NATO OTAN

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Advanced Research Workshop
ARW G6276
Security Enhancement for Climate Changes impacting Urban Resources
SECCURe

9-12 July 2024, Montelibretti (Rome)
CNR Area territoriale di Ricerca di Roma 1
Strada Provinciale 35d, 9 – 00010, Montelibretti (RM)

Scientific Program, Abstracts and List of Speakers/Participants

NATO Advanced Research WorkshopARW G6276
Title: *Security Enhancement for Climate Changes impacting Urban Resources –SECCURe*

Due to climate change, population growth, and geopolitical instability, water, energy, and food resources are critical to communities' livelihoods. These resources are under growing pressure, leading to supply-demand resource gaps. These gaps are expected to grow by 2030. The interdependencies between these resources add to the complexity of achieving human security and bridging these gaps. Furthermore, in recent years, Europe, the U.S., and other regions globally have been facing some of the most significant migratory crises in modern history. People are forced to flee due to a legitimate fear of persecution, man-made causes (e.g., famine, war, conflict, violence), or as a result of disasters (e.g., environmental disasters, climate change). In addition, the health of individuals and communities is directly linked to their access to safe water, reliable energy, and nutritious food. Lack of access to any of these basic needs can lead to malnutrition, waterborne disease, and other health problems. The development of new solutions that simultaneously embrace and solve these needs represents a pillar topic of future interests (water-energy-food nexus), with impressive positive social implications. New knowledge would generate a safer society but also new opportunities for highly qualified jobs.

Several regions around the globe are expected to be hard hit by climate change impacts, but it is argued that the epicenter is going to be the broader Mediterranean, Middle East, and North Africa (MENA) region. Within that region, many countries are facing extreme water scarcity, limited freshwater resources, high energy dependence, population health issues, and a growing population to feed. Moreover, as of 2010, the Middle East and Europe have witnessed a surge in armed conflicts (Syria, Libya, Yemen, and recently Ukraine) that have led to increased refugee flows and consequently exerted significant pressures on already fragile resource systems, especially to the developing countries in the region. The role of new-generation pollutants (emerging pollutants) must be taken into consideration for the preservation of resources quality. The development of new technologies, capable to exploit the potential of waste(water) and minimizing the energy needs for their degradation/treatment could be a way forward.

The complex nature of these pressures begs for a systems approach to better understand the existing interconnections and to support the co-creation of cross-sectoral solutions to address them. Multi-sectoral decision-makers lack the tools for quantifying the impact of growing climatic, demographic, disasters, and geopolitical shocks on these interconnected resource systems, and improving communities' resilience and regional security.

Such tools would require a convergent approach, bringing different disciplinary experts to create multifaceted solutions that respond to this grand challenge's social, economic, technological, and policy dimensions. New views and approaches need to be designed and defined to face not only already known criticisms but also future challenges for defining the basis for a safer and more secure society.

The SECCURe AWR will offer the opportunity to faculty and researchers from the Mediterranean region as well as all over the world whose research focuses on the topics of this workshop to discuss about these themes, proposing new best practices and actions that well-address modern societies' needs. The workshop will be hybrid in order to offer the opportunity for the wider scientific community to participate.

AWR SECCURe Structure

The structure of the SECCURe AWR will follow the logical flow of the aforementioned concepts. An initial critical description of resource depletion's state-of-the-art in the broader Mediterranean region will be considered. This evaluation will be compared with the natural conditions of different geographical regions: case studies in South America regions and Qatar/GCC will be considered in a harmonic view, contemplating any possible redundancies. Social implications to this state-of-the-art will be rationalized and possible solutions will be discussed.

According to this plan of activity, intense brainstorming among scientists and experts will be promoted with the intention of defining new best practices to be applied for a more secure regional development. New forthcoming risks will be also included in the discussions and the development of new strategies will be suggested at the end of the works using a holistic approach towards improved resource management and full exploitation of renewable resources.

New concepts of wastewater depuration, new smart-cultivation practices, innovative valorization routes of residual biomasses (food waste included), will be described and critically discussed. The integration of technologies and design of processes will play a crucial role in the view of defining new harmonized network of processes, resulting in biorefineries having lower Greenhouse Gas Emissions (GHG), compatible with sustainable growth and human well-being. Principles of the Circular Economy will be stressed, with a particular attention to the perennial energies (solar) up to exhausted resources (carbon dioxide). The water-energy-food interconnections will be considered in a wide geographical context, making diversity a resource and a property that promote integration between different territories and populations.

The mutually beneficial cooperation on issues of horizontal interest will be realized including international efforts to meet emerging security challenges in Environmental Security. A well-distributed participation of experts coming from America, Europe, Africa, and Asia will guarantee not only a transversal view of the optimization of the use of resources from a geographical point of view, but also from a field of competencies that will range from various scientific aspects to the social implications.

Even the social security problems deriving from environmental and resource constraints, including health risks, climate change, water scarcity, and increasing energy needs, which have the potential to significantly affect NATO's planning and operations, will be considered from a wide perspective. Particular attention will be dedicated to the Gender role in sustainable development and climate change.

Goals and Outcomes

- Identification and assessment of root causes of security vulnerabilities in water, energy, and food systems emanating from climate changes
- Creation of strategic roadmaps for enhancing security in NATO/NATO Partners countries in the field of WEF nexus with integration of prominent stakeholders and resources
- Targeted networking among prominent experts and rising stars and preparation of initial steps for future large-scale proposals and collaborative activities

Program of the SECCURe WORKSHOP

9th July 2024		
15:00-21:00	Dr Carlo Pastore & Prof Adel Khalil	Welcome, Registration of speakers
10th July 2024		
8:30 - 8:35	Dr Carlo Pastore & Prof Adel Khalil	General Presentation of the SECCURe Workshop
8:35 - 8:50	Mr Richard Brewin	NATO Science for Peace and Security Programme Perspectives on Energy Security, Environmental Security, and Climate Change
	Chairman: Prof. Adel Khalil	*Energy/Food/Water Nexus: from Worldwide Contexts to the Mediterranean Area*
8:50-9:05	Prof. Eduardo Sánchez Tuirán	Sustainable alternatives for socially-vulnerable communities in Latin America to access water and energy
9:05-9:20	Prof. Patrick Linke	Planning for National Food Security – Experiences from Qatar
9:20-9:35	Prof. Nader Noureldeen Mohamed	Impacts of Climate Change on Water Resources and Land Degradation in MENA Region with Focus on Egypt
9:35-9:50	Dr. Tania Tellini	How to Address Competition Among Different Water Uses
9:50-10:05	Prof. Iqbal M Mujtaba	Water, Water Everywhere, Not Any Drop to Drink: Water-Energy-Food-Health Nexus
10:05-10:35	Round Table & Discussion	
10:35-11:15	Coffee Break	
	Chairman: Dr. Carlo Pastore	*Modern concepts of Water depuration towards a secure resource*
11:15-11:30	Prof. Mira Petrović	Urban runoffs as a source of Emerging Contaminants in aquatic environments

11:30-11:45	Dr. Giuseppe Mascolo	The environmental issue of fluorinated contaminants of emerging concern in groundwater: impact to food resources and technologies for their minimization
11:45-12:00	Prof. Sixto Malato Rodríguez	Mitigating risks and maximizing sustainability of treated wastewater reuse using advanced oxidation processes
12:00-12:15	Dr. Claudio Di Iaconi	Advanced technologies for water reclamation and reuse
12:15-12:45	Round Table & Discussion	
13:00-14:00	Light lunch	
	Chairman: Prof. Massimiliano Errico	*Depletion of resources and Social effects on the human health and safety*
14:00-14:15	Prof. Dhabia Al-Mohannadi	Utilizing Industrial Biosolids and Treated Wastewater for Non-Food Cash Crop Production in Arid Agriculture: A Circular Economy Approach
14:15-14:30	Prof. José P. Coelho	How different sources of biomass can enhance the security of urban resources
14:30-14:45	Prof. Roumiana P. Stateva	Can Sustainable Conversion of Abundant and Renewable but Underutilized Biomass Help Harnessing Climate Change?
14:45-15:00	Prof. Karina Angélica Ojeda-Delgado	Challenges and circular economy alternatives to enhance security in developing countries through the valorization of agricultural residues
15:00-15:30	Round Table & Discussion	
15:30-16:20	Coffee Break	
	Chairman: Dr. Carlo Pastore	*Process design, intensification and control for a safe and secure grow*
16:20-16:35	Prof. Massimiliano Errico	Process system engineering leading the way to green transition

16:35-16:50	Prof. Stefania Tronci	Advanced process control strategies for sustainable and efficient bioprocesses
16:50-17:05	Prof. Henrique Matos	The role of Process Integration in the nexus energy-water
17:05-17:20	Prof. Zoughaib Assaad	Methodology and technology development toward circular industrial clusters: application to the energy-water-hydrogen nexus
17:20-17:35	Prof. Mariano Martin	Multiscale approach for the design of biorefineries: Towards added value products and a circular economy
17:35-18:05	Round Table & Discussion	

11th July 2024

	Chairman: Dr. Konstantinos Pappas	*Circular Economy as a strategic route towards the rationalization of resources in the perspective of a sustainable and secure grow*
8:30-8:45	Prof. Lyberatos Gerasimos	Food Waste Prevention and Valorization
8:45-9:00	Dr. Georgia Antonopoulou	Sustainable processes: Exploitation of residual biomass and wastes for the production of gaseous biofuels
9:00-9:15	Dr. Ioanna Ntaikou	Challenges and Strategies for plastic pollution management and transition to green and sustainable technologies
9:15-9:30	Dr. Camilla Braguglia	Urban biodegradable waste: available resources for sustainable circular cities
9:30-9:45	Dr. Carlo Pastore	New sustainable technologies for sewage sludge valorization: energy and resources from wastewater treatment in the sign of the circular economy
9:45-10:00	Dr. Konstantinos Moustakas	Sustainable Waste Management: the pathway to Circular Economy & the UEST/NTUA experience
10:00-10:30	Round Table & Discussion	
10:30-11:10	Coffee Breack	

	Chairman: Dr. Jeff Sammons	*Solar Energy: best practices for a safer management of a perennial resource*
11:10-11:25	Prof. Adel Khalil	Potential and Strategy for Green Hydrogen in Egypt
11:25-11:40	Prof. Andreas Kazantzidis	New challenges in solar energy resource and forecasting
11:40-11:55	Prof. Ahmed Hamza H. Ali	Toward Interactive and Integrative Planning and Resource Allocation Platform for Food-Energy-Water Nexus
11:55-12:10	Prof. Carla I.C. Pinheiro	Solar-driven Ca-Looping using Wastes and Natural $CaCO_3$-based Materials for Thermochemical Energy Storage
12:10-12:40	Round Table & Discussion	
13:00-14:00	Light lunch	
	Chairman: Prof. Adel Khalil	*Technical and Social perspective for a safer management of resources*
14:00-14:15	Prof. Mostafa Abdelgeliel	Automation System in Water Energy Food Nexus
14:15-14:30	Dr. Daniela D'Agostino	Security and sustainability of water use in agriculture: the experience from CIHEAM Bari
14:30-14:45	Dr. Alessandro Pagano	System thinking approach to address Nexus Biodiversity- Climate- Society governance challenges
14:45-15:00	Prof. Fatma Ashour	Gender and Climate Change Resilience: The Power of Women as Agents of Change
15:00-15:15	Prof. Zeinab Saleh Safar	Gender Role in Sustainable Development With Emphasis on Energy Sector
15:15-15:45	Round Table & Discussion	
15:45-16:15	Coffee Break	
16:15-17:20	Round Table	Water/Energy/Food Nexus and connections with safe and resilient society (Technical aspects)

16:15-17:20	Round Table	Water/Energy/Food Nexus and connections with safe and resilient society (Policy aspects)
17:20-18:20		Sharing of Discussions and harmonization

12th July 2024

	Chairman: Prof. Prof. Nader Noureldeen Mohamed	*Energy/Food/Water Nexus: Secure correlations, Future Risks and possible technical mitigations*
9:00-9:15	Dr. Konstantinos Pappas	Climate risks impacts to scarce water, energy, food resources, and migratory flows and the effects on regional security
9:15-9:30	Prof. Rabi Mohtar	Developments and future prospects of the water - energy - food - health nexus
9:30-9:45	Prof. Mohamed Salah Elsobki	Energy strategies/regional interconnections and related legislation/regulations
9:45-10:15	Round Table & Discussion	
10:15-10:50	Coffee Break	
10:50-11:10	Round Table & Discussion	
11:10-12:00	Dr. Carlo Pastore, Prof. Adel Khalil, Mr Richard Brewin	Closing session & Final Discussion: New Solutions and proposal towards resilience and security

Book of Abstracts and Bios of Participants

NATO Science for Peace and Security Programme Perspectives on Energy Security, Environmental Security, and Climate Change

Mr. Richard Brewin
NATO Programme Manager – Energy, Environmental, and Climate Security
brewin.richard@hq.nato.int

Abstract: NATO has been addressing environmental challenges for over half a century, initially mostly from a science and research perspective. Since the turn of the century, a number of environmental standards and guidelines have been developed.
Most recently, NATO's Strategic Concept sets out that: Climate change is a defining challenge of our time, with a profound impact on Allied security. It is a crisis and threat multiplier. It can exacerbate conflict, fragility and geopolitical competition. Increasing temperatures cause rising sea levels, wildfires and more frequent and extreme weather events, disrupting our societies, undermining our security and threatening the lives and livelihoods of our citizens. Climate change also affects the way our armed forces operate. Our infrastructure, assets and bases are vulnerable to its effects. Our forces need to operate in more extreme climate conditions and our militaries are more frequently called upon to assist in disaster relief.
At their Summit in June 2021, NATO Heads of State and Government endorsed NATO's Climate Change and Security Action Plan (CCSAP), outlining NATO's commitment to address the impact of climate change on security.
Although NATO is not the first responder for every challenge related to climate change, the Alliance has a role to play in a comprehensive response to climate change. NATO also has to take into account the impact of climate change on security to successfully fulfil its three core tasks of collective defence, crisis management, and cooperative security.
In the Strategic Concept, NATO has set out that it will contribute to combatting climate change by reducing greenhouse gas emissions, improving energy efficiency, investing in the transition to clean energy sources and leveraging green technologies, while ensuring military effectiveness and a credible deterrence and defence posture. In the time of the global energy transition, energy efficiency and innovative energy solutions help the military to become more sustainable, while maintaining operational effectiveness.
To address these challenges, NATO is leveraging its science and technology programmes and communities to support research on the impact of climate change on security.

Mr. Richard Brewin
NATO Programme Manager – Energy, Environmental, and Climate Security
brewin.richard@hq.nato.int

Richard Brewin is a chartered scientist, member of the UK Royal Society of Biology, and Institute of Environmental Management and Assessment.
He worked for several years in the UK government, first in the Department for Environment, Food, and Rural Affairs (Defra) on environmental research management and sustainability policy, but spent most of his UK career in the MOD working on policy development, research management, and equipment acquisition. When working in the EU, he managed the European Defence Agency's Energy and Environment Programme including a suite of capability development projects; these included smart deployed camps in Mali, sustainable energy management in fixed infrastructure, sustainable water network management, and climate change vulnerability assessment.
He is currently a Programme Manager in NATO HQ and focused on the establishment of NATO's Climate Change and Security programme; he is also the Energy and Environmental Security Advisor in NATO's Science for Peace and Security programme, managing a portfolio of international science and technology collaboration projects with NATO partners.

