ICREC 2023 | 2023 8TH INTERNATIONAL CONFERENCE ON RENEWABLE ENERGY AND CONSERVATION
ROME, ITALY NOVEMBER 10-12, 2023

Conference Program

2023 8th International Conference on Renewable Energy and Conservation (ICREC 2023)

Rome, Italy | November 10-12, 2023 | GMT+2

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Address: Via Capo d'Africa, 54 -00184 - Roma

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GENERAL INFORMATION

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◆Onsite Registration

Go to the registration desk→ Inform the staff of your paper ID→ Sign-in→ Claim your conference kit.

◆Devices Provided by the Organizer

Laptops (with MS-Office & Adobe Reader) / Projectors & Screen / Laser Sticks

◆Materials Provided by the Presenter

Oral Session: Slides (pptx or pdf version). Format 16:9 is preferred.

◆Duration of Each Presentation

Onsite/Online Oral Session: 15min apiece, include 13 min for presentation, 2min for Q&A.

◆NOTICE

※ Please wear your delegate badge (name tag) for all the conference activities. Lending your participant card to others is not allowed.
※ Please take good care of your valuables at any time during the conference. The conference organizer does not assume any responsibility for the loss of personal belongings of the participants during conference day.
※ Wear a Mask. Make sure your mask fits well with the nose clip. Avoid hands shaking and Skin-to-skin contact.

◆Zoom Meeting ID

Room	Meeting ID	Meeting Link	✧ Zoom Download: here ✧ Guide for new users: here ✧ Conference Banner: here ✧ Zoom Background: here *We suggest you to download the Zoom platform in advance.*
A	833 3208 3274	https://us02web.zoom.us/j/83332083274	

WELCOME MESSAGE

We are pleased to welcome you to 2023 8th International Conference on Renewable Energy and Conservation (ICREC 2023). The conference is scheduled in Rome, Italy during November 10-12, 2023. as hybrid conference.

The annual international conference is aimed to bring together the researchers, experts, and scholars around the world to exchange their research results and address open issues in related fields. We hope ICREC would be able to achieve its objective in providing an effective forum for academician, researchers, and practitioners to advancing knowledge, research, and technology for humanity. It is one of the leading international conferences for presenting novel and fundamental advances in the fields of Renewable Energy and Conservation.

This year's Rome conference will consist of 3 oral sessions (2 offline sessions and 1 online sessions), 2 keynote talks from Belkacem Ouldbouamama (University of Lille, France), Dimitrios Karamanis (University of Patras, Greece), 1 invited talk from Paolo Scarabaggio (Polytechnic of Bari, Italy).

It is pleasing to note that the agenda of this conference covers a wide range of interesting topics related to all theoretical and practical aspects, but not limited to Renewable Energy and Conservation, such as New Energy Power System and Power Electronics Technology; Bioenergy Production, Combustion and Thermal Energy Engineering; Carbon Capture and Energy Chemical Engineering; Power Transmission, Measurement and Energy Harvesting, etc.

Last but not least, our deepest gratitude goes to the Advisory Board, Organizing Committee, International Scientific Committee, institutions, and volunteer who have directly and indirectly supported the success of this seminar. Wish you a very productive conference with exciting and encouraging discussions and exchange of knowledge so that together we can anticipate a future of ground-breaking knowledge, research, and technology.

Finally, we wish you a very successful conference! Hope you will enjoy your stay to Rome.

ICREC 2023

Conference Organizing Committee

CONFERENCE COMMITTEE 2023

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Belkacem Ouldbouamama, University of Lille, France

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Manickam Minakshi, Murdoch University, Australia
Ashfaque Ahmed Chowdhury, Central Queensland University, Australia
Zhenzhi Lin, Zhejiang University, China

AGENDA OVERVIEW (GMT+2)

November 10 | Friday		
10:30~12:00	Zoom Pre-test for ALL Online Attendees	ZOOM Room: 833 3208 3274
13:30~17:00	Onsite Registration for ALL offline attendees	Hotel Lobby

Zoom Pre-test for All Online Attendees

※Participants who are going to do an online presentation are required to join the Zoom pre-test on November 10 (GMT+2).

※Duration: 3 minutes apiece. Free to leave after you finish the rehearsal.

※We will test control panel including screen sharing, audio, video and "Raise Hand" feature, etc. Please get your presentation slides and computer equipment prepared beforehand.

◆Name Setting

Keynote Speaker: Keynote-Name Author: Paper ID-Name

Committee: Position-Name Listener: Listener-Name

November 10, 2023 Friday	ZOOM ROOM: 833 3208 3274
13:30-15:30	
10:30-11:30	ER049, ER050, ER055, ER052, ER036, ER040, ER019
11:30-12:00	※Participants who are unavailable during the above allocated time can join the rehearsal at 11:30-12:00

November 11, 2023 | Saturday (GMT+2)		
Coronati room, Floor -1 | Zoom Room: 833 3208 3274 Chairman: Prof. Pierluigi Siano, University of Salerno, Italy		
09:20-09:30	Opening Remarks from Conf. Organizing Chair	Prof. Pierluigi Siano, University of Salerno, Italy
09:30-10:15	Talk Title: Optimal Design of Resilient Green Hydrogen Production System	**Prof. Belkacem Ouldbouamama** University of Lille, France
10:15-11:00	Talk title: Building Integration of Photovoltaics towards Carbon Neutral Cities and Mitigation of Climatic Change	**Prof. Dimitrios Karamanis** University of Patras, Greece
11:00-11:30	Group Photo & Morning Break (Lobby, Floor 0)	
11:30-12:00	Talk Title: Technology Use in the Classroom: Benefiting Students with and without Disabilities	**Asst. Prof. Paolo Scarabaggio** Polytechnic of Bari, Italy
12:00-13:30	Lunchtime <Restaurant, Floor 4 >	
Onsite Sessions		
13:30-16:15	**Coronati room, Floor -1**	
	Onsite Session 1: Clean Energy Technology and the Applications ER013, ER038-A, ER042, ER059, ER014-A, ER039, ER022, ER015-A, ER017, ER018, ER024	
16:15-16:30	Coffee Break	
16:30-19:30	**Onsite Session 2: Microbial Fuel Cells, Energy Storage Technology, and Energy Conservation** ER043, ER046, ER008, ER028, ER034, ER010, ER012, ER016, ER020, ER009, ER025, ER035	
19:15-21:00	**Dinner Time** < Restaurant, Floor 4 >	
Online Sessions		
	Zoom Room: 833 3208 3274	
13:30-15:15	**Online Session 1:** Renewable Energy Generation and Energy Conservation ER049, ER055, ER052, ER036, ER040, ER050, ER019	

Note:

The meeting room will open 30 minutes earlier than scheduled. Please enter your room 10-15 minutes early.

