Call for applications for admission to XXXVIII Cycle of Politecnico di Bari PhD Programmes

Attachment 3

PhD PROGRAMME IN

RISK, ENVIRONMENTAL, TERRITORIAL AND BUILDING DEVELOPMENT

Project Identification Code (CUP): D93C22000530001; D93D22001340001

XXXVIII CYCLE DOCTORATE PROGRAMME PROFILE	
DEPARTMENT	Department of Civil, Environmental, Land, Building Engineering and Chemistry
COORDINATOR	Prof. Vito Iacobellis (vito.iacobellis@poliba.it)
PLACES AVAILABLE	17
of which	
Places with Politecnico di Bari grant	4
*Places with **Politecnico di Bari grant reserved for graduates from non-Italian universities***	1
*Places with grant funded by NRRP – as per Ministerial Decree **351/2022*** ***Refer to research topic list below***	5 of which: GRANT N.1 - **Area:** Public Administration; **Topic: "***Innovative digitalized decision-making support models for shared and inclusive spatial planning for fragile and vulnerable groups and individuals*"; GRANT N. 2 - **Area:** Public Administration; **Topic: "***Digital hub for the understanding, enhancement and protection of monumental architectural heritage*"; GRANT N.3 - **Area:** Public Administration; **Topic: "***SMARTSEAS - Sustainable Materials by Recycling and Treating Sediments, Shells And Seagrass*"; GRANT N. 4 - **Area:** NRRP; **Topic: "***Hydrodynamic study of turbines for the production of energy from marine currents (IDROTURB)*"; GRANT N. 5 - **Area:** NRRP; **Topic: "***Innovative and high-efficiency luminophore materials for luminescent solar concentrators*".
*Places with grant funded by NRRP – as per Ministerial Decree **352/2022*** ***Refer to research topic list below***	3 of which: GRANT N. 6 - **Co-funded by**: Print Bag s.r.l.; **Topic: "***Influence of bio-plastics on the performance of organic treatment plants for solid urban waste"*; GRANT N. 7 - **Co-funded by**: Studio Professionale - Architetto Mauro Sàito; **Topic: "***Map of High-Performance Facades for carbon neutral buildings"*; GRANT N. 8 - **Co-funded by**: V.F. CAVE s.r.l.; **Topic: "***Recovery and ecological, environmental and territorial regeneration of underground quarries in Cutrofiano: transition from extraction activity to a circular model of production and consumption based on agricultural, social and environmental sustainability"*.

Places without grant funding	4
ADMISSION REQUIREMENTS *Applicants to the PhD programme in Risk, Environmental, Territorial and Building Development* ***must hold a second level (specialized) degree:***	➢ Degree diploma awarded by the Italian university system prior to Ministerial Decree 509/99; ➢ Specialist Degree (as per Ministerial Decree 509/99); ➢ Master's Degree (as per Ministerial Decree 270/04); ➢ Degree qualifications awarded by foreign universities officially recognised as equivalent[1].

APPLICATION PROCEDURES	
Please note that the information provided below complements and does not substitute that contained in arts. 2 and 3 of the general Application Call.	
REQUIRED DOCUMENTATION *Candidates must upload the following documentation to their online application.* ***Failure to do so will result in their exclusion from the selection procedure****.*	➢ **A CV** following the layout of the example provided by Politecnico di Bari at https://www.poliba.it/it/dottorati-di-ricerca. *(File to be named "01.CV")*. ➢ **Copy of a current identification document**. Only the following documents will be considered eligible: • ID cards issued by an EU member state; • driving licence issued by an EU member; • in all other cases, a full validity passport (also non-EU citizens). *(File to be named "02.Documento Riconoscimento")*. ➢ **Degree qualification certification for first (Bachelor's) degrees and second (specialization/Master's) degrees (or 5-year Single Cycle degrees)**. **Candidates with qualifications awarded in Italy** must attach the Politecnico form available at https://www.poliba.it/it/dottorati-di-ricerca, specifying: • final degree mark; • a list of all exams taken with their relative marks in both degree courses (or the Single Cycle course); • results of exams taken. *(File to be named "03.Titoli di Laurea")*. **Candidates with a degree qualification awarded by a non-Italian university** must attach the following documents to their application, as issued by the awarding body. This supersedes any form of self-declaration [2]: • Degree certificate or diploma showing relative final mark; • Official transcript of exams taken during all university study programmes, showing relative results;