Sustainable alternatives for socially-vulnerable communities in Latin America to access water and energy

Prof. Eduardo SÁNCHEZ TUIRÁN
Chemical Engineering Program, College of Engineering, in Universidad de Cartagena, Colombia
esanchezt2@unicartagena.edu.co

Abstract: In Latin America, ensuring access to water and energy for socially-vulnerable communities is essential for sustainable development and also promotes peace and security. Several innovative solutions have been proposed to tackle these complex issues while promoting environmental sustainability, social equity, and stability.
In this way, community-based renewable energy projects represent a promising alternative. These initiatives empower local communities to generate clean energy taking advantage of natural resources available to them to develop solar, wind, hydroelectric, or biological systems. By decentralizing energy production, these communities can reduce dependence on fossil fuels, create economic opportunities, and enhance resilience against energy price fluctuations.
Similarly, decentralized water management systems offer sustainable access to clean water, critical for human needs, health, and agricultural productivity. Rainwater harvesting, for instance, allows communities to collect and store rainwater, lessening reliance on centralized infrastructure and mitigating drought impacts. Moreover, water conservation and efficiency initiatives play a pivotal role in ensuring equitable access to this essential resource. Educational programs and technology adoption also are vital to optimize water usage across sectors, reducing waste and promoting sustainable practices.
These efforts are crucial for environmental sustainability and mitigating conflicts over scarce resources. Additionally, prioritizing socially-vulnerable communities in water and energy planning through inclusive policies that addresses their unique challenges is important for fostering development and averting social tensions thus contributing to social cohesion and stability.
In conclusion, sustainable alternatives for accessing water and energy in Latin America's socially-vulnerable communities, alongside peace and security efforts, involve community driven renewable energy projects, decentralized water management systems, conservation endeavors, and inclusive policy frameworks. By embracing these integrated approaches, Latin America could progress towards a more equitable, resilient, and peaceful future.

Prof. Eduardo SÁNCHEZ TUIRÁN
Chemical Engineering Program, College of Engineering, in Universidad de Cartagena, Colombia
esanchezt2@unicartagena.edu.co

Eduardo Luis SÁNCHEZ TUIRÁN is a full-time faculty at the Chemical Engineering Program, College of Engineering, in Universidad de Cartagena, Colombia since 2014. Professor Sánchez Tuirán holds a doctorate in Chemical Engineering and a bachelor degree in Chemical Engineering from Universidad Industrial de Santander. His research is focused on process intensification, optimization of energy and water use, and education in engineering.

Planning for National Food Security – Experiences from Qatar

Prof. Patrick Linke
Chemical Engineering at Texas A&M University at Qatar, Qatar
patrick.linke@qatar.tamu.edu

Abstract: Ensuring National Food Security requires careful planning across short to long time horizons to ensure resilience to supply chain disruptions and long-term sustainability in the environmental, economic, social and human pillars. The talk outlines the national food security planning challenge and requirements for a secure and sustainable food supply system. Emphasis will be placed on discussing sustainability aspects of food supply chains, risks and vulnerabilities as well as emerging opportunities from holistic planning for food security. The development towards a sustainable and secure food supply system is structured as an engineering design problem. It is presented as a system of system design challenge considering not only the core material and energy system providing food supply involving technical solutions, but also diverse and interacting surrounding systems spanning across policy and regulation, economics and trade, as well as social and cultural aspects. Particular emphasis will be placed on sustainable technology selection in systems contexts. Given that food security needs to be achieved locally for specific communities, the case of Qatar will be considered for specific context. The discussed food security solutions take into account its unique hot and arid climate, water scarcity, limited land availability, geographical location, demographics, cultural aspects, environmental footprints and economy. The lecture will conclude with a critical reflection on the limitations of widely used sustainability assessment approaches and suggestions for developing improved practices.

Prof. Patrick Linke
Chemical Engineering at Texas A&M University at Qatar, Qatar
patrick.linke@qatar.tamu.edu

Dr. Patrick Linke is a Professor of Chemical Engineering at Texas A&M University. He currently serves as the Senior Associate Dean for Research and Graduate Studies at Texas A&M University at Qatar. Dr. Linke is a process systems engineer and his activities focus on the design of efficient materials, processes, integrated systems and associated infrastructures with a focus on sustainability and resource efficiency. His research has resulted in several systematic methods for computer-aided molecular design, for the design and optimization of efficient production processes, and for the development of integrated resource management strategies across the materials and energy nexus. Dr. Linke is an Associate Editor of the Journal of Cleaner Production. Dr. Linke also served the State of Qatar as Chief Engineer and Director of Water and Energy Sectors for the Qatar National Food Security Programme (QNFSP) from 2009-2014. Dr. Linke obtained his Ph.D. in Process Integration from the University of Manchester (UMIST) in the UK.

Impacts of Climate Change on Water Resources and Land Degradation in MENA Region with Focus on Egypt

Prof. Nader Noureldeen Mohamed
Soil Department, Faculty of Agriculture, Cairo University, Egypt
nader.mohamed@agr.cu.edu.eg

Abstract: Water Resources, land degradation, forestry and food production will be affected directly by global warming. Energy which represents 33% of the total agriculture cost, industry and delta ecosystem will also affect indirectly. Agriculture's share in global GDP by about 4%, which means that agriculture is highly intensive greenhouse gas producers by 31%. Developing countries are more vulnerable to climate change because they rely mostly on agriculture due to the lack of infrastructure, and the lack of capital investment for adaptations and mitigations. Agricultural production directly counts on weather conditions which include rainfall or irrigation that together with soil proper's control the status of plant growth and crop yield. MENA countries are one of the most vulnerable regions to climate change, because they have the least water resources with high dryness and drought. MENA's temperatures due to climate change are expected to increase by 2-2.5°C by 2050 and the precipitation expected to decrease by 10.5% and may reach up to 30-40 % with possibility of increasing the frequency of dryness cycle in addition to increased land degradation and desertification processes. Salt building up and waterlogging of the Delta soils will increase sharply gathering with decreasing of available water needed to leach out the soil salinity as a leaching fraction or as leaching requirements. Egypt may be affected by sea level rise by the end of this century. Sea level rises in the northern Nile Delta will affect 4 million people who have to be migrated, and an area of almost 1800 km^2 of fertile soils would be lost. In case of 1.5 meter of sea level rise, almost 5700 km^2 of land will be submerged in the north Nile Delta and 8 million people will be affected. Egypt will also be impacted indirectly by dryness and changes of precipitation pattern in the Nile basin countries especially in Ethiopia which shares 85% of the total Nile water. Climate change may affect Egyptian agricultural production according to rise of temperatures which will decline yields of various crops, causing a decrease in yield crop by 30% for essential crops such as wheat, rice, maize, barley, sunflowers, and soybeans. Higher temperature means also higher water consumption by the plants to get the same regular crop yield in addition to increased evaporation from irrigation canals and also increased water contamination.

Prof. Nader Noureldeen Mohamed
Soil Department, Faculty of Agriculture, Cairo University, Egypt
nader.mohamed@agr.cu.edu.eg

Education: PhD, Fac. of Agric., Cairo Univ. 1988.
M. Sc., Fac. of Agric., Cairo Univ. 1983.
B. Sc., Fac. of Agric., Cairo Univ. 1977, (soil) Excellent with Honors.
National and International Experiences
Member of Board of Land Reclamation and ground water Research holding company, Ministry of Agriculture and land Reclamation, Egypt from July 2023 tell now.
Member of Bord of Fertilizers and growth organizer committee, Ministry of Agriculture and land reclamation, Egypt, from January 2023 till now.
Member of board or Desert Research Center. Minister of Agriculture and Land Reclamation, Egypt, From July 2018 – Jan 2022.
Climate Changes and Human Mobility, October 2022, American University in Cairo with IOM (International Organization for Migration).
Expert on evaluation on PRIMA proposal to be funded "Soil and water management to combat land degradation and desertification. May 2021.
Technical and senior expert in the European bank for reconstruction and Development (EBRD), October 2020.
June 2019 – Technical Expert in Soil Partnership plenary Assembly of Food and Agriculture organization (FAO) From 2019.
4/1/2005 – 12/31/2005; full time consultant for the Minister of food supply and interior trade, Egypt.
7/14/2001 – 7/31/2004, Cultural and Educational Attaché, Embassy of Egypt in Kuwait.

How to Address Competition Among Different Water Uses

Dr. Tania Tellini
Utilitalia
tania.tellini@utilitalia.it

Abstract: Italy faces pressing water scarcity issues exacerbated by climate change, particularly evident in the Mediterranean region. A notable precipitation deficit in 2022 underscores the urgency of the situation. Competing water uses across civil, agricultural, and industrial sectors have led to conflicts, with regions like Sicily declaring a state of emergency.

Agricultural water usage, comprising a significant portion of withdrawals, is particularly vulnerable, posing threats to primary production and inter-sectoral harmony. Italy has responded with initiatives to bolster water resilience, including leveraging funds from the National Recovery and Resilience Plan and implementing infrastructural interventions.

Strengthening Basin District Authority Observatories and the ongoing mandate of the special commissioner for drought emergency management highlight Italy's commitment to addressing water scarcity.

Expedited reforms in the Integrated Water Service are crucial, entrusting it to capable industrial managers to mobilize investments essential for confronting climate change challenges.

Dr. Tania Tellini
Utilitalia
tania.tellini@utilitalia.it

Director of UTILITALIA's water sector activities.
Graduated in Natural Sciences at the University of Parma, she subsequently obtained a master's degree in "Environmental Management and Sustainable Development" at the Faculty of Architecture of Ferrara.
From 1999 to 2015 she carried out consultancy activities, as a freelancer for numerous public bodies and private companies, in relation to technical-administrative obligations in the environmental field and environmental sustainability assessments of plans and projects.
Before joining Utilitalia she carried out significant administrative experience in some public bodies.
She has participated in the implementation of various sector studies in both the waste and water fields as well as in numerous conferences as a speaker.

Water, Water Everywhere, Not Any Drop to Drink: Water-Energy-Food-Health Nexus

Prof. Iqbal M. Mujtaba
Chemical Engineering Division, Faculty of Engineering & Digital Technologies,
University of Bradford, Bradford, UK
I.M.Mujtaba@bradford.ac.uk

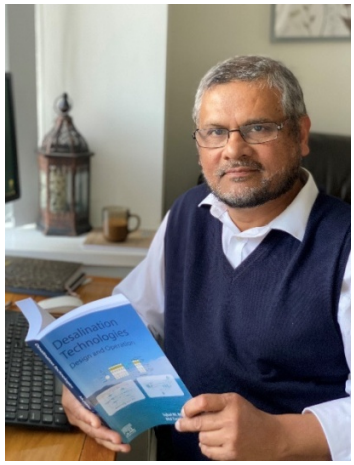
Abstract: Improved standards of living require increasing amounts of freshwater. Consequently, in the last 50 years, a sharp increase in the volume of industrial effluents being generated and disposed of into rivers and oceans is witnessed causing significant harm on our ecosystem and health. Although the Ancient Mariners' rhyme: "Water, water everywhere/Not any drop to drink" was referring to 97% of the planet's water (seawater), vast amount polluted river streams around the world would fit equally to this rime.

Climate change also results in river water levels falling in many parts of the world to a dangerous level impacting agriculture, transportation of essential commodities, etc. Currently, 11% of the world population do not have clean water close to home. Globally, about 2 billion people use a drinking water source contaminated with faeces. Water has been a device used for religious conflict and regional and local battles leading to waves of migration to other countries. The disputes over water will inevitably become more common, as 220 river basins globally are shared by two or more countries.

Interestingly, UN report estimated that three out of four jobs that make up the global workforce are either heavily or moderately dependent on water. This means that water shortages and problems of access to water and sanitation could limit economic growth and job creation in the coming decades. The report also highlights that water and jobs are inextricably linked to economic, environmental or social perspective.

This lecture will highlight these global issues around the world and will reflect on potential technical solutions.

Prof. Iqbal M. Mujtaba
Chemical Engineering Division, Faculty of Engineering & Digital Technologies,
University of Bradford, Bradford, UK
I.M.Mujtaba@bradford.ac.uk



Iqbal M. Mujtaba is a Professor of Computational Process Engineering and is currently Associate Dean (Learning, Teaching & Quality) of the Faculty of Engineering & Informatics at the University of Bradford. He is a Fellow of the Royal Academy of Engineering, Fellow of the IChemE, a Chartered Chemical Engineer. He was the Chair of the European Committee for Computers in Chemical Engineering Education from 2010-2013 and the Chair of the IChemE's Computer Aided Process Engineering Special Interest Group from 2012-2019.

Professor Mujtaba leads research into dynamic modelling, simulation, optimisation and control of batch and continuous chemical processes with specific interests in distillation, industrial reactors, refinery processes, desalination, wastewater treatment and crude oil hydrotreating focusing on energy and water. He has managed several research collaborations and consultancy projects with industry and academic institutions in the UK, Italy, Hungary, Malaysia, Thailand, India, Qatar, South Africa, Iraq, Algeria, China, Libya, Jordan, Bangladesh, Bahrain and Saudi Arabia. He has published over 400 technical papers and has delivered more than 80 invited lectures/seminars/plenaries/keynotes/short courses around the world. He has supervised 42 PhD students to completion and is currently supervising 10 PhD students. He is the author/co-author of (1) 'Batch Distillation: Design & Operation' (textbook) published by the Imperial College Press, London, 2004 (2) ‘Wastewater treatment by Reverse Osmosis’ published by CRC Press, 2020 (3) ‘Desalination technologies: Design & Operation’, Elsevier, 2022. He is one of the co-editors of the books (1) 'The Water-Food-Energy Nexus', CRC Press, 2017, (2) ‘Water Management: Social & Technological Perspective’, CRC Press, 2018.

Urban runoffs as a source of Emerging Contaminants in aquatic environments

Prof. Mira Petrović
[a]*Catalan Institute for Water Research (ICRA), Girona, Spain*
[b]*Catalan Institution for Research and Advanced Studies (ICREA), Barcelona, Spain*
mpetrovic@icra.cat

Abstract: Freshwater ecosystems are continuously affected by the influx of contaminants from urban runoff, especially during rainfall events. This runoff, originating from various urban surfaces like roads, pavements, residential, industrial, and green areas, carries a diverse range of micropollutants, posing a significant threat to surface water quality and aquatic ecosystem health. Climate change has further compounded these issues, leading to more frequent and intense extreme weather events in cities. These events exacerbate the mobilization of pollutants through rainfall wash-off, resulting in heightened contamination levels beyond normal conditions. Additionally, prolonged dry periods facilitate the accumulation of pollutants on urban surfaces, which are subsequently flushed into urban streams and water bodies during rainfall, further impacting biodiversity and water quality.
To tackle these challenges, we propose a method for assessing the presence of micropollutants in urban runoff during extreme weather events. This approach utilizes LC-HRMS and incorporates both target and suspect screening methods to detect compounds, quantify concentrations. Finally, we give some insights on the observed effects on urban aquatic environments. By gaining insights into the composition, concentrations, and impacts of micropollutants in urban runoff, we can develop effective strategies to mitigate their adverse effects and safeguard the health of freshwater ecosystems in the face of changing climatic conditions.