NO-SHOW POLICY Papers unpresented at the conference, without prior written approval by the Conference Technical Program Chair, will be removed from the final conference proceedings before uploading to journals. No refund will be approved to authors of those papers.

INTRODUCTION OF SPEAKERS

Keynote Talk I

November 11, 2023 (Saturday) **Venue: Coronati room, Floor -1**
09:30-10:15

Prof. Belkacem Ouldbouamama, University of Lille, France

The speech title: Optimal Design of Resilient Green Hydrogen Production System

Abstract: The production and development of green hydrogen within a renewable energy mix by Hybrid Renewable Energy Systems (HRES) face several primary challenges. These include the high cost associated with the process, ensuring installation safety, and ensuring the resilience of these systems to meet energy demands and maintain availability. The resilience of the system consists of finding alternative solutions that allow the Key Performances Indicators (KPI) to be re-increased when its value has decreased following a degradation of one of the system's components.

The plenary presentation exposes a review of multisources system control and proposes a model builder for optimal design and the control of HRES based on an innovative generic graphical formalism named Linear Fractional Transformation Event Driven Hybrid Bond Graph (LFT-EDHBG) as an extension of uncertain Bond graph and functional modelling theories. Optimal performances concern energy efficiency and resilience to the equipment degradation and to the intermittency of energy sources. The developed methodology is illustrated by a real application represented by a multisources system which consists of solar photovoltaic panels and wind turbine coupled with an electrolyser to produce green hydrogen feeding a Fuel Cell.

Professor Belkacem OULD BOUAMAMA is full Professor of automatic control at Graduate School of Engineering Polytech Lille (France), where he has been Director of the Research. He is the leader of research PERSI group at the CRIStAL laboratory of the National Center for Scientific Research in Lille, where his research activities concern Integrated Design for Supervision of System Engineering based on multiphysics Bond graph modelling. Their industrial applications are mainly process engineering, renewable energies, and mechatronic systems. He has authored and co-authored more 65 peer-reviewed journals, 180 conference papers and 20 books and book chapters in Diagnosis, Prognosis and bond graph modeling of mechatronic systems. He has given more than 15 invited talks and tutorials and keynotes around the globe. For additional information see

https://wikis.univ-lille.fr/ci2s/membres/belkacem-ould-bouamama.

Keynote Talk II

November 11, 2023 (Saturday) **Venue: Coronati room, Floor -1**
10:15-11:00

Prof. Dimitrios Karamanis, University of Patras, Greece

The speech title: Building Integration of Photovoltaics towards Carbon Neutral Cities and Mitigation of Climatic Change

Abstract: To mitigate climate change and keep the mean temperature increase lower than 1.5°C compared to preindustrial levels, full decarbonization is urgently needed with the massive deployment of renewable energy sources. In this context, the building integration of photovoltaics (BIPV) is a key component in the proposed actions of WGIII and a step forward to distributed energy systems with high contribution from buildings becoming prosumers. Since the building structure is the interface between humans and their natural environment, sustainable development requires a rethinking of the photovoltaics integration in harmony to local environmental and bioclimatic conditions. In moving beyond the self-sufficient and self-consumption concepts in electricity generation, positive energy sharing within local communities could overcome the barriers in BIPV deployment and support energy equality and accessibility according to SDG7. In this context, the SERAS concept (sufficiency, efficiency, renewables and sharing) that we recently proposed in BIPV deployment will be presented and discussed towards carbon neutral cities.

Professor of Alternative Energy Sources at University of Patras. His research interest started with the development of appropriate countermeasures for the mitigation of the severe environmental consequences of the Chernobyl accident and followed by cross section measurements in the thorium fuel cycle for energy production and waste incineration. Expanded to the study of wind and solar energy systems in the last fifteen years and currently research focused on solar cooling of buildings and the integration of photovoltaics in buildings for electricity production towards carbon neutral cities. By participating in national and international research programs as a scientific coordinator and researcher, he has published more than 110 scientific papers in scientific journals, patents, undergraduate textbook on RES and book chapters with >3500 citations and h-index 35 (Scopus). Prof. Karamanis teaches courses in the subject of renewable energy sources and their applications since 2006 in Departments of the Universities of Ioannina and Patras.

Invited Talk

November 11, 2023 (Saturday) **Venue: Coronati room, Floor -1**
11:30-12:00

Asst. Prof. Paolo Scarabaggio, Polytechnic of Bari, Italy

The speech title: Game Theory for Distributed Control of Autonomous Power Grids

Abstract: Power systems are currently undergoing a period of unprecedented transformations. Environmental and sustainability concerns lead to replacing centralized generation, based on conventional fossil fuel-based power plants, with distributed generation from renewable energy sources. In addition, various new autonomous entities able to adjust their load demand or provide ancillary services to the grid are increasing the complexity of energy systems, requiring the control structures to become autonomous. Due to its capacity to capture interactions among interdependent decision-making entities, game theory offers a promising way to implement and control these autonomous power grids. This talk focuses on resolving key research challenges to design effective game-theoretical control frameworks, aiming to enhance grid flexibility through active autonomous entity involvement while addressing coordination complexities due to interconnections and power flow constraints.