[1] *Where a qualification awarded by a foreign university has not yet been declared equivalent to an Italian university degree, subject to verification by the administration offices, the Selection Committee will decide upon the eligibility of the foreign qualification in line with current Italian regulations and those of the country of origin, as well as any international treaties or agreements on qualification recognition for further study.*

[2] **N.B.**: These documents must be in Italian, French or English or translated into Italian or English and verified by an official Italian diplomatic or consular representative under the responsibility of the candidate. These should follow the guidelines set out in the document "*PROCEDURES FOR ENTRY, RESIDENCY AND ENROLMENT OF INTERNATIONAL STUDENTS AND THE RESPECTIVE RECOGNITION OF QUALIFICATIONS, FOR HIGHER EDUCATION COURSES IN ITALY FOR THE ACADEMIC YEAR 2022/23*" available at the Ministry link https://www.studiare-in-italia.it/studentistranieri/".

	• Any other type of document which demonstrates the equivalence of qualifications with those required in this application call (Supplementary Diploma, *Dichiarazione di Valore* (statement of value) issued locally. *(File to be named "03.Titoli di Laurea")*. ➢ **An abstract of the thesis topic for specialist/Master's degree (or five-year Single Cycle degree),** stating the title and name of thesis supervisor(s) (max 3,000 characters). *(File to be named "04.Abstract Tesi")*. ➢ **Candidate thesis for specialist/Master's degree (or five-year Single Cycle degree)** For **graduating students** whose thesis is not yet complete (see art.2), a draft version of the thesis which has been completed up to the time of application; (**N.B.** "draft version" implies a version of the thesis text as completed by the graduating candidate up to the date of application, which, in terms of chapters and pages, allows the Selection Committee to evaluate its relative content and subject area. The abstract is uploaded as a separate file and is not considered as a draft version of the thesis under any circumstances. *(File to be named "05.Tesi")*.. ➢ **PhD research** proposal which the candidate intends to develop during the programme, stating the scientific basis of the proposal, its research objectives and the methods to be used. **Research proposals must use the format available at the following link (title "*ALLEGATO C_FORMAT PROPOSTA DI RICERCA_DRSATE.doc*":** **https://www.poliba.it/sites/default/files/dottorati/allegato_c_format_proposta_di_ricerca_drsate_english.docx.** **N.B**: Candidates who intend to propose a research project based on the topics set out in Ministerial Decrees 351/2022 and 352/2022 must prepare a proposal in line with one or more of the topics listed below. Research proposals and projects are assessed purely for the purposes of admission and are not necessarily those which the candidate will follow during the programme. *(File to be named "06.Proposta di Ricerca")*
OPTIONAL DOCUMENTATION	➢ **A self-certification declaration for any other qualifications** deemed suitable for evaluation which must be signed and dated (following the layout of the example provided at https://www.poliba.it/it/dottorati-di-ricerca), as per arts.46 and 47 of Presidential Decree n. 445/2000. *(File to be named "07.Dichiarazione altri titoli")*.

	➢ **Either one or two letters of reference from teaching staff** who have supervised the candidate throughout their university-level studies. *(Files to be named "08.Lettera presentazione 1", "08. Lettera presentazione 2"*). ➢ **Language certification** demonstrating a knowledge of English which corresponds to at least B2 level. Only those candidates who are non-Italian citizens may attach certification which demonstrates knowledge of the Italian language. *(File to be named "09.Certificazione linguistica 1"; etc*). ➢ **Any publications** related to activity carried out and shown on the candidate's CV. These must be in either Italian or English or translated into Italian or English on behalf of and under the responsibility of the candidate. In cases of **large publications** unavailable in electronic format or which exceed the number of MB permitted for documents, applicants may submit these separately (in paper format or as a CD or DVD-ROM), together with a detailed explanatory list, by 2 p.m. on the deadline date for applications. All publications submitted on paper or on electronic media must be sent in a sealed envelope, signed along the flap, to the following address: Magnifico Rettore del Politecnico di Bari – Direzione Gestione Risorse e Servizi Istituzionali - Settore Ricerca, Relazioni Internazionali e Post-Lauream - Ufficio Protocollo – Via Amendola 126/B, 70126 BARI (Italy). Envelopes must show the name and surname of the candidate together with the following text: "*Concorso di Ammissione al Corso di Dottorato in…* (name of the PhD programme)". The delivery of the envelope containing publications to Politecnico di Bari – by postal service, private courier or shipping agency – is wholly at the candidate's risk. *(File to be named "10.Pubblicazione 1"; etc*).
DOCUMENT CHECKLIST	**<u>Required documentation:</u>** ➢ **CV** *(to be named "01.CV"*); ➢ **Copy of a current identification document** *(to be named "02.Documento Riconoscimento"*); ➢ **Degree qualification certification for first (Bachelor's) degrees and second (specialization/Master's) degrees (or 5-year Single Cycle degrees)** *(to be named "03.Titoli di Laurea"*); ➢ **Abstract of the thesis topic for specialist/Master's degree (or five-year Single Cycle degree)** *(to be named "04.Abstract Tesi"*); ➢ **Candidate thesis for specialist/Master's degree (or five-year Single Cycle degree)** *(to be named "05.Tesi"*);