Prof. Mira Petrović
[a]*Catalan Institute for Water Research (ICRA), Girona, Spain*
[b]*Catalan Institution for Research and Advanced Studies (ICREA), Barcelona, Spain*
mpetrovic@icra.cat

Mira Petrovic is an ICREA research professor at ICRA. PhD in Chemistry (1995), Faculty of Chemical Engineering and Technology, University of Zagreb, Croatia. Since May 2024 Deputy Director of Research at ICRA. She has published 247 papers, 36 book chapters and edited 10 books. Her H index is 84, and the number of citations >24.000 (Scopus). Highly Cited Researcher (Clarivate Analytics) ranked as top 1% of researchers by citations, in the field of Environment/Ecology (2018) and in the cross-field (2019). Specific research interest are: Study of the fate and behavior of emerging pollutants in the treatment of waste water, regenerated water and drinking water through conventional and innovative treatments; Study of biotic and abiotic transformations of emerging pollutants, identification of transformation products, elucidation of transformation pathways; Assessment of the risks associated with wastewater derived pollutants.

The environmental issue of fluorinated contaminants of emerging concern in groundwater: impact to food resources and technologies for their minimization

Dr. Giuseppe Mascolo
CNR-Istituto di Ricerca sulle Acque, Rome, Italy
giuseppe.mascolo@cnr.it

Abstract: Per- and poly-fluoroalkyl substances (PFAS) include over 4700 fluorinated aliphatic compounds used in a wide variety of commercial products and industrial applications. Current knowledge shows that most of PFAS are persistent under environmental conditions, thus posing concern regarding their bioaccumulation.
Real contaminated was sampled from those Veneto area where it is well known that the PFAS contamination is still present. Analyses, carried out by liquid chromatography interfaced to high resolution mass spectrometry also employing an online preliminary step of solid phase extraction, revealed that the concentration of C4-C10 organic fluorinated acids as well as organic fluorinated sulphonates ranged between 7 and 2090 ng/L.
Experiments with VUV were carried out with a 7 L lab-scale reactor equipped with an excimer lamp of 200 W emitting at 172 nm. PC and PEC experiments were performed with a 1 L lab-scale reactor equipped with a low pressure UV lamp emitting mainly at 254 nm but also having a lower emission at 185 nm.
Experiments with VUV showed that the process is able to remove most of the PFAS present in the contaminated groundwater. Specifically, the fluorinated pollutants that were easily removed were the long-chain acid ones while the short chain sulphonated ones were removed only to a very limited extent.

Dr. Giuseppe Mascolo
CNR-Istituto di Ricerca sulle Acque, Rome, Italy
giuseppe.mascolo@cnr.it

He is currently Director ad interim of CNR-IRSA and since 1988 is working at CNR-IRSA.
His main scientific field of interest are as follows:

- Degradation of organic pollutants in water and wastewater by advanced oxidation processes;
- Mechanisms of by-products formation during organic pollutants degradation;
- Determination of organic pollutants in wastewater, sludge and soils;
- Understanding formation of products of incomplete combustion (PICs) during incineration;
- Thermal decomposition of hazardous materials during incineration.

He is referee of several ISI Journals and is external reviewers of several international organizations. He is author and co-author of more than 140 ISI papers.

Mitigating risks and maximizing sustainability of treated wastewater reuse using advanced oxidation processes

Prof. Dr. Sixto Malato Rodrìguez
Director of Plataforma Solar de Almeria, Spain
smalato@psa.es

Abstract: Scarcity of freshwater for agriculture has led to increased utilization of treated wastewater, establishing it as a significant and reliable source of irrigation water. However, years of research indicate that if not managed adequately, it may pose a hazard to human and environmental health. New-generation pollutants (contaminants of emerging concern, CECs) must be taken into consideration for the preservation of resources quality. The development of new technologies, capable to exploit the potential of waste(water) and minimizing the energy needs for their degradation/treatment could be a way forward.

Advanced oxidation processes are characterized by the formation of non-selective radicals which can effectively remove micro-pollutants as well as inactivate microorganisms. Solar photo processes stand out as effective, energetically efficient and simple process to address such challenges in urban wastewater, especially when applied at neutral pH thanks to the use of iron complexing agents for maintaining iron in solution. Amortization costs of photoreactors can be significantly reduced when using raceway pond open solar photoreactors that are simple to manufacture.

However, to evaluate the feasibility at full scale, comparisons with other technologies (namely, ozonation, UVC, etc) under realistic conditions (e.g., pilot scale tests, real wastewater), including toxicity, are necessary before scaling up the process. The main goal of this work will be to compare the capability of Solar AOPs and other advanced treatments to simultaneously remove CECs and inactivate microorganisms from urban wastewater secondary effluent.

Prof. Dr. Sixto Malato Rodrìguez
Director of Plataforma Solar de Almeria, Spain
smalato@psa.es

Since 1990 he works at the Plataforma Solar de Almeria (PSA-CIEMAT) in all the EU R&D projects linked to the Solar Treatment of Water, being involved in 31 International, 37 National R&D Projects and different Contracts with Private Companies.
Director or Co-Director of Joint Research Center (Univ. Almería-CIEMAT) of R&D in Solar Energy (CIESOL). http://www.ciesol.es. 2006- up to now.
Director of Plataforma Solar de Almeria (www.psa.es). 2012-2017.
Head of Research Unit at CIEMAT. 2012- up to now.
Some of his milestones have been: i) fundamentals for design of solar photoreactors; ii) methodology for combination of photocatalysis with aerobic treatments; iii) combination of membrane processes with advanced oxidation, iv) advanced treatment methods for the removal of contaminants of emerging concern (CECs) from urban wastewater; and v) production of hydrogen using solar photoreactors.
He is author of 1 book and co-author of 18 books as well as >60 chapters in others. He has also co-authored more than 310 publications in indexed international journals (>200 in Q1), and more than 370 contributions to different International Congresses and 5 patents. He has given seminars at universities around the world, from Argentina or Brazil, to China or Thailand. In the last 5 years, he has given more than 20 plenary lectures or "keynotes" at International Congresses. He has directed 20 PhD Thesis. >28000 cites, h-index: 88 (SCOPUS).
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Advanced technologies for water reclamation and reuse

Dr. Claudio Di Iaconi
CNR-Istituto di Ricerca sulle Acque, Bari, Italy
claudio.diiaconi@cnr.it

Abstract: Freshwater represents just 2.5% of all available water on the planet, and only 0.5% is available. This explain why freshwater should be considered a precious resource on earth. Given the many uses of freshwater a sustainable freshwater management will be crucial in the coming decades for coping with the challenges of population growth and climate change. The global freshwater consumption has increased faster than the population growth over the past decades. In particular, the global water withdrawals have increased more than double the rate of population growth over the past century.

It is necessary to speed up the transition from a linear economy model essentially based on extraction, usage, and discharge of the water towards a circular economy model where water is used, regenerated and then re-integrated back into the supply cycle as a new resource.

Wastewater generated from freshwater uses can be reused if properly regenerated. Reclaimed water from wastewater treatment is the main unconventional resource providing for agriculture sector, which is the largest consumer of water in the world saving potable water only for drinking needs.

However, the use of reclaimed wastewater poses potential risk for public health if the wastewater is not properly treated. The reclaimed wastewater must be safe for the intended use, i.e., its quality *has to be*guaranteed. For achieving this goal, advanced and reliable treatment technologies are required.

The application of advanced technologies to strengthen reclaimed water safety in agriculture will be discussed

Dr. Claudio Di Iaconi
CNR-Istituto di Ricerca sulle Acque, Bari, Italy
claudio.diiaconi@cnr.it

Dr. Claudio Di Iaconi is a research director at Water Research Institute (IRSA) of National Research Council of Italy (CNR), Bari headquarter. Since 2020, he is also the head of Bari headquarter.
Dr. Di Iaconi has completed his MS degree in Industrial Chemistry at the University "La Sapienza" of Rome in 1993. He has a vast experience in water-related environmental technologies and in particular in wastewater treatment and resource recovery, biomass and sludge treatment. Mr Di Iaconi developed several advanced processes for municipal and industrial wastewater and sludge treatment according to the circular economy model. He is the principal inventor of the patent (WO 2019/097463) “Plant and method for treating urban waste water” applied at full scale. He was coordinator/principal investigator in more than 30 national and international research projects (e.g. Perbiof, Innovatech, Mediwat, Therbior, Biopos, Mangiafanghi, Trafande, Idroforsu, Ecotec, Bracco, Erica, etc). He received more than 2 million euros from private companies in the last 10 years for several research projects. He is a co-author of more than 200 scientific papers published in peer reviewed journals or presented to scientific conferences, book chapters on different subjects within the wastewater treatment field. He is serving as an editorial board member for several international peer reviewed journals. He was member of the international scientific committee in several conferences. He has received some national and international awards for having achieved innovative scientific results in the field of water-related environmental technologies.

Utilizing Industrial Biosolids and Treated Wastewater for Non-Food Cash Crop Production in Arid Agriculture: A Circular Economy Approach

Prof. Dhabia Al-Mohannadi
Chemical engineering at Texas A&M University at Qatar, Qatar
dhabia.al-mohannadi@qatar.tamu.edu

Abstract: This collaborative study, conducted in partnership with Qatar University, Wageningen University, Texas A&M University, Shel Qatar, and the Ministry of Environment and Climate Change (MECC), addresses the pressing challenge of water scarcity in arid regions, particularly the Arabian Peninsula, by exploring the potential of reusing industrial biosolids and treated wastewater in agriculture for non-food cash crop cultivation. The scarcity of water resources and arable land, coupled with the environmental concerns associated with fossil fuel usage, necessitate innovative solutions for sustainable agricultural practices in the Gulf Cooperation Council (GCC) region.

The research focuses on using residual industrial streams, specifically biosolids generated during wastewater treatment, to enhance soil fertility and support the growth of non-food cash crops such as cotton, flax, and others. By applying biosolids and biochar directly to arid soils, the study aims to achieve self-sufficiency in nutrient supply for crop production, reducing reliance on imported organic materials. Importantly, the study employs industrial symbiosis principles, utilizing waste from one industry as feedstock for another, thereby fostering a circular economy paradigm for hyper-arid regions.

Methodologically, the study involves soil deficiency mapping, identification of critical nutrient deficiencies in Qatari soils, risk assessment for various industrial biosolids, and development of a screening tool for evaluating biosolid suitability. Techno-economic analyses are conducted to evaluate the feasibility of cash crop production using sludge and wastewater, considering factors such as capital and operational costs, return on investment, and infrastructure requirements.

Preliminary results indicate successful cotton growth; however, economic feasibility remains a concern due to high production costs. Nonetheless, contaminant levels meet regulatory standards, suggesting the potential viability of the approach. Future research will focus on optimizing crop yield, assessing soil reusability for food crops, and exploring alternative biosolid sources beyond gas-to-liquid (GTL) processes. Overall, this study contributes to advancing sustainable agricultural practices in water-stressed regions through the utilization of industrial waste streams within a circular economy framework.

Prof. Dhabia Al-Mohannadi
Chemical engineering at Texas A&M University at Qatar, Qatar
dhabia.al-mohannadi@qatar.tamu.edu

Dhabia Al-Mohannadi, assistant professor of chemical engineering at Texas A&M university at Qatar. Her work deals with multidisciplinary problems that involve different decision-making processes, engineering and economics. Her research leads to developing analytical tools that can assess flexibility, robustness, reliability of process systems at the design and operational level. Her research resulted in over 30 published works including peer reviewed journals, conference proceedings and book chapters. Dhabia was the co- chair of the 2023 Arab American Frontiers Conference and serves on the board of Qatar Women Engineering Association, the Arab Climate Youth Movement. She is also a member of the American Chemical Engineering Institute, the American Chemical Society and Omega Chi Epsilon Honor Society. Dhabia is a graduate of Qatar Rising Leaders Program, 2022 and she obtained her PhD from TAMU in 2018.

How different sources of biomass can enhance the security of urban resources

Prof. José P. Coelho
Instituto Politécnico de Lisboa, Instituto Superior de Engenharia de Lisboa, Lisboa 1959-007, Portugal
jcoelho@deq.isel.ipl.pt

Abstract: Biomass from different sources can help improve the security of urban resources. Local or regional biomass production reduces dependence on centralized energy supplies, improving resilience to disruptions in transportation or supply chains, and ensuring a more reliable energy supply for all areas.

Diversify the energy mix using various biomass sources like wood chips, agricultural residues, or organic waste. This reduces dependence on a single source and improves energy security. Moreover, biomass is a source of high-value compounds that can develop antioxidants and nutraceuticals. They have the potential to revolutionize the industry and bring significant benefits. Simultaneously, utilizing organic waste streams, such as food waste or yard trimmings, as biomass resources can help reduce the burden on landfill space and mitigate environmental pollution.

A brief analysis of different biomasses will examine their potential and the main characteristics that make them most attractive: coffee grounds, rice bran and grape seeds.

In 2021/22 and 2022/23, approximately 168 million 60 kg of coffee were produced annually. Considering that every kg of coffee results in 0.91 kg of spent coffee grains, we have a huge amount of waste that can be recovered.

Rice, one of the top grain producers globally in 2021/22, has two by-products: rice bran (8-10%) and rice husk (20%). Rice bran has 8-20% bio-oil and is highly nutritious, making it ideal for energy or nutraceuticals.

Finally, seed biomass from *Vitis vinifera* L. typically contains (8–15) % (w/w) of oil, which is rich in long-chain polyunsaturated fatty acids (PUFAs) and antioxidants.

The extraction methods, their analysis and the different components and potentialities will be discussed and analyzed, presenting the different added values of these biomasses.

Prof. José P. Coelho
Instituto Politécnico de Lisboa, Instituto Superior de Engenharia de Lisboa, Lisboa 1959-007, Portugal
jcoelho@deq.isel.ipl.pt

José Augusto Paixão Coelho earned his Ph.D. in Chemical Engineering in February 1996. Since then, he has specialized in Chemical Engineering and has developed expertise in using greener technologies such as supercritical fluids and microwaves, thermodynamics, extraction of natural products, characterization of extracts, and reuse of biomass from agricultural and food residues.
He is currently a Coordinating Professor at IPL-ISEL and Deputy vice president of the Polytechnic Institute of Lisbon (IPL) 's research, development, and innovation. He was president of the Scientific Board of Instituto Superior de Engenharia de Lisboa (IPL-ISEL) from 2008 to 2010 and president of the Chemical Engineering Department from 2002 to 2003 and 2004 to 2005.
Since April 2023, evaluator and report in the European Commission, Research Executive Agency, program HORIZON-EIC-2023-ACCELERATOR, in Central Finance and Contracting Agency (CFCA) and State Education Development Agency (SEDA) of the Republic of Latvia, since 2018. Member and secretary of the Executive Board of ISASF, member of ACS and SPQ.
Published 60 papers, 2 books, and 2 chapters of books. More than 150 communications oral and poster, of which 12 were by invitation. Member of the Scientific Committee and Chairperson in 13 international conferences. Research and responsible for 30 national and international projects in extraction, characterization, modeling, and extraction with green technologies of plants and biomasses.
Current research focuses on exploring the use of green technologies for the extraction of natural products such as essential oils, oleoresins, and biomasses. The aim is to develop alternative techniques to conventional extraction methods.

