

FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING¹

1. BASIC DATA

Mentor's name and surname	Lidija Čuček	Mentor's register number at ARIS (SICRIS) :	30944
Mentor's e-mail:	lidija.cucek@um.si	Mentor's tel. no.:	+386 2 22 94 452
Research programme (RP) leader's name and surname:	Lidija Čuček	RP leader's register number at ARIS (SICRIS) :	30944
Title of research programme:	Sustainable technologies and Circular Economy	RP's Register number at ARIS (SICRIS) :	P2-0421
Research organisation (RO) of University of Maribor, where training shall be conducted:	Faculty of Chemistry and Chemical Engineering	RO Register number at ARIS (SICRIS) :	0552-0794
Research field according to ARIS classification :	2.02.03	Research field according to EURAXESS classification	Systems engineering

2. DEFINITION OF RESEARCH PROBLEM AND GOALS OF DOCTORAL RESEARCH²

Starting point of research task of the early stage researcher and its position in the research programme, where the mentor is included, work hypothesis, research goals and foreseen result with emphasis on an original contribution to science:

Background and its position within the research programme:

The transition toward the sustainable use of energy and resources represents an important global and European strategic direction that significantly influences the design and operation of resource conversion systems, as well as the production and use of products along entire value chains. The increasing integration of renewable and waste resources, such as renewable electricity, CO₂, water, and secondary raw materials, leads to systems characterized by pronounced temporal variability in resource availability and increased dynamics of operation. As a result, numerous challenges arise in the design, operation, and performance

¹ Term early stage researcher (ESR) is written in male form and used as neutral for women and men.

² Research and study programme of training have to harmonise with contents of the research programme, where the mentor is a member.

assessment of such systems, since multiple technological alternatives, different dimensions of sustainability (economic, environmental, and social), and time-varying constraints should be addressed simultaneously. Power-to-X technologies play an important role in sector coupling by enabling the conversion of electricity from renewable sources into hydrogen, ammonia, and other energy carriers and chemicals. Although these technologies offer significant potential for decarbonization and long-term energy storage, they also substantially increase the complexity of infrastructure, logistics, and supply networks. Sectorally separated design approaches therefore do not allow for a comprehensive treatment of such systems.

The research problem addressed in this doctoral work is the development of methods that enable the integrated design and optimization of energy and resource use systems under conditions of time-varying production and demand, while simultaneously accounting for multiple sustainability objectives.

Research hypothesis and objectives:

This research is based on the hypothesis that the effective integration of renewable energy sources can only be achieved through a holistic process systems approach and the development of advanced optimization methods and mathematical models that simultaneously address the production, conversion, storage, and distribution of energy and chemicals. Isolated consideration of individual technologies or sectors does not allow for the identification of optimal solutions under conditions of temporally variable availability of renewable resources. Particular emphasis will be placed on addressing the temporal dynamics of production and demand and on the development of computational approaches that enable robust decision support.

The objectives of the research are the following:

1. To develop process-systems models for the integrated assessment of energy and resource use;
2. To develop multi-criteria optimization models for integrated systems incorporating Power-to-X technologies and energy storage;
3. To analyze and optimize infrastructure solutions for the production, conversion, storage, and distribution of energy and chemicals;
4. To develop methods for optimizing supply networks and sector coupling under conditions of variable production and demand;
5. To integrate the developed models and methods into decision-support tools for the long-term development of sustainable, robust, and flexible integrated systems.

Expected results with an emphasis on original contribution to science:

The research work will include the development of advanced mathematical models, optimization methods, and algorithmic approaches for design and management of energy and resource use in complex integrated systems. Multi-criteria and multi-level models will be developed to enable the quantitative evaluation of different scenarios for the integration of renewable energy sources, hydrogen, and Power-to-X technologies across connected sectors.

The developed models and methods will be implemented in GAMS, MATLAB, and Python, and validated using representative case studies to assess their applicability and robustness. The research is expected to result in at least three original scientific publications in international open-access journals, as well as presentations of the results at leading conferences in the fields of process systems engineering and sustainable development.

3. STUDY PROGRAMME

Foreseen study programme, to which early stage researcher shall be enrolled in academic year 2026/2027:

Chemistry and Chemical Engineering

4. DESCRIPTION OF WORK AND TASKS

Implements scientific and research projects.
Participates in design of research programmes.
Works professionally with research clients.
Prepares research reports and studies.
Monitors and coordinates research work in accordance with funding agreements.
Ensure safe and healthy working conditions.
Organises and instructs staff and students in the use of personal protective equipment and other safety measures.
Performs other related duties as directed by employee's line manager.
Participates in working and standing committees of the UM and its members.
Replaces colleagues and supervisor in their absence (by mandate).
Participates in annual and other inventories.
Performs other related work as assigned by superiors.

5. REQUESTED LEVEL OF EDUCATION

VII/2. tariff group

6. REQUESTED FIELD OF EDUCATION

Tehnickal, Natural science

7. KLASIUS SRV

Seventh level: Second cycle of higher and similar education/Second cycle of higher and similar education

8. KLASIUS P

4 - Natural science, mathematics and computing
5 - Engineering, manufacturing and construction

9. REQUESTED KNOWLEDGE

Computer skills: MS Windows, Word, Excel, Internet, e-mail, e-commerce

10. REQUESTED SPECIAL REQUIREMENTS

/

11. REQUESTED LANGUAGES

Active knowledge of one world language

12. REQUESTED WORK EXPERIENCE

/

13. FORESEEN POSTDOCTORAL TRAINING

Yes

Mentor's signature:

Lidija Čuček Digitally signed by Lidija Čuček
Date: 2026.02.05 16:24:17 +01'00'

Research programme leader's signature:

Lidija Čuček Digitally signed by Lidija Čuček
Date: 2026.02.05 16:24:33 +01'00'

Name and surname of Dean or
authorised person³:

Prof. Dr. Zoran Novak

Signature of dean or authorised person:

E-žig ustvarjen za:

Zoran Novak

zoran.novak@um.si

Napredni e-žig s kvalificiranim
potrdilom

Imetnik potrdila: mSign

Datum e-žiga: 06.02.2026

Potek veljavnosti potrdila: 04.04.2030

Place and date:

Kliknite ali tapnite tukaj, če želite
vnesti besedilo.

Kliknite ali
tapnite
tukaj, če
želite vnesti
datum.

Stamp:

³ The training program is signed by the dean of the member where the ESR's employment and training will take place.