efficiency (LHE) for all designed donors (D2–D6). Global reactivity parameters further confirmed improved charge separation and greater electronic adaptability. Photovoltaic assessments indicated that the designed donors maintained favorable open-circuit voltages and high fill factors. Complementary MD simulations supported these findings, with radial distribution functions (RDF) revealing stable donor–acceptor interactions and mean squared displacement (MSD) profiles confirming adequate molecular mobility. Overall, D4 emerged as the most promising donor, combining optimal electronic, optical, and photovoltaic properties with favorable dynamic behavior, thereby validating terminal acceptor engineering as an effective route toward high-efficiency organic solar cells.

NUMERICAL EVALUATION OF INNOVATIVE RIB GEOMETRY FOR BOOSTING HEAT TRANSFER IN SOLAR AIR HEATER DUCTS**Mouad Benaicha^{1*}, Youssef.Ech-Chine ^{2*}, Mohammed El Goual ^{2*}**^{1*}LPTPME Laboratory, Faculty of Sciences, Mohammed 1st University, 60000, Oujda, Morocco^{2*}Laboratory of Mechanics & Energetics, Faculty of Sciences, Mohammed First University, 60000 Oujda, Morocco**Abstract**

This work presents a numerical investigation of a solar air heater duct enhanced with an innovative rib geometry placed on the absorber plate. The purpose of this rib design is to overcome the poor convective exchange typically observed in smooth solar air heater channels by stimulating stronger turbulence and near-wall mixing. The simulations are performed across a Reynolds number range of 3,800 to 18,000 to capture the flow behavior from low to fully turbulent regimes. The results reveal that the proposed rib shape significantly alters the flow structure by generating persistent vortical motion, expanding recirculation regions, and intensifying turbulent energy close to the heated surface. These flow features collectively improve the thermal interaction between the air stream and the absorber wall, resulting in a clearly enhanced heat-transfer process. Furthermore, the innovative rib achieves this thermal improvement while maintaining a reasonable hydraulic penalty, offering a balanced and efficient solution for solar air heater applications.

Keywords: Solar Thermal Collector, Heat transfer, turbulent flow, Computational fluid dynamics.

METAL SULFIDE PHOTOCATALYSTS: PROGRESS AND CHALLENGES IN SOLAR ENERGY CONVERSION**Saeeda Mubashra, Tanzeela Riaz**

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Abstract

Metal sulfide semiconductors have emerged as an up-and-coming class of photocatalysts for solar-to-chemical energy conversion due to their narrow band gaps, strong visible-light absorption, tunable electronic structures, and abundant active sites. Recent advances have focused on improving their light-harvesting ability, charge separation efficiency, and long-term stability, which are essential for applications such as photocatalytic water splitting, CO₂ reduction, N₂ fixation, and pollutant degradation. Engineering strategies, including element doping, vacancy engineering, heterojunction construction, cocatalyst deposition, and morphological control, have significantly enhanced the performance of CdS, MoS₂, ZnS, ZnIn₂S₄, and polynary sulfides. Despite these developments, photocorrosion caused by oxidation of lattice S²⁻ ions remains a major challenge. Innovative solutions such as dual cocatalysts, protective layers, and Z-scheme systems have demonstrated improved durability and selectivity. This presentation highlights the mechanistic principles, engineering strategies, emerging challenges, and future opportunities for designing robust metal sulfide photocatalysts for efficient solar-driven chemical transformations.

ASSESSMENT OF THE ZINC SULFIDE INSULATION LAYER'S IMPACT ON CIGS SOLAR CELL EFFICIENCY**Abdelali Laid, Abed zoulikha**

Applied Material Laboratory, University Djillali Liabes of Sidi Bel Abbes, Algeria

Abstract

In this paper, we present a simulation of a CIGS solar cell with a ZnS buffer layer, performed using the Silvaco-Atlas simulator. However, we obtained an efficiency of 24.13%, short-circuit current of 37.81 mA/cm², an open circuit voltage of 740 mV, and a fill factor of 78.78% at was around 1.41 eV, corresponding to an x ratio of 0.5 for the CIGS solar cell using a ZnS buffer layer. We optimized the performance of the ZnS/CIGS solar cell with the improved effects of layer parameters such as thickness and acceptor densities ZnS buffer layers.

