**11 PhD positions in the EU Horizon Europe Marie Skłodowska-Curie DN Project:
INCLUE (From waste to resource: Training young researchers on developing
innovative, circular solutions for wastewater treatment sludge)**

Applications are invited for 11 PhD positions ("Doctoral Candidates - DC") to be funded by the Marie-Skłodowska-Curie Doctoral Network INCLUE within the Horizon Europe Programme of the European Commission. INCLUE is the "From waste to resource: Training young researchers on developing innovative, circular solutions for wastewater treatment sludge" project. The INCLUE Doctoral Network will train 11 motivated and talented Doctoral Candidates (DCs) in a crucial field of today's society: the exploitation of organic waste streams as a resourceIn this training through research program, INCLUE doctoral candidates will focus on sustainable and circular solutions to treat wastewater treatment sludge containing a wide variety of (in)organic pollutants, enabling the application of this untapped resource for renewable chemicals, materials, fuels and fertilisers. INCLUE hereby responds to the European Green Deal and Farm-to-Fork strategy, in which sludge has been identified as a prime biogenic renewable resource to boost circular economy in terms of renewable energy generation and organic fertilisers production. INCLUE entails an intersectoral consortium of 6 academic and 11 non-academic partners from 7 countries, who have developed an interdisciplinary training program, encompassing the fields of chemical & environmental engineering, (nano)materials science, chemistry, environmental biotechnology, microbial ecology, life sciences, modelling and ecotoxicology. The success of the program is guaranteed via a unique combination of state-of-the-art PhD research, intersectoral secondments, international mobility and interdisciplinary platform-wide courses.

Key dates
- 5 July 2023: Launch of 11 DC Positions
- 19 September 2023: Deadline for on-line application
- 29 September 2023: Circulation list "INCLUE pre-selected candidates"
- 9 November 2023: INCLUE Recruitment Event (date subject to confirmation)
- 10 November 2023: Circulation list "selected INCLUE DCs"
- March 2024: Targeted starting date for DC contracts (or earlier, if possible)

Key background info

Number of positions available
11 PhD Positions

Project type
INCLUE is a MSCA DN project (Doctoral Network). 10 recruited researchers will be enrolled in a doctoral program in one EU Member States, one recruited researcher will be enrolled in the Great Britain

Research Fields
Chemistry, Biology, Chemical Engineering, Materials Science, Industrial application and social science, Mathematics

Keywords
Chemical analysis & assays, High-resolution analysis & sample prep, Microbial ecology, Plant & soil biology, Environmental biology, Ecotoxicology, Adsorption phenomena, Chemical process design & engineering, Reactor design, Nanomaterials synthesis, Economic assessment, Scale-up, Machine Learning/Data acquisition, Modelling, Statistics

Benefits and salary
The successful candidates will receive an attractive salary in accordance with the MSCA regulations for Recruited Researchers. The exact (net) salary will be confirmed upon appointment and is dependent on local tax regulations and on the country correction factor (to allow for the difference in cost of living in different EU Member States). The salary includes a living allowance, a mobility allowance and a family allowance (if applicable). The guaranteed PhD funding is for 36 months (i.e. EC funding, additional funding is possible, depending on the local Supervisor, and in accordance with the regular PhD time in the country of origin). In addition to their individual scientific projects, all fellows will benefit from further continuing

education, which includes internships and secondments, a variety of training modules as well as transferable skills courses and active participation in workshops and conferences.

On-line Recruitment Procedure (see Appendix 1)
All applications proceed through the on-line recruitment portal on the https://inclue.eu/ website. Candidates apply electronically for one to maximum three positions and indicate their preference. Candidates provide all requested information including a detailed CV (Europass format obligatory) and motivation letter. During the registration, applicants will need to prove that they are eligible (cf. Recruited Researchers definition in Horizon Europe MSCA work programme 2023-2024, mobility criteria, and English language proficiency):

- Supported researchers must be doctoral candidates, i.e. not already in possession of a doctoral degree at the date of the recruitment.
- Researchers must be enrolled in a doctoral programme leading to the award of a doctoral degree in at least one EU Member State or Horizon Europe Associated Country.
- Recruited researchers can be of any nationality and must comply with the following mobility rule: they must not have resided or carried out their main activity (work, studies, etc.) in the country of the recruiting beneficiary for more than 12 months in the 36 months immediately before their recruitment date.

The deadline for the on-line application is **19th of September 2023**. THE INCLUE Selection Committee (SC) selects between 11 and maximum 22 candidates for the Recruitment Event which will take place in Leuven, Belgium (**9th of November 2023 – date subject to confirmation**). The selected candidates provide a 20-minute presentation and are examined by the Selection Committee. In order to facilitate their travel, selected candidates (from outside Belgium) receive a fixed, lump sum of 250 Euro (paid by the inviting Supervisor). The final decision on who to recruit is communicated the day after the Recruitment Event. The selected DCs are to start their research as quickly as possible (target: March 2024). Prior to the recruitment event, videoconferencing (or in person, when possible) interviews between the Supervisors and the candidates will be organized. The final decision on who to recruit is communicated no later than 10th of November 2023. The selected DCs are to start their research as quickly as possible (ideally around March 2024).

Applicants need to fully respect three eligibility criteria (to demonstrated in the Europass cv):
Conditions of international mobility of researchers:
Researchers are required to undertake trans-national mobility (i.e. move from one country to another) when taking up the appointment. At the time of selection by the host organisation, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more than 12 months in the 3 years immediately prior to their recruitment. Short stays, such as holidays, are not taken into account.
English language proficiency: Network fellows (DCs) must demonstrate that their ability to understand and express themselves in both written and spoken English is sufficiently high for them to derive the full benefit from the network training.

