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SCC Virtual Institute's Research grants

DELIVERABLE 6.3
MONTH 6

D6.3 SCC Virtual Institute's Research grants

I. Introduction

The Task 6.1 of the EC2U project has for objectives the design, implementation and consolidation of a Virtual Institute, active within the EC2U Alliance, in the area of the United Nations Sustainable Development Goal 11 - Sustainable Cities and Communities (SCC). The concept of Virtual Institute pretends to gather in a dematerialized institution, i.e. without walls or physical headquarters, research teams and research labs already existing in the seven universities of the EC2U Alliance and willing to develop collaborative works dedicated to common topics.

Two Research Seed Projects have already been identified and their structure and workplan have been finalised. They will enable to initiate the research work of the SCC Virtual Institute. The names of these two projects are:

a) Increasing the resilience of sensible groups to the effect of heat waves in European cities, in a Climate Change scenario;
b) Preservation and retrofitting of historical university buildings with relevant cultural heritage.

Additionally, to promote the interaction within the research groups participating in the Work Package 6 of EC2U, different types of grants will be launched.

II. Types of Grants

a) Since the coordination of WP6 is assured by the University of Coimbra, it has been decided to have a personal dedicated to supporting the organization of research and teaching tasks related with the implementation of the SCC Virtual Institute and the launch of the Joint Masters Programme in SCC. Thus, a call for a Research Grant has been opened on the 5th of April 2021 by the University of Coimbra in Eracareers, with a period for the submission of applications closing on the 19th of April 2021. The selection process by a jury of 3 members has already been closed and the minutes were communicated to the participating applicants on the 7th of May 2021. The selected grant holder has accepted the position and will start on the 1st of August 2021. The documents related to the admission process are included in the Annex I.

b) The University of Poitiers has launched a Call for 6 Joint Co-Financed Theses (2 for the Health and Well-Being Virtual Institute, 2 for the Quality Education Virtual Institute and 2 for the Sustainable Cities and Communities Virtual Institute). The selection process will close on the 18th of June 2021, and the results announced on the 9th of July 2021. The documents of the Call as well as the first proposals are included in Annex 2.

c) Mobility Grants both for EC2U PhD students and for EC2U Staff are foreseen for the Research activities of the Work Package 6 (60 Staff Mobility Grants with a typical duration of 4 to 6 days, 24 Ph D Students Mobility Grants with a typical duration of 6 days)

On account of the restrictions imposed by the EU governments due to the COVID-19 pandemic, it has not been possible to start the Mobility Grants activity within EC2U Alliance until now, since the starting date of the project was on the 1st of November 2020.

For this type of grants, the dissemination, selection and assessment processes usually implemented by the partners in the framework of Erasmus Program will be applied, on account of the existing similarities.

The Calls for Mobility Grants will be broadcasted at the EC2U portal and in each of the seven universities through the usual Erasmus dissemination channels (university, faculties and departments webpages, international relations webpage, students' associations, newsletters, email and newspapers) either in the national language or in English.

The Calls for the grants will be open assuring an equity situation between the two Seed Projects previously mentioned.

The Admission Commission of WP6 Board will interact with the international relations services for the selection process of the Mobility grants.

The holders of the Mobility Grants will have the obligation to submit a Mission Report two weeks after its conclusion. The mission reports will be assessed by the WP6 Board that will provide in its annual report an analysis of the set of received reports.

III. Annex 1- Document related to the Research Grant Admission process

THE RESEARCHER'S MOBILITY PORTAL • PORTUGAL

If you are a researcher planning your next move in Europe look here for career opportunities in Portugal and to find relevant information and assistance

EUROPE

Home page

For Organisations

Identificação da Instituição:
Universidade de Coimbra
Last access on:05-04-2021 14:31:00

- View all research opportunities
- Post research opportunities

Overview
1. Job/Fellowship Description
2. Organization contact data
3. Required education Level
4. Required languages
5. Required research experience

Job/Fellowship Status

Information for FCT

- Find the ideal candidate
- Edit organisation data
- Log out

Post Research Opportunities

Unique identifier: de5c1c77-4fdf-46e2-850e-e2a8d1343cd0

Português

1. Descrição do cargo/posição/bolsa
1. Job description

Cargo/posição/bolsa:
Uma bolsa de investigação

Referência: EC2U - Bolsa de Investigação

Área científica genérica: Engineering

Área científica específica:

Resumo do anúncio:

A Universidade de Coimbra abre concurso para atribuição de uma bolsa de investigação, no âmbito do projeto European Campus of City-Universities (EC2U).