Can Sustainable Conversion of Abundant and Renewable but Underutilized Biomass Help Harnessing Climate Change?

Prof. Roumiana P. Stateva
Institute of Chemical Engineering, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria
r.stateva@iche.bas.bg

Abstract: Scenarios that try to encompass the various aspects of meteorological and human activities combined impacts on climate change are numerous– from the "dry" future to land-use changes. Still, the main causes of climate change are well known. Among those, without the ambition to be exhaustive, are: *i*) Burning fossil fuels (e.g. coal, oil and gas) to generate energy, and power transport, which leads to increased emissions of greenhouse gases; *ii*) Deforestation, and *iii*) Farming livestock like beef and dairy cattle that create considerable amounts of methane through their digestion and waste. In times of geopolitical instability, it is difficult to predict fluctuations in fossil fuel prices. Furthermore, demands for cleaner environment and improved standards for quality of life are increasing, and it is crucial to have a vision of the measure to be taken to protect our planet's welfare. Measures that will help not to disregard but embrace challenges, seize and further develop opportunities by identifying ways for manufacturing bio-based products and biofuels. One such possibility is to upgrade and/or transform abundant, renewable, primarily plant-, algae-based biomass and waste to high value compounds. That will require the development of green sustainableprocesses that implement circular approaches where all process streams are reused and/or valorized.
Along those lines, two biomass resources that are underused and to a certain extent even neglected, namely roots of *Arctium lappa*, commonly known as burdock, and algal species of different genera, will be presented as generic examples. The Pro's and Con's of how the introduction of cutting edge-technical solutions for their conversion to non-energy and energy related compounds could help improve energy security, reduce generation of waste, increase climate resilience, and consequently contribute to harnessing its change, will be discussed.

Prof. Roumiana P. Stateva
Institute of Chemical Engineering, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria
r.stateva@iche.bas.bg

Education and Qualification:

- MSc in Chemical Engineering and Chemical Cybernetics, Dmitry Mendeleev University of Chemical Technology, Faculty of Physical Chemistry, Department of Chemical Engineering and Chemical Cybernetics, Moscow, The Russian Federation. Graduated with distinction *Summa cum laude*;

- PhD in Technical Sciences (Chemical Engineering), Dmitry Mendeleev University of Chemical Technology, Faculty of Physical Chemistry, Moscow, The Russian Federation.

Main Fields of Scientific Research, Public Profile:

Chemical Engineering; Chemical Engineering Thermodynamics; Green Chemistry; Advanced techniques for valorisation of high added value substances from natural matrices; Physical and Thermodynamic Properties Prediction; Modelling, Simulation and Design of Processes.

h-index – 29; Google Scholar

Fellowships, Stipends, Visiting Professorships

- Visiting Professor at the Department of Chemical Engineering, University of Valencia, Spain: NATO Senior Fellowship;
- Visiting Fellow at the Department of Chemical Engineering and Chemical Technology, Imperial College London, UK: Two Royal Society Individual Fellowships;
- Visiting Fellow at the Department of Chemical Engineering, Carnegie-Mellon University, Pittsburgh, Pa. USA: Twice, one year each.

Participation in European Collaborative Research Projects (recent):

- HORIZON 2020 MSCA-RISE-2017: PROJECT IPROPBIO "***INTEGRATED PROCESS AND PRODUCT DESIGN FOR SUSTAINABLE BIOREFINERIES*".**
- Six research projects with the Department of Chemical Engineering, Imperial College, London, UK, two years each, financed by the Royal Society, UK. Principle investigator of the Bulgarian Teams.
- Agreement Coordinator of seven Inter-Institutional ERASMUS+ Programme 2022-2027 Agreements.

Challenges and circular economy alternatives to enhance security in developing countries through the valorization of agricultural residues

Prof. Karina Angélica Ojeda-Delgado
Process Design and Biomass Utilization Research Group (IDAB). University of Cartagena, Department of Engineering, Cartagena, Colombia
kojedad@unicartagena.edu.co

Abstract: There are countless global challenges, especially in developing countries that struggle to increase opportunities for economic development and provide better living conditions for their populations. Many developing countries have extensive biodiversity where agricultural practices play an important role in their economies and environmental sustainability. However, agricultural practices coexist with conflictive situations and poverty in their territories. In recent years, efforts have been made to strengthen productive chains through agro-industrial waste valorization for new products under a circular economy perspective, providing greater opportunities to the rural population, generating new jobs, and diversifying economies. However, large-scale valorization practices from one-crop feedstock could promote unsustainable farming practices leading to deforestation, and monocropping, affecting food security. Also, residual biomass transportation costs could be a barrier for small farmers to be part of strengthening strategies in regional economies. Therefore, small-scale decentralized biorefining represents a suitable alternative due to the economic, ecological, and social benefits. In this talk, the current situation and the challenges regarding value-added products from biomass in developing countries are analyzed. Opportunities to achieve sustainable agricultural chains are identified as alternatives to empower local communities by promoting self-sufficiency and security.

Prof. Karina Angélica Ojeda-Delgado
Process Design and Biomass Utilization Research Group (IDAB). University of Cartagena, Department of Engineering, Cartagena, Colombia
kojedad@unicartagena.edu.co

Ph.D. in Chemical Engineering. Full Professor at the Chemical Engineering Program – College of Engineering – Universidad de Cartagena (Colombia). Head of the Process Design and Biomass Utilization Research Group (IDAB). Senior Researcher at the Ministry of Science, Technology and Innovation in Colombia (MINCIENCIAS). Head of the Research Department of the College Engineering– Universidad de Cartagena (2018-2021), Academic Vice-dean of the College Engineering– Universidad de Cartagena (2021-2022)

Process system engineering leading the way to green transition

Prof. Massimiliano Errico
Department of Green Technology of the University of Southern Denmark (SDU), Denmark
maer@igt.sdu.dk

Abstract: The green transition catalyzes a great amount of research in proving the feasibility of the recovery and valorization of different biowastes and biomasses to obtain building blocks of added-value compounds to substitute their synthesis production from non-renewable sources. This invaluable amount of information is of paramount importance for setting a suitable and sustainable process for component isolation and purification. Taking levulinic acid as an example the work will discuss the challenges in property estimation and their influence on the design of multicomponent separation units. New separation units based on distillations are also discussed from a synthesis and optimization perspective comparing their performance to the ordinary solutions known in the literature.

Prof. Massimiliano Errico
Department of Green Technology of the University of Southern Denmark (SDU), Denmark
maer@igt.sdu.dk

Massimiliano Errico is employed in the full professorship promotion programme at the Department of Green Technology of the University of Southern Denmark (SDU).
His research activity includes experimental testing of methods to extract, characterize, and purify high-added-value compounds from biowastes or edible plants. Moreover, new synthesis methodologies, process modeling and optimization of multicomponent separation units are also a fundamental part of his scientific contribution. He developed design and optimization procedures for carbon dioxide capture and his book "CO2 Capture by Reactive Absorption-Stripping Modeling, Analysis and Design" is in the top 20% of most downloaded books of the whole Springer´book list. Among the participation in national and international projects, he coordinated the Integrated Process and Product Design for Sustainable Biorefineries project funded by the European Commission within the Horizon 2020 programme. Over his career at SDU, he developed a teaching portfolio of 10 different courses offered at the bachelor and master level and won the prize as the best teacher of the Engineering Faculty in 2021. From 2017 holds the position of head of the Master Programme in Chemical Engineering and Biotechnology and from 2019 is the Deputy Head of the Chemical Engineering section at the Department of Green Technology of SDU.
He published more than 100 articles in international peer-reviewed journals, and several book chapters.

Advanced process control strategies for sustainable and efficient bioprocesses

Prof. Stefania Tronci
Dip. di Ingegneria Meccanica, Chimica e dei Materiali, Università degli Studi di Cagliari, Cagliari, Italy
stefania.tronci@unica.it

Abstract: Chemical and biochemical process sustainability involves different aspects such as energy and material efficiency, waste reduction, productivity, product quality, and process safety. These challenges can be effectively tackled through the implementation of advanced process monitoring and control systems. Designing control systems for bioprocesses is inherently challenging due to various factors such as model uncertainties, nonlinearity, and slow response of the system. The complexity primarily stems from the involvement of living organisms whose metabolism is highly sensitive to environmental conditions like temperature, pH, and substrate concentrations. Additionally, the absence of reliable on-line sensors for measuring biomass or product concentration further complicates efficient process control. Soft sensors present a viable alternative to hardware sensors, using available on-line measurements along with a process model and estimation algorithm to estimate unmeasured variables. They not only serve as an excellent means for advanced process control but also enable the prediction of equipment maintenance and the identification of anomalous behavior. Taking a fermentation unit as a case study, various tailored control and monitoring solutions have been developed to precisely regulate key quality parameters essential for the operation of biochemical plants. The analysis revealed that the control of engineering variables (e.g., temperature) alone couldn't maintain the required ethanol concentration in presence of severe disturbances. Integrating robust state estimators with advanced control algorithms emerges as the optimal solution for addressing this specific challenge.

Prof. Stefania Tronci
Dip. di Ingegneria Meccanica, Chimica e dei Materiali, Università degli Studi di Cagliari, Cagliari, Italy
stefania.tronci@unica.it

Stefania Tronci received her MSc in Chemical Engineering with honour from the University of Cagliari (Italy) in 1994 and her PhD in Chemical Engineering from the University of Pisa in 2000. She is an associate professor at the University of Cagliari and received the national scientific qualification for the calls as a full professor in 2023. She teaches mandatory courses at the master level regarding advanced systems of process control and control systems in the food industry. Her research interests mainly focus on process modelling and simulation, dynamic analysis of nonlinear systems, and the monitoring and control of chemical and biochemical processes. The developed control algorithms, state estimators and soft sensors (static and dynamic neural networks) have been applied to chemical and biochemical processes such as bioreactors (wastewater treatment, fermentation, microalgae growth), distillation columns, polymerization reactor, production of detergents, crystallization. She is a co-author of 80 publications in international peer-reviewed journals (h-index = 15, citations = 646. Source Scopus, April 2024).

The role of Process Integration in the nexus energy-water

Prof. Henrique Matos
Chemical Engineering Department (DEQ) in the Instituto Superior Técnico of the University of Lisbon (IST-UL), Lisbon, Portugal
henrimatos@tecnico.ulisboa.pt

Abstract: European Union's Energy System Integration Strategy (ESIS), is dealing with the practical application of the energy efficiency concepts that have been gradually introduced in the main policies adopted by each country in the world on several industrial sectors. The ESIS itself resulted from the combination of the aims of both the European Green Deal and the 2050 long-term strategy, in the sense that it pretends the attainment of a net-zero GHG emission-based economy through the promotion of the circular economy perspective on the conceptualization and operation of energy systems.
The principle of progress towards industrial sustainability is based on the reduction of resource consumption and the environmental impacts associated to the waste produced in plants. The most important resources include water, electric energy, fuels and process raw materials. In practice, promotion of industrial sustainability may be performed by the implementation of improvement measures which overall optimise water and energy use, the application of renewable energy resources and the application of waste-to-energy technologies. The concept of Process Integration (PI) is a powerful strategy and tool to find the best alternatives that has a resource conservation and the highest impact on the energy-water nexus and consequently on the industrial global efficiency. This strategy has been emerging on the scope of circular economy by promoting reuse, recovery and recycling of resources (either material or energy) within the same industrial site. The important features of the process integration will be addressed in the view to a more strong, independent and secure industry.

Prof. Henrique Matos
Chemical Engineering Department (DEQ) in the Instituto Superior Técnico of the University of Lisbon (IST-UL), Lisbon, Portugal
henrimatos@tecnico.ulisboa.pt

Henrique A. Matos is Full Professor at the Chemical Engineering Department (DEQ) in the Instituto Superior Técnico of the University of Lisbon (IST-UL). He completed his PhD in Chemical Engineering at IST (Technical University of Lisbon) in 1993 and earned his Habilitation from the same institution in 2010. Following his PhD in Experimental Thermodynamics, he spent one year as a post-doc at Imperial College (UK) where he began working in Process System Engineering. He is currently the Vice-President for Academic Affairs and the Coordinator of Bachelor's and Master's Degrees in Chemical Engineering at DEQ (IST-UL). He is also the Energy Group Coordinator at Centro de RecursosNaturais e Ambiente (CERENA), an R&D unit at IST-UL. Additionally, he has been a Member of the CAPE-WP of the European Chemical Engineering Federation (EFCE) since 2001, representing Portugal on behalf of the Portuguese Engineers Association. Furthermore, he holds the position of Coordinator of the Portuguese National Support Group from IETS-IEA (https://iea-industry.org/). Throughout his career with several collaborations with international partners and industrials, Henrique A. Matos has published 155 documents with 138 WoS peer-reviewed publications in scientific journals. Is the co-author of 9 books and 6 book chapters and has 4 registered patents in the Supercritical Fluids field. Supervised 17 PhD, 2 Post-Doc, and 87 MSc theses and has received 7 awards and honors. He has been involved as Principal Investigator in 7 projects. Works in the area(s) of Engineering and Technology with emphasis on Chemical Engineering with emphasis on Process Systems Engineering.

Methodology and technology development toward circular industrial clusters: application to theenergy-water-hydrogen nexus

Prof. Assaad Zoughaib
École nationale supérieure des mines de Paris, PSL University, Paris, France
assaad.zoughaib@minesparis.psl.eu

Abstract: Water usage in industry constitutes the largest share of water usage in industrialized countries. This water usage overpass agriculture by far. A large part of water is consumed for process cooling but a non negligible part is used within the process as steam or pure water. More recently, green hydrogen expected production will contribute to highly increase the demand.
Waste water can be barely reused in these processes which lead to poor recovery ratios even with a comprehensive mass integration effort. Recently, methodologies coupling mass and energy integration allowed showing that coupling waste heat with waste water allows upgrading waste water into distilled water thanks to thermal membrane distillation.
This novel technology has proven it ability to handle water with different concentration in minerals making it preferable to reverse osmosis when it comes to highly concentrated waste water.
This paper focuses on water upgrading opportunities in the industrial sectors thanks to the waste heat valorization. Waste heat quality and availability is screened together with the need for pure water.
Several matching are identified showing that the development at industrial scale of thermal membrane distillation technologies allows important energy and water savings.