Keywords: Buffer layer (ZnS), CIGS, Solar cell, Optimization, Silvaco-Atlas

ENHANCING THIN-FILM PHOTOVOLTAIC SUSTAINABILITY USING SPRAY-DEPOSITED Cu_2SnS_3 ABSORBERS**Belarbi Faten**

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2 Electromagnetism and Guided Optics Laboratory (LEOG), Abdelhamid Ibn Badis University of Mostaganem, Algeria

Abstract

In this work, we investigate Cu_2SnS_3 (CTS) as a promising sustainable absorber material for thin-film photovoltaic applications. CTS is considered one of the most eco-friendly and cost-effective semiconductors because it is non-toxic, inexpensive, and composed of earth-abundant elements. Due to its direct band gap and high absorption coefficient ($\sim 10^6 \text{ cm}^{-1}$), CTS is well suited for efficient light harvesting in solar cell devices. In this study, CTS thin films were synthesized using a low-cost spray pyrolysis technique. Structural, optical, and morphological characterizations were performed to assess the quality of the deposited layers and evaluate their suitability for photovoltaic applications. The results confirm the potential of spray-deposited CTS films as sustainable absorber layers for next-generation thin-film solar cells.

Keywords: Cu_2SnS_3 , thin-film solar cells, spray pyrolysis, eco-friendly absorber, sustainable photovoltaics.

THEORETICAL STUDY OF NEW D- π -A ARCHITECTURE ORGANIC MATERIALS FOR APPLICATION IN DYE-SENSITIZED SOLAR CELLS**Brahim AZZIMANI**

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Yasser KARZAZI

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Abstract

Solar energy has emerged today as a concrete and sustainable response to both energy and environmental challenges. It harnesses an inexhaustible resource — the sun — to generate clean electricity in a decentralized manner, with minimal environmental impact throughout its life cycle. Among emerging solar technologies, dye-sensitized solar cells (DSSCs) stand out due to their innovative approach: they are less expensive to manufacture, more flexible, and can operate efficiently even under low-light conditions. Inspired by the natural mechanisms of photosynthesis, DSSCs use dyes to capture light and generate electricity, thus opening new possibilities for photovoltaic integration in a variety of contexts. As part of this final year project, we theoretically designed and investigated six novel organic D- π -A dyes (D1-D6) for dye-sensitized solar cells (DSSCs), derived from a previously synthesized dye (RD). The objective was to evaluate the impact of structural modifications on their optoelectronic and photovoltaic properties. All quantum chemical calculations were performed using density functional theory (DFT) for ground-state geometry optimization and electronic structure analysis, while time-dependent DFT (TD-DFT) was employed to investigate excited-state properties. The results show that all dyes exhibit planar geometries and appropriate HOMO-LUMO energy levels for effective electron injection into TiO₂ and subsequent dye regeneration by the electrolyte. All compounds demonstrate high light-harvesting efficiency (LHE > 0.974), with D5 and D6 showing particularly strong oscillator strengths (f). Among the studied dyes, D3 stands out with the most favorable photovoltaic descriptors, including the highest open-circuit voltage (V_{oc}), as well as favorable electron injection driving force (ΔG_{inj}) and regeneration energy (ΔG_{reg}). Charge transfer behavior was further confirmed through transition density matrix (TDM), electron density difference (EDD), and charge centroid analyses, all indicating efficient intramolecular charge separation. This work provides valuable insights into the rational design of high-performance D- π -A dyes for DSSC applications.

Keywords: DSSCs, Organic dyes, D- π -A, DFT, Photovoltaic, optoelectronic, Charge transfer.

