

7th International Conference on Energy and Environment Research, ICEER 2020, 14–17
September 2020

ICEER2020—Driving Energy and Environment in 2020 Towards A Sustainable Future

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Abstract

The 7th International Conference on Energy and Environment Research (*ICEER 2020*) followed six previous successful editions hosted in three European Countries (Portugal, Spain, Czech Republic). This last edition was planned to be held in Italy first, and then in Portugal, due to the pandemic situation. Finally, for safety reasons, it was decided to organize a virtual event, which was held from 14 to 17 September 2020. Despite the limitations imposed by COVID-19 spreading, the online format did not affect the original spirit of the Conference, which was born as “a privileged space to discuss current matters related to energy and the environment research”. This year the Conference main topic was “Driving Energy and Environment in 2020 towards a Sustainable Future”, bringing attention to the dramatic changes that occurred in the energy and environment sectors in the last years, speeded up by the pandemic, and their perspectives for a sustainable future.

This paper gives a comprehensive outline of the conference organization as well as of the main research topics addressed in the three keynote speeches and in the dedicated sessions planned to enhance the event effectiveness and boost discussion and interaction among experts in those fields.

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Keywords: Energy markets; Power production; Supercritical carbon dioxide; Sustainable energy; Techno-economic analysis; Waste heat recovery

1. Introduction

The 7th International Conference on Energy and Environment Research (*ICEER 2020*) belongs to a successful series of Conferences organized by the SCIENCE and Engineering Institute (SCIEI) and the School of Engineering (ISEP) of P.Porto. The Conference was planned to be held in Italy, hosted by the University of Roma Tre. However, due to the pandemic, it was moved to Portugal at the School of Engineering (ISEP) of P.Porto, and then, for safety reasons, it definitively took place as a virtual event, held from 14 to 17 September 2020. Despite the limitations imposed by COVID-19 spreading, the online format did not affect the original spirit of the Conference, aimed at sharing expertise and discussing matters related to energy and environment topics. Under this new format, the

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ICEER 2020 conference had a good success, thanks also to the support of CIETI and LEPABE research laboratories, and the University of Roma Tre. Moreover, *Energies*, *Sustainability*, *Climate* and *ChemEngineering* journals gave their support as media partners, improving the Conference appealing.

The kind participation of the three well-known keynote speakers promoted intense and interactive debate among the participants of *ICEER 2020* in the fields of power electronics role on the provision of a sustainable energy supply, energy efficient buildings and their sustainability assessment and microalgae biorefineries as important pieces of the circular economy.

This Special Issue of *Energy Reports* offers 64 full papers presented at *ICEER 2020*, and serves as the Proceedings of ICEER2020 – *The 7th International Conference on Energy and Environment Research*, 14–17 September 2020.

2. Conference topics

Researchers from 38 Countries from four continents (Africa, America, Asia and Europe) took part in the event, and were actively involved in the most relevant topics connected with energy, environment research and education on sustainability, both as Authors and as Members of the STC/Reviewers.

Eleven thematic sessions were organized to make more effective the knowledge sharing among researchers. These multidisciplinary sessions with experts from different fields were as follows:

- Advanced Control & Monitoring Systems;
- Advanced Energy Technologies;
- Biomass & Bio-based Products;
- Education for Sustainable Development;
- Energy Efficiency;
- Energy Policy, Economics, Planning & Regulation;
- Environmental Pollution, Prevention & Pollution Control;
- Life Cycle Analysis Methodologies;
- Modelling, Simulation and Forecasting of Energy & Carbon Market;
- Renewable Energy;
- Sustainable Buildings.

3. Committees

The quality of a Conference depends, not only on the quality of the submissions received and on their Authors' expertise, but also on the expertise and generosity of their Scientific and Technical advisors. The members of the Scientific and Technical Committee (STC) have the huge task to *peer review* the large number of papers submitted in a very short time, contributing to the final improvement of the quality of the manuscripts. Therefore, *ICEER 2020* Conference, Program and STC Chairs would like to thank all the experts involved in the STC activities, who guaranteed the quality of the contributions presented in the Conference sessions. Furthermore, we would like to address a *big thank you* to the Staff of SCIEI who made possible this online edition, managing all the technical problems and unforeseen events connected with virtual presentations and discussions. The STC of *ICEER 2020* as well as the overall organization are described below.