	➢ **PhD research proposal** (*to be named "06.Proposta di Ricerca").* **<u>Optional documentation:</u>** ➢ **Self-certification declaration for any other qualifications** *(to be named "07.Dichiarazione altri titoli"*); ➢ **Either one or two letters of reference from teaching staff** *(to be named "08.Lettera presentazione 1", "08. Lettera presentazione 2"*); ➢ **Language certification** *(to be named "09.Certificazione linguistica 1"; etc*); ➢ **Any publications** *(to be named "10.Pubblicazione 1"; etc).*

ADMISSION EXAMINATION	
1.ASSESSMENT OF QUALIFICATIONS HELD	Assessment of qualifications held (average exam scores, final degree mark, theses, Master's degrees, post-graduate courses, language certification, publications, etc.).
2. INTERVIEW	The interview provides an opportunity for a complete evaluation of the candidate and a verification the applicant's aptitude for research and willingness to undertake experience abroad, as well as areas of research interest.
DATES OF INTERVIEWS	Wednesday 21 Sept 2022.

The Examination Board will assess candidates' qualifications and interview with a mark **out of 100** (maximum mark for qualifications 40 and interview 60).
Candidates awarded less than **10 marks** for the **qualification evaluation** will not be admitted to the interview phase of the selection process.

The minimum pass mark for the **interview is 15.**

The minimum overall pass mark for the selection procedure is 25.

The results of the Board's assessment for qualifications and research proposals will be published on the Esse3 portal in the private area of each candidate. No other direct notification will be sent to the candidates.

At the end of the examination procedure, the Board will carry out an overall assessment and draw up an admission rankings list on the basis of the marks obtained by candidates in each part of the examination.

The assessment criteria for qualifications will be established by each Examination Board.

<u>LIST OF RESEARCH TOPICS FOLLOWS</u>

GRANT N. 1
DRSATE

D.M. 351/2022
Area: Public Administration

Topic: "*Innovative digitalized decision-making support models for shared and inclusive spatial planning for fragile and vulnerable groups and individuals*"

RESEARCH PROPOSAL:

The project aims to investigate and improve the participation of the most fragile and vulnerable people (in particular the elderly and children) in the planning and design processes of settlement spaces, on an urban or territorial scale. The research will be carried out with a perspective of innovation and digitalization of systems of decisionmaking and policymaking, as well as of community spatial knowledge management.

From a substantive point of view, the research will be developed along two parallel conceptual lines. The theme of the participation of vulnerable people will be aimed at developing awareness of representation and use of (in particular urban) living spaces, according to a spatial cognition approach (Denis 2017), applied to territorial engineering. Instead, the theme of the innovation of decision support systems will be oriented towards developing dynamic management models of complex spatial and social knowledge based on applied ontology approaches (Borgo et al. 2018).

The research will include an initial period of study of the state of research in progress on the international scene, concerning the issues of the cognitive involvement of fragile people in spatial planning processes, as well as the construction of innovative IT-based and/or AI-based models for decision support. This period will also be carried out by taking advantage of attendance at higher level university courses already provided or activable by the Polytechnic University of Bari.

