Transilvania University of Brașov
INTERDISCIPLINARY DOCTORAL SCHOOL

ADMISSION TO DOCTORAL STUDIES Session September 2025

Field of doctoral studies: Environmental Engineering
Doctoral supervisor: Prof. Dr. Luminița ANDRONIC

TOPICS FOR THE ADMISSION TO DOCTORAL STUDIES

TOPIC 1:

Assessing the economic, environmental, and social impact of Nature-Based Solutions (NbS) through life cycle approaches

Contents / Main aspects to be considered

This research aims to analyze the efficiency and economic feasibility of Nature-Based Solutions (NbS) compared to conventional alternatives. NbS are recognized for their contributions to climate resilience, biodiversity protection, and resource sustainability. The study will use SimaPro software to conduct a comprehensive assessment of the impact of these solutions, focusing on life cycle assessment (LCA), life cycle costing (LCC), and social life cycle assessment (s-LCA) in addition to cost-benefit analysis to conduct a comprehensive assessment of the impact of these solutions.

Recommended bibliography:

Tsatsou, A.; Frantzeskaki, N.; Malamis, S. Nature-Based Solutions for Circular Urban Water Systems: A Scoping Literature Review and a Proposal for Urban Design and Planning. *J. Clean. Prod.* **2023**, *394*, 136325. https://doi.org/10.1016/j.jclepro.2023.136325.

Kisser, J.; Wirth, M.; De Gusseme, B.; Van Eekert, M.; Zeeman, G.; Schoenborn, A.; Vinnerås, B.; Finger, D. C.; Repinc, S. K.; Bulc, T. G.; Bani, A.; Pavlova, D.; Staicu, L. C.; Atasoy, M.; Cetecioglu, Z.; Kokko, M.; Haznedaroglu, B. Z.; Hansen, J.; Istenič, D.; Canga, E.; Malamis, S.; Camilleri-Fenech, M.; Beesley, L. A Review of Nature-Based Solutions for Resource Recovery in Cities. *Blue-Green Syst.* **2020**, *2* (1), 138–172. https://doi.org/10.2166/bgs.2020.930

Seddon, N.; Chausson, A.; Berry, P.; Girardin, C. A. J.; Smith, A.; Turner, B. Understanding the Value and Limits of Nature-Based Solutions to Climate Change and Other Global Challenges. *Philos. Trans. R. Soc. B Biol. Sci.* **2020**, *375* (1794). https://doi.org/10.1098/rstb.2019.0120

Prerequisites: *While a background in Environmental Engineering, Materials Science, Chemistry, Biology, or Agronomy is recommended, candidates with related degrees or interdisciplinary backgrounds may also be considered based on their qualifications and research interests.*

■ **Scientific Doctorate (full-time only)**
☐ **Professional Doctorate (full-time or part-time)**

■ **without tuition fee (state budget funded)**
■ **with tuition fee or with funding from other sources than the state budget**

TOPIC 2: *Development of solar-driven processes for the photocatalytic conversion of CO_2 into fuels and high-value chemicals*

Contents / Main aspects to be considered This research project focuses on the innovative development of a solar-driven process for the photocatalytic conversion of carbon dioxide (CO_2) into sustainable fuels and high-value chemicals, aligning with the Circular Economy and Environmental Sustainability principles. The escalating levels of CO_2 and the pressing need for renewable energy sources have propelled the search for efficient, environmentally friendly solutions that can mitigate climate change impacts while providing economic benefits. The project aims to harness solar energy to activate a photocatalytic process that transforms CO_2, a predominant greenhouse gas, into various valuable products such as methane, synthesis gas, and hydrocarbons. This approach not only seeks to reduce atmospheric CO_2 levels but also to create a sustainable raw material base for the chemical industry, thus contributing to a circular economy model. The project intends to improve the efficiency and selectivity of the CO_2 conversion process by developing and optimising catalysts and identifying effective additives. This involves comprehensive research on environmental engineering, materials science, reaction mechanisms, and system integration to design a scalable and economically viable solar-powered recycling process. The outcomes of this project are expected to pave the way for groundbreaking advancements in CO_2 utilisation technologies, offering a dual benefit of mitigating climate change and contributing to a sustainable, zero-emission economy. Through this initiative, we aim to demonstrate the feasibility of converting CO_2 into fuels and chemicals, thereby closing the carbon loop and fostering environmental resilience.

Recommended bibliography:

Ma, Y, Wang, S & Duan, X. 2023. Recent advances in direct gas–solid-phase photocatalytic conversion of CO_2 for porous photocatalysts under different CO_2 atmospheres. *Chemical Engineering Journal*. 455:140654. http://doi.org/10.1016/j.cej.2022.140654

Nascimento, LL, Carvalho Souza, RA, Zacour Marinho, J, Wang, C & Patrocinio, AOT. 2024. Light-driven conversion of biomass-derived compounds into green fuels and chemicals. *Journal of Cleaner Production*. 449:141709. http://doi.org/10.1016/j.jclepro.2024.141709.

Paulista, LO, Ferreira, AFP, Rodrigues, AE, Martins, RJE, Boaventura, RAR, Vilar, VJP & Silva, TFC V. 2024. Solar thermo-photocatalytic methanation using a bifunctional RuO_2:TiO_2/Z13X photocatalyst/adsorbent material for efficient CO_2 capture and conversion. *Journal of Environmental Chemical Engineering*. 12(3):112418. http://doi.org/10.1016/j.jece.2024.112418

Yuan, Z, Zhu, X, Gao, X, An, C, Wang, Z, Zuo, C, Dionysiou, DD, He, H, et al. 2024. Enhancing photocatalytic CO_2 reduction with TiO_2-based materials: Strategies, mechanisms, challenges, and perspectives. *Environmental Science and Ecotechnology*. 20:100368. http://doi.org/10.1016/j.ese.2023.100368.

Prerequisites: *While a background in Environmental Engineering, Materials Science, or Chemical Engineering is recommended, candidates with related degrees or interdisciplinary backgrounds may also be considered based on their qualifications and research interests.*

■ **Scientific Doctorate (full-time only)**

☐ **Professional Doctorat (full-time or part-time)**

■ **without tuition fee (state budget funded)**

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Doctoral supervisor,

Prof. Dr. Luminița ANDRONIC

Coordinator of the field of doctoral studies,

Prof. Dr. Luminița ANDRONIC