

# Industrial Decarbonization through CCUS value chains

 Short Program |  3 Days |  English

 University Mohammed VI Polytechnic – Benguerir Campus

**UM6P**



# Executive Education Science & Technology



**The Executive Education Science & Technology (Exed S&T) program at Mohammed VI Polytechnic University (UM6P)** supports executive leaders in Morocco and Africa in their development goals through diverse training programs led by recognized experts. Focused on science and technology domains such as digital, sustainable development, mining, renewable energy, Industry 4.0, and more, these courses enable participants to gain advanced knowledge and develop unique expertise in the market. This is achieved through a favorable, flexible, creative, and stimulating learning environment that encourages practical application through business cases.

Centered around science and technology, these programs align with UM6P's pedagogical project, bringing it closer to the realities of professionals. They also rely on high-quality multidisciplinary scientific research.

## An Ecosystem for Research, Innovation, and Real-Scale Experimentation





# Program

## Summary

Carbon capture, utilization, and sequestration, CCUS, has the potential to be established as a huge knowledge-based industry incentivized by the need to cut 7% per year to meet the 1.5 °C global warming targets. CCUS is now recognized as a key tool for decarbonizing the hard-to-abate industry (e.g., phosphate, cement, waste-to-energy). Cheap renewable energy is key for enabling the massive deployment of such an industry while maximizing its environmental performance.

In this aspect, Africa is well positioned for accommodating the different value chains of the CCUS industry, given the large renewable energy potential, sequestration and mineralization resource availability, as well as the complementarity with the different priorities of the green hydrogen economy, biogenic energy, and water management. CCUS can boost those priorities, both as an enabler (e.g., use of the captured CO<sub>2</sub> from hard-to-abate industry to produce renewable methanol, jet fuel, green chemicals & fertilizers) and for waste handling. Carbon-negative pathways are also on the rise worldwide, driven by the need to suck CO<sub>2</sub> from the atmosphere, bringing large opportunities in the carbon credit market.

The deployment of CCUS can mitigate the negative impact of the newly established CBAM (Carbon Border Adjustment Mechanism) taxation being applied by the EU on imports, risking reducing African industry competitiveness, through increased costs.

## Description

CCUS is a knowledge-based decarbonization pathway dictating acquiring specific engineering skills and a minimum understanding of the correct context (dependence on the hosting industry, geographical, political, legislative, and social).

This material will deliver a comprehensive education program on CCUS value chains for industrial decarbonization with dedicated training by experts to enhance the knowledge, skills, and mindset thinking of participants.

# Program



## Key Benefits

This is a unique, comprehensive program, blending several disciplines and methods, to assess CCUS value chains for industrial decarbonization purposes within an entrepreneurial mindset aiming to maximize the environmental benefits while maintaining economic and social growth.

## Who Should Attend?

Engineers, energy & industrial consultants, environmentalists, geologists, chemists, entrepreneurs,  
**NB.** A minimum master or engineering degree is accepted to enroll in the program.

## What you will learn

This education program provides comprehensive material covering the CCUS value chain, addressing all the aspects affecting its industrial deployment (technical, economic, environmental, social, legislative, and financing). It will provide an introduction to the context of decarbonization and the role CCUS will play, as well as introduce the audience to the different technologies and CCUS pathways with the link to the targeted CO<sub>2</sub> industrial source, their involved costs, and environmental performance, then finishing with the required legislation, social & financing frameworks for deployment of such an industry.

## The Courses

The program is articulated around six modules:

- 1 Carbon accounting, certification, market & Financing
- 2 CO<sub>2</sub> Capture from the different sectors
- 3 CO<sub>2</sub> handling, sequestration & utilisation
- 4 Chemical engineering in CCUS
- 5 Techno-economics of CCUS
- 6 Life Cycle, social, & policy assessments

