Position Description

1. General Information

Name of the position	**Enhancing sustainability of critical and strategic raw materials production for the energy transition by promotion of greening technologies**
Foreseen enrolment date	September 2025
Position is funded by	• COFUND, Marie Skłodowska-Curie Actions (MSCA), Horizon Europe, European Union • Universitat Politècnica de Catalunya (UPC) • RMIT University
Research Host	Universitat Politècnica de Catalunya (UPC)
PhD awarding institutions	Universitat Politècnica de Catalunya (UPC) & RMIT University
Locations	Primary: Barcelona, Spain Secondary: Melbourne, Australia
Salary	26,626.09 EUR annual **gross** salary (2,218.84 EUR monthly gross salary)
Supervisors	• Cesar Alberto Valderrama, Professor, UPC • Monica Reig, Lecturer, UPC • Jega Jegatheesan, Professor, RMIT University • Biplob Pramanik, Senior Lecturer, RMIT University • Industry Partners: CETAQUA & Radical Innovations Group (RIG)
Group of discipline	Circular Process Engineering, Chemical Engineering, Raw Materials Enginnering

2. Research topics (only one of these projects will be funded)

Project 1: ***Improving the sustainability of the production and recovery cycles of strategic raw materials for the energy transition by promotion of greening technologies using carbon dioxide-based chemicals***
Pressure on demand growth for resources such as metals, minerals and biotic materials due to increasing global population, industrialisation, digitalisation, increasing demand from developing countries and the transition to climate neutrality. Dependence of critical raw materials may soon replace today's dependence on oil. Raw materials are indispensable for the EU's industry and stand at the very beginning of each value chain. Amongst the non-energy, non-agricultural raw materials that are assessed by the European Commission, some are defined as critical based on objective criteria including their economic importance and their supply risk. CRMs are often produced and used in relatively small quantities but have special characteristics that make them essential ingredients for products in strategic areas such as renewable energy, digital, aerospace and

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defence technologies. Well-known examples include the rare earths elements found in the permanent magnets used to manufacture wind turbines motors and lithium, cobalt and nickel used for batteries. In general, the processing schemes in mining and metallurgical processing routes, for both primary and secondary sources are based on the use of sulphur containing minerals (e.g. sulphide minerals) or in the use of chemicals for the processing stages (e.g. sulphuric acid). In any of those scenarios, the main waste streams generated are strongly concentrated solutions of sulphate salts (e.g. sodium, calcium and magnesium sulphates). This PhD thesis is devoted to the substitution of the classical leaching chemicals (e.g. sulphuric and hydrochloric acids) by more greener chemicals as carbon dioxide in supercritical conditions (s-CO2(g). Main efforts will be centred in the evaluation of both primary and secondary minerals containing Lithium as cobalt to substitute the classical leaching conditions using high temperature pre-treatments for phase transformation, as it is the case of lithium minerals, or high temperature and high-pressure leaching reactors as it is the case of lateritic minerals from cobalt production. Process to be developed are always depending on the management options of the disposal of leachates generated that in this case will be base in carbonate and bicarbonate solutions. The PhD thesis will evaluate the techno-economic and environmental feasibility to develop a circular processing approach-based carbon-dioxide chemistry on the use of pressure and electrochemical (RO/ ED/BP) driven membranes technologies to demonstrate the on-site chemical recovery of the chemicals used in the leaching stages of minerals leading the green transition as lithium, nickel, cobalt are rare earth elements.

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Research Fields: Raw Materials, Green Transition, Chemical Engineering, Sustainability

Project 2: ***Greening and closing the production cycles of strategic raw materials for the energy transition by promoting on-site chemical production.***

Pressure on demand growth for resources such as metals, minerals and biotic materials due to increasing global population, industrialisation, digitalisation, increasing demand from developing countries and the transition to climate neutrality. Dependence of critical raw materials may soon replace today's dependence on oil. Raw materials are indispensable for the EU's industry and stand at the very beginning of each value chain. Amongst the non-energy, non-agricultural raw materials that are assessed by the European Commission, some are defined as critical based on objective criteria including their economic importance and their supply risk. CRMs are often produced and used in relatively small quantities but have special characteristics that make them essential ingredients for products in strategic areas such as renewable energy, digital, aerospace and defence technologies. Well-known examples include the rare earths elements found in the permanent magnets used to manufacture wind turbines motors and lithium, cobalt and nickel used for batteries. In general, the processing schemes in mining and metallurgical processing routes, for both primary and secondary sources are based on the use of sulphur containing minerals (e.g. sulphide minerals) or in the use of chemicals for the processing stages (e.g. sulphuric acid). In any of those scenarios the main waste streams generated are strongly concentrated solutions of sulphate salts (e.g. sodium, calcium and magnesium sulphates). Process to be developed are depending on the management options of the disposal of such streams as the market options are limited. The PhD thesis will evaluate the techno-economic and environmental feasibility to develop a circular processing approach based on the use of pressure and electrochemical (ED, EDBP) driven membranes technologies to demonstrate the on-site chemical productions of chemicals used in the leaching stages of the primary and secondary minerals used on the recovery of critical elements for the green transition as lithium, nickel, cobalt are rare earth elements.