Texto do anúncio

Anúncio para atribuição de Bolsa de Investigação

A Universidade de Coimbra abre concurso para atribuição de uma bolsa de investigação, no âmbito do projeto European Campus of City-Universities (EC2U), com as seguintes características:

N.º de bolsas: 1

Tipo de Atividade: Executar tarefas de investigação no contexto das atividades do projeto, nomeadamente relacionadas com o apoio à Iniciativa Energia para a Sustentabilidade da Universidade de Coimbra na implementação de um Instituto Virtual (IV) relacionado com o Objetivo 11 de Desenvolvimento Sustentável das Nações Unidas sobre Cidades e Comunidades Sustentáveis.

Nomeadamente colaborando nas tarefas desenvolvidas para produzir os seguintes entregáveis do projeto EC2U:

- D1.17: linhas orientadoras para gestão dos IVs do EC2U (governance and policy);
- D6.2 and D6.6: projetos de pesquisa/investigação
- D6.3: bolsas de pesquisa/investigação de pré-projeto;
- D6.4 and D6.5: cursos em e-learning;
- D6.7: desenho curricular (final) para o Mestrado em CCS;

- D6.8 and D6.9: processos de acreditação para o Mestrado em CCS;

- D6.10: promoção do Mestrado em CCS;

- D6.11: Projetos de Dissertações e Dissertações;

- D6.12: Implementação do Mestrado em CCS e avaliação provisória;

- D6.13: Cidades EC2U "Pacto de Presidentes de Câmara";

- D8.1: Mapa de instrumentos de financiamento interno e externo;

- D8.5 to D8.11: EC2U Fora;

- D8.12: Iniciativas Campus Sustentáveis para promover UNSDGs;

- D8.13 to D8.15: Campanha/Divulgação Interna para Ciência Aberta (Open Education, Open Science);

- D8.20: Plano de Internacionalização EC2U

- D8.21 and D8.22: Projetos internacionais EC2U

Financiamento: Co-financiado pelo programa Erasmus+ da União Europeia.

Destinatários/as da (s) bolsa (s): Mestrado em Energia para a Sustentabilidade, Sistemas Sustentáveis de Energia ou áreas afins. Os candidatos têm de estar inscritos em programa doutoral na área de Sustentabilidade Energética, com conhecimentos comprovados em eficiência energética em edifícios e em critérios de sustentabilidade na fase operacional.

Serão valorizados conhecimentos comprovados com o uso de ferramentas de avaliação da sustentabilidade em campi universitários e conhecimento aprofundado sobre requisitos e alternativas para avaliação do desempenho energético de edifícios universitários, bem como na definição de critérios de sustentabilidade na fase operacional de campo universitários. Será dada preferência a candidatos com publicações de artigos científicos na área dos trabalhos a desenvolver.

Será igualmente valorizado o domínio da língua inglesa na área científica em avaliação.

Local de realização da (s) Bolsa (s): Faculdade de Ciências e Tecnologia da Universidade de Coimbra.

Duração da (s) Bolsa (s): 6 meses.

Renovação: Eventualmente renovável

Orientação Científica: Professor Doutor Manuel Carlos Gameiro da Silva

Condições Financeiras da Bolsa: A bolsa ascende a € 1104,64 correspondente ao subsídio mensal de manutenção estipulado na tabela FCT (https://www.fct.pt/apoios/bolsas/valores). Este subsídio mensal será pago no final do mês, por transferência bancária (A este valor acresce o seguro social voluntário correspondente ao primeiro escalão, caso o/a candidato/a opte pela sua atribuição, bem como o seguro de acidentes pessoais). O valor da bolsa não aumentará ao longo de todo o período da sua duração.

Regime de Atividade: A atribuição da bolsa não gera nem titula uma relação de natureza jurídico-laboral, é exercida em regime de dedicação exclusiva. É atribuído ao/à Bolseiro/a o Estatuto de Bolseiro/a da UC, conforme disposto no Estatuto do Bolseiro de Investigação, e no Regulamento de Bolsas de Investigação da Fundação para a Ciência e a Tecnologia, I.P., ambos

na sua redação atual.

Método (s) de seleção: A Avaliação Curricular (AC) e Entrevista (E) aos três melhores classificados na AC.

Critérios de seleção e atribuição:

Na avaliação curricular (AC) serão considerados os seguintes parâmetros:

(i) mérito absoluto do Curriculum Vitae (M);

(ii) adequação do perfil do candidato ao plano de trabalho (PT);

(iii) características adicionais (CA), como a motivação demonstrada para o trabalho a desenvolver e disponibilidade para iniciar a bolsa.

Na Entrevista (E) serão considerados os seguintes parâmetros:

(i) Capacidade de comunicação (CC)

(ii) Motivação e Interesse para o trabalho (MI).

A fórmula de classificação para o posicionamento relativo dos candidatos na Avaliação Curricular (AC) será a seguinte: 0.4·M + 0.4·PT + 0.2·CA. Em caso de não haver candidatos com Avaliação Curricular superior a 60%, o Júri reserva o direito de não atribuir a bolsa.

