EURECA-PRO

The European University on Responsible Consumption and Production

Participants:	Montanuniversität Leoben, Mittweida University of Applied Sciences, Technische Universität Bergakademie Freiberg, University of León, University of Petrosani, Silesian University of Technology, Technical University of Crete, Universiteit Hasselt, Universite de Lorraine
WP 3:	Research, Montanuniversität Leoben
D3.1:	Organisational Scientific Framework Charter (SFC) for interuniversity research collaboration
Type:	E-Book
Due date:	M5
Submission:	15.04.2021 (last Update 07.2023)

Grant Agreement No.: 101004049

Project duration: 1.11.2020 – 31.10.2023

Co-funded by the Erasmus+ Programme of the European Union

Content

1 Introduction

The European University on Responsible Consumption and Production (EURECA-PRO)

Responsible Consumption and Production (RCP) is one of the major factors influencing our global society, and many of the biggest challenges of our time are linked to it. Without RCP patterns we are not able to sustain a healthy environment, society or economy. For this reason, EURECA-PRO has joined forces of 9 partner universities[1] to become a true global actor and role model in this field. The long-term vision is to be the global educational core hub and interdisciplinary research and innovation leader in qualitative environmental and social framework development for responsible consumption and production of resources and goods by 2040. This will comprise technological, ecological, policy, economic and societal aspects and their transfer into society and industry.

Organisational Scientific Framework Charter (SFC)

The Scientific Framework Charter is the scientific manifesto of EURECA-PRO to create a New Open European Research Area. The Charter is organized like a book with different chapters corresponding to the deliverables of EURECA-PRO. It defines the roles and responsibilities of each partner, designates a Research Task Force and governs the communication throughout the project. Lighthouse Research Missions regarding responsible consumption and production are established in all relevant disciplines and cross-institutional research groups yield promising research results that flow into the practical education of the European Studies programme via problem-based learning (PBL).

The SFC is provided in English as it is the lingua franca of the project consortium and is available on the official EURECA-PRO website[2]. Due to the deliverables associated with the document, the Scientific Framework Charter is iteratively evolutionary and will be continuously updated. Different access rights for different users ensure legal certainty regarding IPR issues.

[1] The term university in this document refers to all institutions of higher education allied in the EURECA-PRO European University initiative.

[2] https://www.eurecapro.eu/

2 General organisational framework

Chapter 2, which corresponds to D3.1 of EURECA-PRO, outlines the general organisational framework regarding the collaboration mode. It is a hybrid form between an interorganisational chart and a project charter.

It will include the denomination of the key staff assigned to actively work in the group as illustrated in the chart, key scientists and personnel that will additionally contribute with their expertise, a mode and schedule for virtual meetings that ensures the timely completion of the tasks, infrastructure that can be used, communication solutions proposed and further points of importance.

The EURECA-PRO consortium consists of nine participating partner universities that are listed in the following table and their expertise is shown in section 2.1.

Tab. 1: Participating Universities in EURECA-PRO

Number	Role	Name in original language	Name in English	Short name	Country
1	COO[3]	Montanuniversität Leoben	Montanuniversität Leoben	MUL	Austria
2	BEN[4]	Technische Universität Bergakademie Freiberg	Technische Universitaet Bergakademie Freiberg	TU BAF	Germany
3	BEN	Universitatea din Petroșani	University of Petroşani	UP	Romania
4	BEN	Universidad de León	University of León	ULE	Spain
5	BEN	Polytechneio Kritis	Technical University of Crete	TUC	Greece
6	BEN	Politechnika Śląska	Silesian University of Technology	SUT	Poland
7	BEN	Hochschule Mittweida – Hochschule für angewandte Wissenschaften	Mittweida University of Applied Sciences	HSM W	Germany
8	OAP[5]	Universiteit Hasselt	Hasselt University	UH	Belgium
9	OAP	Universite‘ de Lorraine	University of Lorraine	UL	France

[3] Coordinating organisation
[4] Beneficiary organisation
[5] Official Associate Partner in the first project phase

2.1 Expertise of the partner universities

The realisation of the visionary Sustainable Development Goal 12 (SDG12) on RCP is based on three system layers:

1. the technological layer of primary and secondary raw materials, processes, energy and products,
2. the layer of consumers, societal consumption behaviours and motivations, industrial culture, business models and market mechanisms,
3. the layer of policy, regulations and communication.

The constitution of the nine partners of EURECA-PRO with their scientific expertise is ideal, as together, they cover the interdisciplinary scientific areas needed to succeed in tackling the complexities of the vast RCP task. A team of three types of universities, (1) technical, (2) comprehensive and (3) universities of applied sciences, was selected. Silesian University of Technology (SUT), Technical University of Crete (TUC), Technische Universitaet Bergakademie Freiberg (TU BAF) and Montanuniversität Leoben (MUL) cover the technological layer. Research, development and education (R&D&E) at these universities is strongly dedicated to designing systems for Circular Economy, recycling, sustainable material flows and energy efficiency. Digitalisation, artificial intelligence, added-value manufacturing, biotic and abiotic resources are just a few of the many areas, where these technical universities have their special strengths. As comprehensive universities, University of Petroşani (UP), University of León (ULE), Hasselt University (UH) and University of Lorraine (UL) cover the first and the second layer. Intrinsic consumer motivation, sustainable business models, industrial culture as well as policy and regulations are the foci of R&D&E at these institutions. Mittweida University of Applied Sciences (HSMW) covers layer 1 in the field of Energy Technologies and Digitization and layer 3 in the context of third mission and external image, a crucial aspect in achieving intended EURECA-PRO goals and reaching the relevant target groups.

2.1.1 Montanuniversität Leoben (MUL)

Founded in 1840, MUL is a "Global Center of Academic Excellence" in its highly-ranked core disciplines, which are oriented along the value-added life cycle of materials and goods. It claims a special position in the Austrian as well as in the international academic landscape as its research and education profiles are specifically centred around this cycle of product genesis, ranging from the exploration and extraction of raw materials, to their processing, material and product design, process and energy technologies, product distribution and industrial environmental protection, as well as the recycling of end of life products in order to introduce them into the value life cycle as secondary raw materials again and thus closing loops and reducing environmental impacts. The 15 institutes and departments demonstrate the centring on this cycle, such as Applied Geosciences and Geophysics, Electrical Engineering, Polymer Engineering and Science, Mathematics and Information Technology, Product Engineering, Metallurgy, or Mineral Resources and Engineering.

Montanuniversität Leoben is uniquely linked in research clusters with business and scientific partners across Austria. COMET[6]-Centres are characterised, for example, by their ambitious research programmes in various fields, such as Sustainable Metal Production, Smart Polymers for the Future or Evolutionary Engine Technologies for a Sustainable Tomorrow. The understanding of raw materials as a holistic, circular and systemic concept is a central thought at MUL as it also represents the current global trends of environmental, societal, industrial and scientific development, as reflected by the UN's Sustainable Development Goals (SDGs). MUL has become thoroughly involved in relevant research and education activities regarding SDG12 – Responsible Consumption and Production in recent years. In its Resources Innovation Center (RIC), which is home to the international scientific and educational partnerships of the university in the areas of sustainable resources development, MUL has gained great experience in responsible consumption and production matters. UniNEtZ, a project in which the Montanuniversität Leoben collaborates to produce an option catalogue for the Austrian government on how to most effectively implement the SDGs in Austria and the EIT Climate-KIC flagship project eCircular in which RIC is concerned with the sustainable

[6] Competence Centers for Excellent Technologies

life cycle of plastics and polymers, are just two examples of MULs broad scientific project landscape.

RIC's partnerships range from the EIT RawMaterials, a pan-European 125-partner network for raw materials, a so-called Knowledge & Innovation Community (KIC) of the European Institute for Innovation and Technology, across to the EIT Climate-KIC, a KIC concerned with climate change mitigation to other more local networks.

Currently, the Montanuniversität Leoben (MUL) has around 3500 students, thereof 20% foreigners, and 45 study programmes.

For further information, see: https://www.unileoben.ac.at/en

2.1.2 Technische Universität Bergakademie Freiberg (TU BAF)

TU BAF is the oldest university of mining in the world with a continuous operation since its foundation in 1765. Its original mission was to train students in natural sciences with a focus on mathematics, chemistry, physics and geosciences, and in mining technologies for employment in the mining and metallurgical sectors. Since the beginning, an international student body became established as the norm. Professors and academic teachers dedicated themselves to research for the promotion of scientific knowledge and for education. This tradition has been maintained up to the present day. Currently TU BAF operates six faculties dealing with (i) Mathematics and Computer Science, (ii) Chemistry and Physics, (iii) Geosciences, Geo-Engineering and Mining, (iv) Mechanical, Process and Energy Engineering, (v) Materials Science and Materials Technology, (vi) Business Administration. The university has a unique profile focusing on the entire value chain of materials, from exploration to mining and processing, production and use of products, treatment of end-of-life products and materials recycling. In addition, there is a seventh faculty called "Virtual Faculty". This new structure was created to offer online courses for the preparation of future students in STEM study programmes.

Researchers of TU BAF co-operate in numerous Special Research Groups and competence centres. For this task, the university is equipped with a high-level scientific infrastructure, composed of laboratories for natural sciences and engineering, computer labs and large-scale pilot plants for the development and the testing of industrial processes. Above mentioned faculties i, ii and iii deliver characterizations, modelling and simulation, visualization and synthesis, robotics and value creating chemistry to the scientific areas Mathematics and

Natural Sciences. Faculties iii, iv and v develop technologies, plants and processes, sensors and light-weight materials as their contributions to the second scientific area Engineering Sciences. Faculty vi studies valuation, innovation management, economics and ecological management of resources as a contribution to the third scientific area Economics. TU BAF's research interests with regard to EURECA-PRO range from innovative technologies for mining operations, climate mitigation and adaptation strategies to study consumer patterns and behaviour with respect to natural resources, energy and water, recycling and re-use.

TU BAF has strong ties with partners in the region, especially Helmholtz Centre Freiberg for Resource Technologies, Geokompetenzzentrum Freiberg, Fraunhofer Technology Centre for Semi-Conductors and industrial companies. The university also maintains a large global network through 18 agreements at university level and 184 partnerships at faculty level with 260 universities in 72 countries.

TU BAF has around 4000 students, of which 27% are foreigners, 90 chairs and 70 study programmes.

Further information: https://tu-freiberg.de/en

2.1.3 University of Petroşani (UP)

UP is strategically located in the Jiu Valley of Romania and has a long tradition, since 1864. Taking as a basis the strong academic tradition and prestige enjoyed at home and abroad, the university today provides the necessary conditions for its students to acquire high qualification in many different areas. Students are educated for professional careers by the following three faculties: Faculty of Mining, Faculty of Mechanical and Electrical Engineering and the Faculty of Sciences. The mission of UP is education and research in these subjects within the European context. At university level the following scientific research centers are operational: Center for Rocks Engineering Useful Mineral Substances, and Building Materials; Mining Engineering Center; Center for Mechanical Engineering in Mining; Center for Risk Evaluation in Industry; Center for Methods, Techniques and Software for the Monitoring and Control of Mining Processes. UP aims to support scientific research directions in accordance with the research policy documents of the European Commission. The University of Petroşani conducts fundamental and applicative studies and research in the following fields: the engineering of natural resources and raw materials extraction and processing; the improvement and automatic control of machines, installations and technological processes;

the evaluation of the impact of economic activities upon the environment; the rehabilitation of mining areas, the elaboration of new management, marketing, and entrepreneurial development systems and methods for innovation and organizational competitiveness; the identification of opportunities for regional economic growth, jobs insurance and improved competitiveness of the companies in a knowledge – oriented society. UP has been involved in a series of projects funded at European level, in the fields of raw materials, mining and waste recovery like in ERA-NET Cofund on Raw Materials (ERA-MIN 2) and Horizon 2020 – RFCS as well as in national and international projects, with business environment in the fields of mineral resources, reducing the internality of energy of industrial processes, and improving the energy efficiency of production and consumption processes.

UP was evaluated by the Romanian Agency for Quality Assurance in Higher Education and obtained a "High Trust" certification and the university won a valuable grant from European Funds in 2020, which meets the thematic objectives 10 of the EU's Smart Specialization Strategy.

The University of Petroşani is currently training over 4500 students.

For further information, see: https://www.upet.ro/en

2.1.4 University of León (ULE)

ULE is a public institution of higher education and research founded as an autonomous entity in 1979. ULE is located in León province, in the northwest part of Spain. It is a comprehensive university based on two campuses which offer 42 bachelor and double degrees, 38 official master's degrees, 17 PhD programmes and 23 university-specific degrees adapted to the European Higher Education Area in all branches of knowledge. They are organized in 13 different schools/faculties: Faculty of Veterinary Medicine, Faculty of Biological and Environmental Sciences, Faculty of Laws, Faculty of Arts, Faculty of Economics and Business Administration, Faculty of Work Studies, School of Industrial Engineering and Information Technology, School of Mining Engineering, School of Agricultural Engineering, Faculty of Education, Faculty of Health Sciences, Faculty of Sciences of Physical Activity and Sport and the associated centre School of Social Work.

The region where ULE is located has a strong coal mining tradition. Although coal continues to play a key role in the energy matrix, the decline of the carbon industry due to the CO_2 emissions encouraged universities to develop teaching and research activities that contribute

to a more sustainable energy model and to promote a new economic paradigm in the region. ULE is committed to the implementation of the guidelines of the 2030 Agenda for Sustainable Development of the United Nations through the inclusion of the SDGs in the society. In addition, ULE has been accredited as Campus of International Excellence, with a programme that aims to promote strategic aggregations between universities to create 'knowledge ecosystems' that favour employment, social cohesion and territorial economic development. ULE has signed more than 2400 agreements with international institutions and companies from more than 40 countries and has participated in several Capacity Building projects. ULE is aligned with the regional research and innovation strategy for an intelligent specialization (RIS3) of Castilla y León, based on R&D in ICT, Energy and Sustainability. The university belongs to several networks and initiatives that mainstream sustainability in several key areas. Some of these networks are the U-Mob network (the European University Network for Sustainable Mobility); Universities for Fair Commerce or CRUE-CADEP (University Organization for Environmental Quality, Sustainable Development and Risk Prevention). ULE is in the European Higher Education Space (EEES) and will participate in the development of the Iberoamerican Space of Knowledge (EIC) and the Euromediterranean Space of Higher Education and Research.

The total number of students is currently 12643 from which around 1000 are international students from more than 50 different countries.

For further information, see: https://www.unileon.es

2.1.5 Technical University of Crete (TUC)

TUC is one of the two Technical Universities in Greece and the only one in the Region of Crete. Strategically located in the southeast part of the Mediterranean Sea, at the crossroads between Europe, the Middle East and North Africa, TUC plays a major role in the outreach beyond Europe towards the South and South East. TUC was established as a legal entity in 1977 and received students for the first time in 1984. It consists of 5 Schools: Production engineering & management, Mineral resources engineering, Electrical & computer engineering, Environmental engineering, and Architectural engineering. In addition to the 5 undergraduate engineering diplomas, TUC grants 15 Master's level degrees, three of which are international. TUC provides its students with an education that combines vigorous academic study and excitement of discovering new knowledge and offer of intellectual stimuli

within the framework of a dynamic academic community. TUC is a small technical (engineering) university with a clear mission: To expand knowledge and benefit society through research integrated with education. In this endeavour, the pursuit of excellence is the driving force. More than 50 laboratories with prime equipment, high technology infrastructure and eminently qualified personnel attest to the level of excellence in education and research. According to the External Evaluation Report by the Hellenic Quality Assurance & Accreditation Agency, "Research is a core mission of the Institution and as a result, TUC delivers scientific output of high calibre and volume. In terms of research publications, TUC is one of the most productive research institutions in Greece and compares very favourably with peer institutions in Europe and North America.

TUCs special location on an island results in combined expertise and experience of specific challenges such as remote energy supply and supply chains. TUC plays a pivotal role in the development of Crete, providing innovative solutions for environmental, productivity, business and organisational problems in areas such as water resources, waste management and valorisation, sustainable tourism and urban mobility. The university is characterised by intense education/research activities, agriculture and agribusiness, tourism, strong historical and cultural backgrounds, and a Mediterranean life-style that supports responsible consumption and production of food systems. TUC participates strongly in EU and international programmes, including Horizon 2020, Interreg and Med programmes, and has cooperation agreements with major universities in USA, China, India, and Argentina, while in cooperation with the European Space Agency TUC operates one of the four satellite altimeter centres worldwide.

At present there are 5000 undergraduate students and around 600 Master students and PhD students at TUC.

Further information: https://www.tuc.gr/index.php?id=5397

2.1.6 Silesian University of Technology (SUT)

SUT is the sole technical university in the Upper Silesian-Zagłębie Metropolis, and the largest technical university in the entire Silesian Voivodeship. It was established in 1945 as a scientific and educational facility for Upper Silesia, the most industrialized area in Poland, and one of the most industrialized in Europe. SUT consists of 15 educational units at 3 campuses that offer almost 60 study programmes and about 200 major specializations for the students. It is

implementing Project Based Learning to all study programmes. SUT offers 17 BSc and 19 MSc programmes taught entirely in English and aside from technical programmes, candidates may also study administration, business analytics, mathematics and management as well as foreign languages and pedagogy.

SUT operates in the Katowice Special Economic Zone, which for the third time has been recognized as the best economic zone in Europe, and recently as best economic zone in the world. This region has changed its specialization from heavy industry into modern technology industry and in the vicinity of the university there are approx. 500 thousand enterprises of international and even global scale, focused on climate and environment protection, responsible use of resources, and modern energy. The connection to the innovative companies and highly involving those to dual studies, project-based learning, and joint research is an outstanding best practice, which is a role model for other universities. SUT in close collaboration with the Metropolis authorities works on protection of the environment since decades and defined it as one of six priority research areas within the framework of climate and environment protection and modern energy. Further research interests are for example: Artificial intelligence and data processing; Materials of the future; Smart cities and future mobility; Process automation and Industry 4.0.

The Silesian University of Technology, as one of the top 10 Polish Universities awarded with the status of Research University, has ambitions to play a significant role in the field of environmental protection in more extensive, international scale. Therefore, SUT is an active participant in international associations of universities and collaboration networks, including European University Association (EUA), European Society for Engineering Education (SEFI), Santander Universidades, European Regions Research and Innovation Network (ERRIN), and the European Association for International Education. SUT actively joins national and international initiatives, for example, within EIT RawMaterials and EIT InnoEnergy and it created the Centre for Climate and Environmental Protection jointly with Bertrand Piccard's Solar Impulse Foundation, the city of Gliwice and the Silesian-Zagłębie Metropolis.

The Silesian University of Technology is currently training around 18500 students.

Further information: https://www.polsl.pl/en

2.1.7 Mittweida University of Applied Sciences (HSMW)

HSMW is located in Eastern Germany, Saxony. Empowering this region is one of its major priorities but its impact extends far beyond. HSMW has developed an intellectual and cultural hub in Saxony and the third mission, understood as the transfer of knowledge and technology within and beyond the region, is its core task.

HSMW is a high-performance University of Applied Sciences within Saxony‘s universities and it teaches and conducts research in the faculties of Engineering Sciences, Applied Computer Sciences and Biosciences, Industrial Engineering, Social Sciences as well as Media Sciences. The university offers more than 30 accredited study programmes and the institution is characterized by a comprehensive internationalization strategy, both in terms of students and staff. Students come from over 50 countries and receive the benefits of applied education in social and media sciences prior to either staying in the region as skilled professionals or bringing their acquired knowledge to their home countries to contribute to further development there. In addition, students can certify their intercultural competence at HSMW or study Global Communication in Business and Culture (Bachelor of Science) at the Institute for Technology and Knowledge Transfer.

Recognized research foci of HSMW are: product and process development, digitization in economy and society, applied computer science and laser technology. With the Institute for Competence, Communication and Languages as well as the aforementioned certification programme, HSMW is able to train students from other countries in these areas in a target group-specific manner. The courses are designed to interact with other disciplines and are practice oriented.

Especially through the research foci, HSMW offers a wide range of experience in international research cooperation. Digitization is of enormous importance for HSMW and it can already proudly point to a large number of successful projects and entire study programmes such as General and Digital Forensic Science.

HSMW teaches approximately 7000 students from over 50 countries.

Further information: https://www.hs-mittweida.de/en

2.1.8 Hasselt University (UH)

Founded in 1971, Hasselt University (UHasselt) is a leading public university situated in Belgium within a stone's throw from the capital Brussels. With two campuses, in Hasselt and Diepenbeek, UHasselt stands for excellence in education, cutting-edge research in signature research themes, and a deep commitment to innovation and entrepreneurship. As a civic university, UHasselt combines academic excellence with economic innovation, social impact and public relevance. With more than 6600 students (14.29% international students) and 1400 research staff (with 564 PhD students of whom 46.45% are international students), Hasselt University ranks amongst the top 10 institutions worldwide in U-Multirank 2022, the top 300-350 in the THE World University Ranking, as well as 53th in the THE Ranking of Universities less than half a century old.

Over the past decades, Hasselt University has grown towards a comprehensive university with compelling undergraduate, graduate and PhD programmes in 7 Faculties (Architecture and Arts, Business Economics, Medicine and Life Sciences, Engineering Technology, Law, Rehabilitation Sciences, Sciences) and 3 Schools (Transportation Sciences, Social Sciences, and Educational Studies). Hasselt University offers 18 Bachelor's and 34 Master's degrees and 5 Anglophone programmes.

At UHasselt we are committed to research-led teaching and innovation, based on fundamental and applied academic research consolidated in four research institutes (Biomedical Research Institute (BIOMED), Research Institute: Centre for Environmental Sciences (CMK), Institute for Materials Research (IMO), Data Science Institute (DSI)), and three research centres (Transportation Research Institute (IMOB), Expertise Centre for Digital Media (EDM), Limburg Clinical Research Centre (LCRC)). In line with its civic mission, UHasselt prioritises research that will drive the region and beyond to a more sustainable, healthy and inclusive society. Here the focus on its signature research themes allows UHasselt to uphold its reputation as a world-leading centre of research and generate impact as a member of various inter-university and international networks.

2.1.9 Université de Lorraine (UL)

Université de Lorraine (UL) is a comprehensive, research-intensive university with a strong focus on engineering and technology. Its location in the heart of Europe, with borders on three European member states (Germany, Belgium and Luxembourg) offers to UL a privileged

position for strong international partnerships. It was created in 2012 by the merger of 3 universities and 1 national polytechnic institute, thus becoming the first and to this date only French university having completely included the site's Graduate Schools of Engineering (Grandes Écoles d'Ingénieurs) as integral parts of the university. With 11 schools, UL is the French institution delivering most "engineering degrees" degrees. With more than 3,900 teaching and research faculty members and approximately 62000 students, including nearly 10,000 foreign students, UL is one of France's largest multidisciplinary universities. UL is also a major player in life-long learning in France, with about 3900 registered learners and more than 1500 degrees granted. Besides, doctoral training represents about 1900 PhD students distributed in 8 graduate schools for nearly 400 theses per year. The scientific activity of the Université de Lorraine is organized in 60 research laboratories located in 10 scientific centres covering a wide range of disciplinary fields and topics: agriculture, food science, forestry, environment, energy, biology, medicine, health, chemistry, physics, process engineering, product engineering, materials science and engineering, metallurgy, mechanical engineering, computer science, automation, electronics, mathematics, communication, social sciences, literature, languages, law, political science, economics, management , arts, architecture... In addition, the university houses several technology platforms including large-scale facilities and large measurement instruments, providing research teams with the most efficient equipment.

Since its creation, UL has developed to become a major player in France, in the top 10 of French universities according to the Shanghai ranking (ARWU- estimate ranking is 210 in 2021). It has also gained a real visibility at the European level and has taken a central place in its regional innovation ecosystem. UL has also been confirmed as a member of the French Excellence Initiative, with the label I-SITE (science, innovation, territory and economy). With this label, UL is recognised for its capacity to develop strong cooperation with the industrial partners, to implement innovative actions of joint research, of entrepreneurship development and of vocational, initial and continuing training. Within this initiative, called "Lorraine Université d'Excellence (LUE), UL develops a common education and research strategy with the main objective of achieving international leadership in global engineering for a healthy planet. UL's trademark is to opt for interdisciplinary and entrepreneurial

approaches (UL has been ranked France's #1 entrepreneurial university for several years) to tackle issues such as the transition towards low carbon society and economy, major health challenges, questioning of a world with open borders, or the place of humans in the digital society.

Further information: https://www.univ-lorraine.fr/en/univ-lorraine/

2.2 Research Task Force

The Research Task Force (RTF) is created by selected scientists from all partner institutions. Joint research inside EURECA-PRO focuses on new technologies and processes that integrate primary and secondary resource material flows and efficient resource use in the sense of a Circular Economy as well as substitution of non SDG12, Planetary Boundaries or Climate Neutrality compliant Resources. In addition, new concepts for responsible consumption behaviours that are aligned with societal expectations concerning the fight against climate change, biodiversity loss or atmospheric and land system changes are required.

The main tasks of the RTF, together with the required deliverables, are shown in following graphical summary (figure 1).

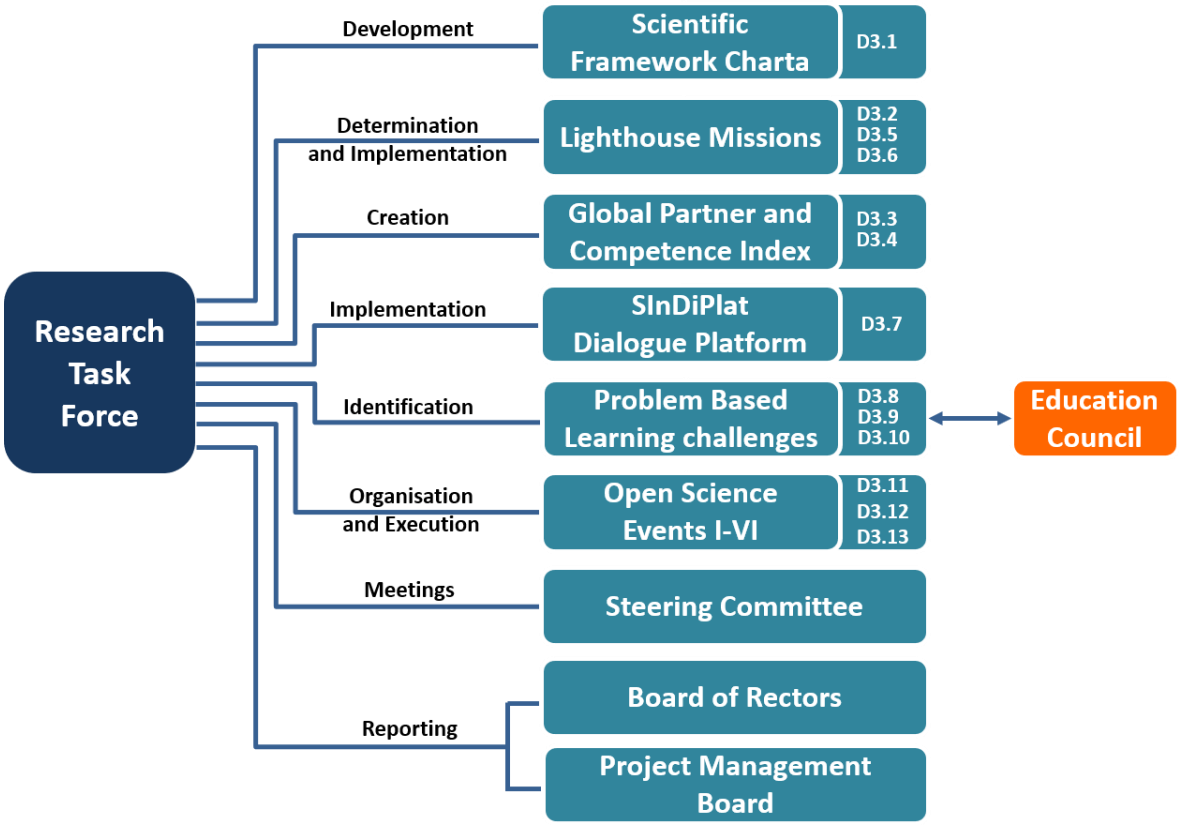
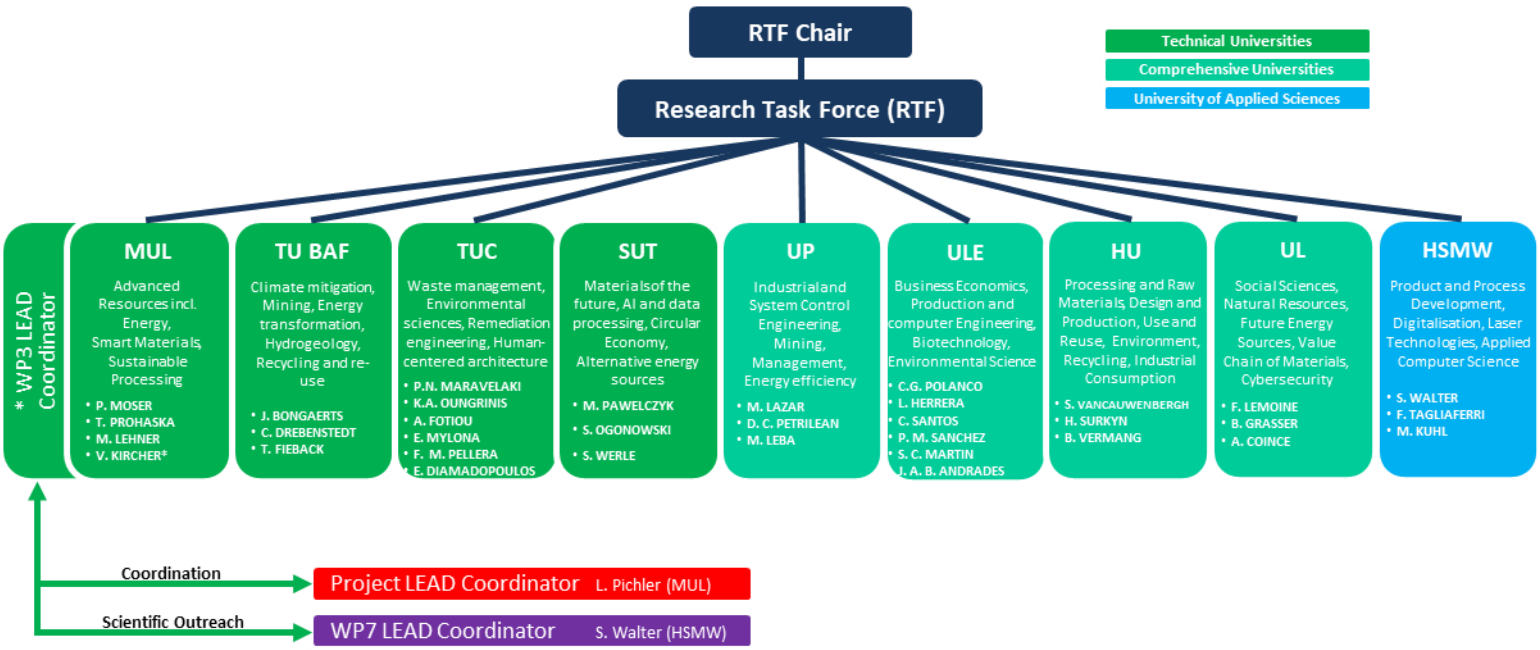


Figure 1: Deliverables and main tasks of the Research Task Force

The RTF develops the general framework of the research organization, defines and implements the topical lighthouse missions, forms global knowledge alliances for collaboration, and defines educational problem-based learning challenges. The RTF installs a digital Societal Dialogue Platform that serves as information, communication and activity interface between EURECA-PRO and civic society. Citizens and companies can contribute to research and society will benefit from the outcomes. Close cooperation and exchange will be achieved by actively involving citizens in regular open science events.

2.2.1 Interorganisational chart



The interorganisational chart (figure 2) delineates the composition of participating individuals in the Research Task Force and their affiliated institutions with according professional expertise. In this illustration communication flows and roles and responsibilities are highlighted as well.

Figure 2: Interorganisational chart of the Research Task Force

The RTF consists of at least 3 scientists from 9 partner institutions and the WP3 LEAD Coordinator. The RTF members have to elect a Chairperson that manages the RTF activities. One RTF member from each partner is appointed for the Education Interface Task Force. As RTF is subordinated to Work Package 3 – RESEARCH the WP3 LEAD Coordinator will coordinate project specifics with the Project LEAD Coordinator and will communicate scientific results to the WP7 LEAD Coordinator for third mission and external image.

Staff Persons as well as their expertise will be continuously updated in the Chart during the project duration.

2.2.2 Research Task Force staff members

In this section, each EURECA-PRO consortium partner introduces the skills and expertise of the key staff involved in the Research Task Force.

Montanuniversität Leoben (MUL) appoints the following scientists to the RTF:

Univ.Prof. Dipl.-Ing. Dr.mont. Dr.-Ing.E.h Peter MOSER (MUL)

Despite his extensive agenda as vice-rector Univ.-Prof. Dipl.-Ing. Dr.mont. Peter Moser is actively involved in further developing and positioning the Resources Innovation Center Leoben and the EIT Raw Materials activities on an international level through networking in relevant committees and circles. He is further an irreplaceable support through his great project-ideas as well as their initiation. He completed his MSc in Mining Engineering in 1983 and his PhD in 1989. Since 2006 he is the Head of Department of Mineral Resources & Petroleum Engineering and holds the Chair of Mining Engineering & Mineral Economics. In 2011 he was appointed Vice Rector, responsible for International Affairs and University infrastructure. He has written around 130 scientific papers in the field of technical, economical and societal issues of safe and efficient raw materials production and sustainable raw materials supply. He is a certified expert and works as consulter for the mining industry. Through his very active involvement in the European Raw Materials landscape, such as his involvement in the European Innovation Partnership on Raw Materials as member of the High-Level Steering Group or his role as steering committee member in the EIT RawMaterials Community, his research and devotion currently revolve around the societal challenges regarding a sustainable raw material supply of Europe and the globe.

Name of Institution	Montanuniversität Leoben (MUL)
Full Name of Representative	**Univ.Prof. Dipl.-Ing. Dr.mont. Dr.-Ing.E.h Peter Moser**
Position	Head of Chair, Vice Rector of Montanuniversität
Address	Franz-Josef Strasse 18
ZIP Code	AT-8700 Leoben
E-mail	peter.moser@unileoben.ac.at
Phone Number	+43 3842 402 2000
Mobile Phone Number	+43 664 526 7929

Univ.-Prof. Dipl.-Ing. Dr.techn. Thomas PROHASKA (MUL)

Professor Prohaska graduated in Technical Chemistry (Dipl.-Ing.) at the Vienna University of Technology in 1992. Diploma thesis: "In-situ investigations of surface reactions on alkali halides by atomic force microscopy (AFM)". In 1994 he received the "Doctor of Technical Sciences (Dr. techn.)" at the Vienna University of Technology. Dissertation: "Investigation of surface reactions by scanning probe microscopy". He finished both studies with distinction and habilitated (venia docendi) in 2002 for Analytical Chemistry at the University of Natural Resources and Life Sciences, Vienna.

From 1992–1995 he was university assistant at the Vienna University of Technology at the Institute of Chemical Technologies and Analytics. From 1995 until 1998 he worked as Research Assistant at the University of Natural Resources and Life Sciences Vienna, Division of Analytical Chemistry. From 1998–2000 he was scientific researcher at the European Commission Joint Research Center IRMM in Geel, Belgium. In 2000, he returned to the Department of Chemistry at the University of Natural Resources and Life Sciences Vienna. In 2002, Dipl.-Ing. Dr.techn. Thomas Prohaska was appointed Associate Professor and remained so until his move to the Montanuniversität Leoben as full Professor and Head of the Chair of General and Analytical Chemistry at the Montanuniversität Leoben in 2018.

Fields of activity:

Analytical chemistry, development and application of novel methods in materials-, geo-, environmental- and life sciences as well as the implementation of metrological principles, mass spectrometric methods for elemental and isotopic analysis, chemical research and novel technological developments of methods in the combination of analytical chemistry and material science.

Univ.-Prof. Dipl.-Ing. Dr.techn. Thomas Prohaska is the person appointed from MUL for the Education Interface Task Force.

Name of Institution	Montanuniversität Leoben (MUL)
Full Name of Representative	**Univ.-Prof. Dipl.-Ing. Dr.techn. Thomas PROHASKA**
Position	Head of the Chair of General and Analytical Chemistry

Address	Franz-Josef Strasse 18
ZIP Code	AT-8700 Leoben
E-mail	thomas.prohaska@unileoben.ac.at
Phone Number	+43 3842 402 1200

Univ.-Prof. Dipl.-Ing. Dr.-Ing. Markus LEHNER (MUL)

Univ.-Prof. Dipl.-Ing. Dr.-Ing. Markus Lehner holds a degree in mechanical engineering with specialisation in process engineering from the Technical University of Munich. In 1996, he completed his doctorate at the Chair A for Thermodynamics at the TU Munich on the topic of "aerosol separation in Venturi scrubbers in self-priming operation". He worked as a postdoctoral researcher at the same chair until 1998. From 1999–2010 he worked with RVT Process Equipment GmbH (previously Rauschert Verfahrenstechnik GmbH) in Steinwiesen, Germany. Past position: Head of sales, engineering and construction. Since October 2010 he is full Professor and Head of the Chair of Process Engineering for Industrial Environmental Protection.

Fields of activity:

Energy process engineering, recycling processes for industrial wastes, integration and chemical storage of renewable energy, thermal cracking, catalytic processes for CO_2 utilisation, power-to-gas, industrial gas cleaning processes (mainly absorption).

Name of Institution	Montanuniversität Leoben (MUL)
Full Name of Representative	**Univ.-Prof. Dipl.-Ing. Dr.-Ing. Markus LEHNER**
Position	Head of the Chair of Process Technology and Industrial Environmental Protection
Address	Franz-Josef Strasse 18
ZIP Code	AT-8700 Leoben
E-mail	markus.lehner@unileoben.ac.at
Phone Number	+43 3842 402 5000

Dipl.-Ing. Dr.mont. Volkmar KIRCHER (MUL)

Dipl.-Ing. Dr.mont. Volkmar Kircher studied Building Materials and Ceramics at the

Montanuniversität Leoben. After the graduation he became university assistant at the Chair of Ceramics at MUL and was engaged in research activities, project management of funded (COMET[7], FFG[8]) research projects, as well as bilateral industrial projects, and teaching. In 2017, he completed his doctorate on the topic "Investigation of melting-, dissolution- and crystallization behaviour in oxidic-siliceous systems". The research mainly focused on corrosion of refractory materials in silicate slags, continuous casting of steel, crystallization of slags and high-temperature measurement devices. In addition to project work, Dr. Kircher has been involved in the public relations team of the Department of Mineral Resources Engineering and in Curriculum Commissions. In the context of these activities, he contributed to the cooperation between the MUL and the Wuhan University of Science and Technology (WUST) by establishing a Joint Double Degree Programme "International Master in Building Materials and Ceramics" at MUL. He is currently active in the Curriculum Commission for Circular Engineering and Responsible Consumption and Production at the Montanuniversität Leoben, working on joint EURECA-PRO studies. In EURECA-PRO he is coordinating the Research Work Package and supports education. He contributes in scientific conferences, publishes SDG12 related work and coordinates the Research Agenda including the Research Task Force, the Research Lighthouse Mission Groups as well as the Open Access Team.

Research areas: melting-, dissolution- and crystallization of slags, continuous casting of steel, ceramics, refractory corrosion, laboratory measuring equipment, responsible consumption and production, green technology, Sustainable Development Goals (SDGs).

Name of Institution	Montanuniversität Leoben (MUL)
Full Name of Representative	**Dipl.-Ing. Dr.mont. Volkmar KIRCHER**
Position	Senior Scientist, EURECA-PRO: WP3 Lead Coordinator Research
Address	Franz-Josef Strasse 18
ZIP Code	AT-8700 Leoben
E-mail	volkmar.kircher@unileoben.ac.at
Phone Number	+43 3842 402 7245
Mobile Phone Number	+43 664 80898 7245

[7] Competence Centers for Excellent Technologies
[8] Austrian Research Promotion Agency (FFG)

Technische Universität Bergakademie Freiberg (TU BAF) appoints the following scientists to the RTF:

Prof. Carsten Drebenstedt (TU BAF)

Carsten Drebenstedt is since 1999 Professor for Surface Mining and was from 2000 to 2006 vice-rector for research, from 2013 to 2016 dean of the faculty of geoscience, geoengineering and mining, and actual member of the Senat and director of the institute for mining and special civil engineering at Technical University Freiberg. Before he starts his career at university, he worked 17 years since 1982 in different positions in production and planning departments in German mining industry and was member of the board of an Engineering and Consulting Company. Fields of teaching and research activities are mine planning, mining technologies and ecology in mining, reclamation, and mine water management. Carsten Drebenstedt initiated three international Master programs with actual 250 students from 40 countries. He is study dean, head of study and examination commissions of these programs and invited lecturer e.g. in Kazakhstan, Kenia, Laos, Namibia, Mongolia, Russia, and involved in accreditation missions for geology/mining related study programs in Romania and Kazakhstan. He participates in the establishment/ modernisation of mining schools in Kenia, Mongolia and Afghanistan. Professor Drebenstedt supervised 40 PhD students completing their thesis´s and reviewed another 20 theses He worked in more than 80 scientific, educational and industrial projects. Up to know he has organised 60 national and international conferences and published 17 books in German, Mongolian and Russian languages. Furthermore, he issued 70 proceedings and more than 430 papers in scientific journals, conference-proceedings and university publications. Carsten Drebenstedt is member of the Society of Mining Professors (SOMP), where he represents Europe from 2006 up to 2015 in the council, member of the national and international organizing committees of the Word Mining Congress, member of the International Mine Water Association, and Secretary General of the World Forum of Resource Universities on Sustainability (WFURS). He is member of the Saxonian academy of sciences and international scientific academies. He is 6-times honour PhD in Russia, Ukraine, Romania, and Bulgaria, honour professor in Mongolia

and Russia, honour geologist of Mongolia, honour miner of Vietnam and held the “award of merit” of the Vietnamese minister of science.

Prof. Jan Bongaerts (TU BAF)

Prof. Jan Bongaerts is emeritus professor of environmental and resources management. He has experience in environmental sciences, renewable energy technologies economics of renewable energy, mining and environment etc. He currently teaches mining economics, mine planning, financing of mining operations and mining and stakeholder analysis and management. He contributes to an international project on the establishment of a School of Mining Engineering and Minerals Process Engineering at a University in – “DAAD African Centre of Excellence for Mining, Environmental Engineering and Resource Management (CEMEREM)”.

Prof. Tobias Fieback (TU BAF)

He is a full Professor for Technical Thermodynamics and director of the institute for heat technology and thermodynamics since 2015, head of the competence center DBI: Bergakademie since 2015, head of the scientific diving center since 2017 and dean of the faculty of mechanical, process and energy engineering since 2019 as well as CO international strategic alliances since 2022. He worked in more than 20 projects, organized 8 international and national conferences and has about 30 peer reviewed papers.

University of Petroşani (UP) appoints the following scientists to the RTF:

Professor PhD eng. Maria LAZAR (UP)

Professor PhD eng. Maria Lazar is PhD supervisor in the field of Mine Petroleum and Gas. Teaching and project coordination disciplines: Restoration and reconstruction of degraded land; Human impact on the environment; Stability of slopes and slopes; Hydrology and Hydrogeology Research in the field of mining and environmental engineering. Organizational capacity and leadership of research projects and international conferences, gained as national and international project manager.