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Project 3 Improve the sustainability of production and recovery cycles of strategic raw materials for the energy transition through recovery from secondary resources such as electrical and electronic waste at the end of their useful life.
Pressure on demand growth for resources such as metals, minerals and biotic materials due to increasing global population, industrialisation, digitalisation, increasing demand from developing countries and the transition to climate neutrality. Dependence of critical raw materials may soon replace today's dependence on oil. Raw materials are indispensable for the EU's industry and stand at the very beginning of each value chain. Amongst the non-energy, non-agricultural raw materials that are assessed by the European Commission, some are defined as critical based on objective criteria including their economic importance and their supply risk. CRMs are often produced and used in relatively small quantities but have special characteristics that make them essential ingredients for products in strategic areas such as renewable energy, digital, aerospace and defence technologies. Well-known examples include the rare earths elements found in the permanent magnets used to manufacture wind turbines motors as rare earth elements, lithium, cobalt and nickel used for batteries and germanium, gallium, antimony and indium or semiconductors production. In general, the processing schemes in mining and metallurgical processing routes, for such type of secondary sources are characterized by the higher complexity dur to the presence of a large number of metals present when compared to primary sources. Typically end-of-life wastes are concentrated after shredding and sorting to be treated in pyrometallurgical furnaces. Wastes generated after the recovery of the main elements present Cu, Zn or Pb by electrowinning processes generates as a waste the know anode slimes containing the elements present in minor contents. Classical mineral concentration technologies could not be applied as the mineral liberation is not possible, Additionally, the classical leaching technologies developed for primary sources are not applicable. This PhD thesis is devoted to the substitution of the classical leaching chemicals (e.g. sulphuric and hydrochloric acids) with the integration of by more greener chemicals incorporating specific redox chemistries promoting the selective leaching of the target critical elements to be recovered. The processes developed will be fractionating elements according to their redox properties and latter integrating specific separation and concentration processes using ion-exchange and solvent extraction between others. The PhD thesis will evaluate the techno-economic and environmental feasibility to develop a circular processing approach to recover critical elements from end-of life electric and electronic waste to be used in the production of semiconductors, photovoltaic cells and water electrolizers.
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Research Fields: Raw Materials, Green Transition, Chemical Engineering

3. Employment Benefits and Conditions

Universitat Politècnica de Catalunya (UPC) offers a 48-month full time work contract. The total working hours per week are 37.5.

The remuneration, in line with the European Commission rules for Marie Skłodowska-Curie grant holders, will consist of a **gross annual salary** of yearly 26,626.09 EUR (which is of monthly 2,218.84 EUR). Of this amount, the estimated net salary to be perceived by the Researcher is 1,819.00 EUR per month. However, the definite amount to be received by the Researcher is subject to national tax legislation and the personal situation.

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Benefits include

- Becoming a Marie Skłodowska-Curie fellow and be invited to join the Marie Curie Alumni Association
- Access to all the necessary facilities at UPC and RMIT University
- Tuition fees exemption at both PhD awarding institutions
- Travel allowance to cover flights and accommodation for participating in DREAM+PLAN events
- Up to 12 months in Australia
- 22 days paid holiday leave
- Social security coverage
- Sick leave
- Parental leave

4. PhD enrolment

Successful candidates for this position will be enrolled by the following institutions and must comply with their specific entry requirements, in addition to DREAM+PLAN's conditions.

Universitat Politècnica de Catalunya (UPC)

To enrol in a Doctorate program you must meet the general conditions, namely:

As a rule, applicants seeking admission to an official doctoral programme must hold a Spanish bachelor's degree or equivalent and a Spanish master's degree or equivalent, provided they have passed at least 300 ECTS credits on the two degrees. Any of the following applicants may also gain admission:

- Holders of official Spanish degrees or equivalent Spanish qualifications, provided they have passed 300 ECTS credits in total and they can prove they have reached Level 3 in the Spanish Qualifications Framework for Higher Education.
- Holders of degrees awarded in foreign education systems in the European Higher Education Area (EHEA), which do not require homologation, who can prove that they have reached Level 7 in the Spanish Qualifications Framework for Higher Education, provided the degree makes the holder eligible for admission to doctoral studies in the country in which it was awarded. Admission on this basis does not imply homologation of the foreign degree or its recognition for any purpose other than admission to doctoral studies.
- Holders of degrees awarded in a country that does not belong to the European Higher Education Area, which do not require homologation, on the condition that the University is able to verify that the degree is of a level equivalent to that of official university master's degrees in Spain and that it makes the graduate eligible for admission to doctoral studies in the country in which it was awarded. Admission on this basis does not imply homologation of the foreign degree or its recognition for any purpose other than admission to doctoral studies.
- Holders of another doctoral degree.
- University graduates who, having previously been awarded a training post in the entrance examination for specialised health training posts, have passed and obtained a positive

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assessment in at least two years of training on a programme leading to an official qualification in a Health Sciences specialisation.

Specific requirements and admission procedure:

Each doctoral programme may have specific requirements for admission in addition to the general requirements. The additional specific requirements that must be met for admission are listed on the web pages for each programme.

More information: https://doctorat.upc.edu/en/future-doctoral-candidates/access-and-admission/general-entrance-requirements?set_language=en

RMIT University

Visit the website: https://www.rmit.edu.au/research/research-degrees/how-to-apply

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