Subsequently, the research will be conducted with reference to analyses and experiments developed on international case studies, using models for comparing processes and results. Therefore, there will be study periods in Italy and abroad, in qualified research centers with skills and experience on the topics covered by the study. Preliminary research agreements are already established with the Cognitive Systems Department (CoSy) of the University of Bremen (Barkowsky et al. 2014) and the Bartlett School of the University of Central London (UCL) (Batty 2017), as well as with the Laboratory of Applied Ontology of the ISTC-CNR of Trento (Guarino et al. 2012), with the Department of Educational Sciences, Psychology, Communication of the University of Bari (Lopez et al. 2021) and with the Department of Energy of the University of Pisa (Cutini 2010). However, agreements may be extended by benefiting from a constant participation of the group in international research networks, including the Association of European Schools of Planning (AESoP) for spatial planning, Spatial Intelligence and Learning Center (SILC) for Spatial Cognition, International Association for Ontology and its Applications (IAOA) for ontological models of knowledge.

The final part of the research project will focus on applicative and operational perspectives, albeit of a preliminary and prototype type. It will concern in particular the possible creation of digital environments

for the dynamic management of collective spatial knowledge, keeping in structural reference ways of systemic involvement of fragile people in spatial planning processes.

References

Barkowsky T., Freksa C., Nebel B., Hegarty M. (Eds.) (2014). Spatial cognition IX (International Conference, Spatial Cognition 2014, Bremen, Germany, September 15-19, 2014. Proceedings ed.). Heidelberg: Springer.

Batty, M. (2017). The New Science of Cities: MIT Press.

Borgo S., Hitzler P., Kutz O. (Eds.) (2018). Formal Ontology in Information Systems. Amsterdam: IOS Press.

Cutini V. (2010). La rivincita dello spazio urbano. L'approccio configurazionale allo studio e all'analisi dei centri abitati. Pisa: Plus.

Denis, M. (2017). Space and Spatial Cognition: A Multidisciplinary Perspective. London: Taylor & Francis.

Guarino N., Bottazzi E., Ferrario R., Sartor G. (2012). Open ontology-driven sociotechnical systems. In M. De Marco, D. Te'eni, V. Albano & S. Za (Eds.), Information systems: crossroads for organization, management, accounting and engineering (pp. 535-542). Heidelberg: Springer.

Lopez A., Germani A., Tinella L., Caffò A.O., Postma A., Bosco A. (2021). The road more travelled: The differential effects of spatial experience in young and elderly participants. International Journal of Environmental Research and Public Health, 18(2), 709.

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GRANT N. 2
DRSATE

D.M. 351/2022
Area: Public Administration

Topic: " Digital hub for the understanding, enhancement and protection of monumental architectural heritage"

The project is aimed at maximizing the relationship between survey, 3D modeling, analysis and management of historical artifacts through a digitalization of the acquired knowledge, guaranteeing the traceability of sources and processes. BIM models will become "digital hubs" for a representation of the state of affairs that can connect and update data on historical, geometric-dimensional, morphological- figurative, technical-constructive, etc. characteristics. The verification of the workflow starts from the laser scanner and photogrammetric survey and ends with the development of models that can be used in different areas of application: accessibility and enhancement, documentary-archival research, conservation and artificial intelligence. The following objectives will be pursued: Extend the domain of the BIM model, integrating and enhancing the semantic level of representation; Provide a formal representation through an ontological structuring of the data; Allow the use of the model for dissemination purposes through the use of Virtual Reality.

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GRANT N. 3
DRSATE

D.M. 351/2022
Area: Pubblica Amministrazione

Topic: *"SMARTSEAS - Sustainable Materials by Recycling and Treating Sediments, Shells And Seagrass"*

SMARTSEAS intends to foster a change of perspective in the management of high-impact *blue waste*, such as dredged marine sediments, mussel shells and beached Posidonia oceanica. The project aims to transform them into new materials and industrial by-products. The research will be conducted according to a triple helix model and will benefit from the collaboration between research groups in Italy and abroad, companies in the industrial sector and local authorities in charge of managing these materials. Recently, also within the framework of a recently concluded industrial PhD, the possibility of recycling mussel shells, suitably treated, as a partial replacement of commercial cements has been verified for the creation of new binders with a lower environmental impact and capable of stabilising dredged marine sediments, with the same chemo-hydro-mechanical effectiveness as commercial cements. Based on these results, SMARTSEAS will mark a step forward to i) optimise the design of innovative solutions for the chemo-hydro-mechanical stabilisation of sediments and the reuse of other *blue waste* materials and ii) set up targeted protocols for the management of dredged sediments considering the chemo-mechanical characteristics of the material, the technical targets, the economical constraints and the current legislative framework.