A fórmula de classificação para o posicionamento relativo dos candidatos na Entrevista (E) será a seguinte: 0.4·CC+ 0.6·MI. A falta à entrevista é considerada como desistência por parte do candidato.

A fórmula de classificação para o posicionamento final será 0.8·AC + 0.2·E.

Formalização da candidatura: As candidaturas devem ser formalizadas, obrigatoriamente, através do envio de carta de candidatura acompanhada dos seguintes documentos: carta de motivação, onde o candidato deve mencionar se tem disponibilidade para iniciar a bolsa; curriculum vitae (CV) com a descrição das habilitações do candidato, bem como a lista de publicações e conhecimentos comprovados em projetos de investigação e/ou desenvolvimento; certificado de habilitações, incluindo comprovativo do grau de Mestre e o comprovativo de inscrição em doutoramento, a declaração de compromisso de honra do candidato sobre o benefício de outras bolsas anteriores atribuídas ao abrigo do atual Regulamento de bolsas da FCT; bem como quaisquer outros elementos ou documentos considerados relevantes.

Os/As candidatos/as com graus académicos obtidos no estrangeiro terão de apresentar Certidão de registo de reconhecimento de acordo com a legislação aplicável. Este documento é obrigatório apenas na fase de contratação.

Envio da candidatura: As candidaturas deverão ser remetidas por correio eletrónico para o seguinte endereço: silvia.silva@uc.pt, indicando no assunto a referência "Bolsa Mestre – EC2U".

Composição do júri de seleção: Professor Doutor Adélio Manuel Rodrigues Gaspar; Professor Doutor José Joaquim da Costa; e Professor Doutor Manuel Carlos Gameiro da Silva.

Prazo para formalização da candidatura: Entre 06/04/2021 e 19/04/2021

Data de Publicitação: 05/04/2021

Data limite de candidatura: 19/04/2021

Informações complementares: Os resultados da avaliação serão divulgados até 90 dias úteis a contar da data limite de submissão de candidaturas, através de envio de comunicação aos/às candidatos/as, via correio eletrónico. Após a divulgação dos resultados, os/as candidatos/as serão notificados/as para, caso pretendam, se pronunciarem em sede de audiência prévia no prazo máximo de 10 dias úteis após aquela data. Findo este prazo, os/as candidatos/as selecionados/as terão que declarar, por escrito, a sua aceitação e comunicar a data do início efetivo da bolsa. Salvo apresentação de justificação atendível, a falta da declaração dentro do prazo referido equivale a renúncia à bolsa. Em caso de renúncia ou desistência do/a candidato/a selecionado/a, será notificado/a o/a candidato/a imediatamente melhor classificado/a.

Número de vagas: 1

Tipo de contrato: Temporário

País: Portugal

Localidade: Coimbra

Instituição de acolhimento: Faculdade de Ciências e Tecnologia da Universidade de Coimbra

Data limite de candidatura: 19 April 2021
(A data limite de candidatura deve ser confirmada no texto do anúncio)

↑ Top of page

2. Dados de contactos da organização
2. Organization contact data

Instituição de contacto: Identificação da Instituição: Universidade de Coimbra

Endereço:
Edifício da Faculdade de Medicina, 1.º andar, Pólo I, Rua Larga
Coimbra - 3004-504
Portugal

Email: bolsas@uc.pt

Website: *indisponível*

IV. Annex 2 – Call for co-financed Theses

European Campus of City-Universities (EC2U)

EC2U Alliance co-financed PhD Theses

Call for Subjects 2021

The "European Campus of City-Universities" (EC2U) Alliance (www.ec2u.eu) is one of the 24 Alliances selected by the European Commission in the 2020 call for the pilot phase of the "European universities"initiative. It is coordinated by the University of Poitiers and brings together 6 other universities from the Coimbra Group: the universities of Coimbra (Portugal), Alexandru Ioan Cuza of Iasi (Romania), Friedrich Schiller of Jena (Germany), Pavia (Italy), Salamanca (Spain) and Turku (Finland).

The Alliance's ambition is to develop a pan-European, inclusive campus, including common cultural and sports activities, producing **multidisciplinary synergies between education, research and innovation**, with the contribution of academic communities (students, teachers, researchers, staff), municipalities in associated cities, higher education regulatory bodies, socio-economic actors and citizens of our regions.

EC2U proposes a new interdisciplinary approach of the United Nations Sustainable Development Goals (UNSDG) with **the creation of the first three Joint Virtual Institutes**, integrating education, research and innovation, and focusing on the following UNSDGs: **Health and Well-being, Quality Education, Cities and Sustainable Communities**. Three joint EC2U masters are being built on these UNSDGs.