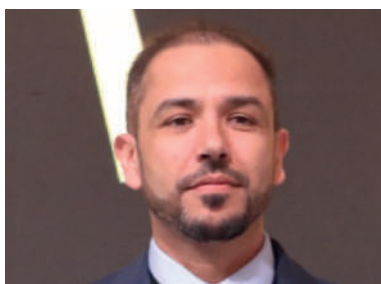
# Speakers

## Pr. Abdelghafour ZAABOUT



Prof. Abdelghafour Zaabout is coordinating CCUS research efforts at Mohammed VI Polytechnic University, focusing on hard-to-abate industry decarbonization and carbon-negative energy solutions. He holds a Ph.D. in mechanical engineering (Fluidization) from Aix-Marseille University in France. He has over a decade of deep experience from Norway (Senior Scientist at SINTEF) and the Netherlands (a Postdoc at Eindhoven University of Technology) in development, upscaling, and commercialization of CCUS technologies, through several Norwegian and European projects. His activities covered various low-carbon technologies (e.g., blue and carbon-negative hydrogen production, decarbonization of hard-to-abate industries, Direct Air Capture, Power-to-X, etc.).

## Pr. Youssef BELMABKHOUT



Pr. Youssef BELMABKHOUT is a Full Professor of Chemical and Process Engineering for Energy and Environment and Director of Applied Chemistry & Engineering Research Center of Excellence (ACER CoE) at Mohammed VI Polytechnic University (UM6P). He has a Ph.D. in Applied Sciences from the University of Mons (Belgium). Pr. Belmabkhout's doctoral expertise covers various aspects of reactive and non-reactive adsorption. He also holds a Chemical Engineering degree (oil and gas technologies) from the Gubkine «Russian State University of oil and gas in Moscow (Russia). Before he was appointed a professor at UM6P, Pr. Belmabkhout occupied a senior research scientist at KAUST and a few months in ICPET-NRC (Ottawa, Canada). He also held a research associate position in the chemistry department at the University of Ottawa (Ontario, Canada).

# Speakers

## Pr. Jamal CHAOUKI



Pr. CHAOUKI is full professor at Polytechnique, Montréal. He is an affiliated professor at UM6P.

He has supervised 53 PhDs and 52 PhDs. He published more than 450 articles in refereed journals and more than 320 in different reviewed proceedings and edited 34 books. He has 50 patents on different processes. He is a member of the Canadian Academy of Engineering. He received many awards.

He received the R.S. Jane Memorial Award in 2019 for an exceptional achievement to the field of chemical engineering or industrial chemistry in Canada and in 2020 the “Excellence in Research and Innovation Awards” at Polytechnique. Last year he received the SCI Kalev Pugi Award and Honoris Genius 2021 Innovation from OIQ. He is internationally recognized for his skills in process development and scale-up.

He has created 6 start-ups with his students (the last are Pyrowave and PyroCycle). His work is mainly dedicated to developing processes from waste, biomass, and complex feedstocks to heat & power, fuels, and chemicals.

## Prof. Matteo Romano



Matteo Romano is full professor of Systems for Energy and Environment at the Department of Energy of Politecnico di Milano, where he is a member of the Group of Energy Conversion Systems ([www.gecos.polimi.it](http://www.gecos.polimi.it)). He holds an MSc in Environmental Engineering and a PhD in Energy Engineering.

His research work focuses on supporting the development of medium/low-TRL technologies for CO<sub>2</sub> capture in various industrial sectors (cement, iron and steel, hydrogen, bioenergy) through process engineering and techno-economic analyses.

Matteo has published more than 130 scientific papers, about 100 of which on technical and economic analysis of CO<sub>2</sub> capture technologies. He is associate editor of the Elsevier International Journal of Greenhouse Gas Control.

## Speakers



### Dr. Ana Ramos



Doctor Ana Ramos is a senior researcher at INEGI - Institute of Science and Innovation in Mechanical and Industrial Engineering focused on developing Waste-to-Energy strategies for the sustainable production of renewable energy.

She holds a Chemistry degree, a MSc in Environmental Analytical Chemistry, and a PhD in Environmental Engineering from the University of Porto. After having worked and developed studies in the fields of circular economy and sustainability, her most recent research covers the assessment of Waste-to-Energy schemes, evaluating the environmental and socio-economic aspects of the techniques, namely for the thermal conversion of biomass and municipal solid wastes through gasification-assisted solutions.