The 11 available PhD positions

DC1: Hybrid US/SCWO system for the combined removal of PFAS and sludge disintegration (WP1)

Host Institution: KU Leuven

Country: Belgium

Supervisor: Raf Dewil (PhD promoter); Co-supervisors: William Peveler (University of Glasgow), Jan Pels (Torwash)

Objectives: to develop a hybrid process comprising ultrasound-assisted supercritical water oxidation (US-SCWO) for the treatment of sludge resulting in (i) a complete mineralization of the organic matter, energy recovery as heat and electricity, (ii) recovery of heavy metals by solubilizing them to the liquid phase and (iii) the full degradation of recalcitrant organic pollutants (with focus on PFAS).
DC1 will assess the use of O_2 as added oxidative species in SCWO (<250°C) and compare it to the typical H_2O_2-addition. DC1 will evaluate the technique for different sludges applying sets of batch experiments. DC1 will apply a design of experiments to support the experimental plan, using metal recovery efficiency and degradation of PFAS (PFNA, PFOA) as output parameters and temperature, pressure, oxidant type and concentration as input parameters. DC1 will define optimised process conditions and link them to the sludge composition and consistency, hereby building a multivariate statistical model. Starting from these results, DC1 will evaluate ultrasound (US) to pre-crack the macromolecular sludge structures and to induce the catalytic activity of indigenous iron on SCWO performance and its influence on the optimum process conditions. DC1 will develop a kinetic model to assess the mechanisms taking place. DC1 will carry out a full energetic evaluation.

Expected results: An optimised hybrid process for metal recovery and PFAS degradation from sludge comprising of US and SCWO. Insights in the kinetics and influential parameters of SCWO of sludge.

Enrolment in Doctoral degree(s): KU LEUVEN Arenberg Doctoral School of Science, Engineering and Technology (BE)

Planned secondments:

- [University of Glasgow](#) *Sup.:* W. Peveler): M28-31; 4 months: *Insights in biosensor development and measuring toxicity via chemical sensing arrays.*
- [Torwash](#) (*Sup.:* J. Pels): M20-22; 3 months: *Practical training on PFAS removal through thermal sludge hydrolysis.*

Candidate Requirements:
- You hold a master's degree in chemical engineering, bioscience engineering or a related field and you thrive in a multidisciplinary research environment.
- You have a solid knowledge of separation processes, reactor engineering, and are well-trained in chemical analytical methods.
- You are ambitious, well organized and have excellent communication skills.
- You speak and write fluent English and have the ability to work effectively and collaboratively.
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities.
- You have demonstrated your commitment to high quality research.

DC2: Energy-efficient microwave-assisted sludge carbonisation ([WP1](#))

Host Institution: [KU Leuven](#)

Country: Belgium

Supervisor: Lise Appels (PhD promoter); Co-supervisors: Maria Westerholm (SLU), Jan Leenknegt (Inagro)

Objectives: to develop a microwave-based hydrothermal carbonisation (HTC) system for the production of hydrochar while investigating the fate of pesticides, endocrine disruptors and heavy metals in the process and the influence of the processing conditions hereon.
DC2 will integrate microwave application in hydrothermal carbonization (HTC) of sludge, leading to higher yields and quality of the produced carbonaceous hydrochar and lower the energy requirement and reaction time. DC2 will investigate the influence of the major HTC operating conditions (temperature (profile), pressure and reaction time) and sludge composition on the yield and characteristics of the hydrochar (including carbon content, specific surface area and porosity, polarity, aromaticity, elemental composition). DC2 will investigate the heavy metal solubilization induced by the microwaves, and their subsequent catalytic effect (e.g., iron) on the carbonisation rate. DC2 will compare the microwave assisted process with classical HTC towards yield and characteristics of the hydrochar. DC2 will carry out pot trials simulating soil application of the hydrochar.

Expected results:A novel microwave-assisted HTC-system to produce hydrochar from sludge. Knowledge on the degradation mechanism of organic pollutants during carbonisation. Knowledge on the behaviour and catalytic properties of heavy metals during the process.

Enrolment in Doctoral degree(s): KU LEUVEN Arenberg Doctoral School of Science, Engineering and Technology (BE)

Planned secondments:
- [SLU](#) (*Sup.:* M. Westerholm): M18-20; 3 months: *Application of microwave pre-treatment prior to sludge digestion: impact on community dynamics.*
- [Inagro](#) (*Sup.:* J. Leenknegt): M28-31; 3 months: *Agricultural application of hydrochar – impact on soil fertility and crop growth.*

Candidate Requirements:
- You hold a master's degree in chemical engineering, bioscience engineering or a related field and you thrive in a multidisciplinary research environment.
- You have a solid knowledge of separation processes, reactor engineering, and are well-trained in chemical analytical methods.
- You are ambitious, well organized and have excellent communication skills.
- You speak and write fluent English and have the ability to work effectively and collaboratively.
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities.
- You have demonstrated your commitment to high quality research.