Motivation and background

The total amount of dredged sediment in Europe reaches 200,000 m3/year (SedNet, 2011). Currently, dredged sediments are classified as waste and mainly disposed of in large basins with high costs and significant consumption of space, resources and energy. Recent National regulations (DM 173/2016) have made explicit the need to aim at the recognition of sediments as a resource to be valorised rather than waste to be disposed of. However, the contributions in this direction and the available technologies do not offer a clear picture of treatment optimisation and, the same, are often only feasible with energy costs that are no longer sustainable today (Federico et al., 2015; Sollecito et al., 2021). The need to reuse shells emerges, on the other hand, in view of the large quantities currently landfilled in Europe and the complexity of disposal procedures (Roque et al., 2021; Tang et al., 2021,). Finally, Posidonia Oceanica, a plant of great ecological value and an endemic species in the Mediterranean, becomes one of the predominant components of the so-called beach litter when its leaves reach the shore and become urban waste (Legislative Decree 152/2006). The transition towards the adoption of large-scale sustainable technologies aimed at the management and valorisation of dredged sediments in different production contexts is, however, undermined by the lack of a homogeneous regulatory framework at national and European level, also in terms of end-of-waste. Recently the possibility of recycling mussel shells, as a partial replacement of commercial cements for the creation of new sustainable binders to mechanically stabilise dredged sediments has been verified (Vitone et al., 2020; Petti, 2022).

Research Development

Based on these results, SMARTSEAS aims to convert marine sediments into original construction materials that can be used as alternatives for cast-in-place or prefabricated products (breakwaters, etc.) and building components (bricks, etc.). The study will be divided into two macro-actions that will involve, for the experimental and numerical parts, the Laboratories of the Politecnico di Bari, the National Research Council on Terrestrial Ecosystems CNR-IRET in PISA, a university abroad among those with which there is already a collaboration on the subject (ETH-Zurich, Université Grenoble Alpes, University of Twente, IIT Bombay). The implementation and validation aspects of the industrial products and those connected with the systematisation of the processes will, on the other hand, see the involvement of companies and/or public bodies already involved in studies and other project proposals on the subject (e.g., Italcementi HeidelbergGroup, Vibrotek Srl, Huesker Srl, Bari and Taranto Port Authorities, ISPRA, ASSET, mussel cooperatives). In detail, research activities include:

A1. Development and optimisation of the mixtures.

This phase will be conducted by analysing sediment-binder and additive mixtures and characterising their technical effectiveness. The laboratory experimental activity will involve different scales of observation (particle scale, microstructure scale, volume element scale) and will be aimed at highlighting the interactions between types and quantities of additives and binders, in order to identify the key factors that regulate them and have an effect on the chemo-hydro-mechanical performances of the mixtures. Part of the experiments will be dedicated to study the chemo-hydro-mechanical effects of Posidonia Oceanica (in powder and fibre form) as a natural additive in the mixture composed of sediment, binders and mussel shell powder. Part of the characterisation of the sediments and mixtures will be addressed to the evaluation of the chemical-physical, biochemical and toxicological properties, in order to guarantee a safe environmental use of the mixtures produced. With reference to the selection of binders, the possibility of using alkaline-activated binders will be investigated, considering the sediments as an alumino-silicate source (precursors), with a specific focus on mussel shell. The study of the cementing processes induced by the alkaline activation of the precursor will allow the mix-design of the binder to be optimised, as a preliminary step to its use for sediment treatment. The characterisation phase of sediments and mixtures will be conducted by coupling destructive methods and non-destructive geoelectrical and geophysical tests, according to an original approach. Direct current geoelectric methods are suitable for assessing the interaction between the solid phase of sediments and the interstitial fluid, determining parameters such as electrical resistivity and natural polarisation related to electrochemical processes between minerals and fluids or electrokinetic processes related to the flow of ions in the soil. Seismic methods will be used to determine the mechanical properties of soils by analysing the propagation velocity of artificial elastic waves.

A2. Realisation of prototypes, development of prediction models and integrated management protocols.

The calibration of measurements at the laboratory scale will enable the transfer of measurement methodologies to the prototype scale. The mixtures that appear to perform best will be used to build first prototypes of the products. Specifically, in collaboration with the company, the feasibility of cast-in-place or prefabricated products (breakwaters, mass stabilisation) and building components (bricks, self-locking outdoor paving slabs) will be verified. Part of the research can involve the FabLab of the Politecnico di Bari for the use of 3D printing in the manufacture of some products and the Coastal Engineering Laboratory (LIC) for the performance and durability verification of scale models of some of the above-mentioned products.