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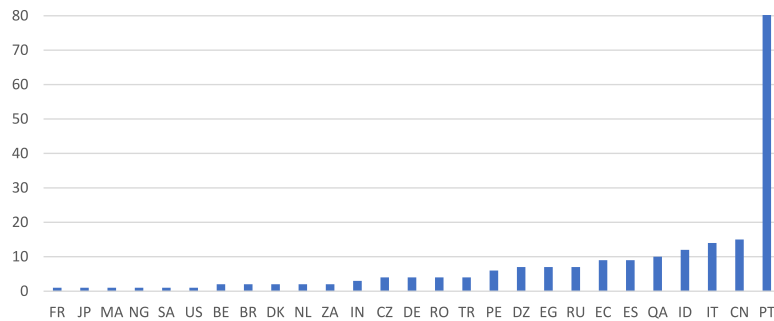


Fig. 1. Distribution of authors in ICEER 2020 by country.

Simona Varvara	“1 Decembrie 1918” University of Alba Iulia/Dept. of Exact Sciences and Environmental Engineering	RO
Sónia A. Figueiredo	REQUIMTE/LAQV/ISEP	PT
Teresa Fidélis	GOVCOPP/DAO/University of Aveiro	PT
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4. Conference statistics

In total, 82 contributions were submitted to the 7th edition of the conference by 174 authors from 27 countries, confirming *ICEER 2020* as a relevant international event to discuss and share knowledge on the most relevant aspects related to Energy and Environment. In Fig. 1 details about the distribution of authors by country are shown.

As seen, the highest number of authors (47%) came from Portugal, followed by China (9%), Italy (8%), Indonesia (7%), Qatar (6%), Spain and Ecuador (5% each), Russia, Egypt and Algeria (4% each), Peru (3%), India, Czech Republic, Germany, Romania and Turkey (2% each) and the other 11 countries with 1% authors each. This broad distribution of authors reinforces the interest and internationalization of ICEER, with important share of authors coming from very different places in the world. It is noteworthy the number of submissions by authors from Asian countries, such as China, Indonesia and India, whose participation under online conference format was facilitated as there was no need for VISA application. Besides the significant number of participants from previous editions, coming from a very large number of countries, the ICEER community included this year a significant number of new authors, some of which coming from other new countries. This diversity of cultures enriched the conference, and made it a live and truly inclusive arena where participants could freely discuss the world energy related matters. Interestingly, and in spite of the overall lower number of participants when compared with previous editions of ICEER, the number of participants in each online session was kept at a level similar to previous years, which can be attributed to the conference online format allowing participants to attend all the sessions (no parallel sessions).

At least two experts, selected among the STC members, reviewed each paper. In the end, 64 full papers were accepted for oral presentation. In Fig. 2 the distribution of papers by topic is presented.

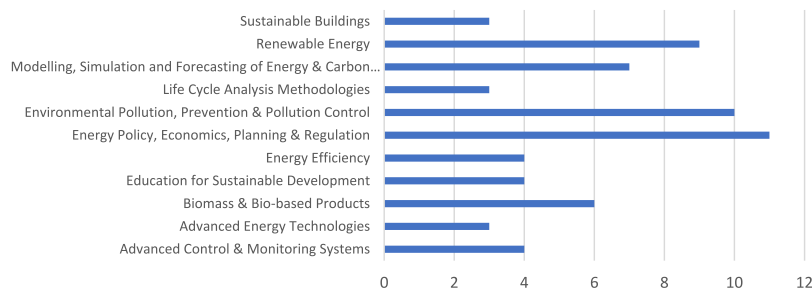


Fig. 2. Distribution of papers presented at ICEER 2020 by topic.