DC3: Impact of electrochemical treatment on sludge biodegradable character and physical properties ([WP1](#))

Host Institution: [Nijhuis](#)

Country: Netherlands

Supervisors: Nadine Boelee, Yasmina Doekhi-Bennani, Raf Dewil (PhD promoter); Co-supervisors: David du Pasquier (WATCHFROG), Elisabete Costa (UAveiro)

Objectives: to develop an energy-efficient electrochemical pre-treatment (EPT) process to achieve both efficient heavy metal removal and pathogen inactivation, while simultaneously increasing sludge biodegradability and dewaterability.
DC3 will investigate the influence of the most important process conditions to simultaneously maximize *(i)* in-situ generation of active chlorine species and hydroxyl radicals produced (i.e., electro-oxidation) for the removal of heavy metals and inactivation of pathogens in sludge, and *(ii)* the promotion of nutrient winning (P), Al, Fe and Ni (i.e., electro-disposition and electrowinning). Additional beneficial effects of EPT that will be monitored are: (i) enhanced biodegradability as the resulting cell wall lysis increases the bio-accessibility of the sludge organic components, and (ii) enhanced biostability and dewaterability of the sludge. Applied power, electrode materials and configuration will be explored in first instance. ORP (measure for oxygen species), heavy metal content, pathogen abundance, capillary suction time (measure for dewaterability) and organic matter solubilisation will be measured as primary output parameters.

Expected results: Electrochemical pre-treatment strategy to simultaneously recover heavy metals, inactivate pathogens and increase sludge biodegradability

Enrolment in Doctoral degree(s): KU LEUVEN Arenberg Doctoral School of Science, Engineering and Technology (BE)

Planned secondments:
- [Watchfrog](#) (*Sup.: D. du Pasquier*): M20-23 (4 months): *Training in embryotoxicity assessment of organic pollutants using Xenopus Eleuthero embryo Thyroid Assays (XETA).*
- [University of Aveiro](#) (*Sup.: E. Costa*): M28-31 (4 months): *Investigating different functionalised engineered biochar-based materials for their potential to remove heavy metals from sludge and economic comparison with EPT*

Candidate Requirements:
- You hold a master's degree in (electro)chemistry, chemical engineering or a similar field.
- You are interested in electrochemical and/or oxidative purification processes as well as biological wastewater treatment.
- You are committed to high quality research with environmental impact in an industrial setting.
- You are able to analyze your results on a scientific level and you can also translate these results into a full-scale (industrial) application.
- You speak and write fluent English.
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities.
- To be able to successfully fulfill this position, you must also have the following competencies: curious, proactive, creative, analytical and communicative.

DC4: Fate of micro-pollutants during thermal pre-treatment of sludge ([WP1](#))

Host Institution: [TU Delft](#)

Country: Netherlands

Supervisor: Merle de Kreuk (PhD Promoter); Co-supervisor: Jan Pels (Torwash), Jan Leenknegt (Inagro)

Objectives: to optimise thermal hydrolytic sludge treatment efficiency by modelling and predicting the changes in (bio)availability of dedicated pollutants in a wide temperature interval.
DC4 will investigate the changes in the sludge structure (EPS formation, disintegration of organics) and changes and fate (liquid solid phase) of the micropollutants (i.e., PFAS, endocrine disruptors, microplastics) during thermal treatment over a wide temperature range (70-300°C) and for different reaction times (10-240 min). Sludges that will be studied are different types of sewage sludge (activated sludge, aerobic granular sludge and digestate). DC4 will model and predict the degradation and fate of these pollutants based on main pre-treatment process parameters (temperature, pH, sludge origin) and will select the best temperature range for sludge treatment in order to minimise negative effects of sludge application in agriculture with respect to the pollutants under scrutiny. DC4 will carry out a full energetic evaluation of the most optimal process conditions selected and carry out pot trials simulating soil application of the obtained sludge/digestate.

Expected Results: An optimised strategy of thermal sewage sludge treatment for the recovery of a micro-pollutant free fraction to be used in agriculture as soil enhancer

Enrolment in Doctoral degree(s): Graduate School of faculty of Civil Engineering and Geosciences (CEG), TU Delft (NL) - [see overall PhD requirements at Tu Delft](#)

Planned secondments:
- [Torwash](#) (*Sup.:* J. Pels): M20-22 (3 months): identification of (reformed) pollutants in the produced liquid and solid fractions at a pilot or full scale TORWASH sludge treatment installation.

- Inagro (*Sup.:* J. Leenknegt): M28-31 (4 months): *Agricultural application of thermally treated sludge/digestate – impact on soil fertility and crop growth.*

Candidate Requirements:
- You hold a master's degree in chemical engineering, bioscience engineering, environmental engineering or equivalent.
- You are interested in thermal hydrolysis processes, energy balances as well as biological wastewater treatment.
- You are committed to high quality research.
- You have good laboratory skills, and are able to develop new measuring techniques.
- You are able to analyze your results on a scientific level and you can also translate these results into a practical application.
- You speak and write fluent English.
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities.

