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Proceedings of the 3rd International Conference on Water Energy Food and Sustainability (ICoWEFS 2023)

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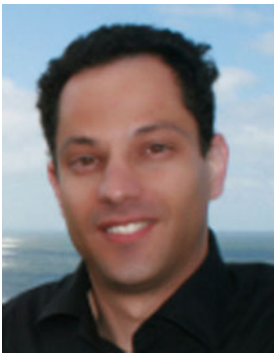

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Keynote Speakers

Eduardo Zarza-Moya
Plataforma Solar de Almería—CIEMAT—Spain

Eduardo Zarza-Moya is a researcher with 37 years of experience in the field of concentrating solar thermal (CST) technologies. At present, he is working at the Plataforma Solar de Almería (PSA) as Technical Coordinator and Head of the R+D Unit online-Focus CST technologies. He has coordinated several national and International R+D projects related to CST technologies (the projects: DISS, Solar Thermal Desalination, CAPSOL, PREDINCER, DETECSOL, etc.). He is a member of the AEN206/SC117 and IEC/TC117 standardization committees for solar thermal power plants, the Scientific and Technical Committee of the European Association of Solar Thermal Electricity (ESTELA), and the Spanish representative at the Executive Committee of SolarPACES.

Concentrating Solar Thermal (CST) Technologies for Sustainability

Abstract

It is estimated that the global energy consumption will reach 18,608 Mtoe by 2035, and it has become evident that fossil fuels must be replaced by renewable energies in order to reduce the global warming and the climate change that are already underway and are clearly endangering the future of the mankind. Due to its unlimited nature, solar energy must play a significant role in this effort to replace fossil fuels. At present, there are different technologies to make use of the solar radiation and some of these technologies are already well known because they have achieved a wide commercial deployment worldwide. Photovoltaic (PV) systems are a good example of these successful solar technologies. However, Concentrating Solar Thermal (CST) technologies are also a very promising option to achieve a fully decarbonized energy sector. The commercial deployment of CST technologies is still small, with a total installed power of less than 8 GW if both power and heat applications are taken into account, and less than 7 GW if only CST power plants are considered. Nevertheless, CST technologies have many socio-economic and technical benefits that must be considered (i.e., they are suitable for both power and heat generation, there are many countries with a high level of direct solar radiation, excellent dispatchability due to their thermal energy storage systems, significant job creation in places where they are implemented, high local content and excellent complementarity with PV plants), and these benefits altogether make CST technologies an excellent option for clean and sustainable energy supply. The reasons why CST technologies must play a significant role in the decarbonization of the energy market will be further explained in this invited talk.

Fernando José Cebola Lidon
Faculty of Sciences and Technology of Universidade Nova de Lisboa (FCT/UNL)—Portugal

Fernando José Cebola Lidon is a full professor at the Faculty of Sciences and Technology of Universidade Nova de Lisboa (FCT/UNL) and a coordinator of

the Research Center "Geobiosciences, Geoengineering and Geotechnologies"—GeoBioTec—Polo FCT/UNL and graduated in Biology and Geology from the University of Évora and in Biochemistry from the Faculty of Sciences of the University of Lisbon, with a Ph.D. in Biology—specialty Plant Biochemistry from FCT/UNL and recognition by ECE/USA. Develops is work in the field of Agroindustrial Production and Transformation Technologies, focusing its activity on the development of functional foods following sustainable perspective, considering principles of eco-efficiency with the adoption of last generation technologies and aiming at the promotion of economic added value. Thus, articulation with the agro-industrial industry is developing techniques for the biofortification of edible parts of foods of vegetable origin, equating with the introduction of technical itineraries to increase productivity indices, adoption of crop monitoring techniques with the introduction of edaphoclimatic sensors and definition of food and nutritional quality standards.