As shown in Fig. 2, the topics most hotly presented and debated by researchers who attended ICEER 2020. From the list of 11 topics, ICEER 2020 had the largest number of presentations related to Energy Policy, Economics, Planning & Regulation, followed closely by Environmental Pollution, Prevention & Pollution Control. The third biggest group of contributions was the one related to Renewable Energy. Other two hotly debated topics in ICEER 2020 were Modelling, Simulation and Forecasting of Energy & Carbon Market and Biomass & Bio-based Products. The least participated topics, in terms of number of presentations, were Sustainable Buildings, Life Cycle Analysis Methodologies and Advanced Energy Technologies. However, even these presentations were largely discussed by the audience, demonstrating the high relevance these topics have particularly in sustainable energy systems.

5. Keynote speakers and lectures of ICEER 2020

In ICEER 2020 there were three Keynote Lectures, held in the three different days of the conference. Three international experts kindly accepted the invitation to share their knowledge on three key topics in the field of Energy and Environment. Their keynote lectures boosted a vivid debate and interaction among participants. Senior and young researchers had the opportunity to meet these experts, without any kind of gender, cultural or generational barriers hindering participants' interaction. The ICEER Chairs and Program Chairs are deeply grateful to Prof. Saad Mekhilef, Prof. Francesco Asdrubali and Dr. Parthiba Karthikeyan for sharing their huge and valuable expertise with the conference participants.

Saad Mekhilef is a Chartered Engineer (CEng) and Fellow of The Institution of Engineering and Technology (IET), and a Senior Member of The Institute of Electrical and Electronics Engineers (IEEE). He is an Associate Editor of various top journals such as IEEE Transactions on Power Electronics and the Journal of Power Electronics. He is a Professor at the Department of Electrical Engineering, Faculty of Engineering, University of Malaya, since June 1999. He is currently the Dean of the Faculty of Engineering, and the Director of Power Electronics and Renewable Energy Research Laboratory (PEARL). A total of 116 Philosophy Doctorate (Ph.D.) and Master Degree candidates have successfully graduated under his supervision. He has filed six Intellectual Property (IP) in his expertise. He is frequently invited as honorary keynote lecturer at international conferences, congress, meetings, and symposiums. He authored and co-authored more than 400 publications in academic journals and proceedings including 253 International Scientific Indexed, ISI publications, and five books with more than 22,500 citations and 74 Hindex. Saad Mekhilef has been listed by the Thomson Reuters (Clarivate Analytics) as one of the Highly Cited (Hi.Ci) engineering researchers in the world, and included in the "Thomson Reuters' The World's Most Influential Scientific Minds: 2018 and 2019". He is actively involved in industrial consultancy for major corporations in the Power Electronics and Renewable Energy projects. His research interests include Power Conversion Techniques, Control of Power Converters, Maximum Power Point Tracking (MPPT), Renewable Energy, Energy Efficiency, Smart Grid, Microwave and Wireless Technologies.

In his interesting and timely lecture titled *The role of power electronics in providing a sustainable energy supply for the future generation*, Prof. Saad Mekhilef could demonstrate how power electronics plays an increasingly important role in providing a sustainable energy supply. This affects not only the present time but also the future generation, through the provision of clean, safe, affordable and reliable energy.

Francesco Asdrubali is a full professor of Building physics and building energy systems at the University of Roma Tre since 2015. Previously he served as Assistant Professor and Associate Professor at the University of