Professor Maria Lazar is the main contact person from UP for the WP3 LEAD Coordinator.

Name of Institution	University of Petrosani
Full Name of Representative	**Professor PhD eng. Maria LAZAR**
Position	Vice Rector of University of Petrosani
Address	University street, no. 20
ZIP Code	RO-332006 Petrosani
E-mail	marialazar@upet.ro
Phone Number	+40 2545 42580
Mobile Phone Number	+40 7665 625934

Prof. Dan Codrut PETRILEAN (UP)

Professor PhD. engineer, PhD supervisor in the field of Industrial Engineering, Director in 27 grants, national and international projects, author and co-author of paper in scientific journals with impact factor and SRJ, monographs, handbooks. His scientific career focuses on thermotechnics and thermal machines, thermal engines, thermal balance sheet and energy efficiency, having Certificate of habilitation in Industrial Engineering, since 2017. He is part of the scientific committee of national and international journals, and he has participated as plenary speaker, chair in prestigious conferences and workshops. He currently holds the position of Vice Rector for European Projects, partnerships with the economic environment, institutional promotion and admission. He holds the position of Director of the Centre for International Relations and European Development at the

University of Petrosani for 3 years. He supervised 3 successfully completed PhD theses and is taking care of 5 others.

He has been an authorized energy auditor since 2006, being member of Association of energy auditors from Romania, as well. In the energy auditor contracts, he provided over 60 technical solutions to improve the energy efficiency, verified and applied by the beneficiaries for the analyzed energy installations.

Name of Institution	University of Petrosani
Full Name of Representative	**Professor PhD eng. Dan Codrut PETRILEAN**
Position	Vice Rector
Address	University street, no. 20
ZIP Code	RO-332006 Petrosani
E-mail	danpetrilean@upet.ro
Phone Number	+40245542580
Mobile Phone Number	+400721373261

Prof. Monica ELBA (UP)

Professor PhD. engineer and PhD supervisor in the field of System Control Engineering, with research results in design and control of robotic systems for medical, industrial or entertainment applications, of automotive systems for electrical autonomous drive vehicles developments, visible light communication systems for industrial or domestic applications, unconventional human-machine interfaces, like brain communication. She is the Director of the Grants for many research contracts and patent holder.

Name of Institution	University of Petrosani
Full Name of Representative	**Professor PhD eng. Monica ELBA**
Position	?
Address	University street, no. 20
ZIP Code	RO-332006 Petrosani
E-mail	monicaleba@upet.ro
Phone Number	+40245542580
Mobile Phone Number	+40743172975

University of León (ULE) appoints the following scientists to the RTF:

Professor Dr. Liliana HERRERA (ULE)

Dr. Liliana Herrera is an Associate Professor at ULE in Spain, she has extensively worked in the R&D policy effects evaluation as well as in the area of scientific knowledge transfer. Since 2002 she has been working at the Department of Business Administration of the Faculty of Economics and Business Administration of the ULE, where she obtained her PhD in Business Administration. Her research is geared towards estimating the effects of public instruments supporting industrial innovation. She has published several papers indexed in the Journal Citation Reports that reveal the importance of public support to stimulate the innovative activity of firms. She has evaluated several public support instruments that range from R&D subsidies to mobility of human resources in science and technology. She has evaluated the impact of these instruments on the innovation behaviour of firms. Liliana Herrera has worked with several data sources and she has evaluated R&D programmes at regional, national and European levels. In particular, she has analysed the interactions between instruments taking into account firm size, firm location and the industry. Her most recent research focuses on scientific knowledge transfer from the R&D public system to the industry through assessing the mobility of researchers. She analyses how firms take advantage of the knowledge and skills embodied by theses human resources, as well as their roles played in the innovation process of firms. She has participated actively in more than 20 competitive research projects.

Dr. Liliana Herrera is the main contact person from ULE for the WP3 LEAD Coordinator.

Name of Institution	Universidad de León
Full Name of Representative	**Dr. Liliana HERRERA**
Position	Associate Professor
Address	Avenida de la Facultad, 25
ZIP Code	ES-24004 León
E-mail	liliana.herrera@unileon.es
Phone Number	+34 987 293485

Dr. Pilar MARQUÉS-SÁNCHEZ (ULE)

Dr. Pilar Marqués-Sánchez is currently the Head of the Ponferrada Campus of ULE. This role includes responsibility for infrastructures and academic, research and internationalisation proposals. She also has to plan the cultural and sporting activities that makes the campus more dynamic.

Her academic background includes: Degree in Nursing, Master in Health Legislation, Master in Health Management, Doctorate in Business Organisation in Economics and Business Administration from ULE.

She has worked for 14 years in different hospitals. She has been a lecturer at ULE for 21 years and teaches in the Degree in Nursing, in the Master of Research in Social and Health Sciences and in the Doctorate Programme in Health and Human Motricity.

Regarding research, she leads an interdisciplinary and international group: SALBIS Research Group. The group is oriented to the health and well-being of the person including technology in a citizen-friendly way.

Dr. Pilar Marqués-Sánchez main research topic is Social Network Analysis, a mathematical methodology that analyses contacts between people both face-to-face and digitally. She was trained at the College of Gatton (USA). Her post-doctoral research stays were at the Institute for Population Health and the School of Social Sciences (University of Manchester). She has been a visiting lecturer at the Mitchell Centre for Social Network Analysis (University of Manchester) and the School of Health Science (University Southampton). She has also carried out an international cooperation stay in São Tomé de Príncipe with the aim of establishing institutional contacts with the university.

She is a reviewer of research journals and a member of several national and international networks.

Name of Institution	Universidad de León
Full Name of Representative	**Dr. Pilar MARQUÉS-SÁNCHEZ**
Position	Head of Campus de Ponferrada, University of León
Address	Avenida de la Facultad, 25
ZIP Code	ES-24004 León
E-mail	pilar.marques@unileon.es
Phone Number	+34 987 442045

Professor Dr. Carmen RODRÍGUEZ SANTOS (ULE)

Carmen Rodríguez Santos, Professor at ULE, Research Fellow at Leeds Beckett University (UK), Adjunct Professor at University of Vaasa (Finland), Professor Visitor at IAE (France) and the University of Kassel (Germany). She is also Professor in various Private Business Schools (such as ESIC) and key speaker in international conferences.

Professor Dr. Carmen Rodríguez Santos has coordinated several international projects as well as has taken part as partner in Strategic Alliances and Seventh Programmes. Now she coordinates a European Project on Brand Management. She is also a Referee for several scientific journals and congresses.

Furthermore, Prof. Rodríguez Santos shows her research outputs through 19 publications in national and international indexed journals. She has also written 5 books and has contributed chapters in 15 books.

In addition to her engagement in academic and scholarly pursuits, she has considerable and recognized professional experience in consultancy in private companies, in the areas of Brand management, B2C Engaging Communication and Consumer Insights.

Name of Institution	Universidad de León
Full Name of Representative	**Dr. Carmen RODRÍGUEZ SANTOS**
Position	Professor
Address	Avenida de la Facultad, 25
ZIP Code	ES-24004 León
E-mail	carmen.santos@unileon.es
Phone Number	+34 987 293481

Vice-Rector Associate Professor Dr. Carlos G. POLANCO DE LA PUENTE (ULE)

Dr. Carlos G. Polanco de la Puente is Vice-Rector for Research and Transference since November 2018 and was Head of the Department of Molecular Biology from May 2014 to May 2018, and the Director of Research Institutes and Services at the Vice-Rectorate for Research of the ULE from June 2018 to November 2018. He is Associate Professor of Genetics at ULE since 2001, PhD in Biology.

His teaching activity is currently focused in the Degrees of Biology, Biotechnology and Environmental Sciences, as well as in the Master in "Research in Fundamental Biology and Biomedicine" and he has participated in a teaching innovation project. He has been Coordinator of the Degree in Biology and Coordinator of the Doctoral Programme in "Molecular Biology and Biotechnology".

His research work has been developed mainly in the field of Plant Genetics, having participated in more than twenty research projects supported by the European Union, the Spanish D.G.I.C.Y.T., ITACyL of Castilla y León (Spain) and the NERC[9] of the United Kingdom, being a principal investigator in projects of the MINECO (Spain) and Junta de Castilla y León (Spain). The results have been reflected in the publication of more than forty scientific articles in prestigious journals and the presentation of more than fifty communications in national and international conferences. He has directed four doctoral theses as well as dissertations and end-of-studies projects. He has supervised doctoral theses, post-graduate student projects to obtain the DEA title previous to PhD degree, and final projects of pre-graduate students.

Name of Institution	Universidad de León
Full Name of Representative	**Dr. Carlos G. POLANCO DE LA PUENTE**
Position	Vice-Rector for Research and Transfer, Associate Professor
Address	Avenida de la Facultad, 25
ZIP Code	ES-24004 León
E-mail	vice.investigacion@unileon.es
Phone Number	+34 9872 91637

Dr. Sheila GARCÍA MARTÍN (ULE)

Dr. Sheila García Martín holds a PhD in Educational Psychology and Education Sciences from ULE and she is Lecturer in Didactics and School Organization area at ULE.

Author of various articles such as Use of digital tools for teaching in Spain during the COVID-19 pandemic (2021), Teachers 3.0: Patterns of use of five digital tools (2019) or Use of technologies and academic performance in

[9] Natural Environment Research Council

adolescent students (2019) among others. She has also published book chapters such as Evidence-Based Practice and improvement plans in educational centers (2021) or University teaching innovation: Use and application of Educaplay (2020). Her main research lines focus on the use of digital tools for knowledge management at schools and about the influence of such use on students' academic performance. All her publications can be found in the following link: https://bit.ly/39PqDm0.

She has participated in International Conferences and Seminars, and she has attended training courses about educational and organizational innovation in schools, as well as on teacher training. She has collaborated in European projects such as Apprentissage Hybride Mutualisé et Ouvert dans les Universités Marocaines –MARMOOC-. Erasmus+ Capacity building in Higher Education (EAC/A04/2015). Currently, she participates in a National Project: PRUNAI (PRofesorado UNiversitario y Aprendizaje Intergeneracional, 2020–2023).

She is part of expert committee of the accreditation programme: ACREDITA (bachelor's and master's degrees) of ANECA, as well as of the Paulo Freire + academic mobility programme of the Organization of Ibero-American States. Also, she is reviewer of Sustainability, Comunicar, Sensors, Education Sciences journals, among others.

Dr. Sheila García Martín is the person appointed from ULE for the Education Interface Task Force.

Name of Institution	Universidad de León
Full Name of Representative	**Dr. Sheila GARCÍA MARTÍN**
Position	Lecturer
Address	Avenida de la Facultad, 25
ZIP Code	ES-24004 León
E-mail	sgarcm@unileon.es
Phone Number	+34 987 29 3621

Prof. Dr. José Alberto Benítez-Andrades (ULE)

Jose Alberto Benítez-Andrades received the B.S. degree in Computer Engineering and PhD in Production Engineering and Computing from the University of León, Spain, in 2010 and 2017 respectively. He is Associate Professor at the University of León. His research is related to the application of artificial intelligence techniques, knowledge

engineering and social network analysis applied mainly to problems related to the field of health. He has more than 40 publications indexed in JCR, 30 communications in international conferences, is associate editor of the journal BMC Medical Informatics and Decision Making, PeerJ Computer Sciences, has organized several international conferences since 2018 and is an evaluator of international projects for the government of Spain and Peru. In EURECA-PRO Prof. Benítez-Andrades is part of the Research Work Package (WP 3). He contributes to scientific conferences, publishes papers related to SDG12 and works on the different tasks of other Work Packages such as the one related to the Research Agenda.

Key specialities:

1. **Data processing**: specialising in the processing and curation of all types of data for experiments related to artificial intelligence.
2. **Artificial intelligence:** creation and application of machine learning models for classification or regression tasks in different fields. Specially in natural language processing problems.
3. **Social Network Analysis:** application of the methodology of social network analysis with data in the form of matrices and attributes to study organisations or personal networks from a network perspective, not an individual one.
4. **Knowledge Engineering:** application of knowledge engineering techniques obtaining knowledge from structured data as knowledge graphs.

Name of Institution	Universidad de León (ULE)
Full Name of Representative	**Prof. Dr. José Alberto Benítez-Andrades**
Position	Associate Professor
Address	Campus de Vegazana s/n
ZIP Code	Universidad de León
E-mail	C.P. 24071, León (Spain)
Phone Number	jbena@unileon.es
Mobile Phone Number	+34 987 29 3628

Technical University of Crete (TUC) appoints the following scientists to the RTF:

Professor Pagona-Noni MARAVELAKI, PhD (TUC)

Professor Pagona-Noni Maravelaki (Scopus Author ID: 6603617131, ORCID: 0000- 0002-8776-6695) is Professor in the Architecture School at TUC, teaching materials and techniques used for building and monument conservation. She holds a Degree in Chemistry from National Kapodestrian University of Athens/Greece (1983) and a PhD from the Department of Environmental Science, Ca' Foscari University of Venice/Italy (1992). She was employee of the Hellenic Ministry of Culture (1997-2008).

She has 33 years of experience on issues regarding the deterioration and conservation of monumental cultural heritage. Invited specialist in the European Committee for Standardization CEN, in the COST G7 Artworks Conservation by Laser, in TD COST Action TD1406 MC Substitute Innovation in Intelligent Management of Heritage Buildings (i2MHB), in Conferences and specific Workshops. She is the author of 50 publications in peer reviewed journals, 14 chapters in books, 20 publications in periodical books, 80 publications in Proceedings of Conferences, 1 Greek Patent (OBI). Number of citations 1458, h = 20, source Scopus. Number of citations: 2226, hindex = 23, i10-index = 40, source Google Scholar. She currently coordinates two European projects on the use of nano-materials for the amelioration of properties of construction materials. She has participated in national and European research projects (one Horizon 2020, one international competition) as project leader (25), principal investigator (15) and as a member of the project team (9). She acts as reviewer in 12 international journals. She has supervised 10 master's degree and 5 PhD theses.

Research areas:

Study of built heritage, more specifically the weathering mechanisms and stone decay forms; Technology of historic mortars, pigments and ceramics; Cleaning techniques of deteriorated stone surfaces ranging from conventional chemical cleaning to laser cleaning and nanogels; Assessment of cleaning with micro-destructive and nondestructive analytical techniques; Application and assessment of nondestructive spectroscopic techniques for the study of

historic building materials; Development of eco-friendly and energy efficient plasters and paints for building envelope; Development and characterization of novel self-cleaning nanocomposites for the conservation and protection of historic monuments; Development of innovative multi-functional materials (mortars, hydrophobic coatings, strengthening) for building and monument protection; Development of antimicrobial coatings for buildings; Development of anticorrosive materials for concrete protection.

Professor Pagona-Noni Maravelaki is the main contact person from TUC for the WP3 LEAD Coordinator.

Name of Institution	Technical University of Crete
Full Name of Representative	**Pagona-Noni MARAVELAKI, PhD**
Position	Professor, School of Architecture
Address	Chania
ZIP Code	EL-73100
E-mail	pmaravelaki@isc.tuc.gr
Phone Number	+30 28210 37661
Mobile Phone Number	+30 69733 07066

Professor Konstantinos-Alketas OUNGRINIS, PhD (TUC)

His work on dynamic, human-centered architecture involves research on kinetic structures, smart materials and responsive control systems for the creation of intelligent environments that can respond actively with 'sense' to the needs and wishes of people. His research specializes in transformable environments, activity-based design methods, time-space relationships, user-experience design, digital media and cultural heritage, educational environments, and spaces within extreme environmental conditions. He has developed two specific approaches for the successful implementations of IT in design titled Spatial Economy and Sensponsive Architecture. His thematic areas of study are interdisciplinary, rooted in the field of architecture and from there on branching out mainly into the domains of psychology, neuroscience, interactive media, robotics, and computer science. He is the Principal Investigator at 37 research programmes and 26 pilot research programmes.

He has 6 book publications and is the author of 74 book chapters, journals, and papers. He also writes sci-fi novels. In 2008 he received the Europe 40 under 40 Architecture Award and has received since then 14 more national and international awards and distinctions.

He holds an Architect Engineer degree from the Aristotle University of Thessaloniki (1994) and received his Doctoral Degree at the same university, under the title "Structural Morphology and Kinetic Structures for Transformable Spaces (2009). During 2004–2006 he was a Visiting Research Associate at the Harvard Graduate School of Design [GSD].

Research areas:

Transformable environments; activity-based design methods; time-space relationships; user-experience design; digital media and cultural heritage; educational environments, and spaces within extreme environmental conditions.

Name of Institution	Technical University of Crete
Full Name of Representative	**Prof. Konstantinos-Alketas OUNGRINIS, PhD**
Position	Professor,
Address	Chania
ZIP Code	EL-73100
E-mail	kouggrinis@isc.tuc.gr
Phone Number	+30 28210 37128

Afroditi FOTIOU, Civil Engineer M.Sc. (TUC)

Afroditi Fotiou, M.Sc., is a Civil Engineer, graduate of the National Technical University of Athens (NTUA), Greece (2007) with postgraduate studies M.Sc. "Energy efficiency in the building sector" from the Technical University of Munich (TUM), Germany (2010) and M.Sc. "Integrated protection of historically built environment" from the Technical University of Crete (TUC), Greece (2018).

She was a research associate in the Chair of Bioclimatic Architecture and Building Systems (Lehrstühl für Bauklimatik und Haustechnik) of the Architecture Department of the TUM under the scientific supervision of Professor Gerhard Hausladen (10.2008-07.2009), occupied with research projects of energy planning for municipalities and communities focusing on RES and energy efficiency. She worked in the consulting company Büro Happold Berlin in the Department of Sustainable Development directed from Dr. Susan Draeger (10.2009-07.2010),

occupied with green building certificates (BREEAM, LEED, DGNB) and energy planning in building and urban scale and was responsible for the company's ISO 14001 environmental management certification. She was a research associate in the Laboratory of Renewable and Sustainable Energy Systems of the School of Environmental Engineering of TUC under the scientific supervision of Professor Theocharis Tsoutsos (02.2014-06.2017), providing administrative and technical support in the European Projects: Green Partnerships (MED), RecOil (IEE), NEZEH (IEE) und UPSWING (IEE) dealing with RES, energy efficiency and sustainable energy planning. Afroditi Fotiou also worked as a research associate in the Laboratory of Materials for Cultural Heritage and Modern Building of the School of Architecture of TUC with scientific responsible Professor Pagona Maravelaki (12.2018-12.2020). Her research duties in this position involved technical, laboratory and administrative support for the European Programme Horizon2020: 'Innovative materials and techniques for the conservation of the 20th century concrete-based cultural heritage' (2018-2020), for the research programme "Development of ecological construction materials from natural resources of Gavdos island" and in the research projects dealing with analysis of ancient mortars and design of compatible repair mortars: "Venetian castle in Hora Sfakion" and "Ottoman Medrese of the Castle of Mytilini".

In EURECA-PRO Afroditi Fotiou holds the position of Academic Affairs Coordinator. She is a member of the Education Council and Research Task Force and the representative of TUC in the Open Access Team of EURECA-PRO. She is responsible for the development and implementation of training activities in the field of Innovation & Entrepreneurship and assists the activities related to Lighthouse #3 'Sustainable Materials and Products'.

Research areas: integrated protection of Cultural Heritage with use of traditional and innovative materials and technologies, restoration mortars, calcined clays, mineral pigments, energy efficiency of modern and historical buildings, responsible consumption and production, Sustainable Development Goals (SDGs).

Name of Institution	Technical University of Crete (MUL)
Full Name of Representative	**Afroditi Fotiou, Civil Engineer M.Sc.**
Position	EURECA-PRO: Academic Affairs Coordinator
Address	TUC University Campus, Kounoupidiana,
ZIP Code	73100, Chania, Greece

E-mail	afotiou@tuc.gr
Phone Number	+30 28210 37090
Mobile Phone Number	+30 697 4209982

Dr. Evan DIAMADOPOULOS (TUC)

Dr. Evan Diamadopoulos is Professor Emeritus and Former Rector of the Technical University of Crete. Prof. Diamadopoulos received a Diploma in Chemical Engineering from the Aristotle University of Thessaloniki, Greece (1978), and a M.Eng. and PhD in Chemical Engineering from McMaster University, Canada (1982 and 1985, respectively). From 1987 till 1990 he was a member of the Research Staff of the Chemical Process Engineering Research Institute, Thessaloniki, Greece, while in September 1990 he joined the Technical University of Crete. Currently, he is Professor Emeritus in the School of Chemical and Environmental Engineering. During the period December 2017 to August 2022, he served as the elected Rector of the Technical University of Crete. His area of academic interest is Environmental Technology with emphasis on water quality, water and wastewater treatment and waste valorization. For his research he has received funding from the European Commission, the General Secretariat for Research and Technology Hellas, the Greek Ministry of Education, the Regional Government, and the private sector. He has published 99 papers in international journals and his work has been cited 8500 times (h-index 45) according to Google Scholar.

Prof. Diamadopoulos is currently active in the EURECA-PRO Alliance being a member of TUC's Steering Committee and the main coordinator for the overall academic and organizational activities.

Research areas: Identification and removal of emerging contaminants from water and wastewater; Biomass valorization through pyrolysis for production of biochar intended for agronomic and environmental applications.

Name of Institution	Technical University of Crete (TUC)
Full Name of Representative	**Dr. Evan DIAMADOPOULOS**
Position	Former Rector and Professor Emeritus; EURECA-PRO: TUC Steering Committee Member
Address	
ZIP Code	

E-mail	University Campus, Chania, Greece
Phone Number	GR-73100
Mobile Phone Number	ediamantopoulos@tuc.gr +30 28210 37795 +30 6944 779874

Dr. Eleni Mylona (TUC)

Eleni Mylona joined the team of the Technical University of Crete (TUC)-European University on Responsible Consumption and Production (EURECA-PRO) as a member of the Education Council, October 2022. Also, she is an Adjunct Assistant Professor of Biology at the University of Maryland Global College at Souda Bay, Crete, Greece, since September of 2010. Prior, she held an Adjunct Scientist position, following a Post-Doctoral Fellow position, at the Institute of Applied and Computational Mathematics, Heraklion, Crete, Greece, and a Post-Doctoral Fellow position at the Department of Pharmacology and Chemical Biology at Emory University School of Medicine, Atlanta, GA, USA, from 2005 to 2008 and 2003 to 2005, respectively. She earned her Doctoral degree in Applied Physiology, with a minor in Cell/Molecular Biology and her Master's degree in Exercise Science, both with distinction, from the Department of Exercise and Rehabilitation Sciences, The University of Toledo, Toledo, OH, USA in 2003 and 1998, respectively. Her undergraduate degree (B.Sc.) in Physical Education and Exercise Science was completed with distinction at the Department of Physical Education and Sports Sciences at the Democritus University of Thrace in Komotini, Greece, in 1996. Her research has been focused on the cellular and molecular mechanisms that dictate cell movement in skeletal muscles inflammation and repair as well as the mechanical and chemical cues that affect cancer cell metastasis. She has taught a number of lecture and laboratory classes in Biology and Physiology, both at the undergraduate and graduate level at The University of Toledo and Emory University. Since 2010, she has been teaching online and in-person undergraduate Biology classes for the University of Maryland Global Campus, at Souda Bay, Crete, Greece. She has received the "Outstanding Teaching Award" for three consecutive years (2019 to 2022), while she has been a nominee for the "Drazek Teaching Excellence Award" for faculty

at UMGC (2013). Her published research work includes 10 journal papers and according to Google Scholar, has been cited more than 700 times by other researchers (h-index: 10).

Research areas: Cell and Molecular Biology; Research Methods; Health Education; Health Promotion; Sustainable Healthy Lifestyle

Name of Institution:	Technical University of Crete
Full Name of Representative:	**Eleni Mylona, Ph.D.**
Position:	Research Scientist; Education Council member
Address:	Building K4.A2, Technical University of Crete Chania, Crete, Greece
ZIP Code:	73100
E-mail:	emylona@tuc.gr
Phone Number:	+30 28210 37820
Mobile Phone Number:	+30 6937 921953

Frantseska-Maria PELLERA, Environmental Engineer, Ph.D., M.Sc. (TUC)

Frantseska-Maria Pellera is an Environmental Engineer, Ph.D., M.Sc., with experience in academic research on management, treatment and valorization of solid organic waste, removal of contaminants from water and wastewater, and soil remediation, using waste-derived adsorbents and amendments.

She graduated with honours from the School of Environmental Engineering of the Technical University of Crete in Greece in 2010, receiving her Diploma in Environmental Engineering. In 2011, she obtained her M.Sc. Diploma in Environmental and Sanitary Engineering, while in 2017, she obtained her Ph.D. Diploma in Environmental Engineering, also from the same School. During her studies, she has been awarded many scholarships, and specifically during her doctoral studies, she had the honour of being a scholar of the 'Alexander S. Onassis' Public Benefit Foundation.

Dr. Pellera has worked as a Postdoctoral researcher at the School of Environmental Engineering of the Technical University of Crete in Greece, and as a Postdoctoral fellow at the Research group of Waste Science and Technology, at the Department of Civil, Environmental

and Natural Resources Engineering of Luleå University of Technology in Sweden. Currently, she works on Research management in EURECA-PRO.

Research areas: agroindustrial waste/by-products, municipal (solid) waste, treatment and valorization of solid waste for energy and added-value materials recovery, anaerobic digestion of solid organic waste/by-products, pretreatment of solid organic waste/by-products, pyrolysis, hydrothermal treatment, biochar production from waste/by-products and environmental applications (removal of contaminants from water/wastewater, metals immobilization in contaminated soils), removal of contaminants from water/wastewater using non-conventional adsorbents (e.g. lignocellulosic biomass, waste biomass, etc.), landfill technology, valorization of waste/by-products as solid fuels, circular economy.

Name of Institution	Technical University of Crete (TUC)
Full Name of Representative	**Frantseska-Maria PELLERA, Environmental Engineer, Ph.D., M.Sc.**
Position	Staff in Research management
Address	TUC Campus, Chania, Crete, Greece
ZIP Code	73100
E-mail	fpellera@tuc.gr
Phone Number	
Mobile Phone Number	

Silesian University of Technology (SUT) appoints the following scientists to the RTF:

Prof. Marek PAWELCZYK, DSc, PhD (SUT)

He is a Full Titular Professor at SUT and holds the position of Vice Rector for Science and Development, and Head of the Department of Measurements and Control Systems. He gained professional experience at a number of universities in Germany, UK, and Denmark. He was elected President of the International Institute of Acoustics and Vibration, which is an international scientific society with 25-years tradition and members from about 70 countries. For recent 11 years he has been organising international congresses in different countries with participation of 700–1300 delegates from over 50 countries. He was a member of over 60 scientific committees of international congresses and conferences and chaired over 60 scientific sessions. He delivered 20 invited lectures at international

conferences or foreign universities. He is the Managing Editor of a JCR recognised journal and member of the Editorial Board of several journals. He was reelected to the Committee on Automation and Robotics and to the Committee on Acoustics of the Polish Academy of Sciences. He is also a member of three scientific committees of the International Federation of Automatic Control. He is the Chair of the Chapter of Ambassadors of Congresses for Poland. He is an author of about 220 papers, 3 books in English, 10 user manuals, and 9 patent applications. He supervised 5 successfully completed PhD theses and is taking care of 3 others. He headed 5 competitive and 15 collaborative projects. For his research he received many prizes, including FIAT and SIEMENS. Many of his achievements in that field have been commercialised. Among them there are over 1000 sold licences of localisations of SCADA – supervisory control and data acquisition systems.

Research areas: Automation systems including raw materials recovery enhancement via integration of innovative technologies, developing an innovative installation of dry and watered grinding of minerals with application of an electromagnetic mill, and innovative noise barriers.

Name of Institution	Silesian University of Technology
Full Name of Representative	**Prof. Marek PAWELCZYK, DSc, PhD**
Position	Vice Rector for Science and Development
Address	Akademicka 2A
ZIP Code	PL-44-100 Gliwice
E-mail	Marek.Pawelczyk@polsl.pl
Phone Number	+48 3223 72453
Mobile Phone Number	+48 6064 88695

Prof. Dr. hab. Eng. Sebastian WERLE, PhD (SUT)

He is an Associate Professor at the Faculty of Energy and Environmental Engineering of SUT and the Head of the Laboratory of the Renewable Energy Sources. He is a Faculty Vice Dean for Cooperation and Development and the Coordinator of the Priority Research Area Climate and Environmental Protection, Modern Energy. He has participated extensively as a partner and coordinator in European and national research projects and has published over 300 papers in peer-reviewed journals. He is a Member of the Polish Section of the Combustion and Thermodynamics Committee Polish Science Academy and

Polish Section of the Combustion Institute, Member of the Asia-Pacific Chemical, Biological and Environmental Engineering Society and World Academy of Science, Engineering and Technology. He is an editorial board member of: Journal of Power Technologies, International Journal of Energy and Power Engineering and International Journal of Waste Management and Technology.

Research areas: His field of expertise covers subjects related to thermal treatment of biomass and waste, low emission combustion, alternative energy sources

Name of Institution	Silesian University of Technology
Full Name of Representative	**Prof. Dr. hab. Eng. Sebastian WERLE**
Position	Ass. Prof. at the Faculty of Energy and Environmental Engineering
Address	Akademicka 18
ZIP Code	PL-44-100 Gliwice
E-mail	sebastian.werle@polsl.pl
Phone Number	+48 3223 72610
Mobile Phone Number	+48 6024 72911

dr inż. Szymon Ogonowski, PhD **SUT** (more information in the next update)

Mittweida University of Applied Sciences (HSMW) appoints the following scientists to the RTF:

Prof. Dr.-Ing. Michael KUHL (HSMW)

Michael Kuhl has been Professor for systems electronics at HSMW since 2017. He holds a PhD in engineering from Chemnitz University of Technology. Prof. Kuhl is also member of the research group systems electronics at Mittweida University. His fields of teaching include physics of electronic components, analogue and digital circuit technology and embedded systems. He is study dean for the bachelor's programme electrical engineering and automation.

From 2012–2017 he worked at Fraunhofer Institute for Machine Tools and Forming Technology as Executive Senior Engineer for Research and Development. In 2014 he became head of the department "Strategy and International Affairs".

Research areas:

His research activities focus on multisensory machine, plant and process monitoring through correlation of information from pre-, in- and post-process stages (process assurance, quality control, predictive maintenance) as well as human-machine interaction (especially environmental monitoring, decision support, werable systems and applications in the field of "Health Care" and "Ambient Assisted Living").

Prof. Dr.-Ing. Michael Kuhl is the person appointed from HSMW for the Education Interface Task Force.

Name of Institution	Mittweida University of Applied Sciences (HSMW)
Full Name of Representative	**Prof. Dr.-Ing. Michael KUHL**
Position	Professorship System Electronics
Address	Technikumplatz 17
ZIP Code	DE-09648 Mittweida
E-mail	kuhl@hs-mittweida.de
Phone Number	+49 3727 581625

Dr.-Ing. Stefanie WALTER (HSMW)

Dr.-Ing. Stefanie Walter studied Media Management (B.A.), Information and Communication Sciences with a focus on Public Affairs and Political Campaigning (M.A.) and Sustainability in Macroeconomic Cycles (M.Eng.) at Mittweida University of Applied Sciences. She wrote her dissertation on acceptance communication in the energy and raw materials sector at the Technische Universität Bergakademie Freiberg.

She has worked as a cooperation officer, transfer and regional marketing representative and EU project manager and works now as Assistant Professor of Integrated European Sustainability Communication at Mittweida University of Applied Sciences. She mainly teaches project management, basics of sustainable development, and entrepreneurship in an international context. Dr.-Ing. Walter also works as a freelance communication, project and event manager for SMEs, start-ups and associations in the fields of natural resources, regional development and education.

At Mittweida University of Applied Sciences she is the EURECA-PRO coordinator for work package 7 "Third Mission and External Image". She is also a member of the Research Task

Force, the Education Council, and the Event Task Force, an advisory member of the Communication Task Force and a member of the subgroups Citizen Engagement and Diversity, Inclusion and Equality of the FOREU2 Association of European Higher Education Alliances.

Research areas: Communication, Communication Science/studies, Communication Management, Acceptance Communication, Sustainability Communication, Communication Theory, Media Studies, Mass Communication, Social Communication.

Name of Institution	Hochschule Mittweida – Mittweida University of Applied Sciences (HSMW)
Full Name of Representative	**Dr.-Ing. Stefanie Walter, M.Eng/M.A./B.A.**
Position	Assistant Professor of Integrated European Sustainability Communication
Address	Technikumplatz 17
ZIP Code	09648 Mittweida - Germany
E-mail	walter@hs-mittweida.de
Phone Number	+49 3727 581127
Mobile Phone Number	+49 162 2906391

Dr. Ing. Flaviana Tagliaferri **HSMW** (more information in the next update)

University Hasselt (UH) appoints the following scientists to the RTF:

Dr. Sadia VANCAUWENBERGH (UH)

Sadia Vancauwenbergh works as Director Research, Library and Internationalisation at Hasselt University, Flanders, Belgium and is President of euroCRIS. Over the past 10 years, she has been working in the field of research information management as project leader of ECOOM, where she has been assisting the Flemish Government in designing and implementing the architecture and semantics of the Flemish Research Information Management System FRIS (Flemish Research Information Space). In addition, Sadia is member of several European Open Science Cloud (EOSC)-related task forces at the Flemish and European level, and is running a project on 'Research data management practices in the Latin Americas' in Bolivia, Cuba and Peru, funded by VLIR-UOS.

Research areas:

Research information management, Open Science

Name of Institution	Hasselt University (UH)
Full Name of Representative	**Sadia Vancauwenbergh**
Position	Director Research, Library and Internationalisation
Address	Martelarenlaan 42
ZIP Code	B-3500 Hasselt
E-mail	Sadia.Vancauwenberg@uhasselt.be
Phone Number	0032 11 26 90 09

Dr. Hanne SURKYN (UH)

Hanne Surkyn was recently appointed as staff member Research at Hasselt University within the Directorate Research, Library and Internationalisation. She is the main contact person from Hasselt University for the Research component within EURECA-PRO. Hanne received the M.A. degree in linguistics from the University of Leuven (KU Leuven) and the Ph.D. degree in linguistics from the University of Antwerp. During her doctoral research, she studied psycholinguistic and sociolinguistic patterns in Dutch spelling phenomena through corpus analyses.

Research areas: Sociolinguistics, psycholinguistics, corpus linguistics

Name of Institution	Hasselt University (UH)
Full Name of Representative	Hanne Surkyn
Position	Staff member Research
Address	Martelarenlaan 42
ZIP Code	B-3500 Hasselt
E-mail	Hanne.Surkyn@uhasselt.be
Phone Number	0032 11 26 82 18

Dr. Bart VERMANG (UH)

Bart Vermang received the M.Sc. degree in physics from the University of Ghent (UGent) and the Ph.D. degree in electrical engineering from the University of Leuven (KU Leuven), both in Belgium. He performed his M.Sc. final research project at the Norwegian University of Science and Technology (NTNU), where his interest in renewable energy was triggered. He obtained a Ph.D. for research in silicon PV at Imec – Belgium, followed by 2 personal Postdoctoral fellowships to work on thin film PV. A Marie Skłodowska-Curie

individual fellowship to move to the University of Uppsala in Sweden, and a fellowship from the Flemish Research Foundation (FWO) to return to Imec. In 2016, Bart acquired an ERC starting grant and became professor at Hasselt University (UHasselt) in Belgium. Currently he is PV program manager of the PV technology & Energy systems group at IMOMEC (i.e., an associated lab from imec at UHasselt), and also co-leading the underlying "thin film PV technology" team. Bart is a member of the operational Board of EnergyVille, the executive board of IMOMEC, the Belgian Energy Research Alliance (BERA) board, the editorial board of the Solar Energy Materials & Solar Cells journal (Elsevier), and the Young Academy of Flanders.

Research areas:

Renewable energy, photovoltaics, solar fuels, materials engineering

Name of Institution	Hasselt University (UH)
Full Name of Representative	Bart Vermang
Position	Professor UHasselt, PV program manager imec
Address	Thor Park 8320
ZIP Code	B-3600 Genk
E-mail	Bart.Vermang@uhasselt.be
Phone Number	+32 16 28 12 05

University of Lorraine (UL) appoints the following scientists to the RTF:

Benoît GRASSER (UL)

Benoît Grasser received a PhD degree in economic sciences in 1997. From 1999 until now, he is a teacher and researcher at Université of Lorraine (assistant professor until 2015, full professor after this date). He teaches in a School of Management (IAE Nancy School of Management), more precisely in the field of organization theories and human resources management (HRM). He had been in charge of degrees in HRM (L & M levels) for more than 15 years. As director of degree programs, he has paid particular attention to the development of work-study programs and to relations with the socioeconomic world. Based on his teaching experience, he has also written three manuals for Vuibert, a well-known French academic publisher. In the field of research, he has held direction responsibilities in laboratories or research teams; in particular, from 2016 to 2022 he was the deputy-director of CEREFIGE (European Center for Research in Financial Economics and Business Management), one of the major French laboratories in management sciences (170 members

and about 40 PhD students). Between 2020 and 2022 he has been in charge of mission for the Vice-president Research of the University of Lorraine, and in July 2022 he became Vice-president in the research policy field.

Benoît Grasser has been an expert and a committees' president for the French high authority for evaluation (HCERES), both for teaching and research aspects. Since 2020 he is a member of the National Council of Universities in Management Sciences (CNU 06).

Research areas: His expertise is in HRM and organizational theories field. More specially, he's interested in understanding the dynamics between individual, collective and organizational competences, using different theoretical frames (organizational learning, routine dynamics, socio-materiality…). He has authored or co-authored about 100 journal and conference publications, book chapters, research reports. One of his last publication (2020) is the 272 p. Handbook *Managing Competences, Research, Practice, and Contemporary Issues* (Grasser B, Loufrani-Fedida S., Oiry E. (by), Taylor & Francis). His researches are usually based on qualitive methods, and he has investigated a lot of various organizations in numerous sectors such as hospitals, administrations, automotive or aeronautical companies and other industrial activities. For a few years, he's also engaged in the forest sector, and he pays a strong attention to develop inter-disciplinary approaches. He's in charge of a national research team on Competences Management at the francophone academic association for HRM (AGRH), and since 2020 he's a co-chief editor of @Grh, an academic journal figuring in the French ranking for the Management Sciences field.

Name of Institution	Université de Lorraine
Full Name of Representative	Prof. Benoît Grasser
Position	Vice-president in scientific policy
Address	34 cours Léopold, NANCY, FRANCE
ZIP Code	54000
E-mail	benoit.grasser@univ-lorraine.fr
Phone Number	33-6-88-58-32-56

Fabrice LEMOINE (UL)

Fabrice Lemoine is currently full Professor of mechanical engineering at Université de Lorraine, since 2004. He has been recently (July 2022) appointed as vice president of the UL, specifically in charge of the European strategy. He was, between 2009 and 2017, the head of the Laboratoire Energies, Mécanique Théorique et Appliquée (LEMTA), a research laboratory in mechanics and energy research. He is the coordinator of the socio-economic challenge “Energies for the future”, one of the axis of the excellence programme of Université de Lorraine (LUE). In this framework, he was the coordinator of the ULHyS project dedicated to a multidisciplinary approach of the hydrogen sector, from basic science to societal concerns (2016-2021). Since 2019, he is the director of the Erasmus Mundus Joint Master program DENSYS “Decentralised Smart Energy Systems”, a worldwide excellence interdisciplinary program, coordinated by UL in collaboration with top European partners in engineering, namely KTH (Stockholm, Sweden), PoliTo (Turin, Italy) and UPC (Barcelona, Spain), funded by the European commission. In 2021, he was appointed by the CNRS to lead jointly with IFPEN (a national research organisation dedicated to new energies) a vast national research programme dedicated to decarbonisation of the industry-budget 70 M€ over 6 years-, within the framework of France 2030 (French future investment plan merged with the recovery plan), managed by the Prime Minister's services (SGPI). He is a member of several French commissions and international groups dealing with research and education in energy: representative of University Rectors Conference (now France Universités) in the French alliance for energy research (ANCRE)- he served as a coordinator of the steering committee for the last two years (2019-2021), French national research funding agency (ANR) strategic committee “Energy Transition”. He is representative of Université de Lorraine in the European Energy Research Alliance (EERA), he was recently appointed of representative of France in the advisory board of the European coordination and support action SUNER-c, that aims to foster the emergence of a European roadmap on e-chemistry and solar chemistry (or fuels). He is also a member of the steering committee of the Energy and Environment platform of the European University Association (EUA) and newly appointed in the « Green Deal task and finish group », aiming at advising the European commission

about the strategic orientations of the Green Deal.Research areas: His research speciality is heat and mass transfer in two phase flows applied to energy transfer processes.

Name of Institution	Université de Lorraine
Full Name of Representative	Prof. Fabrice Lemoine
Position	Vice-president European strategy
Address	34 cours Léopold, NANCY, FRANCE
ZIP Code	54000
E-mail	fabrice.lemoine@univ-lorraine.fr
Phone Number	+33-6-76-54-54-96

Prof. Karl TOMBRE (UL)

Karl Tombre received a PhD degree in computer science in 1987. From 1987 to 1998, he was senior researcher at INRIA, a French national institute devoted to research in computer science and applied mathematics. In September 1998, he joined École des Mines de Nancy at Institut National Polytechnique de Lorraine as full professor, and was head of its computer science department from 2001 to 2007. From 2007 to 2012, he returned to Inria on secondment, to hold the position of director of the Inria Nancy - Grand Est research centre. Since September 2012, he is vice-president of Université de Lorraine, in charge of the university's European and International Strategy. Since 2016, he is also the executive officer of the *Lorraine Université d'Excellence* initiative, focusing on Global Engineering, and funded by the French excellence initiatives program. He has been chair or member of a number of evaluation committees for universities and research centres. Since December 2012, he is member of the Regional Economic, Social and Environmental Council (CESER) of the Grand Est region, as representative of higher education and research. As such, he has been actively involved in commission work on the region's S3 specialization strategy, and on the regional scheme for economic development, innovation and internationalization (SRDEII). As vice-president in charge of International and European strategy, he is also actively promoting the involvement of Université de Lorraine in partnerships on several of Europe's major social and economic challenges. He represents the French University conference of presidents/rectors in EUA's expert group on Innovation Ecosystems.

Research areas:

His scientific expertise is in pattern recognition and image analysis, more precisely document image analysis. In 2002, he founded a research group on graphics recognition and led this group until September 2007. He is also at the origin of a free software package for graphics recognition. He has authored or edited 4 books, including a 1000-pages *Handbook of Document Image Processing and Recognition*, published in 2014, and has authored of co-authored about 100 journal and conference publications. From August 2006 to December 2008, he was the president of the International Association for Pattern Recognition (IAPR). He was a co-founder of the International Journal on Document Analysis and Recognition (Springer Verlag) and one of its editors in chief until 2013, member of the editorial board of 3 other journals, and member of numerous international conference committees.