Biofortification of Pear Rocha with Calcium: Production Workflow and Quality Definition of the Final Product

Abstract

Low dietary intake of Ca in humans has been epidemiologically linked to various diseases (such as osteoporosis), which can have serious health consequences over time. Accordingly, the development of an agronomic workflow for Ca biofortification of Rocha pears (Pyrus communis L.) and the assessment of physicochemical deviations was carried out in an orchard located in the West region of Portugal. During fruits development, leaves were sprayed a total of seven times with $Ca(NO_3)_2$ (with concentrations between 0.1–0.6 kg ha^{-1}) and/or $CaCl_2$ (with concentrations between 0.4–8 kg ha^{-1}). During fruits development, chlorophyll a parameters, as well as leaf gas exchange parameters such as net photosynthesis, stomatal conductance, transpiration rate, instantaneous and water use efficiency, only showed minor deviations, which indicated that the threshold of toxicity was not surpassed. Calcium contents varied during fruits development and at harvest the average biofortification index varied between 47 and 63%. Besides, the equatorial region of the fruits showed for all treatments (substantially in Ca treated samples) higher Ca contents in the epidermal and in the central regions. It is concluded that, although prevailing a heterogeneous distribution of Ca in fruit tissues, high indexes of biofortification in Rocha pears can be prompt in the orchards, without substantial physicochemical changes. Accordingly, agronomic biofortification with Ca can be used as a strategy for benefiting consumer's health.

Wolf-Gerrit Früh
School of Engineering and Physical Sciences, Institute of Mechanical, Process and Energy Engineering, Heriot-Watt University, Edinburgh, Scotland

After completing a first degree in Physics at the University of Freiburg in Germany and a D.Phil. in Atmospheric Physics at the University of Oxford, Wolf-Gerrit Früh took up a position in 1997 teaching Mechanical and Energy Engineering at Heriot-Watt University in Edinburgh. His research covers a wide range from fundamental fluid dynamics experiments and simulations through wind turbine aerodynamics to energy systems modeling and the application of data science for prediction and optimisation for energy systems design and scheduling.

Recent work relevant to the energy-water-food nexus include a study to reduce the carbon footprint of whisky distillation through Renewable Energy and thermal storage, heat-recovery in commercial kitchen, aquaponics, vertical farming, and desalination through solar-powered reverse osmosis. Most of these projects included collaboration with industry.

The Role of Low-Carbon Energy Sources and Storage in the Water-Food-Energy Nexus

Abstract

Water, food, and energy are absolutely essential. Providing all three in a way where supply of one does not endanger any of the other is a key requirement for sustainable development. This contribution identifies key challenges of, and opportunities for, providing energy for water and food provision. A brief overview over the energy requirements for water treatment and food production will identify some of the main challenges, such as water purification to drinking water quality, or growing crops for the increasing population. Having identified some specific challenges, this contribution will illustrate opportunities for more sustainable water and food production through renewable energy systems with a particular focus on local solutions. Examples include water purification powered by solar energy, energy recovery from water

treatment, and design of renewable energy systems required for controlled agriculture or aquaponics. The examples will highlight that many opportunities exist but that the energy system to support the water or food production must be carefully designed and optimized to improve the sustainability of water, food, and energy provision. In many cases, the optimization of an energy system for a particular task in a specific location will point toward a hybrid system, combining a range of energy generation technologies as well as some form of energy storage.

Antje Disterheft
NOVA School of Science and Technology, NOVA University Lisbon, Portugal

Antje Disterheft is a postdoctoral researcher and an integrated member at Center for Environmental and Sustainability Research (CENSE), from NOVA School of Science and Technology, NOVA University Lisbon. She is enthusiastic about exploring transformative processes that can support keeping human-nature systems in balance. Her research focuses on capacity building and new approaches to collaboration and co-creation for sustainability in Higher Education Institutions. In the past years, she started to engage deeper with the lens of care when thinking about sustainability and founded The CareLab for People and Planet at her faculty. The CareLab is a new space of collaboration, co-creation, and transformative learning where the interlinkages of inner and outer sustainability are explored.