The study will be dedicated to the development of advanced numerical modelling and data analysis with Machine Learning in order to predict the performance of mixtures as the characteristics of waste change and generalise solutions for the optimisation of finished products. Finally, the triple helix collaboration between public bodies, research organisations and companies will make it possible to develop integrated waste management protocols that consider technical, economic and social acceptance aspects.

Particular attention will be paid to the analysis of the existing regulatory framework at national and supranational level concerning the management of dredged sediments and other used materials and their reuse in different production contexts (End of Waste). The experiences gained in European research projects (LIFE CLEANSED; LIFE SUBSED) on the management of dredged sediments through nature-based technologies and their reuse in different production contexts (nursery, environmental, construction) will be the starting point to identify and overcome the existing legislative barriers that prevent their effective valorisation.

Objectives

SMARTSEAS aims to achieve the following macro-objectives:

OB1. Prototyping of eco-compatible and innovative mixtures and definition of mix-design according to the performance to be achieved and/or the intended use of the products.

OB2. Development of integrated protocols useful to public bodies to start virtuous processes of management and reuse of dredged sediments, potentially usable within the port areas themselves, for the construction of products such as breakwaters and/or mass stabilisation.

The achievement of OB1 will be facilitated by a multidisciplinary, multi-scale testing programme (A1) involving Italian and foreign researchers in the fields of applied chemistry, geochemistry and environmental technology, geotechnical engineering and hydraulic construction. In addition, as anticipated, the research will involve a company operating in the construction sector for the development of prototypes (A2). For the achievement of OB2, the interaction with public bodies that are now in the forefront of marine sediment management will be crucial.

SMARTSEAS appears fully in line with the national thematic area of Intelligent and Sustainable Industry, Energy and Environment, identified in the National Strategy for Intelligent Specialisation (SNSI). In addition to contributing to closing the gap between research and industrial innovation, by accelerating the transition time between idea, scientific result and market application (M4C2 of the PNRR), SMARTSEAS activities fall within the Blue Growth specialisation area with particular reference to the area of research, regulation and environmental protection (M2C4 of the PNRR). The theme fully falls within the scope of ecological transition and, specifically, within that of interventions aimed at reducing pollution emissions and minimising the impact of production activities. Central to the project idea is also research at the service of industry for the strengthening of the circular economy and industrial symbiosis (M2C1 of the PNRR).

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GRANT N. 4
DRSATE

D.M. 351/2022
Area: PNRR

Topic : *"Hydrodynamic study of turbines for the production of energy from marine currents (IDROTURB)"*

RESEARCH PROPOSAL

With this research project we intend to develop a horizontal axis hydraulic turbine for the exploitation of sea currents equipped with a diffuser capable of increasing the flow rate of water with the same rotor size. The prototype will be sized considering the main sea current parameters. This configuration requires a peculiar hydrodynamic design in order to maximize the performance of the system.

The project will be developed at the DICATECh (prof. Michele Mossa) in collaboration with the DMMM (prof. Marco Torresi). In particular, the first phase of the project is devoted to the "Design, prototype realization and experimentation". In this phase, the structural design of the prototype will be carried out, followed by the turbine construction. The second phase is devoted to the "Hydrodynamic Design". In this phase, the hydrodynamic design of the prototype will be carried out with the aim of maximizing the performance of the integrated horizontal axis turbine and diffuser system. An appropriate analytical model will be assessed for the preliminary design and the performance of the turbine will be analyzed using CFD (Computational Fluid Dynamics) simulations. The result of this activity will enable us to define the best geometry of the axial turbine and diffuser. Through the CFD simulations we will obtain the best technical solution of the prototype which will be tested also with a physical model. On this point experimental tests will be carried out at the hydraulic laboratory of the DICATECh, using a channel able to simulate sea currents. During different experimental tests, we will assess the velocity flow field close to the turbine also using a Laser Doppler Velocimeter (LDA) and Particle Image Velocimeter (PIV).

Finally, the third phase is that of "Design, prototype construction and experimentation". During this phase, the structural design and construction of the prototype will be carried out. The prototype will be tested also in situ, assessing fundamental data that will be compared with the results of the numerical simulations and the laboratory tests.