DC5: Stimulating biodegradation of organic pollutants towards VFA via stress-induced fermentation (WP2)

Host Institution: KU Leuven

Country: Belgium

Supervisor: Lise Appels (PhD promoter); Co-supervisors: Marina Pasteris (EBA), Luis Mchado (Raiz), Maria Westerholm (SLU)

Objectives: to steer mixed-culture anaerobic fermentation processes towards a higher degradation efficiency of pollutants while simultaneously increasing the VFA-yield.
DC5 will investigate the impact of 3 different stressors (low & high pH, pollutant presence & concentration, temperature – 30-55°C) on the adaptive response of the microbial community during anaerobic sludge fermentation. The response will be monitored on 5 levels: *(i)* gene expression levels, *(ii)* mixed-culture community activity and dynamics, *(iii)* VFA concentration and composition, *(iv)* ammonia yield and *(v)* pollutant degradation/removal efficiency. DC5 will employ lab-scale bioreactors (Type Eppendorf BioFlo® 320) for the conversion of sludge containing different levels of pesticides (desphenyl-chloridazon, Fluroxypyr), PFAS (PFNA, PFOA) and heavy metals. Long-term tests in continuous operation will be foreseen to allow community adaptation to the external stressors and to generate insights in long-term stability of these processes for future industrial application. The effects of the addition of the hydrochar (DC2) and engineered biochar (DC7) on increasing pollutant degradation during bioconversion through improving the DIET and microbial colonisation rate will be studied. In addition, pre-treated sludges from DCs 3&4 will be investigated for their fermentation potential via lab-scale batch assays. DC5 will carry out pot trials simulating soil application of the obtained digestate. DC5 will use the results to build a predictive model (based on e.g., ADM1), extendable to other types of sludge and other pollutants from the same classes.

Expected Results: Proof-of-Principle of enhanced pollutant degradation via anaerobic fermentation towards high ammonia- & VFA-yields.

Enrolment in Doctoral degree(s):KU LEUVEN Arenberg Doctoral School of Science, Engineering and Technology (BE)

Planned secondments:
- European Biogas Association (*Sup.:* Marina Pasteris): M13-15 (3 months): *Training on interactions of industry, governmental and research organizations, and influence of European associations on the EU biogas market and related sectors. Inventory analysis on biogas potential from industrial wastewater throughout EU.*
- Raiz (*Sup.:* Luis Machado): M35-38 (4 months): *Training on the forestry biomass-based value chain, competitiveness and sustainability aspects of the pulp and paper sector, and existing and innovative waste management applications.*

Candidate Requirements:
- You hold a master's degree in biochemical engineering, bioscience engineering, microbiology or a related field and you thrive in a multidisciplinary research environment.
- You have a solid knowledge of microbiology, molecular analysis, and reactor engineering.
- You are ambitious, well organized and have excellent communication skills.
- You speak and write fluent English and have the ability to work effectively and collaboratively.
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities.
- You have demonstrated your commitment to high quality research.

DC6: Development of high-performance biogas systems for increased bioplastics degradation (WP2)

Host Institution: SLU

Country: Sweden

Supervisor: Maria Westerholm (PhD promoter); Co-supervisors: Jan Moestedt (Tekniska verken), Julie Jimenez (INRAE)

Objectives: to investigate the potential of a novel anaerobic digester system to improve bioplastics degradation in sludge and contribute to a more fundamental understanding of the involved microbial mechanisms, to build on process strategies that minimize the risk of BP spreading upon land application of sludge.

DC6 will investigate the impact of a novel anaerobic digester set-up, i.e., 2-step mesophilic (37°C) process with an intermediate thermal treatment (70°C), on enhanced biodegradable plastics (BP) degradation. For this purpose, an in-house developed novel macro-fluidic bioreactor system combined with a motorized microscopy system for cultivation and analyses of anaerobic microorganisms will be employed. DC6 will continuously monitor the process performance (methane yield, presence of intermediate degradation compounds) of the digester. DC6 will carry out physico-chemical monitoring (particle size, consistency, discolouring, presence of additives, degradation products) to follow-up effective degradation. DC6 will employ molecular analyses, including illumina 16S rRNA gene illumina, whole-genome and RNA sequencing targeting selected genes and data analyses will be performed. DC6 will carry out pot trials simulating soil application of the obtained digestate. DC6 will identify key microorganisms for BP degradation and determine link with substrate and operating conditions.

Expected Results: Novel anaerobic digester set-up (two-step mesophilic process with inclusion of a mid-step thermal treatment) and impact on BP degradation and formation of microplastics. List with identified key microorganisms for BP degradation in various biogas plants. Recommendations for optimal substrate and operating conditions.

Enrolment in Doctoral degree(s): Dept. of Molecular Sciences, Swedish University of Agricultural Sciences (SE)

Planned secondments:

- **Tekniska verken** (*Sup.:* J. Moestedt): M10-13 (4 months): *Training in system scale-up: design principles and building lab-scale fermenters; assessment of economic feasibility*.
- **INRAE** (*Sup.:* J. Jimenez): M20-23 (4 months): *Insights in microbial enrichment and enzyme activity measurements of hydrolytic bacteria responsible for BP degradation*

Candidate Requirements:

- You hold a master (or similar) in the area of microbiology or molecular/applied biotechnology.
- You should have experience of molecular work, bioinformatics and cultivation of microorganisms.
- You should be motivated with a strong interest in industrial biotechnology, microbiology and renewable energy production.
- You have the ability to work effectively, independently as well as collaboratively.
- You speak and write fluent English and have excellent communication skills.
- You are ready to participate in education, international travel and public awareness activities

---

DC7: Synergistic promotion of methane and nutrient recovery by engineered biochar-based materials (WP2)

Host Institution: University of Aveiro

Country: Portugal

Supervisor: Isabel Capela (PhD promoter); Co-supervisors: Aida Marques (CTIC), Dominique Patureau (INRAE)

Objectives: To perform side-by-side comparisons of various functionalized biochars to assess their effectiveness in the anaerobic digestion of sludges for biogas enhancement and/or efficient capture of agronomically relevant nutrients N and P from the digestate.