Besides, the University of Poitiers is financially supported by the French government in its coordination role within the EC2U Alliance: this additional funding will allow the Virtual Institutes to start activities, with further additional support from the "RI4C2" H2020 sister project (https://ec2u.eu/ri4c2-project-awarded-horizon-2020-funding/). In this context, the **University of Poitiers has decided to co-finance 6 PhD theses** (2 for each Virtual Institute), in co-supervision with research laboratories from the partners universities of the EC2U Alliance (cotutelles).

A call for PhD thesis proposal was therefore submitted late March 2021 to the research laboratories of the University of Poitiers in one of the three following themes:

- Health and well-being: prevention, ageing, imaging, cancer;
- Quality education: multilingualism, interculturalism, educational innovation;
- Sustainable cities and communities: air quality; water quality, energy, public policy.

The collected proposals will be communicated to the EC2U partner universities via forms filled-in by the Poitiers teams.

EC2U partners are therefore requested to express their interest in the proposed PhD topics by replying with a support letter signed by the potential co-supervisor and his/her laboratory director. The support letter should include the information about possible co-funding (second half of the PhD candidate salary) and the contribution of the partner to the PhD thesis work plan.
The support letter should be sent to the Poitiers local coordinator Flora Dausque before June 18th.

All completed proposals (Poitiers form and partner support letter) will be send to the concerned Virtual Institute scientific boards (EC2U Work Package boards) for examination.

CALENDAR

June 18th: deadline for submission of support letters to Flora Dausque

End of June – Early July: selection of topics by Virtual Institute scientific boards

July 9th: Communication of the selected topics

Fall 2021: start of joint PhD theses

Contact :

Flora Dausque flora.dausque@univ-poitiers.fr

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European Campus of City-University (EC2U)

Call for co-financed Thesis Subjects 2021 – EC2U Alliance

RESEARCH THEME (VIRTUAL INSTITUTE) :

Good Health & Well-Being	**Quality Education**	**Sustainable Cities and Communities**
Prevention Ageing Imaging Cancer	Multilingualism Interculturalism Education innovation	Air quality Water quality Energy Public policy
☐	☐	☒

Topical UP Campus :

Aerospace and Transport	**Energy, Environment, Evolution**	**Mathematics and Digital Sciences**	**Biology-Health**	**Humanities**	**Legal Sciences**
☒	☒	☐	☐	☐	☐

PhD thesis Title : Improving solar-receiver efficiency by manipulating turbulence in heat-collecting, fluid-conveying pipes
Contact details of the potential thesis supervisor Family name: AGOSTINI First name: Lionel Laboratory: Institut Pprime Phone number: Email: lionel.agostini@univ-poitiers.fr
Contact details of the partner team head Family name: First name: Laboratory: Phone number: Email:
Delete or add frames if needed

Context:

The harvesting of energy from solar radiation is one of the most potent routes to the replacement of fossil fuel by renewable sources. Among a number of alternative technologies, the use of mirrors to focus sunlight onto receivers in which fluid flow is heated to very high temperatures is an efficient method to create a high-capacity thermal-energy store or generate a large amount of power using a turbine/generator assembly. Collectively, this technology is referred as **Concentrating Solar Power (CSP)**. It involves hundreds of sun-tracking mirrors, each typically 20 m^2, focusing sunlight onto a close-to-vertical receiver having an exposed area of around 50 m^2 located in a tower. The receiver contains (usually circular) conduits which carry a fluid, such as water-steam, molten salt, CO_2 or Air, which is heated as it is transported through the receiver. **The hydro-thermal design of the fluid-carrying conduits is a crucial factor in efforts towards maximising the efficiency and cost-effectiveness of the power plant.** This proposal is inspired by ongoing work of Colleoni et al. (2012) to design efficient practical CSP systems that use **pressurised air** for the following reasons: (i) air is abundant and easily exploitable, thus minimising, or avoiding altogether, difficulties linked to extraction, transportation, storage and recycling; (ii) a leak will not be a concern for public and environment safety; (iii) air can be heated to high temperatures without seriously detrimental changes to its physico-chemical integrity. At a pressure of approximately 20 bars and temperature of 1000^oC, the air allows electricity to be produced by a gas turbine (Brayton cycle), and the residual heat exiting the turbine can, in addition, be converted to electricity by using a steam turbine (Rankine Cycle). The compressor is driven by the gas turbine, but can alternatively be operated by an independent, secondary, low-grade solar facility. The performance characteristics of the receiver are complicated by the fact that it is subjected to radiation from one direction only. It is also subjected to extreme operational conditions: very high radiation flux, high pressure, high temperature and high temperature gradients within the material and working fluid. From a thermo-fluid perspective, the over-riding goal is to **maximise the receiver's heat-transfer capacity** and to **minimise the pressure loss due to friction between the fluid and the conduit**. The major requirement is to heat the fluid to 1000^oC, or higher, subject to an upper limit of receiver-material temperature. Efforts to meet this constraint hinge on careful attention the mixing processes within the receiver fluid and the turbulence conditions close to the wall. A research programme is proposed in which the efficacy of near-wall turbulence control is investigated in **efforts to increase the heat transfer at minimum drag penalty** in pipes that convey heated air within a solar receiver to a power-extracting device. The proposed near-wall control combines rapid oscillatory circumferential wall motion with slow pipe rotation in an environment in which unidirectional solar radiation results in heating of the air to a temperature of around 1000^oC. The programme combines direct numerical simulation and Machine Learning (ML) algorithms, together designed to derive the optimum control parameters that yield **maximum of heat transfer, minimum increase in drag and maximum circumferential uniformity in temperature**.

