University of Antwerp

GHENT UNIVERSITY

KU LEUVEN

MASTER'S THESIS TOPIC PROPOSALS

2026-2027

Master Bioscience Engineering:
Sustainable Urban Bioscience Engineering

Overview

Title of the thesis topic	Competitive local water reuse with a novel MABR-MBR bioreactor combination: Towards full scale
Keywords	water reuse, novel bioreactor, energy efficiency, membrane aeration, membrane filtration

Description

Water scarcity is on the rise; water stress and frequent droughts inspire the search for alternative water sources. An omnipresent water source is wastewater; its re-use after treatment is increasingly implemented. While domestic water re-use seems most obvious, the drive for (innovation in) sustainable water supply in industrial sectors is much higher. This is due to their reliance on water for their production, the more strict water discharge norms and water intake limits during periods of droughts. One sector where these water problematics have severe impact is the water intensive Food & Beverage industry, which is responsible for ~10% of the total water consumption in Belgium.

The primary method for generating reusable water locally is through membrane bioreactors (MBRs), that combine a bubble aerated biological step for COD & N removal to a filtration, to remove solid materials. However, this technology has its limitations, such as 1) being prone to fouling, 2) not being resistant to load fluctuations 3) its substantially higher operational costs to prevent fouling and clogging, by extensively aerating the biology and filtration membrane tank.

We developed and proofed a concept in the lab that could overcome these issues, namely adapting the use of aeration membranes in MBRs; MA-MBR. Membrane aeration is energy efficient, reducing the aeration energy needs by ~75% (Syron and Casey, 2008). The growth of bacteria in biofilm yielded much more stable N- and COD removal than in suspended systems at 2-4x the rates. The bacteria themselves, being in biofilm on the aeration membranes, would not clog the filtration membranes as much as in the normal MBR. And we could keep the filtration membranes from fouling and clogging with less aeration of the membrane tank, outlining a substantial operational cost benefit.

These results look promising, and this high-tech solution is the foundation of our ambition to start a spinoff company. However, the results must first be replicated in realistic full-scale environment (100-5000 m3). This thesis project aims to set the first step in scale-up, by replicating the benefits of the MA-MBR in a 200 liter pilot scale reactor operated on-site, treating potato processing wastewater. Potato wastewater contains plenty of N & COD to be removed, which will enable us to maximally showcase the benefits of this newly invented technology.

Objectives

This thesis works towards the successful demonstration of technology in the pilot reactor. We will perform multiple long term operational runs producing water of reusable quality from the potato wastewater and compare them to the normal MBR performance to assess N & COD removal, filtration performance and operational stability. This study is crucial to conclude if the benefits previously found are scalable towards industrial size.

You will work in a small team with members working on this technology with biotechnological, economic and electromechanical backgrounds. Together, you will realize and operate a working pilot reactor. You will be responsible for the general performance of the reactor, sampling and maintaining the pilot 2 times per week, and analysing the samples in our lab in Antwerp. You will also collect the on-line data that will show us the filtration performance. Finally, you will take the lead in understanding, interpreting and reporting the data.	
Related to CityLab	CityLab 1: The Urban Ecosystem CityLab 2: Urban Resources
Relevance to urban challenges and/or applications This high tech solution is highly relevant for concepts such as Flanders in transition as allows for, once realized, compact treatment of wastewater and reuse close to source. Water re-use is a crucial step in reducing water stress in densely populated areas such as flanders, and industrial (food and beverage) has more market pull for innovative water treatment technologies than domestic treatment due to the push of legislative limits by VMM for water extraction and effluent quality standards. Finally, the transition from lab scale to piloting and full scale application is a great challenge, and working in this interdisciplinary team will give the student a good overview of the hurdles to be tackled.	
Max. number of students	1
Promoter	Siegfried Vlaeminck (siegfried.vlaeminck@uantwerpen.be)
Co-promoter	Tim Van Winckel (Tim.vanwinckel@uantwerpen.be)
Supervisors	Patricia Gutierrez Lozano (patricia.gutierrezlozano@uantwerpen.be), Marijn Timmer (Marijn.timmer@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	Not applicable
Extra information	This is a challenging project with on-site operations. We will provide proper training, but autonomous working and pro-active communication are key for this project. Operation of the reactor will be twice per week, timing are flexible. Lutosa, a large potato processing company, agreed to on-site operation at their facilities; This is exciting and allows for very realistic and high quality data gathering. The site is located in Waregem, and (self-arranged) transport to this location or a driving license to drive our departmental van is a requirement to start this project.

Title of the thesis topic	Consumer-Driven Innovation in Microbial Nutrition: The Case of Purple Phototrophic Bacteria
Keywords	Microbial foods, Circular food systems, Sustainable nutrition

Description

As food production becomes increasingly opaque to consumers, society faces growing challenges from climate change, population growth, and disruptions in food supply chains. New biotechnologies are needed to secure sustainable nutrition, and microbial foods offer one of the most promising solutions. They can generate high-quality proteins and bioactive compounds such as vitamin B_{12} and antioxidants with minimal use of land, water, and energy compared to conventional agriculture.

Engineers are central to developing these processes, from bioreactor design to product formulation, yet technological success alone does not guarantee public acceptance. Research on novel food technologies shows that adoption depends strongly on trust, transparency, and perceived naturalness. Understanding these perceptions helps engineers create food systems that are both efficient and socially accepted.

This MSc thesis examines the acceptance of purple phototrophic bacteria (PPB) as a potential microbial food source. PPB can convert light and diverse carbon sources, including CO_2, power-to-X intermediates, and sugars, into protein- and antioxidant-rich biomass. Although not yet approved for human consumption under EU Novel Food Regulation, they hold strong potential as safe and nutritious ingredients for sustainable urban food systems. The student will develop realistic PPB-based product scenarios (ingredient, supplement, meat alternative, etc.) and test them through a choice-based conjoint experiment with Flemish citizens. Statistical modelling using hierarchical Bayes and latent-class segmentation will quantify willingness to try and willingness to pay, identifying key product attributes and consumer segments. The results will support the design of market introduction strategies for microbial foods and provide valuable insights for policy advisory on novel food communication and acceptance.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

Urban areas concentrate most of the world's population and food demand while relying heavily on external agricultural production. This dependency creates environmental pressure, high carbon footprints, and vulnerability to supply disruptions. Developing microbial foods based on purple phototrophic bacteria (PPB) offers a local and circular alternative that can be integrated into urban biorefineries and resource recovery systems. PPB can valorize CO_2, organic residues, and renewable hydrogen into protein- and antioxidant-rich biomass, reducing the need for imported feedstocks.

Understanding consumer acceptance of such microbial foods is essential for their implementation in urban environments, where social acceptance, trust, and perceived naturalness strongly influence food innovation. The project thus connects biotechnology and behavioural research to support resilient, transparent, and sustainable urban food systems.

Max. number of students	1
Promoter	Siegfried Vlaeminck (siegfried.vlaeminck@uantwerpen.be)
Co-promoter	Ingrid Moons (ingrid.moons@uantwerpen.be)
Supervisor	Luis Diaz Allegue (Luis.DiazAllegue@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	The thesis follows a social-science and design-based approach, so no laboratory experiments are required. The main activities—survey design, data collection, and statistical analysis—can be planned flexibly around the student's internship period.

Title of the thesis topic	CSO treatment wetlands: impact of fine suspended solids
Keywords	combined sewer overflows; treatment wetlands; solids load; clogging

Description

Combined sewer overflows (CSOs) are a major source of water pollution during periods of heavy and prolonged rainfall. Since the revision of the European Urban Wastewater Treatment Directive entered into force in 2024, EU Member States are required to drastically reduce discharges of untreated CSOs. One of the most effective solutions to treat CSO water consists of treatment wetlands, which are part of the broader group of nature-based solutions. Such treatment wetlands have already been implemented in several countries and enable partial removal of solid particles and dissolved pollutants as well as reducing hydraulic pressure, thereby significantly improving surface water quality and mitigating impacts on river morphology.