DC7 will develop functionalised biochars (with/without embedded nanomaterials) to improve sludge resource recovery in the form of fuels (biogas) and nutrients (N, P). DC7 will engineer biochar-based materials (EBM) to enhance the methane yield during anaerobic digestion and facilitate the recovery of fertiliser nutrients. DC7 will identify appropriate processing conditions leading to (i) the activation (doping) of biochar, (ii) the synthesis of catalyst nanoparticles to be used (metal(oxides)), and (iii) the efficient coupling of the catalyst to the biochar support (e.g., cation adsorption, wet impregnation or chemical precipitation), which will enable obtaining biochar-based catalysts with enhanced catalytic

activity to reach the objectives set forth. DC7 will study the catalytic influence of EBMs on methane production during long-term experiments in continuous lab-scale bioreactors (Type Eppendorf BioFlo® 320). DC7 will investigate the influence of EBMs on nutrients capture and recovery. DC7 will also correlate the key physico-chemical properties of the EBMs (i.e., crystalline structure, specific surface area and porosity, surface charge, pH, and surface functional groups) with the anaerobic digestion performance in terms of process stability, waste stabilisation, energy production and nutrient recovery. DC7 will identify the key pollutants in the selected sludges and follow up on their microbial degradation and/or adsorption onto the EBM. DC7 will monitor the microbial community dynamics to gain insights in the augmented biological activity during digestion with EBM-addition.

Expected Results: Optimized anaerobic digestion strategy with inclusion of EBM to simultaneously increase methane production and recover/capture nutrients (N and P) from the digestate for future agriculture application.

Enrolment in Doctoral degree(s): Doctoral Program in Environmental Sciences and Engineering, University of Aveiro (PT)

Planned secondments:

- **INRAE** (*Sup.:* D. Patureau): M20-23 (4 months): *Assessing the agronomic value of (treated) sludge and digestate, and their potential as fertilising agents for future application in agriculture.*
- **CTIC** (*Sup.:* J.M.A. Salguiero Gaiao & A. Marques): M29-31 (3 months): *On-site validation of EBM technology and economic assessment; training in industrial management methodologies of sludge streams.*

Candidate Requirements:

- Master degree in Environmental Engineering, Environmental Sciences, Chemical Engineering, Materials Engineering or related areas;
- Experience and/or background in wastewater treatment processes, in particular anaerobic biological processes, demonstrated by high quality publications;
- Experience in biochar subjects, in particular on biochar production, characterization and functionalizing;
- Experience and/or background in materials synthesis and processing
- Experience and/or background in materials characterization techniques (ex: XRD, gas adsorption(BET), particle size analysis (coulter), electronic microscopy (SEM), FTIR, zeta potential, among others)
- Skills in laboratory work, including analytical chemistry;
- Fluence in spoken and written English language;
- Availability to live in Portugal.

DC8: Socio-economic and policy-driven evaluation of innovative sludge treatment techniques (WP3)

Host Institution: KU Leuven

Country: Belgium

Supervisor: Raf Dewil (PhD promoter); Co-supervisors: Isabel Capela (UAveiro), Nadine Boelée (Nijhuis)

Objectives: To gather and interconnect the results obtained by DCs 1-10. This will allow to comprehend and map the implications that the developed technologies and improved properties of the investigated sludges will have on policies and decision-making within the EU member states and the EU as a whole, thereby reinforcing our green transition.

DC8 will quantify the economic impact that the technology and process implementation at wastewater treatment plants and industrial sites will have, with a calculation of associated capital expenditure (CAPEX), operating expenditure (OPEX), and return on investment (RoI) to accelerate their adoption by the industry. DC8 will investigate the influence of wide-spread implementation on existing legislation concerning the effective use of sludge, such as the EU Sewage Sludge Directive, currently under review, which regulates the utilization of sewage sludge to prevent negative effects on soil, vegetation, animals, and people. Apart from the technical, environmental and policy considerations, DC8 will examine the social acceptance of the developed sludge treatment techniques as a third crucial aspect for the long-term viability and effectiveness of these techniques, considering public perception, stakeholder engagement, and community acceptance.

Expected Results: Thorough understanding of the socio-economic and regulatory consequences and opportunities of wide-spread technology implementation.

Enrolment in Doctoral degree(s): KU LEUVEN Arenberg Doctoral School of Science, Engineering and Technology (BE)

Planned secondments:

- **Nijhuis** (*Sup.:* N. Boelee): M18-21: *Training on full-scale industrial sludge treatment, including cost assessment*.
- **University of Glasgow** (*Sup.:* W. Peveler): *Insights in biosensor development and toxicity screening via chemical sensing arrays.*

Candidate Requirements:

- You hold a master's degree in policy and management, environmental sciences or a related field and you thrive in a multidisciplinary research environment.
- You have a solid knowledge of LCA, economics and (EU) policy and decision-making.
- You are ambitious, well organized and have excellent communication skills.
- You speak and write fluent English and have the ability to work effectively and collaboratively.
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities.
- You have demonstrated your commitment to high quality research.

DC9: Understanding the fate of carbon, nutrient and pollutants to propose typology of organic sludge fertilisers (WP3)

Host Institution: INRAE

Country: France

Supervisor: Dominique Patureau (PhD promoter); Co-supervisors: Martin Hitzl (Ingelia), Nadine Boelée (Nijhuis)

Objectives: To characterise the effectiveness of various treatments on the quality of the treated sludges, digestates and the char-based materials (hydrochar, EBM) as a fertiliser.