Name of Institution	Université de Lorraine (UL) Prof. Karl Tombre Vice-president International and European strategy 34 cours Léopold, NANCY, FRANCE 54000 Karl.tombre@univ-lorraine.fr +33 6 08 01 54 84
Full Name of Representative	
Position	
Address	
ZIP Code	
E-mail	
Phone Number	

All partnering institutions are obliged to report personnel changes to the Work Package 3 LEAD Coordinator so that this document can be updated immediately. An up to date version can always be found on the EURECA-PRO website[10] and the TUC own cloud.[11]

2.3 Roles and responsibilities

The Manual of Operations of the Research Task Force (RTF) regulates the roles, tasks and organisational issues, in particular the way the Research Task Force (RTF) functions and communicates within the EURECA-PRO project. During the first RTF meeting a proposed Manual of Operations should be adopted by majority vote. If changes in the content of the

[10] https://www.eurecapro.eu/
[11] see chapter 2.4.2 “cloud”

MOP are necessary, its adoption may be carried out using electronic communication, within seven days after the date of the first meeting.

If changes in the manual of operation also affect the content of this document, these changes will be incorporated in the next update.

RTF Chair

During the first RTF meeting, an RTF Chair is elected from among the RTF members by majority vote. Candidates for RTF Chair may be proposed by any RTF member present at the meeting and by a representative of the EURECA-PRO Consortium. RTF activities are managed by the RTF Chair with the assistance of one or two deputies. The elected RTF Chair shall propose candidates for one or two vice chairs, whose election shall be made by majority vote.

WP3 LEAD Coordinator

The Work Package 3 LEAD Coordinator is responsible for the completion of the deliverables of the Work Package 3. The WP3 LEAD Coordinator is the interface between Work Package 3 with associated tasks, institutions and the Project LEAD Coordinator.

As the Research Task Force is a part of the Work Package 3, the WP3 LEAD Coordinator will coordinate project specifics, with the Project LEAD Coordinator and will communicate scientific results to the WP7 LEAD Coordinator for third mission and external image. The communication paths are shown in the Project Coordination Chart below. In WP3 and the Research Task Force the reporting and communication structures are bottom-up and top-down. Specific tasks defined by the RTF are coordinated by the responding Task LEAD Coordinators and information from tasks and Inter WP Teams are forwarded to the WP3 LEAD Coordinator.

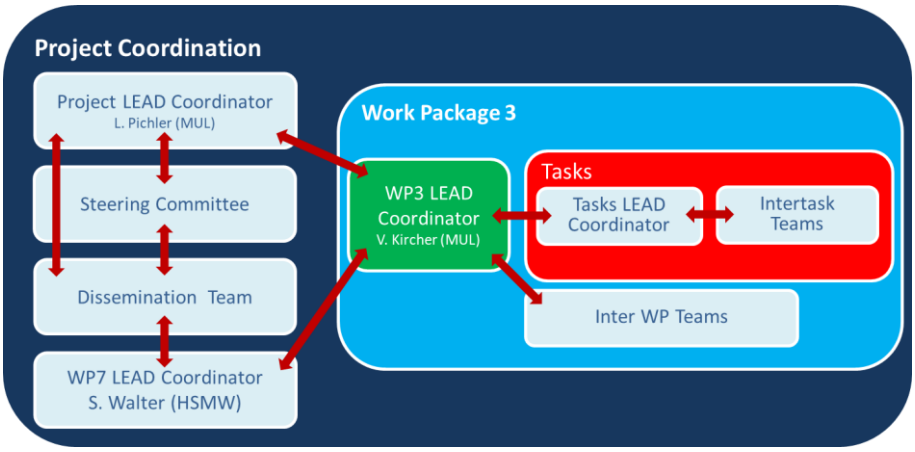


Figure 3: Communication paths between Project Coordination and Work Package 3

Education Interface Task Force

An Education Interface Task Force, which consists of researchers from the Research Task Force, Student Centred Co-Creation Group, education and pedagogics experts as well as members of Education Council, establishes the PBL challenges and converts them into formats that are applicable by teachers, students and official administrative organs of the institutions as well as a form that is suitable for dissemination purposes. The task force also creates an accompanying guidance manual and evaluation feedback forms for teachers for continuous evaluation purposes.

RTF - conflict management

The RTF is one of the bodies of settlement proposals when the Board of Rectors cannot find a common approach to decisions to be made, depending on the content of a conflict.

Should any conflict among or within RTF fail to be resolved the Project Management Board will be the mediator, and if the solution is not found, the Board of Rectors is entitled to ultimately resolve the conflict.

If a member of the RTF is not active or hinders the project, he/she may be removed upon the proposal of at least three members of the RTF or Steering Committee. A binding decision on removal of an RTF member requires the voting of at least 60% of the RTF members. The replacing member will be appointed by the relevant institution.

2.4 Communication

This section of the organisational Scientific Framework Charter focuses on feed mechanisms, communication tools and communication frequencies.

2.4.1 Input and feedback mechanisms

The Communication flow in Work Package 3 is organised similar to the Project Management Board (Task 1.1) and it is shown in the Project Coordination Chart in Chapter 2.3.

As an input and feedback mechanism a quarterly updated report of the progress in the Work Package Research must be sent to the Project LEAD Coordinator. This update should include a summary of the progress of the deliverables, a preview on the next steps to be taken, timesheets and a financial overview on expenses.

Thus, an assessment of activity progress and possible deviations is made every three months. In case of deviations, the project board develops remedial actions together with the responsible persons and organisations.

2.4.2 Communication tools

Daily Communication

Daily communication is done mainly by phone, e-mail and Zoom- or WebEx meetings. A common EURECA-PRO google calendar keeps all partners of the alliance informed about events, deadlines and meeting dates.

Virtual conferencing

For online meetings Zoom (first choice) and WebEx are used. Meetings are announced as stated in the Manual of Operations of the RTF. If meetings are recorded, participants will be informed before the meeting.

Cloud

An online storage for all documents is found on TUC own cloud https://filebox.isc.tuc.gr. The server is hosted locally at TUC and the cloud can be accessed by all institutions. All project relevant documents are stored in the cloud.

Platform for live chats

RTF, being advised by the Communication Task Force, installs a digital Societal Dialogue Platform that serves as information, communication and activity interface between EURECA-PRO and civic society.

2.4.3 Communication frequencies

Ordinary meetings of the RTF shall be held four times a year. When urgent matters need to be considered, an extraordinary meeting may be called at the request of the RTF Chair, at least 1/3 of the RTF members or the EURECA-PRO Leader.

Meetings may be held in virtual mode allowing the identity of the meeting participant to be confirmed. Not less than twice during the project implementation period, before the end of the 18th month and 34thmonth, meetings are held in contact mode in a place proposed by the Project LEAD Coordinator and accepted by the RTF Chair. The costs of organizing the meeting are covered by the consortium fund.

Minutes of the RTF meetings shall be drawn up with the assistance of the staff provided by the EURECA-PRO Project LEAD Coordinator and shall be distributed to the RTF members and other persons attending the meeting within 14 days after the meeting.

RTF can invite experts to their meetings. Where this has financial implications, the approval of the Project LEAD Coordinator is required in each case, so that expenses can be reimbursed.

2.5 Corporate Identity and Design

The dissemination plan includes the creation of a project identity with a cohesive external appearance that includes the design of the logo, a set of graphic elements and images, a key colour palette, corporate typefaces, and templates for presentations and reporting in line with the content identity based and project key messages.

The EURECA-PRO corporate design, as defined in the Guidance Portfolio, is applied to all products created by the alliance (reports, documents, presentations, dissemination material, merchandise material, etc.).

2.6 Quality Assurance Research

New Research Action Areas will be developed inside WP3 and formally evaluated and agreed on by the Research Task Force.

Once the research agenda is in place and operational details are rolled out at the participating universities, the Research Task Force will take responsibility of the evaluation. These comprise the following KPI's and items:

- Controlling of the joint research agenda in terms of targets, activities and the outcomings
- Regular review of research agenda
- Enabling and assistance with the allocation of research resources from national, European and international sources
- Evaluation of the quality of research results

As a general approach, research results will be evaluated on the basis of SCI publications and the impact factor increase for the participating faculty member (e.g. increase in Hirsch factor). In summary, the evaluation of Admission, Education Programmes, Mobility Programmes and Mobility Activities and Research is under the responsibility of the Education and Research Task Force and the Student-Centered Co-Creation Group on the basis of the following indicators:

- Number of students admitted to the European programmes and percentage of successful completion (success rates in programmes, failure rate)
- Number of overall students participating in the mobility activities (PHD, MSc, BSc) and percentage of them meeting the set targets (language skills, cultural competence, achievement in knowledge, international Master and PhD thesis completion)
- Satisfaction survey through formative and summative evaluations
- Number of faculty members participating in European education and research activities and percentage of them meeting the targets (SCI publications, increase in Hirsch factor)
- Verification of the concordance and applicability of the accumulated knowledge, with the objectives of SDG12.

- Employability rate of students graduating from the joint programmes and their geographical place of first professional activities

This overall evaluation and the assessment against European and international standards will be done by an independent external quality assurance company.

3 Catalogue of Lighthouse Missions (LH)

3.1 Introduction

Lighthouse Research Missions regarding responsible consumption and production will be established in all relevant disciplines and cross-institutional research groups already yield promising research results that flow into the practical education of the European Studies programme. Each participating university focuses on their expertise areas to achieve complementarity and an enhanced level of interdisciplinary research results. Society and industry are actively involved in the knowledge creation process through designated events and discussion fora as well as online discourse. This enables the research groups to apply real-life challenges in the definition of their Lighthouse Missions as well as in the definition of the challenges for the problem-based learning classes that are deducted from research results. Global Knowledge Alliances are formed to strengthen the LH. Open Science Awareness Events are frequently held to create a civic society and industry community.

This WP subtask establishes a common understanding of sustainability frameworks to be worked with concerning the United Nations Sustainable Development Goal 12 (SDG12), seen from a holistic and systemic point of view, revolving around abiotic materials and goods. This comprises a

- scientific problem definition, gap analysis and resulting confinement of thematic scope, which inherently leads to the
- definition of lighthouse missions, which is subsequently followed by the
- creation and coordination of according interinstitutional research groups, including members from all relevant institutions on level senior, junior and student

The Catalogue of LH will be defined, implemented and publicly available according to the schedule of the EURECA-PRO project.

The key to EURECA-PRO's strength in research is its interdisciplinary set-up. Each university brings into the alliance a different set of competencies that enable a systemic point of view in each approach to a challenge. This comprises technological, ecological, economic, societal, legal and policy aspects and their transfer into society and industry [12].

[12] Feiel, S., Frühauf, S., Pichler, L., Kircher, V., Kosciuszko, A., & Egger, J. (2021). EURECA-PRO, The European University on Responsible Consumption and Production: An Alliance for Sustainability. Proceedings of ERSCP 2021: European Roundtable on Sustainable Consumption and Production, Graz, Austria, 8/09/21 - 10/09/21, p153. https://doi.org/DOI: 10.3217/978-3-85125-842-4-21

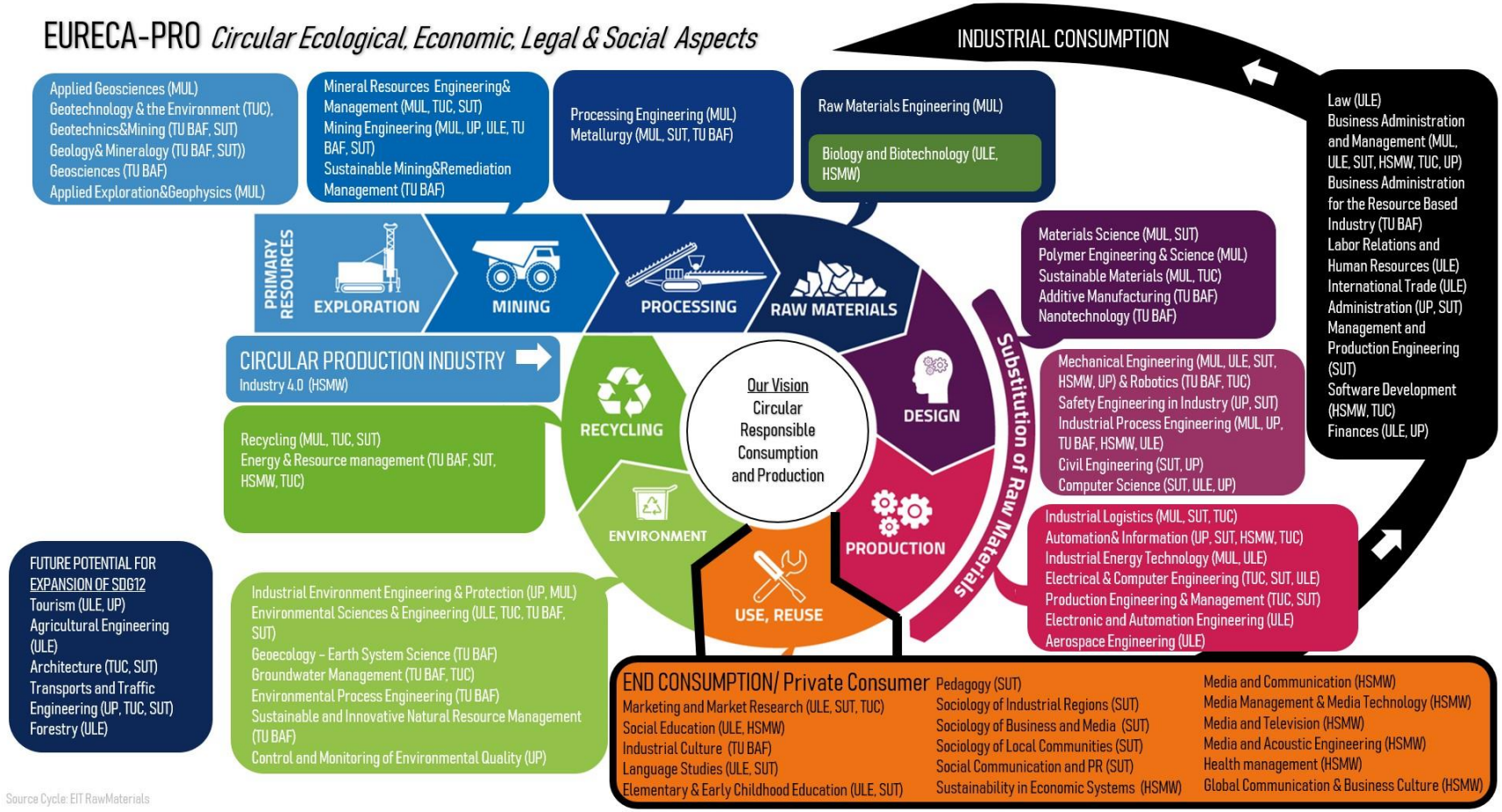


Figure 4: Interdisciplinary competencies of EURECA-PRO [13]

[13] Moser, P., Feiel, S., Barbknecht, K., Diamadopoulos, E., Mezyk, A., Baelo, R., Radu, S., Himler, L. and Komnitsas, K. (2021). EURECA-PRO, The European University Alliance on Responsible Consumption and Production. Proceedings of the European Metallurgical Conference 2021 (EMC2021), online, 27/06/21 – 30/06/21.
ISBN: 978-3-940276-96-4

During project proposal writing for EURECA-PRO the areas of interdisciplinary research competencies of our consortium, illustrated in Figure 4 [13], have been determined mainly due to analysis of departments, faculties and chairs. EURECA-PRO joint the forces of 4 technical universities, 2 comprehensive universities and 1 university of applied sciences to cover the whole value chain. Research is related to Circular Responsible Consumption and Production that ranges from exploration of primary raw materials, over mining, processing and raw material engineering to clever product design and responsible production. The private Consumer and industrial consumption are covered as well as environmental protection and recycling which closes the loop.

3.2 Scientific problem definition

The vision of EURECA-PRO is to be an educational core hub and an interdisciplinary research and innovation leader for responsible consumption and production of goods. By focusing on SDG12 in both, education and research, EURECA-PRO sees itself as a major contributor for the realisation of the European Green Deal and Circular Economy. To ensure this vision, several measures are needed to structure a common research:

It is necessary to build SDG12 related Lighthouse Topics around the core competencies, identify weaknesses and overcome them through additional engagement. If there may be a lack of expertise in the consortium, an appropriate search must be conducted among the associated partners and Global Knowledge Alliances need to be formed as well to strengthen the lighthouses. The number of Lighthouse Topics have to grow with time in order to work on all Sustainable Development Goal 12 Targets. Subgroups are to be formed for each Lighthouse Topic. Every Lighthouse Topic is an umbrella term for a large research area and requires a Lead University that owns the main expertise in that specific research area. Based on the selected Topic, the Lead University has to define the Lighthouse Mission (LH) including corresponding research subtopics.

Therefore, the Lighthouse Topics in this document are representative working titles for the respective Lighthouse Missions that will be updated regularly together with the Scientific Framework Charter.

3.3 How the Lighthouse Topics were derived

As a starting point for common research in EURECA-PRO first Lighthouse Topics have been identified and selected by a systematic approach that was developed in the Research Task Force. Information about possible and SDG12 relevant research topics was gathered from three sources:

- Interdisciplinary competencies of EURECA-PRO
- Proposals of Lighthouse Topics by RTF members and project Coordinators
- Comprehensive inventory about SDG12 projects and publications

Information of all three sources were compared, gaps and overlaps were analysed and Lighthouse Topics have been fixed during the EURECA-PRO Working and Review Week that took place from 18-22.10.2021 in Leoben, Austria.

Proposed Research Lighthouse Topics

In addition to the interdisciplinary competencies of EURECA-PRO that are shown in Figure 4, all partner universities proposed Research Lighthouse Topics regarding responsible consumption and production that address the most pressing current issues. The proposals were clustered into thematic areas, as indicated by the colour scheme in table 2.

Tab. 2: Proposals of Lighthouse Research Topics from all partner universities

University	LH Topic
MUL, TUC	Responsible and Transparent Supply Chains
TUC, TUBAF	Circular Economy
ULE	Production and consumption models and development of a sustainable society
MUL, TUC, SUT, TUBAF	Sustainable Materials, Green Materials, Materials of the Future
TUC, SUT	Industry 4.0, Process automation and industry 4.0
TUC, SUT, UP, TUBAF	Climate change & implications, Climate and Environmental Protection
TUBAF	Water circles in anthropogenic and geological systems
TUC, SUT, UP, TUBAF	Clean Energy, Modern Energy
HSMW, TUBAF	H_2 as new Wideband Energy Technology
SUT, UP	Smart cities and future mobility

Abbreviations: Montanuniversität Leoben (MUL), Technische Universität Bergakademie Freiberg (TUBAF), University of Petrosani (UP), University of León (ULE), Technical University of Crete (TUC), Silesian University of Technology (SUT), Mittweida University of Applied Sciences (HSMW)

EURECA-PRO's research inventory on SDG12

The *European University Alliance on Responsible Consumption and Production* is strongly related to the UN Sustainable Development Goal 12 (Sustainable Production and Consumption), therefore a comprehensive inventory about SDG12 projects (for publications still running) has been carried out in all universities and it resulted in astonishing 488 research projects covering 805 SDG12 research topics[14] as can be seen on our Website: https://www.eurecapro.eu/for-researchers/

The inventory was also clustered, and on the Website all SDG12 projects can be seen per university as well as SDG12 projects of all universities related to *Responsible Material Flows, Environment and Water, Sustainable Materials and Products, Advanced Energy Technologies, Process automation and Industry 4.0* and *Other SDG12 Topics*.

As example, Figure 5 shows the presentation of projects related to *Environment and Water* on the EURECA-PRO Website. It is possible to see all project information like *University, Country, SDG12 Topic, Project Acronym, Project Title and Project Description as well as Responsible Faculty, Department or Chair, Principal Investigator and a Link to more project information* by clicking on the small hexagons.

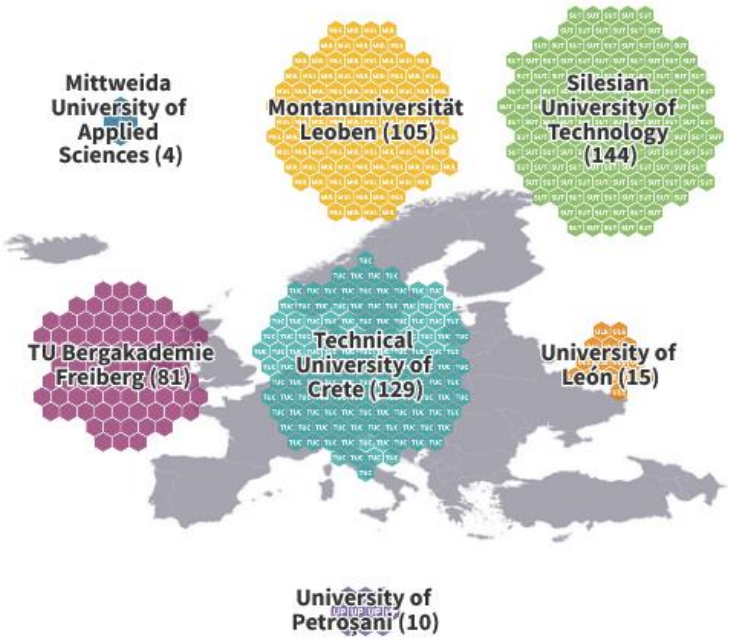


Figure 5: SDG12 research inventory of EURECA-PRO on the Webpage https://www.eurecapro.eu/for-researchers/

[14] There are 805 SDG12 research topics clustered on the website, as only one *Other SDG12 Topic* was considered per project, although it may address more than one.

3.3.1 Gap Analysis concerning the SDG12 Targets

12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries
→ **International policy issue; EURECA-PRO has to find access into the programmes established by the European Commission**

12.2 By 2030, achieve the sustainable management and efficient use of natural resources
→ **Target covered: SDG12 Research Inventory**

12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses
→ **Target not well covered so far: SDG12 Research Inventory**

12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
→ **Target covered: SDG12 Research Inventory**

12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse
→ **Target covered: SDG12 Research Inventory**

12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
→ **Target covered in future: Increase in the number of associated partners; partnerships with industry; establishment of Global Knowledge Alliances**

12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities
→ **National and international policy issue; sensitize to do this within our own institutions as first step and contacting (federal) procurement agencies in future**

12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
→ **Target covered: Open Science and Open Access**

12.a Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production
→ **International policy issue**

12.b Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products
→ **International policy issue, Tourism partly covered by TUC: SDG12 Research Inventory**

12.c Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities
→ **International policy issue**

Gap Analysis conclusion

The inventory of SDG12 Related projects and publications lead to a clear picture of the Status Quo. It became clear, that the amount of research on the consumption side is with 30% significantly lower compared to production with 60%. This finding was not too surprising, since 4 of the 7 universities are technical universities, but it shows that the efforts have to focus more on consumption. To overcome these obstacle, EURECA-PRO already started communication with other comprehensive universities and with potential associated industrial partners in order to enlarge the consortium, the knowledge and the competencies of EURECA-PRO.

The main finding of the SDG12 Target analysis is that SDG Target 12.3 (food waste) is not well covered and needs to be pushed further.

3.4 Lighthouse Topics

The alliance has agreed that it must act responsibly to ensure sustainability. Therefore, the Goal for new common research projects is to consider the material flow system boundaries as well as systemic dimensions (economic, ecological, social, technological, policy &legal etc.). Due to the implementation of the dimensions, we will consider consumption and production in every project, which is why we currently do not intend to establish our own lighthouse topics in this regard. These research areas are the starting point for joint research and EURECA-PRO will expand the research agenda in the future.

By comparing and analysing all data, following five Lighthouse Topics for the further research direction were identified and confirmed by all partner institutions:

LH1 Responsible Material Flows

LH2 Environment and Water

LH3 Sustainable Materials and Products

LH4 Clean Energy

LH5 Process automation and Industry 4.0

LH1 Responsible Material Flows

The current economic system of human civilization is built on growth. But what can sustainable growth look like, so it does not disadvantage future generations? In order to prevent or reduce future resource scarcity, it appears to be essential to understand the environmental impact of product flows. Concerning the negative environmental impacts of extraction and production, it is necessary for further considerations to also examine the consumption phase and the end use in more detail. Since products generate an impact along their entire value chain, it is necessary to know all aspects and to analyse not only the environmental impact but also the social and economic dimension. Based on this data collection, hereafter decisions can be made that adequately address problems. The goal is to direct all aspects of human life into sustainable paths through a closed loop economy. To achieve this goal a risk impact assessment must be carried out. Additionally, the alternative with the least consequential damages has to be selected. Cradle to cradle is already extensively possible today. With the aim of consistently completing this path, it is mandatory to get every involved and required person on board to integrate them into this process.

LH2 Environment and Water

The natural system on earth is currently changing rapidly. The scientific community is now talking about a new geological era (the Anthropocene). However, to what extent and in which context are humans actively intervening in the natural cycle of the Earth´s ecosystem? How can solutions be found to reduce this influence in the future? Through a targeted monitoring

of pollution indicators and a targeted impact management, which includes all pollution aspects as well as interrelationships of the planetary boundaries, negative end effects such as the fast-on-going climate change can be slowed down, reduced and in the best case stopped. Impacts such as man-made climate change, the loss of the ozone layer, eutrophication of landscapes and waters, etc., have a major negative impact on human civilization and on ecosystems. Due to the interaction of human activities with nature, it is essential to better describe and evaluate the cause-effect relationships.

LH3 Sustainable Materials and Products

Sustainable materials and products are thematically very closely linked to the Lighthouse Topic 1 "Responsible Material Flows". The future long- term environmental impact of more sustainable products and material alternatives in particularly has not been thoroughly researched yet. It can be assumed that these alternatives have a great potential to strongly reduce human environmental impacts. Therefore, it is important not to repeat the same mistakes in the value chain when using more sustainable materials and products. Value creation systems must be viewed holistically and globally, and countries of the global South in particular must be included in the structure. The case of the soap nut in India should make us aware of not drawing the system boundaries too narrow. Due to the globalization (especially the sale to Europe and North America) of the soap nut, this sustainable resource became almost unobtainable for the Indian population. As a result, harmful chemical cleaning agents (which are banned in industrialized countries) are increasingly used in Indian households. Due to the rapid population growth of emerging and developing countries, it is important to switch to more sustainable materials and products as quickly as possible, globally.

LH4 Clean Energy

In order to achieve the Paris climate targets a push forward to the expansion of renewable energies is needed. But what are possible obstacles to the conversion of the energy system? Which forms of energy are clean? Besides the aspects of a functioning supply network, questions of energy storage and distribution have to be answered. Today it already seems feasible to replace all fossil energy sources by their renewable counterpart. To reach this goal

a qualitative planning strategy is required, which includes all economic, social and ecological aspects.

LH5 Process automation and Industry 4.0

The goal of process automation and Industry 4.0 is to combine industrial production with communication and information technology. Self-organized production is intended to make the process as smooth as possible. The unit of man, machine, plant and logistics should be directly interconnected through networking. The aim is not to optimize individual processes but to improve entire value chains at the same time. Industry 4.0 can contribute to a climate-friendly and resource-conserving future by reducing consumption and increasing impact. In addition, besides production, use, maintenance and recycling, the process of finding ideas for a product is also to be embedded in the system process.

3.5 How the Lighthouse Missions (LH) will be defined

Each Lighthouse Topic covers a broad research area, thus Lead universities were identified for all topics according to their expertise and future research plans, as shown in table 3.

Tab. 3: Lead Universities and **Lighthouse Topics**

Lead University	**LH Topic**	
ULE	LH1	Responsible Material Flows
TUBAF	LH2	Environment and Water
TUC	LH3	Sustainable Materials and Products
MUL	LH4	Clean Energy
SUT	LH5	Process automation and Industry 4.0

Lead Universities have to establish Lighthouse Topic subgroups and all partner institutions agreed to send one person to each subgroup. Based on the selected topic, Lead Universities have to define the Lighthouse Mission including corresponding research subtopics. The LH Missions will be discussed in detail in the next Research Task Force Meeting and the definition will be agreed by all partners. A separate group will work on the definition of “Responsibility in the context of EURECA-PRO” which will be integrated in the next update of the Scientific Framework Charter together with a sound explanation of all five Research Lighthouse

Missions. A systematic approach for the derivation of Research Lighthouse Missions is summarized in Figure 6 and the first report on LH Implementation can be found as Chapter 5 of the SFC.

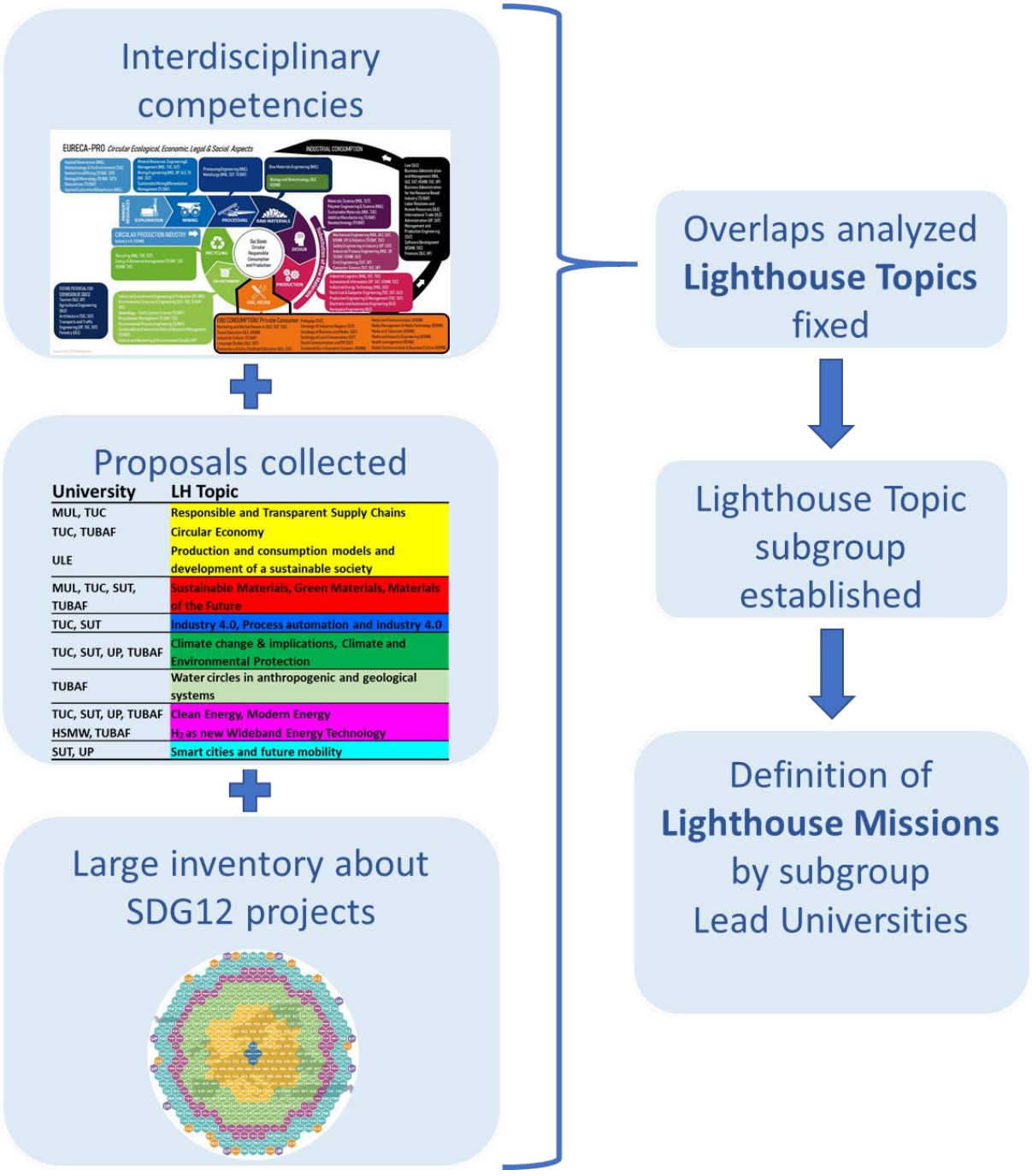


Figure 6: Systematic approach for the derivation of Research Lighthouse Missions

4 Global Partner and Competence Index (GPCI)

4.1 Introduction

The Global Partner and Competence Index (GPCI) is the indexically organised Chapter 4 of the Scientific Framework Charter (SFC). The European University on Responsible Consumption and Production (EURECA-PRO) focuses on research and education related to the United Nations' Sustainable Development Goal (SDG) 12: "Ensure Sustainable Consumption And Production Patterns". In order for EURECA-PRO to reach its goal of being the core global SDG 12 hub by 2040, a well-connected partner structure as well as high-quality research and education capabilities are needed.

A detailed project inventory, including strengths and weaknesses, supports EURECA-PRO's work as well as Work Package 3 (research). Defining Lighthouse (LH) Research Missions[15,16] and establishing respective EURECA-PRO research groups laid the foundation for EURECA-PRO to become a global SDG 12 pioneer. Since the accumulated knowledge related to SDG 12 (production as well as consumption) is diverse, EURECA-PRO pursues active partnerships with associations, communities, cities and companies in order to ensure a comprehensive view of production and consumption. The aim of these partnerships is to access broad knowledge and expertise not yet available within the alliance. This indispensable external input is essential in allowing EURECA-PRO to work on research topics holistically.

At the same time, EURECA-PRO partners are encouraged to identify topics where they would like to gain more expertise or conduct more research. Bilateral exchange allows student research and education to be more closely linked to real-life and industrial problems. This creates additional advantages when acquiring further funding and supports students in the job market after graduation, since their education has been partly designed according to the needs of the industry.

Each EURECA-PRO research partner must sign an official commitment agreement to ensure a responsible and sustainable research agenda. This commitment intends to support synergistic

[15] EURECA-PRO Deliverable D3.5, First Progress Report on LH Implementation Status, submitted to EC on July 31, 2022.

[16] V. Kircher, A. Griebler, S. Feiel, P. Moser, Forschungsdimension der European University on Responsible Consumption and Production – EURECA-PRO, BHM (2022) Vol. 167 (4): 187–192, https://doi.org/10.1007/s00501-022-01220-8

development and future cooperation. The goal of EURECA-PRO is to actively involve all partners in the LH mission groups. Future joint projects not only create direct added research value, but also increase financial sustainability within the alliance. While the expansion of the partner network is important to acquire worldwide recognition, it is also necessary that we obtain more expertise under the EURECA-PRO umbrella. Through a better social media presence, participation in international research/information/discussion events, the development of study programme exposés and continued research performance, EURECA-PRO is being systematically professionalised.

In order to reach the potential of all EURECA-PRO partners, a Global Partner and Competence Index was created. This index lists the partners, their origin and their expertise and will, together with the inventory, represent a clear added value for all EURECA-PRO research institutions. All partners benefit from the network and expertise of the EURECA-PRO consortium. This exchange creates opportunities (also for small, regional companies) to be more competitive, both nationally and internationally. EURECA-PRO follows a clear Open Science/Open Education strategy without any barriers.

4.2 Identification of Relevant Stakeholders

4.2.1 Gap Analysis within EURECA-PRO

Each university within EURECA-PRO has unique research foci and expertise in specialised fields of research. In order to identify the research strengths and weaknesses within the alliance, research projects of each university were screened and assigned to thematic clusters. By conducting a research gap[17] analysis and through dedicated discussions, the alliance determined where additional expertise would be most appreciated. In total, 408 projects were analysed and assigned either to EURECA-PRO's five Lighthouse Missions or to a sixth category, "other SDG 12 topics".

4.2.1.1 Technical University of Crete

The Technical University of Crete (TUC) is particularly active in conducting basic and applied research that promotes science and growth, respects academic ethics and cooperates with national and international organisations. TUC manages a substantial number of research and development projects funded by national, European and international public and private

[17] EURECA-PRO Deliverable D3.2, Catalogue of Lighthouse Missions (LH), submitted to EC on October 31, 2021.

organisations. A large number of TUC undergraduate and postgraduate students are employed in these projects and thereby benefit from the best possible training while learning to conduct research. Due to highly developed expertise in the consumer sector, TUC leads Lighthouse Mission 3, “Sustainable Materials and Products”.

4.2.1.2 University of León

Unlike most EURECA-PRO universities, the University of León is a comprehensive university. Due to its broad positioning in its fields of focus (both with respect to research and education), the University of León (ULE) leads EURECA-PRO’s trans-/interdisciplinary sciences. Furthermore, the University of León is a knowledgeable network hub in consumer/consumption sciences; this is reflected by myriad ULE projects. At least half of all ULE projects are directly related to the Lighthouse Missions “Responsible Material Flows” and “Sustainable Materials and Products”. Because of this unique expertise within the alliance, ULE is leading Lighthouse Mission 1, “Responsible Material Flows.

4.2.1.3 Technische Universität Bergakademie Freiberg

The Technische Universität Bergakademie Freiberg (TUBAF) is a modern research university with a strong focus on the fundamentals and processes related to natural resources, energy and materials. Based on its long tradition in mining and metallurgy, it has aligned its profile areas GEO(SCIENCE), MATERIAL, ENERGY and ENVIRONMENT with the challenges of the future. Concentrating on cooperation with regional, national and international enterprises, TUBAF conducts research focused on both the fundamentals and on practical applications. Due to its mining focus, TUBAF has many ongoing and finished projects within Lighthouse Mission 2, “Environment and Water”. Therefore, TUBAF leads this Lighthouse Mission.

4.2.1.4 University of Applied Science Mittweida

The University of Applied Science Mittweida (HSMW) is well-known nationally and internationally for its innovative research and practical education. As a University of Applied Sciences, Mittweida’s focus is on research, development and technology transfer; specifically, HSMW focuses on DIGITALIZATION IN ECONOMY AND SOCIETY, PRODUCT AND PROCESS DEVELOPMENT, APPLIED COMPUTER SCIENCE and LASER TECHNOLOGIES. With modern, well-equipped laboratories and close ties to regional commerce and industry, HSMW fosters a dynamic and application-oriented research environment. Additionally, ¾ of its projects are

directly related to process automation and industry 4.0. This specialization is an advantage for the alliance because of the ongoing industrial change toward cyber-physical systems.

4.2.1.5 Silesian University of Technology

The mission of the Silesian University of Technology (SUT) is to conduct innovative scientific research and development. Their priority research areas are:

1. Computational Oncology and Personalized Medicine,
2. Artificial Intelligence and Data Processing,
3. Materials of the Future,
4. Smart Cities and Future Mobility,
5. Process Automation and Industry 4.0,
6. Climate and Environmental Protection, Modern Energy

SUT is currently intensifying its educational and research focus in the field of process automation and industry 4.0. Because of this specialization, SUT is leading Lighthouse Mission 5, “Process Automation and Industry 4.0”.

4.2.1.6 University of Petrosani

The University of Petrosani (UP) is well known for its expertise in the field of mining and engineering. Throughout history, the university has trained and educated many of today’s well-known specialists and experts in these fields. The University of Petrosani draws upon a large reservoir of knowledge relevant to Lighthouse Mission 2, “Environment and Water”.

4.2.1.7 Montanuniversität Leoben

The research portfolio of Montanuniversität Leoben (MUL) covers the entire value-added lifecycle from the exploration and extraction of raw materials through research fields such as metallurgy, high-performance materials, process- and production engineering and all the way to environmental engineering and recycling. Montanuniversität Leoben is strongly committed to integrating sustainability into the value-added cycle and is enhancing the development of high-tech manufacturing and production processes. Because of its expertise in the fields of responsible energy technologies, energy process engineering, energy management and supply, MUL is leading Lighthouse Mission 4, “Clean Energy”.

4.2.1.8 Hasselt University

As the newcomer in EURECA-PRO Hasselt University (UH) does not yet lead a Lighthouse Mission. Nevertheless, scientific experts from Hasselt University will be actively involved in

each Lighthouse Mission. A project inventory is currently being conducted at UH. Due to its status as a comprehensive university, Hasselt University will contribute particularly to EURECA-PRO's consumer research. Additionally, UH plans to create its own Lighthouse Mission.

4.2.2 Holistic Research

EURECA-PRO wants to be a holistic research and educational institution in the field of SDG 12. In order not to lose sight of the big picture, it is necessary to have expertise in both consumption and production of goods. In addition to proven expertise, a direct and indirect connection to varied scientific disciplines is essential for EURECA-PRO to be able to adequately reflect our current way of life in the Anthropocene. Only through the dissemination of knowledge across scientific disciplines can knowledge be accumulated sustainably. According to the United Nations, "sustainable consumption and production is about doing more and better with less. It is also about decoupling economic growth from environmental degradation, increasing resource efficiency and promoting sustainable lifestyles"[18].

In order to achieve these targets, it is essential for EURECA-PRO's work to be both trans- and interdisciplinary. Based on the gap analysis of EURECA-PRO's research projects, strengths and weakness analyses were carried out within the consortium. Since most of the universities within the alliance are technical universities (with a focus on mining), EURECA-PRO has extensive expertise in the field of production. However, consumption sector expertise is not as well developed. As a result, special attention is being paid to acquiring additional know-how in this sector as EURECA-PRO expands its alliance to include new partners. The Hasselt University, for example, is one step towards building a comprehensive university campus with comprehensive expertise in both consumption and production.

4.2.2.1 SDG 12 Production

What are the impacts of products and services not only at their point of sale in Europe, but during their entire supply chain and life cycle? Which of these impacts are not influenced by European legislation? Many products currently consumed in the EU have a large

[18] UN, Goal 12: Ensure sustainable consumption and production patterns, 2022,

available at: [https://www.un.org/sustainabledevelopment/sustainable-consumption-production/] accessed 16.08.2022

environmental impact in third countries. Due to disparities in production and consumption with EU trading partners, important sustainability issues related to various products and services are not being sufficiently addressed. As a result of the large number of technical and mining universities within the EURECA-PRO alliance, enormous knowledge of these issues exists. Building on this foundation, EURECA-PRO plans to conduct first-class research on the environmental impact of production. As consciousness of the finiteness of earth's resources grows, questions about the social and scientific impacts of consumption multiply.

EURECA-PRO seeks to use a holistic approach to answer these questions.

4.2.2.2 SDG 12 Consumption

The implementation of Lighthouse Missions 1 ("Responsible Material Flows") and 3 ("Sustainable Materials and Products") reflects a focus on overlaps, and especially on the importance of interdisciplinary knowledge related to the production and consumption of goods and services. Today, supply chains are rudimentarily described by Life Cycle Assessment (LCA) software and databases as well as general information databases such as ProBas and Agribalyse. This is not the case when it comes to consumption. Due to insufficient cradle-to-cradle evaluation, particularly of goods, a very inaccurate picture of respective product impacts has been drawn. Although cradle to gate represents a sufficient system boundary for most companies, it usually reflects only a fraction of the environmental impacts that occur within a product's life chain. EURECA-PRO's expansion, so far to integrate the Hasselt University but with future plans to further expand the associated partners network, will support improved research into these consumption-related challenges. By using future research to understand whole life cycles in research and education, additive value will be created for industry, society and all EURECA-PRO partners.

4.2.3 Research about Responsible Companies, NGOs, Communities and Cities

In order to find the right associated partners for EURECA-PRO, it is essential to conduct thorough preliminary analysis of the strengths and weaknesses of potential candidates. EURECA-PRO is also specifically looking for NGOs to support the European University's activities in the field of Responsible Consumption and Production. Since many entities are advertised as sustainable, it is important that EURECA-PRO protects its global reputation as an educational and research core hub of SDG 12 and defends it against free riders by being discerning in its selection criteria. EURECA-PRO does this is by requiring associated partners

to commit themselves to the core values of EURECA-PRO by signing a Letter of Intent that excludes unsustainable business practices within the alliance. This signed Letter of Intent ensures that companies whose values do not align with those of EURECA-PRO will be excluded as partners.

