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Releasing of training modules

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[1] PU = PUBLIC
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

Publishable Executive Summary

The GREENER project aims to accelerate the remediation of contaminated sites, for a range of organic and inorganic pollutants of high concern, while producing end-products, such as bioelectricity and/or harmless metabolites of industrial interest.

This deliverable D8.3 "Releasing of training modules" is focusing on the training activities performed by the GREENER consortium in order to promote the relevant technologies and achieve knowledge transfer to the specified GREENER focus groups. In order to ensure the wide-scale uptake of knowledge and technology generated within the sector, the partners engaged in different training activities, among which training to youth, to academic students, as well as to the scientific community are performed and are also planned for the next months.

The main objective of the training modules was to promote bioremediation technologies in different fields of application. In general, bioremediation is a branch of biotechnology that employs the use of living organisms, e.g., bacteria and fungi, in the removal of contaminants and toxins from soil, water, and other environments. The ultimate goal is, through training activities, to provide to key stakeholders (public and private) a background knowledge and awareness on the GREENER technologies.

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1. Introduction

The main objective of the GREENER training modules was to transfer the knowledge acquired under the GREENER project to all the interested groups in order to highlight the benefits of the technologies involved and the processes followed during the project for the bioremediation of contaminated sites. This deliverable is the first version of Training modules that are going to be updated by M54.

GREENER focuses on the degradation of pollutants by the use of microorganisms and plants employing different bioremediation techniques and analyses of the techno-economic feasibility of the various technologies involved at required scales to demonstrate their use in the particular industries.

The technological developments that will be in the spotlight of the GREENER project implementation will be:

1. Novel modular flexible designs to cope with a wide variety of contaminated soils, waters, and sediments.
2. Development and optimisation of the technologies for bioremediation of the polluted sites.
3. Combination of technologies in hybrid systems.
4. Better efficiencies, reduced times, and enhanced performances via technology optimization and monitoring

The technologies to be developed and optimised for the depollution of water, and soil/sediment by the GREENER project are summarised below:

- Phycoremediation
- Phytoremediation
- BES
- Nanoparticles in biological systems
- Hybrid systems: Phytoremediation + BES (CWMFC)
- PFC
- Biopile
- Ecopile
- Plant fuel cells + ecopile

Since the Project successfully connects innovative methodologies, increasing the awareness of GREENER results and highlighting the advantages these bioremediation solutions lead to is of high importance. Moreover, the suggested GREENER training will:

- Encourage interested stakeholders to apply bioremediation techniques for de-contamination of water and soil systems by using GREENER technologies.
- Familiarise young individuals with the developed technologies and their applications in everyday life.
- Provide new insights to academic students with the potential to continue their studies in the field.
- Promote the stakeholder platform (D8.5, Task 8.6.) and decision-making tool (D6.3, Task 6.5.) developed with the goal to connect relevant organizations, and increase awareness of the continuous bioremediation technological improvements at European scale, in connection with Chinese achievements.
- Contribute to the exchange of useful feedback from the stakeholders and users of the platform.
- Pave the way towards a circular economy approach linking decontamination purposes and reuse of resources.

2. Training activities

2.1 The strategy

In order to promote the new knowledge generated during the project execution as well as to create new links with the interested audiences in GREENER market, several e-learning modules, as well as training events were held during the GREENER project. Based on our strategy several training workshops and dedicated talks are planned for the future months until the project end. These trainings have a strong scientific focus on the current remediation and bioremediation techniques and how to implement BES and GREENER single and hybrid bioremediation solutions, apart from the potential skills acquired for the development of the solutions in the EU and Chinese demo sites. Furthermore, GREENER Project targets to expand the dissemination actions towards younger audiences which can help to achieve higher visibility of the project by organizing workshops in secondary schools, producing and sharing training material and prototyping practices for teaching the public how to conduct remediation. This could also be an exploitable outcome of the project.

The presented strategy consists of the following elements:

- Identify key strategic objectives.
- Identify target audience and engage relevant stakeholders.
- Transfer of knowledge within the target audience, including students, researchers and industrial staff.
- Include audio-visual material, in the form of videos (GREENER talks, youth training teasers), presentations and printed training material for future use.
- Spreading of knowledge from both the academic and industrial experts within the project to young scientists and to relevant industrial stakeholders outside of the consortium.
- Raise awareness of key stakeholders with the ultimate goal to successfully exploit and commercialise the developed technologies.
- Allow the replication of the project's technologies and approaches through trainings and the involvement of target audiences.
- Monitor and track specific KPIs to evaluate the trainings' impact.