In this thesis project, we will investigate the role of fine suspended solids in terms of clogging. This will involve analyzing samples from real CSO's (particle size distributions) as well as operating a column setup in the lab.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

Urban water cycle problems and solutions (including nature-based ones) are discussed in CL2.

Max. number of students	1
Promoter	Diederik Rousseau (diederik.rousseau@ugent.be)
Supervisor	*PhD student will start on 1/1/2026*
Research project abroad?	No
Compatibility with internship	No issues specified
Extra information	This topic requires a regular (3-4 days per week) presence at UGent Campus Kortrijk. Experience with water quality analyses is a plus. Having a driving license is also a plus.

Title of the thesis topic	Cut-Through Traffic in Street Canyons and Its Impact on Urban Air Quality
Keywords	Traffic ; air quality ; health

Description

Cut-through traffic—motorized vehicles diverting from main roads into residential streets—is an important determinant of living quality. This thesis will investigate these traffic flows with particular focus on street canyons, where building geometry and limited ventilation may exacerbate pollutant concentrations. Because surprisingly little data on cut-through traffic exists for Antwerp, the research will help fill a critical knowledge gap at the intersection of mobility and public health. Moreover street canyons represent a critical challenge in view of the more stringent EU air quality regulations that will come into effect in 2030. The project will be carried out in collaboration with Recht op Lucht, a local organization actively engaged in air-quality advocacy and mobility research, ensuring strong links to real-world policy debates and community concerns. The specific methodology will depend on the student's interests and strengths. Possible pathways include: air-quality modelling; data-driven approaches (e.g., scripting pipelines to retrieve, process, and visualize traffic or floating-car data, or integrating open mobility datasets); or fieldwork-oriented research focusing on localized air-quality measurements in suspected hotspots.

Related to CityLab	CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

Urban mobility is both a sustainability challenge and an opportunity. The combination of high population densities and large volume of motorized traffic makes it one of the prime determinants of health and living quality in cities. At the same time, proximity to services and the openness to change make cities hotspots of innovative mobility solutions (from bike sharing to congestion pricing). Cut-through traffic and air quality in street-canyons is an urban sustainability topic par excellence.

Max. number of students	1
Promoter	Tom Cox (tom.cox@uantwerpen.be)
Co-promoter	Tom Tytgat (tom.tytgat@uantwerpen.be)
Supervisor	Marjan Demuynck (marjan.demuynck@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	No issues specified

Title of the thesis topic	Does a multisensory VR nature experience work better for improving emotional health?
Keywords	Urban green spaces, well-being, wearables, virtual reality

Description

Connecting with nature enhances both physical and mental well-being, but in urban areas many people face barriers to accessing natural environments due to mobility limitations, urban design constraints, or a lack of nearby green spaces. Virtual reality (VR) may offer a promising solution by providing immersive, nature-based experiences that replicate outdoor environments. However, most studies have focused only on the visual dimension, whereas very few have explored the effects of multisensory VR nature experiences those incorporating visual, auditory, olfactory, and tactile elements on individuals' physiological responses. In particular, little is known about their impact on Electrocardiography (ECG) measures, which are related to emotional valence and arousal. This raises a central question: Does a multisensory VR nature experience work better for improving emotional health?

In this study, we will first examine the use of VR technology within environmental psychology. Next, we will employ tools such as panoramic cameras and Unreal Engine software to capture and construct realistic, immersive virtual natural settings. Finally, we will conduct a laboratory experiment to compare participants' physiological and psychological responses between a single-sensory (primarily visual) and a multisensory VR nature experience. To achieve this objective, a series of facilities will be used, including climate rooms, Meta Quest 2 headsets, and the Zephyr Bioharness to better control the experimental environment and accurately measure cardiac activity. Psychological measures will also be included.

This research aims to evaluate the potential advantages of multisensory virtual nature experiences compared to single-sensory ones. Our findings may contribute to a deeper understanding of VR's role in health-related applications of nature exposure and its potential use in therapeutic contexts.

Related to CityLab	CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

This topic contributes to a deeper understanding of VR's role in health-related applications of nature exposure in cities and its potential use in therapeutic contexts

Max. number of students	1
Promoters	Jean-Marie Aerts (jean-marie.aerts@kuleuven.be) & Ben Somers (ben.somers@kuleuven.be)
Supervisor	Yangyang Shi (yangyang.shi@kuleuven.be)
Research project abroad?	No

Compatibility with internship	No issues specified
Extra information	We expect participants in this study to have a strong interest in the topic, enthusiasm for working with wearable sensors, and a commitment to interdisciplinary collaboration. Proficiency in Dutch would be preferred.

Title of the thesis topic	Exploring microbial transfer from urban green spaces to humans
Keywords	Beneficial microorganisms, Urban health, Biodiversity hypothesis, Immune balance

Description

Ongoing urbanization has been linked to a rise in allergies and other immune-related diseases. According to the biodiversity hypothesis, reduced contact with nature and its diverse microbial communities can lead to immune dysregulation. Restoring this contact, such as through contact with urban green areas (UGAs), may help restore this immune balance. However, it remains unclear which types of activities effectively promote microbial transfer to the human microbiome - for instance, is simply walking through a park, without direct interaction, sufficient? This project explores the passive transfer of microorganisms upon urban nature exposure, to improve urban planning and support urban health.

The student will organize citizen science workshops in the context of the BUGS (Benefits of Urban Green Spaces) project at Middelheimpark in collaboration with Middelheimmuseum (open air museum), where art and nature come together. Participants will self-collect skin and nasal swabs before and after visiting the park-museum, while the student will collect environmental samples to identify microorganisms transferred during exposure. Additionally, it is expected that the student supports lab work focusing on microbial DNA isolation and 16S rRNA sequencing preparation, although experience with molecular and microbiological lab work is not a strict prerequisite for this thesis. Statistical analyses in R will assess alpha- and beta-diversity and detect specific transferred taxa, as well as shifts in human microbiomes following nature contact. In addition, the student will communicate the (preliminary) results back to the participants, as well as to the broad public via the project's website and social media.

This project offers a unique opportunity to understand how urban nature exposure affects the human microbiome. The student will acquire a wide range of skills, from project coordination (e.g., recruitment, material development) to science communication. In the long term, these insights can guide policies that integrate microbial diversity into urban environments, improving human health in an increasingly urbanized world.

Related to CityLab	CityLab 1: The Urban Ecosystem CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

This project addresses urban challenges by exploring ways of restoring contact with nature and its microbial diversity in an increasingly urbanized world. It aims to uncover how and which microbes transfer from the environment to the human microbiome. These insights will inform urban planning and nature exposure guidelines, helping design healthier, more resilient cities that support human health.

Max. number of students	1

Promoter	Irina Spacova (irina.spacova@uantwerpen.be)
Co-promotor	Roeland Samson (Roeland.samson@uantwerpen.be)
Supervisor	Agustina Santullo Latorre (agustina.santullo@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	The student will perform one workshop in September and process, sequence, analyse the samples afterwards. A second workshop can be organized in December/January.
Extra information	Speaking Dutch may facilitate the communication with citizen scientists and collaborators, but should definitely not be a limiting factor.