She holds a Ph.D. in Social Sustainability (Universidade Aberta) and is an alumni of the Postdoc Academy for Transformational Leadership. German by nationality, but living in Portugal for more than 16 years, she enjoys being in nature, biking, and cooking.

Sustainability and Care—Why Our Inner Worlds Matter for Transformative Change

Abstract

Sustainability is inherently linked to questions of relationship: How do we relate to ourselves and to the world around us, and how can we enhance our transformative

capacity to thrive within the planetary boundaries? In the current times of multiples crises, e.g., the climate crisis, the effects of the recent pandemic due to COVID-19, as well a global crisis of trust, the concepts of intertwined inner and outer care are highly relevant: Personal care for ourselves (physical, emotional, and mental care) will impact and reflect in care for our communities and environment and draws on the social-ecological system perspective. Besides progress and growing awareness of sustainability, the world continues on a rather unsustainable path. While the Sustainable Development Goals (SDGs) offer us a roadmap of sorts toward a more sustainable future by 2030, it is becoming more apparent that without deeper transformation the goals might not be reached. What is missing in a world of increasing knowledge and sophisticated technology, where knowledge and technology might not hold the only solutions to solve complex unsustainability?

A growing number of scientists regard the inclusion of inner transformation as a deep leverage point for our sustainability endeavors. In this speech, I will explore why sustainability and care start with us and how our inner transformation can contribute to achieving the SDGs and help implement transformative change.

Shaul Sorek
Ben-Gurion University of the Negev
Jacob Blaustein Institutes for Desert Research, Zuckerberg Institute for Water Research, Department of Environmental Hydrology and Microbiology, Sde Boker Campus, Israel

Graduated as B.Sc. in mechanical engineering at the Ben-Gurion University of the Negev and received his M.Sc. and Ph.D. degrees at mechanical engineering of the Technion—Israel Institute of Technology. His research interests are in the development of fundamental modeling for biomedical and environmental systems. These address theoretical formulation for macroscopic transport phenomena of multiphase and multi-components driven through heterogenous media by inertia to drag dominant forces, and related numerical methods implementing Eulerian and Lagrangian concepts. Concerning quantitative decision making for water related resources management, he aims on causality-driven directed information in addition to spatiotemporal measures.

Policy Directed Information Technology Governing Network Welfare by Balancing the Water-Energy-Food Nexus and Human Perceptions (WEFH) Measures

Abstract

The water-energy-food (WEF) nexus represents the most fundamental requirements for human existence. It is essential for social welfare and thus is a top strategic priority in the management of water related stakeholders, which enables security and sustainability of the WEF limited resources. In previous publications, following Boltzmann entropy, we prove that the WEF resources are linked by information, across the regional administrative nodal network (municipalities, districts, and states) system. We suggest the Volume (normalized WEF expenditures product) as the nexus holistic measure from high to low Volume nodes. The node's Volume with its household income combined density allows for a decision-making policy tool on a node's Welfare Mass (WM—product of Volume and density). This enables the aiming at balancing regulation of the system welfare. The intervention to balance household WEF consumption inequality, in conjunction with the subjective attitude uses big data mining and analytics approach vis a vis water availability, yields a computer-based decision-support system (DSS) for defunding/subsidizing actions to over/under respective consumption leads to activating regulatory policy instrument.

This WEFH input across a region welfare imbalanced nodal network is quantified and visualized to derive recommendations for policy-driven interventions to regional ascribed nodes' WM source/sink terms.

Our hypothesis of causality-driven directional information is exemplified by a sharp price increase in wheat and rice, for USA and Thailand, respectively, that manifests its impact on the temporal trend of Israel's administrative districts of the WEF expenditures.