Circa 50 scientific publications in peer-reviewed journals were achieved throughout her career, 2 guest-edited special issues and a book chapter. Dr. Ramos has been supervising MSc and PhD students, as well as coordinating and lecturing advanced training courses, mainly related to the Circular Economy & Sustainability and to the Industry Decarbonization themes. Doctor Ramos is INEGI's representative in the European Partnership Processes4Planet (A.SPIRE network), also leading working and discussion groups in international consortia to support industry and technology development, while leveraging business, research and innovation.

# Speakers



**Miss Tasnime Mansouri**

Miss Tasnime Mansouri is a senior water and environmental engineer with 08 years of experience. Currently, she works at the German development cooperation GIZ as a technical advisor on the green transition of the private sector.

She leads the awareness campaigns for SMEs on new decarbonization regulations, promoting understanding and compliance (Carbon accounting, Reduce CO2 emissions and Carbon reporting) in Tunisia. Tasnim has a strong interest in the challenges related to global warming, energy, and the environment. The projects she has followed, the technical experience she has acquired, and the training courses she has attended have led her to acquire a broad and multidisciplinary knowledge base that widened her understanding of the complexity and the systemic nature of environmental, energy, and climate issues.

**Dr. Mohammed Abu Zahra**



Prof. Mohammad Abu Zahra joined the Global CCS Institute in January 2022 as Head of Middle East North Africa (MENA) region, bringing 18 years of deep experience and international expertise in the Carbon Capture field. Prof. Abu Zahra is also an experienced university professor and a current member of the UN Council of Engineers for Energy Transition (CEET). Previous responsibilities included the management of projects in carbon dioxide capture and CCS integrated systems, consultancy, chemical engineering, and process design.

Prior to joining the Institute, Prof. Abu Zahra worked as a professor and CO2 capture research leader at Masdar Institute and Khalifa University (2011-2022). He worked at the International Energy Agency Greenhouse Gas R&D Programme (IEAGHG) as a project manager for the carbon capture and integrated energy systems team.

the Young African Researchers Award by the Egyptian Academy of Science, Research, and Technology (ASRT).»



# Speakers



## Prof. Kumar Patchigolla



I am recently appointed Professor of Decarbonisation of Industrial Clusters at NZIIC, expertise in renewables, hydrogen and carbon capture. Prior to that he was at Cranfield served for 14 plus year and has been worked on wider energy systems development.

His current research leverages fundamental blue-sky research to top level industrial demonstrations from a range of multidisciplinary areas based on 3 key pillars- efficiency improvements, CCUS and hydrogen for decarbonising any industrial sectors, and energy storage and renewables provide flexibility in its operation. His efforts so far aimed at addressing whole system analysis under net zero agenda to different sectors from power generation to domestic heat provision. Along with these his research group is designing, building, and demonstrating pilot scale cryogenic hydrogen (20K) system with sufficient flow rates to in and out the storage tank via loading and unloading arms to simulate aviation and maritime operations.

In addition, his research portfolio covers designing, commissioning and running several pilot scale. high temperature and high -pressure capabilities - high temperature storage (molten salt), medium temperature storage (PCM), thermal driven absorption chiller (Li-Br), low temperature storage (rock bed), cryogenic PCM storage, combustion/gasification/pyrolysis systems, CO2 transportation - pipeline and shipping, capture of CO2, heat recovery, renewables (CSP and solar thermal) and green hydrogen generation. This is all for the vision of carbon neutral and sustainable fuel generation and its utilisation.

## Speakers



### **Prof. Mamoun Al-Rawashdeh**



Dr. Ma'moun Al-Rawashdeh is a Chemical Engineering assistant professor at Texas A&M University at Qatar.

His research aims to make circular and sustainable fuels and chemicals by developing unconventional reactors and novel process technologies. His research projects are all conducted with leading international industrial companies on applications such as low-carbon methane conversion to hydrogen and fuels, electrified reactors for chemical energy storage, and shipping decarbonization.