Possible co-funding (Yes/No. If yes, specify the source of funding): yes - ADEME

Brief state of the art:

This project is at the cutting edge of several scientific capabilities and thus likely to have a substantial academic impact in several respects, regardless of practical exploitation of the concepts investigated. First, the exploitation of advanced DNS for combined drag and heat-transfer optimisation, subject to oscillatory wall motion is novel, if not unique, and is likely to advance DNS into a new flow-control direction that will be of interest to the flow-physics community. Second, the adaptation of ML to optimise thermo-fluids systems is in its early infancy, and the application of this emerging technology for optimising drag and heat transfer in the manner proposed is unique, as far as the applicant is aware.

Signature of the project principal investigator (PI) Signature of the PI's laboratory Director

lionel agostini

Karl JOULAIN
Directeur
Institut Pprime

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European Campus of City-University (EC2U)

Call for co-financed Thesis Subjects 2021 – EC2U Alliance

RESEARCH THEME (VIRTUAL INSTITUTE) :

Good Health & Well-Being	**Quality Education**	**Sustainable Cities and Communities**
Prevention Ageing Imaging Cancer	Multilingualism Interculturalism Education innovation	Air quality Water quality Energy Public policy
☐	☐	☒

Topical UP Campus :

Aerospace and Transport	**Energy, Environment, Evolution**	**Mathematics and Digital Sciences**	**Biology-Health**	**Humanities**	**Legal Sciences**
☒	☒	☐	☐	☐	☐

PhD thesis Title : Development of an oscillating wind turbine
Contact details of the potential thesis supervisor Family name: CHATELLIER First name: LUDOVIC Laboratory: INSTITUT PPRIME UPR CNRS 3346 Phone number: +33 5 49 49 69 23 Email: ludovic.chatellier@univ-poitiers.fr
Contact details of the partner team head : To be defined Family name: First name: Laboratory: Phone number: Email:

Project description (1 page max, font Calibri 11) :

Context:

Wind as a worldwide exploited renewable energy source is facing societal acceptability issues due to the ever growing scale of windfarms and their environmental imprint on natural lands. As an alternative, networks of small scale wind (or water) energy harvesters may facilitate their installation directly in dense urban environments in order to provide electricity locally, with limited land occupation, transport infrastructure and connexion cost. However, the use of such technologies must be acceptable in heavily populated area, from both the design and disturbance points of view. The proposed project aims at developing alternative energy harvesting technologies at small scale, designed to be integrated in urban or remote environments. Such solutions fall in the Energy topic of the the research theme "Sustainable Cities and Communities", and in the "Energy, Environment, Evolution" topical UP campus.

Possible co-funding (Yes/No. If yes, specify the source of funding):

Yes. Regional funding call from "Nouvelle Aquitaine" may fund 50% of the project.

Brief state of the art:

Oscillating airfoil-based structures are seen as possible alternatives to the the conventional rotating horizontal or vertical wind - or water - turbines thanks to their limited spatial extent and lower operating velocities. A two d.o.f. prototype was designed by Costa (2018) which will be experimentally investigated by the PI. Using a different approach, the "Eel energy" demonstrator (Träsch, 2018) exploits the deformation of an elongated membrane made of articulated rigid segments acting as a multi d.o.f. oscillator. The present project will focus on a continuously deformable flag-like structure with embedded devices designed to convert self-sustained oscillations (Eloy, 2008) in electricity. From the design and disturbance points of view, this concept will limit the use of moving parts and assembly in order to reduce both the structural fatigue and noise emission. One of the main challenges of the project lie in the prediction of multi-modal operating points in order to extend the operability range of the energy harvester.

Possible work plan with partner, incl. timeline (and time spent by PhD student at partner laboratory):

The first 9 month of the Thesis will be spent at the host institution to define the energy harvesting concept that will be developed. The PhD student will then spent 9 month at the partner University to work either on the numerical modelling or energy conversion aspects. The remaining 18 month will be devoted to the development and analysis of an experimental prototype.