4.2.4 Strategic Alignment

In addition to alliance development, local conditions and the expertise of potential partners must be considered as EURECA-PRO seeks to further its knowledge and expand its reach. Sustainable consumption and production requires a special focus on an overall social transformation that is currently in its early stage of development. Therefore, EURECA-PRO seeks additional partners who are in the position to be changemakers in the field of societal sustainable development. However, the possibility is not excluded that EURECA-PRO's support could help former polluters to become such pioneers.

4.2.4.1 Location, Expertise and Potential for Change

The establishment of partnerships with entities in geographic proximity to EURECA-PRO universities is essential to ensure close integration with local society and industry. In phase one, EURECA-PRO's associated partners network will be expanded regionally and locally to include companies that understand EURECA-PRO's vision and want to contribute to it. In phase two, additional SDG 12 pioneers on a national level will be integrated into the network. This thematic broadening is meant to support an eventual transition to phase 3: partner expansion. In this third phase, transnational and global institutions will be actively involved in research and knowledge transfer to substantially increase EURECA-PRO's reach. This expanded reach will in turn support the involvement of the broader society. Given that climate targets will most likely be missed by 2035 at the latest, it is all the more essential that EURECA-PRO has completed all three phases of partner expansion by this time.

4.3 Templates

In order to professionalise EURECA-PRO's external appearance as well as to ensure that EURECA-PRO is recognized as a consortium, various exposés were created. Within these exposés, EURECA-PRO seeks to emphasise its SDG12-related research and education. In addition, a letter of intent defining possible future EURECA-PRO research and its overarching focus was drafted.

4.3.1 Exposés

In order to align its external communication and visual branding, EURECA-PRO created exposés, and flyers about the universities as well as for study programmes. The EURECA-PRO core team of Montanuniversität Leoben (MUL) drafted the first version of the flyers and exposés based on valuable input from partner universities. To build a transparent decision-making process, the application Miro Boards was used both to brainstorm and for final design. After finalising the first drafts, decision-making authorities at MUL reviewed and approved the material. A subsequent review process was then conducted with all partners. The figures 7-10 show one of our flyers that has been created for the EURECA-PRO RCP Studies.

Figure 7: Flyer 1 – Study Programmes - page 1-3

Bachelor's Study Programme
7 semesters + internship
240 ECTS

WHAT WILL I STUDY?

Semesters 1 and 2 at Montanuniversität Leoben:

- Introductory Module
- Module Fundamentals of Chemistry
- Module Fundamentals of Mathematics
- Module Fundamentals of Physics
- Module Fundamentals of Engineering Mechanics
- Module Digital Competences & Statistics Fundamentals
- Do-it Labs eg. on Circular Economy

Semesters 3 to 6: you choose!
Stay in Leoben or go to one of our partners.

- Module 1 Engineering Disciplines
- Module 2 Sustainable Development
- Module 3 Primary Raw Materials
- Module 4 Secondary Raw Materials and Recycling
- Module 5 Process Engineering
- Module 6 Materials
- Do-it Labs

Semester 7: It's time to learn about responsible consumption! Study at one of our partner universities.

To apply the knowledge and skills acquired in the studies as well as gain jobs skills, choose your company for the compulsory internship.

Free electives | Bachelor thesis

Master's Study Programme
4 semesters
120 ECTS

WHAT WILL I STUDY?

In the master's programme you are free to choose in which order you want to complete the mandatory modules, and your specialisation (=electives) in the semesters 1 to 3.

Mandatory Modules

- Sustainable Development at Montanuniversität Leoben
- Responsible Consumption at one of our partners

Pick one of four specialisations (=electives), which you can either complete in Leoben or at one of our partners.

- Material Sciences
- Primary Raw Materials
- Secondary Raw Materials and Recycling
- Process Engineering (Metallurgy, Building Materials etc.)

Digitalisation is central to this study programme and is integrated into all modules.

Semester 4: further explore your most favourite topic and write your master thesis.

Where will I study?

During the Bachelor's, Master's or PhD programme, you will explore Europe studying at our partner universities in at least two countries.

- Austria: Montanuniversität Leoben
- Belgium: Hasselt University
- Germany: TU Bergakademie Freiberg, Hochschule Mittweida
- Greece: Technical University of Crete
- Poland: Silesian University of Technology
- Spain: Universidad de Léon
- Romania: University of Petrosani

All subjects are taught in English.

Figure 8: Flyer 1 – Study Programmes - page 4-6

Career perspectives

Graduates of the study programmes in Responsible Consumption and Production occupy - *nationally* and *internationally* - *key positions* in companies, institutions, industry organisations and public authorities.

Sectors in which graduates can apply their knowledge and competence may include:

- Raw material extraction and processing industry,
- Cement and binder industry,
- Metallurgical industry,
- Companies in the recycling sector,
- Plastics industry,
- Product manufacturing companies,
- Plant construction companies
- Companies in the service sector
- Public institutions
- Municipalities
- NGOs
- Consulting companies

In this context, their expertise is also in great demand with regard to the development of regulations towards the circular economy and sustainably designed material flows in the production and consumption sector.

Further benefits for you

- degree programmes that are unique in Europe
- learn about global pressing challenges
- explore Europe during your studies
- learn skills that prepare you for international jobs (bonus: your English becomes perfect!)
- study abroad without losing time in your studies and don't worry about funding ;)
- be part of a Europe-wide network & community
- participate in great events (e.g. STEM contest, internships, summer schools)
- a dedicated EURECA-PRO team who looks afters the students directly and indirectly

...and so many more. Be part of it and enroll now!

Figure 9: Flyer 1 – Study Programmes - page 7-8

Figure 10: Flyer 1 – Study Programmes - page 9-10

The following figures 11-12 and 13-14 show exposés of EURECA-PRO.

Figure 11: Flyer 2 – Exposé 1 EURECA-PRO - page 5, 6, 1

Figure 12: Flyer 2 – Exposé 1 EURECA-PRO - page 2-4

OUR OFFER

- Regularly held stakeholder days, to show you the latest scientific results and also to answer your individual questions.
- An international university located in 7 different countries with over 60.000 students and 10.000 staff members.
- Unique expertise in the field of SDG 12 and correlated contract and grant-funded research in any university within our alliance.
- A "comprehensive" university with high-class reputation and at the same time specialisation in the whole value creation cycle.
- Possibility to present at EURECA-PRO events and expand your international network.
- EURECA-PRO can support you with lectures and workshops.
- Possibility to jointly organise events on SDG12, European Green Deal, Circular Economy, Planetary Boundaries etc.

ABOUT US

Eight Universities in seven different countries (all over Europe: Germany, Belgium, Spain, Greece, Romania, Poland and Austria), have joined forces to achieve one common goal:
to be the worldwide core hub for issues and topics around sustainabilty and responsible consumption and production. The future is now.

Sustainability is not just a phrase for us. Our goal is to tackle pressing social, economic and environmental problems worldwide. Through our novel research approach, involving civil society and industry, we aim at rethinking sustainability holistically without leaving anyone behind.

Do you, or your company need support to answer questions about sustainability, sustainability reporting, or what the future will hold for you (rapidly changing systems)?
Then you've come to the right place. The EURECA-PRO team is available for all questions and will be very happy to help you for your own future sustainability journey.

Figure 13: Flyer 3 – Exposé 2 EURECA-PRO - page 3, 2, 1

OUR OFFER

- Possibility to attract graduates from partner universities for your industry/ company (>60.000 students).
- The EURECA-PRO consortium includes over 10.000 employees and over 80 departments/faculties with researchers and teachers in all areas of sustainability and the circular economy (especially SDG12). Here, joint research projects are just as conceivable as joint publications.
- We offer media companies the opportunity of regular information about our events, research performance and teaching for new, fresh media contributions on today's crucial topics.
- Do you want to have supervised bachelor's, master's or doctoral thesis on topics that are important to you? If the topics fit to the scientific agenda of EURECA-PRO we would love hearing from you.
- Joint external appearance & a reliable international partner with top ranked associated universities.

HOW TO SUPPORT US

ASSISTANCE IN RESEARCH & SUBMISSION OF JOINT PROJECTS

For current and future projects, we need reliable partners who are willing to make an important contribution to research. Please contact xyz

MONETARY DONATIONS

- You want to use the resources of an international, globally connected university, with high-class reputation?
- You want to kick start a new era of international univiersities or can connect to the values of EURECA-PRO? Please get in touch with our Industrial Liaison Department.

BE A PARTNER FOR OUR NEXT EVENTS

EURECA-PRO regularly holds events on topics related to sustainability and responsible production and consumption that can be followed via livestreams worldwide. Would you like to be a part of it? Please contact the EURECA-PRO team to discuss further details: info@eurecapro.eu.

Contact Details

EURECA-PRO

info@eurecapro.eu
www.eurecapro.eu

For more information **follow us on instagram**. Information about: studies and your possibilities are coming soon!

EURECA-PRO
RESEARCH & INNOVATION

Figure 14: Flyer 3 – Exposé 2 EURECA-PRO - page 4-6

An exposé focused on the strengths of individual EURECA-PRO universities and of EURECA-PRO as a whole is currently under development.

4.3.2 Letter of Intent

In order to link associated partners with EURECA-PRO and its values, a letter of intent was drafted to be signed by the decision makers of the joining institution. To ensure that the signed document is in line with relevant national legislation, the letter of intent is then reviewed by EURECA-PRO's governance department. Following review, the letter is finalised and submitted to each associated partner for signature (figure 15).

Full name of the assoc. partner
Address 1
Address 2
Address 3
Email contact

Logo of the assoc. partner

To
Susanne Feiel
Lisa Pichler
Montanuniversität Leoben,
Büro für Internationale Beziehungen
Franz Josef Strasse 18
8700 Leoben / Austria
Lisa.pichler@unileoben.ac.at

Location, Month Day, 2022

Letter of Intent

With this letter of Intent, we wish to give our support as an Associate Partner to the Consortium that currently consists of seven universities located in Austria, Germany, Greece, Poland, Romania and Spain, and plans to be expanded, for

The European University on Responsible Consumption and Production (EURECA-PRO)

funded by the European Commission within the ERASMUS+ Programme, which started in November 2020.

We fully support the idea of this European University Alliance based on the Sustainable Development Goals of the United Nations, especially SDG12, we are committed to the Paris Climate Agreement, Circular Economy and we will act in accordance with the values of EURECA-PRO. Name of assoc. partner hereby agrees to be named as a supporting partner of the Alliance.

We pledge our assistance through inputs according to our abilities and we will contribute to the communication and dissemination of the outcomes.

Yours sincerely,

first name surname

Figure 15: Final version of the letter of intent

4.3.3 Details of Associated Partners

In order to involve associated partners in EURECA-PRO tasks, detailed questionnaires are sent out to joining partners. In addition to the usual queries such as company name, address and contact addresses, a special focus is placed on areas of work and on the new partner's unique

expertise. Table 4 shows the template of this questionnaire. Additionally, completed tables are available in the appendix of this deliverable. Based on these questionnaires, associated partners are assigned to the Work Packages and Lighthouse Missions where they can most effectively contribute.

Tab. 4: Template of the associated partners questionnaire

Associate Partners	
for *The European University on Responsible Consumption and Production* (EURECA-PRO)	
Contact details of the organisation	
	Please enter your information here
Name	
Address	
Email	
Phone Including international dialing code	
Type of organisation	
	Please enter your information here
What is the type of the organisation? e.g. international industry association, higher education institution, research centre, enterprise, public body, NGO, media company etc.	
What are the main aims and activities of the organisation?	
What is the radius of action of the organisation? In particular outreach, such as number of employees, recipients of newsletters, readers and viewers of media companies reached, etc.	
Role of the organisation in the alliance	
	To be completed by the EURECA-PRO partner university
Partner university that initiated the contact?	
What will be the role in the alliance? **In which way will EURECA-PRO be supported?**	
To which WP n° will the company contribute?	

4.4 Associated Partners (August 2022)

EURECA-PRO was initiated with 24 associated partners and a project structure plan to successively expand this partnership network as a way to grow insufficient research and education expertise in the alliance. As of August, 2022, EURECA-PRO has 32 associated partners. Additionally, EURECA-PRO is in final discussions with two more potential partners. In addition to future expansions, binding current partners to the alliance long term is important. A successful integration, therefore, should avoid a brain drain, which weakens research and education. This does not mean that all potential partners are suitable—the International Competence Centre for Mining (UNESCO), for example, had to be excluded from the alliance and the partnership with Saint Petersburg University was terminated due to the condemnable Russian war of aggression against Ukraine. Current associated partners are described below; a detailed breakdown of the partners can be found in the appendix of this deliverable.

Media partners

ARTE G.E.I.E.

ARTE is a French-German television network that promotes cultural programming. As a responsible European public media provider, ARTE is committed to covering issues that are important to European citizens, for example social, cultural, economic, geographical, gender- or disability-related inequality, and the promotion of sustainable development (https://www.arte.tv/sites/corporate/en/who-we-are; 17.08.2022).

One of EURECA-PRO's most important tasks is raising societal awareness of sustainability goals and challenges. To this end, media collaborations can be helpful, especially with newspapers and TV programmes. ARTE will support and contribute to the proposal with publishing outcomes and challenges.

Wiener Zeitung GmbH

Wiener Zeitung GmbH is the oldest Austrian Newspaper in publication that is owned by the Republic of Austria; it is used for Austria's formal announcements. The newspaper publishes articles on myriad political, cultural and economic topics through various medias (print, online and social media). Its quality is guaranteed by its membership in the Austrian Press Council,

which binds its members to a code of honour. Additionally, the Wiener Zeitung has established an SDG channel for sharing information.

EURECA-PRO's relationship with the Wiener Zeitung further supports its goal of increasing societal awareness with respect to sustainability issues. As a high-quality newspaper, the Wiener Zeitung will contribute to EURECA-PRO's mission by using research results and useful information as agreed upon by the Republic of Austria.

Strengthening the Lighthouse Missions

External expertise from the following NGOs, companies and government institutions are needed to start collaboration on the topic of the alliance and to find out if they are valuable challenge owner. This work will be organised by integrating them into EURECA-PRO research groups.

Polish Society of Circular Economy (PSCE)

The main aim of PSCE is to protect the environment and improve waste management, in particular by using recovery technologies, in the Republic of Poland and the broader European Union. PSCE promotes environmentally-friendly waste management focused on reusing and recycling.

Katowicka Specjalna Strefa Ekonomiczna (KSSE)

The Katowice Special Economic Zone is a world-leading Polish economic zone where over 390 business entities currently operate. Since the economic zone unites numerous companies, it can be used to establish cooperative links that support EURECA-PRO's commitment to problem-based learning.

Fundación Ciudad de la Energia - Ciuden, F.S.P.

CIUDEN is a Spanish Government institution created to execute R&D&I programs related to energy and the environment and contribute to the economic development of the Bierzo. It is a foundation of the state public sector, under the Secretary of Energy of the Ministry for Ecological Transition and Demographic Challenge (MITECO).

Ente Público Regional de la Energía de Castilla y León (EREN)

(Regional Entity of Energy of Castilla y León)

EREN is the regional institution in charge of impulse and the realization of programs linked to activities for the research, study and support of the energetic technological actions, with the inclusion of the renewable ones. Likewise, it promotes the improvement of the saving and the efficiency energy, the promotion of the rational use of energy, integrating the protection of the environment and the optimal management of energy resources, in the different economic sectors of Castilla y León, thus serving as support for the promotion and execution of the energy policy of the region.

IMASALEON INGENIERIA S.L.P.

The company comprises engineers and architects with the vision of improving the quality of life of people using all the technical tools available. They combine pioneer spirit with their experience and are active in different public and private fields both nationally and internationally.

Red Ambiente S.L.

The company has expertise in environmental engineering and consulting, pollution studies and environmental diagnostics as well as environmental training and sustainable development. In its history, Red Ambiente S.L. has successfully developed around a thousand projects at national and international level.

SERVIMA, Servicios Ambientales y Recursos Educativos, S.L.

The company sees itself as an intermediate, which provides and manages the means and coordination necessary for consulting institutions and companies on the matters of environment. In this sense the company also provides education.

Support for EURECA-PRO education

Aalborg Centre for Problem-Based Learning in Engineering Science and Sustainability under the Auspices of UNESCO

The Aalborg Centre combines Problem and Project-Based Learning (PBL), Engineering Education Research (EER) and Education for Sustainable Development (ESD) to contribute to

beneficial reformation of higher education. The UNESCO centre has two foci: education and research.

The Aalborg Centre's educational expertise can be used in EURECA-PRO's Education Task Force and in the Research Task Force. It will also be a vital asset in interfacing between research and education and will help EURECA-PRO to define challenges to problem-based learning (PBL) based on ongoing challenge-based research.

Campus M21 GmbH

The Campus M21 GmbH is a private higher education institution (HEI) with many fields of education such as international marketing or management and media management.

The HEI has a vast network of professors and lecturers to augment the pool of EURECA-PRO lecturers.

COBANT Group S.A.

COBANT Group is a joint-stock company that is involved in post-industrial site reclamation and waste recovery. With its modern mobile installation for coal waste recovery and on-site coal slurry pond reclamation as well as other projects related to waste reuse and recovery it fits perfectly to the overall idea and project aims.

COBANT Goup S.A. supports the definition of the problem-based learning (PBL) challenges to be established that are deducted from the ongoing challenge-based research. Therefore, they will be part of an Education Interface Task Force.

<u>Student involvement</u>

It is important for the alliance to keep close ties with students, who are the target group of EURECA-PRO programmes. Student co-creation is key to the development of the alliance; therefore, student organisations are included as associated partners. Furthermore, including student organisations in interinstitutional research groups working in WP 3 will establish a common understanding of SDG 12 sustainability frameworks.

AEGEE-León European Students´ Forum (Edificio de Servicios)

AEGEE is one of Europe's biggest interdisciplinary student organisations. As a non-governmental, politically independent non-profit organisation, AEGEE is open to students and

young people from all faculties and disciplines. Founded in 1985 in Paris, today AEGEE has grown to a Network of 13.000 AEGEEans spread across 161 cities in 40 countries all over Europe (https://www.aegee.org/about-aegee; 17.08.2022).

Erasmus Student Network Spain (ESN)

Erasmus Student Network is one of the largest interdisciplinary associations in Europe, founded support and develop student exchange.

Coordinadora de Representantes de Estudiantes de Universidades Públicas - CREUP (Spanish Coordination of Students' representants of Public Universities)

The organisation unites students' representatives of public universities and advocates the rights and claims of the students. CREUP is the national association representing more than 1,000,000 students. Currently consisting of 35 public universities and in constant growth, 19 years of raising the voice of the student body to the relevant organisations on matters of higher education both nationally and internationally.

National, regional and municipal authorities

National, regional and municipal authorities will be members of a consultation process to analyse the legislative bases for the creation of the autonomous European University, its degrees and their recognition.

Ayto de León (City council of León)

The city council is the legislative instance that governs the city of León.

Junta de Castilla y León, Consejeria de Educación (Regional Ministry of Education of Castile and León)

The Junta of Castile and León is the governing and administrative body of the autonomous region of Castile and León. The function of the Junta is to administer and govern the autonomous community. They will be part of an Education Interface Task Force, which establishes the problem-based learning challenge.

Consejo Comarcal De El Bierzo (County council El Bierzo)

The county council is the legislative instance that governs the county El Bierzo.

Cityhall of Ponferrada

Ponferrada is the second city of the province in size. It is the administrative capital of El Bierzo county. El Bierzo was the heart of the coal mining in León and now it is in the midst of industrial reconfiguring using sustainability as a flagship. Ponferrada, and El Bierzo, have great compromises with new models of production linked with the respect for the natural environment and life cycles. They will be part of an Education Interface Task Force, which establishes the problem-based learning challenge.

Industrie- und Handelskammer Chemnitz

The Chamber of Commerce and Industry Chemnitz (CCI Chemnitz) is the representation of interests of the companies of commerce and industry in the region of Chemnitz and the employees are responsible for about 70.000 member-companies.

CCI Chemnitz uses its own media to inform its member-companies in South-West Saxony. CCI Chemnitz supports the role of the Mittweida University of Applied Sciences and TU Bergakademie Freiberg within EURECA-PRO.

Further support for EURECA-PRO

Hellenic Health Foundation

The Hellenic Health Foundation (HHF) provides expertise in the area of health research. Its efforts are focused on informing the general public on important health issues.

The foundation will be the liaison among SDG 12 Responsible Consumption and Production on one hand and health-related issues on the other hand. This includes that the foundation will provide input into the interface of health, climate change and responsible production and consumption food systems.

Engineers for a sustainable future

The organisation aims to bring the topics sustainability, environmental protection and climate change closer to students of engineering degrees.

It is important to bring these topics to the future graduates and professionals because many will work in leading position in sectors where they can have a high impact on the future

development. ESF will bring this perspective. In the development and re-adjustment of the working of the alliance student co-creation will be key, therefore student organisations are included as associated partners. Furthermore, student organisations are needed to be part of the interinstitutional research groups working in WP 3 to establish a common understanding of sustainability frameworks relating to SDG 12. ESF can help here as it unites students with a high interest in sustainability."

IIASA – International Institute for Applied Systems Analysis

IIASA is an international, independent research institute with National Member Organisations in Africa, the Americas, Asia, and Europe. Its research activities are based on system analysis into issues too large or complex to be solved by a single country or academic discipline. This includes humanities' great challenges of the 21st century such as climate change, energy security, and sustainable development.

The research institute IIASA supports the formation of a Research Task Force and will be a valuable asset to the interinstitutional research groups working in WP 3 to establish a common understanding of sustainability frameworks relating to SDG 12 within the Challenge Lighthouses. Being an expert on research on complex issues IIASA is an ideal support for the work on SDG 12 because the SDGs are multi-layered and link to the various other SDGs.

edmedien GmbH

Conception and developing of education projects and further education are the main aim of edmedien GmbH. Saxony is the home base, where edmedien is interconnected in the regions, but their networks reach far beyond the borders of Saxony.

It will be an additional expert contact involved in the development of the programmes that the alliance will create. It will also be supporting the development of digital courses.

Climate Change Centre Austria

The CCCA is the network of Austrian climate research. It characterises climate research as the scientific examination of climate change, its systemic causes, its effects on society, economy and environment, as well as mitigation and adaptation strategies. The CCCA does not actively conduct research but sees itself as an institution which coordinates Austrian climate research. The CCCA sees its social responsibility in providing and communicating scientifically sound

contributions to combat challenges associated with climate change. The CCCA sees itself as the focal point for all questions on the physical and societal basis of climate change, adaptation and mitigation.

EURECA-PRO will be supported according to CCCA's possibilities and by contribution to communication as well as dissemination. Further possible cooperation content:

- Regular updates and meetings for information exchange on operational agenda
- Support finding appropriate experts for technical advice and consultation if needed

Fraunhofer Institute for Machine Tools and Forming Technology IWU

Fraunhofer Institute for Machine Tools and Forming Technology IWU is a driver for innovations in the research and development of production engineering. The Institute taps the potential for competitive manufacturing in automotive and mechanical engineering, aerospace technology, medical engineering, electrical engineering, and precision and micro engineering. It focuses on scientific developments and contract research concerning components, processes, methods, and the associated complex machine systems – the entire factory. The Fraunhofer IWU develops technologies and intelligent production systems for car body and powertrain components and optimizes production stages of forming, cutting, and joining processes while considering the entire process chain, factoring in regenerative systems and circular economy. Crucial factors of success include the development of innovative lightweight structures and technologies for the processing of new materials, the transfer of functions into assembly units, and last but not least, the economic utilization of fuel cell technologies.

The Fraunhofer IWU is one of the leading research institutes in the field of production technologies as well as in the subject areas of Industry 4.0, green economy and circular economy. Based on many years of experience, the institute can support the alliance both in terms of research and implementation with industrial partners."

TeleskopEffekt GmbH

TeleskopEffekt is the innovation engine for banks, medium-sized companies and start-ups. It sees itself as driver of digitization. It reduces complexity and offers orientation. It accompanies and enables banks and companies on their way to initiating and implementing digital projects. It offers direct access to future technologies, creates opportunities to try things out and helps

applied technologies to become new business models. Digital change can only succeed together. That's why TeleskopEffekt offers a unique ecosystem of startups, companies and public partners. Regionally, nationally and internationally, it brings the best minds and ideas together to put its customers' innovations on the road.

It is an innovation forge for sustainable digitization with a special focus on various future technologies. It is the network node for a vital innovation ecosystem, which is constantly being expanded by partner companies and partner institutions. Among other things, it has direct access to digitization pioneers such as Estonia and its partners are leaders in methods and technologies. It is the operator of the innovation center Werkbank32, where startups and outstanding ideas in particular are supported.

Volksbank Mittweida eG

As a cooperative regional bank it serves all traditional banking businesses with a focus on retail and corporate banking. In addition to its core banking business, it is intensively engaged in innovative and promising topics and business models. The purpose of Volksbank Mittweida eG consists of the cooperative mission to promote its members, which is anchored in its statute. Volksbank Mittweida eG focuses all activities on the economic promotion and support of its members and customers. It will provide general support for EURECA-PRO.

Förderkreis Hochschule Mittweida e.V.

The main activities are promotion of science and research, education and training as well as art and culture at the Mittweida University of Applied Sciences.

Possible support for EURECA-PRO could be: Participation in and support of exhibitions; visits by public figures and conferences; purchase of objects for the museum's technical collections; recognition of outstanding student theses; awarding of interest-free loans to students; awarding of scholarships to students; support and participation in graduate reunions.

Cinector GmbH

It is a producer of software for digital learning and communicative solutions.

Cinector GmbH will support: Presentation and use of teaching/learning software as appropriate; implementation of teaching/learning videos; experience with start-ups and spin-offs.

Prostartup

The owner-managed company offers experience to start-ups:

- in the development of corporate and management structures,
- in crisis management during restructuring,
- in personnel management and communication management,
- in the development of family-friendly corporate policies,
- lecturing on corporate development, leadership and on media and medical technology"

Prostartup will help with lecturing and teaching, mentoring, internships, as well as master's theses.

IMM electronics GmbH

IMM electronics GmbH has a special focus on E²MS (Electronic Engineering and Manufacturing Services) of customized products and printed circuit boards.

The company will provide internships, BA theses and MA theses for EURECA-PRO.

4.5 Further Procedure

In order to ensure high-quality work in the research unit beyond the initial project duration, future planning based on an evaluation of past tasks and work assignments is currently being carried out. The overall goal of this planning is to condense collected expertise under one umbrella in support of a holistic approach to SDG 12 issues. EURECA-PRO will initiate and conduct inter-university research in the final phase of the first project period. This joint research represents a milestone for the alliance as well as for EURECA-PRO's ability to present itself to the world. Within the scope of this joint research, projects will be submitted to various funding institutions. This, in turn, will directly contribute to EURECA-PRO's financial sustainability and further anchor EURECA-PRO within each partner university.

4.5.1 Cities and Communities as Strategic Partners

In order to create long-term change toward a more sustainable way of living within our planetary boundaries, it is of great strategic importance to actively involve regional as well as national cities and municipalities. The first step in this process seeks to inspire all "home cities and municipalities" of EURECA-PRO partners and to win them as associated partners (Phase 1). Open Science does not only mean publishing research results in open-access journals, but

also actively approaching the population to answer SDG 12-related questions; systemic change can only be achieved if all stakeholders are enthusiastically on board.

In the second step of strategic city and community partnerships (Phase 2), cities and municipalities that are pioneers in thematic areas of SDG 12 are to be integrated into the EURECA-PRO network as partners. This expansion is intended to accumulate expertise that will further boost the work in EURECA-PRO's various Lighthouse Missions. In the final step, Phase 3, nationally active institutions are to be the key stakeholders (ministries, chambers of commerce, chambers of labor, etc.). Information from these institutions will help to submit research projects of European relevance by EURECA-PRO. New study programmes and research priorities are communicated to the Federal Ministries of Education, Science and Research. The SDG targets cannot all be achieved by EURECA-PRO alone, for example target 12.6 - *Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle* - needs to be supported by influential associated partners with political background. Target 12.7 - *Promote public procurement practices that are sustainable, in accordance with national policies and priorities* - will be covered by internal awareness raising of the consortium and in a second step by contacting procurement agencies and policy makers. All other SDG targets are reflected in the inventory and are therefore also the consortium's own competences.

4.5.2 Regional and National Media

In order to make the work of EURECA-PRO, especially its research results, available to the broader public, adequate dissemination is essential. For this reason, EURECA-PRO plans to expand its partnerships with media institutions. Therefore, a twofold media plan is already in place. To support regional/local dissemination, regional television broadcasters as well as radio broadcasters and news networks will be embedded within EURECA-PRO. After successfully connecting with local and regional media, a special focus will be turned towards (inter-)national broadcasters. By connecting with local, regional and (inter-)national media, EURECA-PRO and its results will catch the attention of a bigger audience.

4.5.3 Possible partner contributions for the next funding period

In addition to further and better networking of researchers within the Lighthouse Missions and the joint submission of projects, the establishment of a joint research project office within EURECA-PRO is planned. This office will ensure that researchers are ideally supported in their

project applications. Additionally, the research office will screen potential project calls (those that are already open as well as those soon to be opened) and link respective university research groups to relevant calls. Moreover, the office will provide valuable input related to the development and formulation of project proposals. Since EURECA-PRO's research project catalogue has been enlarged by the alliance's expansion, the project inventory itself needs a detailed update. This Second Project Evaluation in the current funding period will ensure that all already-launched Lighthouse Missions continue to reflect the research taking place within EURECA-PRO universities. In order to meet the Open Science, Open Access and lifelong learning approach, it is important that the EURECA-PRO consortium builds up a wide expertise in the field of Microcredentials. In addition, a database/repository should be created containing publications, presentations, lectures, project information, research equipment, current PhD students and their research topics. This repository is intended to serve as a knowledge management system and thereby should further foster the transfer of knowledge and the joint research performance. Due to the fact that researchers are not yet funded by EURECA-PRO, a direct benefit must be created for the scientists. By covering the travel costs for Lighthouse Mission research meetings and by paying for the working hours with EURECA-PRO funds, such benefit that supports collaboration between universities is created. A further boost for EURECA-PRO publishing would be a targeted funding of open-access publications. Since EURECA-PRO has a strong open science approach, as many publications as possible should be published in open-access. In addition, young researchers (PhD students) will also be given the opportunity to dissertate in EURECA-PRO. One goal of EURECA-PRO is therefore to finance at least one PhD student per Lighthouse Mission in the next project period. This will require additional commitment from all partner universities.

4.5.4 Tasks for Associated Partners

Activities within the Research Task Force have to be adequately coordinated and defined in order to achieve EURECA-PRO's vision. During the upcoming meeting at Technical University of Crete in Chania (27.-30.9.2022), a precise roadmap will be created to guide future research within the alliance. In this process, a landscape will be created that supports researchers and universities in their daily business based on the work done so far and the will to acquire joint research projects. With EURECA-PRO's expansion to eight partners and the further expansion to nine partners by September 2022 (Université de Lorraine), the Lighthouse Missions and

their working groups need to be reviewed. As additional expertise in consumption has been and will be acquired, an expansion of the existing five Lighthouse Missions groups to 6 - 7 groups is an important step toward supporting a holistic research and education agenda. Hasselt University has already expressed interest in leading its own Lighthouse Mission. Associated considerations will be explored in discussions in Chania. In order to better integrate all associated EURECA-PRO partners in research, thereby creating an active added value for all participants, it is planned to assign each associated partner concrete tasks within EURECA-PRO. Corresponding tasks for associated partners will also be discussed during the review week in Chania. For associated partners, such a task allocation should not result in much additional work, but rather create a win-win situation based on streamlining and clarifying already existing work.

5 Report on LH Implementation (July 2022)

5.1 Introduction

The Paris Climate Agreement[19], the European Green Deal[20], the Sustainable Development Goals[21] and lastly the condemnable Russian war of aggression against Ukraine all show that human systems and research priorities must focus more strongly on sustainability and responsibility: a shift away from fossil energies and unsustainable behaviours is indispensable in building stability, both within the climate system and within human society. EURECA-PRO, the European University on REsponsible Consumption And PROduction, is actively promoting this shift to ensure that future generations will have living conditions equal to or better than those we enjoy today. Through the implementation of five Lighthouse research topics (Responsible Material Flows, Environment and Water, Sustainable Materials and Products, Clean Energy and Process Automation and Industry 4.0) and the new establishment of further LH missions, EURECA-PRO is creating a research

[19] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[20] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, The European Green Deal, COM(2019) 640 final, Brussels, 11.12.2019

[21] https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

environment focused on actively developing solutions to current global challenges. Proactive work of EURECA-PRO's individual, trans-university research groups can identify these challenges at an early stage and, ideally, find solutions before problems even manifest. All EURECA-PRO research groups submit project proposals to various national and international funding bodies, thus improving the international positioning of EURECA-PRO as a future core hub for SDG 12 topics while conducting solution-focused research. The planned and already implemented expansions of EURECA-PRO will allow for a holistic approach to SDG 12 topics. These expansions reflect an effort to gather additional, previously unavailable expertise and add depth to the EURECA-PRO alliance and ensure the ability to represent a comprehensive university actively involved in all scientific research disciplines. This transdisciplinary research approach furthermore ensures that EURECA-PRO is as inclusive as possible and that no one is left behind.

5.2 Lighthouse Missions (LH)

5.2.1 LH1 – Responsible Material Flows

Lead University: University of León, Spain

Definition of Lighthouse Mission 1 (LH1) by Angela Taboada, PhD, in collaboration with the LH1 research group

Introduction to Lighthouse Mission 1 [22]

The current economic system of human civilisation is built on growth. But what can sustainable growth look like, can there be growth that does not disadvantage future generations? In order to prevent or reduce future resource scarcity, it is essential to understand the environmental impact of product flows. In examining the negative environmental impacts of extraction and production, the consumption phase and end use must be considered in more detail. Given that products generate an impact along their entire value chain, it is necessary to evaluate all stages of this chain and to analyse not only environmental impacts, but also the social and economic consequences of production. Such holistic data collection and analysis enables decisions that adequately respond to complex

[22] EURECA-PRO Deliverable D3.2, Catalogue of Lighthouse Missions (LH), submitted to EC on October 31, 2021.

problems. The goal is to direct all aspects of human life into sustainable paths based on a closed-loop economy. To achieve this goal, a risk impact assessment must be carried out. Subsequently, the alternative with the least consequential damages must be selected. Cradle to cradle is already possible. In order to consistently adhere to these guidelines, everyone involved must be on board and integrated into the process.[22]

General Objective for the First Project Application

To bring a transformative change to European society, and especially to the youth, in order to reduce the current environmental footprint of plastic consumption and production, thereby addressing related impacts on biodiversity and ecosystem services.

Possible sub-objectives

1) To apply Citizen Science to improve and disseminate knowledge of the causes of biodiversity decline, particularly in relation to plastic and its profound impact on ecosystem services upon which human health depends.
2) To develop a sustainable and innovative solution that addresses the impact of plastic waste on biodiversity loss by closely collaborating with businesses to convert plastic waste into high-quality, secondary raw materials and thereby reduce the use of natural resources.
3) To prevent plastic pollution, especially in marine environments, by transformatively involving consumers with a focus on the youth (who will be the end-users of project results). (…)

Relevant Key Actors (Multi-actor Approach)

Consumer associations, young citizens (high school students and undergraduates), civil society organisations (NGOs such as ECOEMBES and The Ocean Cleanup; fishermen's groups), businesses related to plastic recovery and transformation into second-life products (such as fabrics: 'ECOALF', 'Textil Santanderina'; furniture: 'Revolución Limo'; mobility products: 'ZICLA'; and petrochemical products and chemical compounds: 'Nantek'). Build synergies with MARLISCO EU 7FP Project.

Project Proposal Contributions

1) The UN's Sustainable Development Goal 12: responsible consumption and production. Target 12.5: substantially reduce waste generation through prevention, reduction, recycling, and reuse. Target 4: quality education (target 4.3: education for sustainable development and global citizenship).
2) European Green Deal: seeks to foster innovation supportive of circular economy development to reduce waste from industrial processes while avoiding trade-offs that damage biodiversity.
3) Horizon Europe Strategic Plan Orientation C (make Europe the first climate-neutral and sustainable economy by transforming its production systems) and D (create a more resilient European society by empowering all citizens to act in the green transition).
4) EU Biodiversity Strategy for 2030: protect and restore the integrity of ecosystems to support their capacity to deliver a wide range of essential services while avoiding biodiversity loss.
5) Circular Economy Action Plan.
6) EU Plastics Strategy.

Expected impacts

1) Biodiversity and Ecosystem Services are expected to be preserved as a result of improved knowledge and innovation (Destination: Biodiversity and Ecosystem Services).
2) Sustainable and circular management of resources and prevention/removal of pollution, when mainstreamed, will guarantee healthy ecosystems based on a better understanding of planetary boundaries and the deployment of innovative technologies (Destinations: Circular economy and bioeconomy sectors, and Clean environment and zero pollution).

Lighthouse Mission 1 Topics

1) Use a Citizen Science approach to estimate the biodiversity footprint of plastics, especially in marine environments, and to conduct an economic analysis. Potential partners: Research Groups 402 ULE, 384 ULE; local high schools, undergraduates, fishermen.

2) Improve the processes of plastic waste recovery and classification through artificial intelligence (either by detecting plastic islands through visual analysis of Copernicus satellite images—remote sensing—or by helping industrial classification processes of plastic waste, e.g. plastic bottle caps). Potential partners: Research Groups 397 ULE, 453 ULE; The Ocean Cleanup.
3) Design an innovative and cheap solution to transform plastic waste (like plastic bottle caps) into raw material for 3D printing (prototype design, viability analysis, etc.). Potential partners: Businesses, Research Groups 403 ULE, 444 ULE.
4) Develop a prototype product and make it available for testing in educational facilities to engage young citizens (end-users) in reducing plastic consumption and footprint while improving their learning skills. Potential partners: Research Groups 402 ULE, 384 ULE.
5) Analyse consumer perceptions and quantify the degree of consumption of second-life products (made with recycled plastic) in order to increase societal awareness and feelings of co-responsibility around the actions needed to make a green transition. Potential partners: Research Group 460 ULE.
6) Possible application to medical 3D printing.

5.2.2 LH2 – Environment and Water

Lead University: TU Bergakademie Freiberg, Germany

Definition of Lighthouse Mission 2 (LH2) by Univ.-Prof. Dr. Traugott Scheytt, Univ.-Prof. Dipl.-Ing. Dr.mont. Roland Pomberger, Asst. Prof. Dr. Alexandros Stefanakis

Introduction to Lighthouse Mission 2

The EURECA-PRO Alliance consists of Montanuniversität Leoben (Austria), Technische Universität Bergakademie Freiberg (Germany), Technical University of Crete (Greece), University of León (Spain), Silesian University of Technology (Poland), University of Petrosani (Romania) and the University of Applied Sciences Mittweida (Germany). All partner Universities are represented in LH2 and have sent members to participate in LH2 activities.

Sustainable development means meeting the needs of present generations without jeopardizing the ability of future generations to meet their own needs. The EU has mainstreamed sustainable development policies and prioritises SDG 12, "responsible consumption and production." Responsible consumption and production in this context is aimed at promoting economic growth and social cohesion without impairing environmental quality.

The objective of LH2 is to restore, protect and preserve the health of our environment and water. The mission is designed to deliver on the European Union's 2030 quantified and measurable targets for protecting and restoring ecosystems and waters, creating zero pollution, engaging in decarbonisation and reducing net greenhouse gas emissions towards neutrality.

Lighthouse Mission 2 Topics

1) Sustainable Environmental Practices

EURECA-PRO contributes to the EU Green Deal and LH2 produces techno-environmental research on the environmental performance of products, sectors and production processes in order to support evidence-based analysis indications of environmentally sustainable technologies.

LH2 identifies the best environmental technologies—measures or actions that allow organisations to minimize their impact on the environment—and promotes cutting-edge research in diverse sectors so that other organisations may apply and replicate impactful technologies.

2) Waste and Recycling

In support of the EU Circular Economy Action Plan (2015), Waste Framework Directive (2008/98/EC) and the Resource Efficiency Roadmap, LH2 will research and develop methods and applications related to Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) in waste management decision making.

Moreover, LH2 contributions will support a shift from mere waste management toward the development of a circular economy. Building on earlier end-of-waste criteria analysis for high quality waste streams, LH2 is planning to research development of nutrient recovery rules for

waste-based fertilizers, to produce new bio-based materials, to explore untapped potential in waste-to-energy and to review metals and other valuable resources.

3) Water Cycle Studies

LH2's focus on environment and water supports research and innovation exploring the production and protection of mankind's most valuable natural resource: fresh water. LH2 will contribute to the recovery of our waters, and more specifically to the following objectives:

- Protect and restore freshwater ecosystems in line with the EU Biodiversity Strategy 2030;
- Prevent and eliminate pollution of our waters in line with the EU Action Plan towards Zero Pollution for Air, Water and Soil;
- Make the sustainable blue economy carbon-neutral and circular as according to the proposed European Climate Law.

All actions of the LH2 are expected to disseminate their results according to FAIR (findable, accessible, interoperable, reusable) principles compatible with ongoing EU initiatives such as the European Open Science Cloud (EOSC). In line with this approach, specific actions within LH2 will be devoted to widening access to data and knowledge of environmental and freshwater resources through the Digital Twins.

Detailed Working plan

LH2 has agreed to work on specific topics. These topics, briefly explored, are:

1) Mining and Water Resources

Mining and groundwater are inextricably connected. A mine draining acid, for example, can devastate groundwater, rivers and aquatic life for decades. At metal mines, target ore is often rich in sulphide minerals. Exposed to water and air in the mining process, sulphides react to form sulfuric acid. This acid, in turn, can dissolve harmful metals and metalloids (like arsenic) from the surrounding rocks.

However, mining and groundwater are also connected by flooding. When abandoned mines are flooded, lignite mining areas can be re-cultivated. Flooding has significant, long-term effects on ground and surface water quality.

2) Water Contamination: Organic Trace Pollutants and Microplastics

Organic trace pollutants and microplastics are synthetic or natural compounds released from point and nonpoint resources that end up in aquatic environments at low concentrations. They are not commonly monitored and measured, but they can have adverse effects on human and aquatic health. Organic trace pollutants include pharmaceuticals and personal care products, detergents, steroid hormones, industrial chemicals, pesticides, antibiotic resistance genes and many other contaminants. Although the effects of micropollutants in aquatic environments are not yet fully understood, there are clear indications that they have acute and chronic impacts on an ecosystem. Bioaccumulation, toxicity and resistance to degradation are some of the potential risks of organic trace pollutants. Most conventional wastewater treatment plants are not designed to completely remove these compounds at low concentrations; as a result, treatment processes tend to be unskilled in removing these compounds. This research topic will therefore focus on designing and testing cost-effective and sustainable treatment technologies (such as nature-based solutions) that can control and remove organic trace pollutants from aquatic environments. In practical terms, these results will support the development of advanced solutions to fill the knowledge and application gaps existent when it comes to addressing organic trace pollutants and microplastics in aquatic environments.

3) Industrial Landfill Mining

Landfill mining and the recycling of valuable metals and other resources from existing landfills relates to issues of water contamination and associated technological challenges. As a solution, we seek to actively intervene in processes through intelligent, digital networking of machines and sensor technology. Such intervention is based on material data of waste streams, combined information from sensor data and suitable algorithms that optimize output streams in accordance with specific requirements. In addition, new methods for material characterisation will be developed that incorporate artificial intelligence approaches. To do so, individual components in landfills must be identified with additional sensors for material flow and machine monitoring in order to obtain data capable of analysing the process. Furthermore, real-time measurements will obtain information about current machine performance in order to optimise both individual machines and the process as a whole.