Paolo Scarabaggio is an assistant professor at Politecnico di Bari, Italy, where he recieved his Ph.D. in Electrical and Information Engineering. In 2019, he visited the Delft Center for Systems and Control, Technical University of Delft, The Netherlands. His research interests include modeling, optimization, game theory, and control of complex multi-agent systems, with application in energy distribution systems, and social networks. He is author of 20+ printed international publications. He is the recipient of the 2022 IEEE CSS Italy Best Young Author Journal Paper Award.

PARALLEL SESSION

November 11 (Saturday) 13:30-16:15
(Coronati room, Floor -1)
Onsite Session 1: Clean Energy Technology and the Applications
Session Chair: Prof. Eugen Rusu, Dunarea de Jos University of Galati, Romania

Time	Paper ID	Speech Title & Presenter
13:30-13:45	ER013	Feasibility Study of a Sustainable Roof Top Domestic Solar Energy System in the UK **Joel Richards, University of South Wales, United Kingdom** Abstract: This paper investigates the feasibility of a rooftop Solar PhotoVoltaic (PV) system for domestic use in the UK. With ever rising energy prices in the UK, and the disruption to energy markets due to recent extensions to the energy price cap, partly as a result of economic factors such as Brexit and the geo-political trends in the European Energy market that has been primarily driven by the conflict in Ukraine, an investigation took place to understand the feasibility of installing roof top domestic solar PV panels and to determine payback periods of these systems. The application chosen was a typical grid connected domestic three-bedroom house. The research investigates several scenarios in order to develop a model which defines typical payback periods for a variety of systems. The premise was to understand if a system could payback in reasonable timeframes that would be attractive to domestic user, who currently face an energy crisis as well as a cost of living crisis in the UK. Using global irradiation data from PhotoVoltaic Geographical Information System (PVGIS) and typical electricity demand profile data, this paper determines the current payback periods of rooftop solar installations using a 4kW solar array, it can be shown that the payback periods are viable, being as low as six to seven years.
13:45-14:00	ER038-A	Improvement of the texturization of N-type silicon substrates for the production of heterojunction solar cells **KEZZOULA FAOUZI, CRTSE, Algeria** Abstract: The texturing of silicon substrates in the manufacture of solar cells is a prelimi-nary step. The aim of this work is to improve the surface texturization of N-type silicon substrates and to produce emitters based on P-type hydrogenated amor-phous silicon, in order to increase the efficiency of heterojunction solar cells (a-Si :H(p)/c-Si(n)/(a-Si : H(i))/(a-Si : H(n)). An optimization of the texturing of an N-type silicon substrate has been carried out. On these surfaces, an emitter based on P-type hydrogenated amorphous silicon was produced by varying the thickness. This structure is intended for the production of heterojunction solar cells. At the end one we found that the current Icc decreased with the increase of the thickness of the emitter, on the other hand the Voc remained almost unchanged, because it depends on the doping of the layer of the emitter.
14:00-14:15	ER042	Artificial Neural Network Application for the Prediction of Global Solar Radiation Inside a Green house **Salah BEZARI, Unité de Recherche Appliquée en Energies Renouvelables, URAER, Centre de Développement des Energies Renouvelables, CDER, 47133, Ghardaïa, Alegria** Abstract: Solar radiation prediction is essential for several research applications in renewa-ble energy. In particular, solar irradiation can be considered as a target parameter related to greenhouse microclimatic. This study developed a model based on an artificial neural network (ANN) for predicting incident solar radiation on a hori-zontal surface in an agricultural greenhouse. Standard neural networks with dif-ferent architectures (6-15-1) were designed using the Neural Toolbox for MATLAB. Based on the meteorological data collected of semi arid region of Ghardaïa (32.36° N, 3.81° W)

		Algeria. It considering as input several parameters indoor and outdoor greenhouse using for the prediction. Our results showed that the ANN predictions had a correlation coefficient of over 96% with the actual so-lar radiation, indicating that the model is highly reliable for assessing solar radia-tion levels inside the greenhouse. We also found that the ANN method is suitable for predicting other greenhouse climatic data, and can be used for the preliminary design of agro-system.
14:15-14:30	ER059	Optimizing Energy Savings in Polyisoprene Production Through Solar-Based Thermal Technology **Ivana Špelić, University of Zagreb Faculty of Textile Technology, Crotia** Abstract: The textile industry is one of the most energy consuming industry sectors with lot of chemical treatments, from fibers/raw materials productions to garment finish-ing. In order to maximize energy conservation, beside hot condensate and flue gases heat recovery, solarized hybrid systems should be analyzed and implement-ed. Potential implementation cases are presented and discussed in details. The in-vestments into solar-based thermal technology will have an essential role in clean energy transition from habitual textile plants to Eco-friendly textile production. The natural gas consumption could be significantly decreased through solar ener-gy partial substitution as shown in polymer production for polyisoprene. The case study showed energy efficiency increase employing flue gases through an economizer and an air preheater and condensate heat recovery simultaneously with the solar energy in polyisoprene manufacturing, resulting in fuel savings of as much as 84%, when compared to basic process variant.
14:30-14:45	ER014-A	The Expected Dynamics of the Wind Power along the European Seas **Eugen Rusu, University Dunarea de Jos of Galati, Romania** Abstract: It is certain that the green road toward a low-carbon future represents the most re-liable development model for society. In this context, in 2019 the European Green Deal was publically released. This is a programmatic document designing the most important pillars of the near future development in the European Union. On this green road, offshore renewable energy takes a very important place. From this perspective, the objective of the present work is to perform an analysis of the wind power resources along the European Seas. This includes the Baltic, North, Mediterranean, and Black Seas and is based on reanalysis wind data, for the past 40-year period and on data provided by RCMs for the future, corresponding to the most credible RCP and SSP scenarios. The results show that wind energy is expected to increase in the future in various locations and this increase will be higher in the near future, followed by a small decrease by the end of the century. For most of the coastal environments studied, it was noticed that in the locations with high wind power resources a higher seasonal variability is characteristic than for the locations with lower wind resources. The number and intensity of extreme events (characterized by hurricane-level wind speeds are also expected to be en-hanced in the future, especially in the North, Mediterranean, and the Black Seas. Many areas from the European nearshore appear to be appropriate for joint re-newable energy projects; wind-wave, wind-solar, and wind-wave-solar.
14:45-15:00	ER039	Stochastic Simulation of Wind Power Profiles from Time Series Analysis Considering Dependencies on Meteorological Variables **Gaia Ceresa, Ricerca sul Sistema Energetico - RSE S.p.A., Italy** Abstract: Due to the higher and higher shares of generation from variable renewable energy sources, electric power systems are characterized by increasing variability and uncertainty that call for the application of probabilistic methods at different stages of system management. For the evaluation of adequacy and techno-economic in-dices within the scope of grid planning applications, Monte Carlo simulation is a typical approach, whose iterations are fed by instances of time series of stochastic quantities such as load demand and renewable production. Here the method un-derlying “SPOPSI_wind” (Stochastic wind POwer Profile SImulator) is de-scribed and validated, that starting from the analysis of historical series of wind power in Italian regions and considering the dependence of historical wind power on temperature and wind speed, synthesizes a model that is used to generate new plausible stochastic series in the future. The new series maintain the statistical properties of the past but exhibit a