Title of the thesis topic	Exposure assessment of food process chemical contaminants from street vended foods in Ethiopia
Keywords	Street-vended foods, Process contaminants, Exposure assessment, Food Frequency Questionnaire (FFQ), Food safety policy

Description

Street-vended foods are increasingly common urban food matrices in developing countries including Ethiopia, yet little is known about the chemical risks associated with their consumption. High-temperature frying, roasting, and grilling can generate process contaminants that has health risk among the consumers. Exposure assessment using accurate consumption data very relevant for estimation of the consumer health risk in street vendors. Context specific exposure survey is essential to conduct risk assessment of process contaminants and to inform mitigation strategies. However, there is gap in exposure assessment of process chemical contaminants of street vended foods including Ethiopia. Hence, in this study, we will conduct exposure assessment of street vended foods in selected cities. The student will engage in data collection using food frequency questionnaire (FFQ) in Ethiopia from mid-August till end of September/beginning of October 2026 (6-8 weeks). Then the student will perform data processing of FFQs and use the contaminant concentration data to estimate the risk of process contaminants (research in Ghent, Belgium). Finally, a proposal for food policy in cities regarding street food in Ethiopia is expected. The study will contribute in determining the risk level of process contaminants and eventually provide evidence-based recommendations to enhance the safety of street vended foods in cities in Ethiopia.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

Street-vended foods are an essential component of urban food systems, especially in rapidly growing cities, where they provide accessible and affordable meals to large populations. However, they also present public health challenges when high-temperature processing leads to chemical contaminants. Understanding consumer exposure is therefore crucial for designing effective urban food safety strategies. This research supports evidence-based policies to improve the safety, governance, and sustainability of street food within dense urban environments.

Max. number of students	2
Promoter	Liesbeth Jacxsens (Liesbeth.jacxsens@ugent.be)
Supervisor	Awrajaw Dessie Zeleke (AwrajawDessie.Zeleke@UGent.be)
Research project abroad?	Yes: Ethiopia

Compatibility with internship	A research project abroad is planned from August until September/October. No professional internship can be planned during that period.
Extra information	Students cannot have a resit exam in August / September. There is a possibility of a scholarship.

Title of the thesis topic	Food Agency and Forgotten Vegetables: Enhancing Urban Food Resilience in South Africa
Keywords	food security, food supply, food preferences, food culture, agricultural economy

Description

Urbanization in South Africa has created a disconnect between the urban diaspora and traditional crops commonly grown by smallholder farmers in rural areas. These “forgotten vegetables” (indigenous or underutilized crops) are typically cultivated on a small scale for household consumption, while most of the farmers’ produce is marketed for income. Despite their cultural significance and nutritional value, urban populations often lack access to these crops, or have even lost awareness of them. Although urban consumers generally have greater purchasing power than rural smallholders, they cannot access these products even if they still know and desire them.

This thesis will investigate how food agency - the ability of individuals and households to make autonomous food choices - can be strengthened in urban settings by reconnecting people with traditional crops. Key research questions include:

- What role do forgotten vegetables play in food agency and cultural identity among rural and urban populations?
- What barriers prevent urban consumers from accessing these crops (e.g., market structures, knowledge gaps, cultural shifts)?
- How can sustainable urban food strategies (e.g., local markets, urban gardens, short supply chains) integrate forgotten vegetables to enhance resilience and autonomy?

The research will combine qualitative methods (interviews, focus groups) with policy and market analysis in Pretoria and the surrounding Gauteng area. Collaboration with local research initiatives will ensure alignment with existing funding and expertise.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

The findings can inform strategies to promote urban food resilience and cultural diversity through sustainable supply chains, contributing to SDGs on food security, health, and sustainable cities.

Max. number of students	1
Promoter	Wannes Slosse (wannes.slosse@ugent.be)
Co-promoter	Marijke D’Haese (Marijke.Dhaese@ugent.be)
Supervisor	Mieke Uyttendaele (mieke.uyttendaele@ugent.be)
Research project abroad?	Yes: the research project will take place at the University of Pretoria, South Africa (guided by Prof. Lise Korsten, Co-

	Director of the Department of Science and Innovation, Centre of Excellence in Food Security located at the Agricultural Sciences Building at the University of Pretoria)
Compatibility with internship	The research project preferably starts in the first semester (but 'to be discussed' to start if needed in the second semester).
Extra information	It is advised to take the advanced elective ‘Sustainable Food Systems’.

Title of the thesis topic	Food Agency and Sustainable Urban Food Systems: Balancing Autonomy and Safety for Vulnerable Groups
Keywords	safety, justice, pathogens, food choice, food governance, stakeholder engagement, food policy

Description

Urban areas face growing challenges in ensuring sustainable, safe, and equitable food systems. Vulnerable populations such as low-income households, refugees, and elderly residents often depend on institutional food provision (e.g., food banks, shelters, care homes). While these systems aim to guarantee food security and safety, they may unintentionally limit individual autonomy and cultural preferences. For instance, in elderly care homes (in Dutch 'woonzorgcentra (WZC)'), the recent pathogen E. coli outbreak raised the question of whether we should still serve vulnerable groups dishes like ‘américain préparé’ (raw meat). Yet food brings joy and is something to look forward to. The emerging concept of food agency, defined as the dimension of food security and food safety which looks at the capacity of individuals and households to make choices and express their voice within the food system, offers a new lens to evaluate these trade-offs.

This thesis will explore how food agency can be integrated into sustainable urban food strategies without compromising food safety. Key research questions include:

- How is food agency currently understood and practiced in urban contexts?
- What tensions arise between food safety regulations and autonomy in food choices for vulnerable groups?
- How can urban food policies and initiatives enhance food agency while promoting sustainability?

The research will combine literature review, policy analysis, and empirical work (e.g., interviews, focus groups, or surveys) with stakeholders in urban settings such as food banks, community kitchens, and care facilities.

Related to CityLab	CityLab 2: Urban Resources CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

The findings can inform urban food policies and interventions that respect cultural diversity, promote autonomy, and maintain safety standards. This way it contributes to sustainable and inclusive cities.

Max. number of students	1
Promoter	Wannes Slosse (wannes.slosse@ugent.be)
Co-promoter	Mieke Uyttendaele (mieke.uyttendaele@ugent.be)
Supervisor	Marijke D’Haese (Marijke.DHaese@UGent.be)

Research project abroad?	No
Compatibility with internship	No issues specified
Extra information	It is advised to take the advanced elective ‘Sustainable Food Systems’.

Title of the thesis topic	Food Safety Concerns and Food Safety Literacy in Urban Environments
Keywords	Foodborne pathogens; foodborne illness; social media; food information communication; consumer study; beliefs; concerns; awareness; food-handling practices

Description

Urbanization has transformed food systems, introducing complex supply chains. Food often travels long distances and passes through multiple handlers before reaching consumers, raising contamination risks. In cities, the popularity of takeaway meals and last-mile delivery might introduce additional vulnerabilities, as these services may lack adequate refrigeration, hygiene practices, and regulatory oversight.

At the consumer level, food safety literacy remains a critical challenge. Many urban consumers are unaware of basic principles such as safe cooking temperatures or proper interpretation of expiry dates. Beliefs and concerns about food safety are often shaped by cultural habits, personal experiences, and information sources - including social media - which can both spread unsafe practices and amplify risk perception unnecessarily.

This master dissertation will explore the interplay between food safety risks and the level of food safety literacy among urban populations and analyse how these might be influenced by information sources. The study aims to identify strategies that enhance consumer awareness and reduce foodborne illness risks and to provide recommendations to cities that offer platforms for campaigns, apps, and community programs to improve awareness on food safety and food literacy.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

This research is highly relevant to urban challenges, as cities are characterized by complex food supply chains and widespread reliance on convenience-based food services, which create distinct vulnerabilities in ensuring microbial food safety. Urban populations also exhibit substantial variation in food safety literacy and are exposed to diverse information sources that can shape consumer concerns and consumer behaviour. By analysing how literacy levels and information sources influence these dynamics, the study will generate insights that support cities in developing evidence-based communication strategies, digital tools, and community programs aimed at strengthening food safety practices and reducing the incidence of foodborne illness in urban settings.