The new scientific knowledge, obtained thanks to the realization of the IDROTURB project, will be disseminated in a way that also interests the stakeholders. The dissemination of the project results will be carried out through:

- diary of the project's activities, constantly updated with the main results, inserted in an open data repository such as Zenodo;
- papers published in international scientific journals;
- participation in conferences and workshops;
- dissemination of results with social media.

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GRANT N. 5

DRSATE

D.M. 351/2022
Area: PNRR

Topic: " Innovative and high-efficiency luminophore materials for luminescent solar concentrators"

Luminescent solar concentrators (LSC) are windows made of transparent polymeric materials containing, suitably dispersed inside them, emitters endowed with a high quantum yield of fluorescence. [1] Due to the refractive index of the polymers used, a fraction of emitted photons remains trapped in the system through an internal reflection process. Photons are then conveyed to the edge of the LSC where they are harvested by suitable photovoltaic cells to produce electric energy. This proposal aims at the identification, synthesis, and application in LSC of new and optimal luminophores of both inorganic and organic nature. The role of the PhD student will consist of the following activities organized in two lines. For Line 1: a synthetic effort directed at the development of new nanomaterials based on $CsPbX_3$ perovskites (X: halogen) for solar concentrators, based on the observation that the incorporation of specific amounts of Mn^{2+} ions in high bandgap lead halide perovskites nanocrystals induces an emission shift with respect to the corresponding non-doped nanomaterials, mitigating self-absorption loss issues [2]. In parallel (Line 2) the PhD student's activity will focus on the design and synthesis of new organic materials with electronic and structural characteristics as to promote properties of thermally activated delayed fluorescence (TADF).[3] These activities will continue during the second year. For Line 1, it will be addressed the development of the post-synthetic treatment, which will be conceived in such a way as to optimize the transfer of energy from the perovskite to the dopant (Mn^{2+}). Moreover, an in-depth characterization of the obtained nanomaterials will be carried out, concerning morphology in particular, by means of TEM and optical microscopy. For Line 2, the purification and spectroscopic, optical, and electrochemical characterization of the synthesized molecules will be carried out. During the third year, the characterization of the most promising materials obtained in the previous activities will be completed, outlining the necessary structure-property relationships, and envisaging their application in test LSC devices which will require the interaction of the PhD student with the several research institutions currently collaborating on the topic.

[1] a) I. Papakonstantinou, et al. The Hidden Potential of Luminescent Solar Concentrators. Adv. Energy Mater. 2021, 11, 2002883 . https://doi.org/10.1002/aenm.202002883 ; b) Roncali, J., Luminescent Solar Collectors: Quo Vadis?. Adv. Energy Mater. 2020, 10, 2001907. https://doi.org/10.1002/aenm.202001907

[2] F. Meinardi et al., Doped Halide Perovskite Nanocrystals for Reabsorption-Free Luminescent Solar Concentrators, ACS Energy Letters 2017 2 (10), 2368-2377 https://doi.org/10.1021/acsenergylett.7b00701

[3] F. Mateen et al., Luminescent solar concentrators based on thermally activated delayed fluorescence dyes, J. Mater. Chem. A, 2020,8, 3708-3716. https://doi.org/10.1039/C9TA13312G.

GRANT N. 6
DRSATE

D.M. 352/2022
Co-funded by: Print Bag S.r.l.

Topic: *"Influence of bio-plastics on the performance of organic treatment plants for solid urban waste"*

PROPOSED RESEARCH

a) Research topic and coherence with the National Strategy of Smart Specialisation (SNSI) approved by the European Commission

Due to the increasing amount of bio-plastics in the market and the unsuitability of the waste treatment plants of treating the increasing amount of these materials, this research aims to evaluate the fate of bio-plastics in the treatment plant of the Organic Fraction of Municipal Solid Waste (OFMSW). This topic is in line with the SNSI (field of smart and sustainable industry, energy and environment; "water and waste treatment systems and technologies" and "innovative and eco-compatible materials" development paths)

b) Proposed research, materials and methods

Methodologically, 4 bio-plastic products are going to be assessed: for each sample lab-scale assessment will be carry out with the set-up already owned by the university. Different OFMSW and bio-plastics blends will be identified and tested under composting and anaerobic digestion test (90 and 30 days respectively) in order to evaluate the bio-plastics disintegration and the biogas enhancement.

c) Innovation of the proposed research on the action field

The studies present in literature are limited and the only few one already published are recent and carried out by the proposer research group (Gadaleta et al., 2022; De Gisi et al., 2022).