DC9 will study the impact of the various treatments on the organic contaminant accessibility and mobility. DC9 will adapt and apply recent methodologies to assess the stability of the organic matter, the nutrient availability, and the mobility of the remaining organic contaminants. DC9 will apply statistical analysis to build a methodology to define optimal process conditions to obtain a targeted organic fertiliser, depending on the associated agrosystem needs. DC9 will characterize the impact of the produced organic fertilisers on the C, N and P compounds fate in soil using an in-house developed biochemical sequential extraction technique. DC9 will apply particle-size fractionation to characterize the fraction that could be vertically transferrable in soil thanks to colloidal transport. DC9 will develop a design support tool for sludge treatment and application and assess the environmental impact.

Expected Results: Knowledge and design support tool on fertiliser properties of different INCLUE sludges, digestates and or char-based materials to asses the agronomic value and fate of (residual) pollutants.

Enrolment in Doctoral degree(s): Gaia Doctoral School, University of Montpellier (FR)

Planned secondments:

- **Nijhuis** (*Sup.:* N. Boelee): M12-15 (4 months): *Understanding the source and handling principles of the samples and investigating the impact of electrochemical treatment on sludge nutrient availability*.
- **Ingelia** (*Sup.:* M. Hitzl): M29-31 (3 months): *Impact of the HTSC process conditions on hydrochar properties; consequences for heavy metal and organic pollutant immobilisation.*

Candidate Requirements:

- You hold a master's degree in process engineering
- You have basis in modelling and mathematics
- You have interest on biochemical characterization and environmental chemistry

- You speak and write fluent English
- You are organized, have the ability to work effectively and collaboratively
- You like to communicate and participate to international exchanges
- You are an enthusiastic and motivated person

DC10: Project title: Investigating residual embryotoxicity of micropollutants and degradation products (WP3)

Host Institution: INRAE

Country: France

Supervisor: D. du Pasquier, D. Patureau (PhD promoter) ; Co-supervisors : Raf Dewil (KU LEUVEN), M. de Kreuk (TU Delft)

Objectives: To assess embryotoxicity and environmental impact of treated sludges, digestates, and char-based materials in the context of agricultural land use. To link toxicity with the presence of specific classes of molecules.

DC10 will assess embryotoxicity and endocrine disruptive properties of the INCLUE sludges and digestates, and use this to evaluate the efficacy of the treatments to depollute the sludge. DC10 will employ bioassays, and in vivo bioanalytical assessment at the whole organism level, using fish and amphibian embryos (e.g., Medaka). DC10 will identify the most efficient treatment for toxicity removal and provide guidance to optimize the individual treatments towards toxicity decrease. DC10 will identify the chemicals acting as drivers of embryonic or endocrine toxicity in sludges, using Effect Directed Analysis, which is based on the fractionation of the samples followed by the identification of positive fractions using bioassays.

Expected Results: Bioassays developed for monitoring ecotoxicity, by creating knowledge on (i) the chemicals as drivers of sludge ecotoxicity, (ii) the effectiveness of the INCLUE sludge treatment methods towards depollution of sludge.

Enrolment in Doctoral degree(s): Gaia Doctoral School, University of Montpellier (FR)

Planned secondments:

- **KU Leuven** (*Sup.:* R. Dewil*)*: M12-15 (4 months): *Training in high-resolution analysis of micropollutants in sludge matrices, optimisation of sample preparation.*
- **TU Delft** (*Sup.:* M. de Kreuk): M29-32 (4 months): *Insights in the kinetics of thermal pre-treatment and formation of transformation products*.

Candidate Requirements:

- You hold a master in toxicology, ecotoxicology, biotechnology, endocrinology or a related field.
- You are very keen to join the R&D team of the first private laboratory dedicated to the assessment of endocrine disruptors.
- You are motivated to use and promote NAMs (New Approach Methodologies) using embryos of aquatic organisms (fish and frogs) in an ecotoxicological context.
- You are well-organized and have good communication skills.
- You speak and write fluent English and have the ability to work effectively and collaboratively.
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities.

DC11: Holistic sensing of pollutants and ecotoxicity in treated sludge (WP3)

Host Institution: University of Glasgow

Country: Great Britain

Supervisor: William Peveler (PhD promoter); Co-supervisors: Raf Dewil (KU LEUVEN), David du Pasquier (WATCHFROG)

Objectives: to design and develop biosensing technologies that can rapidly assess the potential bacterial toxicity of treated sludge, and may in turn act as tools for better understanding the efficacy and applicability of different treatment regimens and different sludge sources.

Associated DC (DC11) will design and construct a sensor array capable of detecting key pollutants (with a focus on heavy metals, pesticides and PFAS) in both untreated and treated sludges. associated DC (DC11) will employ high throughput targeted and un-targeted or 'fingerprinting' approaches for rapid toxicity assessment. Associated DC (DC11) will test the developed sensor approach for assessing the impact of treatment regimens and sludge sources. Associated DC (DC11) will benchmark the efficacy and sensitivity of such a biosensor tool on a range of samples from project partners with 'gold standard' techniques. Associated DC (DC11) will link the output of the sensor tool with bacterial and wider ecotoxicity. Associated DC (DC11) will employ a range of molecular synthesis and engineering techniques (to link molecules and nanoparticles) alongside a wide range of analytical tools (e.g., fluorometric & colorimetric tests, plasmonic chips) and multivariate statistical analysis techniques, with the potential to undertake machine learning.

Expected Results: Biosensor array, capable of both detecting and differentiating various heavy metals, PFAS and pesticides commonly found in sludge and assess bacterial toxicity effects in sludges.