Short bibliography:

Costa, S., Chatellier, L., Pons, F., & Ba, M. 2018,Parametric Design of a Hydro-Elastic Energy Harvester, RENEW2018 - 3rd International Conference on Renewable Energies Offshore, 8 - 10 October, Lisbon, Portugal, 2018

Träsch, M., Déporte, A., Delacroix, S., Drevet, J.-B., Gaurier, B., Germain, G., Power estimates of an undulating membrane tidal energy converter, Ocean Engineering, Volume 148:115:124, 2018

Eloy, C., Lagrange, R., Souilliez, C., Schouveiler, L., Aeroelastic instability of cantilevered flexible plates in uniform flow. J. Fluid Mech., 611(97), 2008

Signature of the project principal investigator (PI) Signature of the PI's laboratory Director

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of the European Union

European Campus of City-University (EC2U)

Call for co-financed Thesis Subjects 2021 – EC2U Alliance

RESEARCH THEME (VIRTUAL INSTITUTE) :

Good Health & Well-Being	**Quality Education**	**Sustainable Cities and Communities**
Prevention Ageing Imaging Cancer	Multilingualism Interculturalism Education innovation	Air quality Water quality Energy Public policy
.	.	X

Topical UP Campus :

Aerospace and Transport	Energy, Environment, Evolution	Mathematics and Digital Sciences	Biology-Health	Humanities	Legal Sciences
.	X	.	.	.	.

PhD thesis Title: *Management and optimization of energy flow-paths in university campus buildings: consumption, production, storage and share*
Contact details of the potential thesis supervisor Family name: TNANI First name: Slim Laboratory: LIAS Phone number: +33 6 63 25 70 28 Email: slim.tnani@univ-poitiers.fr
Contact details of the partner team head Family name: GASPAR First name: Adélio Laboratory: ADAI – LAETA/University of Coimbra Phone number: +351 910 206 503 Email: adelio.gaspar@dem.uc.pt

Project description (1 page max, font Calibri 11):

Either in buildings or in cities, energy performance is recognized as an equation composed of demand, supply and its management, in a balance that, according to the European energy policies, should tend to zero.
Today, more than a half of the world's population lives in cities. Thus, urban district scales require novel approaches to the study of both buildings and cities, which have been studied distinctly, highlighting the fact that, in urban scenarios, buildings' performance cannot be assessed individually.

Smart campus Building is based on three main axes:
1 / Smart buildings with production and storage of renewable energy
2 / Communicating buildings with their own management system.
3 / Global management, with continuous optimization.

Smart buildings should produce and consume their own energy and, if possible, have a positive energy balance, compensating the negative energy balance of other buildings in an energy community context. It will therefore be necessary to install renewable energy sources, such as photovoltaic panels or thermal systems, with the main objective of producing the energy required by the users of the building. The impact of peaks in energy consumption and fluctuations in the production of renewable energy sources, in a short (daily, weekly) or long term (seasonal) period, can be limited by the installation of storage systems on batteries or in the form of heat, as well as hydraulic storage and production of other energy sources, like green hydrogen. These means can be installed at the urban scale, with centralized management. The energy efficiency of buildings depends on the envelope thermal quality, occupants behaviour and performance of the energy systems, being their energy management systems very important. These systems must manage energy flows (generation, storage, consumption, sharing, …) but also directly control users' devices according to their priorities (smart contracts). The forecasting of production and consumption levels and the management of energy flows between the different buildings promote the integration of intermittent renewable energy. The decentralized and local management of these networks could be favoured by the blockchain. Applied to energy management in real estate, they allow safe and decentralized management. Achieving resilient energy management of an urban area involves using technologies to securely upload local information (temperature, consumption, production and their forecasts, user priorities, etc.) at a more global level, such as blockchains and smart contracts.
In this sense, the objective of this work is to develop a methodological tool able to manage energy generation, storage and sharing of a set of buildings, contributing to embody the concept of energy community and moving towards zero energy district goals.
For that, the workflow between BIM-based software and "smart buildings" tools will be evaluated and developed.
Energy management in buildings is generally analysed taking into account the reduction of consumption through the retrofit of the envelope or the installation of efficient equipment. Knowing that this step is not always achieved, this work adopts a different approach, by focusing on energy management on the supply side, independently of demand, and considering that the buildings performance conditions may not improve, but do not prevent the adoption of more sustainable sources of energy supply.
The objectives of this project and the expected impacts are clearly defined in a work program.
We have defined a work program that fully combines the skills of our research teams.