4) Water and Wastewater Reuse

The EU is creating new measures and initiatives to reduce irrigation risks related to water shortages and quality. A new regulation adopted in 2020, for example, builds upon the Urban Wastewater Treatment Directive (91/271/EEC) and the Water Framework Directive (WFD) (2000/60/EC) to facilitate the use of treated urban wastewater for agricultural irrigation. Such use is intended to support the EU's adaptation to climate change impacts. This regulation applies the principles of circular economy to the water sector and aims at improving both the availability of water and its efficient use. To do so, different wastewater treatment technologies should be tested, developed and upgraded to meet the relevant reuse classes. Particular focus should be paid to disinfection of pathogens and deactivation of viral indicators. Ensuring that sufficient, safe water is available for irrigation, especially during heatwaves and severe droughts, will help prevent crop shortfall and subsequent food shortages.

5.2.3 LH3 – Sustainable Materials and Products

Lead University: Technical University of Crete, Greece

Definition of Lighthouse Mission 3 (LH3) by Prof. Noni-Pagona Maravelaki and Afroditi Fotiou MSc in collaboration with the LH3 research group

Introduction to Lighthouse Mission 3

How our society uses materials is fundamental to our economic and environmental future. Global competition for finite resources will be intensified as the world population and economies grow. More productive (and therefore less impactful) use of materials will help our society to remain economically competitive, contribute to our prosperity and protect the environment in a resource-constrained future.[23]

Materials production requires a large amount of energy consumption and is a significant source of greenhouse gas (GHG) emissions, producing approximately 25% of all anthropogenic CO_2 emissions. It produces large volumes of waste, both in production and at end-of-life disposal. More efficient use of materials could play a key role in achieving multiple

[23] https://www.epa.gov/smm/sustainable-materials-management-basics

environmental and economic benefits. Such material efficiency entails the pursuit of technical strategies, business models, consumer preferences and policy instruments that would lead to a substantial reduction in the production of new materials used to deliver well-being.[24]

Sustainable materials are materials used throughout our consumer and industrial economy that can be produced in required volumes without depleting non-renewable resources and without disrupting the established, steady-state equilibrium of the environment or key natural resource systems.[25]

The term *sustainable materials* refers to locally sourced materials with low embodied energy (anything a material requires for growth, production and transportation, including the water and other resources needed to grow natural items as well as the gas consumed during product transportation) that are appropriate for the climate in which they are used. This term also considers the degradation rate and replacement frequency of a given material.[26] Replacing the "end-of-life" concept with that of reducing, reusing and recycling materials, in conjunction with the consideration of waste streams as a part of production processes, would serve to integrate the circular economy approach within the material production sector.

Cement is the largest globally manufactured product, with 4.1 billion tonnes produced in 2018.[27] The next most-produced products are steel, iron, paper, ammonia, aluminium and copper. Industry and construction are responsible for almost 70% of global CO_2 emissions (19.32 Gt CO_2 annually).[28] Large-scale industrial growth, economic development and population expansion have resulted in enormous waste generation—2.01 billion metric tons of waste is produced annually worldwide, and that number is expected to increase to 3.40 billion metric tons by 2050. The renewable potential and energy content of different waste

[24] Worrell, E., Allwood, J., Gutowski, T. The Role of Material Efficiency in Environmental Stewardship. Annual Review of Environment and Resources. 2016. Vol. 41:575-598 https://doi.org/10.1146/annurev-environ-110615-085737

[25] http://sustain.rutgers.edu/what_are_sustainable_materials

[26] https://www.smartcitiesdive.com/news/most-eco-friendly-building-materials-world-bamboo-cork-sheep-wool-reclaimed-metal-wood/526982/

[27] IEA (2019), Tracking Industry, IEA, Paris https://www.iea.org/reports/tracking-industry

[28] Worrell, E., Allwood, J., Gutowski, T. The Role of Material Efficiency in Environmental Stewardship. Annual Review of Environment and Resources. 2016. Vol. 41:575-598 https://doi.org/10.1146/annurev-environ-110615-085737.

materials is gradually exploited by means of technological advancements and the formulation of new policies based on the concept 'from waste to energy'.[29]

Some examples of how we could incorporate sustainability and circular economy principles in the material production sector, taken from international literature, are outlined below:

Waste concrete, available globally, is used primarily to produce recycled aggregates. Alternative uses include applications as fine recycled aggregates, supplementary cementitious materials, filler and feedstocks for clinker production. Recycling concrete provides an alternative, recycled material resource streams are capable of reducing the demand for primary extraction of construction materials.[30]

The replacement of cement clinker with other materials such as reactive by-products from other industries is an additional example. Granulated blast furnace slag, a by-product of pig-iron production in blast furnaces and fly ash generated by burning coal to produce electricity, reduces energy consumption and increases production without requiring new kilns.[31]

Carbonised biomass known as biochar is another effective, partial replacement of cement that provides improved mechanical strength and thermal properties as compared to concrete with a smaller carbon footprint.[32] In addition, enriching soil with biochar is an amendment that contributes to efforts toward carbon neutrality.[33]

Combining natural fibres with cement and lime mortars ensures sustainability, mechanical resistance and endurance. The most common natural fibres are flax, hemp, jute, coconut,

[29] Sodhi, A.S., Sharma N., Bhatia S., Verma A., Soni S., Batra N. Insights on sustainable approaches for production and applications of value added products. Chemosphere, Volume 286, Part 1, 2022, 131623, ISSN 0045-6535, https://doi.org/10.1016/j.chemosphere.2021.131623

[30] Villagran-Zaccardi, Y.A., Marsh, A.T.M., Sosa M.E., Zega C.J., De Belie, N., Bernal, S.A. Complete re-utilization of waste concretes–Valorisation pathways and research needs. Resources, Conservation & Recycling, 177, 2022. https://doi.org/10.1016/j.resconrec.2021.105955

[31] UN Environment, Scrivener, K.L., John, V.M., Gartner, E.M. Eco-efficient cements: Potential economically viable solutions for a low-CO2 cement-based materials industry. Cement and Concrete Research 114 (2018) 2–26. https://doi.org/10.1016/j.cemconres.2018.03.015

[32] Mensah, R.A., Shanmugam, V., Narayanan, S., Razavi, S.M.J., Ulfberg, A., Blanksvärd, T., Sayahi, F., Simonsson, P., Reinke, B., Försth, M., et al. Biochar-Added Cementitious Materials—A Review on Mechanical, Thermal, and Environmental Properties. Sustainability 2021, 13, 9336. https://doi.org/10.3390/su13169336

[33] Vamvuka D, Esser K, Komnitsas K., Investigating the Suitability of Grape Husks Biochar, Municipal Solid Wastes Compost and Mixtures of Them for Agricultural Applications to Mediterranean Soils, 2020 Resources 9(3):33, DOI: 10.3390/resources9030033

bamboo, sisal, rice husk, cotton and sugarcane.[34] Polymeric composites reinforced with natural fibre have excellent mechanical properties, relatively low cost, low density and are recyclable. As a result, such composites are gradually replacing energy intensive products as well as composites based on synthetic fibres. Currently, construction is the biggest market for bio-composite materials, followed by the automotive and electronics sectors.[35]

An additional, effective option for environmentally friendly and high-performing paving products is mixing reclaimed asphalt and steel slag with a warm mix asphalt organic additive, which lowers production temperatures. The warm recycled asphalt mixtures show equivalent or better performance as compared to the hot mix asphalt in terms of moisture susceptibility, stiffness, rutting, fracture resistance and surface macrotexture.[36]

Lighthouse Mission 3 Topics

The EURECA-PRO Consortium covers a wide range of research areas related to sustainable materials and products. Sustainability is an essential point that is anchored in all partner institutions. Based on an analysis of competencies and research interests, the following topics were identified for Lighthouse Mission 3:

1) Sustainable Materials Management: a systematic approach to using and reusing materials more productively over their entire life cycle to reduce toxic chemicals and environmental impacts throughout the material life cycle and assure sufficient resources to meet current and future needs.23
2) Eco-friendly Building Materials (ecological and sustainable building materials)
3) Natural Ecological Materials
4) Rapidly Renewable Materials such as bamboo, straw, cork, hemp, true linoleum products, wool, wheatboard and strawboard
5) Waste-based Materials
6) Reclaimed or Recycled Materials and Products such as wood and metal

[34] Kesikidou, F., Stefanidou, M., Natural fiber-reinforced mortars. Journal of Building Engineering. 2019. https://doi.org/10.1016/j.jobe.2019.100786

[35] Olhan, S., Khatkar, V. & Behera, B.K. Review: Textile-based natural fibre-reinforced polymeric composites in automotive lightweighting. J Mater Sci 56, 18867–18910 (2021). https://doi.org/10.1007/s10853-021-06509-6

[36] Georgiou, P., Loizos, A. Characterization of sustainable asphalt mixtures containing high reclaimed asphalt and steel slag. Materials 2021, 14, 4938. https://doi.org/10.3390/ma14174938

7) All Materials and Products with Decreased Environmental Impact
8) Natural and Green Materials that Preserve Cultural Heritage
9) Sustainable Packaging

5.2.4 LH4 – Clean Energy

Lead University: Montanuniversität Leoben, Austria
Definition of Lighthouse Mission 4 (LH4) by Prof. Thomas Kienberger and Prof. Markus Lehner in collaboration with the LH4 research group

Introduction to Lighthouse Mission 4

Based on the Paris COP21 resolutions, which are binding under international law, a large-scale transformation of our energy systems to rely on renewable energy sources will take place in the coming decades. However, even if high shares of potential renewables are implemented globally, most industrialised countries will continue to rely on (renewable) imports. In order to reduce these as much as possible, primary energy efficiency measures must be increased. Many countries have already started to use more energy-efficient processes and to increase their use of renewable energy. The search for new power technologies, energy carriers, energy storage methods and new solutions must continue. Moreover, new clean energy solutions must take global energy poverty into consideration.

While decreasing CO_2 emissions can already be observed in private consumption (especially space heating), services and agriculture, industry and manufacturing emissions have stagnated. The use of renewable energies and, in particular, energy efficiency measures, has only reduced CO_2 emissions to the extent that would otherwise have resulted from economic growth effects. In addition to providing energy coverage and reducing CO_2 emissions, future energy systems and the management of volatile energy generation resulting from wind and Photovoltaics (PV) will play an essential role.

Lighthouse Mission 4 “Clean Energy” research focuses on system approaches. By means of a structured working plan currently in development, individual components to be researched will be combined with overall energy systems to optimize environmental impacts. Systemic approaches and technology development must be combined to develop solutions that achieve

primary energy savings built on cascading energy use. Moreover, such a combination of technological and system-oriented research will ensure optimal designs and a suitable operation of all components to be developed within the Lighthouse.

Lighthouse Mission 4 Topics

EURECA-PRO's diverse partners cover a large field of research topics crucial for a just energy transition. Our distribution of competences perfectly supports the proposed research approach combining technological and system-oriented methods. For our future work, we have identified the following LH4 topics:

1. Photovoltaics (PV): Increasing the efficiency of PV components will lead to higher electricity yields from the same available areas. To increase efficiency, PV materials, PV system-units and their energy system implementation must be researched.
2. Research in Materials, Catalytic Materials: Material-oriented research is not only crucial for PV components—all technologies needed for a just energy transition depend on appropriate materials. Especially in the focus field of energy conversion technologies, new or adapted materials for fuel and electrolyser cells, batteries or chemical conversions are of increasing importance. Many of those materials are catalytically active.
3. Energy Conversion and Storage: As already mentioned, future energy systems must have high primary energy efficiency. This is only possible if overall energy conversion chain technologies, from primary energy to energy services, are highly efficient. In addition, these technologies must allow for flexible operation as variable energy storage (in the form of heat, electricity, or something else) is often required. One such technology is the industrial heat pump.
4. Power Engineering Machines: The need for effective utilisation of renewable energy sources like waves, wind or water, together with the increasingly frequent use of new energy carriers such as biofuel, hydrogen or ammonia and new requirements for the maintenance of power engineering machines make further work in this area both necessary and important.
5. Carbon Capture and Utilisation (CCU) and Power to X: In order to evaluate CCU and Power to X with respect to climate neutrality, a number of technological as well as

energy system research questions have to be answered. Fundamental contributions are to be developed here.

6. Energy Systems, Energy System Modelling: Energy system research in the Lighthouse will be done on the development of optimal designs and operations for all components in said systems. Here the interplay between energy efficiency and flexibility is particularly important. Accordingly, research will focus on appropriate energy systemic algorithms.
7. Energy Security, Energy Poverty and Energy Resilience: Energy security is an increasingly problematic issue. Secure energy relies (in part) on both economic and technical context related to energy supply and energy storage. Extensive research is required to ensure both energy supply security in the EU and equal access for every citizen. Polygeneration systems and storage can be key components of this process.

5.2.5 LH5 – Process Automation and Industry 4.0

Lead University: Silesian University of Technology, Poland

Definition of Lighthouse Mission 5 (LH5) by Dr inż. Szymon Ogonowski in collaboration with the LH5 research group

Introduction to Lighthouse Mission 5

Throughout history, humankind has sought to improve labour efficiency, usually by applying the insights gleaned from nature and scientific research. Such approaches eventually sparked each industrial revolution that was based on new discoveries. The beginning of the first industrial revolution at the end of the 18th century, for example, was driven by mechanical production plants based on steam power. At the beginning of the 20th century, a second revolution based on mass labour production had electrical energy as its foundation. The third industrial revolution of the 1970s was driven by automatic production based on electronics, robotics and internet technology.

Process automation requires using technological solutions to limit or replace human intervention and labour in the execution of processes. It can be applied to every level of a process, from the physical actions of the actuators to decisions made at the management level. The goal of automation is to improve production efficiency based on specific criteria,

e.g. economic, environmental or product quality considerations. Process automation is therefore a powerful tool that can be leveraged to achieve specific SDG12 targets at the enterprise, socio-economic, environmental, local, country or continent level. With every subsequent industrial revolution, automation has become an increasingly crucial part of the production process. It is now present in every branch of industry, and is frequently an important part of our everyday life as well. The concept of a fourth industrial revolution (often called Industry 4.0) has catalysed diverse, novel and innovative tools that have improved the efficiency of automatic systems even further.

Aiming to achieve a higher level of automatization and operational productivity, Industry 4.0 would require vast computerization and interconnection as well as both horizontal and vertical integration within the traditional industry. Such a production process creates a cyber-physical system (CPS) based on heterogeneous data and integration of knowledge. CPS is defined as a set of transformative technologies allowing the management of physical assets and computational capabilities of interconnected systems. In turn, CPS creates an interoperable, adaptive and scalable manufacturing or production system that usually is service-oriented. Such systems can be optimised according to specific requirements, e.g. minimization of material footprint, energy consumption, water usage, waste or CO_2 production. This allows for an intelligent and controlled flow of processed material or subcomponents between machines in a factory or supply chain with real-time communication between assets. Such systems require application of new technologies, such as the Internet of Things (IoT) and Services (IoS), Industrial Internet of Things (IIot), Big Data (BD), Edge, Fog and Cloud Computing, Blockchain, Digital Twins, Industrial Automation, Cybersecurity, Intelligent Robots and/or Cobots.

The main obstacle in introducing these technologies is the low technological readiness of companies, especially in the SME sector; most companies would require substantial support, training and education to be able to incorporate such technologies. As a result, the fourth industrial revolution increasingly places high expectations on governments, thereby giving the state a new role in the economy and asking it to solve the problems of unreliable markets. The key issue here is management and effectiveness of the state's activities, rather than the state size. Industrial policy being implemented by many countries is de facto aimed at reorienting

national economies toward a fourth generation of industry, whether with the aim of preserving and restoring jobs or in the hopes of improving competitiveness and adding value to domestic production. The possible benefits are not only an improvement in efficiency, a reduction in errors, lower demand for raw materials and cost reduction, but also an opportunity to sell your own solutions.

Transformation towards Industry 4.0 will, in the long run, bring a higher rate of return on invested company capital. The road to this outcome is, however, very difficult. Such transformation presents not only technological challenges, but also organizational and sociological ones. In turn, the most challenging task for the research community focused on our socio-economic environment is to skilfully use these tools in the automation of entire value chains from primary resource exploration through production, use and recycling. Such actions require tight cooperation between interdisciplinary research teams, industry and policy makers.

Lighthouse Mission 5 Topics

The following LH5 topics cover all abovementioned aspects of process automation and Industry 4.0 applications. This list is subject to future expansion.

1. Industrial Automation and Process Optimization: Research into automation of production processes, industrial automation and application of control theory and process control for the purpose of process optimization. Dedicated sensing methods, signal processing and control algorithms and structures will be used.
2. Robotization of Production: Exploration of industrial robotics, mobile robotics, autonomous robots, service robots, communication with plant production planning and issues related to human-robot cooperation and interaction (e.g. cobots).
3. Digitization and Applications of Information Technologies: Research will include processing large data sets, edge, fog and cloud computing, cybersecurity, (Industrial) Internet of Things and inter-process communication networking, including communication between machines.
4. Simulation and Modelling of Processes: Includes the development of methods for production system simulation models and the use of computer simulation systems to implement a digital twin capable of developing intelligent factories based on cyber-physical systems.

5. Vertical Networking and Horizontal Integration in Management Systems: Research into vertical and horizontal integration of smart production systems, smart factories and smart logistics to design needs-oriented, individualized and customer-oriented production processes.
6. Predictive Maintenance and Condition Monitoring: This subarea applies predictive maintenance and condition monitoring in service of responsible usage of machine parts, resources and maintenance scheduling to optimize machine availability.
7. Applications of Virtual and Augmented Reality: The introduction of virtual reality technology into training processes in a simulated environment, for example into plant maintenance operations, virtual commissioning of production lines, robotic stations and control systems.
8. Reverse Engineering and Additive Technologies: Development of 3D printing and scanning solution to rapidly create prototypes of physical tools and equipment.
9. Socio-cultural and Methodological Challenges of Industry 4.0: All socio-cultural aspects of the wide-scale introduction of Industry 4.0 will be explored, including Society 5.0 and Post-Digital Society challenges from a training and educational point of view.
10. Industrial Design and Machine Construction: Development of industrial design focused on machine ergonomics and human-friendly handling.
11. Digital Transformation and Models of Technological Maturity: Identification of transformation path patterns and best practices in the field of assessment models focused on the digital maturity of enterprises.
12. Rapid Prototyping of Control Systems: Research into design methodologies that accelerate the process of control system software design, e.g. multi-context systems and hardware-in-the-loop solutions.

5.3 Progress to Date (31.07.2022)

Following the establishment of individual LH missions and the staffing of LH working groups (at least one delegate from each university per LH), the first meetings were planned and held. These meetings focused on defining the boundaries of different LH groups and identifying overlapping topics in research. Within this discourse, focus areas as well as research priorities of individual universities and of EURECA-PRO shifted. As a result, staffing of further LH core team members continues (though a lead for each LH group is established).

Since the emergence of the LH mission groups, the respective LH leads have established clear structures that facilitate future joint research. Common joint research calls for respective LHs were discussed and evaluated at the last onsite research meetings during the EURECA-PRO Review Week in Gliwice. Of particular thematic importance in this context are the “Life” and "HORIZON EUROPE" calls of the European Commission. EURECA-PRO’s shared goal is to submit first projects from individual LH groups by the end of 2022.

Daily communication takes place via emails, phone calls or short zoom meetings. Through joint preparation and submission of materials, links between individual universities are strengthened while long term funding and operating sustainability for EURECA-PRO and its members is created.

Meetings

Lighthouse Mission 1 – Responsible Material Flows

- LH1 Kick-off Meeting on March 30th 2022
- LH1 Meeting during the Review week at Silesian University of Technology (SUT) in Gliwice on May 18th 2022

Participants:

Lead University - University of León, Spain: Angela Taboada, PhD

Technical University of Crete, Greece: Prof. Kostas Komnitsas

Montanuniversität Leoben, Austria: Dipl.-Ing. Alexander Griebler, Sarah Kollnig, PhD, Marinella Passarella, PhD

University of Petrosani, Romania: Conf. univ. dr. ing. Andrei Andras, Conf. univ. dr. ing. Razvan Itu

Silesian University of Technology, Poland: Prof. Marcin Adamiak

Mittweida University of Applied Sciences, Germany: Dr. Flaviana Tagliaferri, Dr. -Ing. Stefanie Walter

Lighthouse Mission 2 – Environment and Water

- LH2 Kick-off Meeting on January 11th 2022
- LH2 Meeting during the Review week at Silesian University of Technology (SUT) in Gliwice on May 18th 2022

- Various meetings with selected researchers

Participants:

Lead University - TU Bergakademie Freiberg, Germany: Prof. Dr. Traugott Scheytt, Dr. Alizera Arab

Montanuniversität Leoben, Austria: Prof. Dr. Roland Pomberger

University of Petrosani, Romania: Sef lucr.dr.ing. Florin Faur

Technical University of Crete, Greece: Asst. Prof. Dr. Alexandros Stefanakis

Silesian University of Technology, Poland: Dr. Edyta Kudlek

University of León, Spain: Prof. Carlos Sierra PhD, Prof. Eduardo García-Meléndez PhD,

University of Lorraine: Christina Barralis

Lighthouse Mission 3 – Sustainable Materials and Products

- LH3 Kick-off Meeting on February 8th 2022
- LH3 Meeting during the Review week at Silesian University of Technology (SUT) in Gliwice on May 18th 2022

Participants:

Lead University – Technical University of Crete, Greece: Prof. Pagona Maravelaki,

Montanuniversität Leoben, Austria: Dr. Volkmar Kircher

University of León, Spain: Prof. Andres Juan Valdes, Paula Garcia Llamas, Prof. Maria Fernandez Raga

University of Petrosani, Romania: Prof. Traista Eugen

Silesian University of Technology, Poland: Dr. Alina Brzęczek-Szafran

Mittweida University of Applied Sciences, Germany: Dr. Flaviana Tagliaferri,

Lighthouse Mission 4 – Clean Energy

- LH4 Kick-off Meeting on March 14th 2022
- LH4 Meeting on May 11th 2022

- LH4 Meeting during the Review week at Silesian University of Technology (SUT) in Gliwice on May 18th 2022
- LH4 Meeting Lead University – (Montanuniversität internal) on December 17th 2021 and May 30th 2022.

Participants:

Lead University - Montanuniversität Leoben, Austria: Prof. Thomas Kienberger, Prof. Markus Lehner,

Technical University of Crete, Greece: Prof. Koutroulis Eftychios

University of León, Spain: Dr. David Borge Díez

University of Petrosani, Romania: Conf.univ.dr.ing. Dosa Ion

Silesian University of Technology, Poland: prof. dr hab. inż. Sławomir Dykas

Mittweida University of Applied Sciences, Germany: Dr.-Ing. Stefanie Walter, Synnöve Hochstein, M.Sc.

Hasselt University, Belgium: Dr. Sadia Vancauwenbergh

Lighthouse Mission 5 – Process Automation and Industry 4.0

- Kick-off Meeting/Introductory meeting on February 8th 2022
- LH4 Meeting during the Review week at Silesian University of Technology (SUT) in Gliwice on May 18th 2022

Participants:

Lead University - Silesian University of Technology, Poland: Dr. Szymon Ogonowski

University of León, Spain: Laura Estevez Mauriz, Hilde Perez Garcia

Montanuniversität Leoben, Austria: Priv.-Doz. Dr.sc.admin. Manuel Woschank

University of Petrosani, Romania: Prof.univ.dr.ing. Monica Leba

Mittweida University of Applied Sciences, Germany: Prof. Dr.-Ing. Michael Kuhl

TU Bergakademie Freiberg, Germany: Prof. Dr.-Ing. Urs A. Peuker

Technical University of Crete, Greece: Georgis Arampatzis

Hasselt University, Belgium: Dr. Sadia Vancauwenbergh

Further meeting updates for all Lighthouse Missions will be given in the deliverable D3.6 Last Progress Report on LH Implementation status of the project.

5.4 Outlook

5.4.1 Support for LH Researchers

To ensure high-quality research, EURECA-PRO has established a variety of measures focused on strengthening networking and exchange within and between LH working groups. Some of these measures include use of the communication and research platform SInDiPlat and the application of Miro Boards.

5.4.1.1 SInDiPlat

Created by the Montanuniversität Leoben with the help of the WIFI Institute in Graz, SInDiPlat[37] connects citizens, industry representatives and EURECA-PRO members through a digital communication platform. An Open Science Society Forum is used to announce and discuss future Open Science Events and to share insights gleaned from previous events.

Since January 2022, SInDiPlat acts as an exchange/collaboration platform between different scientific research groups as well as between industry and civil society. There is a dedicated, open science training space, an events page, a forum for media articles, a news forum for projects and calls and a shared workspace where researchers from all over the world can work simultaneously. While certain SInDiPlat content is only available for certain research groups, direct communication between society or industry and researchers remains possible through various channels. In the future, the communication task force and the working staff of work package 3 (research) will collaborate directly to process and distribute SInDiPlat content.

5.4.1.2 Miro Board

Miro[38] is an online application used as a project management tool within the Research Task Force (RTF). Besides a general management board for the RTF, each LH group has its own management board. Due to the ease of use and the ability to assign user rights to all visitors, information can be shared without any barriers. In addition, it is possible for teams to work

[37] EURECA-PRO Deliverable D3.7, Implementation of Open Science Societal and Industrial Dialogue Platform SInDiPlat, submitted to EC on December 30, 2021.

[38] Miro is a visual collaboration platform: https://miro.com/

simultaneously within a single board. This feature is of particular support for EURECA-PRO researchers, given that in-person meetings only occur biannually.

The design of respective Miro Boards is up to the individual research group, although a pre-set management matrix has been created by the WP 3 lead. By storing meeting minutes and documents directly, Miro Boards also create an archive that facilitates the integration of newcomers in respective research groups.

5.4.2 LH-related Events

EURECA-PRO integrates the five Research Lighthouse Missions on various levels. Foundational to this integration are Open Science Events, PhD programs, the annual EURECA-PRO Conference and Summer Schools, as outlined below.

Open Science Events

Open Science and Knowledge Creation Events serve to interact with citizens and industry and to provide information, but also to identify important topics and to integrate them into the EURECA-PRO research agenda. The Open Science Events I and II helped in the selection process for the LH Missions—the topics *Nature-based Solutions for Sustainable Wastewater Management in the New Circular Economy Paradigm* and *Electromobility* were found to overlap with missions proposed from partners and could be evaluated within a project inventory. EURECA-PRO Research LH Missions actively support key European and global initiatives such as the Sustainable Development Goals (SDGs), the European Green Deal and the Circular Economy. [39]

While content of the Open Science Event I (OSE I) is primarily relevant for LH1 (Responsible Material Flows) and LH2 (Environment and Water), the content of OSE II for LH2 (Environment and Water), LH3 (Sustainable Materials and Products) and LH4 (Clean Energy) and the content of OSE III for LH4 (Clean Energy), OSE content does connect to all Lighthouse Missions. Further information about the connection of Open Science Events to EURECA-PRO Lighthouse Missions will be found in Deliverable D3.12.[39]

[39] EURECA-PRO Deliverable D3.12, Open Science Event II and III, submitted to EC on April 30, 2022.

Three additional Open Science Events are planned for the remaining project funding period, all of which will contribute to the Lighthouse Missions and increase public awareness surrounding these.

PhD Journey

A one-week PhD Journey, hosted by each partner university for up to 20 PhD students, will take place as physical activity from November 21-26, 2022. The PhD Journey is based around one or more scientific topics thematically linked to the Lighthouse Missions. An online, virtual component before the journey kicks off the week, which then includes in-person events and a wrap-up activity report. Students receive 3 ECTS credits for successfully participating in the PhD Journey and writing an individual report sharing their experience and research outcomes. Activities during the journey will be determined by the host university and may include, but are not limited to:

- Introduction to local research groups
- Tours of laboratories
- One to one meetings with supervisors
- Learning research skills (software, laboratory, etc.)
- Informal meetings with host university PhD students
- Joint publication/proposal workshops
- Research related excursions

2nd EURECA-PRO Conference on Responsible Consumption and Production

The 2nd EURECA-PRO Conference on Responsible Consumption and Production (RCP) will be held on October 19 - 21, 2022 at the University of León in Spain.

The Sustainable Development Goal 12 of the United Nations 2030 Agenda forms the umbrella of this interdisciplinary forum, where innovative RCP solutions will be explored from technological, humanistic, economic, educational, social and environmental perspectives. The conference programme includes two plenary conferences, three panel discussions, two workshops and five series of oral presentations focusing on the Research Lighthouse Missions of EURECA-PRO:

- Recycling, reuse, and longer-lasting products (LH1 and LH3)
- Fresh air, clean water, healthy soil and biodiversity (LH2)

- Cleaner energy and cutting-edge clean technological innovation (LH4)
- Industry 4.0 (LH5)
- Smart and healthy societies (LH1 - LH5)

Researchers are invited to submit a short paper (1500 words) that matches at least one of the five research areas listed above. After successfully passing the peer review process, the papers will be published in Springer Proceedings in Earth and Environmental Sciences.

Further information can be found on the Conference Website:

https://conference.eurecapro.eu/

EURECA-PRO Summer School

The EURECA-PRO Summer School will take place from 19-26.09.2022 in Greece at the Technical University of Crete with preparatory work given between 22.07.2022 and 16.08.2022. This "Innovation Summer School" aims to inspire students with information about the 5 Lighthouse Missions of EURECA-PRO and will ask students to:

- Present a challenge their home or study city is facing that relates to one of the 5 LHs (pre-school work)
- Think about the challenges presented and choose the most interesting/inspiring challenge for each student group
- Develop a business idea through a Design Thinking Workshop to address this challenge
- Design an MVP (minimum viable product)
- Design a landing web-page and check the demand for the product
- Fill-in the Business Model Canvas for the business idea

5.4.3 First Research Plans for Lighthouse Missions (31.07.2022)

LH1 – Responsible Material Flows

Discussions during LH1 meetings revealed that there is a lot of potential for improving and optimising product flows in the field of **plastic waste**. This topic fits very well into Lighthouse Mission 1 (Responsible Material Flows) and aligns with SDG12; LH1's first project submission will most likely address this topic. Possible funding calls could be:

1) Horizon Europe Programme. Cluster 6: Food, bioeconomy, natural resources, agriculture and environment. Destination 1: Biodiversity and ecosystem services / Destination 3: Circular Economy and bioeconomy sectors / Destination 4: Clean environment and zero pollution
2) Life Programme. Standard Action Projects (SAPs) for circular economy and quality of life, nature and biodiversity, climate change mitigation and adaptation sub-programmes (4th October 2022)

LH2 – Environment and Water

The topic of **industrial landfill mining** includes many aspects, e.g. sorting, water and soil contamination and mineral processing. After group discussions, LH2 has decided to explore industrial landfill mining. Suitable calls for proposals are currently being sought. Possible funding calls could be:

1) Horizon Europe, Cluster 6: Food, bioeconomy, natural resources, agriculture and environment

LH3 – Sustainable Materials and Products

The LH3 research group will likely submit their first project proposal in the research area of **Sustainable Building Materials**.

Possible funding calls could be:

1) LIFE Calls for proposals 2022 published on May 17th 2022. Life – Circular economy and quality of life[40]
2) MSCA – Doctoral Networks[41]

Open calls regarding *more sustainable buildings with reduced embodied energy* or *circularity in buildings* can be found also in Horizon Europe Cluster 5: Climate, energy and mobility, and in Cluster 6: Food, bioeconomy, natural resources, agriculture and environment.

LH4 – Clean Energy

[40] https://cinea.ec.europa.eu/programmes/life/circular-economy-and-quality-life_en

[41] https://marie-sklodowska-curie-actions.ec.europa.eu/actions/doctoral-networks

The LH4 research group's first project will likely be the submission of a **Capacity Building** Proposal.

Suitable calls for proposals are currently being sought. Unfortunately, there are no open Capacity Building Horizon Europe calls in the field of Clean Energy, but other interesting calls could be found in Cluster 4: Digital, Industry and Space, and in Cluster 5: Climate, energy and mobility.

LH5 – Process Automation and Industry 4.0

LH5's research will focus on Industry 4.0 applications: the primary and secondary raw materials sector (I4.0 in Circular Economy), the energy sector and manufacturing.

Possible funding calls could be:

1) Horizon Europe calls in Pillar II (Key Strategic Orientations: A and C) Cluster 4: Digital, Industry and Space, Cluster 3: Increased Cybersecurity and Cluster 5: Climate, energy and mobility.
2) Pillar III also contains possible EIT calls via EIT RawMaterials, EIT Manufacturing and EIT Digital.

5.4.4 Future Research Collaboration

On November 23rd, 2021, the Board of Rectors of the EURECA-PRO Consortium approved Hasselt University as associate partner of EURECA-PRO beginning January 1st, 2022. On 26th April, the official signing of our collaboration with Hasselt University took place at their campus in Hasselt, Belgium. The Rector of Hasselt University, Bernard Vanheusden, stated: "The objective of EURECA-PRO fits perfectly with the policy themes Hasselt University is working on: sustainability, inclusiveness, lifelong learning and internationalisation. Moreover, sustainability is the common theme in our education and research, with many projects focused on circular economy, energy transition and sustainable materials. As Hasselt University, we immediately felt at home in this alliance and are very pleased to be part of it." [42]

Hasselt University is currently identifying appropriate researchers for all 5 Lighthouses and will be actively involved in EURECA-PRO research. We are in the process of determining whether

[42] EURECA-PRO Website, News, Hasselt University has joined the EURECA-PRO Alliance, 26th April 2022: https://www.eurecapro.eu/hasselt-university-has-joined-the-eureca-pro-alliance

Hasselt University will create a new Lighthouse mission, and whether this would occur in the current or in the next funding period.

6 Catalogue of PBL challenges

6.1. Introduction to PBL

Problem-based learning (PBL) and project-based learning use a practice-oriented teaching method. Students are expected to acquire knowledge and problem-solving skills by learning from real and application-oriented problems and by finding their own answer to a large extent. The PBL method trains students in how to approach problems and thus significantly improves their transversal skills. The method requires students to develop for instance organisational skills, learn to coordinate, make decisions, think critically, solve problems, work in teams, work result-oriented, provide and accept feedback, communicate and resolve conflicts.

Problem-based learning requires fundamental changes in the curricula, because in traditional education, students first receive the knowledge allowing for its application to a pre-defined method of solution, whereas in PBL, the problem is presented first and, for its solution, students are required to use various education tools, such as the above mentioned. Students are required to identify, collect and acquire the knowledge which is needed for the solution of the problem. Figure 16 illustrates the difference between Traditional Learning and PBL [1].

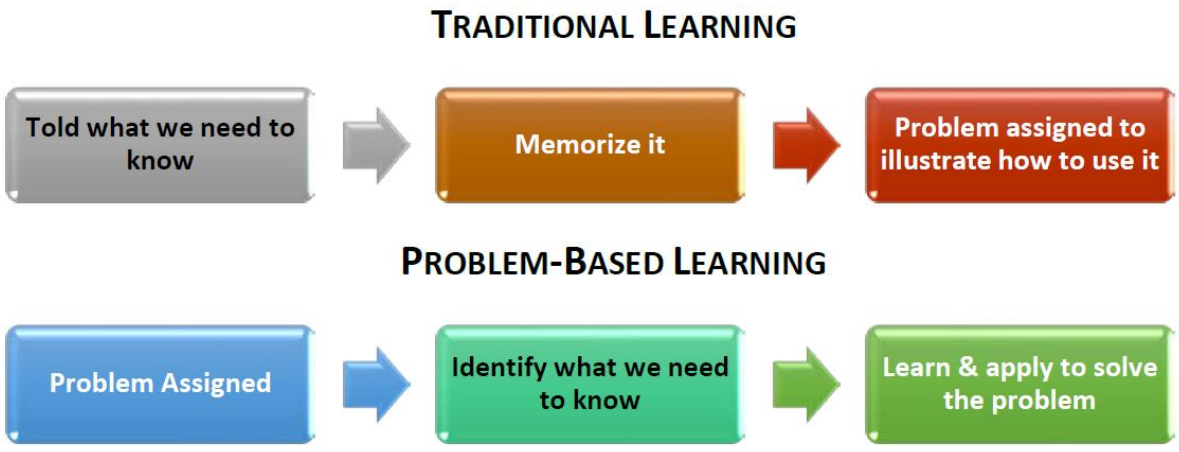


Figure 16: Traditional Learning and Problem Based Learning [1, 2]

There is an additional benefit when the PBL method is used in international study programmes, as it also improves intercultural competences and language skills. In programmes initiated by EURECA-PRO, it also promotes the students' personal identification with Europe, which supports the formation of a pan-European identity. Furthermore, an awareness of the importance of the circularity of materials and goods, as well as their impact on the environment, is created.

The above-mentioned abilities facilitate the graduates' entry into professional life, because most job recruiters and companies look for certain inter- and intra- personal skills and competences in applicants, in addition to their academic and technical knowledge. The so-called "employability skills", commonly referred to as "soft skills", are lifelong acquired social, inter- and intrapersonal competencies that are the result of innate abilities and our professional knowledge, as well as our performance in academic and working environments [3].

This report complements the deliverable D3.1 Organisational Scientific Framework Charter (SFC) for interuniversity research collaboration [4]. As Chapter 6 of the SFC, the report consists of the listings of the educational problem-based learning challenges that were derived from the previous content work of the Research Task Force (RTF), the pedagogic input from the education experts and the student centered-co creation input. Each listing contains a problem description, its derivation, its pedagogic and scientific value and its associated aspired learning outcome. In addition, an accompanying guidance manual and evaluation feedback forms for teachers were prepared for continuous evaluation purposes.

6.2. Problem-based learning in EURECA-PRO

This chapter summarizes the information on PBL efforts undertaken within EURECA-PRO collected in Deliverable D2.24 “Problem Based Learning Module Layout”. The deliverable outlines the creation of a PBL module layout, PBL definitions, characteristics and advantages of problem-based learning based on a literature review. It also includes information gathered from Aalborg University, where all degree programs are based on the PBL method [1].

EURECA-PRO has incorporated the methodology of student-centered Problem-Based Learning (PBL) into its study programmes and educational activities, as it is particularly suitable for the

topic of "Responsible Consumption and Production (RCP)". In summer schools, the use of active learning methods, such as international project-based learning (iPBL), is combined with ICT resources in a multicultural environment [1].

The priority of PBL for the Alliance is clearly evident in its strong embeddedness in several work packages [1]:

- The implementation of the Lighthouse Missions provides PBL challenges and conducts an evaluation (WP3).
- Two types of PBL-problem-based and project-based- should be shared as best practices and knowledge on teaching methodologies with support of training courses and study visits (WP 5).
- PBL should be integrated into summer school (WP2),
- A module that is taught according to PBL method is to be developed for all partner universities (this deliverable) (WP2).
- PBL realisation is intended to promote cooperation between the Education Council and the Research Task Force.
- The exchange with the students through the SCCG on their perception, expectations and motivation about PBL.

The aim of the deliverable D2.24 is to outline a pathway to integrate PBL into higher education on “Responsible Consumption and Production”, with the result of creating a new module. In order to achieve this goal, several activities were carried out [1]:

- Short review of the current discussion and practice of PBL, in particular to identify characteristics and challenges.
- Support from the Silesian University by proposing PBL regulations.
- Presentation of the methodology, of the first draft of the module and discussion in different councils of EURECA-PRO (EC, SCCG, RTF).
- Awareness raising and training course for educators by University of Leon (ULE) and within further Universities such as Technische Universität Bergakademie Freiberg (TUBAF) and Silesian University of Technology (SUT).
- A short survey on the status of PBL at the partner universities.
- Compilation of a list of PBL modules at the partner universities.

The consortium's debate has shown a broadly similar view on the PBL method and the current status within the EURECA-PRO partner universities has been compiled in Table 5. The information was obtained through a questionnaire, and from educators and students in the Education Council (EC), as well as from students in the Student Co-Creation Group (SCCG) [1].

Tab. 5. Current status of PBL within the EURECA-PRO partner universities (compilation based on a survey among the EURECA-PRO partner universities and feedbacks from EC and SCCG) [1].

Experiences with PBL	- Mostly yes and limited to selected educational activities any by some lecturers - Integral teaching and learning method in the educational systems of HSMW and SUT - TUBAF -and probably other Partner Universities- PBL is used in different modules without being named as PBL
Use of PBL in BSc and MSc study programmes	- For mandatory courses and for elective courses - For advanced BSc courses and for specialized MSc courses - HSMW uses PBL at both levels – BSc and MSc – on a regular basis
Access of students to PBL	- At some partner universities for all students of a course, at other partner universities for selected students of that course
Use of PBL by course type	- Mostly for courses with practical contents (applications of theory, practicals, lab work, field work, student projects etc.) - Specifically in STEM study programmes
Choice of PBL as method of education	- Generally, by the lecturer - In SUT, in addition: also defined by the respective study regulations
When a new course is established	- No formal requirement to use PBL
PBL trained lecturers and training offers	- At MUL and HSMW - A course was organised by SUT in collaboration with ULE in the framework of EURECA-PRO at the beginning of 2022 - Knowledge exchange between lecturers at TUBAF May 2022
Analysis of student performance when PBL is used	- Currently no practice of monitoring student performance

The new educational activities of EURECA-PRO focused on RCP comprise a large variety of types of modules and student tasks. PBL offers a substantial potential for many of them, that is why all partner universities plan to integrate the PBL method in their and in joint study programmes. TUBAF conducted an Inventory on PBL and related modules/courses at EURECA-PRO partner universities and shows an excerpt of it with 36 modules/courses at TUBAF and 6 at SUT in Annex B.a. of the Deliverable D2.24 [1].

6.3. Catalogue of PBL challenges

In contrast to the listing of modules and courses that teach by means of "projects", "problem based" or "case studies", this Deliverable D3.8 is about listing problem-based learning challenges, that were derived from the research work at the partner universities, work of the Research Task Force and Lighthouse Mission groups, and the pedagogic input from education experts and Student centered-co creation input.

The catalogue of PBL challenges is a listing of pressing contemporary issues in science, research and society, with each listing comprising a problem description, its derivation, its pedagogical and scientific value, and the associated intended learning outcome.

The methodology of Problem Based Learning was discussed in EC, SCCG and RTF meetings and a PBL Challenge template was created and distributed among the partner universities. The template shown in Table 6 intentionally does not fully correspond to the content or layout of the module draft presented in chapter *4. PBL guidance manual*. In the challenges query, current topics were sought, which is why neither credit points nor hours (workload) were prescribed on purpose, and also the problem definition and the derivation of the topic could be filled in quite freely.