THE IMPACT OF SOLAR POWER SETUP IN RURAL AREAS OF RAJASTHAN: A SOCIAL DEVELOPMENT PERSPECTIVE**Mohd Kaif¹, Abdul Rehman², Bhavani Singh³, Abdul Hannan⁴**^{1,2,4}Aligarh Muslim University, ³SRIJAN org.**Abstract**

Rajasthan, with its high solar potential and vast rural landscape, has emerged as a leading state in India's solar energy expansion. This study examines the social and developmental impact of solar power setups—such as solar home systems, solar pumps, and decentralized mini-grids—in rural areas of Rajasthan. Using a social science lens, the paper analyses how improved energy access influences livelihood opportunities, education, women's workload, community well-being, and overall quality of life. It also identifies challenges such as maintenance issues, unequal access across caste and income groups, low awareness about efficient usage, and dependency on external agencies for repairs. Drawing on field insights and secondary evidence, the study highlights how solar energy has enhanced agricultural productivity, reduced diesel dependence, and expanded evening study hours for children. The research concludes that solar power can be a transformative force in rural Rajasthan, provided community participation, local capacity building, and inclusive implementation models are strengthened for long-term sustainability.

NUMERICAL INVESTIGATION OF THERMO-HYDRAULIC PERFORMANCE IN SOLAR AIR HEATER DUCT WITH NOVEL RIB ROUGHNESS GEOMETRY**Youssef Ech-chine**

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Mohammed Jami

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Abstract

This study presents a numerical investigation of the effect of rib pitch on the thermo-hydraulic performance of a solar air heater duct equipped with a ribbed absorber plate. Using computational fluid dynamics (CFD) simulations, the airflow and heat transfer characteristics were analyzed under turbulent conditions with a constant heat flux applied to the absorber surface. The analysis focuses on how variations in rib pitch influence the flow structure, turbulence intensity, and overall heat transfer efficiency. By modifying the distance between ribs while maintaining constant rib height and other geometrical parameters, the study highlights the role of rib spacing in controlling recirculation zones and thermal boundary layer disruption. The results reveal that rib pitch has a significant impact on both the enhancement of convective heat transfer and the associated pressure losses. A smaller pitch promotes stronger turbulence and higher heat transfer rates, whereas a larger pitch reduces frictional losses but limits heat exchange. An optimal rib spacing is identified, offering a balanced compromise between heat transfer improvement and pressure drop. These findings provide useful guidelines for the design and optimization of efficient solar air heater systems.

Keywords: Solar air heater; Thermo-hydraulic performance; Heat transfer enhancement.

APPLICATIONS OF RENEWABLE ENERGIES IN SEAWATER DESALINATION**Chaimae Lamiri¹, Jamal Mabrouki¹, Khadija El-Moustaqim², Ayoub Ghailane¹ and Younes Abrouki¹**

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Abstract

Millions of people do not have access to a safe source of fresh water. However, as many arid regions are coastal, desalination of seawater is a reasonable alternative. However, desalination requires a lot of energy. In addition, energy supply in less developed countries or isolated areas can be problematic, particularly when electricity is needed. Since most arid regions have significant renewable energy resources, using them for seawater desalination represents an attractive opportunity, and in some cases the only solution, for ensuring a safe source of fresh water. The current status and prospects for the development of renewable energy systems coupled with desalination units are examined. It is emphasized that there are prospects for development, even for technologies that appear to be the most mature.

Keyword: Renewable energy, Seawater desalination, énergie, Fresh water

DFT/TD-DFT BASED COMPUTATIONAL STUDY OF NON-FULLERENE ACCEPTORS FOR ENHANCED ORGANIC SOLAR CELLS**Ikram Mennas**

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Abstract

In this study, we designed and analyzed novel non-fullerene electron acceptors based on quinoxaline derivatives (R, M1-M5) for organic photovoltaic cells. Using density functional theory (DFT) and time-dependent density functional theory (TD-DFT), we investigated the main electronic and optical properties, including frontier molecular orbitals (FMOs), density of states (DOS), molecular electrostatic potential (MEP), global reactivity descriptors, dipole moment, charge mobility, and optical characteristics. Our results reveal that the engineered compounds exhibit a small band gap, favorable optical properties, and efficient charge mobility. Furthermore, when paired with PTB7-Th as an electron donor, these molecules demonstrate strong charge conduction and effective electron transfer. These promising findings suggest that experimental validation of these molecules could lead to improved performance in non-fullerene organic photovoltaic cells.

Keywords: Non-fullerene acceptors, quinoxaline derivatives, organic photovoltaics cells, density functional theory (DFT).