Perugia. Graduated in Civil Engineering in 1990, he obtained a Ph.D. in Thermophysical Properties of Materials in 1995 and served as Director of CIRIAF, an Inter-University Research Center in the field of environment and pollution, based at the University of Perugia, from 2004 until 2013. His teaching activities include the courses of Environmental Acoustics, Applied Thermodynamics and Heat Transfer, Energy systems and Environment, Renewable Energies in the Universities of Perugia and Roma Tre. The areas of scientific research cover a wide range of topics, such as renewable and alternative energies, heat transfer, energy and buildings, Life Cycle Assessment, acoustical properties of materials, environmental noise, natural and artificial lighting, sustainable mobility. Francesco Asdrubali is author of more than 200 scientific papers in the above-mentioned areas, member of the Editorial Board of various international Journals and Editor in Chief of Building Acoustics and Noise Mapping. The international activities include the coordination of various national and EU-funded Projects (LIFE, Intelligent Energy Europe, VII FP; Horizon 2020) and the participation to international networks such as COST Actions. Member of the Scientific and Organizing Committees, Session Organizer and Keynote speaker at several international conferences, such as ICSV 16 (2009), ICAE International Congress on Applied Energy (2011), ECOS (2012), EAA Euroregio (2013), ICSV22 (2015), Euronoise (2015), ICSV23 (2016), ICSV 24 (2017), Internoise (2017), Building Simulation 2019, ICCHMT 2019.

In his lecture titled *Life cycle assessment of energy efficient buildings*, Prof. Francesco Asdrubali demonstrated how the retrofit of the building stock becomes a key issue to meet the Paris agreement requirement to hold global temperatures to a maximum rise of 1.5 °C above pre-industrial levels. In his words, for traditional buildings, between 60% and 90% of the total impacts are imputable to the operational energy demand. However, energy efficiency has recently led to considerable reductions in the environmental burdens of the use stage, cutting the energy and carbon emissions associated with this period but causing a burden shifting towards other life cycle stages of the constructions. For NZEBs (Nearly Zero Energy Buildings) the relevance of the use stage in life cycle analysis decreases. At the same time, the embodied components acquire more importance, which in fact has an adverse effect of transferring the environmental burdens to the present, when energy is environmentally less friendly than it will be in the future, when the building is in use. The Life Cycle Assessment (LCA) approach can be a very useful tool to evaluate the environmental impacts of the different life cycle stages of a building, and to estimate the pros and cons of different retrofit options of an existing building. To this extent, some indicators, like energy and environmental payback times, have to be added to economic payback times in order to obtain a more comprehensive analysis. During his Keynote lecture, Prof. Francesco Asdrubali presented some significant case studies, where the LCA approach was applied to energy efficient buildings, together with the evaluation of the energy and carbon payback times of different retrofit scenarios supposed for an existing building. The so-called dynamic LCA was also discussed, as an important tool for buildings analysis due to their long-lasting characteristics, and to the act that during their life cycle, energy scenarios may change.

Parthiba Karthikeyan is Research Assistant Professor at Department of Engineering Technology, University of Houston, Texas, USA. He has over 12 years of international research experience in the field of environmental microbiology and biotechnology. He has achieved few meritorious awards such as Australia-Thailand Early Career Research Exchange Award-2014, Sêr Cymru National Research Network for Low Carbon Energy and Environment Writing Fellowship and Award-2018 (UK), and Ramalingaswamy Re-Entry Fellowship-2018 (India). Dr. Karthikeyan is a peer review member assessor for the United States Department of Agriculture (USDA)-USA, Agriculture and Agri-Food Canada, Canada, Horizon H2020-Marie Skłodowska-Curie Individual Fellowships-Europe, Australian Research Council-Australia, and the Research Foundation - Flanders (FWO) - Belgium. He is serving as an associated editor for the Frontiers of Microbiotechnology journal and edited a few special issues for Elsevier, Springer and MDPI journals. He has published a number peer reviewed research and review articles, book chapters and edited a few books on specific topics. Dr. Karthikeyan specialties and interests are greenhouse gas mitigation, sustainable solid waste management, bioprocess engineering and bioproduct developments, bioleaching of metals and molecular engineering.