Dr. Al-Rawashdeh comes from an industrial background working 7 years at Jordan's Refinery, Institute fur Mikrotechnik Mainz GmbH in Germany, and Albemarle Catalyst Company in the Netherlands. He successfully led the last in two industry-academic consortiums, commercialized three hydro-processing catalysts to the production scale, and led many R&D projects related to different types of reactor designs, heterogenous catalyst manufacturing, and testing.

# Speakers



**Prof. Khalid Amrouch**

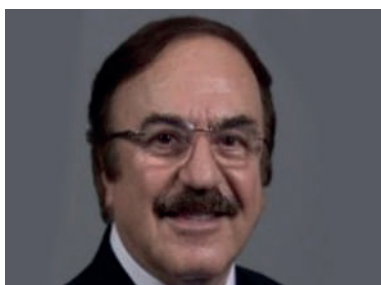
Khalid Amrouch is a Structural Geologist with expertise in Brittle Deformation and Geomechanics, and his main interest relates to brittle tectonics, fracture characterisation, stress analyses, and fluid pressure evolution.

His work within these disciplines focuses on several key research questions: Reconstruction of 4D stress patterns using analyses of faults, fractures, rock mechanics and calcite twins ; 4D Quantification of stress magnitudes in orogenic settings from the scale of the individual structure to the scale of the entire fold belt or foreland basin ; Understanding of the kinematics of faulting and related stress field perturbations and Overpressure evolution in geological time and at a Geo-Reservoir life-time (subsurface resources, subsurface gas storage, including permanent CO2 storage).

Khalid has a Phd, MSc and BSc Hons from Sorbonne University. He started his career in 2005 at the IFP (Institut Français du Pétrole Energie Nouvelle, which sponsored his studies), followed in 2010 by a position as Researcher at Mines ParisTech (PSL University). In 2012 he joined BHP as Exploration Geologist before integrating the Australian School of Petroleum & Energy Resources - Uni. Of Adelaide (ASPER) in 2013 as Assistant Prof. and then as Associate Prof. since 2018. In 2023, Khalid joined the UM6P (GSMI) as Associate Professor (while still holding an Adj. Associate Professor position with UoA), mainly working on Subsurface Resources' associated questions.

# Speakers

## Prof. Muthanna H. Al-Dahhan



Dr. Muthanna H. Al-Dahhan is professor of the Chemical & Biochemical Engineering Department, and Professor of Nuclear Engineering at Missouri University of Science and Technology - Rolla, since January 2009 and he was a chair of the Chemical & Biochemical Engineering department until June 2019.

He received his doctoral degree from Washington University in 1993, his M.Sc. degree from Oregon State University in 1988 and his B.Sc. degree from the University of Baghdad in 1979; all in chemical engineering. After a short industrial experience as a project manager with Xytel Corporation, he joined Washington University, Department of Energy, Environmental and Chemical Engineering from 1994 till December 2008 as a faculty member (2005 full professor with tenure; 2002 associate professor with tenure). His research activities are related to advancing the knowledge and understanding of multiphase reaction engineering via advanced measurement and computational techniques with applications on sustainable energy and environment, production of clean energy, bio-energy, fuels, chemicals, biomass and coal conversion and clean utilization, wastes treatment, and thermal-hydraulics of environmentally responsible and risk free proliferation nuclear energy using 4th generation nuclear power, small modular nuclear reactors, and light water reactors sustainability.

He has developed a unique research lab in the USA and the world comprised gamma ray imaging techniques for multiphase reactors and flow systems complemented with other sophisticated techniques for transport and kinetic parameters measurements using lab to pilot plant scale rigs. He initiated and led several pioneering projects and supervised a large number of post-doc fellows and undergraduate students on a wide range of topics. His research activities include more than 240 publications in refereed scientific and technical journals and over 500 of national and international conference presentations. He gave a large number of invited talks in industry, academia and national labs, plenary and keynote lectures.

## Speakers



Dr. Al-Dahhan has received many national and international awards. Also, his graduate and undergraduate students received many awards for the work done under his supervision. He formed and chaired a number of international conferences on various topics related to energy and environment. He is a member of several scientific conference boards. Also, a Fellow of the American Institute of Chemical Engineers, the American Society of Engineering Education and the American Chemical Society.

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