2.2 Objectives

Based on the training strategy developed for the GREENER project, a main purpose is to specify the key areas of training, identify the appropriate tools and channels, ensure optimum use of available resources for training and increased engagement which will lead to strengthening the capacity of those responsible for their use and management.

Based on the aspects explored above, the plan is to deliver the strategy by the following five cross-cutting and interconnected strategic objectives:

- Identify the focus of the training
- Plan easy-to-access and comprehensive training modules
- Allow participants to engage in the training activities, through interactive sessions, Q&As etc.
- Motivate participants to achieve specific goals toward a larger context, such as mastering navigation at the GREENER platform
- Support business goals through the completion of training objectives

- Measuring progress throughout the project

2.3 Target groups

The GREENER focus groups are summarised below:

- Specialised audience (scientific and technical); engineers; chemists, bioelectrochemists, biochemists; biologists, microbiologists, microbial ecologists;
- researchers in general; universities and research institutes; technology industry;
- wastewater and waste management; policy makers, regulatory bodies; stakeholders from value chain; community associations;
- technology providers for bioremediation; R&I or innovation-related initiatives within the BIOTEC projects or from National funding in order to create impact;
- civil and water engineering services companies;
- industry groups (contaminated places, agricultural activities, oil and gas industry, chemical and pharmaceutical industry, environmental sector);
- young students and
- general public.

2.4 Training to students

GREENER is organising training and educational courses/sessions to undergraduate students. The trainings are performed by the GREENER consortium, where the GREENER objectives are highlighted and the GREENER technologies are in the focus of the training, based on the specific expertise of each partner.

2.4.1 Researchers' night at Mendel University in Brno

In particular, GREENER Project partner, Mendel University in Brno (Department of Chemistry and Biochemistry) participating in the Researchers' night open days on 27th September 2019, organized by Mendel University.

Figure 1. *GREENER Project was popularized within Czech science in night open days on 27.09.2019, organized by Mendel University.*

2.4.2 Master's Course in Environmental Engineering of the University of Basque Country.

Moreover, a series of courses on bioremediation technologies was also given by the GREENER Project partners: i. ICCRAM - University of Burgos, ii. LEITAT Technological Center and iii. Tauw Nederland. The presentations were given on May 5th 2021, at the Master's Course in Environmental Engineering of the University of Basque Country.

In particular:

- University of Burgos and our coordination team, Dr Rocío Barros and Dr Blanca Velasco presented: "Proyecto GREENER: Estrategias integradas para una biorremediación efectiva";
- LEITAT and Dr Eduard Boras presented "Aplicación de sistemas bioelectroquímicos para la descontaminación de suelos y aguas subterráneas" and;
- Alfredo Perez de Mora from TAUW gave a presentation on "Biorecuperación de acuíferos contaminados (casos prácticos)".

2.5 Training to youth

In Table 1, the past training activities are summarized as well as some pictures are included, showing partners attending training events.

Table 1. *GREENER past training activities.*

*Type of training activity**	*Partners Involved*	*Brief description*	*Date*	*Place*
Training for students	ICRAAM-UBU	La semana de la Ciencia de Castilla y León	25/11/2019	Castile and León, Spain
5 Training for students	ICRAAM-UBU	11 February 2020 training activities	1-15/2/2020	Castile and León, Spain
2 Training for students	ICRAAM-UBU	9-11 February training activities	9-11/02/2021	Burgos, Spain

**Training activity: PhD/ post doc fellowship, researcher mobility, seminal events, courses, seminars, etc.*

2.5.1 La semana de la Ciencia de Castilla y León

During "La semana de la Ciencia de Castilla y León", on 25th of November 2019, GREENER partner ICCRAM-UBU performed lectures about microorganisms and pollution as well as basic experiments in a primary school under the frame of the Project. Students familiarised with bioremediation, as a special branch of engineering linked with the use of living organisms to aid in the clean-up of polluted sides.

Figure 2*. ICCRAM, GREENER partner has performed lectures about microorganisms and pollution as well as basic experiments in a primary school.*

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2.5.2 1-15 February 2020 training activities

ICCRAM-UBU participated in the initiative "February 11th 2020", International Day of Women and Girls in Science. ICCRAM scientists performed different lectures, highlighting Greener Project objectives, in several schools, with the aim students get an easier and funnier approach to Science. Material from this training can be found on the GREENER website related to general information on the events as well as the presentation of the experiments conducted to the young students.

Figure 3. ICCRAM organised training activities in primary schools, with the aim students can get an easier and funnier approach to Science.