Table 6. Template sent to partner institutions for gathering Problem Based Learning Challenges

PBL challenge 1:

Problem description of the PBL challenge to be solved

Please mention from where the challenge was derived. For example from: name of the lecture, obvious need in industry XY, company XY, Research Task Force, STEM contest, Open (Citizen) Science Event, research lighthouse mission, pedagogic input from education experts, student centered-co creation input or specify other sources

Derived from

Level for which it is designed:
A) Ca. 10 h (recherche, theory, presenting)
B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Pedagogic and scientific value

Contact and further Information

Name and email are just for internal use! Name: *first name surname (university)* Email: *University e-mail address* Further information:

Many of the challenges received are inspired by the Sustainable Development Goals, especially SDG 12 "Responsible Consumption and Production", some can also be clearly assigned to one or more of our EURECA-PRO Lighthouse Missions (LH): LH1 Responsible Material Flows, LH2 Environment and Water, LH3 Sustainable Materials and Products, LH4 Clean Energy, LH5 Process automation and Industry 4.0, LH6 Health and Circular Economy.
All challenge topics are summarised in Table 7 and if an assignment to lighthouses is possible, then this has been indicated accordingly. It is noteworthy that PBL Challenges could be assigned for all Lighthouse Missions. It is clear that most of the challenges are related to LH5 "Process automation and Industry 4.0". On the one hand, this can be explained by the fact that most of the assignments come from SUT, who have expertise in this area and therefore also lead LH5. On the other hand, digitalisation is progressing faster and faster and there is a need for digital products and correspondingly trained university graduates.

Table 7. Condensed Catalogue of PBL Challenges

No	PBL Challenge	Lighthouse Mission
1	Clean Energy Generation Challenge: Modeling Bioelectricity and Hydrogen Production from Rhodospirillum Rubrum Bacterial Cultures in Microreactors	LH4, LH5
2	Induction of cell death in tumor lines subjected to genome editing by CRISPR/Cas9 technique in the presence of non-steroidal anti-inflammatory drugs and their derivatives	LH6
3	Interpreting Complex Biological Models for Novel Therapeutic Strategies: A Challenge in Contrast Construction and In-Silico Analysis	LH5, LH6
4	Scraper Conveyor Material Configuration Challenge: Investigating the Impact of Material Association on Tribological Wear for Glass Cullet Transport	LH3, LH5
5	The impact of the concentration of heavy metals and organic micropollutants in rainwater on the quality of the environment	LH2
6	Numerical modelling of the personal protective equipment effectiveness and the risk of infection using an advanced model of human respiration and particulate emissions.	LH5, LH6
7	The use of modern computing techniques (CAE) to analyze their operation and assess the risk of failure is one of the most important issues of the upcoming 4th industrial revolution.	LH5
8	Identification of the possibility of technological recovery of chemical substances extracted from forest biomass during the production of construction material in the form of wood with increased strength	LH6, LH1
9	Using UWB technology for positioning system	LH5
10	Occupancy grid map creation based on environment perception	LH5
11	Creation of simulation environment	LH5
12	Engineering in Virtual Reality: Developing an Immersive Experience with Tactile Feedback	LH5
13	Domain adaptation in the process of detecting dangerous actions and disease disorders on image data using synthetic data from crowd simulation	LH5
14	A model of internal communication links of the city of Zabrze to improve the flow of employees and students of the Silesian University of Technology	---
15	Contribution of plastics to achieve the SDGs: Personal protective equipment - Masks	LH2
16	Dissolution kinetics of Zn and ZnAl(Mg) coatings in leaching in hydrochloric acid	LH3
17	Induction of cell death in tumor lines subjected to genome editing by CRISPR/Cas9 technique in the presence of non-steroidal anti-inflammatory drugs and their derivatives	LH6

18	Reconstruction of architectural details using 3D printing methods	LH5
19	Assessing the sustainability of "green" products	LH2, LH3
20	Contribution of plastics to the SDGs	LH3
21	Nuclear energy and its contribution to the SDGs	LH4
22	From the idea to the product	LH3
23	Optimization of a smart material	LH3, LH1
24	Smart and Sustainable City	LH6, LH2
25	Build your scientific skills by providing expertise	LH2
26	Plant and plant-interaction engineering to improve plant health	LH2, LH3
27	Act and watch yourself act in problem-based learning	---
28	Decentralised energy systems	LH4, LH5
29	Reuse of terephthalate polyethylene (PET) in order to give an economic value due to the SDGs	LH2, LH6
30	Opening and Mining of new Gold-Silver Deposits in Romania -YES OR NO?	LH1
31	The achievement of the balance sheet for an Otto (Diesel) engine	---
32	Social Project based learning challenges	---
33	Mine Surveying (Project)	LH5
34	Geodesy (Project)	LH5
35	Special Mine Surveying Works (Project) - Master Study Program	LH5
36	Surveying Engineering (Project)	LH5
37	Designing the rehabilitation works for a mining degraded land (sterile dump)	LH2
38	Stability analyses for open pit and dump slopes	---
39	Anthropic impact on environment I	LH2
40	Anthropic impact on environment II	LH2
41	Contribution of green occupation to achieve the SDGs	LH2, LH3
42	Endemic Morbidities Investigation Project: Exploring Environmental and Natural Causes	LH2, LH6
43	Thermal Equipment and Installation Design Project: Advancing Sustainable Development Goals	LH3
44	Simulating Sustainable Machinery and Equipment Design: A Team-Based Project	LH5
45	Energy Efficiency Audit of Machines, Equipment, or Installations for Sustainable Development	LH4, LH5
46	Optimize workspaces and hardware/software needs of employees through automated processes	LH5

47	Elucidate whether inappropriate medication intake and daily activity contribute to the risk of a fall, especially for the elderly	LH6
48	Provide a solution that will benefit people with disabilities towards their inclusion in everyday fun activities (e.g., in sports, museums, recreation, and attending events)	LH6
49	Bicycle safety & security: a solution to improve safety and security of bike riding through the protection of users and equipment from unexpected incidents (e.g., crashes, accidents, thefts or misuses)	LH3, LH1
50	Art through technology: an art-related technological solution to help to communicate and approach existing art forms to people	---
51	Methodologies or tools to improve the digital content quality targeted at children and teenagers in the web and social media	LH5
52	Development of a model for the valuation of works of art as an investment good	LH1
53	Create a solution to help people living alone, susceptible to suffer any incident, notifying municipal services or caregivers, so that they can intervene and avoid possible consequences	LH3, LH5, LH6
54	No-code application tool helping with the design, allowing to draw, sketch, outline the elements of the user interface to use it in contemporary integrated programming environments (IDEs)	LH3, LH5
55	Evaluation of the urban characteristics and formulation of proposals for the environmental and social upgrade of a central area of Chania city with respects to its social and cultural capital	LH3
56	Monitor and facilitate the delivery process of paver asphalt mixes optimising logistics and coordination through real time data	LH5
57	Design an easy-to- implement solution to recycle laminated/coated products from barrier liners used in paper packaging through existing technologies	LH3
58	Develop an eco- friendly solution for apple harvesting avoiding fruit or tree damage without the use of human force	LH3, LH5
59	Development of a system to automatically detect and recognize LED displayed errors in the production process of LED display boards	LH3, LH5
60	Development of a behavioral scoring system, based on users' behavioral data, to improve the availability of financial products for clients	LH5
61	Development of an electric and magnetic field arm scanner	LH3, LH5
62	Development of a sustainable process for the purification of (2S,3S)-2-benzhydryl-3- benzylaminoquinuclidine from other isomers which are created during its synthesis in veterinary and antiemetic drug industries	LH1, LH3, LH6
63	Create a system that manages the legalization (Industrial Safety, Environment and Occupational Risk Prevention), both initial and subsequent, of all types of installations involved in the operation of a building or facility	LH2, LH3

64	Design a solution to reduce and minimize waste material, especially single-use plastic waste, generated at refreshment points to promote more sustainable marathons and races	LH1
65	Develop a system that allows monitoring the maximum sun potential that can be produced in a specific place	LH4
66	Develop an easily-to-use system that would allow identifying and reporting to the user, in real-time, the health status of the poplar trees, based on symptoms observed in the field	LH2

The individual PBL Challenges, including all the data listed above, can be found in ANNEX a. As this report is intended for the dissemination level public, the contact details requested (Table 6) are initially for internal use only, and are therefore not listed in this deliverable.

6.4. PBL guidance manual

First experiences of Hemker et al. [5] show that students welcome the work with realistic, practical problems and expect positive outcomes from the PBL concept. However, experiences also show possibilities for optimising the didactic design (adjustment to heterogeneous students' characteristics; different levels of instructional support; more literature, etc.). On the one hand, the PBL approach supports strong theory-practice alignment, on the other hand, there are well-acknowledged challenges, most notably the high demand on the learners' time and effort, and learners' potential difficulties to adjust to a new, rather different teaching approach. Both aspects can have an impact on student satisfaction and engagement and ultimately on their learning gains, which is why strong didactic guidance throughout the PBL process seems necessary [5].

The guidance manual in this deliverable consists of two parts, the 7-step method for cooperative problem-solving and a structure template (Table 8) for the creation of new PBL modules.

The 7-step method described by Hemker et al. [5] was used in the teacher education program for different school subjects and school types (master's level) and it seems to be very applicable for the creation of problem based courses or modules. In order to elaborate the didactic concept, it is also very helpful to work in a small group. Following the 7-step method, the problem is discussed in the group according to the steps 1–5 and after a period of individual, self-led research (step 6), the group re-addresses the originally posed problem to summarise and review the newly acquired information (step 7). During step 7, participants

(lecturers, researchers) also evaluate their previous considerations, knowledge and problem-solving skills in order to better understand the particular value of the new information [5].

7-step method for cooperative problem-solving [6, 7, 5]

1st Problem Analysis

1. Clarify terms and concepts not readily comprehensible
2. Define the problem
3. Analyze the problem
4. Draw a systematic inventory of the explanations inferred from step 3
5. Formulate learning objectives

Phase of Knowledge Acquisition

6. Collect additional information outside the group

In-Depth Problem Analysis

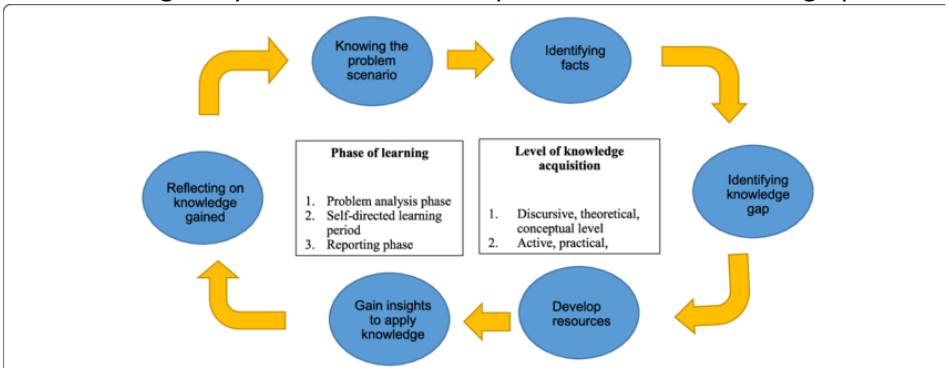
7. Synthesize and test the newly acquired information

Once the desired PBL challenge has been fully developed according to step1-7, the PBL template (Table 8) should be completed by the group.

Based on discussions of the EC and SCCG, a PBL module layout was created in D2.24 [1], considering the design recommendations of the European Commission and the criteria established in the Bologna Process. This module layout (see Table 8), dealing with "Challenges in RCP", serves in the guidance manual as module structure template for the creation of new modules, with different content and possibly different duration or work load for students. It defines responsible institutions and lecturers, the competences to be learned by the students, the content of the course, the indication of further literature, the course semester, as well as the number of hours broken down into teamwork and self-study. In addition, the table contains pre-requisites (lectures and/or knowledge), requirements for credit transfer, credit points and explanations on the awarding of grades.

Table 8. Draft of a Module „Responsible Consumption and Production" using PBL [1].

Data:	PBL for RCP Examination number: -	Version: dd.mm.yyyy	Start Year:
Module Name:	Problem Based Learning on Responsible Consumption		

Responsible:	
Lecturer(s):	
Institute(s):	
Duration:	1 Semester
Competencies:	Students learn to understand and especially practice the method of Problem Based Leaning. They learn the various steps of PBL as shown in the graph below.  They acquire skills to conduct research work focusing on a specific problem. They design and work out an appropriate solution for the problem at hand. They learn to engage in group work with setting and fulfilling individual tasks and coordinating the results in a joint overall output. They learn how to present their project, its method and the output. They apply PBL to a specific problem related to Responsible Consumption.
Contents:	The PBL method is based upon self-education and self-learning by students in teams. As such, there is no pre-set content for this method. Typically, an instructor will identify a (set of) problem(s) for students to tackle in teams on their own. In respect of responsible consumption, such problems could be the following: - How can consumers be motivated to shop for low-carbon products? - How can the acceptance rate of bio food be increased? - What do consumers know about the ecological footprint of their consumption behaviour? - How do consumers decide between products made from virgin or recycled materials? - Is responsible consumption only for middle and higher income groups? - … …
Literature:	Eva Yin Han Chung: Facilitating learning of community-based rehabilitation through problem-based learning in higher education, in : BMC Medical Education (2019) 19:433 https://doi.org/10.1186/s12909-019-1868-4 https://teaching.cornell.edu/teaching-resources/engaging-students/problem-based-learning Andrew Walker, Heather Leary, Cindy Hmelo-Silver (Eds.): Essential Readings in Problem-Based Learning: Exploring and Extending the Legacy of Howard S. Barrows, Purdue University Press, 2015 David H. Jonassen & Woei Hung: Problem-Based Learning, in: Encyclopedia of the Sciences of Learning, pp 2687–2690, Springer DOI: 10.1007/978-1-4419-1428-6_210
Types of teaching	Three in-class group sessions in teams (16 hours for each session) Individual self-study (four hours per week) Preparation of individual contributions to the team report (22 hours)

	Finalization of the team report (20 hours)
Pre-requisites:	None
Frequency:	Annually in Summer or in Winter (depending on the ability to build teams)
Requirements for Credit:	Credits will be awarded upon passing the examination of the module. This comprises AP 1: Presentation with Questions and Answers (45 minutes) AP 2: term paper (minimally 12 pages)
Credit Points:	5
Grade:	The Grade is generated from the examination results with the following weights (w): AP 1: report of the teams (w: 3) AP 2: presentation of the report by the team (w: 1)
Workload:	The workload comprises 150 hours and comprises 48 hours of team work, 60 hours of self-study, 22 hours of individual preparation and 10 hours of team preparation of the report, 10 hours of team work for the preparation of the presentation

Inputs and comments given on the Draft of the Module „Responsible Consumption and Production" (Table 8), are listed in detail in Appendix A, of D2.24 [1].

6.5. Evaluation

Prior to the evaluation process, a key question to be considered is which objective is to be achieved by the evaluation. In the case the challenges in the EURECA-PRO Alliance, this is in addition to the requirements for the best possible methodological implementation in the sense of the Problem-based Learning (PBL) the reference to the Alliance's concern "Responsible Consumption and Production". Therefore, the evaluation should be based on the following objectives:

- Is the challenge methodically with regard to the Problem-Based Learning implemented?
- What learning effects can be demonstrated?
- What is the relevance to "Responsible Consumption and Production"?
- What measures can be derived to improve the implementation of the challenges in terms of problem-based learning and RCP?

In principle, two different types of evaluation are available: the formative and the summative evaluation. Considering the objective and the expenditure, a mixture is recommended in which the participants are questioned by means of a questionnaire (formative) and the lecturers document the process and the course (summative). A discussion as a focus group of

5-7 participants with guiding questions should reveal potentials and deficits in the form of a SWOT analysis.

The questionnaire for the participants is divided into two parts. The first part asks for general information, including subject, experience and the desired outcome of further challenges with open and semi-structured questions. A total of 18 items serves to evaluate the perceived effects and structural realisation. The effects are problem-solving, self-directed learning, collaborative learning, critical thinking, and knowledge increasing. Enquiries about the structural approaches are based on the characteristics described in Deliverable 2.24 [1]. An assignment of the items can be found in Table 9. Last, the participants are asked directly about the perceived reference to "Responsible Consumption and Production" in an open question.

Table 9. Items and Indicators of student's questionnaire of PBL-Sessions.

Indicator	Item
Problem-solving	I understood the given problem well.
	I was able to form reasonable conclusions at the end of each session.
Knowledge-increasing	The PBL challenge leads to breadth and depth of knowledge about the topic.
	I think the learning outcome was as intended.
Critical thinking	I think I learned less than it would be in a usual lecture with the same topic.
	I arranged my thoughts logically and saw clear relationships among them.
	I am not able to list pros and cons of the elaborated solution.
Self-directed learning	I was responsible for my own learning.
Collaborative learning	I enjoyed studying in a team.
	I found it hard to share my ideas in our group.
	I am not sure I can trust my teammates' contribution to my learning.
Problem-Based Learning	The problem integrated multiple disciplines.
	The problem was as it could be in the real world.
	The problem was relevant to my current studies.
	I think the problem exhibit the experience required in the workplace.
	We set our own learning objectives.
	Our lecturer guided by asking questions more than by presenting knowledge content.
	The workload was realistic in terms of timing.

The Log Sheet is kept more comprehensive. This results due to the fact that the previous lecturer should no longer act as a knowledge distributor but as a facilitator. In order to do

justice to the broad understanding (see also Deliverable 2.24 [1]) of PBL, the Log Sheet was labelled "for lecturer/facilitator". The Log Sheet consists of a total of five sections:

6.5.1. General information about the lecturer/ facilitator, e.g. about his/her previous experience with PBL.

6.5.2. General information about the challenge, which is probably not available in the short description.

6.5.3. Run of the Challenge to document the process with exact timing, tasks and equipment needed.

6.5.4. Open questions for the teacher/facilitator on his/her evaluation of the PBL Challenge.

6.5.5. Instructions on how to conduct the discussion.

In the best case, the person conducting the PBL Challenge is assisted by an observer who ensures points 2, 3 and 5.

It is necessary to test the tools before they are widely used.

Whether the method was more effective than, for example, a traditional form of learning, can only be determined by conducting a simultaneous lecture with the same content objective. However, we refrain from doing this because of the effort involved in organising another lecture. However, should this be done, the questionnaires can be used accordingly.

6.6. Conclusions and next steps

A joint degree programme at Bachelor's (BESt) and Master's (MESt) level could unfortunately not yet be offered in EURECA-PRO due to country-specific regulations. Therefore, the PBL challenges could not be applied in classes in the second year of the first cohort of the BESt programme, and the first cohort of the MESt programme. Nevertheless, several Bachelor's and Master's degree programmes on RCP have been established at the partner universities, as summarised by Drebenstedt et al. [8]. Due to the reasons mentioned above, the deliverable D3.10 PBL challenge evaluation report of first trial period has to be postponed.

The collected PBL Challenges will be presented to appropriate multipliers and councils such as the Education Council. It is planned that 8-10 PBL courses will be evaluated (apprx. 1 per partner). Selected PBL Challenges will be elaborated and implemented according to the

guidance manual (chapter 4) and transferred into teaching as soon as possible. The developed learning aids of the modules are to be passed on to the teachers of the consortium in the future. They will be made available on the most suitable digital EURECA-PRO platform, e.g. SInDiPlat or LMS for university staff. While one goal is to integrate PBL into existing teaching structures without changing the entire curriculum, the other is to bring concrete RCP knowledge into education through PBL.

The abovementioned 8-10 PBL courses will be evaluated in the deliverable D3.10. The evaluation report will be based on the assessment of the questionnaire for participants and the lecturers document according to the evaluation procedure described in chapter 5, Annex A.b and A.c. An adapted catalogue of PBL challenges and guidance manual (D3.9) will be an updated version of the PBL catalogue after the first trial period of implementation at the end of the project.

6.7. References

[1] Deliverable 2.24, Problem Based Learning Module Layout, Report, WP 2: Education and Studies, Technische Universität Bergakademie Freiberg, Report to EC, 31.10.2022

[2] K. Serhart, „Problem-Based Learning (PBL),“ 8 Januar 2020. [Online]. Available: https://educationaltechnology.net/problem-based-learning-pbl/. [Zugriff am 03.02.2022]

[3] Deliverable 5.12: International Employability Skills Challenge, WP 5: Transversal European Skills, Values and Tools, University of León, Report to EC, 30.04.2022

[4] Deliverable D3.1, Organisational Scientific Framework Charter (SFC) for interuniversity research collaboration, Report, WP 3: Research, Montanuniversität Leoben, Report to EC, 15.04.2021

[5] Hemker, L., Prescher, C., & Narciss, S. (2017). Design and Evaluation of a Problem-Based Learning Environment for Teacher Training. Interdisciplinary Journal of Problem-Based Learning, 11(2). Available at: https://doi.org/10.7771/1541-5015.1676

[6] Schmidt, H. G. (1983). Problem-based learning: Rationale and description. Medical Education, 17(1), 11–16.

[7] Weber, A. (2005). Problem-based learning—Ansatz zur Verknüpfung von Theorie und Praxis. Beiträge zur Lehrerinnen- und Lehrerbildung, 23(1), 94–105.

[8] Drebenstedt, C., Sishchuk, J., Palmer, L. et al. Education and Study Concepts at the European University Alliance EURECA-PRO. Berg Huettenmaenn Monatsh 167, 477–484 (2022). https://doi.org/10.1007/s00501-022-01281-9

7 Annex

The Organisational Scientific Framework Charter (SFC) can be found on official EURECA-PRO website[43]. As a public version and a confidential version for internal use.

Annex a. Catalogue of PBL Challenges

Annex b. Questionnaire for students

Annex c. Log Sheet for lecturer/ facilitator

[43] https://www.eurecapro.eu

a. Catalogue of PBL Challenges

No.1: Clean Energy Generation Challenge: Modeling Bioelectricity and Hydrogen Production from Rhodospirillum Rubrum Bacterial Cultures in Microreactors

Problem description of the PBL challenge to be solved

The scientific goal of the six persons team is to create a mathematical model reflecting a real microreactor, where a platform for real-time monitoring of the growth of Rhodospirillum rubrum bacterial cultures has been created using precise fluid manipulation. These bacteria have the ability to produce bioelectricity and hydrogen, depending on the amount of energy supplied by the form of light. An important issue is mapping of the kinetics of the biofilm electrode, including the inoculation procedure and the dependence of the electrode area on the volume of the microreactor included in the microsystem. The microsystem and the culture used are the subject of current research carried out by the supervisors together with the team of students involved in the project.

Derived from

1. One challenge is the use of biomass for the production of green hydrogen.
2. It is also a challenge to reduce the direct use of biomass for energy production with the release of greenhouse gases such as carbon dioxide and methane, in favour of maximising the potential for the extraction of green hydrogen, whose energy use does not involve the production of greenhouse gases.
3. JSSYSTEMS Student sp. j. Gliwice, Poland.
4. Competition organized within the project "Silesian University of Technology as a Centre of Modern Education Based on Research and Innovation".

Level for which it is designed:

A) Ca. 200h
B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

This self-study module guides students to develop measurements based on optical and fluorescence microscopy image analysis and also using classical estimation techniques. For this purpose, students will use a mathematical model that describes the growth of microorganisms in the form of a differential equation, where the measured product flux is proportional to changes in the specific growth rate of the microorganisms. The identification of the parameters of the mathematical model of the microreactor will be made using measured data from experiments and using the least squares. They will understand how the coefficients of the model for different culture conditions allow the values of these coefficients to depend on the quantities controlling the culture.

Pedagogic and scientific value

The proposed project involves interdisciplinary research using microelectronic techniques, measurement data analysis, biomathematical modelling, chemical methods, environmental engineering, and systems biology with strong support for image and electrical signal processing tools. This will provide new tools based on microfluidic technology to support interdisciplinary research. The results obtained from the project will clarify important questions about the energy potential of biomass. They will provide theoretical, experimental, and simulation tools to support Industry 4.0 and efficient energy management.

No.2: Induction of cell death in tumor lines subjected to genome editing by CRISPR/Cas9 technique in the presence of non-steroidal anti-inflammatory drugs and their derivatives

Problem description of the PBL challenge to be solved

The use of anti-inflammatory drugs in the combination of oncological therapy (active substances with gene therapy) for creating a new therapeutic strategy

Derived from

1) Informative knowledge from the "Tissuess cultures" and "Cell Biology"; 2) Obvious need in human protection (oncology) with possible implementation in National Institute of Oncology; 3) Competition organized within the local conference "Silesian Stientific Meetings"; 4) Involving the students project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200h
B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Students will be able to design and construct the genomic tools *in silico* (for electric energy, consumable single-use laboratory plastics, an experiments *in vitro* and *in vivo* reduction); and program an experimental systems supporting pharmacological drugs screeneing for therapeutic pourposes (human health protection); conduct research aimed at diagnosing the mechanism of action in cells.

Pedagogic and scientific value

This self study module guides students to: + think critically and in a networked way about our society, technology, nature and the environment as a whole (reduction of electric energy; laboratory plastics; paper for printing - in silico studies). + reflect on the environmental impacts of plastics and their contribution to achieving the *in silico* experiments for drug screening. + an awareness of the various possibilities to contribute to the SDGs. + understand the importance of plastics in improving global living standards. The project fits into the priority research areas of the Silesian University of Technology, i.e. computational oncology and personalized medicine (POB1). The project is aimed at students of Biotechnology/Biotechnology (Bioinformatics, Applied Biotechnology); Chemistry (Biotechnology, Cosmetic and Pharmaceutical Chemistry) Mathematical and computer processing of data for signal paths, obtained from databases and as part of performed experiments will be the basis for the preparation of subsequent projects, as well as scientific publications.

Further Information

Biotechnology Centre: https://www.polsl.pl/rjo11-cb/

No.3: Interpreting Complex Biological Models for Novel Therapeutic Strategies: A Challenge in Contrast Construction and In-Silico Analysis

Problem description of the PBL challenge to be solved

The constructions of complex contrast for linear models biological experiments and in-silico knowledge interpretation to obtain a new therapeutic strategy

Derived from

1) Medium knowledge in R programming as well in Statistics; 2) Competition organized within the local conference "Silesian Stientific Meetings"; 3) Involving the students project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200h B) Semester course C) Bachelor or Master thesis

Associated learning outcome

Students will be able to correctly recognize contrast designs in linear modeling which are necessary to correct calculations and scientific conclusions; Studetns will increase they skills of computetional biology and statistics

Pedagogic and scientific value

This self study module guides students to:
+ think critically and in a networked way about our society, technology, nature and the environment as a whole (reduction of electric energy; laboratory plastics; paper for printing - in silico studies).
+ reflect on the data managment and storage as well as power used during computational analysis
+ understand the importance of plastics in improving global living standards. The project fits into the priority research areas of the Silesian University of Technology, i.e. computational oncology and personalized medicine (POB1). The project is aimed at students of Biotechnology/Biotechnology (Bioinformatics, Applied Biotechnology); Chemistry (Biotechnology, Cosmetic and Pharmaceutical Chemistry) Mathematical and computer processing of data for signal paths, obtained from databases and as part of performed experiments will be the basis for the preparation of subsequent projects, as well as scientific publications.

Further Information

https://www.polsl.pl/rau4/joanna-zyla/

No.4: Scraper Conveyor Material Configuration Challenge: Investigating the Impact of Material Association on Tribological Wear for Glass Cullet Transport

Problem description of the PBL challenge to be solved

The scientific objective of the project is to assess the impact of the material configuration on the tribological wear of the cooperating elements on the scraper conveyor for the transport of glass cullet. The currently used configuration of materials that form an association in the form of a transport chain element (alloy steel forgings for hardening of the surface of grade 20MnCr5) moving on a wear-resistant steel plate (CDP 1001 DP) and an alternative proposal that creates a material association of an alloy steel forgings moving on a specially designed slide made of Hadfield steel grade X120Mn12 will be subjected to comparative tests. The corresponding material association guarantees low costs of making the scraper conveyor while ensuring its reliability, high durability, and an adequate level of safety. An additional goal of the project is to master students' skills to solve practical technical problems encountered in the industry using the university's laboratory base. The project will create opportunities to verify theoretical knowledge gained during lectures conducted by a recognized foreign lecturer in engineering practice. The result of the project will also be scientific publications in domestic or foreign high-scoring journals, prepared together with committed students, industrial partners, and scientific staff of domestic and foreign technical universities.

Derived from

The urgent need to solve the research problem reported by a representative of the glass industry, Forglass based in Krakow, which offers services in the field of construction and repair of glass equipment, machines, and furnaces in Poland and Europe. The competition was organized within the project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200h (recherche, theory, presenting)
B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

As a result of the project, the students will acquire the knowledge and skills necessary to understand the essence of the design of devices and machines, taking into account the material design process. Participation in the project will allow students to comprehensively familiarize themselves with the process of designing structures that perform responsible tasks, taking into account the aspect of user safety. An additional very important effect of the project, of great technical importance, is sensitization to the phenomena accompanying friction, which are the processes of tribological wear of materials – causing the risk of damage and huge losses in the economy resulting from the need to replace worn and damaged elements and production downtimes.

Pedagogic and scientific value

Today's production of glass and glass products, thanks to an innovative approach to automation, intelligent machine production networks, and transport equipment, includes several elements of the Industry 4.0 idea, mainly related to glass handling, sorting, storage, and processing systems. The scientific problem proposed by the industrial partner is therefore of great importance for the socio-economic context, but also for the business context. Together, students will learn the complex context of the design process for devices with a high degree of reliability, guaranteeing high durability and safety of operation. The solution to these problems may be the implementation of modern materials and innovative technologies for the production of surface layers, from materials with a designed structure and high resistance to abrasive wear, corrosion, high unit pressures, and dynamic loads. This is in line with the idea of Industry 4.0, because it enables better control over tribological wear processes thanks to the integration of production data, tracking the course of consumption, and collecting information on each product, which is intended to promote full autonomy of the scraper conveyor operation. Applying the concept of continuous and constant wear monitoring of consumables using built-in sensors and assist systems can enable predictive and preventive maintenance and repair. This would prevent unplanned downtime and increase plant uptime. An undoubted advantage of this project is the participation of partners from the socio-economic environment, Forglass and Castolin. In addition, students will have the opportunity to consult the results of the research with researchers from Polish and foreign technical universities. The participation of other experts in the implementation of wear-resistant materials and the operation of machines and industrial transport installations that meet environmental protection requirements are also planned. As part of the project, 30 hours of classes conducted in English by a foreign senior lecturer are planned. The topics of the lectures will concern the principles of selection of engineering materials for structural elements of machines and devices, as well as the technology of manufacturing wear-resistant layers and coatings.

Further Information

https://omega.polsl.pl/info/author/PSL9e96fcabae68405fa63acb0dcd995bb5/Profil+osoby+%25E2%2580%2593+Artur+Czupry%25C5%2584ski+%25E2%2580%2593+Politechnika+%25C5%259Al%25C4%2585ska?r=publication&ps=20&lang=en&pn=1&cid=237335

No.5: The impact of the concentration of heavy metals and organic micropollutants in rainwater on the quality of the environment

Problem description of the PBL challenge to be solved

Determination of the amount of pollutants in rainwater coming from streets and roofs in the urban environment. Indication of the possibility of removing impurities - adsorption ? Use of mesoporous materials ? The use of mesoporous silicas with high specific surface area, high pore volume and thermal stability ? Possibilities of functionalization to change the chemical character of the silica surface and their impact on its sorption properties ?

Derived from

1) Obvious need in company Gliwice Water Supply and Sewage Company 2) Competition organized within the project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200 h B) Semester course

Associated learning outcome

Reflection on the impact of organic micropollutants in rainwater on the environment. Reflection on the role of heavy metals and their impact on the ecosystem. The project will also investigate the impact of different functionalization strategies on the adsorption capacity of the mesoporous silicas.

Pedagogic and scientific value

This self-study module guides students to + think critically about our society, technology and environment as a whole. + consider the impact of micropollutants on the environment. + understand the importance of heavy metals and their impact on the deterioration of living standards. + understand the impact of pollutant identification on environmental risk assessment. + understand the level of pollutants present in rainwater that runs off from streets and roofs in the urban environment. + The project aims to explore methods for removing these impurities from the water.

No.6: Numerical modelling of the personal protective equipment effectiveness and the risk of infection using an advanced model of human respiration and particulate emissions.

Problem description of the PBL challenge to be solved

The aim of the project is to develop a reliable numerical model to study the spread of pollutants emitted by humans. This is a key issue for optimizing modern ventilation systems in buildings, analyzing the risk of infection and the effectiveness of the use of Personal Protective Equipment. As part of the project, experimental tests of the flow characteristics of the masks will be carried out on a dedicated measuring stand and tomographic scans of the masks will be carried out. The measurement results will be used to develop and validate the microscopic model of the mask. Numerical calculations will be performed for models with breathing people in ventilated rooms. Validation based on CO2 dispersion measurements will be performed for the selected room. An interdisciplinary team of tutors and experts will ensure the achievement of the assumed goals within a limited time frame.

Derived from

Competition organized within the project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

C) Bachelor or Master thesis

Associated learning outcome

Students will get a background in CFD modelling, will be able to perform a numerical calculation, to conduct research in the area of ventilation and distribution of indooor air contaminants.
Students will develop a reliable numerical model that can be used to study the spread of pollutants emitted by humans, particularly in indoor environments.
The students compile important data to optimize modern ventilation systems in buildings, analyze the risk of infection, and evaluate the effectiveness of personal protective equipment (PPE).

Pedagogic and scientific value

The main scientific value of the project is to develop a reliable mathematical model for predicting the spread of pathogens and assessing the probability of infection, fits very well into the fifth stage of industry 4.0 development, which is to focus on a human being - an employee of the company and ensuring appropriate working conditions - in particular safety . The Covid-19 pandemic, which in 2020 caused the greatest recession since the Great Depression of the early 20th century, has shown how important this is for the development of industry and guaranteeing supply chains, causing a decrease in global GDP by about 4%.
The project is interdisciplinary, covers issues in the field of environmental engineering and materials engineering, numerical fluid mechanics as well as automation. In addition, as part of international cooperation.
As part of the project, the team will continue the cooperation established earlier with the Polish company Euro Profil, which produces personal protective equipment based on raw materials obtained from recycled plastics. Pedagogical value of the project: students will learn how to perform scientific research in reflection to environmental issue.

No.7: The use of modern computing techniques (CAE) to analyze their operation and assess the risk of failure is one of the most important issues of the upcoming 4th industrial revolution.

Problem description of the PBL challenge to be solved

The aim of the project is to continue the research on the corrosion of the reinforcement of prestressed concrete beams subjected to an aggressive environment simulated in a climatic chamber and to further develop a numerical model of this process. This project is a continuation of the projects implemented in Editions IV and V, in which, for objective reasons, we focused mainly on modeling and software development. Then, in the 8th edition, we started a cycle of research on the corrosion progress of the reinforcement of prestressed concrete beams placed in a climatic chamber purchased from the project funds. Currently, we plan to further develop modeling and continue a long-term research cycle aimed at verifying the developed model. The model is designed to predict the occurrence of corrosion risk for reinforced concrete and prestressed structures. The problem of reinforcement corrosion in reinforced concrete and prestressed concrete structures is of great importance, as it is associated with huge maintenance costs of objects exposed to chloride ions and CO2, and the risk it poses to human life.

Derived from

1) obvious need for the companies in the construction industry: Fabud, Conbet and companies Małro and Elbud - producers of prefabricated reinforced concrete and prestressed concrete elements,
2) Competition organized within the project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200h
B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Students will be able to design strength tests of large elements of prestressed concrete beams made in a prefabrication plant placed in a climatic chamber under variable temperature, humidity and CO2 conditions with simultaneous long-term load on these beams. Students will be able to develop power supply and signal conditioning systems for the measuring sensors used and will design and implement the electrical installation of these sensors in the climatic chamber. Students will be able to used the ANSYS Fluent software, a multi-phase mathematical model of moisture and chloride ion transport in a porous material such as concrete.

Pedagogic and scientific value

In this project the cooperation with the following companies from the construction industry is continued: Fabud, Conbet and Małro and Elbud - producers of prefabricated reinforced concrete and prestressed concrete elements. The use of modern computing techniques (CAE) to analyze their operation and assess the risk of failure is one of the most important points of the upcoming 4th industrial revolution. The project will allow the use of advanced simulation tools to solve an extremely practical problem - predicting the occurrence of corrosion of reinforced concrete and prestressed structures, and to familiarize the construction industry with the huge possibilities of this type of software.
Cooperation with scientists from the Department of Structural Mechanics, Faculty of Civil Engineering, VSB-Technical University of Ostrava, Czech Republic is planned.

No.8: Identification of the possibility of technological recovery of chemical substances extracted from forest biomass during the production of construction material in the form of wood with increased strength

Problem description of the PBL challenge to be solved

Biodegradable and pro-ecological, and at the same time competitive in terms of strength, construction materials are one of the main directions of complementary development of materials engineering and construction sciences. Processes based on partial extraction of natural wood components, followed by thermal and mechanical treatment of the resulting semi-finished product, lead to favourable changes in its strength parameters. The proposed research topic is a continuation of the promising work carried out during the 6 previous editions of PBL. In the case of spruce wood, a material with a strength of over 300 MPa was obtained. The material modified in this way can therefore be a real competition even for steel, and as a renewable material, wood perfectly meets the requirements of the Circular Economy strategy.
In the current PBL edition, the subject will focus on the holistic aspects of the technology (possibly waste-free - Circular Economy) for the production of this material - both on the strength properties of wood samples obtained in various extraction conditions, and on the identification (a team from the University of Valladolid, Spain) of the possibility of extraction-based recovering selected substances from forest biomass to solutions during the production of construction material in the form of wood with increased strength.
The essence of the PBL project is learning to work and complementary cooperation in an interdisciplinary and international project team (soft skills).
The final result of the Project will be the determination of optimal technological conditions for the process - both from the point of view of the properties of the new construction material (reinforced densified wood), and towards the best and possible full use of the resulting post-extraction solutions through separation and required purification of selected full-value organic compounds that may still be used in other chemical processes.

Derived from

Competition organized within the project "Silesian University of Technology as a Centre of Modern Education Based on Research and Innovation". Need reported in industry – company EUROLAM, Rybnik, Poland.

Level for which it is designed:

A) Ca. 200 h (research tasks, theory, presenting)
B) One semester course
C) Bachelor and Master thesis

Associated learning outcome

Students will be able to design the technological process of densified wood manufacturing. Students will have in-depth knowledge of the technological production process of wood with increased strength, also taking into account the chemical conditions related to the optimal management of the post-process solutions towards the recovery of useful bio-substances of natural origin. Students will also learn about the economic conditions of technological processes and methods of selecting optimal technological solutions that take into account various aspects of the process and the necessity of recycling rules and natural environment protection, sustainable development tasks and global Circular Economy strategy.

Pedagogic and scientific value

The PBL project will be implemented in cooperation with the EUROLAM company from Rybnik and their cooperators, who during many consultation meetings have repeatedly indicated the market demand for this type of pro-ecological materials. Students and Specialists in the field of chemical engineering, mechanical and civil engineering from our university – Silesian University of Technology, as well as from Spain, will be involved in the process of manufacturing and testing the use of the new construction material. The foreign team of Students under the supervision of Professor Silvia Bolado Rodriguez (University of Valladolid, Chemical Engineering and Environmental Technology Department, Industrial Engineering School, Dr Mergelina s/n 47005, Valladolid, SPAIN) will be involved - in accordance with its long-term research profile (biotechnology) - in works related to the experimental verification of economic, technical possibilities of separating selected organic compounds from post-extraction solutions (recovery of full-value chemical compounds) in order to develop the basis for a comprehensive technology for the production of reinforced structurally densified wood in accordance with modern trends in Circular Economy and environmental protection.
The technological problem of structural and spatial modification of the lignocellulosic fraction of wood in order to significantly improve the mechanical and strength properties of this construction material fits perfectly into the idea of the fourth industrial revolution. Both the material itself and the optimized in various respects (solid product features, economic recovery of organic compounds from post-extraction solutions) technology of its production and application (computer simulation of the work of a new construction material in various application environments, conceptual designs) meet all the assumptions of the Industry 4.0 philosophy, Circular Economy (CE)) and the principles of sustainable development of society

No.9: Using UWB technology for positioning system

Problem description of the PBL challenge to be solved

How to use Ultra-wideband (UWB) technology for environment perception?
Tasks to be fulfilled in teams of 2-4 persons:
- adjustments of UWB technology:
- anchors-tags distribution and communication idea creation;
- check the accuracy of the positioning system;

Derived from

Required by R&D industry partners, e.g. APTIVE for improvement of a car perception

Level for which it is designed:

A) Ca. 200 h
B) All starting from 4 semester
C) Bachelor and Master thesis, but Master preferable

Associated learning outcome

Student will be able to design UWB positioning system. Students will understand and apply Ultra-wideband (UWB) technology for accurate positioning and environment perception. Students will gain hands-on experience in using UWB technology for environment perception, including practical knowledge on UWB device configuration, system setup, communication protocols, and positioning accuracy assessment.

Pedagogic and scientific value

This self study module guides students to + think critically about various positioning systems, and challenges related to UWB positioning systems + understand positioning methods offered by UWB technology. + learn about wireless communication, signal processing, and position sensing

Further Information

https://sites.google.com/site/damiangrzechca

No.10: Occupancy grid map creation based on environment perception

Problem description of the PBL challenge to be solved

How to create occupancy grid map? Tasks to be fulfilled in teams of 2-4 persons: - gathering data from sensors to get initial occuancy grid map; - application of Dempster Schafer method for data fusion; - obtaining the most valuable fusion operator;

Derived from

Required to get more reliable system perception and towards the car autonomy next level (one of the challenges of the automotive branch)

Level for which it is designed:

A) Ca. 200 h B) All starting from 4 semester C) Bachelor and Master thesis, but Master preferable

Associated learning outcome

Student will be able to create occupancy grid map. Students will understand and apply the Dempster-Shafer method for data fusion to create an accurate and reliable occupancy grid map of an environment. The team will gain practical knowledge on sensor data collection, preprocessing, and fusion, as well as on evaluating and selecting the most appropriate fusion operator.

Pedagogic and scientific value

This self study module guides students to
+ think critically about importance of various sensors for occupancy maps creation
+ understand methods and operators for data fusion.
Hands-on experience: The project provides a hands-on learning experience for team members to learn about sensor data fusion and mapping.
+ project lead to novel research in the field of sensor data fusion and mapping, which can contribute to the development of new techniques and methods.
+ teamwork and collaboration: The project is designed for teams of 2-4 persons, which encourages teamwork and collaboration among team members.
+ skill development: The project helps team members develop skills in data collection, preprocessing, and fusion, as well as in evaluating and selecting the most appropriate fusion operator.
+ real-world application: The project provides an opportunity to apply the acquired knowledge and skills in a real-world scenario, which enhances the learning experience and prepares team members for future projects and careers.

Further Information

https://sites.google.com/site/damiangrzechca

No.11: Creation of simulation environment

Problem description of the PBL challenge to be solved

How to build the simulation.
Tasks to be fulfilled in teams of 2 persons:
- creation of test scenarios;
- configuration of e.g. Matlab toolbox for gathering data from sensors to get occuancy grid map;
- application of Dempster Schafer method for data fusion;

Derived from

Obvious preliminary step before further application for real scenarios.

Level for which it is designed:

A) Ca. 200 h
B) All starting from 4 semester
C) Bachelor or Master thesis

Associated learning outcome

Student will be able to simulate car perception in simulation environment.
Students will gain knowledge and practical experience in creating simulations for testing and validating sensor data fusion and mapping algorithms.
The team will gain practical knowledge on test scenario design, sensor data simulation, and data fusion algorithm implementation using Matlab.

Pedagogic and scientific value

This self study module guides students to
+ know how to create a scene for car perception in simulator environment;
+ understand the importance of simulation step before gathering real data while driving.

