Sustainable Water Management Doctoral Programme (Water4All)

Title of the PhD Project	CO_2 Capturing from Flue Gas via $CaCO_3$ Inducing Microorganisms
Acronym	CaptureAlg
Research Fields of the Project	Molecular Biology, Microbial Ecology, Bioreactor Engineering, Biosystems Engineering
Keywords	Carbon mitigation, co-culture, microalgae, flue gas
Host Institution, Department and Campus Location	Istanbul Technical University, Department of Environmental Engineering, ITU Ayazaga Campuss, Maslak, 34467 Istanbul
PhD Awarding Institution and Graduate Programme	Istanbul Technical University, Graduate School, PhD in Department of Environmental Engineering
Name and Affiliation of Main Supervisor	Assoc. Prof. Dr. Mahmut Altınbaş
Name and Affiliation of Co-Supervisors	Dr. Ece Polat
Research Environment and Infrastructure	Istanbul Technical University is an institution that plays a leading role in science, technology, arts, and sports. ITU aims to be the center of science, which connects the past to the present by producing projects for the future. The ITU Environmental Engineering Laboratories (https://cevmuhlab.itu.edu.tr) consist of 2400 square meters of management offices, 2300 square meters of research laboratories, and 350 square meters of student laboratories. The ITU Environmental Engineering department has 17 different laboratory infrastructures, including Molecular Biology Laboratory, Instrumental Analysis Laboratory, and Physical Processes Laboratory.
Scientific Context of the Project	The carbon emission problem is complex and multidimensional globally. The carbon emission problem refers to environmental problems caused by excessive amounts of carbon dioxide (CO_2) and other greenhouse gases released into the atmosphere. These gases can affect various ecosystems, climate, and human health, contributing to global warming and climate change. Burning fossil fuels, industrial activities, and other anthropogenic factors release large amounts of greenhouse gases into the atmosphere. These gases capture the sun's rays and increase the temperature of the atmosphere, leading to global warming. Global warming is also called climate change and can result in significant changes in climate patterns around the world. Climate

	change can affect water resources, and extreme weather events such as droughts or floods can threaten water and food supplies. This can cause water and food safety issues. Industrial processes such as replacing fossil fuels with renewable energy sources and carbon capture and storage technologies can reduce carbon emissions from energy production and industrial activities. In addition, microorganisms, which have significant functions in the carbon cycle and soil health, are also important alternatives in the fight against carbon emissions. Microalgae can produce energy through photosynthesis by taking carbon dioxide (CO_2) from the atmosphere and converting carbon into biomass in the process. These roles of microalgae indicate significant potential for sustainable energy production and environmental protection. However, technological advancements and improvements in manufacturing processes may be required to increase its commercial viability. This study will examine the development of microalgae communities with high carbon dioxide retention capacities that live symbiotically with bacterial cultures. It will also examine the genetic manipulation of the selected microalgae species focusing on rubisco and Calvin cycle.
Brief Workplan	Isolation of bacteria and microalgae cultures with high carbon capture capacity, development of co-cultures capable of capturing large amounts of carbon, characterization of metabolites, analysis of the expression level of genes related to the carbon metabolism of the cultures, and modify carbon capture pathways
Innovative Aspects of the Project	To improve carbon sequestration capacity, indigenous species with high carbon sequestration capacities will be identified, stress environments will be developed for co-cultures, and a genetic modification considering carbon fixation and CO2 acceptor molecules in rubisco will be applied.
Training Opportunities of the Project	The researcher will be trained in the area of strain isolation, molecular biology techniques, and microalga cultivation in conjunction with biomolecule and metabolite characterization. There will be an opportunity for participation of the researcher in field studies.
Interdisciplinary Aspects	This highly multidisciplinary project involves molecular biology (DNA sequencing, gene expression), chemical biology (metabolomics and metabolic engineering techniques), analytical biotechnology (characterization and purification techniques), bioreactor engineering (bioreactor designing techniques).
Intersectoral Mobility **☒ Short Visit**	Host: RS Research Context of Mobility: Training in sequencing and analytical biotechnology

☐ **Secondment**	
Intersectoral Mobility ☐ **Short Visit** ☐ **Secondment**	TBD
International Academic Secondment	TBD

Main Supervisor	
Brief CV	**Assoc. Prof. Dr. Mahmut ALTINBAŞ** **E-mail:** altinbasm1@itu.edu.tr **Academic Degrees** Ph.D. Environmental Engineering, Istanbul Technical University, Türkiye 2007 M.Sc. Environmental Engineering, Istanbul Technical University, Türkiye 2000 B.Sc. Environmental Engineering, Istanbul Technical University, Türkiye 1997 **Professional Networks** Google Scholar: https://scholar.google.com/citations?user=xqbpVMYAAAAJ&hl=en&oi=ao ResearchGate: https://www.researchgate.net/profile/Mahmut-Altinbas Scopus: https://www.scopus.com/authid/detail.uri?authorId=23003289800 ORCID: https://orcid.org/0000-0003-3946-741X
Co-supervisors	

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Brief CV	**Dr. Ece Polat** **E-mail:** polatec@itu.edu.tr **Academic Degrees** Ph.D. Environmental Biotechnology, Istanbul Technical University, Turkey 2023 M.Sc. Environmental Engineering, Gebze Technical University, Turkey 2019 M.Sc. NanoScience & NanoEngineering, Istanbul Technical University, Turkey 2012 B.Sc. Environmental Engineering, Istanbul Technical University, Turkey 2011 B.Sc. Molecular Biology and Genetics, Istanbul Technical University, Turkey 2011 **Professional Networks** Google Scholar: https://scholar.google.com/citations?user=ACCXc0oAAAAJ&hl=tr ResearchGate: https://www.researchgate.net/profile/Ece-Polat Scopus: https://www.scopus.com/authid/detail.uri?authorId=57189055721 ORCID: https://orcid.org/0000-0001-7173-9126