Prof. Assaad Zoughaib
École nationale supérieure des mines de Paris, PSL University, Paris, France
assaad.zoughaib@minesparis.psl.eu

Assaad Zoughaib is a Professor at Mines Paris, PSL University, he is the director of the Energy Master's program at PSL University. He is responsible for the thermodynamic systems research group (TDS) within the center for energy efficiency, environment and processes (CEEP) a laboratory of Mines Paris. His research activities focus on optimization methodologies for industrial energy systems, modeling, and experimental study of thermodynamic systems. Specifically, he has contributed to multiple research projects related to energy and mass integration of processes and territories. He is the main author of the CERES heat and mass integration platform and he developed a new patented thermal membrane distillation technology.

Multiscale approach for the design of biorefineries: Towards added value products and a circular economy

Prof. Mariano Martín
Department of Chemical Engineering. University of Salamanca. Plz. Caídos 1-5. Salamanca, Spain
mariano.m3@usal.es

Abstract: The valorisation of biomass residues is a challenge because of its volume and diversity and an opportunity. The large number of added value products and its use to produce electricity represents a complex product and process design problem. Integrated processes would allow fully reutilization of the residues, self-producing at least a fraction if not all the utilities and intermediates. However, the exploitation of the residues requires a multi scale analysis to understand the transformation of the resources, design the process and finally select the portfolio of products and the location of the facilities, which must include social as well as environmental and economic aspects. Systematic process synthesis techniques are presented to develop integrated processes towards creating a circular economy across different levels and scales. This presentation dwells about the mathematical modelling and optimization approach developed for the simultaneous process and product design. Several examples at process and enterprise scales are described to valorise waste biomass. At process scale residues such as orange peels, wine, coffee and oil production residues, or synthesizing products from manure are studied developing fully integrated processes with reduced use of utilities, energy, and water. It is at a larger or enterprise-wide scale that the circular economy around waste is created considering the integration of different business, the water-energy-food nexus and the effect of social aspects on the decision making. This will be shown with examples in the agricultural and cattle industries and urban waste treatment.

Prof. Mariano Martín
Department of Chemical Engineering. University of Salamanca. Plz. Caídos 1-5. Salamanca, Spain
mariano.m3@usal.es

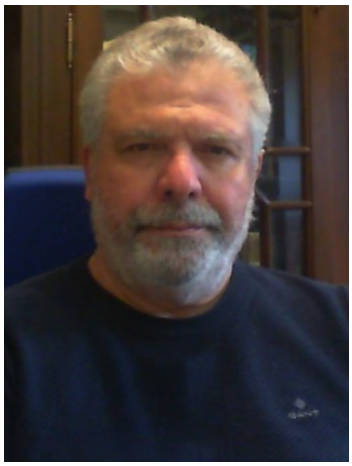
Prof. Martín is Full Professor of Chemical engineering at the University of Salamanca and leader of the Sustainable processes and products lab. Graduated with honors in Chemical engineering, received the Outstanding Thesis award in 2008. He joined P&G where he led the last challenge in the laundry business for which he obtained the P&G award for its outstanding contribution to modelling and simulation. He was Fulbright Scholar under Prof. Ignacio E. Grossmann before accepting the challenge of building a process laboratory in the oldest university in Spain. Prof. Martín was included within the 2% Top researchers in chemical engineering in the ranking developed by Univ. Stanford. He has authored over 185 papers in peer reviewed journals (h=41 SCOPUS, over 5000 citations), 55 book chapters, 2 monographic books and 3 textbooks for Elsevier, Springer and CRC Press. He is evaluator of research proposals (ERC, Fulbright, Canadian, Portuguese, Czech or UK governments) and editor of journals such as Chem. Eng. Sci (Elsevier), J Cleaner Production (Elsevier), LAAR, PIOS, Int. J Green Energy among others. Has graduated 9 PhD students (+2 in the following months) and over 60 Master students.

Food Waste Prevention and Valorization

Prof. Gerasimos Lyberatos
School of Chemical Engineering, National Technical University of Athens, Greece
lyberatos@chemeng.ntua.gr

Abstract: It is estimated that one third of the food produced worldwide is lost or wasted with significant social, economic and environmental consequences. Food loss and waste reduction is the best option from a hierarchical point of view. However, food surplus is always generated and this is best managed by redistribution and upcycling practices. The food that cannot be saved or utilized for human or animal consumption ends up as food waste. Food waste represents one of the most challenging environmental problems in our times. While its disposal to landfills is responsible for the emissions of potent greenhouse gases, such as methane, to the atmosphere, if separately collected, it may be exploited to produce compost, biofuels and other added value products. Source separated and collected Household Food Waste may be directly led to anaerobic digestion or composting facilities for the production of biogas and/or compost. An interesting possibility is to dry and shred the food waste collected at the municipality level, generating a homogeneous, dry, biomass, called FORBI (Food Residue Biomass) that emits no bad odors, may be stored for prolonged periods of time without deterioration and used as a potential feedstock for alternative processes, such as the production of biogas (biomethane, biohydrogen and/or hythane, compost, alternative fuel for the cement industry, pellets for heating, activated carbon for water purification, animal feed etc. These possibilities are discussed in the light of the experiences gained from relevant research programs in two Municipalities, Halandri and Andros.

Prof. Gerasimos Lyberatos
School of Chemical Engineering, National Technical University of Athens, Greece
lyberatos@chemeng.ntua.gr



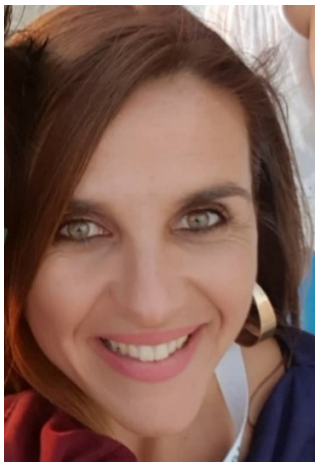
Prof. Gerasimos Lyberatos is currently Professor in the School of Chemical Engineering, National Technical university of Athens (since July 2011) and a collaborating faculty member of the Institute of Chemical Engineering Sciences (Foundation of Research and Technology Hellas) ICEHT/FORTH. He obtained his B.S. at M.I.T. and his M.S. and Ph.D. at CALTECH (USA) and served as Assistant, and Associate Professor at the University of Florida. In 1990 he joined the University of Patras as an Associate Professor and in 1993 became a Full Professor. His research interests are in Biochemical Engineering and Environmental Technologies for liquid and solid waste treatment and valorization. He has over 240 publications in International refereed Journals, and over 400 participations in International Conferences, 9 Chapters in books and two books. He has supervised over 50 PhD theses. He has organized three International Conferences. He has also founded the Hellenic Water Association, which is the Greek Governing member of the International Water Association. Prof. Lyberatos has been Editor of the Journal of Hazardous Materials (Elsevier) and Associate Editor of Waste and Biomass Valorization (Springer). Since 2014, Professor Lyberatos has also served as City Councillor for the Municipality of Halandri, designated for Circular Economy.

Sustainable processes: Exploitation of residual biomass and wastes for the production of gaseous biofuels

Dr. Georgia Antonopoulou
Associate professor in the Department of Sustainable Agriculture, University of Patras, Greece
geogant@upatras.gr

Abstract: A shift from petroleum refineries to sustainable bio-refineries is becoming increasingly important, due to the fossil fuel depletion and many environmental issues. To achieve the development of bio-refineries for bioenergy generation, environmentally friendly and cost-effective processes, based on renewable resources such as biomass, need to be developed. Anaerobic digestion (AD) is a mature biological conversion process in which residual biomass or wastes can be transformed into biogas, which is a mixture of methane and carbon dioxide that can be used as fuel. The process can be oriented towards dark fermentation (DF), where hydrogen might be produced instead of methane, by controlling operational parameters, inhibiting thus the methanogenesis.
In this presentation, fermentative hydrogen production and AD will be discussed. The microbiological and technological background of both processes, the basic principles and the current technologies will be outlined. Emphasis will be given on the exploitation and use of biomass/wastes of different origin as substrates in AD and DF, in lab and pilot scale experiments, while the factors affecting both processes will be analyzed and correlated with their performance and efficiency.

Dr. Georgia Antonopoulou
Associate professor in the Department of Sustainable Agriculture, University of Patras, Greece
geogant@upatras.gr



Georgia Antonopoulou is an Associate Professor at the Department of Sustainable Agriculture, School of Agricultural Sciences, of the University of Patras and Visiting Collaborative Member in the Institute of Chemical Engineering Sciences (FORTH/ICE-HT). She has a BSc, an MSc and a PhD in Chemical Engineering (2006). She has worked as a Research Associate at the FORTH/ICE-HT, the School of Chemical Engineering of the NTUA, the Aegean University and the University of Patras. She was also Collaborating Teaching Member at the Hellenic Open University (2015-2023). Her research focuses on the design and development of innovative biochemical processes for the treatment and valorization of municipal, agricultural, industrial wastes and residual biomass, through the use of mixed and pure microbial cultures, microbial electrochemical technology and mathematical modeling and optimization of anaerobic and aerobic biological production processes. She has gained 3 Post-Doctoral Fellowships, a PhD and an MSc fellowship.
She is co-author of ~65 scientific papers in peer-reviewed international journals, 9 book chapters, 1 monograph (Scopus h index =27, citations: ~3015; google scholar h index =31, citations: ~4250) and >100 articles in proceedings of international and national conferences. She has participated in >25 international and national R&D projects, she is a reviewer for >40 international scientific journals and a member of proposal evaluation panels, editorial boards, scientific committees and associations.

Challenges and Strategies for plastic pollution management and transition to green and sustainable technologies

Dr. Ioanna Ntaikou
University of Patras, Department of Civil Engineering, Greece
intaikou@upatras.gr

Abstract: Plastics have been widely used worldwide for almost a century as materials inextricably linked to everyday life and the economy. Unfortunately, the excessive use and accumulation of fossil-derived plastics that exhibit great strength and resistance to biodegradation has inevitably led to the so-called plastic pollution. Plastic pollution poses a major threat to the environment, contributing both directly and through the creation of microplastics to the deterioration of both marine and terrestrial ecosystems and the disturbance of ecological balances, whereas the production of fossil plastics themselves is also linked to the greenhouse effect. To deal with the adverse consequences of plastic pollution, the EU adopted a European strategy for plastics in January 2018, which is a key element of Europe's transition towards a carbon-neutral and circular economy. In the framework of this strategy, banning single-use plastics is included i.e. all plastic packaging should be designed to be recyclable or reusable and measures for the gradual substitution of conventional fossil-derived plastics by bio-plastics i.e. alternative plastics that might be bio-based and biodegradable are proposed. Among the main challenges, however, towards the commercialization of sustainable and affordable plastics that are biodegradable and also durable, remains the reduction of the upstream production process cost. This challenge could be addressed by exploiting waste, wastewater, and biomass as renewable feedstock in combination with utilizing different types of microorganisms that may function as efficient, self-renewing, and robust biocatalysts with perpetual bioplastic production potential. Through such methodologies, not only the goals for the management of plastic pollution can be achieved, but also other EU strategic goals aiming to ensure that the resources used are kept in the EU economy for as long as possible.

Dr. Ioanna Ntaikou
University of Patras, Department of Civil Engineering, Greece
intaikou@upatras.gr

Ioanna Ntaikou is Assistant Professor in the Department of Civil Engineering of the University of Patras, Greece, being a member of the Environmental Technology Division. She has a BSc in Biology and a PhD in Chemical Engineering from the University of Patras with expertise in environmental biotechnology. Her core research interests are on the sustainable treatment of wastewater, wastes and residues through biochemical and thermochemical processes with simultaneous valorization towards high added-value products, including biofuels, microbial bioplastics and bioactive molecules. She is co-author of 55 research papers in peer-reviewed international journals, 5 book chapters, 1 monograph and >100 articles in proceedings of international and national conferences. She has participated as researcher and coordinator or project manager in >25 international and national R&D projects, she is a reviewer for >30 international scientific journals and member of the Editorial Boards of the International Journal of Biobased Plastics Taylor & Francis) and the Sustainability (MDPI) and also member of scientific committees and associations.

Urban biodegradable waste: available resources for sustainable circular cities

Dr. Camilla M. Braguglia
CNR-Istituto di Ricerca sulle Acque, Roma, Italy
braguglia@irsa.cnr.it

Abstract: Presently, over half of the world's population lives in cities and this proportion is expected to increase to two-thirds by 2050, with 90% of the increase occurring in low- and middle income countries. This trend implies an increasing demand for food, water and energy in cities. At the same time, urban residents generate growing quantities of waste, in particular organic waste and municipal wastewater. The Urban Nexus approach is an action-oriented guiding principle within the vision of the circular bioeconomy, where urban biodegradable waste is viewed as a resource for sustainable innovative cities, contributing to solving the challenges of waste management and ecosystems protection. Here we will present applied research studies carried out at lab and semi-pilot scale where urban organic waste were converted into renewable energy (i.e methane) and useful by-products, such as marketable carboxylic acids through anaerobic microbial transformations. The strategic combination of waste streams as biological sludge and food waste taking into account the peculiarities of each in terms of origin and composition, is the winning move to increase resource efficiency, process stability and sustainability. Besides, in a safe, circular, nexus approach we cannot overlook the increasing amount of compostable bioplastics typically associated with food waste, namely starch-based bags and tableware made by poly-lactic acid managed by the organic waste treatment plants. For the first time, these bioplastic waste are considered key feedstock for carboxylate platform, recovering valuable materials and building blocks to be re-used, not disregarding their fate in anaerobic digesters towards a final plastic-free compost.

Dr. Camilla M. Braguglia
CNR-Istituto di Ricerca sulle Acque, Roma, Italy
braguglia@irsa.cnr.it

Camilla Braguglia is Senior Scientist of the Water Research Institute (IRSA) of the Italian National Research Council (CNR), where she leads since 2008 the Research team on Waste Treatment and Valorization. She graduated in Chemistry at the University of Rome La Sapienza and obtained a PhD in Industrial Chemical Processes from the same University. Her main research interests falls within the broad area of environmental biotechnology for waste minimization, decontamination and biomass valorization, in particular bioenergy and chemicals production. The approach is to study and develop efficient technological solutions with particular attention to the fundamental aspects of the processes together with the technological transferability. She (co)-authored 90 articles in peer-reviewed ISI Journals and International Book chapters, and co-inventor of a patent on sludge reduction and biogas production.

New sustainable technologies for sewage sludge valorization: energy and resources from wastewater treatment in the sign of the circular economy

Dr. Carlo Pastore
CNR-Istituto di Ricerca sulle Acque, Bari, Italy
carlo.pastore@cnr.it

Abstract: Urban wastewater treatment produces around 10 million tons of urban sewage sludge per year on the European continent alone. It is also expected that this value will increase significantly (up to 13 million tons, 91/271/EEC) over the next ten years. For this reason, the management and treatment of urban sludge in an economically, environmentally and socially acceptable way represents one of the major problems that modern society will have to face.
In recent decades, alternative methods of sludge management have been studied, based on the principle of resource recovery and the concomitant minimization of waste to be disposed of. A promising approach to address this problem consists in preserving the chemical complexity of the organic components of urban sludge, through sustainable processes capable of recovering and transforming them into products with a market value, in accordance with the principles of the Circular Economy.
In this Workshop, several scenarios developed within various international and national projects will be reported, through which it was possible to define new routes of recovery and valorization of the lipid component of sewage sludge towards biofuels, biolubricants and biosurfactants of new generation, by estimating the relevant environmental impacts.