Enrolment in Doctoral degree(s): University of Glasgow, College of Science and Engineering Doctoral School (GB)

Planned secondments:

- **KU Leuven** (*Sup.:* R. Dewil): M12-15 (4 months): *Understanding the source and handling principles of the samples, insights in the kinetics of plasma treatment and formation of (inhibitory) PFAS-degradation products and establishment of the gold-standard techniques that are used to analyse them.*
- **Watchfrog** (*Sup.:* D. du Pasquier): M20-23 (4 months): *Insight and investigation into other measures of ecotoxicity and comparison of benchmark data across different test samples.*

Candidate Requirements:

- You hold a master's degree in chemistry or related molecular sciences, and you have a good knowledge of how to make and modify molecules.
- You understand the principles of analytical chemistry, how to probe molecular structure and supramolecular interactions.
- You are well organised and can work collaboratively with others in diverse and multidisciplinary research environment.
- You can speak and write fluent English and have excellent communication skills
- You are enthusiastic and motivated to undertake laboratory research, are ready to participate in personal training, international travel and development activities.
- You have demonstrated your commitment to high quality research.

DN INCLUE project abstract and key project information

The INCLUE Doctoral Network will train 11 motivated and talented Doctoral Candidates (DCs) in the field of sludge pre-treatment combined with state-of-the-art bioconversion techniques and multi-level toxicity assessment, for the effective removal and/or recovery of both hazardous and valuable compounds from municipal and industrial sludges. Lastly, a socio-economic and policy-driven evaluation of the proposed technologies will be performed, to support successful implementation, thereby reinforcing EU's green transition.

The intersectoral training programme (INCLUE has 6 academic and 11 non-academic partners from 7 countries) is dedicated to the technical and economic challenges and innovative developments associated with the development of sustainable sludge treatment technologies and scientific insights to facilitate the recovery of renewable chemicals and (gaseous) fuels from hazardous sludges to exploit them as bioresources. The combination of state-of-the-art doctoral research projects, intersectoral secondments and supervision by leading companies and universities will be the foundations of INCLUE's success.

Research Objectives:

- Develop and optimise sustainable techniques to enhance the properties and composition of sludge through removal of (in)organic pollutants to eliminate any adverse effects for sludge application (i) in a subsequent bioconversion process or (ii) directly as a fertiliser on land.
- Develop augmented fermentative bioconversion processes to produce renewable chemicals and fuels, and to recover nutrients from municipal and industrial sludges, potentially combined with pre-treatment technologies.
- Create tools to assess the overall environmental performance of treated sludges towards toxicity, pollutant soil dynamics and agricultural fertilising value in a combined decision support tool for 5 different types of pollutants: pesticides, endocrine disrupting compounds, heavy metals, PFAS and antibiotics. Develop a socio-economic evaluation tool, to support decision-making and societal acceptance.

General coordinator for DN INCLUE:
Prof. Lise Appels (KU Leuven)
lise.appels@kuleuven.be

Project Manager DN INCLUE:
Ionuț-Alexandru Popa (KU Leuven)
ionut.popa@kuleuven.be
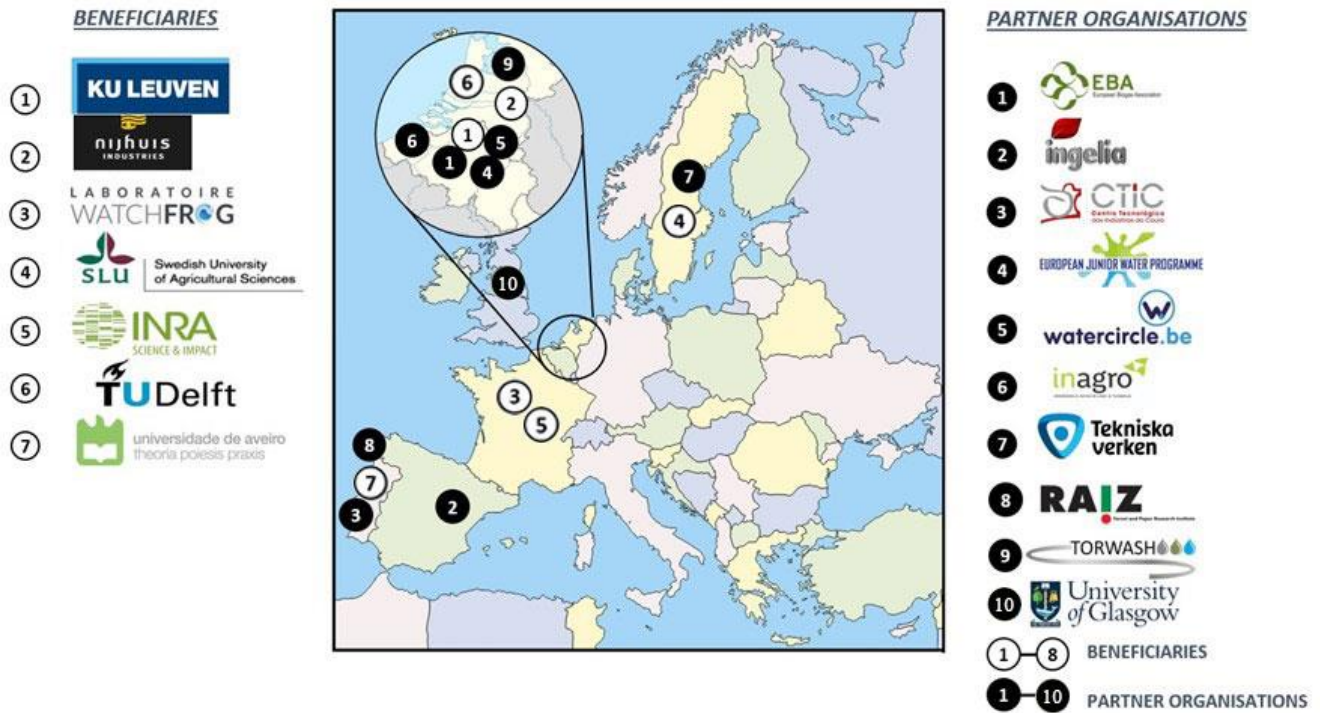
INCLUE Consortium:

Figure 1: INCLUE CONSORTIUM

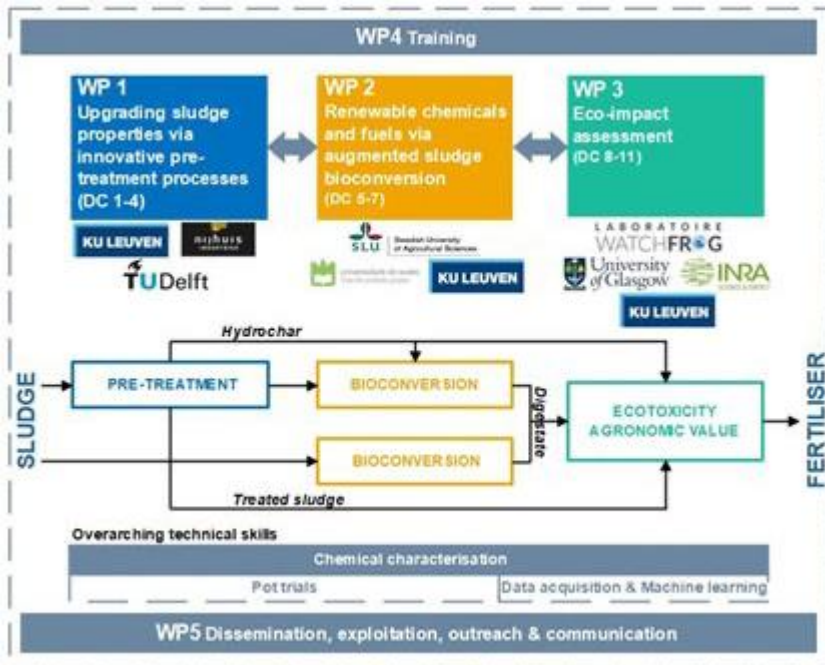**INCLUE research programme overview:**

Figure 2: The scope and interconnectivity of the INCLUE DN

Appendix 1: Recruitment Procedure and Principles

A INCLUE recruitment webpage is put on-line (July 2023), as part of the INCLUE project website: https://inclue.eu/

Key dates
- 5 July 2023: Launch of 11 DC Positions
- 19 September 2023: Deadline for on-line application
- 29 September 2023: Circulation list "INCLUE pre-selected candidates"
- 9 November 2023: INCLUE Recruitment Event (date subject to confirmation)
- 10 November 2023: Circulation list "selected INCLUE DCs"
- March 2024: Targeted starting date for DC contracts (or earlier, if possible)

Applications are made through an on-line, eligibility-proof form on the INCLUE recruitment webpage. The candidates apply for a maximum of three specific DC positions and list their order of preference. The Supervisors provide the names of their preferred candidates to the Selection Committee (SC), which in its turn produces a short list of candidates: 2 per position. As such a maximum of 22 DCs (from an initial expected pool of 120-200 candidates) are invited to the Recruitment Event (Leuven, M1).

Each candidate gives a presentation and is interviewed by the SC. After a thorough evaluation, the candidates are ranked and a collective decision is made. In this way a complementary team of DCs can be assembled, as positively experienced from previous similar recruitment events.

In case not all 11 DCs can be recruited during the collective Recruitment Event, the recruitment procedure is "decentralised", meaning that the involved supervisors continue the search for good candidates. The SC is kept informed at all times when new eligible candidates appear. The SC makes an official complaint in case the Code of Conduct for the Recruitment MSCA of Researchers is breached. The involved supervisor is then expected to find another candidate. Recruitment problems are also, if still needed, discussed during the Network Wide Event meeting (M7) in order to deliver specific action plans to target specific networks relevant for the vacant DC positions.

All details concerning the recruitment-procedure principles are communicated on the on-line application portal, so that potential DCs know exactly what to expect and are stimulated to apply. All recruitment (pre and final selection) is in line with the European Charter for Researchers, providing the overarching framework for the roles, responsibilities of both researchers and employers. The Code of Conduct for the Recruitment of Researchers functions ensures that the selection procedures are transparent and fair.

The recruitment strategy of INCLUE fully complies with the Code of Conduct definition of merit. For example, merit is not just measured by a researcher's grades, but on a range of evaluation criteria, such as teamwork, interdisciplinary knowledge, soft skills and awareness of the policy impact of science.

The SC has members of each gender and considers the promotion of equal opportunities and gender balance as part of the recruitment strategy. Also, in view of the RRI principles, special efforts are made to attract women DCs from new EU Member States.

INCLUE aims for a gender balanced participation of DCs in the network. Researchers are employed on fixed-term contracts and are registered as staff candidates for PhD degrees. Therefore, they are entitled to pension contributions, paid holidays, and other benefits as governed by the universities and industrial companies.

For any inquiries regarding the recruitment procedure, please send an email to info@inclue.eu