d) Research topic coherence with the Ph.D. disciplinary field and the College of Teachers composition

The research fits in the DICATECh "Risk and environmental, territorial and building development" Ph.D., strongly characterized by a multidisciplinary approach. The proposed research involves expertise fully represented by the DICATECh department (ING-IND/22; CHIM/07).

e) Technical feasibility and time schedule of the proposed research

The research is structured in 3 years. The first is mainly focused on the literature review of bio-plastics characteristics and their fate in the OFMSW treatment facilities. The second year aims to carry out laboratory experiment on the anaerobic digestion and/or composting process. The third year is characterized by an "evaluation" approach, which use the results obtained for environmental and economic assessments.

f) Synergies with the potential subsequent Ph.D. employment

At the end of the Ph.D., the candidate will learn an engineering background, with expertise in the materials and sustainable bio-plastics production field. The candidate will fit perfectly with the demands of the firms that produce bio-plastics and the OFMSW treatment companies.

References

Gadaleta et al. 2022, Waste Manage. 144, 87-97.

De Gisi et al. 2022. J. Environ. Manage. 310, 114769

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GRANT N. 7
DRSATE

D.M. 352/2022
Co-funded by: architectural atelier Sàito

Topic: *"Map of High-Performance Facades for carbon neutral buildings"*

The research aims at the creation of a conceptual map for the assessment of the performances of innovative building envelopes for carbon neutral buildings. The final goal is the definition, for each climatic zone of the optimal performances of external envelopes, with the final aim of reducing the energy consumptions of complex buildings during their whole life cycle, and of improving indoor and outdoor comfort conditions. The project is aligned with Italian National Strategy for Industrial Development, aimed at innovating the production of building components through a synergic collaboration between industry partners and research institutions.

The research will be developed through the creation of an interactive framework, to be used by engineering and architectural professionals throughout the phases of the design process (from the preliminary to construction design). The framework will be validated during a research period at the University of Berkeley (USA) and will be applied to relevant projects developed by the architectural atelier Sàito.

The research will have a duration of 36 months and will be organized in the following macro-phases (12 months/each):

1. Review of existing literature and development of the framework (6 months at the Polytechnic University of Bari and 6 months at architectural atelier Sàito);
2. Validation of the framework and data inclusion (6 months at the University of Berkeley and 6 months at Polytechnic University of Bari)
3. Application of the framework to selected case studies (12 months at architectural atelier Sàito).

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GRANT N. 8
DRSATE

D.M. 352/2022
Co-funded by: V.F. CAVE s.r.l.

Topic: *"Recovery and ecological, environmental and territorial regeneration of underground quarries in Cutrofiano: transition from extraction activity to a circular model of production and consumption based on agricultural, social and environmental sustainability"*

Protection and redevelopment of an area of Salento (Cutrofiano) affected by a high hydrogeological instability, aimed to a diversification and revival of production activities also through the optimization of the use of water resources. The goal is to create new potential ground for an economic development that, exploiting research and identification of suitable enabling technologies, may burst the redevelopment of the Salento area, its wealth and value, improve its living condition and provides new working activities that can last over time.

The research will be developed through the preliminary study of the potential hazards threatening the area (geomorphological and hydraulic risks), the evaluation of the development capability deriving from the urban planning (infrastructures and organization) to find scenarios of redevelopment of production activities (agricultural) and through the identification of risk mitigation works aimed necessary for a productive revival of the territory. A degraded area of the municipal territory of the city of Cutrofiano (Le) is taken into consideration for the presence of historical underground mining activities (tunnels) that still determine phenomena of hydrogeological instability (sink holes) affecting buildings and agricultural areas. The study will determine the definition of best practices that starting from a pilot area can be extended to the whole territory.

The research is based on the explitment of innovative methodologies such as GIS-based techniques and drone surveys and remote monitoring of the environmental features of the area and of the physical and mechanical characterization of the rocks present in the subsoil. In addition, techniques of underground agricultural cultivation will be studied provided with automated management systems including water supply control systems aimed to the optimization of the resource exploitation.

The research project will need a preliminary phase of study on the type and mechanisms of instability typical the selected study area. It will continue with the systematic survey of available information and data to be collected directly on the territory (hydraulic, geological and geotechnical survey, urban destinations, production activities) and through a monitoring of the microclimatic conditions and stability characteristics of the underground tunnels.