Max. number of students	1
Promoter	Mieke Uyttendaele (mieke.uyttendaele@ugent.be)
Co-promoter	Liesbeth Jacxsens (liesbeth.jacxsens@ugent.be)
Supervisor	Charlie Van Paepeghem (charlie.vanpaepeghem@ugent.be)

Research project abroad?	No
Compatibility with internship	No issues specified

Title of the thesis topic	Green Hydrogen Production
Keywords	Hydrogen, (photo)electrolysis, catalysis

Description

In this thesis you will contribute to new disruptive hydrogen production technologies. Depending on the interests of the student, the work will focus on either catalyst synthesis, reactor development and/or modeling. The research will be conducted at the Verbruggen-lab within the A-PECS research group at the Department of Bioscience Engineering (UAntwerp), under the guidance of an interdisciplinary team of engineers and photo/electro-chemists. At the level of catalyst research, you will actively study new, earth-abundant materials for water splitting, as opposed to the current generation of platinum group metals. You will develop new synthetic methods and test your materials in a lab setting.

In addition, or alternatively, you will focus on new reactor configurations. These can be based on unique compartmentalized photo-electrolyzers developed in our group, that couple oxidative treatment of waste sources, to hydrogen production. These can also be based on a novel type of membraneless electrolyzer that we have recently patented, and that we aim to bring to scale. Flexible engineering using 3D printing techniques will be a key facility.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

The quest for alternative energy carriers in an urban context is a key challenge. These carriers also need to be produced in a sustainable way. Hydrogen has been identified by the EU as an important candidate in this regard, and explorative city-related projects have already been performed (e.g. H2-busses of De Lijn).

Max. number of students	2
Promoter	Sammy Verbruggen (sammy.verbruggen@uantwerpen.be)
Co-promoter	Rituraj Borah (depending on the exact final topic) (Rituraj.borah@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	Ideally, the thesis starts between 15/08 and 01/09, but depending on the situation this can be discussed. Proactive communication is the only request.

Title of the thesis topic	How urbanisation and green connectivity shape earthworm diversity in the city: A landscape-scale analysis.
Keywords	Functional connectivity, urban biodiversity, soil health, urban tree health

Description

Urbanisation is transforming city landscapes at an unprecedented pace, reshaping not only how people live but also how soil ecosystems function beneath our feet. Earthworms, often invisible, are key ecosystem engineers that play a central role in soil functioning through bioturbation, nutrient cycling, and organic matter decomposition. Yet despite their importance, we still know remarkably little about how urban spatial patterns and green-space connectivity influence earthworm diversity across an entire city.

Cities are highly fragmented landscapes: street trees are isolated in small pits, parks are separated by roads, and vegetated patches differ strongly in management intensity. This fragmentation reduces the continuity of soil habitats and may limit earthworms' movement, survival, or recolonisation ability. At the same time, green corridors, connected tree rows, and park edges may act as pathways that enhance biological exchange.

This master's thesis investigates how the configuration of Antwerp's urban landscape—its parks, street trees, gardens, tram corridors, and sealed surfaces—affects where earthworms can persist and thrive. Using a landscape-scale approach, the research combines field sampling of earthworm communities with spatial analyses of green connectivity and urbanisation intensity. By integrating ecological data with GIS-based connectivity indices, the project seeks to answer a fundamental question: Do connected green spaces form networks that support soil biodiversity, or is earthworm diversity primarily constrained by the harshness of dense urban environments?

The results will not only help to understand how urbanisation pressures shape below-ground ecosystems but also provide valuable insights for urban planners and green managers working to build more resilient, biodiverse cities.

Related to CityLab	CityLab 1: The Urban Ecosystem

Relevance to urban challenges and/or applications

A healthy soil is critical for a healthy and biodiverse urban environment

Max. number of students	1
Promoter	Roeland Samson (roeland.samson@uantwerpen.be)
Supervisor	Rune Melis (rune.melis@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	No issues specified

Title of the thesis topic	Investigating urbanization-associated factors that impact the vaginal microbiome and metabolome of self-reported healthy women
Keywords	microbiome, metabolome, urbanization, women's health

Description

Global urbanization presents many challenges for human health, including a potential disruption of the delicate microbiome balance. While the skin microbiome is of interest, as it forms the primary interface with the environment and protects us against infection and inflammation, the microbiomes of intimate body sites remain largely understudied in this context. In addition, how urban environmental, socio-economic, and lifestyle factors influence vaginal microbial communities, and their activities remains poorly understood.

To investigate these influences, we will analyse vaginal microbiome and metabolome data alongside survey-based metadata from appr. 250 self-reported healthy Belgian women participating in the Isala program (https://isala.be/en/). Specifically, vaginal swabs were self-sampled by the participants at home, shipped to the host lab, and separately analysed via 16S rRNA amplicon sequencing for microbiome profiling and Liquid Chromatography-Mass Spectrometry (LC-MS) for untargeted metabolome profiling (including microbiota- and host-derived as well as xenobiotic compounds). Survey-based metadata reported by participants at the time of sampling will be supplemented with publicly available environmental and socio-economic data, such as yearly averages of ozone, nitrogen dioxide and particulate matter (as derived from IRCELINE) and socio-economic status estimated using the Belgian Index of Multiple Deprivation (BIMD).

In the scope of this Master's thesis, analyses will be conducted to reveal possible correlations between urban factors and the vaginal microbiome and metabolome composition. The following techniques will be addressed: applying, developing and optimizing bioinformatic pipelines, integrative analysis of multiple datasets (including amplicon sequencing data and untargeted metabolomics data), integrative analysis of survey data, etc. In addition, several soft skills will be developed as well, such as presentation skills, teamwork within the Isala project and our core computational team, strategic communication, collaborations with external partners, etc. Altogether, this work will pave the way for exploring how environmental and socio-economic factors impact women's health in urban populations by investigating the interplay between urban living and vaginal microbiome and metabolome composition.

Related to CityLab	CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

Understanding how urban environmental conditions (e.g., air quality indicators such as ozone, nitrogen dioxide, and particulate matter) and socio-economic factors (e.g., deprivation indices) shape the vaginal microbiome and metabolome provides insights into women's health in densely populated areas. Such knowledge can inform public health strategies, urban planning, and personalized healthcare interventions aimed at mitigating health risks associated with urbanization. By integrating microbiome and metabolome data

with environmental and socio-economic metrics, this research bridges molecular biology and urban health, offering a novel perspective on how city living impacts intimate microbial ecosystems.	
Max. number of students	1
Promoter	Sarah Lebeer (sarah.lebeer@uantwerpen.be)
Supervisor	Thies Gehrmann (thies.gehrmann@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	The thesis can start at the start of the academic year.
Extra information	Competency of programming in R or python is required. Interest in statistics a plus.

Title of the thesis topic	Light-driven CO2 conversion
Keywords	CO2, (photo)catalysis, photo thermal, materials

Description

In this thesis you will contribute to new methods for CO2 conversion, through which large CO2 quantities (such as those from point sources or the product of direct air capture technologies) are converted into useful molecules such as CO or methanol.

Depending on the interests of the student, the work will focus on either catalyst development, or catalytic process optimization. The research will be conducted at the Verbruggen-lab within the A-PECS research group at the Department of Bioscience Engineering (UAntwerp), under the guidance of an interdisciplinary team of (environmental) engineers and chemists.

At the level of catalyst research, you will actively study new, earth-abundant photoactive materials for CO2 conversion, as opposed to the current generation of platinum group metals, or noble metals like gold. You will develop new synthetic methods and test your materials in a lab setting.

In addition, or alternatively, you will focus on catalytic process optimization, by testing novel materials in the photocatalytic (i.e. purely light-driven) or photo-thermo-catalytic (i.e. light + heat) conversion of CO2. This part of the work will involve studying the relation between process parameters, and the activity/selectivity/stability of the catalyst, to enable further optimization of the overall technology. It can also involve studying the reaction pathway in more detail by making use of a newly acquired photo-thermal in-situ reaction cell. In this way, both fundamental as well as applied insights can be gathered, depending on the student's main interest.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

The relevance of air quality in a city context is clear. Especially in highly populated areas with a lot of traffic and little green infrastructure, CO2 levels can be high. Application of direct air capture technologies is one thing to reduce these levels, but we want to go beyond that point by also converting CO2 in useful feedstock chemicals.