**PUBLIC PERCEPTIONS OF THE ENERGY TRANSITION IN THE CONTEXT OF
TECHNOLOGICAL INNOVATION****Francisco J. Rey**Research Assistant, University of A Coruña, CITIC, A Coruña-Spain
ORCID: <https://orcid.org/0000-0002-7393-8628>**Abstract**

Public perceptions of the energy transition are strongly shaped by how technological innovation is understood, trusted, and integrated into everyday life. Current literature indicates that attitudes toward renewable energy technologies are influenced not only by environmental awareness but also by the perceived reliability, fairness, and long-term benefits of new systems. Social acceptance is influenced by expectations of technological progress, such as improvements in efficiency, digital monitoring, smart infrastructures, or advanced storage solutions, which often generate optimism but also raise concerns related to transparency, equity, and potential local impacts. Research highlights that communities tend to support innovation when it is framed as accessible, safe, and aligned with socio-economic development. However, persistent gaps remain in how citizens evaluate the broader technological shift that accompanies decarbonisation, especially regarding trust in institutions, pace of change, and the perceived distribution of risks and benefits. This state-of-the-art synthesis highlights the need for approaches that integrate technological innovation with participatory strategies to establish legitimacy and promote sustained public support for the energy transition.

Keywords: energy transition; public perceptions; technological innovation; social acceptance; decarbonisation; socio-technical change.

Ag-Doped WO₃/TiO₂ PHOTOELECTRODE FOR EFFICIENT GREEN HYDROGEN PRODUCTION VIA PEC WATER SPLITTING**Sneha Ghosh¹, Subhasis Roy*,**

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Abstract

The exploration of clean energy is currently one of the most critical challenges. In that context, hydrogen has the foremost importance. The study focuses on producing green hydrogen in an energy-efficient and cost-effective manner using renewable energy, with water as the sole feedstock. The soul of this technology is to fabricate a photoresponsive semiconductor electrode. The electrochemical reaction typically requires a voltage of 1.23-1.8 V to break down a single water molecule, and the energy is primarily supplied by a series of batteries in conventional electrolysis. To minimize a major part of this production cost, water splitting is carried out by the charge carriers, electrons and holes, generated when the semiconductor electrode is illuminated by light. The key component of the photoelectrode is a coating of a WO₃ solution containing a specific doping percentage of Ag (bandgap ~2.79eV) on TiO₂-coated FTO glass. Electrochemical analysis enables the direct correlation of the obtained data with real-world hydrogen production efficiency. It is a promising photoelectrochemical technique for efficient hydrogen production, addressing energy and environmental challenges. It can be a significant step towards a sustainable energy future, leveraging cutting-edge technology.

Keywords: Clean energy, Green hydrogen, Photoelectrode, Electrolysis

HYDROGEN PRODUCTION VIA SEAWATER SPLITTING USING NaSiCon MEMBRANES: A SUSTAINABLE APPROACH**Atreyee Hazra**

University of Calcutta, India

Dr. Subhasis Roy

University of Calcutta, India

Abstract

The sheer fact that a NaSiCon (Sodium Super Ionic Conductor) membrane is used for the purpose of seawater splitting to produce hydrogen is an environmentally friendly method of hydrogen generation. Seawater electrolysis is the process that this method operates on, which in turn runs at a much lower cost and is more accessible than freshwater. The main breakthrough in this process is the NaSiCon membranes, which are known for their highest sodium ion (Na^+) conductance but at the same time, they prevent the passage of water molecules and other ions, thus making the ion separation step in electrolysis much more efficient. In the electrolysis of seawater method, water is converted to hydrogen gas (H_2) at the anode and oxygen gas (O_2) at the cathode. The NaSiCon membrane is critical in the process because it isolates the cathode (hydrogen production) and the anode (oxygen release) and prevents the combination of the two gases. This not only keeps the chlorine from being released from the salts that dissolve in seawater, as is the case with conventional seawater electrolysis, but it also improves the separation. NaSiCon technology, due to its increased ion conductivity and membrane life, not only makes the process of hydrogen extraction from seawater more effective but also more environmentally friendly. This technique relies on the vast ocean resources and thus can be a large-scale and green replacement for the traditional hydrogen production that is part of the clean energy solution.