		significant variability, thus being suitable for simulating a wide range of plausible power system operating conditions. Moreo-ver, the formulation has the potential to deal with the impact of climate changes as well.
15:00-15:15	ER022	Exploring Liquefied Dimethyl Ether for Lipid Extraction from Fat Balls in Wastewater Pumping Stations **Febrian Rizkianto, Kyoto University, Japan** Abstract: Fat balls are floating solid substances formed by fat, oil, and grease (FOG) that are discharged into wastewater systems. This material has a high proportion of organic and calorific content which could serve as an alternative lipid feedstock for biodiesel production. This study aimed to characterize and evaluate an effec-tive method for recovering lipids from fat balls by using liquefied DME (L-DME). The Lipid extraction performance was evaluated by comparing it with mechanical shaking extraction using hexane. Fat balls consisted of 55% of the to-tal solid content, with 52 % of raw lipids (based on hexane extraction). The re-sults showed that the L-DME method extracted 46% of the lipids, with a recov-ery efficiency of approximately 89% of the total lipid content. The characteristics of methyl esters showed that the unsaturated fatty acids and saturated fatty acids represent 52.2% and 47.8% of total methyl ester produced, respectively. The re-sults demonstrate the great potential of utilizing the L-DME technique to extract lipids from fat balls.
15:15-15:30	ER015-A	Perspectives and Challenges in Harvesting Wave Energy **Liliana RUSU, 'Dunarea de Jos' University of Galati, Romania** Abstract: Wave energy is abundant, it has a higher density, and it is more predictable than wind or solar. Taking into account the general concern related to a future development based on green energy, the European Green Deal assumed a rapid enhancement in extracting ocean energy, including especially wave, tide and floating solar. Thus, a 40GW capacity is targeted in the European Union for 2050, representing a more than 3000 times increase in relationship with 2021. From this perspective, the objective of the present work is to present the most important perspectives and challenges in harvesting wave energy. The global wave energy resources are first presented based on an analysis of 30 years of ERA5 data. Two case studies are further discussed. The first is the west Iberian nearshore, a coastal environment with high wave energy resources while the Black Sea represents the second. Further on, a discussion is employed on the technological advances expected and also on the most important challenges. The conclusions highlight that an important next step in the development of the wave energy sector is to move from full-scale testing of individual technologies to the deployment of the array and cost reduction measures. Collocation approaches or hybrid solutions represent an advantage in making efficient the wave energy extraction. Further research includes new materials to reduce the device's weight and biofouling effects, collaboration and synergetic research with the offshore wind industry, and new concepts of multiplatform or hybrid devices.
15:30-15:45	ER017	Hydrogen Fuel for a sustainable aviation **Ghida AlZohbi, Prince Mohammad Bin Fahd university, KSA** Aviation industry has a great impact on the world energy consumption with a global energy consumption fluctuating between 2.5% and 5%. Presently, the primary fuel used in aviation sector is liquid fossil fuel, resulting in high emissions of Greenhouse Gases. A fast growing of aviation industry is recording to comply with the requirements of the rise of population growth and air traffic. The need to develop an eco-friendly power technology to be used in aviation sector has been recently raised pointedly. Hydrogen fuel is considered as one of the promising alternative solutions to be used in aviation sector since it is renewable and environmentally friendly. The current paper aims at reviewing the use of hydrogen as an alternative aviation fuel, focusing on energy consumption, emission linked cost, and environmental cost. In addition, the different challenges facing the use of hydrogen in aircraft are presented and discussed. Results revealed that despite the numerous advantages of using hydrogen in aviation sector, many challenges slowed down the development of hydrogen fuel. These challenges are mainly the high price of green hydrogen generation, difficulty of storing hydrogen, absence of suitable infrastructure for