In particular, from February 1st to February 15th, scientists from different fields of expertise, working T ICCRAM-UBU, participated in the initiative, carrying out several activities - mainly talks, lectures and workshops – that took place in many schools in Burgos. Among the activities, workshops turned out to be very appealing for young people as they included uncomplicated experiments while they were adequately interactive and fun. The common thread for these scientific actions was the "GREENER" project. In a very simple way, microbiological and electrochemical experiments were carried out so students could get to know some of the techniques developed within the project, employed for soil remediation and environmental protection. All the activities were designed for different educational levels, from 5-years-old kids to 16-years-old teens. In every activity, there was always a short time slot dedicated to introducing the "GREENER" project to students and raise awareness of the importance of taking care of the environment.

Every workshop was split into two parts. The first part was theoretical and tried to present prominent female personalities throughout history; and the second one, more of a practical kind, that allowed students to witness and collaborate on some experiments. The following table (Table 2) is summarising these activities.

Table 2. Theoretical and Experimental section of the GREENER training on 11 February 2020.

Theoretical Part: Female Scientists throughout History	Practical Part: Experiments
Merit Ptah: The first renowned woman in the History of Medicine and, possibly, in all Science History., ***Tapputi (Tapputi-Belatelallin):*** She is considered as the first chemist in the world., ***Maria la Judia:*** She was the first known female alchemist. ***Nicole-Reine Lepaute:*** She was a French astronomer and mathematician, ***Wang Zhenyi:*** A famous Chinese scientist who struggled to overcome many feudal traditions that hinder women growth and development, ***Jeanne Villepreux-Power***: A pioneer in marine biology and the first woman in making an aquarium to observe, study and experiment with aquatic beings. ***Mileva Maric***: She was the first wife of Albert Einstein. There is no little controversy about her participation in the calculations and findings ascribed to Einstein. ***Maria Salomea Skłodowska-Curie (Marie Curie):*** Pioneer on the radioactivity field, Marie was the first person in history to receive two different Nobel prizes – in Physics and Chemistry – and the first woman to occupy a position in the University of Paris. ***Rosalind Fraklind***: She was a British chemist and crystallographer who played a fundamental role on discovering the functioning of the double DNA helix. ***Margaret Hamilton:*** Computational scientist, mathematician and systems engineer.	**Volcano:** Sodium bicarbonate and vinegar erupt due to an acidic-basal reaction. The acetic acid, which is a weak acid, reacts and neutralizes the sodium bicarbonate (basal). The expelled carbon dioxide is a gas and is responsible for the sparkling during the "eruption". **Potato:** The part of Chemistry that studies transformations from chemical energy into electrical energy, and vice versa, is called "Electrochemistry". In this experiment, the electrical current produced out of the "potatoes battery" comes out of a chemical reaction that takes place between the anode (negative electrode, zinc) and the cathode (positive electrode, copper). **Slime:** White glue contains a polymer called PVA (Polyvinyl Acetate). Borax in water is ionized allowing the cross-linking of the different PVA molecules.

The locations where the trainings took place were Padre Manjón, Magea, Círculo, Freetime Urbano and La Estación. Some pictures of the events are shown below.

Indicative pictures from the event in Padre Manjón





Indicative pictures from the event in Magea


Indicative pictures from the event in Círculo



Indicative pictures from the event in FreeTime



Indicative pictures from the event in La Estación



Figure 4. *Indicative pictures from defferent training events organised by UBU.*

Thanks to the communication work in collaboration with the initiative "11 de Febrero", UCC+i of the University of Burgos, CENIEH and local mass media, ICCRAM research center and GREENER project have obtained a positive impact, reaching between all of them more than **250.000** people.

2.5.3 9-11th February 2021 training activities

From February 9th to February 11th, 2021, scientists from different fields of research working at UBU-ICCRAM carried out several activities –mainly practical workshops and talks, as part of the "Xth Women and Science Week in Burgos" initiative. Workshops were specifically devoted to girls ranging from 4- to 10- years-old, turning very appealing since they included uncomplicated experiments and were adequately interactive and fun. The common thread for these scientific disclosure actions was the "GREENER" project. In a quite simple way, plant physiology and soil sciences experiments, along with microscopy and electrochemical assays were carried out so children could get to know some of the techniques developed within the project, employed for soil and water remediation thus leading to environmental protection. Behind each activity somehow referred to with the objective was to increase somehow the visibility of the "GREENER" project targets, thus raising awareness of these little girls concerning the importance of taking care of the environment regarding the planet and human health.

In addition, GREENER´s coordinator Dr. Rocío Barros was part of an interesting round table on which important women linked to the scientific world discussed the Matilda effect.