Keywords: Sea water splitting, Hydrogen production, NaSiCon membrane, Seawater electrolysis, Sodium ions (Na^+).

OPERATIONAL OPTIMIZATION OF BATTERY SWAPPING STATIONS WITH PHOTOVOLTAIC: A MILP–HEURISTIC COMPARISON

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Abstract

Battery Swapping Stations (BSS) offer a faster alternative to conventional EV charging, by replacing depleted batteries with fully charged ones. This decoupling of charging and discharging phases significantly reduces waiting times. However, managing these operations, especially when integrated with renewable energy sources like solar power, requires complex optimization. This paper presents a novel mixed-integer linear programming algorithm to optimize the operations of a BSS integrated with a photovoltaic power plant. The algorithm simulates yearly operations, considering hourly energy prices and grid constraints. It aims to maximize station revenue by optimally scheduling battery charging after swaps and utilizing renewable energy. Simulation results demonstrate significant economic savings, highlighting the algorithm's effectiveness in capitalizing on cost differentials in electricity pricing. This approach provides valuable insights for enhancing the economic viability and operational efficiency of BSS integrated with renewable energy sources

Keywords: Electric Vehicles (EVs), Battery Swapping, Energy Services, Optimization Models, Renewable Energy, Feasibility Analysis.

CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES: INTEGRATING POLICY, TECHNOLOGY, AND COMMUNITY ACTION FOR A RESILIENT FUTURE**Sandeep Saini¹, Prince Kumar², Raghav Upadhyay³**

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Abstract

Weather change poses a growing and high risk to ecosystems, economies, and human well-being global. Addressing this disaster calls for a twin method: mitigation to reduce greenhouse fuel emissions and version to decrease the unfavourable impacts already being experienced. This paper explores included techniques for both mitigation and model, with a focus on how policy frameworks, technological improvements, and local network movements can paintings synergistically to create sustainable and resilient societies. on the mitigation the front, the studies analyzes the function of renewable energy transitions, carbon pricing mechanisms, and sustainable land-use practices. It highlights an success case research from countries which have significantly reduced emissions thru national coverage and private region collaboration. For version, the look at examines nature-based totally answers, weather-resilient infrastructure, and early caution systems, in particular in susceptible areas together with small island growing states and coffee-earnings coastal regions. moreover, the paper emphasizes the importance of stakeholder engagement, equity concerns, and indigenous know-how in crafting context-unique responses to weather dangers. It argues for an inclusive, multi-degree governance method that bridges international agreements similar to the Paris Accord with grassroots implementation. through synthesizing present day studies, worldwide superb practices, and area-degree evidence, this paper gives actionable suggestions for policymakers, city planners, and development practitioners. The findings underline the urgency of transitioning from isolated interventions to finish techniques that align mitigation and version desires. great thru such protected and inclusive techniques can we successfully combat the weather catastrophe and attain lengthy-term sustainable improvement.

Keywords: Climate Change, Mitigation, Adaptation, Sustainability, Resilience, Policy, Technology, Community Engagement

HYDROLOGICAL RESPONSE TO CLIMATE CHANGE IN A SEMI-ARID BASIN: A CASE STUDY OF THE TENSIFT WATERSHED (MOROCCO)

BATE Hind, KHARROU Mohamed Hakim, BOUAMRI Hafsa, JAFFAR Oumar, EL KHALKI El Mahdi and CHRHBOUNI Abdelghani