		hydrogen fuel, and the need to redesign the air jet. Aviation sector is required to consider all existing options to minimize the emissions from aviation industry and to develop and redesign new airplane to be able to comply with the different challenges.
15:45-16:00	ER018	Scenario analysis on deployment of clean liquid fuels in Japan toward decarbonizing energy systems **Akito Ozawa, National Institute of Advanced Industrial Science and Technology (AIST), Japan** Abstract: The global movement toward carbon neutrality is gaining momentum as concerns about climate change have escalated. Japan has set ambitious targets to reduce greenhouse gas emissions by 46% compared to 2013 levels by FY2030 and achieve net-zero emissions by 2050, necessitating a significant energy transition. In Japan's long-term energy plan, clean fuels are considered a silver bullet for de-carbonizing sectors that are difficult to electrify. This study provides a new car-bon-neutral scenario for Japan that incorporates clean liquid fuels, particularly e-fuels and biofuels. Japan's energy transition toward net-zero CO2 emissions by 2050 was simulated using an energy model which can analyze the whole energy system in Japan. The model identifies a combination of energy carriers and tech-nologies that minimize the total energy system cost by solving a linear program-ming problem. The results of the scenario analysis suggested that the primary en-ergy supply will decrease from 20.2 EJ in 2010 to 18.1 EJ in 2050. The results also indicate that clean liquid fuels, which used for automotive fuels, will account for 10% of the primary energy supply in 2050. These results provide insights in-to the long-term transformation of the energy supply and technology deployment.
16:00-16:15	ER024	Classification of Types of Daily Solar Radiation Patterns Using Machine Learning Techniques **Marcelo Sebastián Alvarez, Universidad Politécnica Salesiana, Ecuador** Abstract: In this work, a new model is used for classifying solar radiation patterns, with the aim of studying the production and enhancement of solar energy efficiency. The model incorporates various clustering and pattern recognition methodologies, considering different criteria. To achieve a comprehensive and generalized recog-nition of these patterns, a methodology previously applied in similar approaches, which focuses on the analysis of time series data, is employed. Specifically, an exploratory analysis is initially conducted, followed by the conversion of the data into a daily polar representation. Subsequently, the process involves extracting relevant features and performing classification using solar irradiation data collect-ed in the city of Cuenca, Ecuador, between 2014 and 2017. The analysis yielded four distinct clusters, accompanied by supplementary information and the corre-sponding average frequency of occurrence. The use of neural networks demon-strates satisfactory results when classifying solar irradiation patterns by not re-quiring prior knowledge of climatic and geographic parameters.

November 11 (Saturday) 16:30-19:30

(Coronati room, Floor -1)

Onsite Session 2: Microbial Fuel Cells, Energy Storage Technology, and Energy Conservation

Session Chair: Assoc. Prof. Paulo Cesar Ribas, Molde University College, Norway

Time	Paper ID	Speech Title & Presenter
16:30-16:45	ER043	Assessing Economic Performance of An Energy Microgrid: A Conditional Value at Risk Optimization Approach **Seyedehsahar Seyedbarhagh, University of Vaasa, Finland** Abstract: Distributed generation resources integration within the energy system not only ensures efficient power penetration and reliable electricity supply but also em-powers consumers to optimize energy consumption, leading to a more flexible and customer-centric energy landscape. To enhance the economic performance of distributed energy resources (DERs), this work utilizes a hybrid fuel cell power generation system utilizing energy storage. This research aims to address uncertainty in the electricity price, a crucial parame-ter influencing economic feasibility. To achieve this, we adopt the conditional value-at-risk (CVaR) optimization method, enabling effective management and mitigation of potential risks associated with volatile electricity and gas prices. This approach seeks to ensure the optimal economic performance of the hybrid energy system under varying market conditions. This integration is aimed at op-timizing energy supply and demand, thereby maximizing the economic benefits of the distributed generation system. Through economic modeling, we give a partic-ular focus on the fuel cell's pivotal role in achieving benefits. The findings offer valuable insights for policymakers and stakeholders in the energy sector, paving the way for a more sustainable and efficient energy future.
16:45-17:00	ER046	Study of the behavior of an Electric Power Generation System with AGM Battery Storage using Sankey Diagrams **Andres Felipe Parada Valle, Universidad Nacional de Colombia, Colombia** Abstract: In agroindustrial processes, it is necessary to meet an electrical demand through sustainable processes in isolated regions that require a certain degree of self-sufficiency. An analysis of energy efficiency is carried out on a system that in-cludes a 110V electric generator powered by Natural Gas, an AC-DC transform-er, and AGM batteries. These components were instrumented to collect data on fuel consumption, current, and voltage. The behavior of the generator was ana-lyzed under varying loads, and an assessment of the system's efficiency was per-formed using a direct method based on the first law of thermodynamics. This as-sessment is represented using Sankey diagrams, which helped determine the magnitude of losses attributed to the generator and the transformer. Suggestions are provided regarding the influence of the equipment on the energy losses for upcoming installations that aim to enhance the efficiency achieved within a com-mercial system.
17:00-17:15	ER008	Eco-friendly generation of electricity using the Bacteria Proteus vulgaris as a catalyst **Santiago M. Benites, Vicerrectorado de Investigación, Universidad Autónoma del Perú, Lima 15842, Peru, Perú** Abstract: The increasing increase in the human population has generated the search for new ways to generate sustainable electrical energy in various ways, among which mi-crobial fuel cell technology has been investigated. In this research, the main ob-jective was to generate electrical energy using Proteus vulgaris bacteria as a bio-catalyst in a physiologically sterile saline solution, this bacterium was molecularly identified and obtained from tomato waste. It has been possible to generate cur-rent and voltage peaks of 0.368 ± 0.0556 mA and 0.9545 ± 0.0399 V, respec-tively; with an optimum operating pH of approximately 5.884 ± 0.07 on the elev-enth day. While the power density found was 85.76 mW/m2 at a current density of 215.53 mA/m2 with an internal resistance of 51.113 ± 4.375 Ω. The micro-graphs show the presence of