Max. number of students	2
Promoter	Sammy Verbruggen (Sammy.verbruggen@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	Ideally, the thesis starts between 15/08 and 01/09. Depending on the situation, this can be discussed. Proactive communication is the only request.

Title of the thesis topic	Modelling dispersion and purification techniques for cleaner urban air
Keywords	Urban air quality, urban microclimate, street numerical modelling, computational fluid dynamics, air pollution

Description

The design of urban environments has a significant influence on local air quality. In many cities, certain locations become air pollution hotspots, where harmful pollutants reach high concentrations. Examples include narrow streets where polluted air becomes trapped, car parks, or the exits of road tunnels where vehicle emissions accumulate. Fortunately, a range of mitigation strategies exists. These vary from enhancing pollutant dispersion, for example through the use of noise barriers, to actively cleaning the air using advanced purification technologies. This project explores the potential for reducing exposure to air pollutants using numerical modelling tools, such as ENVI-met, COMSOL, and OpenFOAM. A specific case study will be chosen in consultation with the student. Possible directions include:

• Investigating the performance of an innovative particulate matter reduction device using measurements and/or simulations

• Simulating the impact of a noise barrier on air pollutant dispersion

• Assessing NO_x reduction using photocatalytic coatings

• Simulating the impact of a tunnel on surrounding air quality

• Designing an innovative tunnel outlet to enhance pollutant dispersion

• Investigate the impact of urban green on air quality

Related to CityLab	CityLab 1: The Urban Ecosystem

Relevance to urban challenges and/or applications

Urban areas face air quality challenges due to dense infrastructure, high emissions, and limited ventilation. Understanding how the built environment influences pollutant behaviour is essential for creating healthier cities. This project contributes to that goal by using advanced modelling tools to evaluate how design choices and mitigation technologies can reduce human exposure. The insights gained can support urban planning, guide infrastructure improvements, and help cities implement more effective air quality strategies.

Max. number of students	2
Promoter	Siegfried Denys (Siegfried.denys@uantwerpen.be)
Co-promoter	Tom Tytgat (tom.tytgat@uantwerpen.be)

Supervisor	Marjan Demuynck (marjan.demuynck@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	Not applicable
Extra information	Urban Air Modelling as an advanced elective is strongly recommended.

Title of the thesis topic	Neighbourhood Lungs in Leuven: Inventory, Ecosystem Services and Future Perspectives for Private Trees with Public Value
Keywords	Private urban trees - Ecosystem services - Urban climate resilience - Green infrastructure

Description

Private trees located within urban building blocks often function as invisible yet crucial “neighbourhood lungs,” providing a disproportionate share of environmental benefits. They mitigate heat stress, buffer stormwater, improve air quality, enhance biodiversity and contribute to mental well-being. At the same time, these trees are under pressure due to high maintenance requirements, difficult access, neighbour complaints about shade or impacts on solar panels, and the lack of structural protection. Because tree removal often does not require a permit, many of these valuable trees are gradually disappearing from the urban fabric.

This master’s thesis investigates how private trees with public value in Leuven can be identified, assessed and sustainably safeguarded. The research includes:

(1) an inventory of mature private trees within selected Leuven neighbourhoods using orthophotos, LiDAR and GIS analysis;

(2) a quantification of key ecosystem services, including cooling, carbon storage, water retention and air purification;

(3) an exploration of the social context through interviews or short resident surveys; and

(4) a risk and future assessment mapping threats such as removal, management challenges and development pressure.

Building on these insights, the student will develop concrete recommendations for the City of Leuven, ranging from priority maps for tree conservation to potential policy instruments, incentives and nudging strategies that strengthen pride and appreciation for neighbourhood trees. The thesis thus provides a scientifically grounded foundation for a new urban “neighbourhood lungs policy” that explicitly recognises private green elements as essential building blocks of a climate-resilient, biodiverse and liveable city.

Related to CityLab	CityLab 1: The Urban Ecosystem CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

Private trees within densely built neighbourhoods address several key urban challenges simultaneously: climate adaptation, biodiversity loss, environmental inequality and declining urban liveability. Despite being located on private land, these trees function as critical “neighbourhood lungs” that reduce heat stress, buffer stormwater, improve air

quality, store carbon and offer psychological and social benefits for local residents. In highly compact cities such as Leuven, where space for new public green infrastructure is limited, recognising and leveraging the ecosystem services provided by private green spaces becomes increasingly important. The proposed thesis directly supports urban planning and environmental management by generating spatially explicit insights into the distribution, condition and value of private trees. These findings can be applied in urban policy development, such as creating conservation priority maps, designing incentives for private tree stewardship, and integrating private green assets into climate and biodiversity strategies. The work therefore contributes to more effective, inclusive and evidence-based urban governance, and helps cities to safeguard and strengthen green infrastructure where it is most needed.	
Max. number of students	1
Promoter	Ben Somers (ben.somers@kuleuven.be)
Research project abroad?	No
Compatibility with internship	No issues specified

Title of the thesis topic	Novel diagnostic test for emerging infectious diseases
Keywords	infectious diseases; dengue, diagnostics; enzyme-free

Description

Mosquito-borne infections, such as dengue, cause millions of infections each year and pose a significant public health burden. While these diseases mainly occur in (sub)tropical areas, they are a growing threat to European citizens due to the expanding distribution of mosquito vectors. This spread is driven by factors such as extensive trade and travel with (sub)tropical regions, climate change and urbanization. Hence, obtaining fast and accurate data on circulating infections in a population is important to effectively implement disease control measures. However, current tests are either expensive and only applicable in lab settings or lack sensitivity and specificity. Therefore, this project will contribute to developing an accurate and affordable diagnostic test for infectious diseases that is applicable at the point of care.

To pursue this goal, this project aims to combine non-enzymatic signal amplification strategies with an electrochemical readout (similar to the glucose meter) to detect viral RNA. More specifically, the design and use of DNAzymes that cleave extracted viral RNA and/or the integration of plasmonic nanoparticles with photosensitizers will be explored. Efforts will be made to develop and optimize sample preparation and biosensing protocols. Thanks to this novel technology, it will be possible to detect various infectious diseases in a fast (less than one hour), specific (discrimination between related viruses) and sensitive (fM range) way.

Related to CityLab	CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

Many infectious diseases, including dengue, cycle between humans and mosquitoes. Rapid urbanization creates ideal breeding sites for mosquitoes due to poor waste management, standing water and high population density. Moreover, increased global travel, trade, and climate change facilitate the spread of these mosquito vectors and the pathogens they carry toward temperate regions, including European cities. Early on-site detection will enable faster outbreak response, strengthen disease surveillance systems and help prevent large-scale epidemics, contributing to safer and more resilient cities.

Max. number of students	2
Promoter	Karolien De Wael (karolien.dewael@uantwerpen.be)
Co-promotor	Elise Daems (elise.daems@uantwerpen.be)
Supervisor	Hannah Op de Beeck (Hannah.opdebeeck@uantwerpen.be)
Research project abroad?	No

Compatibility with internship	No issues specified
Extra information	Spending 2-3 weeks in the lab conducting a literature search and designing sequences before the internship would be beneficial for the thesis student(s).

Title of the thesis topic	PaNDA for the Future: Energy-Smart Nitrogen Removal in Climate-Neutral Urban Water Cycles
Keywords	Urban resources, Urban water treatment, Sustainable wastewater management, PaNDA process, Net-zero water systems

Description

Cities worldwide are striving to become cleaner, greener, and climate-neutral. Wastewater treatment plays a crucial role in this transition, since conventional nitrogen-removal methods (nitrification and denitrification) still consume a lot of energy and require additional chemicals. In addition, organic matter is not always used efficiently, even though it could contribute more to energy production. To build more sustainable urban water systems, innovative treatment strategies are needed—ones that are energy-efficient, robust, and aligned with future climate goals.