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Abstract

Hydrological systems of watersheds are increasingly affected by climate change, leading to major disruptions in precipitation patterns, intensification of droughts, and alterations in runoff dynamics. This study focuses on assessing the implications of these changes for streamflow in the sub-basins of the Tensift region. A methodological approach was applied using the GR2M hydrological model combined with bias-corrected data from climate models (CNRM, CMCC, IPSL, GUF, and ICTP) based on climate projections from the Med-CORDEX domain. The objective was to evaluate the impact of climate change on the hydrological regime of rivers in the Atlas sub-basins within the Tensift region by projecting monthly streamflow for the period 2019–2050 and comparing it to a reference period (1989–2019), under two concentration scenarios: RCP4.5 and RCP8.5. Eight gauged and three ungauged sub-basins were analyzed. Precipitation data were provided by the ABHT and processed using the IDW method to estimate rainfall at the watershed scale. Temperature data were obtained from ERA5-Land, and evapotranspiration was calculated using the Hargreaves method. The GR2M model was calibrated on gauged basins to assess its performance, and future projections were produced using bias-corrected precipitation and temperature data (via the CDF-T method). The calibrated model parameters were regionalized using two approaches to simulate flows in ungauged basins. Results indicated an expected temperature increase of 1.32 °C (RCP4.5) and 2.69 °C (RCP8.5) compared to the reference period, accompanied by a decrease in precipitation of 35% and 44.2%, respectively. Consequently, streamflow is projected to decline by 44.63% (RCP4.5) and 54.30% (RCP8.5) for 2019–2050. These findings highlight the significant impacts of climate change on water resources in the Tensift basin and emphasize the need for adaptive management strategies.

Keywords: Climate change, Tensift basin, GR2M model, climate projections, water resources.

ECO-BRICKS FROM DAM SEDIMENTS: A CIRCULAR SOLUTION FOR SUSTAINABLE CONSTRUCTION**Bouchra Bourhabi^{a*}, Latifa Mouhir^a**

^aLaboratory of Process Engineering and Environment, Faculty of Science and Technology of Mohammedia, Hassan II University, Casablanca, Morocco.

Abstract

Siltation in dams represents a major challenge for the sustainability of hydraulic infrastructures and the efficient management of water resources. This study proposes an innovative approach for the valorization of sediments from the Bin El Ouidane dam (Morocco) as a partial substitute for conventional raw materials in brick production.

Seasonal sampling campaigns were conducted during winter and summer at multiple depths to assess the physico-chemical and mineralogical characteristics of the sediments. The analyses included particle size distribution, pH, organic matter content, and elemental composition (XRF, EDS), complemented by microscopic observations.

The processed sediments were incorporated into brick formulations at varying proportions to evaluate their physical and mechanical properties, such as compressive strength, density, and water absorption, as well as their compliance with relevant construction standards. The results show that, at optimized substitution levels, the inclusion of these sediments does not compromise brick quality and provides a sustainable alternative for sediment reuse, contributing to circular economy principles.

Keywords : Sediments; dam; valorization; bricks; sustainability; circular economy.

**GREEN AND RESILIENT INFRASTRUCTURE: LOW-CARBON DESIGN AND DAYLIGHTING
AS A NATURE-BASED SOLUTION FOR SUSTAINABILITY OF CHURCH ARCHITECTURE IN
ABUJA, NIGERIA**

Ishaku Michael Christopher

Federal University of Technology Minna, Nigeria

Abstract

This research paper investigates the integration of daylighting as a foundational strategy for achieving green, resilient, and low-carbon church buildings in Abuja, Nigeria. Situated within a tropical savanna climate characterized by intense solar radiation, Abuja presents a unique paradox: an abundance of natural light that, if mismanaged, leads to significant energy consumption for cooling and artificial lighting, thereby increasing the carbon footprint of religious structures. Through a mixed-methods approach involving physical measurements of illuminance and glare, occupant surveys, and architectural analysis of five case studies, this study evaluates the performance of various daylighting strategies. The findings reveal that conventional designs relying on extensive, unshaded glazing result in severe visual discomfort, excessive heat gain, and high energy dependency. In contrast, strategies employing diffuse top-lighting, such as clerestories and atria, coupled with passive shading, significantly enhance visual comfort while reducing the reliance on energy-intensive mechanical systems. The research concludes by proposing a framework for daylighting design that re-conceptualizes natural light not merely as an aesthetic or spiritual element, but as a core nature-based solution for climate resilience and carbon mitigation in ecclesiastical architecture. This approach aligns green building principles with the functional and symbolic requirements of sacred spaces, charting a path toward a sustainable future for church buildings in tropical urban environments.

Keywords: Green Infrastructure, Resilience Architecture, Low-Carbon Design, Daylighting, Nature-Based Solutions, Sustainability, Church Architecture.