Further Information

https://sites.google.com/site/damiangrzechca

No.12: Engineering in Virtual Reality: Developing an Immersive Experience with Tactile Feedback

Problem description of the PBL challenge to be solved

The PBL project aims to create a game where the participant is introduced to the world of engineering (machines, software) through virtual reality (VR). The design of the Tactile Feedback glove, constructed in previous editions of PBL, will allow the touching of the designed environments - the game will allow the player to see and touch the inside of devices, or make the player feel what it is like to be part of a mechatronic device or machine code controlling, for example, a 3D printer.

Derived from

1) obvious need in company ZENonVR, 2) Competition organized within the project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200 h
B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Students will be able to design, construct and program a mechatronic system which, through visualisation in VR, will help to understand how engineering systems work, and to conduct research aimed at diagnosing the action and suggesting any modifications
Students will understand Engineering Concepts: The game aims to introduce the participant to the world of engineering, which will provide an opportunity to learn about various engineering concepts related to machines, software, mechatronics, and more.
Participants will gain hands-on experience with virtual reality technology through the game, which can be used in various fields such as gaming, education, and training.
The project involves the design of the Tactile Feedback glove, which will enable participants to touch and feel the designed environments. Participants will learn about the design, construction, and functionality of the glove.
The game will allow players to control mechatronic devices and machine code, providing an opportunity to learn about the design and operation of these systems.
The PBL approach to learning involves collaboration and problem-solving, which will help participants develop their teamwork and critical thinking skills. The project will involve working in a team to design and develop the game, as well as testing and refining it.

Pedagogic and scientific value

Project participants will acquire competences in
- engineering modelling (creating mathematical and 3D models of devices);
- design and construction of mechatronic devices (extending the functionality of the wireless Tactile Feedback glove system);
- programming (creation of VR, programming of embedded systems that control the Tactile Feedback glove);
- acquisition and processing of data from the realised system in order to publish the research in a scientific journal.

No.13: Domain adaptation in the process of detecting dangerous actions and disease disorders on image data using synthetic data from crowd simulation

Problem description of the PBL challenge to be solved

The purpose of the synthetic data generated in this way is to use it to develop algorithms for detecting, simulating and alerting about actions and various dysfunctions (e.g. disorders related to neurological diseases, dementia, dementia, etc.), as well as an appropriate analysis of spatial conditions in terms of ensuring the safety of groups with special needs in public spaces. In a joint article with CNR Pisa, it was shown that there is a need for additional work to generalize the action detection problem - i.e. by training the algorithm with monitoring data, it is not possible to detect fights in a different environment, therefore an algorithm for generalizing the problem and adapting the domain will be proposed.

Derived from

1) Joint work with CNR in Pisa Italy, 2) applications in industry - Blees and Qsystems.pro, 3) continuation of previous PBL projects

Level for which it is designed:

A) Ca. 100 h (recherche, theory, presenting)
B) Semester course
C) Bachelor thesis

Associated learning outcome

Students will be able to program in graphical enviromnent and prepare their own deep learning architectures for many different applications such as detection or recognition.
Participants will learn about data science techniques such as data generation, data preprocessing, and data analysis.
Participants will be involved in developing algorithms for detecting and simulating actions and dysfunctions related to neurological diseases and dementia.
Participants will learn about domain adaptation techniques and their applications.
Participants will learn about spatial analysis techniques, such as spatial clustering and spatial statistics.
The project will involve collaboration and problem-solving, which will help participants develop their teamwork and critical thinking skills.

Pedagogic and scientific value

The main scienitific and practical outcome is to prepare a set of algorithms for detection and recognition of unusal actions on the base of synthetic (simulated) dataset.
Researchers can improve the accuracy and effectiveness of algorithms for detecting and simulating dysfunctions, which can ultimately lead to better outcomes for individuals with neurological diseases and other conditions.
The development of these algorithms can have broader implications for public safety and security in various settings, including transportation, entertainment, and public spaces.

Further Information

https://crowdsim.aei.polsl.pl

No.14: A model of internal communication links of the city of Zabrze to improve the flow of employees and students of the Silesian University of Technology

Problem description of the PBL challenge to be solved

The city of Zabrze has undergone a transformation in recent years - from a city associated with heavy industry - mining and metallurgy, it is becoming a city of science and research. Two faculties of the Silesian University of Technology are located in Zabrze, their operation is related to the characteristic flow of people - students and employees. The existing infrastructure of the city was created in the 20th century, where the communication model was focused on public transport. Due to the lack of parking lots and the reduction in the number of people using public transport, the current and future transport needs of the city are becoming a challenge.

Derived from

The city of Zabrze is transforming into a strong academic center, which results in a significant increase in the number of students coming to and moving around the city. Therefore, a new look at the problem of their communication within the city center is necessary, the possibility of access, parking, and the use of new technologies for this purpose.

Level for which it is designed:

A) Ca. 20 h (one SDG)
B) Semester course (all SDGs)

Associated learning outcome

1. Inventory of the city's communication problems.
2. Determination of possible communication solutions.
3. Building a communication model in the city.
4. Project will contribute to the development of skills in the areas of data analysis, machine learning, and transportation planning.

Pedagogic and scientific value

The cooperation will refer to areas related to public transport and communication related to future investments and "green development" of the city in the context of the idea of industry 4.0
Project provides opportunities to develop innovative solutions to transportation challenges in urban environments, and to advance our understanding of how to design and manage sustainable, livable cities.
Opportunity for students to gain hands-on experience in data analysis, machine learning, and transportation planning.
Researchers might evaluate and test potential solutions to improve transportation efficiency and accessibility in the city.

Further Information

Links for internet research:
+ https://profily.vsb.cz/fro04
+ https://www.fad.stuba.sk/sk/ustavy/ustav-architektury-obytnych-budov/ing.-arch.-edita-vrablova-phd.html?page_id=2658

No.15: Contribution of plastics to achieve the SDGs: Personal protective equipment - Masks

Problem description of the PBL challenge to be solved

How do we contribute with plastics to the achievement of the Sustainable Development Goals (SDGs)?
Task to be fulfilled In teams of 2-4 persons
1. Choose one of the SDGs and describe with examples how plastics contribute substantially to reach this goals.
2. What steps have still to be done to become more successful?
3. What can you personally contribute to support this SDG regarding plastics?
4. You should put together a team of experts to accelerate the development towards a better world for all - Who has to be in this team and why?

1. The aim of the project is to develop a model and flow characteristics of masks protecting the respiratory system and the effectiveness of their use. Currently, the production of personal protective equipment without the use of plastics, including masks, is impossible. As part of the project, the team will cooperate with the Polish company Euro Profil, which produces personal protective equipment based on raw materials obtained from recycled plastics.
2. The materials used for the production of masks should be biodegradable due to the fact that they are composite materials, and their segregation or sorting is technologically difficult.
3. The individual success of the team will be the elimination of masks that do not constitute effective personal protection. Further continuation of their production and their use is pointless and endangers human life and the environment.
4. The selected team is optimal for the implemented project. Undoubtedly, a virologist would be an important additional expert.

Derived from

EURECA-PRO PhD-Journey 2022, Lecture on Responsible Consumption and Production: Processing and Recycling of Polymers
1. Obvious need in company Euro Profil
2. Competition organized within the project ""Silesian University of Technology as a Center of Modern Education Based on Research and Innovation

Level for which it is designed:

A) Ca. 10 h (one SDG)
B) Semester course (all SDGs)
Bachelor or Master studies

Associated learning outcome

Reflection of the role of plastics to achieve the SDGs on the basis of one chosen SDG.
Students will understand the pros, cons and the evironmental impact of different polymer materials.
Based on the research results, students will be able to design a structure that effectively protects the masks, which will reduce the consumption of material during production and increase the time of use of the masks, thus reducing the amount of waste in the form of used masks.

Pedagogic and scientific value

This self study module guides students to
+ think critically and in a networked way about our society, technology, nature and the environment as a whole.
+ reflect on the environmental impacts of plastics and their contribution to achieving the (SDGs).
+ an awareness of the various possibilities to contribute to the SDGs.
+ understand the importance of plastics in improving global living standards.
The project is interdisciplinary and allows students to expand their knowledge of environmental and material engineering, numerical fluid mechanics and automation.
In addition, the results of the research will allow to critically assess the effectiveness of the use of protective masks available on the market.
The results of the research will prove that plastics are necessary for the production of health care products, and our goal is to use them properly.

Further Information

Links for internet research:
+ http ://sdg info.polysustain.com/
+ https://www.umweltbundesamt.de
+ https://www.ifeu.de
+ https://denkstatt.eu/?lang=de
+ https://www.bmnt.gv.at/umwelt
+ https://www.plasticseurope.org
+ https://ec.europa.eu/commission
+ „Presse“ 25.1.2019 , https://diepresse.com/home/ausland/welt/5568395/Plastik wir haben ein Problem

No.16: Dissolution kinetics of Zn and ZnAl(Mg) coatings in leaching in hydrochloric acid

Problem description of the PBL challenge to be solved

Zn coatings are widely used in construction, architecture and automotive industry to protect against corrosion. An alternative to Zn coatings are ZnAl(Mg) coatings with much better corrosion resistance. After an extended period of operation of such products, steel scrap contaminated not only with Zn, but also with other metals is put into circulation. HCl leaching effectively removes the metal coating from the steel surface. The acid used after the leaching process is a rich source for metal recovery. The formation of the intermetallic phases of the Fe-Zn (Zn coating) and Fe-Al (ZnAl(Mg) coating) systems in the coating causes the inevitable dissolution of iron in the acid, which hinders the process of recovery of non-ferrous metals. The scientific goal of the project is to determine the dissolution kinetics of the phases of the Fe-Zn and Fe-Al systems forming metal coatings in HCl. In the utilitarian aspect, this will allow for a rational selection of coating leaching parameters in order to monitor the amount of metals passing into the acid solution.

Derived from

1) obvious need in industry connected with steel corrosion and corrosion protection, 2) Competition organized within the project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) ca. 200h
B) Semester course
C) Bachelor or Master studies

Associated learning outcome

The student will know the problems related to the corrosion of steel and the methods of protection against this corrosion. The student will be able to define the problems associated with the recovery of zinc from galvanized steel. The student will be able to carry out simple experiments related to the leaching of galvanized steel in HCl. The student will learn about the method of hot dip galvanization of steel and will be able to obtain Zn and ZnAl(Mg) coatings on various steels.

Pedagogic and scientific value

This self-study module guides students to: think critically towards the use of the best solutions in the field of corrosion protection of vehicles, railway and road infrastructure, steel structures, or architectural design; reflect on the problem connected with the fact that the development of a technology for the initial removal of Zn and ZnAl(Mg) coatings from the steel surface will allow to reduce dust emissions from the EAF process and prepare the raw material for the secondary recovery of metals; an awareness of the various possibilities to contribute to the studied problem and to achieve appriopprate solutions; understand the importance of corrosion and protection against it.

No.17: Induction of cell death in tumor lines subjected to genome editing by CRISPR/Cas9 technique in the presence of non-steroidal anti-inflammatory drugs and their derivatives

Problem description of the PBL challenge to be solved

The use of anti-inflammatory drugs in the combination of oncological therapy (active substances with gene therapy) for creating a new therapeutic strategy

Derived from

1) Informative knowledge from the "Tissuess cultures" and "Cell Biology"; 2) Obvious need in human protection (oncology) with possible implementation in National Institute of Oncology; 3) Competition organized within the local conference "Silesian Stientific Meetings"; 4) Involving the students project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200h B) Semester course C) Bachelor or Master studies

Associated learning outcome

Students will be able to design and construct the genomic tools *in silico* (for electric energy, consumable single-use laboratory plastics, an experiments *in vitro* and *in vivo* reduction); and program an experimental systems supporting pharmacological drugs screeneing for therapeutic pourposes (human health protection); conduct research aimed at diagnosing the mechanism of action in cells. The associated learning outcome of the project is to develop a comprehensive understanding of the use of anti-inflammatory drugs in combination with oncological therapy, and to develop and test new therapeutic strategies that can improve patient outcomes..

Pedagogic and scientific value

This self study module guides students to: + think critically and in a networked way about our society, technology, nature and the environment as a whole (reduction of electric energy; laboratory plastics; paper for printing - in silico studies). + reflect on the environmental impacts of plastics and their contribution to achieving the *in silico* experiments for drug screening. + an awareness of the various possibilities to contribute to the SDGs. + understand the importance of plastics in improving global living standards. The project fits into the priority research areas of the Silesian University of Technology, i.e. computational oncology and personalized medicine (POB1). The project is aimed at students of Biotechnology/Biotechnology (Bioinformatics, Applied Biotechnology); Chemistry (Biotechnology, Cosmetic and Pharmaceutical Chemistry) Mathematical and computer processing of data for signal paths, obtained from databases and as part of performed experiments will be the basis for the preparation of subsequent projects, as well as scientific publications.

Further Information

Biotechnology Centre: https://www.polsl.pl/rjo11-cb/

No.18: Reconstruction of architectural details using 3D printing methods

Problem description of the PBL challenge to be solved

The main goal of the project is to prepare students to work on the reconstruction of architectural elements using the method of laser scanning of damaged and undamaged elements, data transfer from the object present in the laboratory, where then part of the removed element will be restored. Work related to design tasks will be interdisciplinary in nature and will cooperate with students of two faculties, Architecture and Civil Engineering.

Derived from

1) The need to care for monuments and maintain buildings as a very important element of our cultural heritage
2) Competition organized within the project "Silesian University of Technology as a Center of Modern Education Based on Research and Innovation"

Level for which it is designed:

A) Ca. 200h
B) Semester course
C) Bachelor or Master studies

Associated learning outcome

Project participants will have the opportunity to gain competence in the field of specialist material research, specialized software and devices, taking into account the necessary solutions adapted to the needs of the reconstruction of architectural details
The associated learning outcome of the project is to develop students' technical, analytical, collaboration, and communication skills in the context of using laser scanning technology for the reconstruction of architectural elements.

Pedagogic and scientific value

The subject matter of the undertaken project allows for an innovative approach to the problem, but also for the creation of innovative architectural and specialist solutions, based on modern technical thought. 3D printing will not only make it possible to supplement the losses of a damaged element, but it is also a solution for the production of several to several dozen elements that a traditional production plant will not be able to make due to the fact that the order is too small.

No.19: Assessing the sustainability of "green" products

Problem description of the PBL challenge to be solved

Assessing the sustainability of products marketed as green and socially just
The primary goal of this assessment is to determine whether a product is truly environmentally sustainable, or whether it simply has a marketing advantage due to its "green" label.

Derived from

This PBL challenge is part of the module "Introduction to Responsible Consumption and Production" and is given after a lecture on green consumption and greenwashing.

Level for which it is designed:

A) Ca. 10 h (recherche, theory, presenting)

Associated learning outcome

Students learn to independently assess the strategies by which products are marketed as "green" and "socially just" Learners should have a clear understanding of the concept of sustainability, including the three pillars of sustainability (economic, environmental, and social). Students should be familiar with the different types of green products, such as eco-friendly, sustainable, and biodegradable products. Ability to evaluate the environmental impact of green products.

Pedagogic and scientific value

The PBL fosters independent critical thinking Learners should be able to assess the environmental impact of green products. The project provides valuable educational resources to better assess the complexity of sustainability and the actual environmental and social impacts of products. It can also help consumers make informed decisions when purchasing products that align with their values. The project contribute to the scientific community by providing data of the sustainability of products marketed as "green" and "socially just." It also helps to identify gaps in existing certification and labeling systems and guide the development of more comprehensive and standardized sustainability metrics.

No.20: Contribution of plastics to the SDGs

Problem description of the PBL challenge to be solved

Project and Debate: How do we contribute with plastics to the achievement of the SDGs? Task to be fulfilled In teams of 2-4 persons 1. Choose one of the SDGs and describe with examples how plastics contribute substantially to reach this goals. 2. What steps have still to be done to become more successful? 3. What can you personally contribute to support this SDG regarding plastics? 4. You should put together a team of experts to accelerate the development towards a better world for all - Who has to be in this team and why?

Derived from

EURECA-PRO PhD Journey, November 2022 Lecture on Responsible Consumption and Production: Processing and Recycling of Polymers

Level for which it is designed:

A) Ca. 10 h (recherche, theory, presenting) C) Bachelor or Master thesis

Associated learning outcome

Reflection of the role of plastics to achieve the SDGs on the basis of one chosen SDG. Students will know the use of plastics in the everyday life (Food packaging, medical and hygienic applications, wastewater management, clothing, etc.) Students will learn the pros, cons, and environmental impacts of various polymer materials and understand the importance of recycling and reusing these materials and products.

Pedagogic and scientific value

This self study module guides students to + think critically and in a networked way about our society, technology, nature and the environment as a whole. + reflect on the environmental impacts of plastics and their contribution to achieving the (SDGs). + an awareness of the various possibilities to contribute to the SDGs. + understand the importance of plastics in improving global living standards.

Further Information

Information on PhD Journey: https://www.eurecapro.eu/phd-journey/ http ://sdg info.polysustain.com/ https://www.umweltbundesamt.de Deutsches Institut für Energie und Umweltforschung https://www.ifeu.de https://denkstatt.eu/?lang=de https://www.bmnt.gv.at/umwelt https://www.plasticseurope.org https://ec.europa.eu/commission „Presse“ 25.1.2019 , https://diepresse.com/home/ausland/welt/5568395/Plastik wir haben ein Problem

No.21: Nuclear energy and its contribution to the SDGs

Problem description of the PBL challenge to be solved

Project and Debate: How can conventional energy sources using nuclear fuel contribute to achieving the Sustainable Development Goals (SDGs), in particular the SDG on energy supply? Task to be fulfilled In teams of 3 persons 1. Analyse nuclear energy and its relationship to the SDGs. How can it contribute to achieving or not achieving the goals? 2. What are most important advantages and risks? 3. Are the alternative energy sources a real alternative? 4. You have to carry out a debate about this energy potential. Compare the impacts and SDG achievement potential of each of them.

Derived from

Course on Energy Technology, a subject of an Undergratuate Degree in Energy Engineering at University of León, Spain Information requested by Research Task Force (RTF) and Lighthouse Mission 4, and compiled by the Education Interface Task Force (RTF and Education Council)

Level for which it is designed:

A) Ca. 10 h (recherche, theory, presenting)
C) Bachelor or Master thesis

Associated learning outcome

Reflection of the role of nuclear and alternative energy systems for accesible and secure energy
Students will understand the pros, cons and the current development of energy sources
Students will develop analytical skills to evaluate the relationship between nuclear energy and the SDGs. They will examine how nuclear energy can contribute to achieving or not achieving the goals and identify specific SDGs that nuclear energy can help achieve.
Students will learn to critically evaluate the advantages and risks associated with nuclear energy.
Students will gain a deeper understanding of alternative energy sources and their potential to achieve the SDGs.
Students will develop effective communication skills through the debate.

Pedagogic and scientific value

Participants gain a deeper understanding of the complexities and interconnections of sustainable development, and
the role that energy sources play in achieving the SDGs.
Students identify the most important advantages and risks associated with nuclear energy and explore alternative energy sources.

Further Information

The case study can be particularized for each location (country) for particular analysis
Links for internet research:
+ http ://iea.es
+ http ://iaea.org/
Regional energy information agencies (Eurostat, national energy system regulator etc.)

No.22: From the idea to the product

Problem description of the PBL challenge to be solved

Independent identification of open technical or scientific questions and development of strategies for solutions "from the idea to the product".

Derived from

The necessity derives from the demand that students must be able to gain more independent problem awareness, for example, to recognise open research questions, and, on the other hand, to develop solution strategies independently.

Level for which it is designed:

B) Semester Course (1st. Semester)

Associated learning outcome

Awareness of tasks and problems Analysis skills Use of creative, conceptualisation and planning techniques Knowledge of the methods of scientific work

Pedagogic and scientific value

Development of systematic way of working Analytical thinking interdisciplinary approach to problem areas

No.23: Optimization of a smart material

Problem description of the PBL challenge to be solved

How to optimize a smart material? Task to be fulfilled in teams of 2-4 persons 1. Describe with examples how a smart material could be optimized. 2. Compleate a Pre-design of Experiments based on Statistical approach. 3. Present a possible Design of experiments (DoE) applicable to the proposed topic 4. Data analysis (of the expected results)

Derived from

Lighthouse Mission 3, EURECA-PRO project proposal: Doctoral Network - MSCA - Cement substitution

Level for which it is designed:

B) Semester course (Ph.D. students)

Associated learning outcome

Students will learn how to approach an optimization problem using statistical tools Students will understand the properties and behavior of smart materials, including their mechanisms of response to external stimuli. Students will understand the principles of statistical design of experiments and how to apply them to optimize a smart material. Students will develop skills in experimental design and data analysis. Students will develop problem-solving skills by identifying factors that affect the response of the smart material, determining their optimal levels or ranges, and designing experiments to systematically vary them. Students will develop teamwork and collaboration skills by working in groups of 2-4 people to plan and execute the project. Students will develop communication skills by presenting the project findings and results to a wider audience, including peers, instructors, and other stakeholders.

Pedagogic and scientific value

This self study module guides students to:
+ Understand the advantage of an interdisciplinary approach to problems
+ Develop a systematic approach to the experiments and the data analysis
+ Develop an analytical thinking

No.24: Smart and Sustainable City

Problem description of the PBL challenge to be solved

Develop an urban planning project on an urban brownfield to meet social, economical and environmental objectives.
4-days workshop with interdisciplinary groups from 5 to 7 students
Field survey, socio-economic-environmental diagnosis, innovative design based on Nature Based Solutions

Derived from

University of Lorraine internal pedagogic workshop created by four different academic educations

Level for which it is designed:

A) Ca. 10 h (SDG 11 & SDG 12)

Associated learning outcome

Understanding of sustainable urban development principles
Field survey and diagnosis
Nature-based solutions
Project management skills.

Pedagogic and scientific value

Students learn how to apply theoretical knowledge to real-world problems, thus bridging the gap between theory and practice
Students develop skills in data collection, analysis, and interpretation
Experience in project management, including planning, execution, and evaluation.
Students can explore the social, economic, and environmental dimensions of sustainable urban development in a practical setting.

No.25: Build your scientific skills by providing expertise

Problem description of the PBL challenge to be solved

Companies, cities council or start-ups formulate scientific requests dealing with the ecosystem services provided by Nature Based Solutions (bibliographic study, benchmarking study, innovation) in relation with their business to submit to UL students that are asked to bring answers within a 4-day workshop. Students are both coached by representatives from each start-ups and supervised by teaching tutors from UL.

Derived from

Created in the frame of the BUILD Solutions Erasmus+ program

Level for which it is designed:

A) Ca. 10 h (SDG 6, SDG 9 & SDG 12)

Associated learning outcome

Answer to specific scientific-technical request; Team work; Interact with socio-economical actors (start-ups); analyse the scientific and technical issues of the request; integrate a benchmark approach; conduct a scientific investigation; develop their capacity for innovation; integrate the economical dimension; communicate about the results of their study

Pedagogic and scientific value

Opportunity for students to develop and apply their knowledge in a fast-paced and dynamic environment. Students develop their teamwork and communication skills. Work on real-world problems allows students to develop problem-solving skills and experience the challenges of working in a professional environment. Understanding of the challenges and opportunities faced by businesses. Students can contribute to the growing body of knowledge on Nature Based Solutions and their potential applications.

No.26: Plant and plant-interaction engineering to improve plant health

Problem description of the PBL challenge to be solved

A fictious R&D company formulates requests dealing with plant health to solve its internal or clients issues. Examples : 1) find symbiotic fungi to increase spruce resistance to wood-eating insect (client being a spruce forester), 2) create a lecture and an escape game on phytohormones to internally train colleagues on this topic (situation where the company wants to open an new department for its own development), 3) find genes for apple tree resistance to pathogens (situation when a new genome is published, which could open up the way to produce genetically modified apple tree resistant to pathogens)

Derived from

Lectures in Biology

Level for which it is designed:

A) Ca. 10 h (research, theory, presenting) - SDG2 (sustainable agriculture) & SDG15 (forest sustainable management)

Associated learning outcome

Answer to specific scientific-technical request; Team work; Real-life professional situation; Training in professional writing and oral presentation

Pedagogic and scientific value

Use of specific scientific-technical methodologies and tools Immersive learning experience for students in the field of plant health and R&D Opportunity for students to work in interdisciplinary teams, which allows them to develop their teamwork and communication skills. Students develop their project management skills and experience the challenges of working in a professional environment.

No.27: Act and watch yourself act in problem-based learning

Problem description of the PBL challenge to be solved

Anonymous testimonial: "Before the session started, I worked really hard to define the objectives of the course. Using the reference manual, I covered the content from A to Z throughout the session, for each lesson I prepared presentations, which in my opinion, are effective, organized and nicely embellished with diagrams , figures and tables but the students do not seem to retain anything from my course. In fact, 40% failed my first exam! » **Another anonymous testimony:** "These days, students don't know how to take notes and study the material. Young people are getting lazier and lazier!!! » However, it seems that all the reports, all the observations and the literature tend to show that the students of tomorrow will have to be able to solve interdisciplinary problems, to use innovative approaches to problem solving of varying levels of complexity, to be able to use new sources of information and technology, be flexible, persistent and adaptable. In this context, the question that is no longer the right question is: did the students give the right answer? The right questions are rather: have they developed the expected skills? Are they able to use information correctly, think critically, solve problems? Or do they show a good understanding of the concepts related to the field studied? Do they work as a team? Are they autonomous, able to set long-term goals…? While today … mostly, the individuals who learn the most in classes where teaching is centered on the teacher are the teachers! Indeed, they actively seek new information, they integrate these new concepts on their previous knowledge, they organize everything in a way that allows them to make sense, they have the chance to explain what they have learned! **Show how one PBL is a possible answer?**

Derived from

Teacher training at the University of Lorraine

Level for which it is designed:

A) Ca. 10 h (8h)

Associated learning outcome

Know the fundamentals of university pedagogy, experimenting with active pedagogies Develop skills and competencies that are aligned with the demands of the future workforce. Develop the skills and competencies that are needed for success in the future workforce, including problem-solving, collaboration, adaptability, critical thinking, and autonomy.

Pedagogic and scientific value

Work collaboratively and develop communication, teamwork, and leadership skills. The project encourages self-reflection and metacognition as students monitor and evaluate their own performance and learning outcomes. Emphasizing real-world problem-solving and critical thinking.

No.28: Decentralised energy systems

Problem description of the PBL challenge to be solved

The challenge based module is offered in DENSYS curriculum. The challenge topics are related to decentralized energy systems, taken in a broader context, including design of energy networks (including diverse energy carriers such as electricity, hydrogen, gas, heath), demand-side management and optimization according to technical, scientific, market, regulation, environmental (e.g. carbon imprint) human and societal questions. The full partners, associated partners (academic and industrial) of DENSYS are invited to propose challenge problems. Proposed challenges for 2023 are 1) Green energy buildings: preliminary assessment and detailed simulation analysis, 2) The Future of Aviation Emissions, 3) Renewable energies to supply the University of Lorraine, and 4) Sensible heat recovery from the OFF-GAS flow in Electrical Arc Furnace. Proponents provide the background, the scope of the proposal, and resources to the students, who will work as a group of 4-5 persons.

Derived from

Master ERASMUS MUNDUS DENSYS - Decentralised smart energy systems

Level for which it is designed:

B) Semester course : two semesters, the first one being spent in the UL (Nancy- France), the second in a partner university (KTH - Stockholm, UPC - Barcelona or PoliTo - Turin), according to the student specialization track. The total student workload is to be about 360 hours.

Associated learning outcome

• Design a system based on a given set of problem description • Perform analysis of the system to propose a solution • Perform economic analysis of the prospective product or service, • Integrate, beyond purely economic point of view, the sustainability, the environmental, social, societal, territorial impact(s) (choose the most relevant item(s)) • Implement project management strategy • Present the objectives of the work, the methodology and results in a synthetic and usable report and orally

Pedagogic and scientific value

Students develop important teamwork and communication skills Insight to cutting-edge research in the field and development of solutions that have practical applications in industry and society. Enabling knowledge transfer and the exchange of ideas between the academic and industrial sectors New research opportunities, industry partnerships, and innovative solutions that have a positive impact on society and the environment.

Further Information

https://densys.univ-lorraine.fr/content/

No.29: Reuse of terephthalate polyethylene (PET) in order to give an economic value due to the SDGs

Problem description of the PBL challenge to be solved

How can we reuse plastic bottles in order to be reintroduced in industry as a new product? 3-4 Students 1. What are the amounts of plastic bottles that can be reused? 2. Which is a more economicaly method to build new producs out of plastic bottles? 3. Which are the types of industries that can use your product? 4. Can you build a product for the industry?

Derived from

Apa Serv company in STEM contest -Develop any sistem or tool to improve the recovery, recycling and reuse the plastic municipal waste.

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will understand the importance of waste recycling by reintroducing new products in the industry and at the same time protecting the environment.

Pedagogic and scientific value

This study module guides students to - Reflect on the environmental impacts of plastics bottles and their contribution to achieving the (SDGs). - Realize that waste can be recycled as a new material. - Think of solutions to build industrial products out of waste. - Identify one by one the problems related to environmental protection and to find solutions for them.

Further Information

https://blacksea-cbc.net/wp-content/uploads/2020/09/BSB457_MWM-GMR_-_Guide-to-European-Union-Practices-on-Waste-Recycling-Technologies_EN.pdf
https://www.statista.com/statistics/1315931/recycling-rate-targets-in-european-union/
https://www.recyclenow.com/how-to-recycle/how-is-plastic-recycled

No.30: Opening and Mining of new Gold-Silver Deposits in Romania -YES OR NO?

Problem description of the PBL challenge to be solved

Debate between two students teams, one for and the other against mining projects
1. Documentation on existing mining projects and on other possible projects
2. Preparation of arguments for or against (economic, social, environmental, legislativ)
3. Debate
4. Conclusions

Derived from

Needs of mining industry in Romania, student centered-co creation input

Level for which it is designed:

A) Ca. 10 h (recherche, theory, presenting)

Associated learning outcome

Knowing the main stages of a mining project, understanding the economic benefits, awareness of the dimensions of the impact, but also of the possibilities of ecological reconstruction of the affected areas

Pedagogic and scientific value

Development of critical thinking; Development of documentation/research skills; Building, presenting and supporting arguments; Understanding the impact of mining projects on the economic, social and natural environment

No.31: The achievement of the balance sheet for an Otto (Diesel) engine

Problem description of the PBL challenge to be solved

The usefulness of the energy balance is reflected in the way in which the energy obtained by burning different fuels is distributed and used between the various energy exchanges with the external environment. Task will be achieved by 2 students. The transformation of the chemical energy of the fuel (by burning it) into mechanical energy (work) is accompanied by a series of losses:
a) The share of losses is determined by drawing up the hourly real energy balance and representing the quantities from the balance outline in tabular and Sankey diagram form;
b) The economic efficiency indicators were calculated for the real operating regime, comparing them with the nominal ones given by the manufacturer.

Derived from

Obvious need in industry, student centered-co creation input

Level for which it is designed:

A) Ca. 10 h (one SDG)

Associated learning outcome

Experimental measurements using portable laboratory equipment

Pedagogic and scientific value

Developing of skills to work in calculus numerial programmes. Determining the share of energy losses and reducing the carbon footprint as a contribution to achieving SDG12 goals.

No.32: Social Project based learning challenges

Problem description of the PBL challenge to be solved

The needs of the local community being complex and their diversity required the development of social sustainability projects to support their needs.

Derived from

EURECA-PRO Stakeholders Discussion - Need in public institutions and NGO`s

Level for which it is designed:

A) research, presenting 10 h.

Associated learning outcome

Reflecting on the importance of creating projects for the community that improve the quality of life of the population

Pedagogic and scientific value

Pedagogic tools (for presenting) and scientific value necessary for the analysis and development of the project.

No.33: Mine Surveying (Project)

Problem description of the PBL challenge to be solved

Task to be fulfilled: 1. Transmission of the coordinate system from the surface to the underground, on coastal galleries, vertical shafts, inclined planes. 2. Solving mining traverse lines. 3. The topographical realization of mining breakthroughs.

Derived from

Lecture on Mine Surveying, obvious need in mineral extraction industry.

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will understand how to solve current underground mine surveying problems. Ability to understand and apply methods for transmitting coordinate system from the surface to the underground Ability to solve mining traverse lines. Competency in the topographical realization of mining breakthroughs

Pedagogic and scientific value

This module guides students to + learn how to use the topographical instruments for the underground mine surveying. + reflect on the various possibilities to transmit the coordinate system from the surface to the underground. + use the right method for each task they have to perform as mine surveyors.

No.34: Geodesy (Project)

Problem description of the PBL challenge to be solved

Task to be fulfilled: 1. Measurements that are made in geodetic networks. 2. Processing of measured data in geodetic networks. 3. Solving various types of geodetic networks.

Derived from

Lecture on Geodesy, obvious need in surveying industry.

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will understand how to solve various types of geodetic networks. Ability to solve various types of geodetic networks (e.g. triangulation networks, trilateration networks, and GPS networks). Competency in processing measured data in geodetic networks, including the use of specialized software. Proficiency in making measurements in geodetic networks, including the use of specialized equipment and techniques to accurately determine distances, angles, and elevations.

Pedagogic and scientific value

This module guides students to
+ learn how to establish a geodetic network.
+ learn how to perform measurements in geodetic networks.
+ learn how to use the data processing methods for geodetic measurements.
+ use the right solving method for each type of geodetic network.

No.35: Special Mine Surveying Works (Project) - Master Study Program

Problem description of the PBL challenge to be solved

Task to be fulfilled:
1. Transmission of the coordinate system from the surface to the underground, on coastal galleries, vertical shafts, inclined planes.
2. Special methods for solving mining traverse lines.
3. Applying special works for underground surveying and realization of mining breakthroughs.

Derived from

Lecture on Special Mine Surveying Works, obvious need in mineral extraction industry.

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will learn how to apply special works used in mine surveying to accomplish difficult tasks.
Proficiency in special methods for solving mining traverse lines, which may include the use of laser scanning technology, photogrammetry, or other specialized methods.
Competency in applying special works for underground surveying and realization of mining breakthroughs.

Pedagogic and scientific value

This module guides students to
+ use modern methods to transmit the coordinate system from the surface to the underground.
+ use the special methods for each task they have to perform as mine surveyors.

No.36: Surveying Engineering (Project)

Problem description of the PBL challenge to be solved

Task to be fulfilled:
1. Staking out of industrial platforms.
2. Staking out of the axes of constructions.
3. Staking out of the axes of communication paths.
4. Staking out of the axes of the mine shaft for digging.
5. Designing the bypass circuit of the mine shaft.

Derived from

Lecture on Surveying Engineering, obvious need in surveying industry and in mineral extraction indurstry.

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will understand how to solve various types of surveying engineering problems, especially the staking out of projected objects.
Ability to stake out industrial platforms
Proficiency in staking out the axes of constructions
Proficiency in designing bypass circuits for mine shafts, including the ability to create detailed plans and cross-sections that accurately represent the underground environment and its features

Pedagogic and scientific value

This module guides students to
+ learn how to use the surveying instruments to stake out points and projected objects.
+ learn how to stake out the axes of constructions and commutination paths.
+ learn how to stake out the mining works, like galleries, mine shafts and the bypass circuits.

No.37: Designing the rehabilitation works for a mining degraded land (sterile dump)

Problem description of the PBL challenge to be solved

The task to be fulfilled individually
A deposit of sterile materials from a mining perimeter is given, for which the physical, mechanical, and geometric characteristics are known and it is requested to analyze, propose and carry out modeling works that can be applied to increase the stability reserve up to an acceptable level and for ensuring the necessary conditions for their agricultural, forestry, orchard, or vineyard rehabilitation.

Derived from

Lecture on Rehabilitation of degreaded lands

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will learn to characterize the degraded lands and to design the redevelopment works for reuse.
Students will know the types of land degradation and the causes that produced them.
Students will know and apply specific methods and techniques for the restoration and reintegration into the landscape of the degraded lands.

Pedagogic and scientific value

This type of project encourages students to:
- individual studying,
- critical thinking and finding solutions,
- awareness of the impact on the environment and understanding the importance of rehabilitating degreaded lands and their reintegration into an ecological or economical circuit with important benefits for the environment and human health,
- understanding the contribution they can have to achieving the objectives of sustainable development.

No.38: Stability analyses for open pit and dump slopes

Problem description of the PBL challenge to be solved

The task to be fulfilled individually
There is a natural slope with horizontal stratification that is exploited for the purpose of extracting the useful mineral substance (lignite) and a dump consisting of a mixture of rocks from the mining of lignite for which the geometric, physical, and mechanical characteristics are known and it is required to evaluate the stability of the natural slope and artificial slopes in different conditions and to propose the necessary stabilization measures in order to reduce or eliminate the failure risk and for the safety of the objectives in the areas of influence.

Derived from

Lecture on Stability of natural and artificial slopes

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will know the causes and triggering mechanisms of landslides, their effects on humans and the environment, and the importance of their prevention.
Students will be able to determine the physical and mechanical characteristics of rocks, perform stability analyzes in different scenarios of landslides, identify the failure risk, and design stabilization measures.

Pedagogic and scientific value

"This type of project encourages students to:
- individual studying,
- managing and solving specific environmental problems for sustainable development,
- application of the general principles of technological calculation,
- critical thinking and finding solutions,
- interpretation of stability analysis results,
- identification and design of landslide prevention measures."

No.39: Anthropic impact on environment I

Problem description of the PBL challenge to be solved

Identifying and description of the environmental impact generated by different projects.
Task to be fulfilled In teams of 3-4 persons.
1. Description of the analyzed project and identification of causal actions.
2. Description of the environmental components in the influence area of the project.
3. Identifying and describing sources of environmental pollution/degradation.
4. Presentation and interpretation of data (eg: synergism) related to pollution generated on site.
5. Identification (through specific methods: checklists, impact networks and identification matrices) and description of environmental impacts.
6. Draw conclusions and make comparisons.

Derived from

Lecture name: Human (anthropic) impact on the environment

Level for which it is designed:

C) Bachelor (Specialization: Environmnetal engineering and protection in industry)

Associated learning outcome

Linking the causal actions of the project to the induced pollution/degradation.
Identification of environmental components likely to be affected by pollution/degradation.
Knowledge and interpretation of environmental degradation phenomena at global, regional and local level.
Differentiation of impact depending on the particularities of industrial projects.
Correct use of impact identification and description tools and comparison of results.

Pedagogic and scientific value

This self study module guides students to:
+ defining basic concepts related to environmental impact identification and description.
+ identification of the impact generated by certain categories of industrial projects on the environment (under conditions of qualified assistance).
+ elaboration, with qualified assistance, of studies/projects in the field of engineering, environmental protection and sustainable development.
+ the ability to organize and plan the data collection, processing and interpreting activity.
+ improving professional training by assuming roles in a multidisciplinary team.
+ conducting student scientific research projects (documentation, bibliographic summaries, reports and short articles).

Further Information

+ online support materials available on the university e-Learning platform
+ printed support materials available at the university library
+ links for internet support/research – depending on the type of project assigned

No.40: Anthropic impact on environment II

Problem description of the PBL challenge to be solved

Continuing from PBL challenge 1
Use of environmental impact quantification and evaluation methods and techniques.
Task to be fulfilled In teams of 3-4 persons.
1. Critical study of environmental and sectoral legislation, specific to the project.
2. Quantification and assessment of the impact generated by the studied project through specific methods (evaluation matrices, global impact index, etc.)
3. Hierarchy of environmental problems (impact) generated by the project.
4. Designing an environmental monitoring program in the influence area of the project.
5. Identification and brief description of ways to reduce/eliminate the impact.
6. Draw conclusions and identify future research directions in the field (specific to the analyzed project).

Derived from

Lecture name: Methods and techniques for environmental impact assessment

Level for which it is designed:

B) Semester course (year I, semester I)
C) Master (Specialization: Environmental management and protection)

Associated learning outcome

Continuing from PBL challenge 1
Analysis of specific European and national legislation regarding impact assessment and in the field of the analyzed project (mining, energy, waste management, etc.).
Quantification and evaluation of the impact on the environment generated by the analyzed project.
Apply environmental impact ranking procedures (probabilistic, traffic light color method, by weighting, by calculating specific environmental indices, etc.).
Establishing a program for monitoring the quality of the environment in the area of influence of the project.
Identification of general solutions to reduce/eliminate environmental impact.
Identification of specific alternative technological solutions with low impact on the environment (BAT/BREF).

Pedagogic and scientific value

This self study module guides students to:
+ introducing legislative aspects into the environmental impact assessment process.
+ quantification and assessment of the impact generated by certain categories of industrial projects on the environment.
+ elaboration of technical studies/projects in the field of engineering, environmental protection and sustainable development.
+ improving the ability to organize and plan the data collection, processing and interpreting activity.
+ further improving of professional training by assuming roles in a multidisciplinary team.
+ developing the capacity for systematic environmental impact research.
+ increasing the ability to analyze, synthesize and interpret the phenomena related to environmental impact assessment.
+ conducting professional scientific research projects (documentation, bibliographic summaries, contracts, grants, reports and scientific articles).

Further Information

+ online support materials available on the university e-Learning platform
+ printed support materials available at the university library
+ links for internet support/research – depending on the type of project assigned

No.41: Contribution of green occupation to achieve the SDGs

Problem description of the PBL challenge to be solved

Currently, one of the challenges that the world has to face is to ensure a sustainable development in which economic growth is connected to the requirements to preserve the environment. The transition to green economy also induces changes on the labor market through diminish/phase out of some occupations, but also the creation of other new occupations or the modification of the content of already existing occupations in terms of the skills required.
By fulfilling SDG8 - Decent work and economic growth, the transition to a new labor market is thus ensured, in which when talking about jobs, it is not only the component related to the content of work (work productivity, necessary skills and how to assimilate them) that is important, but also that related to the quality of work (decent work, adequate wages, safe working conditions, job security, reasonable career prospects and worker rights). According to the International Labor Organization (ILO) and the UN Environment Program (UNEP), the development of the green jobs segment within the contemporary labor market ensures not only a workforce capable of ensuring increased efficiency in the use of resources with low or zero impact on the environment, but and workplace safety and security.
Unfortunately, the studies and reports carried out so far show that training in skills for greener jobs is fragmented and led by individual regions, sectors and projects and a weak policy coordination remains a common feature across countries (ILO Skills for a Greener Future, 2019, www.ilo.org). In Romania, the National Strategy for Green Jobs 2018-2025 establishes as priority: Objective 1) Stimulating entrepreneurship and the creation of green jobs with an emphasis on the sectors of increased competitiveness identified in the National Strategy for Competitiveness 2014-2020 and in the National Research Strategy , Development and Innovation 2014 – 2020 and Objective 2) Developing the skills of the workforce in order to ensure quality employment in competitive sectors, generating green jobs.
Through the specifics of the teaching and R&D activity undertaken within the University of Petroșani and the skills possessed by the team of designated experts, it is possible to successfully contribute to the implementation of the following directions of action included in the Strategy:
Objective 1:
- Promoting and strengthening entrepreneurial initiatives for the creation of green jobs;
- Promoting technologies with low carbon dioxide emissions and the efficient use of resources;
- Promoting the entrepreneurial spirit, especially by facilitating the economic exploitation of new ideas and by stimulating the creation of new companies, including through business incubators;
- Promoting sustainable tourism.
Objective 2:
- Training and development of green skills;
- Increasing the Romanian contribution to the progress of knowledge;
- Increasing the role of science in society;
- Consolidation of international cooperation to generate excellence in CDI;
- Supporting partnerships between universities and the private sector, to facilitate the transition from education to employment in the field of climate change or related fields;
- Increasing the relevance of university tertiary education in relation to the labor market and competitive economic sectors.
As mentioned in the Strategy, the focus must be on intelligent specialization, which entails: - stimulating a certain type of economic behavior, with regional or global ambitions and orientation; - understanding the social impact of science, technology and economic activities in the relevant sectors; - interdisciplinary research and development.
Under these conditions, the creation of a team made up of 4 experts whose CV attests training in

the field of economics and management, the labor market and entrepreneurship will allow not only the improvement of the university curriculum by adding new subjects to the current education plans and updating some already existing ones through which the necessary skills are ensured in a labor market in transition towards green employment, but also the enrichment of knowledge in the field by publishing articles and analyses, holding lectures focused on sustainable development, green economy, eco-innovation, the results of which are later disseminated to students.