In the keynote lecture, Dr. Parthiba Karthikeyan discussed the *Microalgae biorefinery and circular bioeconomy* hot topic. In fact, microalgae are photosynthetic organisms that are promising resources for meeting the future global demands on food-energy-fuel. They are considered as mini-biological factories and produce several valuable chemicals from CO₂, supporting the so-called bio-based economy. Microalgae are very versatile and adapt to varying environmental conditions, while no arable lands, freshwater resources and nutrients are required for cultivation. In this keynote lecture, the multifaceted applications of microalgae were discussed: for bioenergy and biofuels; for CO₂

remediation; for nutrient recovery from urban sewage; for bioremediation of wastewater pollutants; for food and feed; for biomedical applications; for space exploratory research and for high-tech industrial engineering. His lecture was wrapped up by the presentation of his research experiences in developing integrated algal biorefinery concepts to improve the process economics and genetic engineering to improve their capacities for industrial applications. Finally, the existing knowledge gaps and future research directions were also discussed.

6. ICEER 2020 at a glance

The three Keynote Lectures set the tone in three specific topics related to energy. Further to these, 20 one-hour sessions were organized for oral presentations, with 15 min coffee breaks to allow participants relax from computer work. The first day of the conference was devoted to registration and testing, followed by three long days of a very intense work.

All the sessions were chaired by at least one conference member from academia, who promoted the discussion of the research presented. Participants of *ICEER 2020* had the opportunity to listen to experts and to discuss with them what they wanted both in different fields of energy and environment related matters.

The selection of the best oral presentation in each topic was assisted by the Session Chairs who have been invited to perform this difficult task. The best oral presentations in each topic were as follows:

- Biomass potential – theory and practice: case example of the Czech Republic region, presented by Jaroslav Knápek, in the topic Biomass and Bio-based Products;
- Economic growth assessment through an ARDL approach: the case of African OPEC countries, presented by Mara Madaleno in the topic Energy Efficiency;
- Community renewable energy: benefits and drivers, presented by Susana Soeiro, in the topic Energy Policy, Economics, Planning & Regulation;
- Techno-economic analysis of a s-CO₂ power plant for waste heat recovery in steel industry, presented by Ambra Giovannelli, in the topic Renewable Energy;
- Life cycle energy and carbon emissions of ergosterol from mushroom residues, presented by Helena Monteiro, in the topic Life Cycle Analysis Methodologies;
- Performance Investigation of Integrated PVT collector/Adsorption Cooling System under the Climate Conditions of Middle East, presented by Ahmed Hassan, in the topic Modelling, Simulation & Forecasting of Energy & Carbon Markets;
- Analysis of the EAR conversion method for air pollutant emission concentration, presented by Yalan Ye, in the topic Environmental Pollution, Prevention & Pollution Control;
- Using diverse sensors to support the load forecasting in an office building, presented by Omid Abrishambaf, in the topic Sustainable Buildings;
- Determination of the typical load profile of industry tasks using fuzzy C-means, presented by Rúben Barreto, in the topic Advanced Control & Monitoring Systems;
- Analysis of the impact of different nanoparticle metal oxides as fuel additives in compression ignition engine performance, presented by Amr Abdallah, in the topic Advanced Energy Technologies;
- Educating water professionals for the Arab world: archetypes, change agents and complex realities, presented by Sudeh Dehnavi, in the topic Education for Sustainable Development.

Finally, a Best Paper award was assigned in each of the categories Energy, Environment and Chemical Engineering. These awards resulted both from the reviewers and from the Session Chairs' evaluation. Thus, the awarded best papers are briefly described below.

In the category Chemical Engineering, the Best Paper title was awarded to Dr. Aytun Onay, with the paper Optimization of lipid content of *Nannochloropsis gaditana* via quadratic models using MATLAB Simulink. This paper the Author examined the changes on lipid content of *Nannochloropsis gaditana* cells cultivated in Johnsons's medium with three effective assisted lipid extraction methods including Osmotic shock (0–20 KCl %), Ultrasound (0–50 kHz) and Lysozyme (0–20 U/mL) by using response surface methodology (RSM) with circumscribed central composite design (CCD). According to the RSM predicted results, the maximum lipid percentage was gained in 10 KCl % of Osmotic shock, 30 kHz of Ultrasound and 10 U/mL of Lysozyme with the lipid content of 37% of biomass. By analyzing the 3D response surface plot and related 2D contour plots, it could be concluded that the

assisted factors play an active role to increase lipid content. Furthermore, *Nannochloropsis gaditana* could meet at these conditions with high lipid content for various goals in the biodiesel industry.