**ENERGY QUALITY SOLUTION FOR VARIABLE FLOW HYDROELECTRIC POWER PLANTS
WITH INTEGRATED CVT TRANSMISSION****Onur Yılmaz**

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Summary

This study examines how continuously variable flow input in hydroelectric power plants (HPPs) causes the turbine shaft to rotate at different RPM values, resulting in varying voltage values. These fluctuations degrade energy quality and make grid integration difficult. The aim of this study is to improve energy quality using a CVT integration system, and a sample plant is used to demonstrate the system's functionality. The system was designed to address this energy quality issue by integrating a continuously variable transmission (CVT). The theoretical framework for the system design was established using flow rate-RPM relationships and energy production formulas. Subsequently, graphical analyses were conducted by considering the annual flow variations of a river. These analyses revealed that as the flow rate increases, the turbine's own RPM value increases, but the generator shaft's RPM value remains constant. This results in improved energy production quality. This regularity ensures the system's grid integration and seamless operation with inverter-based systems. According to the analyses, CVT-integrated turbine-generator sets provide 5-10% higher net energy production compared to inverter/converter-based systems. In other systems, inverter/converter losses are caused by switching and harmonic losses occurring in electronic converters. The study concludes by highlighting that CVT-supported turbine-generator sets offer an innovative solution for stable voltage and consistent high-quality energy production in small-scale hydroelectric applications, and that further improvements in production, field testing, and control algorithms will lead to increased efficiency.

Keywords: Energy, CVT, System, Turbine, Generator

**ENVIRONMENTAL AND HEALTH IMPACTS OF FRENCH NUCLEAR TESTS IN ALGERIA
ON GROUNDWATER****NOUI Abderrahmane¹, GUESBAYA Zineb²,**¹Center for Scientific and Technical Research on Arid Regions CRSTRA – Biskra - Algeria²Department of Agronomic Sciences, University of Biskra, Algeria.**Abstract**

The French nuclear tests conducted in Algeria between 1960 and 1966, primarily in the Reggane and In Ekker regions, had profound and lasting environmental and health impacts, particularly on groundwater resources and local populations. A total of 17 underground nuclear tests were carried out, releasing significant amounts of radionuclides into the environment. This study evaluates the radiological impact of these tests by analyzing the contamination of aquifers with radionuclides such as strontium-90, cesium-137, and plutonium-239. Recent analyses of groundwater samples revealed radioactivity levels exceeding international safety standards by up to 10 times in certain areas near the test sites. Notably, approximately 40% of wells analyzed within a 50 km radius of Reggane showed significant contamination by strontium-90, while traces of cesium-137 were detected at distances up to 200 km from the explosion sites. Furthermore, epidemiological studies conducted among local populations indicate a 50% increase in thyroid cancer cases and a 30% rise in congenital malformations in affected regions since the 1960s, directly linked to long-term exposure to radioactive contaminants present in drinking water and locally grown food. Despite these findings, several challenges remain, including the lack of transparency regarding precise test data (such as the total radiation doses released) and the absence of systematic environmental monitoring programs. To address these issues, it is recommended to conduct further research over a period of 10 to 15 years, implement targeted decontamination strategies, and provide free and sustained medical assistance to affected populations. Ultimately, international accountability is essential to mitigate the persistent effects of this environmental disaster.

Keywords: Nuclear tests, radioactive contamination, groundwater, Algeria, strontium-90, cesium-137, aquifer, public health, health impacts, environmental responsibility.

**RHEOLOGICAL EFFECTS OF MATERIAL SEQUENCING IN CATHODE SLUDGE FORMULATION FOR LITHIUM-ION BATTERIES****Burak AYDIN**

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Abstract

This study aims to systematically investigate the effects of the order of raw material addition on the rheological properties and electrochemical performance of NMC (Lithium Nickel Manganese Cobalt Oxide) based cathode slurries. In this context, cathode slurries were prepared using different addition orders and combinations of PVDF binder, conductive dopants (Super P and carbon nanotube, CNT), and NMC active material. The prepared slurries were characterized in detail using rheological tests such as viscosity-shear rate curves, three-interval thixotropy test (3ITT), amplitude sweep, and frequency sweep. The obtained rheological data reveal the decisive role of the raw material addition order on the flow behavior, structural stability, and processability of the slurries. Furthermore, the relationships between rheological properties and electrode coating quality and cell performance were evaluated. The results show that appropriate raw material addition strategies improve cathode slurries homogeneity, reduce coating defects, and positively affect electrochemical performance. This study presents a fundamental framework for optimizing cathode sludge formulation and aims to contribute to making lithium-ion battery production processes more controlled and repeatable.