Dr. Carlo Pastore
CNR-Istituto di Ricerca sulle Acque, Bari, Italy
carlo.pastore@cnr.it

Dott. Carlo Pastore, graduated "cum laude" in Chemistry at the University of Bari in October 2001, got his PhD in "Applied Enzymatic and Chemical Synthesis "by discussing the thesis entitled "Utilization of Carbon Dioxide for the functionalization of organic substrates with the assistance of metal complexes or enzymatic systems" in March 2005. Since 2011 he works as a researcher at the "National Council of Research" at the "Water Research Institute" (CNR-IRSA). Member of the Italian Chemical Society, Environmental Division and Chemistry for Technologies Division, Green Chemistry Group. Member of the editorial board of Biomass, MDPI and Frontiers on Energy Research (Carbon dioxide uptake and reuse). He is also the topic editor in "New Research on Waste Treatment, Disposal and Valorization" for 9 MDPI Journals. His main research topics concern the chemical characterization of waste biomasses (urban organic waste, sewage sludge, vegetable and animal oils) to identify the relevant chemical potential and design/optimize innovative sustainable processes to recover resources to implement the "Circular Economy" scenario with new solutions.
He had coauthored 91 peer reviewed paper, 7 book chapter and three national patents (over 2500 citations, H-index 28, Scopus). He has been involved as Principal Investigator for IRSA in over ten international and national projects.

Sustainable Waste Management: the pathway to Circular Economy & the UEST/NTUA experience

Dr. Konstantinos Moustakas
Unit of Environmental Science & Technology (www.uest.gr) of the School of Chemical Engineering of the National Technical University of Athens, Greece
konmoust@central.ntua.gr

Abstract: The presentation refers to the developments in European Union towards circular economy. It briefly presents the EU Action Plan for Circular Economy including the key action areas (production, consumption, waste management, secondary raw materials and innovation, investment & monitoring) and the five priority sectors (plastics, food waste, construction & demolition waste, critical raw materials & biomass & bio-based products). The objectives and the key actions are presented in each case.
Furthermore, the main research initiatives of the working team of the Unit of Environmental Science & Technology of the National Technical University of Athens in the field of circular economy, biowaste separate collection, making new products from biowaste and development of modern biorefineries within the last 15 years are presented with emphasis on food waste and generally biowaste, as well as recyclable materials (plastics, metals, etc.). The issue of water circular economy is also discussed.

Dr. Konstantinos Moustakas
Unit of Environmental Science & Technology (www.uest.gr) of the School of Chemical Engineering of the National Technical University of Athens, Greece
konmoust@central.ntua.gr

Konstantinos Moustakas is Senior Researcher, with PhD in waste management. He works as Laboratory-Teaching Staff in the Unit of Environmental Science & Technology (www.uest.gr) of the School of Chemical Engineering of the National Technical University of Athens. He has actively participated in more than 80 projects in many countries. He has long teaching experience and considerable international experience as senior researcher and project manager. He has cooperated with the European Commission directly, as he acted as TAIEX expert (institutional building) in many countries. He has long training activity in the field of environment in different countries and has been working for the Hellenic Open University as Collaborating Teaching Staff in the field of solid waste for more than 10 years. He has already published more than 350 articles (h-index: 43, citations: more than 7,200 citations) in journals and conferences, he serves as Associate Editor in the Journal of Cleaner Production and Member of the Editorial Board of some others, he has served as Guest Editor in a large number of Special Issues, while he has had the key role in the organisation of a large number of international conferences. Indicatively, he is the Head of the Organising Committee and key member of the Scientific Committee for the successful series of conferences on Sustainable Solid Waste Management. He is also Secretary General of the Hellenic Solid Waste Management Association currently.

Potential and Strategy for Green Hydrogen in Egypt

Prof. Adel Khalil
Cairo University, Egypt
adelkhalil@gmail.com

Abstract: Egypt's vision is to become one of the world leaders in low carbon hydrogen production and its derivatives by utilizing significant economic renewable potential, strategic location, geographical proximity to Europe and access to global maritime traffic through the Suez Canal, existing strong logistics and industrial experience and infrastructure with ports and export facilities. This should enable Egypt to produce low carbon hydrogen, with competitive cost, becoming a major regional exporter of low carbon hydrogen and its derivatives to Europe and beyond. This could significantly boost Egypt's GDP and create new jobs as well as providing energy security for the country. To date Egypt issued its Hydrogen strategy and signed 23 memorandums of understanding (MoU) on hydrogen production during COP 27.

In addition to the existing large economic solar energy potential all over Egypt and excellent wind energy potential in the Gulf of Suez, current studies revealed great additional onshore wind energy potential to the west on the Nile. These onshore areas could produce additional 1285 TWh of electrical energy at a LCOE of 2.4-3 $cents/kWh. Additionally, hybridization of Wind and Solar PV in these areas show great economic and technical prospects. These new allocated areas could be utilized for production and export of electricity, Hydrogen or Ammonia to Europe. National laws for land allocation and related incentive schemes for green hydrogen have already been issued. Challenges remain, related to technology development, industrial applications, transport and storage infrastructure and related codes.

Prof. Adel Khalil
Mechanical Power Engineering Department
Faculty of Engineering- Cairo University
Cairo- Egypt
adelkhalil@gmail.com

Professor Khalil is a professor in the Mechanical Power Engineering Department, at Cairo University (FECU), Egypt. He received his Ph.D degree in Mechanical Engineering, from the University of Wisconsin, Madison-Wisconsin, M.Sc. and B.Sc. Degrees in Mechanical Engineering from Cairo University. He also served as vice Dean for Graduate Studies and Research at FECU and visiting professor at the University of Wisconsin, Madison, Nuclear Research Center at Karlsruhe (Germany), American University in Cairo- Egypt, head of Mechanical Engineering Department U.A.E University, U.A.E and former ASHRAE distinguished professor. Prof. Khalil is a professor of heat transfer, refrigeration and Air conditioning. Other areas of teaching and research interests include: Cryogenics, Applied Superconductivity, and Renewable Energy technologies and resource assessment. He has directed and participated in several funded research projects and has numerous publications in the subject of heat transfer. Prof. Khalil is an expert and consultant in Renewable Energy and Energy Efficiency with emphasis on solar thermal technology development and resource assessment. He was also the Chair of the Executive Committee of the Regional Center for Renewable Energy and Energy Efficiency (RCREEE) and Board Member of the National Renewable Energy Authority (NREA). He is currently directing a Joint Masters Degree Program in Renewable Energy and Energy Efficiency between Cairo University and the University of Kassel in Germany and coordinator of the ERECI/RDI cluster"Egypt Renewable Energy Cluster Initiative". Prof. Khalil is a member of several International professional associations such as ASME and ASHRAE and a founding member of the Desertec University Network (DUN).

New challenges in solar energy resource and forecasting

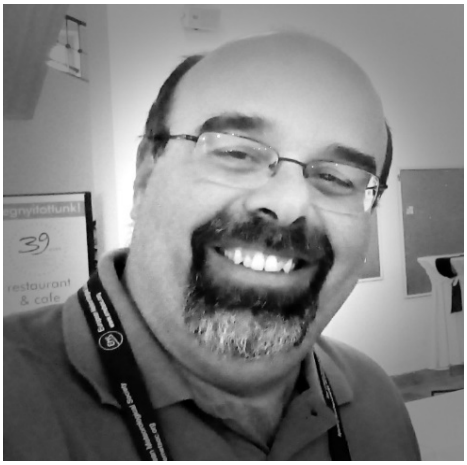
Prof. Andreas Kazantzidis
Head, Laboratory of Atmospheric Physics, University of Patras, Patras, Greece
akaza@upatras.gr

Abstract: The projected future climate change results in heterogeneous changes in energy use intensity among urban areas. The urban energy infrastructure is facing a rising number of challenges due to climate change since the target for climate neutrality adds more complexities, highlighting the need to address this relationship to develop effective strategies for sustainable urban energy infrastructure. The occurrence of extreme climate events can also trigger cascading failures in the system components, leading to long-lasting blackouts.

In this frame, the energy production from solar energy systems has fundamentally different characteristics than with conventional energy sources. The availability of solar energy is largely determined by weather conditions and is therefore extremely variable. Depending on the application and the corresponding time, different prediction approaches have been introduced. Solar irradiance nowcasting and short-term forecasting are important tools for the integration of solar plants into the electricity grid. Understanding the role of clouds and aerosols in those techniques is essential for improving their accuracy.

In this presentation, an overview is provided about the various methods that are used to assess the resource and predict solar radiation and energy at very-short time scales. The accurate forecasting of production at different spatial and temporal scales would facilitate the use of solar energy in a number of areas such as electrical grid balancing, better control of microgrids and operation of PV installations. So, innovative ground-based and satellite-based systems are developed in order to comprehensively address the needs for short-term forecasting with high spatial and temporal resolution to the end users of solar energy production systems.

Prof. Andreas Kazantzidis
Head, Laboratory of Atmospheric Physics, University of Patras, Patras, Greece
akaza@upatras.gr



Prof. Andreas Kazantzidis graduated and completed his Ph.D. on solar ultraviolet radiation in the Physics Department, Aristotle University of Thessaloniki. He is the Director of the Atmospheric Physics Laboratory, Head and Professor at the Physics Department of the University of Patras. He has participated in more than 30 European programs related to the composition of the atmosphere and solar radiation. His main research activities focus on the transfer of solar radiation in the atmosphere and the calculation of the effect of various atmospheric parameters, such as clouds and air particles. . Particular emphasis is placed on theoretical calculations and measurements of solar radiation with extensive use of radiative transfer models in synergy with ground-based and satellite measurements of the optical properties of air particles and clouds. Experimental activities include the measurement of total, ultraviolet and visible irradiance using various types of instruments and the processes of control and analysis of measurements. He is a member of the International Ozone Commission, the committee of the International Union of Geodesy and Geophysics, that helps on the study of ozone around the world, including ground-based and satellite measurement programs and analyses of the atmospheric chemistry and dynamical processes affecting ozone.

Toward Interactive and Integrative Planning andResource Allocation Platform for Food-Energy-Water Nexus

Ahmed Hamza H. Ali, *Prof. Dr.-Ing*

Department of Mechanical Power Engineering, Faculty of Engineering, Assiut University, Assiut 71516, Egypt
ah-hamza@aun.edu.eg

Abstract: Integrative planning for interconnecting water, food, energy, and ecosystems is a significant worldwide security challenge amplified by different parameters, including future population growth, geopolitical risks, and climate change. These challenges are tightly interconnected, which requires a systems approach to address them. Each country has national strategies for the future development of each water, food, and energy sector, and needs to be integrated with the ecosystem. However, the tool for the technical coordination of these resources based on the national security level of each sector as well as the economic and social development needs to exist. The presentation aims to pave the way toward the need for an interactive decision-making platform to support evidence-based inter-sectoral planning among water, energy, and food resource systems integrated with the ecosystem and guide future investments and risk mitigation strategies across these domains. Such a platform must be co-created with close stakeholder engagement throughout the multi-discipline of expertise, bringing together different disciplines to evaluate trade-offs associated with technological and policy interventions on the interconnected food-energy-water resource systems integrated with the ecosystem. This can be achieved through an internationally sufficiently founded project focusing on four interrelated objectives to improve food-energy-water systems' sustainability, resilience, equitability, and integration with the ecosystem.

Ahmed Hamza H. Ali, *Prof. Dr.-Ing*

Department of Mechanical Power Engineering, Faculty of Engineering, Assiut University, Assiut 71516, Egypt

ah-hamza@aun.edu.eg

Ahmed Hamza H Ali has been a full Professor at the Mechanical Engineering Department, Faculty of Engineering, Assiut University, Assiut 71516, Egypt, since July 2009. He is the Director of the Environmental Studies and Research Center, Assiut University, Assiut 71516, Egypt (October 2023 – Now). He is a Certified Consultant and Professional Engineer of New and Renewable Energy Systems and Energy Efficiency and Refrigeration and Air Conditioning (License no. 1373/3). He was the Chairman of the Mechanical Engineering Department at Assiut University, Egypt (July 2017 – July 2023). He was a Director of the Research Excellence Center for Energy Resources and Management (Dean Level), Chairman of the Energy Resources and Environmental Engineering Department, and Professor of Renewable Energy Systems at the Egypt-Japan University of Science and Technology, Alexandria, Egypt, from May 2010 to January 2015. In April 1999, he obtained a Doctoral Degree in Engineering from the Muroran Institute of Technology, Hokkaido, Japan. In December 1992, he was awarded the MSc degree in Mechanical power engineering from Assiut University, Egypt, while obtaining his BSc degree in Mechanical Engineering from Assiut University, Egypt, in June 1986. He worked as a Professor of Energy Systems at Fraunhofer Institute for Energy Systems and Environmental Engineering, UMSICHT, Germany, from March 2006 to April 2008. Honours: Member of the International Solar Energy Society (ISES) since 1994 until now. Alexander von Humboldt Foundation Fellow since 2006. He published more than 200 papers (over 73 in Int. Journals, five books, and five book chapters (with Scopus H index 21)

Solar-driven Ca-Looping using Wastes and Natural $CaCO_3$-based Materials for Thermochemical Energy Storage

Prof. Carla I.C. Pinheiro
Centro de Química Estrutural, Institute of Molecular Sciences, Departamento de Engenharia Química, Instituto Superior Técnico/Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal.
carla.pinheiro@tecnico.ulisboa.pt

Abstract: Solar energy is a free and endless source of renewable energy (RE), especially attractive for countries that hold a high solar exposure along the year. Concentrated solar technology (CST), a promising RE technology to replace fossil fuel plants, has been proposed as a useful way to address the inherent variability of RE sources since it enables thermal energy storage (TES). Among the TES systems, thermochemical energy storage (TCES) allows storing solar energy by means of reversible reactions involving carbonates, hydroxides, oxides, or hydrides, for example. The Calcium-looping (CaL) process, based on the following reaction: CaO (s) + CO_2 (s) ↔ $CaCO_3$ (s), is considered a promising option for TCES in concentrated solar power (CSP) plants owing to the large energy density (1790 kJ/kg for $CaCO_3$), low cost, abundance, and harmlessness of $CaCO_3$ sources such as natural limestones and marble wastes, and the high temperature of the exothermic carbonation reaction, which allows higher thermal/electrical efficiencies than molten salts.
CSP-CaL for TCES consists of using the high temperatures attainable with CST to drive the endothermic calcination reaction whereCaO and CO_2 are generated from $CaCO_3$, ideally under a CO_2 rich atmosphere, and when energy is needed, the exothermic reverse reaction is initiated when there is a lack of solar radiation to supply energy for a connected Brayton or Rankine Cycle.
The relevant aspects for the viability and sustainability of integrating CSP and CaL for TCES processes, including materials behavior, process integration, technology and economic issues, will be addressed.