Derived from

Urgent need for green jobs in Romania and across Europe
Awareness raising through EURECA-PRO

Level for which it is designed:

EURECA-PRO Lectures
A) Ca. 10 h (recherche, theory, presenting)
B) Semester course

Associated learning outcome

The presentation of the concept of green jobs facilitates the understanding of how the need to ensure economic growth, taking into account the impact on the environment, influences the way economies operate and transform through green economy, in which the gradual transition from the linear production model "make-take-use-throw" to the circular one ensures a high efficiency of resources, ecosystem resilience and social equity.
Students will have the opportunity to understand the place and importance of green jobs within the contemporary labor market, the vision of the transition from non-green jobs to green jobs, as well as the ways in which occupations are affected by diminishing, transforming (adding green skills) or the appearance of new ones.

Pedagogic and scientific value

This self study module guides students to
+ think critically and in a networked way about our society, technology, nature and the environment as a whole.
+ reflect on the environmental, economic and social impacts of green jobs and their contribution to achieving the (SDGs).
+ an awareness of the various possibilities to contribute to the SDGs.
+ understand the importance of green jobs in improving global living standards.

Further Information

+ Skills for Greener Future 2019, https://www.ilo.org/skills/projects/WCMS_706922/lang--en/index.htm
+ Sustainable development in the European Union, https://ec.europa.eu/eurostat/en/web/products-flagship-publications/-/ks-09-22-019
+ Green Jobs: Towards Sustainable Work in a Low-Carbon World 2018, https://www.unep.org/resources/report/green-jobs-towards-sustainable-work-low-carbon-world
+ Green Jobs for Youth, https://www.unep.org/explore-topics/education-environment/what-we-do/green-jobs-youth
+ Strategia Națională pentru Locuri de muncă verzi 2018-2025,

https://mmuncii.ro/j33/index.php/ro/minister-2019/strategii-politici-programe/5215-sn-locuri-munca-verzi-21082018

No.42: Endemic Morbidities Investigation Project: Exploring Environmental and Natural Causes

Problem description of the PBL challenge to be solved

Identifying the cause of some endemic morbidities - environmental pollution versus natural causes.

Derived from

Environmental hygiene

Level for which it is designed:

Semester course

Associated learning outcome

The master's student learns to distinguish the effects on human health induced by environmental pollution from those due to natural causes.
Competency in collecting relevant data and information to determine the potential environmental factors, as well as analyzing the data to identify potential sources of pollution.
Ability to draw conclusions and make recommendations based on the analysis of data and information.

Pedagogic and scientific value

Without necessarily wishing for scientific rigor, the master's student learns to analyze certain information in order to identify the source or sources that produced a certain effect. Emphasis is placed on pedagogical tools aimed at developing analytical thinking.

No.43: Thermal Equipment and Installation Design Project: Advancing Sustainable Development Goals

Problem description of the PBL challenge to be solved

Design of different thermal equipment and installations. Task to be fulfilled in teams of 3-5 persons
1. Choose one thermal equipment or installation and describe the mode of operation and fields of use.
2. What do you personally think about enhancing the equipment or installation in order to contribute to the Sustainable Development Goals (SDGs)?
3. If You have to choose a team of experts to enhance the installation/equipment, who has to be in this team and why?

Derived from

Thermal equipment and installations - lecture; Need of industry in order for the students to better understand the operation of the thermal equipment/installations they will encounter in their activity as employees.

Level for which it is designed:

B) Semester course

Associated learning outcome

Better understanding of how to operate different equipments/installations. Better knowledge of maintenance needs of equipment/installations and how they could impact Sustainable Development Goals (SDGs). Competency in researching, analyzing and describing the mode of operation and fields of use for different thermal equipment and installations. Competency in identifying and selecting appropriate experts from various fields (engineering, environmental science, economics, etc.) Understanding of the principles of project management, including setting goals, timelines, and budgets, as well as monitoring and evaluating project progress and outcomes.

Pedagogic and scientific value

This self study module guides students to - think critically and in a networked way about our society, technology, nature and the environment as a whole. - reflect on the environmental impacts of thermal equipment and installations on achieving the (SDGs). - an awareness of the various possibilities to contribute to the SDGs.

Further Information

http ://sdg info.polysustain.com/ https://www.icer.ro/ http://www.icemenerg.ro/ https://ec.europa.eu/commission

No.44: Simulating Sustainable Machinery and Equipment Design: A Team-Based Project

Problem description of the PBL challenge to be solved

Simulation of different machines, equipment or installations using CAD software or different programming languages. Task to be fulfilled in teams of 3-5 persons 1. Choose one machine, equipment or installation and describe the mode of operation and fields of use. 2. What do you personally think about enhancing the machine, equipment or installation in order to contribute to the Sustainable Development Goals (SDGs)? 3. If You have to choose a team of experts to enhance the machine, installation/equipment, who has to be in this team and why?

Derived from

Computer assisted experimental research - lecture; Need of different industries in order for the students to better understand the operation of the machines, equipment/installations they will encounter in their activity as employees.

Level for which it is designed:

B) Semester course

Associated learning outcome

Better understanding of how to operate different machines, equipment/installations. Possibility of optimizing the studied machines, equipment or installations using software tools and how they could impact Sustainable Development Goals (SDGs). Familiarity with CAD software and/or programming languages for simulating machinery, equipment, or installations. Understanding of the mode of operation and fields of use of the chosen machine, equipment, or installation. Ability to analyze and identify opportunities for enhancing machinery, equipment, or installations to contribute to Sustainable Development Goals. Teamwork and collaboration skills.

Pedagogic and scientific value

This self study module guides students to - think critically and in a networked way about our society, technology, nature and the environment as a whole. - reflect on the environmental impacts of machines, equipment and installations on achieving the (SDGs). - an awareness of the various possibilities to contribute to the SDGs.

Contact and further Information

http ://sdg info.polysustain.com/ https://ec.europa.eu/commission https://www.solidworks.com/

No.45: Energy Efficiency Audit of Machines, Equipment, or Installations for Sustainable Development

Problem description of the PBL challenge to be solved

Energy audit of different machines, equipment or installations. Task to be fulfilled in teams of 3-5 persons 1. Choose one machine, equipment or installation and describe the mode of operation and fields of use. 2. What do you personally think about enhancing the energy efficiency of the machine, equipment or installation in order to contribute to the Sustainable Development Goals (SDGs)? 3. If You have to choose a team of experts to enhance the energy efficiency of the machine, installation/equipment, who has to be in this team and why?

Derived from

Energy efficiency evaluation of industrial processes - lecture; Need of industry in order for the students to be able to perform and understand the energy auditing process of machines, equipment/installations they will encounter in their activity as employees.

Level for which it is designed:

B) Semester course

Associated learning outcome

Better understanding of energy auditing process and how energy efficiency can be enhanced for different machines, equipment/installations. Possibility of optimizing the studied machines, equipment or installations form energy efficiency point of view and how they could impact Sustainable Development Goals (SDGs).
Developing skills in designing and implementing measures to improve energy efficiency, such as equipment upgrades, process improvements, and behavior change.
Developing skills in analyzing energy consumption patterns and identifying areas for improvement.
Understanding the principles and techniques of energy auditing for machines, equipment, or installations.

Pedagogic and scientific value

This self study module guides students to
- think critically and in a networked way about our society, technology, nature and the environment as a whole.
- reflect on the environmental impacts of different machines equipment and installations on achieving the (SDGs).
- an awareness of the various possibilities to contribute to the SDGs.

Contact and further Information

http ://sdg info.polysustain.com/
https://ec.europa.eu/commission
https://www.anre.ro/ro/eficienta-energetica/legislatie/legislatie-efic-en

No.46: Optimize workspaces and hardware/software needs of employees through automated processes

Problem description of the PBL challenge to be solved

Under the COVID19 context, medium/large companies and public entities required a solution for managing working spaces and equipments to allow employee coordination regarding full-or part-time and remote working arrangements. They also required a solution for tracking the actual needs of hardware maintenance and software license subscriptions to rationalize the costs of fees.
Students should optimize workspaces and hardware/software needs of employees through automated processes, taking into account the following INNOVATIVE ASPECTS:
Allow easy cooperation between employees in an intuitive way
Include mechanisms to detect anomalies or abuses
Integrate machine learning systems
Compatibility with customary tools like Microsoft Office 365

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:
A) Ca. 10 h (recherche, theory, presenting)
B) Semester course
C) Bachelor or Master thesis

B) Semester course C) Bachelor or Master thesis

Associated learning outcome

Developing project management skills, including requirements gathering, scoping, and planning for software development projects. Understanding user needs and requirements in a specific context, such as the COVID-19 pandemic, and designing solutions that meet those needs. Gaining technical skills in software development, including programming languages, databases, and machine learning frameworks. Understanding the importance of data privacy and security, and designing solutions that protect user data. Developing skills in teamwork and collaboration, including working effectively in a remote team.

Pedagogic and scientific value

Integration of machine learning systems allows students to explore the capabilities and limitations of these systems, and to understand how they can be used to improve the efficiency and effectiveness of workplace management. Gaining a deeper understanding of the importance of sustainability and the role that technology can play in achieving it.

No.47: Elucidate whether inappropriate medication intake and daily activity contribute to the risk of a fall, especially for the elderly

Problem description of the PBL challenge to be solved

Both chronic diseases requiring multiple medications and accelerated lifestyles are becoming increasingly common in our society and may constitute underestimated causes of falls and emergency situations worldwide. This may be particularly critical in the case of the elderly that have limited their mobility and companionship due to the COVID19 situation. INNOVATIVE ASPECTS TO BE VALUED Integrate many variables related to patient physical characteristics, psychological profile, health state, medication intake, medication side effects, etc. Application of mathematical algorithms Minimum 70% reliability in fall detection through non-contact technologies

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

Semester course

Associated learning outcome

Understanding the potential impact of chronic diseases and accelerated lifestyles on falls and emergency situations. Recognizing the challenges faced by elderly individuals due to limited mobility and companionship during the COVID-19 pandemic. Understanding the importance of integrating various patient-related variables to improve fall detection accuracy. Understanding the application of mathematical algorithms in fall detection technologies.

Pedagogic and scientific value

Raise awareness about the impact of chronic diseases and accelerated lifestyles on falls and emergency situations. The use of non-contact technologies can make fall detection more convenient and less intrusive for patients, which can increase compliance. Potential to contribute to the development of more accurate and reliable fall detection technologies. Improving the accuracy of fall detection and provide valuable insights into the risk factors associated with falls.

No.48: Provide a solution that will benefit people with disabilities towards their inclusion in everyday fun activities (e.g., in sports, museums, recreation, and attending events)

Problem description of the PBL challenge to be solved

The ideas have to be indicative of a scale that the capacity of the team can materialize. For instance, the challenge does not pursue the creation of a new sports activity for people with disabilities, but a way to include them in experiencing a sports event. INNOVATIVE ASPECTS TO BE VALUED: The solutions should be clearly related to technology and/or science that a university should and can provide. A methodology, tool, information system, application, hardware system, algorithm, product or service is welcome to undertake the problems that have emerged under our modern way of living. Feasibility based on the team's capacity and technology level. Economic potential and a clear societal and technology impact. Ethics, true conception of the idea and expertise.

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

Semester course

Associated learning outcome

Develop a clear understanding of the role of technology and science in addressing modern-day problems. Participants can gain experience in developing methodologies, tools, information systems, applications, hardware systems, algorithms, products, and services that address contemporary issues. Developing an understanding of the ethical implications of their work and the importance of expertise in developing effective solutions.

Pedagogic and scientific value

Developing practical solutions that are related to technology and science. Gaining hands-on experience in applying scientific and technological knowledge to address real-world problems. Developing critical thinking skills, such as hypothesis testing, data analysis, and evaluation of evidence. Developing solutions that are practical, scalable, and have the potential to create tangible benefits for society.

No.49: Bicycle safety & security: a solution to improve safety and security of bike riding through the protection of users and equipment from unexpected incidents (e.g., crashes, accidents, thefts or misuses)

Problem description of the PBL challenge to be solved

Biking provides a cost-effective travel option, plus a healthy and environmentally friendly one. Ensuring the safety and security of riders on a daily basis is, thus, a priority. Addressing this challenge can be beneficial for all: little children on their first ride, people traveling to their work, casual riders or even professional athletes. The solutions should be clearly related to technology and/or science that a university should and can provide. A methodology, tool, information system, application, hardware system, algorithm, product or service is welcome to undertake the problems that have emerged under our modern way of living. Feasibility based on the team's capacity and technology level. Economic potential and a clear societal and technology impact. Ethics, true conception of the idea and expertise.

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

Semester course

Associated learning outcome

Develop a clear understanding of the role of technology and science in promoting safe and secure biking, which is a cost-effective, healthy, and environmentally friendly travel option. Opportunity for participants to apply their scientific and technological knowledge to address real-world challenges. Participants will learn how to apply a methodology, tool, information system, application, hardware system, algorithm, product, or service to develop solutions that promote safe and secure biking. Participants will learn how to develop solutions that have economic potential and create tangible benefits for society. Learn how to evaluate the societal and technological impact of proposed solutions and develop solutions that have a positive impact on the environment, health, and safety.

Pedagogic and scientific value

Developing solutions that address real-world challenges related to biking, which is a cost-effective, healthy, and environmentally friendly travel option. Developing solutions that are practical, scalable, and have the potential to create tangible benefits for society. Opportunity for participants to develop their scientific and technological skills while addressing important real-world challenges related to biking.

No.50: Art through technology: an art-related technological solution to help to communicate and approach existing art forms to people

Problem description of the PBL challenge to be solved

Technological advances allow artists to explore different ways to express themselves and offer very interesting experiences: augmented reality and virtual reality, touch screens and the internet are increasingly important for the public to interact and enjoy art. The solutions should be clearly related to technology and/or science that a university should and can provide A methodology, tool, information system, application, hardware system, algorithm, product or service is welcome to undertake the problems that have emerged under our modern way of living. Inspiration and fantasy are highly appreciated in a feasible tool, product or service.

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

Ca. 10 h (recherche, theory, presenting)

Associated learning outcome

Technical skills development Collaborative learning - understanding of the intersection between art, technology, and science. Developing artistic vision and push the boundaries of what is possible in the world of art.

Pedagogic and scientific value

Explores the intersection between art and technology. Creation new and innovative forms of art that engage with audiences in exciting and immersive ways. Help students develop technical skills related to art and technology, such as coding, digital design, and interactive media. Foster interdisciplinary collaboration between students from different fields, such as computer science, engineering, and the arts, leading to new ideas and solutions.

No.51: Methodologies or tools to improve the digital content quality targeted at children and teenagers in the web and social media

Problem description of the PBL challenge to be solved

Nowadays, most people, especially children, spend a vast amount of time to produce and "consume" useless information and fake news on the web and especially on social media. This fact, disorients humans from learning and acquiring knowledge that could aid in the refinement of our society and well-being. The solutions should be clearly related to technology and/or science that a university should and can provide. Feasibility based on the team's capacity and technology level. Economic potential and a clear societal and technology impact. Ethics, true conception of the idea and expertise.

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

Ca. 10 h (recherche, theory, presenting)

Associated learning outcome

Developing critical thinking skills to distinguish between reliable and unreliable sources of information. Promoting the importance of knowledge acquisition for personal growth, societal well-being, and development. Developing educational programs and courses that focus on media literacy and critical thinking skills, particularly for children and young adults. Creating online platforms and tools that help users verify the authenticity of information sources and prevent the spread of fake news.

Pedagogic and scientific value

Promoting media literacy and critical thinking skills among individuals, particularly children and young adults. The project can contribute to the development of a more informed and responsible society. The project can generate valuable insights into the effects of social media and internet consumption on individuals and society. Contribution to the development of evidence-based policies and recommendations for policymakers and the public. Help to reduce the spread of fake news and promote the development of critical thinking skills, which are essential for personal growth and societal well-being.

No.52: Development of a model for the valuation of works of art as an investment good

Problem description of the PBL challenge to be solved

Each step leading us towards the emergence of an appropriate model for valuation of works of art will in fact be a step towards innovation, as such a model does not function in the domestic market at the moment, and yet price reliability is essential for the proper functioning of any market. The model can be developed in terms of the selected target group and area of application (companies, individual investors, galleries/auction houses/banks/brokerage houses, European market). Affordability of their use in practice. Transparency of the developed method. The form in which it will ultimately be available to the user, e.g., a local or online application, a tool or a descriptive form of a series of practices producing the desired outcome.

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

Semester course

Associated learning outcome

Developing a model for the valuation of works of art, which is not currently available in the domestic market. The model can be tailored to suit different target groups and areas of application, such as companies, individual investors, galleries, auction houses, banks, and brokerage houses. Development of a reliable, innovative, and accessible model for the valuation of works of art that can benefit various stakeholders in the art market.

Pedagogic and scientific value

The project will contribute to advancing knowledge and understanding of the art market and its dynamics. Project value lies in its ability to educate various stakeholders in the art market about the valuation process and the factors that influence the price of art. Potential to generate new knowledge and insights into the art market's functioning and the determinants of art prices.

No.53: Create a solution to help people living alone, susceptible to suffer any incident, notifying municipal services or caregivers, so that they can intervene and avoid possible consequences

Problem description of the PBL challenge to be solved

Information and Communication Technologies (ICT) have become an essential tool to promote independent living and improve the quality of life of the elderly, who often experience a progressive loss of functions as a result of their age or chronic diseases, which makes it difficult for them to carry out daily tasks, forcing them to depend on third parties. The solution should allow the identification of people at risk, the early detection of possible problems, rapid attention and monitoring of the people and the actions carried out, coordinating the various services responsible. To provide geolocation technology.

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

Ca. 10 h (recherche, theory, presenting)

Associated learning outcome

Developing technical skills in designing and implementing technology solutions for the care of the elderly. Developing communication and collaboration skills to work effectively with interdisciplinary teams involved in the care of the elderly. Understanding the benefits of geolocation technology in providing effective and efficient care for the elderly. Understanding the role of Information and Communication Technologies (ICT) in promoting independent living and improving the quality of life of the elderly.

Pedagogic and scientific value

Improve the quality of life of the elderly and reduce the burden on caregivers and healthcare systems. Opportunity for students and researchers to develop interdisciplinary skills and knowledge. Development of practical skills in software development, data analytics, and project management. The project can potentially contribute to the scientific understanding of the use of ICT and geolocation technology in the care of the elderly. Contribution to the achievement of the United Nations Sustainable Development Goals (SDGs), such as SDG 3 (Good Health and Well-being) and SDG 9 (Industry, Innovation, and Infrastructure).

No.54: No-code application tool helping with the design, allowing to draw, sketch, outline the elements of the user interface to use it in contemporary integrated programming environments (IDEs)

Problem description of the PBL challenge to be solved

No-code application development paradigm is getting more and more popular nowadays. The graphical user interface (GUI) is still the main way to provide interaction between the computer or mobile device and the human user
INNOVATIVE ASPECTS TO BE VALUED
¤ Smart algorithms used to distinguish many standard and complex controls in the GUI design and overall dialogue composition
¤ Compliance with industry standard UX/UI specifications
¤ Level of automation during export to GUI designers
¤ Integration with appropriate programming language

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Understanding the principles and benefits of no-code application development and how it can be used to develop graphical user interfaces (GUI) for computer and mobile devices.
Familiarity with standard and complex controls used in GUI design, and how smart algorithms can be used to distinguish them in the overall dialogue composition.
Knowledge of industry standard UX/UI specifications and how they can be incorporated into GUI design to create user-friendly and engaging applications.
Enabling developers to create more robust and scalable applications.

Pedagogic and scientific value

The project can contribute to the development of new techniques and methodologies for no-code application development and GUI design.
The integration of appropriate programming languages can be explored in more detail to enable the creation of more robust and scalable applications.
The project can also contribute to the development of new insights into the interaction between computer or mobile devices and human users, as well as how GUI design can be used to optimize this interaction.
Teaches students about the principles and benefits of no-code application development, as well as the key components of GUI design.
The level of automation during export to GUI designers can teach students how to streamline the application development process, saving time and effort.

No.55: Evaluation of the urban characteristics and formulation of proposals for the environmental and social upgrade of a central area of Chania city with respects to its social and cultural capital

Problem description of the PBL challenge to be solved

Some of the building squares in this area of Chania (Crete) were constructed in the beginning of the 20th century in an organic way, with narrow streets and dense low-quality buildings in order to house refugees. All these characteristics lead to a downgraded area that needs to be re-planned for the provision of better conditions for its residents and visitors. The participants of the project will evaluate the existing conditions and propose strategies and plans for the environmental and social upgrade of this area to make it a vibrant place with sustainable characteristics.
INNOVATIVE ASPECTS TO BE VALUED
¤ Development of public and green spaces
¤ Sustainable mobility networks

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

A) Ca. 10 h (recherche, theory, presenting)
B) Semester course

Associated learning outcome

Familiarity with urban planning principles and methods, including site analysis, stakeholder engagement, and design strategies.
Knowledge of sustainable design principles and how they can be applied to create environmentally and socially sustainable urban spaces.
Competency in using tools and techniques for urban design, including mapping, zoning, and site modeling.
Understanding of the challenges and opportunities associated with urban regeneration and the potential impact of the project on the local community.

Pedagogic and scientific value

An opportunity for students to apply theoretical concepts and skills in urban planning, design, and sustainability to a real-world project.
Project enables students to develop important skills in collaboration, communication, and project management.
Project contributes to the development of new techniques and methodologies for sustainable urban design.
Creation of more livable and resilient urban environments.

No.56: Monitor and facilitate the delivery process of paver asphalt mixes optimising logistics and coordination through real time data

Problem description of the PBL challenge to be solved

In road engineering, the logistics of asphalt paving, including order and delivery, is quite often a complicated process in which many people are involved, especially construction site managers, asphalt plant managers and truck drivers.
INNOVATIVE ASPECTS TO BE VALUED
¤ Integrate real time interaction with all users (truck drivers, managers, operators, etc.)
¤ Automatic refreshing of truck position and data
¤ Adjustable to different operating systems and devices

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course

Associated learning outcome

Understanding the complexities of asphalt paving logistics and the roles of different stakeholders involved in the process.
Familiarity with road engineering and construction principles, including project management, scheduling, and quality control.
Knowledge of software development and integration, including real-time data transfer and device compatibility.
Competency in using software tools and technologies for data visualization, tracking, and analysis.
Understanding of the challenges and opportunities associated with technology adoption in road construction and the potential impact of the project on the industry.

Pedagogic and scientific value

Opportunity to apply theoretical knowledge to a real-world problem and gain practical experience in road engineering and construction management.
Knowlage about the roles and responsibilities of different stakeholders involved in the process, including construction site managers, asphalt plant managers, and truck drivers, and develop skills in communication and collaboration.
Development of new technologies and methodologies in road engineering and construction management.
By analyzing the data collected during the project, students can identify areas for improvement and propose innovative solutions to address them.
Students can contribute to the advancement of sustainable practices in the industry by exploring the potential of more environmentally friendly methods.

No.57: Design an easy-to- implement solution to recycle laminated/coated products from barrier liners used in paper packaging through existing technologies

Problem description of the PBL challenge to be solved

While paper recycling is well established, liner material and any other non-pulpable material are being removed from the pulp.
The majority of laminated or coated paper packaging is currently not collected or the contraries / reject of the pulping process. Typically, these materials end up in incineration or potentially in a landfill, not recycled
INNOVATIVE ASPECTS TO BE VALUED
¤ Compatibility to a wide range of material compositions in the reject and with relatively high-water content
¤ Low environmental impact
¤ Acceptance of/ demand for the output from a technical point of view
¤ Economically viable
¤ Easily implementation in low-tech environments

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course

Associated learning outcome

Development of solutions that can address the challenges associated with these materials and contribute to sustainable waste management practices.
Students will learn about the properties of different types of packaging materials and develop strategies to recycle them effectively.
Knowledge about the environmental impact of waste disposal and explore ways to minimize it.
Students will learn about the technical aspects of recycling laminated or coated paper packaging, including the different steps involved in the process, such as shredding, washing, and separation.
They can also gain insights into the economic and regulatory aspects of waste management, such as the market demand for recycled materials, the cost of recycling, and the environmental regulations governing waste disposal.

Pedagogic and scientific value

Developing and testing new technologies for recycling these materials, which could lead to advances in the field of recycling and waste management.
The project could involve collaboration between researchers, engineers, and industry professionals, providing valuable opportunities for interdisciplinary learning and networking.
The development of an economically viable and easily implementable solution could have a significant impact on the recycling industry and the environment.

No.58: Develop an eco- friendly solution for apple harvesting avoiding fruit or tree damage without the use of human force

Problem description of the PBL challenge to be solved

The automation of apple harvesting will enable the improvement of work in many fruit farms, contributing to the optimization of the fruit picking process, and reducing high workload of actual physical work and costs.
INNOVATIVE ASPECTS TO BE VALUED
¤ Easy-to-use device
¤ Eco-friendly solution
¤ Ability to remotely supervise the work
¤ Possibility of remote control of the device
¤ Application of AI/ machine learning systems

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Understanding the benefits and challenges of automation in agriculture.
Familiarity with the use of sensors, robotics, and AI/machine learning in fruit harvesting.
Understanding the impact of automation on labor and employment in the agriculture sector.
Familiarity with environmental considerations and sustainability practices in agriculture.
Experience with designing and implementing field tests to evaluate the effectiveness and efficiency of the technology.

Pedagogic and scientific value

Development of expertise in agricultural engineering.
Development of sustainable solutions.
Enhancing efficiency and reducing costs: The automation of apple harvesting can improve the efficiency of the fruit picking process and reduce the workload of farm workers.
Application of machine learning and AI: This can contribute to the development of more advanced technologies for agriculture in the future.

No.59: Development of a system to automatically detect and recognize LED displayed errors in the production process of LED display boards

Problem description of the PBL challenge to be solved

The production process of LED boards requires automatic assistance in detecting production errors, such as faulty diodes, short circuits on PCBs and driver errors. The system will speed up the quality control.
INNOVATIVE ASPECTS TO BE VALUED
¤ Use of image processing to detect errors
¤ Automation of the error detection process and software validation

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course

Associated learning outcome

Real-time monitoring of the production line for quick identification of errors.
Integration of AI/ machine learning algorithms for improving accuracy and reducing false positives.
Ability to generate reports and statistical data for quality control analysis and process improvement.

Pedagogic and scientific value

By automating the error detection process, the system can improve the efficiency of the production process and reduce costs by minimizing the number of defective products.
Reducing waste and improve sustainability.
The project can advance the field of image processing and software validation, which has applications in various industries.
Students can gain hands-on experience in these fields, which can prepare them for careers in engineering, manufacturing, or computer science.

No.60: Development of a behavioral scoring system, based on users' behavioral data, to improve the availability of financial products for clients

Problem description of the PBL challenge to be solved

Epeer is an innovative platform that uses AI to connect investors and borrowers on a website and mobile application. The development of models based on user's behavioral data, such as interest, location, structure of residence, etc. will improve effectiveness of scoring system and the availability of financial products for people without a credit history.
INNOVATIVE ASPECTS TO BE VALUED
¤ Application of advanced methods of analysis and data normalization to data mart
¤ Integration of user clustering methods based on the objective function
¤ Usage of AI for prediction of repayment
¤ System scalability in relation to a variety of objective functions

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Understanding the application of AI in the financial industry.
Knowledge of advanced methods of analysis and data normalization.
Familiarity with user clustering methods based on objective functions.
Understanding how AI can be used for prediction of repayment.
Knowledge of system scalability in relation to a variety of objective functions.

Pedagogic and scientific value

The Epeer project contributes to the growing body of research on the use of AI in the financial industry.
The development of models based on user's behavioral data lead to more accurate predictions of repayment, which can ultimately reduce the risk of default and improve the overall performance of the platform.
The application of advanced methods of analysis and data normalization to the data mart provide insights into how these techniques can be used to improve the effectiveness of scoring systems in other domains.

No.61: Development of an electric and magnetic field arm scanner

Problem description of the PBL challenge to be solved

In order to understand the EMC behaviour and performance of the electronic circuit it is crucial to know which of its components radiates emissions and which are out of concern. This information give to the designer valuable information about parts of the circuit that require investigation in case of circuit EMC debug.
INNOVATIVE ASPECTS TO BE VALUED
¤ Two degrees of freedom
¤ Communication with a spectrum analyzer
¤ Data visualization
¤ Scan area definition procedure
¤ Users should be able to define scan resolution

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course
C) Bachelor or Master thesis

Associated learning outcome

Understanding the importance of EMC (electromagnetic compatibility) testing in electronic circuit design. Knowledge of the components of an electronic circuit that may be responsible for radiating emissions. Familiarity with tools and techniques for identifying and troubleshooting EMC issues.

Pedagogic and scientific value

Understanding of which components are responsible for radiating emissions and how to troubleshoot EMC issues using the innovative aspects of the project. The ability to define scan resolution, the scan area definition procedure, the use of data visualization tools, communication with a spectrum analyzer, and the two degrees of freedom - provides students and designers with hands-on experience in designing and testing electronic circuits. The project contributes to the growing body of research on EMC testing of electronic circuits. The innovative aspects of the project, such as the two degrees of freedom, the scan area definition procedure, and the ability to define scan resolution - provide researchers with new insights into how to improve the effectiveness and efficiency of EMC testing. The project's communication with a spectrum analyzer and data visualization tools can help researchers to identify areas of concern in the circuit and evaluate the effectiveness of different testing methodologies.

No.62: Development of a sustainable process for the purification of (2S,3S)-2-benzhydryl-3- benzylaminoquinuclidine from other isomers which are created during its synthesis in veterinary and antiemetic drug industries

Problem description of the PBL challenge to be solved

Green chemistry focused on the design of products and processes that minimize or eliminate the use and generation of hazardous substances, including reducing consumption of non-renewable resources and technological approaches for preventing pollution. The company Syntal is working under the improvement of technological approaches for synthesis of fine chemicals according to green chemistry rules and with the agreement with economy. INNOVATIVE ASPECTS TO BE VALUED ¤ New product with high purity (at least 80% of enantiomeric excess) ¤ Usage of safe reagents ¤ Increase the sustainability of technology with significant environmental benefits ¤ Well-defined operating conditions

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course C) Bachelor or Master thesis

Associated learning outcome

Understanding the principles of green chemistry, including the 12 principles of green chemistry and the importance of sustainable manufacturing processes. Understanding the risks associated with hazardous substances and the importance of reducing their use and generation in industrial processes. Familiarity with alternative, safer reagents and methodologies for reducing waste and pollution in chemical manufacturing. Knowledge of how to optimize chemical synthesis for efficiency, purity, and environmental impact.

Pedagogic and scientific value

The development of a new product with high purity (at least 80% of enantiomeric excess) that meets industry standards while minimizing environmental impact. The usage of safe reagents, which can reduce the risk of accidents and exposure to hazardous substances for workers and the environment. The increase in sustainability of the manufacturing process, which can provide significant environmental benefits and improve the company's reputation and competitiveness. The use of well-defined operating conditions, which can improve efficiency, reduce waste, and ensure consistent product quality.

No.63: Create a system that manages the legalization (Industrial Safety, Environment and Occupational Risk Prevention), both initial and subsequent, of all types of installations involved in the operation of a building or facility

Problem description of the PBL challenge to be solved

The large amount of legislation that currently affects public entities as private companies (industrial safety, environment, occupational risk prevention, etc.) and its frequent changes, means that they do not have under control their compliance and the documentation that proves it, being outside the law. The solution should be put into practice through computer applications and technological resources.

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

A) Ca. 10 h (recherche, theory, presenting) B) Semester course

Associated learning outcome

Understanding the legal and regulatory framework that applies to public entities and private companies, including industrial safety, environmental regulations, and occupational risk prevention. Familiarity with compliance management systems, including the importance of documentation, monitoring, and reporting to ensure compliance with legal requirements. Knowledge of technology solutions for compliance management, including computer applications and other technological resources. Skills in project management, including planning, implementation, and evaluation of compliance management systems.

Pedagogic and scientific value

The development of a computer application to help public entities and private companies manage compliance with legal and regulatory requirements. The use of technology resources to automate compliance monitoring and reporting, which can improve efficiency and reduce errors. The integration of multiple legal and regulatory frameworks into a single compliance management system, which can provide a more comprehensive view of compliance status. The development of best practices for compliance management, which can be shared with other organizations facing similar challenges.

No.64: Design a solution to reduce and minimize waste material, especially single-use plastic waste, generated at refreshment points to promote more sustainable marathons and races

Problem description of the PBL challenge to be solved

While running and trail running is listed on the rise worldwide, races' organizers are facing the challenge of organizing greener and more sustainable events, specially when single-use plastic products (SUPs) waste generation is one key environmental problem worldwide. INNOVATIVE ASPECTS TO BE VALUED ¤ Economically viable ¤ Adapted to racers' needs ¤ Adjustable to different operating race conditions and trails

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

A) Ca. 10 h (recherche, theory, presenting) B) Semester course

Associated learning outcome

Understanding the environmental impact of running events, including the generation of single-use plastic waste and other waste streams. Familiarity with sustainable event management practices, including waste reduction, recycling, and composting. Knowledge of eco-friendly alternatives to single-use plastic products, such as reusable cups, bottles, and bags. Skills in project management, including planning, implementation, and evaluation of sustainable running events.

Pedagogic and scientific value

Project aims to reduce the environmental impact of such events and promote sustainable practices in the sports industry. The project contribute to the scientific research on waste management, sustainability, and environmental conservation by providing insights and solutions for sustainable event planning and waste reduction. The project leads to the development of new technologies, materials, and practices that can be applied in other industries and sectors to promote sustainable development.

No.65: Develop a system that allows monitoring the maximum sun potential that can be produced in a specific place

Problem description of the PBL challenge to be solved

The company carries out economic activity in the field of installation of lighting fixtures using solar energy. Thus, it is very good to know the maximum capacity of solar energy that can be obtained in a certain location. INNOVATIVE ASPECTS TO BE VALUED ¤ Building a solar panel that can track the maximum sun light ¤ Monitoring and storing information on the amount of energy that can be produced ¤ Wi-Fi management ¤ Smartphone controlling device ¤ Database management

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course C) Bachelor or Master thesis

Associated learning outcome

Developing skills in the field of renewable energy and sustainable development. The project provides hands-on experience in designing, building, and testing solar panel systems, as well as in monitoring and managing energy production using data management tools and smartphone applications. The project can contribute to the development of innovative solutions for renewable energy and sustainable development.

Promote awareness and understanding of the benefits and challenges of using solar energy as a source of power.

Pedagogic and scientific value

The project uses innovative technology to optimize solar energy collection. Reducing carbon footprint and promoting the use of clean energy sources. Efficient management of energy resources, and the Wi-Fi and smartphone controlling devices make it easy for users to access and manage the system remotely. The database management aspect of the project provides valuable insights into solar energy generation, which can be used for further research and development.

No.66: Develop an easily-to-use system that would allow identifying and reporting to the user, in real-time, the health status of the poplar trees, based on symptoms observed in the field

Problem description of the PBL challenge to be solved

Sustainable production of wood is threatened over the world by the increase in biotic damages, caused by pests and diseases that attack trees and slow down their growth or, in the worst case, kill the plant. To detect existing threats, it is necessary to carry out surveillance and monitoring tasks, by specialists in forest health, forest managers, nursery workers, as well as society in general. INNOVATIVE ASPECTS TO BE VALUED ¤ Real time identification of the damage based on images ¤ Multiple potential users such as technicians, owners, forestry agents, students, general public, etc. ¤ Multidisciplinary approach ¤ Integrate complementary materials for the acquisition of pest/pathogen detection skills and knowledge ¤ Citizen Science approach ¤ Use of deep learning and image processing

Derived from

2023 EURECA-PRO STEM Innovation Contest

Level for which it is designed:

B) Semester course

Associated learning outcome

Students will gain knowledge and skills related to sustainable forest management, forest health, pest and disease identification, and citizen science.
Participants will learn about the challenges faced by the forestry industry and the importance of early detection and monitoring of pests and diseases.
Learning about the use of advanced technologies such as deep learning and image processing for identifying damages in real-time.
The multidisciplinary approach of the project will involve participants from various backgrounds, including technicians, owners, forestry agents, students, and the general public, which will help to promote awareness and collaboration among different stakeholders.
Enable participants to develop the necessary skills and knowledge for pest and pathogen detection, data collection, and analysis.

Pedagogic and scientific value

The Project has the potential to improve the accuracy and efficiency of pest/pathogen detection, which is crucial for maintaining the health of forests.
Enhance the knowledge and skills of various stakeholders, including specialists in forest health, forest managers, nursery workers, and students.
The project will contribute to the development of more sustainable forestry practices and promote greater public awareness of the importance of preserving forest health.

b. Questionnaire for students

Evaluation – Problem-based Learning Challenge for students/ PhD students

Note on Privacy: This survey is anonymous. Your survey responses do not contain any identifying information about you. In case you didn't understand a word, question or issue, please underline it.

1 General Information

1.01 Which discipline(s)/ subject(s) are met with the conducted challenge:

1.02 My level of English proficiency (as I feel) is

☐ Beginner ☐ Elementary ☐ Intermediate ☐ Advanced ☐ Proficient

1.03 Have you already participated in any problem-based learning activity? If so, how many activities have you attended?

☐ Yes, in ____ Courses. ☐ No.

1.04 Would you like to attend more often PBL exercises at your studies?

☐ No. ☐ No, I don't like this method.

☐ Yes, but not more than one quarter of my studies (due to ECTS credits)

☐ Yes, but not more than a half of my studies (due to ECTS credits)

☐ Yes, my studies could consist of more than three quarters of PBL courses and exercises.

2 Evaluation of the Activity

Instruction: Please mark appropriate cells with a cross. Please record immediate response to each item rather than thinking about items for a long time. All items should be checked. If you feel that you cannot respond to a particular item, you should mark the centre point of the scale
(1 = strongly agree, 2 = agree, 3 = neither agree, nor disagree, 4 = disagree, 5 = strongly disagree).

		1 strongly agree	2	3	4	5 strongly disagree
2.01	I understood the given problem well.					
2.02	I was able to form reasonable conclusions at the end of each session.					
2.03	The problem integrated multiple disciplines.					
2.04	The PBL challenge leads to breadth and depth of knowledge about the topic.					
2.05	I think the intended learning outcome was fulfilled.					
2.06	I arranged my thoughts logically and saw clear relationships among them.					

		1 strongly agree	2	3	4	5 strongly disagree
2.07	I am not able to list pros and cons of the elaborated solution.					
2.08	I was responsible for my own learning.					
2.09	I enjoyed studying in a team.					
2.10	I found it hard to share my ideas in our group.					
2.11	I am not sure I can trust my teammates' contribution to my learning.					
2.12	The problem was as it could be in the real world.					
2.13	The problem was relevant to my current studies.					
2.14	I think the problem exhibit the experience required in the later workplace.					
2.15	The workload was realistic in terms of timing.					
2.16	We set our own learning objectives.					
2.17	Our lecturer guided by asking questions more than by presenting knowledge content.					
2.18	I think I learned less than it would be in a usual lecture with the same topic.					

2.19 How would you summarise the relevance of the Challenge to the RCP in three statements (maximum)?

c. Log Sheet for lecturer/ facilitator

Log sheet – Problem-based Learning Challenge for the lecturer/ facilitator

***Privacy Policy**: By filling out this form, I agree that my data will be stored and used in context with the analysis of survey results and management operations within the EURECA-PRO.*

GENERAL INSTRUCTIONS FOR FILLING UP OF THIS FORM

- **Section 1 and 2**: As far as possible, please answer these questions best before you start the challenge.
- **Section 3**: Keep track of time and fill in run of the PBL activity.
- Distribute the questionnaires for the participants after the PBL-activity is successfully finished. **The questionnaire should be filled in before any debriefing or discussion takes place!!!**
- After questionnaires have been filled out, collect them.
- Discuss with participants the lecture (optimally, with 5-7 students).
- Please send the questionnaires of the students together with this Logsheet to the Education Interface Task Force: Education Lead Coordinator and Research Lead Coordinator.

1 GENERAL INFORMATION LECTURER

1.01 Your University: _____

1.02 How many years have you been working as a lecturer? for _____ years

1.03 Which teaching methods do you mainly use?

_____

1.04 Have you already led any problem-based learning activity? If so, how many activities have you facilitated?

☐ Yes, in ___ courses. ☐ No, I have not.

1.05 Have you done this challenge before?

☐ Yes, with same content and process. ☐ Yes, but content was different.
☐ Yes, but process was different.
☐ No, I have not.

1.06 Could you please amount the number of hours (á 60 minutes) required for preparation?

_____

1.07 How much effort did you put into the realisation compared to a usual lecture?

☐ Less than usual lecture ☐ Same as usual lecture
☐ Double time ☐ More than double time lecture

2 General Information of the Challenge

2.01	Title:	
2.02	Number of participants:	
2.03	The participants are from the following universities:	☐ HSMW ☐ UH ☐ MUL ☐ SUT ☐ TUBAF ☐ TUC ☐ ULE ☐ UL ☐ UP ☐ other: _____
2.04	Number of teams:	
2.05	Number of mixed teams (different universities):	
2.06	Number of members per team:	
2.07	Number of meetings:	
2.08	Workload:	
2.09	Start – End date of the challenge	

2.10 How would you classify your teaching activity?

☐ Problem based learning ☐ Project based learning ☐ Case study
☐ other _____

3 RUN OF THE CHALLENGE

Work flow[44]	**Date**	**Time required** (hh:mm)	**Further description (e.g. content, given questions)**	**Equipment** (slides, online conference system, blackboard, interactive whitebord ..)
Introduction				
Instructions for PBL				
Working Phase				
(1) Problem Analysis				
(2) Gather existing knowledge				
(3) Solution				

[44] Please try to fill in the predefined structure. If you do not use a step please mark it in the comments. Further, if you have different titles or other steps please use the empty spaces in this column.

(4) Evaluate Solution				
(5) Reflecting gained knowledge				
Asking and answering questions				
Filling in the questionnaires				
General discussion (see following formular)				

4 QUESTIONS TO THE LECTURER/ FACILITATOR

4.01 To what extent would you like to continue using PBL challenges in your higher education activities?

4.02 What did you particularly like about the PBL?

4.03 What added value do PBL offer over traditional teaching methods for you as lecturer/ facilitator?

4.04 What would have to be changed in order to use PBL in teaching for you as the lecturer/ facilitator?

5 DISCUSSION

A) What do students like in the challenge, what was positively different in comparison with "traditional" lecturing, etc.

B) What did students dislike in the challenge, what was negatively different in comparison with "traditional" lecturing, etc.

C) What potential does the implementation of PBL in higher education have?

D) What obstacles can the implementation of PBL in higher education face?

Other important notes of the discussion (if any)