PaNDA (Partial Nitrification–Denitratation–Anammox) is a new nitrogen-removal concept developed for municipal wastewater, designed to reduce energy demand, lower operational costs, and significantly decrease the carbon footprint of treatment plants. By integrating microbial processes in a more efficient way, PaNDA contributes directly to climate-neutral and resource-efficient urban water cycles. This thesis is part of an active collaboration between VITO and the University of Antwerp, embedding the student in ongoing research on next-generation urban water treatment technologies.

In this thesis, the student will conduct laboratory-scale experiments using a dedicated bioreactor system and wastewater to support the development and optimisation of the PaNDA process. This includes planning and running experiments, analysing results, and interpreting findings within the framework of sustainable urban water management. The student will work hands-on with Anammox bacteria, gain deeper insight into advanced nitrogen-removal pathways, and learn essential laboratory techniques such as biomass characterisation, nitrogen-species analysis, and reactor operation. The project offers strong training in experimental design, data processing, and the critical evaluation of eco-technological solutions for urban water systems.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

This topic is highly relevant to urban challenges because wastewater treatment plants are essential nodes in the urban water cycle—responsible for safely returning treated water to the environment and ensuring the long-term sustainability of city water resources. However, conventional nitrogen-removal processes still consume large amounts of energy and chemicals, increasing the carbon footprint of this critical infrastructure. By exploring the PaNDA process, this research contributes to developing more efficient, low-impact treatment technologies that strengthen the urban water cycle, reduce resource use, and support climate-neutral and resilient cities.

Max. number of students	1

Promoter	Siegfried Vlaeminck (siegfried.vlaeminck@uantwerpen.be)
Co-promoters	Dores Cirne (dores.cirne@vito.be) ; Marc Spiller (marc.spiller@vito.be)
Supervisor	Valiallah Amirian Mojarad (valiallah.AmirianMojarad@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	All necessary equipment will be provided by the university. The student is expected to begin on the first day of the official academic semester and submit the thesis by the deadline specified by the program.
Extra information	Communication is conducted entirely in English. Previous laboratory experience is an advantage, and the student should have interest in working with bioreactors and wastewater treatment processes in the lab.

Title of the thesis topic	Potential of silicate mineral fertilization in organic urban farming
Keywords	Urban farming, silicate minerals, silicate weathering, fertilization

Description

Silicate minerals, such as basalt, have become a major focus of scientific research because they can react with atmospheric CO_2 and sequester it for long periods. In addition to their carbon capture potential, these minerals are rich in essential nutrients like calcium (Ca), magnesium (Mg), and potassium (K), as well as beneficial elements such as silicon (Si), which support plant growth. For this reason, silicate mineral fertilization is being tested in croplands worldwide. However, its effectiveness depends heavily on environmental conditions, including soil type, rainfall, temperature, and crop species. In this study, we aim to evaluate the impact of silicate mineral fertilization on plant growth and soil properties in sandy Belgian soil at a community-supported organic urban farm. The farm employs modern organic practices to enhance yields and soil health, but organic farming introduces more variability compared to conventional systems, making efficiency and outcomes less predictable. We hypothesize that silicate mineral fertilization can improve both plant growth and soil health under these conditions.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

Urban areas face significant challenges related to food security, soil degradation, and climate change mitigation. Limited space, intensive land use, and declining soil fertility make sustainable crop production in cities increasingly difficult. Silicate mineral fertilization offers a promising solution by simultaneously addressing multiple urban issues: it can enhance soil health and nutrient availability, improve plant growth in nutrient-poor urban soils, and contribute to long-term carbon sequestration through mineral weathering. Applying this technique in community-supported urban farms not only supports local food systems but also aligns with climate resilience strategies by reducing atmospheric CO_2 and promoting regenerative practices. Thus, integrating silicate minerals into urban agriculture represents a practical and innovative approach to improving sustainability in densely populated environments.

Max. number of students	1
Promoter	Harun Niron (harun.niron@uantwerpen.be)
Co-promoter	Anastasia Papangelou (anastasia.papangelou@uantwerpen.be)
Supervisor	Tom Cox (tom.cox@uantwerpen.be)
Research project abroad?	No

Compatibility with internship	The experiment will take place in a community-supported urban farm in Wommelgem, and the lab analyses will be performed in Campus Groenenborger, UAntwerp. The experiment has start in the second semester (foreseen in May), but the ending will depend on the crop cycle.
Extra information	The starting date is foreseen as mid-April and early May of 2026. The experimental timeframe is expected to be May to September 2026. As the experiment will be performed in a farm, the farmers will supervise the setting and the application. The student is expected to visit the farm in Wommelgem at predetermined times to collect samples and do measurements during the summer of 2026. This atypical timeline (not necessarily aligned with the academic year) is required since most field-based agricultural experiment in Belgium (disregarding greenhouse agriculture) requires to be performed during summer period. Ultimately, it is up to the student to decide whether they can manage the schedule. This provides another flexibility to the student: for instance, if a student begins the project in May, they could submit their thesis in January, or they might have a period of reduced workload during the academic year, allowing them to focus on internships or coursework. This approach acknowledges the unique timing requirements while ensuring academic feasibility.

Title of the thesis topic	Silicate weathering as a nature-based strategy to mitigate CO_2 emissions from urban wastewater treatment
Keywords	Carbon Dioxide Removal, Wastewater Treatment, Enhanced Silicate Weathering
Description Urban wastewater treatment plants contribute significantly to greenhouse gas emissions, making climate mitigation a key urban environmental challenge. This thesis explores whether enhanced silicate weathering could serve as a nature-based engineering strategy to reduce CO_2 emissions from wastewater treatment. By dissolving selected silicate minerals under controlled conditions, the process can generate alkalinity, capture CO_2, and support more sustainable treatment pathways.	
Related to CityLab	CityLab 2: Urban Resources
Relevance to urban challenges and/or applications Wastewater treatment plants are essential components of urban infrastructure but are also significant contributors to cities' greenhouse gas emissions. As urban areas move toward climate neutrality, there is an urgent need for new, low-energy strategies to reduce the carbon footprint of these systems. Silicate weathering offers a nature-based approach that can be integrated directly into existing treatment processes, providing a potential pathway to capture CO_2 while enhancing resource efficiency. This makes the topic highly relevant for sustainable urban water management and the broader transition to low-carbon cities.	
Max. number of students	1
Promoter	Siegfried Vlaeminck (siegfried.vlaeminck@uantwerpen.be)
Co-promoter	Sara Vicca (sara.vicca@uantwerpen.be)
Supervisors	Kaja Czub (kaja.czub@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	There are no specific constraints. The topic can be adapted to the student's internship schedule, and both literature-based and small-scale empirical components are possible. Standard laboratory facilities and supervision will be available within the research group.
Extra information	No specific prerequisites are required. An interest in sustainable water management, climate mitigation, or environmental engineering is helpful but not mandatory. Students from any background within the Master SUBE programme are welcome.

Title of the thesis topic	Sufficiency in food systems: exploring urban practices
Keywords	sufficiency, food consumption, material flow analysis, energy flows, interdisciplinarity

Description

This thesis aims to define what sufficiency means for the Belgian food system and examine how urban food-related practices—such as shopping, cooking, and waste management—can either accelerate or hinder the transition towards sufficiency (=absolute reduction in consumption levels). The student will begin with exploring existing concepts and definitions of food system sufficiency. Building on this, and considering the current Belgian diet, the student will model an urban household (or different household typologies) that operates within the bounds of food sufficiency. This will involve (i) quantifying direct (and eventually embodied) material and energy flows related to food consumption, and (ii) linking these flows to food consumption patterns and food-related practices. The study's findings will provide contextualized insights into the quantities of food necessary for a sufficient diet, the impact on related resource use and emissions, and the everyday practices that influence the transition towards sufficiency. Ultimately, this research will contribute to ongoing efforts to promote sufficiency and demand-side measures as effective strategies for reducing resource use and the environmental impacts of consumption and production.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

Reducing the environmental impact of the current food system requires a combination of a shift in agricultural production (e.g. promoting agro-ecology, developing alternative protein sources), rethinking supply chains (decentralizing power, fostering local food networks), and demand-side measures (reducing food waste, shifts to plant-based diets, and addressing overconsumption). The latter are the most relevant for urban settings, because cities concentrate population, and thus demand for food and other resources, and because urban environments shape people's eating habits. The focus of this master thesis will particularly be on how urban environments influence what people eat and how food sufficiency would translate into urban settings.