Prof. Carla I.C. Pinheiro
Centro de Química Estrutural, Institute of Molecular Sciences, Departamento de Engenharia Química, Instituto Superior Técnico/Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal.
carla.pinheiro@tecnico.ulisboa.pt

Carla I. Costa Pinheiro is Assistant Professor at the Department of Chemical Engineering at Instituto Superior Técnico (IST), Universidade de Lisboa (UL) and an integrated member of Centro de Química Estrutural and IMS. She completed her Ph.D. in Chemical Engineering in 1995 at IST/UL. Her main research interests and publications are in the areas: heterogeneous catalysis, modelling/simulation of chemical and wastewater treatment processes, process dynamics and control, post-combustion CO2 capture, and solar-driven thermochemical energy storage, circular carbon economy and sustainability. Her research resulted in 53 peer reviewed scientific publications in Scopus (h-index of 16), 81 publications in ORCID and 14 book chapters. Additionally, she has 127 other publications in conference proceedings and others. She has participated as team member and tasks' leader in: five national FCT research projects; one European Commission FP7 project; one national IAPMEI-PRR project "GrAPHy – Green Ammonia Production from Intermittent Sources of Hydrogen"; and one national project from C5Lab. Recently, she has coordinated two FCT research projects as Principal Investigator: "CaReCI - Carbon Emissions Reduction in the Cement Industry" (2016-2019), and "SoCaLTES - Solar-driven Ca-Looping Process for Thermochemical Energy Storage" (2019-2023), and in 2022 she was the team leader of European project SURPF2202010061- SolMat4TCES to access a solar installation of the PROMES-CNRS, Font Romeu, France, within the framework H2020 "SFERA III – Solar Facilities for the European Research Area". She has successfully supervised 5 PhD thesis (concluded) and 3 ongoing, 54 MSc. Dissertations (concluded) and 6 ongoing, 12 research fellows (concluded); 5 Post-Docs. More information at (https://orcid.org/0000-0002-2568-3974).

Automation System in Water Energy Food Nexus

Prof. Mostafa Abdelgeliel
Arab Academy for Maritime Transport, Alessandria, Egypt
mostafa.geliel@aast.edu

Abstract: The most current essential national/ international challenges are water scarcity, food security, highly energy demand and environmental Impact. Therefore it is essential to address these challenges in a global view to find an optimal and feasible solution for Water-Energy and Food (WEF) Nexus. Employing a sustainable energy resource in water desalination of underground /sea water to be used in drinking and agriculture purposes is one of the solution of water-energy food nexus**.** Moreover, producing green hydrogen, as an energy carrier that can be stored or utilized directly to produce ammonia fertilizer, is as added benefit of WEF nexus. The optimal feasible nexus can be achieved by employing advanced automation technology in sustainable energy generation for water production and smart agriculture. Many problems related to energy, water and the environment can be mitigated by smart agriculture**.** However, solutions to these challenges are often complex to each other due to the dynamic interactions and interdependence between food, energy and water. Advanced automation employing Internet of Things (IoT) and Artificial Intelligent (AI) to obtain an optimal feasible WEF nexus will be highlighted. The advanced automation feature will cover smart grid technologies, optimal operation and sources allocation, condition monitoring and tolerant system.

Prof. Mostafa Abdelgeliel
Arab Academy for Maritime Transport, Alessandria, Egypt
mostafa.geliel@aast.edu

Mostafa A. M. Abdelgeliel born 1972 and got his BSc in Electrical Engineering from faculty of Engineering Alexandria University in 1995. He obtained his MSc in Control Engineering from AAST at 2000. He has finished his PhD in automatic control from LS of Automation, Mannheim University, Germany, 2006, His thesis title was “Fault Diagnosis and Performance Recovery Based on the Dynamic Safety Margin”. He is a professor since 2020. He was the head of Electrical and Control Engineering department, faculty of Engineering, AAST, Alexandria from 2016 to 2021. He is currently the head of Energy Research unit, AAST since 2014. He is expert in fault detection and tolerant, automation system design, Process control and modelling, AC and DC drives, and optimal operation of multi-source generation, renewable energy system operation and control. He has participated in design, operation and consultancy of many industrial projects and PV plants. He has published more than 55 papers in refereed journals and Conference proceedings. He is a certified energy manger since 2017. He has supervised undergraduate and postgraduate students and worked on projects in areas related to Process control and design, and renewable energy sources control. In addition, he has several years industrial experience in the field of process control and renewable energy system. He has participated in writing many granted project in Tempus, ERSMUs+ Horizon and FP7.

Capacity development for water management security and sustainability: the experience from CIHEAM Bari

Dr. Daniela D'Agostino
Centre International de Hautes Etudes Agronomiques Méditerranéennes - CIHEAM Bari,Italy
dagostino@iamb.it

Abstract: The capacity building of different actors and stakeholders on the theme of water management is a bedrock for effective territorial sustainable development.
The CIHEAM Bari recognizes the urgent need to train high-level officers, technicians and future decision makers on water diplomacy framework to enhance their capacity to understanding and managing complexity, uncertainty and contingency when addressing complex water problems in the face of multiple and competing demands in the natural, societal and political domains.
Water management is a very complex area, in which the different uses and functions of the resource coexist, each with its multiple actors, institutional levels, administrative structures, policies and their implementation tools. Technological development and innovation have managed to create bridges between these elements, since they require coherence, in a long-term and long-lasting perspective, to respond to new needs, recomposing and managing this complexity through a renewed system of coordination between the different competent structures.
CIHEAM Bari encompasses a wide array of capacity development initiatives**:** training and education tailoring programs to address the needs of target groups; territorial partnership, ensuring inclusive participation processes; applied research facilitating the exchange of findings, best practices, and innovative solutions.
The institutional master's program in Sustainable Water and Lanad Management in agriculture play a role in preparing the new generation towards professional and academic careers and enabling their effective contribution to the sustainable management of water and land resources, and to the socio-economic development thereof. The International Water School has the aim of training technical figures of different levels (from young graduates to technical-political decision makers) from the emerging countries and enabling their effective contribution to the sustainable management of water resources, in view of important challenges that include water scarcity, demographic pressures and climate change.
Water Knowledge and WatDEV projects are examples of institutional strengthening through research and capacity development, laying the foundations for international cooperation and for scientific diplomacy. The project REACT4MED is designed to contribute to the implementation of an integrated approach to a more efficient management of scarce water resources through capacity development activities.
To foster development and adoption of best solutions in water management, different approaches are employed: living labs that operates as open innovation ecosystems in real-life environments; Digital Lab that integrates digital tools and data-based approaches with the aim of transforming innovative ideas into (low-cost) prototypes; policy frameworks that shapes decision-making processes and guide sustainable practices.
This session provides an overview of CIHEAM Bari water management programs and initiatives, vehicle for water diplomacy.

Dr. Daniela D'Agostino
Centre International de Hautes Etudes Agronomiques Méditerranéennes - CIHEAM Bari, Italy
dagostino@iamb.it

Daniela D'Agostino works at CIHEAM Bari since 2005 as researcher in the Department of Water and Land Resources Management. Since 2021 she has the role of Scientific Tutor in the Master course on "Sustainable Water and Land Management in Agriculture". She holds a PhD in Agro-Forestry and Environment Engineering at the University of Bari. Her scientific interests are in water resource management and use in agriculture; surface hydrologic modelling; crop growth modelling; semi-quantitative modelling for supporting participatory processes; elaboration, management and analysis of cartographic data using modern GIS techniques; statistical analysis and management of climatic data. She has been involved in many international and regional research projects and has authored and co-authored more than 20 publications in scientific journals, books and conference proceedings.

System thinking approach to address Nexus Biodiversity- Climate- Society governance challenges

Dr. Alessandro Pagano
CNR-Istituto di Ricerca sulle Acque, Bari, Italy
alessandro.pagano@cnr.it

Abstract: Designing policies for managing the Biodiversity Climate Society (BCS) Nexus claims for a better understanding of the complex and dynamic interactions among its components and an effective engagement of the stakeholders.
To this aim, a Participatory System Dynamic Modeling (PSDM) framework was adopted in BIOTRAILS project (https://biotrailsproject.eu/). The PSDM framework is composed by several steps. This contribution focuses on the system mapping phase, whose scope is to map the interactions among the different elements of the BCS nexus, accounting for the stakeholders' understandings and diversity of problem framings. Causal Loop Diagram was used to formalize and analyse the stakeholders' knowledge. Methodological approaches based on Ambiguity Analysis and structural analysis were combined to identify the BCS nexus challenges and detect leverage points. Those elements will be, in a later stage of the project implementation, used to inform the stakeholders' involvement in Nexus policy design.
The developed methodology was experimentally implemented to the gold mining in Ghana, to analyse their impacts on biodiversity losses and the dynamic evolution of the BCS nexus. A PSDM exercise was held in Kumasi to map the BCS Nexus system. The preliminary analysis of the obtained CLD show how stakeholders perceived gold mining impacts on the local environment and socio-economic context and allowed us to start the process for the Nexus policy design.

Dr. Alessandro Pagano
CNR-Istituto di Ricerca sulle Acque, Bari, Italy
alessandro.pagano@cnr.it

Civil Engineer and PhD in Water Engineering and Chemistry. He is currently researcher at the Water Research Institute of the National Research Council (IRSA-CNR). His current research activities, developed within several EU and national projects, are mainly focused on the following topics: i) Water-Energy-Food Nexus; Participatory System Dynamics Modelling (PSDM) for sustainable resources management (with focus on water) in view of the achievement of SDGs; ii) vulnerability and resilience assessment of drinking water supply systems; iii) adaptation and water-related risk reduction measures at urban level.
He is author of more than 40 journal paper (H-index 20) and currently directly involved in the following European projects: REXUS (H2020), LENSES (PRIMA), BIOTRAILS (Horizon Europe).

Gender and Climate Change Resilience: The Power of Women as Agents of Change

Prof. Fatma Ashour
Chair of Center for Environmental Studies -Cairo University, Cairo, Egypt
fhashour@yahoo.com

Abstract: Climate change poses a significant threat to communities worldwide and effects of climate change are already being felt around the world. Rising sea levels, more extreme weather events, and changes in plant and animal life. Nevertheless, its impacts are not equally distributed. Women, often disproportionately burdened by poverty and limited resources, face heightened vulnerability to climate-induced disasters and environmental degradation.

The Middle East and North Africa (MENA) region faces a complex challenge: increasing climate change vulnerability alongside persistent gender inequality.

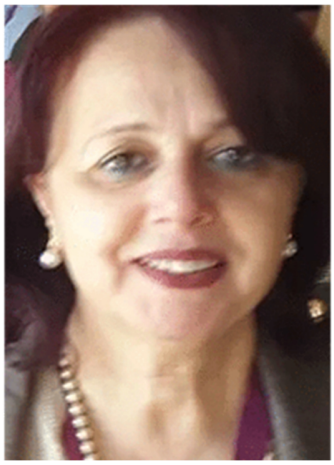
Women often play a central role in managing natural resources like water and food security in their communities. Climate change disrupts these crucial roles, jeopardizing household well-being. Moreover, women possess valuable knowledge and skills in coping with environmental challenges. Empowering women through education, access to resources, and participation in decision-making processes is essential for building resilient communities.

Integrating gender perspectives into policies and programs ensures that both women and men have the resources and capacities needed to adapt to a changing environment.

Investing in women's education, leadership development, and economic opportunities enhances their ability to contribute to climate solutions.

In conclusion, empowering women in the MENA region is not just about social justice; it's a strategic necessity for building climate resilience and ensuring a sustainable future for all.

Prof. Fatma Ashour
Chair of Center for Environmental Studies -Cairo University, Cairo, Egypt
fhashour@yahoo.com



- Former Director of the Center of Hazard Mitigation, Environmental Studies, and Research- Cairo University
- Former Chairperson of the Chemical Engineering Dept., Cairo University
- Dr. Ashour's work covers a wide range of fields ranging from Petroleum Refining and processing to experimental conversion processes of biomass into valuable chemicals and liquid fuels.
- She is the coordinator of the PyroBioFuel project EU- Africa LEAP-RE.
- Dr. Ashour has scientific collaborations with international research institutions.
- Prof. Ashour has more than 82 international publications with an h-index of 19 on Google Scholar and h-index of 16 on Scopus.
- Dr. Ashour is a member of the board of the "Association des Ingénieurs Francophones enEgypte" AIFE and the former President of the "RéseauMéditerranéen des Ecolesd'Ingénieurs et de Management" RMEIM.
- Prof. Ashour is the coordinator of the Green Process Engineering Master's Program (Cairo University and Rovira I Virgili Universität –Tarragona, Spain). Also, Dr. Ashour is developing a joint M.Sc. degree in "Sustainability and Smart Cities" in cooperation with École Centrale de Marseille.
- Awards
  - Chevalier de l'Ordre de Palmes Académiques july 2022
  - Premio Europeo Capo Circeo March 2023

Gender Role in Sustainable Development With Emphasis on Energy Sector

Prof. Zeinab Saleh Safar
Faculty of Engineering, Cairo University, Cairo, Egypt
zeinab.safar@gmail.com

Abstract: Sustainable development is viewed as a process of advancement with the aim of meeting present needs without endangering the capacity of future generations; it comprises mainstreaming economic, social and environmental capitals. Gender equality and empowerment of women are necessary to achieve sustainable development. The Sustainable Development Goals (SDGs) set by the United Nations (UN) in 2015 have gained recognition among UN member states who increasingly build their agendas and policies in line with these goals. Gender equality and empowering women is recognized in the fifth Sustainable Development Goal (SDG 5) and is considered to be necessary to reach other SDGs. Therefore it is essential to investigate the gender role in all areas of sustainable development. In my paper I will focus on the role of women and participation to access modern, clean affordable energy (SDG 7) since there is a wide consensus that sustainable energy is the golden thread that connects ecosystems, economic advancements and social justice. Gender disparities are particularly evident in energy sectors around the world. Renewable energy sectors, as well as non-renewable energy industries, remain relatively male-dominated which is expressed in an under-representation of women on the energy supply-side on the one hand, and a lack of gender mainstreamed energy interventions on the demand-side on the other hand. The main objective of this paper is to investigate the potential to achieve certain sustainable development objectives if a gender approach is adopted in the Egyptian electricity supply-side and demand-side.

Prof. Zeinab Saleh Safar
Faculty of Engineering, Cairo University, Cairo, Egypt
zeinab.safar@gmail.com

Professor Zeinab Saleh Safar, is a Professor of Mechanical Power Engineering, Faculty of Engineering at Cairo University, and a member of the board of Egyptian Electricity Holding Company. Dr. Safar was employed at Florida Atlantic University, the University of California, Berkeley, the American University in Cairo, and the University of Pittsburgh. Along with her academic career, Dr. Safar worked for many organizations, such as UNIDO, UNDP, UNWOMEN, the Organization of Energy Planning, the National Council for Women, and the Arab Women Organization. Dr. Safar led many projects in energy efficiency and energy conservation, environmental management and environmental control, small and micro enterprise development, and gender studies.