Context:
(Describe how the project fits into the themes of the Alliance and potentially into the framework of an already established partnership)

The extension of studies on energy management of buildings to urban scales has come to be the natural succession of those related to zero energy goals, due to the greater feasibility that the urban scale provides. In an urban context, buildings do not perform in isolation, they are influenced by their surroundings and the share of resources, such as the renewables for energy generation, becomes more desirable to reduce the mismatch between demand and supply. The latest recommendations from the European Commission point to the framing and development of regulation that supports the creation of energy communities, with the aim of becoming zero or even positive energy districts.
Given the dimension and importance in the urban tissue in which they are inserted, university campuses are seen as small urban communities. This has particular significance in university cities such as Poitiers and Coimbra, where the influence of the higher education institutions and their campuses on urban living is indisputable. They not only provide the opportunity to function as living laboratories for their students and researchers to experiment innovative solutions, but also to serve as an example and influence to the surrounding urban environment.

In this sense, the project fits completely into Work Package 6 of the EC2U alliance. Work Task 6.1. Topic: Sustainable Retrofitting and/or Reuse of University Historical Buildings.
At the University of Poitiers, we will take two cases of study. The first one is the ENSIP -B25 building and the second one is the GEII department of the IUT. Both are equipped with solar panels and monitoring systems. The choice of these two buildings is relevant. Building B25 is a building with classes for theoretical and practical teaching and with research laboratories.
The second building is exclusively dedicated to academic teaching.
At the engineering campus (Pólo II) of University of Coimbra there are buildings with solar PV systems installed and energy monitoring systems, namely the buildings of Mechanical and Electrical and Computer Engineering Departments and the building of the central services of the Campus. These buildings have different architecture characteristics, uses, HVAC and solar PV systems.
These buildings with different characteristics, locations and profiles will allow us to make more specific models according to the use of the university buildings.

Possible co-funding (Yes/No. If yes, specify the source of funding):

YES. University of Coimbra

Brief state of the art:

Research on sustainable campuses and on sustainable communities are claimed as *hot topics*, being prolific fields to be studied and explored in a near future.
University campuses can resemble small urban communities [1,2] with the same level of complexity, by the diversity of functional uses and users, and the consequent large consumption of resources, environmental impacts and energy demand.
Literature has shown an evident commitment to actions that promote the implementation of renewable energy systems on campus and the reduction of energy consumption in buildings, through their retrofit [3]. However, the adoption of monitoring, storage and data treatment systems (energy and others) is still little applied and referenced. In fact, literature reports that

most of the consumption estimates are usually obtained based on electricity, water and/or natural gas bills [4] or through dynamic simulations [5], giving rise in many cases to inaccurate or of limited utility [6], either for carrying out research studies or for the purpose of efficient management and maintenance of installations. Although they provide a close overview of consumption, these estimates, when used to design measures in the energy area, such as the implementation of renewable energy generation systems or the buildings retrofitting, may offer inaccurate information on the actual consumption of campuses and lead to incorrect sizing of the systems [7].

Some examples of the implementation of similar systems, usually associated with smart meters and centralized management systems, show promising results and demonstrate the importance of more precise approaches in increasing the sustainability of campuses [8]. Similarly, smart grids are seen as viable solutions to manage energy demand, supply and also storage [9].

There is a large literature on energy management in micro-grids (µG). There are two main types of research. Research on transient conditions in these µGs and research on energy flow optimization. In both cases, as the systems are complex, a number of issues remain unresolved.

Today there aren't any algorithms for convergence towards optimal energy solutions. Research in this field is still open, especially for intelligent buildings.

The use of computer-aided tools may help to accelerate the introduction of energy efficiency concerns in buildings design since the urban planning phase. Buildings performance simulation (BPS) and optimization (BPO) tools have a growing interest due to their ability to predict buildings performances and by combining procedures that optimize that behaviour and act as a decision aid in early phases of the design process, where changes are still manageable [10].

In this regard, Building Information Modelling (BIM) based tools constitute the latest developments for the design and construction industry, being its use increasingly mandatory worldwide, taking advantage of the interoperability that these tools allow, and the real-time sharing of all the project information [11]. BIM based software as Revit is already coupled to energy simulation engine as EnergyPlus. However, as a methodology based essentially on the design of isolated buildings, the specific requirements of the urban environment are still to be explored. In the same means are the functionalities related to energy, namely the integration of design methods for energy production, storage and management systems [12] or of devices related to smart buildings. Although may be related to several aspects of buildings functioning, the “smartness” in buildings may also represent a relevant support in the flexibility, adaptability and efficiency of the building’s response to external conditions [13], such as its potential for capturing renewable energy sources.

In this way, several aspects of research opportunities are detected that, together, are believed to contribute to the leverage of more energy efficient and sustainable communities.