Max. number of students	1
Promoter	Anastasia Papangelou (anastasia.papangelou@uantwerpen.be)
Supervisor	Boki Veldscholten (boki.veldscholten@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	No issues specified

Extra information	There is a strong interdisciplinary element in this thesis, as it combines conventional material and energy flow analysis with social practices theory. We expect the student to be interested in this type of work and willing to potentially complement their modeling work with qualitative research methods (e.g. interviews and observations).

Title of the thesis topic	Sustainable production of purple phototrophic bacteria using urban CO_2-derived substrates: high-value bioactives (CoQ10, carotenoids) and applications in urban food systems
Keywords	Purple phototropic bacteria, Carbon-capture-and-utilisation derived substrates

Description

Urban environments face increasing pressure to reduce carbon emissions, close material loops, and ensure access to nutritious, sustainable food sources for growing populations. Purple phototrophic bacteria (PPB) represent a promising biotechnology capable of addressing these challenges simultaneously. PPB can be cultivated on carbon-capture-and-utilisation (CCU)-derived substrates such as acetate or ethanol produced from captured CO_2, enabling urban carbon circularity and the local transformation of emissions into valuable biomolecules.

These microorganisms naturally synthesise high levels of Coenzyme Q10, carotenoids and protein-rich biomass, compounds with substantial relevance to human health, oxidative stress reduction, and nutritional quality. Their cultivation offers a route to producing nutrient-dense ingredients within the city, supporting decentralised “urban biomanufacturing” approaches that reduce dependence on land-intensive agriculture and long supply chains. Furthermore, PPB biomass shows significant potential as an ingredient for alternative meat products, aligning with the dietary transitions and sustainability goals of modern cities.

This thesis will investigate (1) the cultivation performance of PPB on CCU-derived feedstocks; (2) the yield and composition of bioactive compounds (CoQ10, carotenoids, protein); and (3) the feasibility of integrating PPB biomass into sustainable food applications, such as meat analogues. The student will design and optimise laboratory-scale bioprocess experiments, analyse biochemical outputs, and evaluate how such bioproduction systems could be implemented in urban settings, considering environmental, technological, and socio-economic dimensions.

Overall, the project connects biotechnology, circular resource management, and urban food innovation, exemplifying how microbial processes can contribute to healthier, more resilient, and more sustainable cities.

Related to CityLab	CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

Purple Phototrophic Bacteria (PPB) offer an innovative platform for tackling key urban sustainability challenges. Cities are major CO_2 emitters, and PPB can be grown on CO_2-derived substrates such as ethanol and acetate, helping close the carbon loop by converting emissions into valuable bioproducts. Urban areas also face rising demand for nutrient-rich, sustainable food despite limited space. PPB naturally produce CoQ10, carotenoids and protein-rich biomass, enabling local production of health-promoting ingredients and supporting resilient, decentralised urban food systems.

In addition, PPB biomass is a promising component for alternative meat products, promoting healthier diets while reducing the environmental footprint of urban food consumption. Altogether, PPB represent a powerful biotechnological solution for more sustainable, liveable and health-supporting cities.	
Max. number of students	1
Promoter	Siegfried Vlaeminck (siegfried.vlaeminck@uantwerpen.be)
Supervisor	Arianna Reolon (Arianna.Reolon@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	Expected starting date: September/October 2026. Because the project involves working with microorganisms, some experimental phases may be time-sensitive. Growth and metabolic activity can require close monitoring, and certain steps may need to be scheduled to ensure continuity in the lab. Access to equipment and supervision will be coordinated accordingly to support these needs.

Title of the thesis topic	The life of urban streetscape and park trees
Keywords	tree ecophysiology, urban liveability, tree stress, climate change

Description

Urban trees, and certainly streetscape trees are often growing in high stress conditions due to low quality growing sites. Climate change related effects like heat and drought stress are topping up to this stress, further decreasing tree vitality posing a serious threat for tree survival.

All over Europe this results in weakened trees of which many eventually die off. The replacement of trees and the damage that weakened trees can cause (e.g. due to falling branches) can be considerable. Low tree vitality further results in a decreasing delivery of ecosystem services which has a negative impact on the livability of cities.

Monitoring tree vitality is thus key to maintain and enhance urban livability, as it allows that proper management decisions can be taken in time. We therefore need ecophysiological tree stress indicators that can be monitored in a smart and continuous way.

This thesis aims to contribute to an online and continuous monitoring of the ecophysiological health status of trees. Therefore, representative trees will be selected in contrasting urban environments and in the Middelheimpark, and equipped with sensors to monitor some key ecophysiological processes, e.g. sap flow and diameter fluctuations. Trees' responses to stress will be assessed in relation to environmental (e.g. heat and drought stress) and site (soil physical characteristics) parameters, and practical tree health indicators and thresholds will be derived to improve urban tree management.

Related to CityLab	CityLab 1: The Urban Ecosystem CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

Trees are key components of the urban ecosystem, and of the utmost importance for urban liveabilitys.

Max. number of students	1
Promoter	Roeland Samson (Roeland.Samson@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	No issues specified

Title of the thesis topic	Thermal comfort in urban areas: Numerical simulation and design strategies for mitigating urban heat
Keywords	urban heat island, thermal comfort, ENVI-met, OpenFOAM, COMSOL, urban microclimate, urban design

Description

Urban heat and thermal discomfort represent increasingly critical challenges for European cities as climate change and urbanization intensify. The World Health Organization has highlighted that both indoor and outdoor environments are adversely affected, with significant implications for public health and overall quality of life. Urban design plays a pivotal role in mitigating these effects; however, identifying optimal strategies remains complex due to the interplay of environmental, technical, and socio-economic factors. Interventions such as the integration of trees, low vegetation, depaving, and the enhancement of urban airflow have demonstrated potential benefits, yet their long-term effectiveness and economic feasibility warrant rigorous evaluation.

This thesis seeks to examine strategies for improving thermal comfort in urban contexts through advanced numerical simulations using tools such as ENVI-met, OpenFOAM, and COMSOL. The research will combine microclimate modeling with design analysis to assess the impact of selected interventions on outdoor and/or indoor thermal environments, complemented by field measurements where feasible to validate simulation outputs. The anticipated outcomes include a quantitative assessment of thermal comfort improvements, which will inform evidence-based design guidelines for urban planners and support the integration of thermal comfort considerations into sustainable urban development policies.

For illustrative purposes, a previous thesis investigated the transformation of Zuidpark in Antwerp from a parking lot to an urban park, highlighting the relevance of such interventions. The specific focus of the thesis can be tailored in consultation with the student, with potential topics including:

• Comparative microclimate analysis of city versus suburban campuses

• Indoor thermal comfort optimization in lecture halls

• Comparative evaluation of different green mitigation measures

• Cost-benefit analysis of green infrastructure for heat mitigation

• Thermal comfort projections under future climate scenarios

• Differences in thermal comfort strategies and outcomes across European cities

Related to CityLab	CityLab 1: The Urban Ecosystem CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

This topic is highly relevant to urban challenges as European cities face increasing thermal stress due to climate change and rapid urbanization. Elevated temperatures exacerbate health risks, reduce outdoor livability, and increase energy demand for cooling, making thermal comfort a critical component of sustainable urban development. By applying advanced simulation tools to evaluate mitigation strategies such as vegetation, depaving, and airflow optimization, this research provides actionable insights for urban planners and policymakers. Its application lies in guiding evidence-based design interventions that enhance resilience, improve public health, and support climate adaptation in urban settings.