She has served as a technical advisor tothe Ministry of State for Environment, the Ministry of Local Administration, the Ministry of Communication and Information Technology, and the Ministry of Manpower. She was the technical advisor to the Secretary General of the National Council for Women in the areas of the Management Information Centre, the Women Business Development Centre, and e-marketing.

Dr. Safar participated in international dialogues and presented several papers at international conferences in energy, environment, and gender studies. She has more than 100 publications in her area of expertise, and she is a technical reviewer for many international journals.

Climate risks impacts to scarce water, energy, food resources, and migratory flows and the effects on regional security

Dr. Konstantinos Pappas[1,2]
[1] *Texas A&M Energy Institute, Texas A&M University, College Station, TX, United States*
[2] *Borders & Migration Program, Bush School of Government and Public Service, Mosbacher Institute for Trade, Economics, and Public Policy, Texas A&M University, College Station, TX, United States*
kostis.pappas@tamu.edu

Abstract: The world faces a growing web of interconnected threats. Disasters are becoming more frequent and severe, driven by extreme weather events. Population growth, urbanization, and limited resources further pose significant threats to lives and infrastructure. COVID-19 exposed these vulnerabilities, leading to the first rise in global poverty in decades. Water, energy, and food resources are under growing pressure, leading to supply-demand resource gaps. These gaps are expected to worsen by 2030. The interdependencies between these resources add to the complexity of achieving human security and bridging these gaps. Additionally, Europe, the U.S., and other regions globally are facing some of the most significant migratory crises in modern history. People are forced to flee due to a legitimate fear of persecution, man-made causes (e.g., famine, war, conflict, violence), or as a result of disasters. In addition, the lack of access to clean water, reliable energy, and nutritious food threatens the health of individuals and social stability. This presentation, through a scoping review of existing literature and zooming in current events from highly vulnerable to climate change and disasters locations, such the Northern Countries of Central America, the broader Mediterranean, Middle East, and North Africa region, coastal or insular regions, aims to demonstrate that to better understand these interconnected challenges and address underlying conditions and vulnerabilities, a holistic "systems approach" is needed. It outlines three key objectives: 1) Understand the interplay of social, economic, and political factors on the water-energy-food-human mobility nexus in the face of growing hazards. 2) Propose a systems framework for evidence-based decision-making in threatened communities. 3) Identify ways to improve community resilience and regional security, by promoting resource management and investing in decision making tools that safeguard lives and development gains. By taking a systems approach, we can better understand and address the complex challenges of our time, building a more secure and sustainable future.

Dr. Konstantinos Pappas[1,2]
[1] *Texas A&M Energy Institute, Texas A&M University, College Station, TX, United States*
[2] *Borders & Migration Program, Bush School of Government and Public Service, Mosbacher Institute for Trade, Economics, and Public Policy, Texas A&M University, College Station, TX, United States*
kostis.pappas@tamu.edu

Konstantinos Pappas is the Assistant Director of the Texas A&M Energy Institute. Dr. Pappas brings 27 years of experience, including senior roles in the European Commission (Brussels, Belgium, and Luxemburg) on EU environmental policy, and food safety and security legislation, contributing to the facilitation and integration of environmental and resource availability issues into sustainable development policies. Since 2018 he has overseen major projects, emphasizing stakeholder engagement in areas like Carbon Capture, Process Intensification and Optimization, Renewable Technologies, Hydrogen Economy, and more. Dr. Pappas' research explores migration economics and international development, sustainability, energy equity, environmental justice, and the societal aspects of the energy transition. His research focuses on migration patterns and climate change, sustainable development goals, human mobility and its impact on interconnected water, energy and food resources.

Developments and future prospects of the water - energy - food - health nexus

Prof. Rabi Mohtar
Department of Biological and Agricultural Engineering and the Zachry Department of Civil and Environmental Engineering at Texas A&M University
Rabi.Mohtar@ag.tamu.edu

Abstract: The presentation will focus on the development and prospects of the Water-Energy-Food-Health Nexus. It will review the Nexus milestones, with some focus on the nexus development phases and how the framework for the nexus was developed. We will focus on trends in the Nexus, with application to the Sustainable Development Goals (SDGs) and on some of the gaps and challenges to meeting these goals. We will then discuss research trends and future topics. Applications relevant to the nexus gaps will be discussed in detail, as will the future research prospects in this area.

Prof. Rabi Mohtar
Department of Biological and Agricultural Engineering and the Zachry Department of Civil and Environmental Engineering at Texas A&M University
Rabi.Mohtar@ag.tamu.edu

Rabi H. Mohtar, Ph.D., Professor in the Department of Biological and Agricultural Engineering and the Zachry Department of Civil and Environmental Engineering at Texas A&M University. Mohtar founded the Texas A&M Water-Energy-Food (WEF) Initiative (2015). While serving as dean of the Faculty of Agricultural and Food Sciences (2018-2021) at the American University of Beirut, he also established the Water-Energy-Food-Health Nexus Renewable Resources Initiative (WEFRAH). Mohtar serves as a Governor of the World Water Council (AUB and Texas A&M) and chairs the Taskforce in Integrated Water Resources Management (IWRM). He is Vice President of the Governance Committee of the International Water Resources Association (IWRA). He is a Distinguished Alumnus of AUB, Senior Fellow at the Policy Center for the New South (OCP), and while at Purdue University (1996-2014), he was the inaugural director of Purdue's Global Engineering Programs (2008) and a founding member of Purdue's Division of Environmental and Ecological Engineering (2006).Mohtar's research and education activities focus on environmental and natural resource conservation and developing the means to promote sustainable development by identifying primary emerging global challenges to water, food, energy, and health securities, climate change, and natural resources. Effectively addressing these challenges requires reform of existing academic and research models to produce new models that help us better understand, manage, and promote vital natural systems; it also demands global partnerships and cross-cultural or trans-boundary cooperation. His specific contributions to these areas include development of modeling platforms to evaluate the environmental impacts of land use and water management, innovative soil and groundwater remediation technologies, characterization and modeling of the soil-water medium at pedon, field, and watershed scales. Mohtar's work includes the design and evaluation of international sustainable water management programs to address water shortage conditions in arid climates, and the development integrated global engineering programs that promote capacity building and stakeholder engagement. Through his WEF Nexus Research Group at Texas A&M, Mohtar conducts cutting edge research that integrates green water accounting, dynamic soil hydrostructual modeling, and water–energy–food-health nexus tradeoffs. The overarching goal of his work is to provide local, sustainable solutions to bridge water, food, energy, and ecosystem gaps. Together with colleagues from multiple fields, Mohtar's research has contributed to the development of the discipline of hydrostructural pedology, global Water-Energy-Food-Health Nexus platforms, and the development and adoption of food safety regulations in the USA, in Lebanon, throughout the MENA region and globally.
Mohtar has received several awards recognizing his contributions.

Energy strategies/regional interconnections and related legislation/regulations

Prof. Mohamed Salah Elsobki (Jr.)
Professor of Energy Planning, Cairo University, Egypt
Adjunct professor Zewail city, Egypt
X- Chairperson of New and Renewable Energy Authority (NREA), Egypt (November 2014 – December 2016)
Founding Managing Director, Egyptian Electric Regulatory and Consumer Protection Agency (EgyptERA) (May 2001- May 2006)
Chairperson, National World Energy Council (February 2024, -----)
sobki54-2@hotmail.com

Abstract: This article would cover the following points:

- Energy Strategies
  - *Continuity*
  - *Security*
  - *Quality of supply*

- Regional interconnections
  - *Technical requirements*
  - *Commercial agreements*
  - *Legislative frame*

- An example
  - *The case of Egypt*
  - *The current legislations*
  - *The potential future market*

Prof.Mohamed Salah Elsobki (Jr.)
Professor of Energy Planning, Cairo University, Egypt
Adjunct professor Zewail city, Egypt
sobki54-2@hotmail.com

- **Education:** **B.Sc. (1977) & M.Sc.** (1980) Cairo University, Egypt
  Ph.D. (1985) McMaster University, Hamilton, Canada
- *Professor emeritus - Energy Planning (since 2004), Cairo University*
- *Adjunct Professor (since 2018)-Electric Power, Zewail University, Egypt*
- **Former Executive Chairman** for the Egyptian

New and Renewable Energy Authority (NREA), **(Nov 2014-Dec2016)**.

- **Former Director Energy Research Center (2010-2014),** Faculty of Engineering, Cairo Univ.
- **Founding Managing Director (May2001-May2006)**

Egyptian Electric Utility and Consumer Protection Regulatory Agency – EgyptERA

- **Former Manager** of the Renewable Energies and Energy Efficiency Program with the national Industrial Modernization Center – IMC**(2007-2010)**
- **Technical Manager:** National Energy Conservation & Environment Protection **(ECEP)** project **(1989-1995)** - a 68 million US$ funded USA funded project.

❑ **Member of national/regional Energy Committees & Board of Directors for:**

- *Current chairperson of the national chapter of the World Energy Council (WEC), since February 15, 2024.*
- *Advisory board (since 2014-current), for the Arab Electricity Regulators Forum.*
- *Advisory Board (2011-current), for the joint master program "Renewable Energy and Energy Efficiency for the Middle East and North African (MENA) region"-(REMENA) (Cairo University, Egypt and Kassel University Germany, and Monastir University Tunisia), currently chairman.*
- *Energy & Electricity Research Council-Academy of Scientific Research since 2011 (chairman-2018- Oct. 2021).*
- *Board member, NREA, (2020-current).*
- *Board member, Cairo South & North Electricity Distribution. Companies, (2011-2014 & 2015-2018).*
- *Board member, Electronic Research Institute, (2015-2017)*
- *Board member, Electronic Factory, the Arab Organization of Industries (AOI), (2015-2016).*

❑ ***Worked/working,*** *while not assuming a government responsibility****, consultant for number of projects internationally funded*** *(e.g.* ***EU*** *funded projects: CREMP, paving the way for RE master plan of Egypt, TARES;* ***GIZ, AFD, GIF, KFW, UNDP, USAID & WB*** *funded projects on EE&RE, etc.); directly/indirectly contracted.*

Dr. Jeff Sammons

Associate Executive Director, Texas A&M Energy Institute, USA

Jeff Sammons is the Associate Executive Director of the Texas A&M Energy Institute, where he manages the operations of the institute's academic, research, and partnership programs. He has worked in academia for three universities over the last 20 years as a program manager and in various capacities supporting academic programs, sponsored research projects, student recruiting, and fundraising. He holds a master's degree from Texas Tech University and an undergraduate degree from Lubbock Christian University.

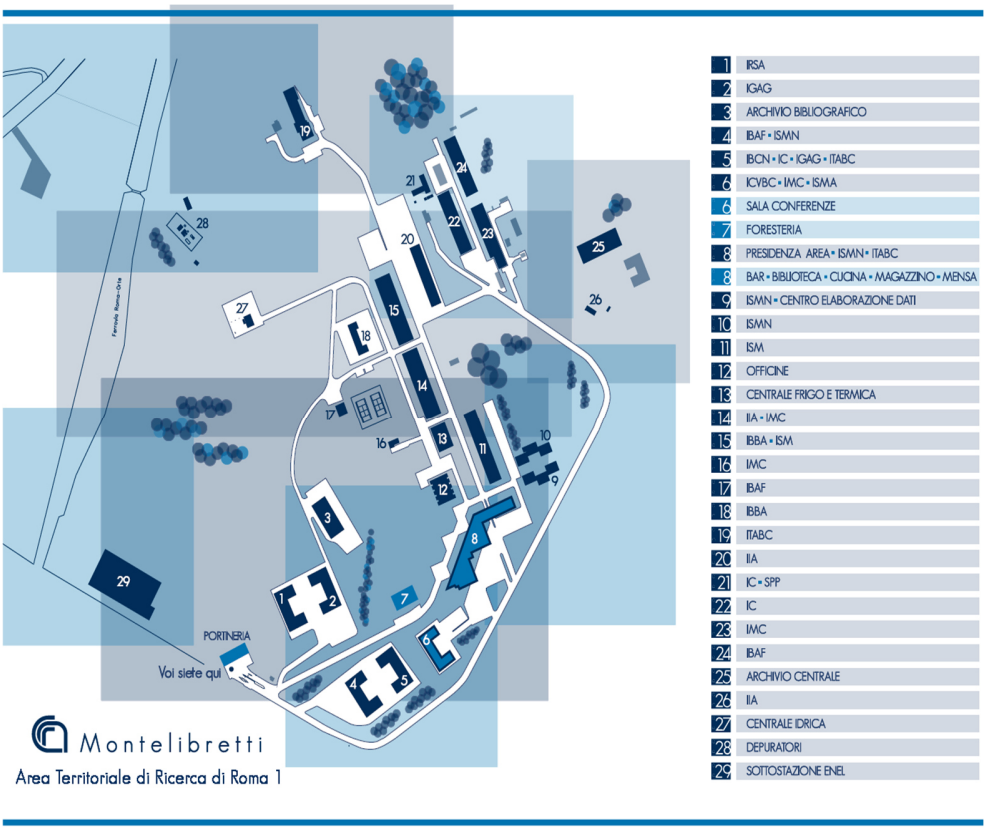
Dr. NahidRasool MBA
Honorary Doctor of Leeds Beckett University
CEO, Shantona Women and Family Centre
Leeds, UK

Nahid Rasool is the Chief Executive of Shantona Women and Family Centre. She has worked in the charity sector for more than 35 years with 25 years for Shantona. She faced lots of challenges, prejudice, inequality and barriers within the South Asian community and these made her determined to do something for the culturally diverse women and girls who live in this country, facing inequality and discriminated within their homes and workplaces.

Nahid has supported various programmes around circular economy and food waste management initiatives engaging the community and its leaders. These includes (a) Recycling clothes and supporting community to reuse school uniform, exchange and sell of unused clothes, stich and pitch session use their creativity to turn old cloths into bags and art materials and sell them to generate income, (b) Partnership with Fare Share, local supermarkets, local farms etc. and use the community kitchen to minimise food waste by donating sell by dates food and vegetable, to support producing soup, warm food for low income families and provide food for children and young people during school holidays.

Nahid has also been involved in the hate crime strategy for Leeds and published a book, "Islamophobia, The Untold Story". Nahid was the UK coordinator of "Gender Wise", a Transnational European Project looking at gender equality issues before the policy came into practice.

Nahid has a BA (Honours) in History from the University of Dhaka and an MBA from Leeds Beckett. In 2017 she received an Honorary Doctorate from Leeds Beckett for her contribution to voluntary and public sector.



Scientific Committee

Dr. Carlo Pastore
Prof. Adel Khalil
Dr. Konstantinos Pappas
Prof. Mahmoud M. El-Halwagy
Dr. Jeff Sammons

Local Organization Committee

Dr. Camilla Braguglia
Dr. Luigi di Bitonto
Dr. Antonella Angelini
Dr. Alessia De Matteis
Roberto Amato
Anna Leuzzi

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