Keywords: NMC cathode, rheology, raw material addition sequence, lithium-ion battery

Özet

Bu çalışma, NMC (Lityum Nikel Mangan Kobalt Oksit) esaslı katot çamurlarında hammadde ekleme sırasının, çamurun reolojik özellikleri ve elektrokimyasal performansı üzerindeki etkilerini sistematik olarak incelemeyi amaçlamaktadır. Bu kapsamda, PVDF bağlayıcı, iletken katkı malzemeleri (Super P ve karbon nanotüp, CNT) ve NMC aktif malzemesi farklı ekleme sıraları ve kombinasyonları kullanılarak katot çamurları hazırlanmıştır. Hazırlanan çamurlar, viskozite-kesme hızı eğrileri, üç aralıklı tiksotropi testi (3ITT), genlik süpürmesi (amplitude sweep) ve frekans süpürmesi (frequency sweep) gibi reolojik testler ile ayrıntılı olarak karakterize edilmiştir. Elde edilen reolojik veriler, hammadde ekleme sırasının çamurun akış davranışı, yapısal kararlılığı ve işlenebilirliği üzerindeki belirleyici rolünü ortaya koymaktadır. Ayrıca, reolojik özellikler ile elektrot kaplama kalitesi ve hücre performansı arasındaki ilişkiler değerlendirilmiştir. Sonuçlar, uygun hammadde ekleme stratejilerinin katot çamuru homojenliğini iyileştirdiğini, kaplama kusurlarını azalttığını ve elektrokimyasal performansı olumlu yönde etkilediğini göstermektedir. Bu çalışma, katot çamuru formülasyonu optimizasyonuna yönelik temel bir çerçeve sunmakta ve lityum iyon pil üretim süreçlerinin daha kontrollü ve tekrarlanabilir hale getirilmesine katkı sağlamayı hedeflemektedir.

Anahtar Kelimeler: NMC katot, reoloji, hammadde ekleme sırası, lityum iyon pil



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29.07.2025

MÜHENDİSLİK FAKÜLTESİ DEKANLIĞINA

İlgi : 28.07.2025 tarihli ve 894666 sayılı yazınız

Fakülteniz Enerji Sistemleri Mühendisliği Bölümü tarafından 12-13 Aralık 2025 tarihleri arasında düzenlenmesi planlanan "5th International World Energy Conference" isimli konferansın etkinlik yürütücüsü olarak Enerji Sistemleri Mühendisliği Bölümü öğretim üyelerinden Prof. Dr. Mustafa Serdar GENÇ'in görevlendirilmesi için gerekli izinlerin verilmesi ilgi yazınızla istenilmektedir.

Söz konusu konferansın anılan tarihler arasında Fakültenizde düzenlenmesi ve adı geçen öğretim üyesinin, etkinlik yürütücüsü olarak görevlendirilmesi Rektörlüğümüzce uygun görülmüştür.

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REKTÖRLÜK MAKAMINA
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"5th International World Energy Conference" isimli konferansın 12-13 Aralık 2025 tarihinde Fakültemiz Enerji Sistemleri Mühendisliği Bölümü tarafından düzenlenmesi planlanmaktadır. Söz konusu konferansta Fakültemiz Enerji Sistemleri Mühendisliği Bölümü öğretim üyelerinden Prof. Dr. Mustafa Serdar GENÇ'in etkinlik yürütücü olarak sayılma talebi Dekanlığımızca uygun görülmüştür.

Bilgilerinizi ve adı geçen öğretim üyesine etkinlik yürütücüsü olarak gerekli izinlerin verilmesi hususunda gereğini arz ederim.

Prof. Dr. Ahmet Alper ÖNER
Dekan

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