Possible work plan with partner, incl. timeline (and time spent by PhD student at partner laboratory):

The work plan is divided in 6 work packages (WP):

WP1. Literature review and identification of requirements

Several perspectives for further investigation are crucial to clarify, before developing the remaining project tasks: (i) update the methodologies and characteristics currently missing in the definition of energy efficient urban communities; (ii) cost effectiveness survey based on the literature meeting the optimal density for the share of resources; (iii) search for methods for sharing common resources and renewable energy production at the urban scale; and (iv) survey on existing methods and tools to manage and optimize energy consumption, production and storage in urban environments.

Building design parameters and energy systems that may be influenced by urban context, as well as urban elements capable of influence buildings energy performance, in a mutual effect, will be identified: buildings design characteristics and energy systems. The result of this task will be a list of prerequisites to be satisfied in the subsequent tasks.
This WP is led by University of Poitiers (UP).

WP2. Monitoring
Several test buildings (at the University of Poitiers and the University of Coimbra) were identified to be used as case studies. These buildings are equipped with monitoring systems. The monitored data will be collected, treated and analyzed, providing an understanding of the evolution of the energy consumption and production. Later, this information will be used to validate the simulation models (WP3). In some cases, depending on the building and system, some independent monitoring campaigns may be necessary.
This WP is led by University of Coimbra (UC).

WP3. Modelling and simulation
In this task, the selected campus buildings (case studies) and their infrastructure will be used to develop the simulation models, based on BIM (Building Information Modelling). The buildings energy performance will be assessed through dynamic simulation (e.g., EnergyPlus). In a first phase, the buildings and their systems will be evaluated individually. Afterwards, they will be integrated in an urban matrix (campus) and assessed simultaneously, following the energy management of flows defined in WP5.
This WP is led by UC.

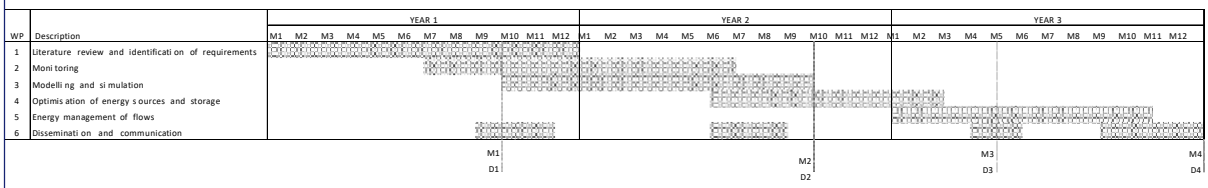
WP4. Optimisation of energy sources and associated storage
The mix of energy sources and storage systems will depend on the specific nature of the buildings. Regarding the forecasting of production and consumption levels, the case studies' models will be used to define optimal architecture corresponding to these case studies and which can then be applied to all the campuses in Poitiers and Coimbra. Afterwards, in what concerns the transient quality of the energy, a set of control rules that allow to have a power quality without disturbances in these low inertia networks will be defined.
This WP is led by UP.

WP5. Energy management of flows
The energy management will be based on the physical modelling of buildings and infrastructure (WP3). Knowledge of their technical characteristics, as well as their maintenance and evolution will lead to more resilient and efficient management of energy and infrastructure. The aim is to optimize the distribution of energy flows between buildings and between production and storage. Different optimization algorithms, including genetic algorithms, will be tested to define the most efficient strategy. This will lead to the development of smarter buildings and districts.
This WP is led by UP.

WP6. Dissemination and communication
The results of different stages of the project are disseminated through a selection of dissemination events and writing of scientific documents to be published in journals and communicated in conferences.
This WP is led by UP.

Timeline

TIMELINE - 36 MONTHS



The average time spent by a PhD student at each institution per year will be 6 months. These periods are clearly defined in relation to the objectives of each WP.
From Month 1 to Month 6 - From month 13 to month 18 - From month 25 to month 30 : UP
From Month 7 to Month 12 - From month 19 to month 24 - From month 31 to month 36: UC

M	Milestones
M1	List of prerequisites to be satisfied in the subsequent tasks
M2	BIM-based modelled campus buildings
M3	Algorithm to optimize the alternative solutions for energy sources and storage
M4	Embodiment of the tool/method to be used in the management of energy flows

D	Deliverables
	Writing of thesis and research articles

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Relevant research published by the UP and UC supervisors related to the topic:

Sabri Mansouri, **Slim Tnani**, Olivier Bachelier Conception and control of a new hybrid four-level inverter associated with a multisource system. Electrical Engineering Journal, 103 (1), 579-593-2021

Sabri Mansouri, **Slim Tnani,** Olivier Bachelier, A Hybrid four-level FC inverter using an internal supercapacitor storage system for a microgrid connected application, IET Power Electronis, IET Power Electronics 13 (17), 4043-4050

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Signature of the project principal investigator (PI) Signature of the PI's laboratory Director

TNANI

P.Coirault

Please note that the content of this activity / deliverable is available in the different languages of the EC2U Alliance upon request.