Dr. Maria Dermiki
Atlantic Technological University, Ireland

Dr. Maria Dermiki has an interdisciplinary background in scientific research with a degree in Chemical Engineering from Aristotle University of Thessaloniki, M.Sc. in

Food Science and Nutrition from University of Ioannina, Ph.D. in Food Biosciences from the University of Reading, postdoctoral research experience in Sensory Science and Dairy Science and finally industrial experience in Food Product Development. She has a holistic approach in product development, starting from Food Chemistry, Food Processing, Sensory Evaluation and Consumer Science, Packaging and Legislation, while adhering to sustainable practices. She is interested specifically in understanding the food choices of different population groups to develop nutritious foods that address the three pillars of sustainability and contribute to sustainable diets. Finally, she applies the UN Sustainable Development Goals to all the modules she teaches at undergraduate and postgraduate level, with the aim to help students apply sustainable practices in their professional and everyday life.

"What Would You Eat to Save the Earth?," Challenges and Opportunities for Sustainable Food Product Development

Abstract

Nowadays, the inadequate natural resources, climate change, and the negative impact of food production on the environment call for more sustainable food production practices that will ensure there will be enough food to feed the growing world population. Numerous solutions are being explored to overcome the multiple challenges that current food production systems are facing. For example, researchers are exploring the application of protein sources alternative to animal, such as insects or plants that could have a lower environmental impact compared to livestock production. Adding to the growing challenge of food security, almost a third of food produced worldwide is lost or wasted along the supply chain. In order to achieve the UN Sustainable Development Goal 12.3 that aims to "halve global food waste at consumer and retailer level and reduce food losses at the primary and secondary production stages" multiple ways to reduce food waste are currently investigated. One way to achieve this and retrieve nutrients from food waste is through the concept of upcycled foods which is gaining research and commercial interest.

Despite the promising outcomes of the shift to more sustainable food products, there are numerous challenges still to be addressed. For example, there is a need for changes in the current legislation that hinders innovation toward the use of alternative ingredients such as insects or underutilized ingredients and food processing by-products. Another challenge is consumer acceptability of such alternative ingredients and products that contain them. This presentation will explore the potential of sustainable food product development while also discussing the challenges industry faces.

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The conference co-chairs and organizing committee wish to acknowledge the support and sponsorship given in the organization of the ICOWEFS 2023—International Conference on Water Energy Food and Sustainability, held at the Polytechnic Institute of Leiria, Portugal.

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Preface

The 3rd edition of **International Conference on Water Energy Food and Sustainability (ICoWEFS 2023)**, taking place in Leiria (May 10–12, 2023) Portugal, aims to be a major event to foster innovation and exchange knowledge in the water-energy-food nexus, embracing the Sustainable Development Goals (SDGs) of the United Nations, building a better future for all bringing together leading academics, researchers, and industrial experts.

Taking into account that the EU has announced several actions for the implementation of the SDGs, such as reducing emissions to achieve climate neutrality by establishing a goal of zero net emissions by 2050, but there will be an interim goal of reducing emissions by 55% by 2030. In addition, the EU required an increase to 45% of renewable sources in the energy mix by 2030, as well as that all new buildings in the EU produce zero emissions from 2030 linked to the plan that in the future, energy consumption should be smaller. The conference will also focus on interconnected areas such as waste and effluent recovery, renewable gases, renewable energies, carbon capture, efficient use of water, and sustainable agrifood technologies.

The conference expects to foster networking and collaboration among participants to advance the knowledge and identify major trends in the above mentioned fields.

This conference is the 3rd co-organization between two Portuguese Polytechnics from Leiria and Portalegre and is open to new partners in the future events.

This edition counted with 87 presentations and 6 keynote speakers from 23 nationalities, that enriched the debate and evolution of these four scientific areas, namely AgriFood, Energy, Sustainability and Water. And as a result of the submitted papers, this book proceedings contains 70 papers.

Finally, the technical visits to a Smart Management Water System and a Biogas Power Plant in the surroundings of the conference city are contributors to promoting the dissemination of knowledge and the interaction among the academy, research centers, and the industry.

Welcome to this 3rd edition of the ICoWEFS 2023 Conference in Leiria, Portugal.

Leiria, Portugal
Portalegre, Portugal

João Rafael da Costa Sanches Galvão, Ph.D.
Paulo Brito, Ph.D.
Conference Chairs

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