In the category Environment, the Best Paper title was awarded to Dr. João Silva, with the paper removal of volatile organic compounds from waste air stream of a furniture factory. This paper, reported the study of an alternative to the thermal oxidation of VOC in a gaseous effluent, aiming to reduce the power consumption and simultaneously mitigate the environmental impact of a furniture factory located in the north of Portugal. Thus, a gas-liquid absorption of n-butyl acetate in a packed-bed column of LECA was used to achieve a VOC outlet complying with the Portuguese regulation for gaseous emission in the atmosphere. Efficiencies over 90% were achieved with a continuous flow of tap water, achieving outlet VOC concentration under the imposed limit of 50 mgC/Nm³ in three experiments. Although in some other experiments the VOC concentration was above the imposed limit, the process proved highly effective, suggesting that if the outlet water can be reused and employed for other purposes, this solution might have an industrial interest. Conversely, using a closed water circuit, the system proved to be less effective, with the removal efficiency of the VOC dropping very fast, which revealed the need for continuous treatment of the recirculated water. The introduction of microorganisms in the system, it was achieved a lower efficiency than for open circuit, suggesting that the system might be an interesting and a sustainable alternative to the system presently in use at the factory, with a significant reduction in the energy consumption.

In the category Energy, the Best Paper title was awarded to Dr. Pedro Faria, with the paper Online estimation and use of price elasticity of demand for shifting loads through real-time pricing. In this paper, the Authors demonstrated the importance Demand Response programs have in the simulations of electric users' loads' profiles. The evolution of these simulations helps define new models that are able to predict power consumption trends for different user types. Highly precise forecasts of loads' profiles are needed to better match consumption and production energy profiles. In this paper, a way to obtain the elasticity factor, that identifies the will of a user to have his consumptions reduced after a remuneration, was presented. The definition of the elasticity factor is also supposed to help building scenarios that consider the impact of the long-term use of RTP (Real Time Price) remuneration. Importance of having a real-time elasticity value able to adapt to specific situations, such as users' habits during the weekends or weekdays and weather forecasts, was also discussed.

The closing session was a very dynamic and interactive session, with participants demonstrating their satisfaction in being present at *ICEER 2020@Online* and cheering the awardees.

Acknowledgments

Dear participant in *ICEER 2020@Online*,

Our first acknowledgement goes to those who participated in the Conference and shared with all of us their ideas and the results of their work – thank you for having resisted to the constraints imposed by the pandemic and for having been there with us!

A huge THANK YOU also to the Keynote speakers, Prof. Saad Mekhilef, Prof. Francesco Asdrubali and Dr. Parthiba Karthikeyan, who promptly accepted our challenge to join the *ICEER 2020* for online participation and generously shared with us their relevant ideas and research results.

A very big THANK YOU to the Department of Engineering of ROMA TRE University, for understanding the need to convert the live to online conference.

We must also publicly thank the SCIEI organization, for their joint and constant commitment and efforts to make *ICEER 2020* go on, and to improve ICEER quality, supporting the Chairs and Program Chairs, and the local organization. Particularly the kind and helpful staff – Tina, Jennifer and Maggie, from China. Without them, there would not have been *ICEER* online.

We must thank our research group coordinators, who recognize the importance and encourage our efforts in dissemination in conferences. They allowed us to spend part of our precious time preparing the conference.

The process of editing the Conference Proceedings in *Energy Reports* – a Scopus Indexed journal from Elsevier, with IF of 3.595 – is now finished.

We hope to have contributed to increase the scientific importance and impact of ICEER series.

The next ICEER (*ICEER 2021 @ Rome*) will take place in 13–17 September 2021 @ Università degli Studi ROMA TRE, Rome, Italy – **Save the Date!**

We are excited to go back to normal and to show you what we are preparing – website is already available with details and news.

Thank you all for having been online with us.

Next event will be bigger and better!!!

We hope to meet you soon (again) in... **ICEER2021@Rome**