		biofilms formed on the anode electrode, which ap-pear rough and porous. Finally, the three monitored microbial fuel cells were connected in series, turning on a red LED light. This research helps to publicize the potential of this bacterium as a fuel source to generate bioelectricity without polluting the environment.
17:15-17:30	ER028	Multiple Block-shaped Vertical Cathodes for Scale-up of Floating Microbial Fuel Cells **Soichiro Hirose, Ritsumeikan University, Japan** Abstract: Microbial fuel cells (MFCs) are a renewable energy source that utilizes the biological activities of microorganisms and is an effective technology for creating a sustainable society. However, MFCs have not yet been put to practical use. Floating microbial fuel cells (FMFC) with block-shaped elec-trodes are expected to be practical due to their high stability, high air cath-ode performance, and ease of fabrication and installation. However, the practical application requires scale-up. In this study, we developed an FMFC with multiple block-shaped electrodes. The relationship between the number of anodes and cathodes and the output power of the FMFC was also investigated. It was found that increasing the number of either anodes or cathodes did not change the output power of the FMFC. Therefore, we fabricated an FMFC with both anodes and cathodes equal to four, result-ing in a maximum power of 467 μW, which is 4.2 times higher than that of a single-electrode FMFC.
17:30-17:45	ER034	Electro-Acoustic Charging Prolongs the Cycle Life of Lead-Acid Battery Cells **Drandreb Earl O. Juanico, Technological Institute of the Philippines, Philippines** Abstract: The impending electric vehicle (EV) transition anticipates the decommissioning of approximately 1.7 million metric tons of starter lighting and ignition (SLI) flood-ed lead-acid batteries (LABs). Notably, LABs, primarily localized in manufactur-ing, boast a near-circular economy with a staggering 90% recycling rate, thanks to stringent policies against toxic landfill disposals. As the automotive sector shifts from SLI towards alternatives, predominantly lithium-ion batteries, the need for renewable, dependable energy storage for off-grid EV charging stations escalates. LABs present a potentially sustainable solution, catering not only to EVs but also off-grid DC-powered households. Nonetheless, their adaptation hinges on resolving current limitations, including short cycle life and associated economic implications, with sulfation being a primary failure mode. This study introduces "electro-acoustic charging," a dual energy input technique blending electricity and sound for LAB recharge, particularly with intermittent renewables like solar photovoltaics. Preliminary evidence underscores its capability to coun-teract the cycle life challenges of LABs, signifying a promising avenue for sus-tainable EV energy storage.
17:45-18:00	ER010	Use of watermelon waste as a fuel source for bioelec-tricity generation **Santiago M. Benites, Vicerrectorado de Investigación, Universidad Autónoma del Perú, Lima 15842, Peru, Perú** Abstract: Organic waste, such as fruit, is becoming one of the major environmental prob-lems of this new era, due to the exponential growth of agro-industrial companies dedicated to the sale of various fruits, which generate a large amount of waste by not meeting the conditions quality. One of the most consumed fruits in this sea-son of the year, are watermelons; of which only the pulp and seeds and peel are not thrown away in places that are not conducive to their use. Due to this, this re-search has as its main objective the use of watermelon waste as fuel for the gen-eration of bioelectricity through microbial fuel cells manufactured at low cost on a laboratory scale (100 mL MFCs). It was possible to generate voltage and electri-cal current peaks of 0.983 ± 0.059 V and 4.575 ± 0.647 mA, which operated at a pH of 5.84 ± 0.27 on the twelfth day of monitoring, with an electrical conductivi-ty of the substrate of 164.87 ± 0.65 mS/cm. The internal resistance shown was 36.748 ± 2.747 Ω which was calculated using Ohm's Law, while the maximum power density was 754 mW/m2 at a current density of 4.51 mA/cm2. Finally, the three manufactured microbial fuel cells were connected in series, managing to light an LED light for 18 days, thus demonstrating the power of watermelon waste to be used as fuel for the generation of bioelectricity.
18:00-18:15	ER012	Evaluation of an Heat Pump Integration in the District Heating Supply of a Production Facility

		Bijan Seyed Sadjjadi, Institute for Energy efficiency in production, University of Stuttgart, Germany Abstract: The decarbonisation of industrial heat is crucial due to changing energy policies and climate challenges. Electrified power-to-heat applications, such as industrial heat pumps, can contribute to the decarbonisation of production systems. This study analyses the integration of a heat pump into an existing district heating sys-tem to reduce energy consumption. A dynamic simulation model evaluates differ-ent integration cases by varying the supply temperature. Integrating the heat pump can reduce the overall energy consumption. It has been shown that the tempera-ture lift, and thus the COP, in this system is highly dependent on the supply tem-perature.
18:15-18:30	ER016	New fuel source: Lemon waste in MFCs-SC for the generation of bioelectricity **Santiago M. Benites, Vicerrectorado de Investigación, Universidad Autónoma del Perú, Lima 15842, Peru, Perú** Abstract: Waste originating from the agricultural industry has become a major global problem due to its exponential growth and the lack of adequate policies for its collection. Due to this, this research provides a novel solution for using lemon waste from the agro-industrial industry as fuel in single-chamber microbial fuel cells. The cells used showed maximum values of electric current and voltage 10.126 ± 0.093 mA and 0.816 ± 0.017 V, respectively; these values were obtained when the cells operated at pH 3 ± 0.12 and with an electrical conductivity of the substrate of 100.362 ± 7.810 mS. / cm, all this on the eighth day. Microbial fuel cells showed an internal resistance of 86.936 ± 14.505 Ω and a maximum power density of 384.365 ± 43.142 mW/cm2 for a current density of 5.266 A/cm2. Finally, the schematization of the light generation process through the cells was carried out, for which all the cells were placed in series, managing to generate 2.90 V, enough to make an LED (red) work.
18:30-18:45	ER020	Evaluation and identification of waste heat utilization pathways: A review **Jan-Niklas Gerdes, Fraunhofer Institute for Manufacturing Engineering and Automation, Germany** Abstract: External factors such as climate change and the current energy crisis due to global conflicts lead to increasing relevance of energy consumption and energy pro-curement in the manufacturing industry. In addition to the growing call for sus-tainability, companies are struggling with rising energy costs and the power grid's reliability, which endangers the competitiveness of companies and regions affected by high energy prices. Due to the range of available technologies and concepts for waste heat utiliza-tion, evaluation methodologies have been developed to assess the implementa-tion's technical and economic feasibility. In addition to the call for sustainability, implementing energy efficiency measures, especially to reduce the thermal energy demand, has become more relevant to combat rising energy prices and ensure competitiveness amid the current energy crisis. However, the complexity of tech-nologies and available utilization methods require rigorous assessment. This pa-per reviews the existing methodology for evaluating industrial waste heat utiliza-tion pathways.
18:45-19:00	ER009	Generation of electrical energy through microbial fuel cells using beet waste as fuel **Santiago M. Benites, Vicerrectorado de Investigación, Universidad Autónoma del Perú, Lima 15842, Peru, Perú** Abstract: The lack of electricity in places far from the big cities, plus the lack of efficient collection of organic waste, has generated two environmental problems that are accentuated in developing countries, mainly because remote places still use fire-wood or tree residues for cooking or giving light at night, while the absence of inefficient collection of waste, mainly vegetables, in city markets causes mer-chants to throw their waste around these markets, attracting bad odors, diseases and rodents. One of the wastes with the largest amount of waste is beets or beets, which due to their decomposition spoil quickly compared to other vegetables. For this reason, this research has as its main objective the generation of bioelectricity through microbial fuel cells (MFCs) with a single chamber using beet waste as fuel on a