Max. number of students	2
Promoter	Siegfried Denys (Siegfried.denys@uantwerpen.be)
Supervisor	Tim Goossens (tim.goossens@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	Depends on the selected topic. The seasons could have an influence for potential field measurements.
Extra information	Urban Air Modelling as an advanced elective is strongly recommended.

Title of the thesis topic	Tree Talk
Keywords	urban trees, nature connectedness, ecosystem services, mental wellbeing

Description

Trees are cornerstones of a healthy urban ecosystem. Full grown trees provide a multitude of ecosystem services. Their importance for cooling, air pollution mitigation, carbon sequestration and biodiversity enhancement are obvious. Besides, trees also have a huge impact on the mental wellbeing of urban residents, just by their presence in the urban landscape.

Moreover, trees often play a crucial role in the connection of citizens with nature in their daily lives. It has been demonstrated that trees are for many people a partner to deal thoughts with, who listens, and often play a role in families over different generations. The health status of trees can on the other hand also be a sign for citizens on the state of their urban environment. But trees are not only careful listeners, they also communicate themselves by sounds.

This thesis aims at setting up a framework by which citizens can listen to the sounds and communication of trees and see whether this has an impact on how citizens are perceiving trees and how it make citizens aware of the fact that trees are important living organisms in the urban ecosystem, even if you can't see them move.

Therefore, important veteran trees will be selected in the city of Antwerp, as well in as outside urban parks (e.g. streetscape trees). Half of these selected urban veteran trees will be equipped with microphones as well above as belowground. The sounds of these trees will be made heard in real time for the visitors and people passing by. The sound produced by these urban trees will be interpreted in terms of soil and atmospheric drought and meteorological and growing conditions. For all trees a communication network – for citizen to 'tree' communication - will be set up. Communication might occur over e-mail or social media like Whatsapp or Instagram. Simultaneously, citizens will be interviewed about their nature connectedness and their knowledge and views on urban trees.Citizens will also be questioned on the importance of making the trees 'hearable' on the citizens' perception of these trees.

This thesis aims at (a) studying the sound communication of trees in relation to potential driving environmental and meteorological factors, (b) creating a platform to allow citizens to communicate with trees with the aim to learn more about the social and mental importance of urban trees and (c) understand the role of making the trees hearable on their perception by citizens. Individual veteran trees will be carefully selected with representatives of the city of Antwerp. Results will be translated into communicating guidelines on urban green infrastructure and environmental/climate impacts on urban tree vitality. The knowledge will also be valorised in infographics for citizens on the importance of urban trees.

Related to CityLab	CityLab 1: The Urban Ecosystem CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications Trees are cornerstones of a healthy urban ecosystem. Full grown trees provide a multitude of ecosystem services. Their importance for cooling, air pollution mitigation, carbon sequestration and biodiversity enhancement are obvious. Besides, trees also have a huge impact on the mental wellbeing of urban residents.	
Max. number of students	1
Promoter	Roeland Samson (roeland.samson@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	No issues specified

Title of the thesis topic	Urban Determinants of Skin Health: Comparing Neighbourhood and Individual Factors
Keywords	Skin microbiome, Urban environments, Public health

Description

Urbanisation presents many challenges hypothesized to compromise human health, in part by disrupting the delicate balance of the human microbiome, the diverse communities of microorganisms that naturally inhabit our bodies. Growing attention has turned to the skin microbiome, which serves as the body's primary interface with the external environment and plays a key role in protecting against infection and inflammation. Despite its importance, the influence of urban environmental (pollution levels, green space availability), socio-economic, and lifestyle (hygiene habits, diet) factors on skin microbiome composition remains largely unexplored. This project aims to address this knowledge gap by investigating how individual and neighbourhood urban-associated factors in large cities such as Antwerp affect skin health and the skin microbiome through two complementary research components.

In a first part, we will analyse detailed questionnaire data and available skin microbiome bacterial profiles collected within the large-scale Belgian Isala project (https://isala.be/en/), which include female participants from several Antwerp neighbourhoods. In addition to the personal questionnaires, we will explore publicly accessible data sources, such as Statbel, DataGov , Scienscano and other open datasets, to retrieve information on the participants' neighbourhoods, including housing prices, average incomes, pollution levels and other relevant characteristics. Using our established bioinformatics pipeline, implemented in R or Python, we will then explore associations between the skin microbiome and the urban environment features retrieved from our questionnaires or the public sources. Furthermore, GIS tools will be used to visualise environmental features and microbiome characteristics across neighbourhoods. By mapping these data layers, we aim to identify spatial patterns and uncover new association, for example, clusters of neighbourhoods that share similar environmental exposures and microbial signatures. Altogether, this integrated approach will help clarify how the urban living environment shapes the human skin microbiome and reveal patterns linked to environmental and socio-economic conditions.

In the second exploratory part of this research, to gain deeper insights at the individual level, we aim to collect self-reported skin health indicators and individual socio-economic and environmental data through questionnaires distributed across diverse Antwerp neighbourhoods. This will involve actively reaching out to participants in multiple areas to ensure broad representation. These data will again be linked to publicly available metrics, and an exploratory statistical analysis will be performed using R or Python. This will enable a direct comparison between the effects of neighbourhood-level factors and individual factors on skin health.

Related to CityLab	CityLab 3: Human Health & Urban Liveability

Relevance to urban challenges and/or applications

Understanding how urban environments shape skin health has several important applications. These findings could inform public health strategies aimed at reducing skin-related health inequalities, contribute to more targeted community interventions in deprived neighbourhoods and support the development of urban planning or environmental policies that promote healthier living environments. Additionally, identifying socio-economic drivers of skin microbiome variation may open new avenues for preventive strategies tailored to urban populations.	
Max. number of students	1
Promoter	Irina Spacova (irina.spacova@uantwerpen.be)
Co-promotor	Sarah Lebeer (sarah.lebeer@uantwerpen.be)
Supervisor	Margo Hiel (margo.hiel@uantwerpen.be) en Emilie Op de Beeck (emilie.opdebeeck@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	No issues specified.
Extra information	Knowledge of the Dutch language will facilitate questionnaire development and contact with the participants in the second part of the project, but is not a strict prerequisite.

Title of the thesis topic	Wastewater treatment of the future: flexibility, modular design and resilience
Keywords	wastewater, technology transfer

Description

If we could really predict the future, we would not have many of the societal issues we are facing today. Unfortunately we cannot, and in sectors such as wastewater treatment it leads to creating infrastructure that is inherently overdimensioned (and thus inefficient) and inflexible. Rather than planning for years towards new treatment plants under assumptions of future population needs and climate impacts, even some large utilities are realizing this is not the way to go. Perhaps we need to build smaller installations and add flexible capacity, or build more small installations overall just like what happened with the photovoltaics revolution. If we want to go this way, we need to think carefully: (i) what are the key needs to have a flexible water architecture? (ii) what would a flexible treatment plant look like? Will it necessity have modular systems that can be added/omitted as needed? (iii) how do we design modular systems that can do this both at large treatment plants, or be a standalone small plant? Can we design a module to be produced at high throughput and low cost, including the right controls and sensors? In this thesis we are looking for a student with vision, to think out of the box and make the case for modular systems and from that design a wastewater treatment plant. More specifically we look for a student that is interested in how technological insight from other sectors can be transferred to wastewater. The student will have the opportunity gain in-depth knowledge of technological design in sectors such as construction or PV (or others e.g. construction and civil engineering) and will be challenged to transfer insights on flexibility into (conceptual) design of wastewater treatment plant. This thesis is a collaboration between the CAPTURE partners UGENT, UAntwerpen and VITO.

Related to CityLab	CityLab 2: Urban Resources

Relevance to urban challenges and/or applications

Wastewater treatment is an integral part of the urban systems, mediating resources flows and causing emissions.

Max. number of students	1
Promoter	Korneel Rabaey (korneel.rabaey@ugent.be)
Co-promoter	Marc Spiller (Marc.spiller@uantwerpen.be)
Research project abroad?	No
Compatibility with internship	No issues specified