		laboratory scale. Thus, 100 mL of beet waste extract was also used in each MFCs (they were carried out in triplicate). It was possible to generate peak electrical current and voltage of 5.64 ± 0.75 mA and 1.03 ± 0.25 V, whose sub-strate had an electrical conductivity of 175.71 ± 6.87 mS/cm with an optimum operating pH of 4.86 ± 0.34. While the internal resistance was calculated using Ohm's Law, yielding a value of 48,253 ± 4,749 Ω, also showing a maximum power density of 96,741 ± 4,874 mw/m2 at a current density of 5,614 mA/m2. The three MFCs-SC were seriously connected to observe their potential for the generation of bioelectricity, managing to turn on a led bulb (RED) for six days.
19:00-19:15	ER025	Effect of a Movable Phase Change Materials (PCMs) Layer on Lowering Energy Usage in Desert Structures **Maamar HAMDANI, Unité de Recherche Appliquée en Energies Renouvelables, URAER, Centre de Développement des Energies Renouvelables, Algeria** Abstract: Current scientific and engineering research has shifted its primary focus to the reduction of conventional energy consumption to mitigate environmental issues such as global warming. With the increasing demand for ventilation and heating in buildings across the globe, there is a need for appropriate technologies to enhance their thermal performance. One such technology is the use of phase change materials (PCMs) for thermal energy storage strategies in buildings, which, when selected appropriately, can meet thermal comfort requirements. This article examines the incorporation of movable phase-changing materials (PCMs) within the building envelope as an alternative to the traditional and permanent use of phase-changing materials throughout the year. Several key performance indicators, such as monthly and annual energy savings, average air temperature, daily average temperature fluctuation. This is accomplished by delaying nighttime air conditioning by incorporating the criticised PCM, which delays the apex of heat to other hours when people are outside the home, as well as temperature amplitude. The results indicate that incorporating movable PCMs into a building's envelope reduces energy consumption by 21.05 percent when compared to conventional fixed PCM panels. In addition, when analysing the integration of traditional PCM in the ceiling, the study reveals a significant reduction in annual energy consumption of 10.15 percent for RT21 PCMs and 17.03 percent for RT26 PCMs. These findings demonstrate the efficacy of integrating movable PCMs as a means to improve building energy efficiency and reduce energy consumption. This research contributes to the optimisation of PCM applications in arid climates and provides insights for enhancing thermal performance and energy efficiency in the built environment.
19:15-19:30	ER035	Short-term scheduling of support vessels in wind farm maintenance **Paulo Cesar Ribas, Molde University College, Norway** Abstract: With the continuous negative impact of traditional energy sources, the emergence of new sustainable energy sources with many advantages is welcomed by socie-ty. Offshore wind energy is one of the most widely used sustainable energy sources. It has the advantages of cleanness, greenness, sustainability, low operat-ing cost, and space-saving. Improperly planned maintenance operations on large vessels such as Service Operation Vessels (SOV) and Crew Transfer Vessels (CTV) can lead to a low-reliability maintenance plan and high fuel consumption. Therefore, planning offshore wind farms' day-to-day operation and maintenance is crucial. This paper contains a solution approach composed of different algo-rithms combined and applied to generate Short-term scheduling of support ves-sels in wind farm maintenance using actual scenarios data. This set of models for supporting the short-term dispatch of ships in wind farms was tested and had their good performance proven. These models could be used to generate a reliable maintenance plan in a quick time.

November 11 (Saturday) 13:30-15:15

Zoom Room: 833 3208 3274 https://us02web.zoom.us/j/83332083274

Online Session: Renewable Energy Generation and Energy Conservation

Session Chair:

Time	Paper ID	Speech Title & Presenter
13:30-13:45	ER049	Prototype of a Solar Photovoltaic Charging Station Applied to the Propulsion of Artisanal Fishing Vessels in Arequipa, Peru **DIEGO ALONSO VALDIVIA VERA, Universidad Tecnológica del Perú** Abstract: The main objective of this research study was to analyze the technical aspects of a prototype of a solar charging station applied to artisanal fishing vessels. The experimental model was made up of two banks of batteries, a charge and discharge module, a photovoltaic solar unit, and a measurement and data acquisition module. The measurement of electrical parameters, such as power, electric current and voltage in the different modules was carried out. In the evaluation phase, the charging effectiveness with different photovoltaic powers were calculated. The charging of batteries with the electrical network, with an inverter generator and inverterless generator was also evaluated. The same tests were performed for charging using 2 banks of batteries (made up of 4 and 8 batteries respectively). Efficiencies were then calculated for each of the tests. The results indicated that the most efficient charging mode was through the use of solar panels, despite the charging time being longer.
13:45-14:00	ER055	Effect of 2023 European Heatwave on Photovoltaic Energy Generation: A case study of Central and Southern Italy **Muhammad Ehtsham, University of L'Aquila, Italy** Abstract: Heatwaves can increase solar energy output due to increased irradiance levels. However, they can also result in decreased efficiency and probable long-term damage to photovoltaic panels. This research work investigates the impact of 2023 European heatwave on the energy generation of photovoltaic installations in central and southern Italy. Data collected from 98 inverters associated with three different plants spanning from 01-01-2017 to 20-08-2023 reveals distinctive per-formance trends among three plants during the summer of 2023 compared to pre-vious years. Plants A and B experienced decreased energy generation, attributed to the extreme heatwave. In contrast, Plant C maintained consistent performance, benefiting from its elevated position and enhanced air circulation due to its geo-logical location at Adriatic coast. Performance metrics based on IEC-61724 standards further support these findings. This study highlights the importance of strategic placement and design considerations for photovoltaic installations to mit-igate the adverse effects of heatwaves.
14:00-14:15	ER052	Experimental Evaluation of a Prototype for the Micro Production of Green Hydrogen **MARIO ENRIQUE DÍAZ COA, Universidad Tecnológica del Perú** Abstract: The main objective of this research project was to experimentally evaluate a green hydrogen production prototype. The experimental model consisted of three modules: the hydrogen generation module, the photovoltaic panel module and the data acquisition module. In each case, measurements of electrical parameters were carried out with regard to intensity and voltage as well as hydrogen production. In order to determine the performance of the prototype, an experimental methodology was proposed where tests were carried out with different numbers of panels to determine the greatest amount of hydrogen production. To that effect, experiments were carried out with 1 panel, 2 panels, 3 panels and 4 panels on different days. In addition, tests were carried out through the electrical network with different amperages that were supplied by the charge controller (15 A, 20 A, 25 A, 30 A, 35 A and 40 A). Once all the tests mentioned above were carried out, the efficiency of the prototype was evaluated, resulting in an efficiency of 18.27% was obtained with a production of 7.47 g for four hours with an energy consumption of 152.32 kW. The

		costs incurred in each of the test scenarios for hydrogen production were as follows: Through the electrical network there was a production of 8.54 g with a cost of 3.49 PEN in four hours of operation. Using the 60V DC combustion generator resulted in a production of 9.09 g at a cost of USD 30.
14:15-14:30	ER036	Commercial Building Energy Optimization by Using EnergyPlus and Case Studies **Qitong Huang, Southwest Jiaotong University-Leeds Joint School, China** Abstract: Cities consume 75% of global energy and emit 80% of greenhouse gases, despite occupying only 3% of the world's surface area. Buildings play a crucial role in urban energy consumption, so it is necessary to reduce building energy consumption for environmental protection. This article reviews the history of energy consumption in buildings, identifies high-energy-consuming buildings like hospitals, and calculates their energy consumption categories using EnergyPlus, a simulation tool. It also demonstrates how changes in design parameters such as building orientation impact building energy consumption, highlighting the importance of early design decisions for a building's lifecycle impact. Investing in these design parameters can reduce buildings' carbon footprint and contribute to a more sustainable future. Reducing energy consumption in cities is a critical step towards a sustainable future. By implementing energy-efficient building design practices and investing in renewable energy sources, we can create a greener and healthier urban environment for all.
14:30-14:45	ER040	Privacy-Preserving Energy Trading with Applications to Renewable Energy Communities **Simona Ramos, University Pompeu Fabra, Spain** Abstract: We present a comprehensive framework that enhances coordination, privacy, and incentive alignment within RECs, while empowering them to establish a trustworthy reputation in the eyes of relevant external stakeholders. Our privacy-preserving energy trading protocol enables secure communication of energy supply and demand. With tokenized incentives, users are encouraged to publish usage profiles and trade energy in a community-controlled public forum. This allows all users in the community to benefit from typically cheaper locally-produced renewable energy, while also allowing the community as a whole to more effectively balance energy supply and demand, without compromising sensitive data confidentiality. With our blockchain-based protocol we aim to contribute to the further adoption of sustainable energy at a community level, laying a foundation for more extensive societal and environmental benefits in RECs.
14:45-15:00	ER050	Evaluation and Improvement of the Efficiency of a Self-Contained Photovoltaic System Applied to a Small Business in Arequipa, Peru **HOLGER CAMPOS PAREDES, Universidad Tecnológica del Perú** Abstract: The aim of this research study was to provide an economic and technical analysis of the efficiency of a self-consumption photovoltaic system operating in a workshop dedicated to vehicle bodywork repair and painting in the city of Arequipa. In said establishment, a photovoltaic system was installed that generates enough energy to satisfy internal demand together with the electrical network. The electrical parameters of energy consumed from both sources (photovoltaic and network) were registered and analyzed in order to establish the feasibility of the project. The economic analysis determined that the project is viable with a payback period of 8.5 years. The need then arises to present possible alternatives for the improvement of the efficiency of the photovoltaic system, since in the self-contained model a considerable amount of solar energy is not used. Based on this, an energy storage alternative is explored, with a first scenario proposed to obtain the greatest amount of energy from the photovoltaic system and a second scenario proposed to prioritize the investor's finances. Within these scenarios, the use of 2 technologies for energy storage may be proposed; Lithium and lead-acid AGM accumulators. The economic analysis showed that with these technologies the system would be economically viable, although only with AGM technology is a reduction obtained regarding the investment recovery time concerning the self- consumption model.
15:00-15:15	ER019	Assessing Carbon Footprint Estimations of ChatGPT

Boris Ruf, AXA, France

Abstract: ChatGPT takes the world by storm, while its environmental impact remains a serious concern. In the absence of official data, several researchers have tried to estimate the carbon emissions linked to the service, with very deviating results. We reproduce three popular calculations using an open data model for carbon footprint quantification. This enables a transparent comparison of the approaches and helps to identify their main differences and possible potential for improvement. Our work demonstrates how open data models can be used to lead the way to more robust carbon footprint estimation.

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