Practical Workshops at "La Estación": During the 10th of February 2021, two practical workshops of 1.30h duration each (one devoted to youngest girls from 4-6- years-old, and the second group including girls from 7-10 years-old), were held at the facilities of "La Estación", the innovative community-building space for co-creation activities mainly relying on STEM (Science, Technology, Engineering and Mathematics) disciplines.

Figure 5. *February 11, 2021 activities performed by UBU.*

This building, created between the University of Burgos and the City Council, embraces numerous hands-on activities and a multitude of divulgation events of very divergent disciplines. All the activities were organized and promoted by the Universidad de Burgos Scientific and Innovation Culture Unit - UCC+i. 3 women scientists (Blanca Velasco, Lara Lubián, and Sandra Curiel) belonging to the Environment and Sustainability Research Group from UBU-ICCRAM, organized the talks and practical activities shared during that day. The workshop was entitled "Descubriendo lo que no vemos" ("Discovering what we are not able to see").

Round table: "How to reverse the Matilda effect": The Xth Women and Girls in Science edition included numerous activities on "How to reverse the Matilda effect", a phenomenon that owes its name to Matilda Joslyn Gage, who describes the lack of recognition of the achievements of women scientists in front of their male colleagues and the absence of female references in research. On the 11th of February, GREENER´s coordinator Dr. Rocío Barros García opened the round table "Is Europe the panacea for female researchers?", in the framework of these activities, in which a fruitful discussion was held among

prestigious women researchers of different disciplines. The video of the discussion is available in Spanish on YouTube.

Thanks to communication actions developed from ICCRAM, the activities promoted by the research center have had a positive impact, with the support of the press and social media. In all the activities photos and videos were taken, which are posted on social networks, increasing the impact of 11F action, thus the outreach of the GREENER project actions. **FINAL CONCLUSIONS:** Thanks to the communication work in collaboration with the initiative 11Th February, UCC+i of Universidad de Burgos, CENIEH and the local mass media, ICCRAM research center and specifically the GREENER project has had a positive impact, outreaching more than **250.000 people.** Events like this help scientists to reach out to a wide public, so they should take advantage of such opportunities to spread their work, communicate science aimed to the public and to reinforce the role of women in Science.

2.6 GREENER talks

More training targeting the scientific community and relevant stakeholders was initiated by AXIA innovation in the course of Task 8.3: Training. These activities are and will be supported by the consortium partners that are willing to participate in these talks.

At first, there were several approaches on how these interviews could be organised: 1. They could be live interviews with the interviewer and the interviewee interacting during the training.

2. Talks could be as pre-recordings that would be edited and compiled by AXIA in one final video, and

3. They could be writer interviews from different representatives from each entity that will be shared in the form of a newsletter or press release or news in the website relevant section.

Finally, live interviews were suggested as they would be more interactive. In future approaches, we could also follow another approach additional to the interviews, if needed.

2.6.1 The plan

The GREENER talks were agreed between the consortium to be held in the form of interviews to be conducted by AXIA or the project coordinator UBU. The interviews will be then edited by AXIA and will be shared on YouTube, in order to be viewed by interesting stakeholders.

After being published the videos will be announced on all of the GREENER social media platforms, as well as the consortium will be responsible to share them among their network via different channels, including personal social media, institutional social media,

The topics to be discussed in during the GREENER talks are:

- Welcoming speech: Welcome by AXIA/UBU. Interviewees will be asked to briefly present themselves.
- Introductory questions (only during the first talk addressed to the project coordination team):
    1. What is the GREENER project and what are its objectives?
    2. What are the benefits of its implementation?
    3. How important is remediation and in particular bio-remediation in our times?
- Short presentation of the activities the partner is undertaking (addressed to all partners participating in the interviews during the talks): The partner(s) should describe their activities across different WPs (an elaborative presentation can be presented to guide the audience through the different technologies)
- Additional questions: Some general questions could be:
    1. What are the impacts that can be expected from this project?
    2. What is the biggest challenge of the project and why is the cooperation between the EU and China so important?
    3. How do you envision the future of bioremediation technologies (or bioremediation) in 10 years?
    4. Specific technical questions are appointed to the interviewees.

The interviews were recorded on an online platform like zoom or teams and will then be edited by AXIA to much the graphic design of the project.

2.6.2 The first GREENER talk

The first GREENER talk was organised among AXIA and UBU on ZOOM platform on the 16th of June 2021. From the coordination team 3 representatives participated in the talk. The project coordinator, Dr. Rocío Barros, the Head of ICCRAM- the Environment and Sustainability Research Group at the University of Burgos, with expertise in the field of environmental technologies and sustainability.

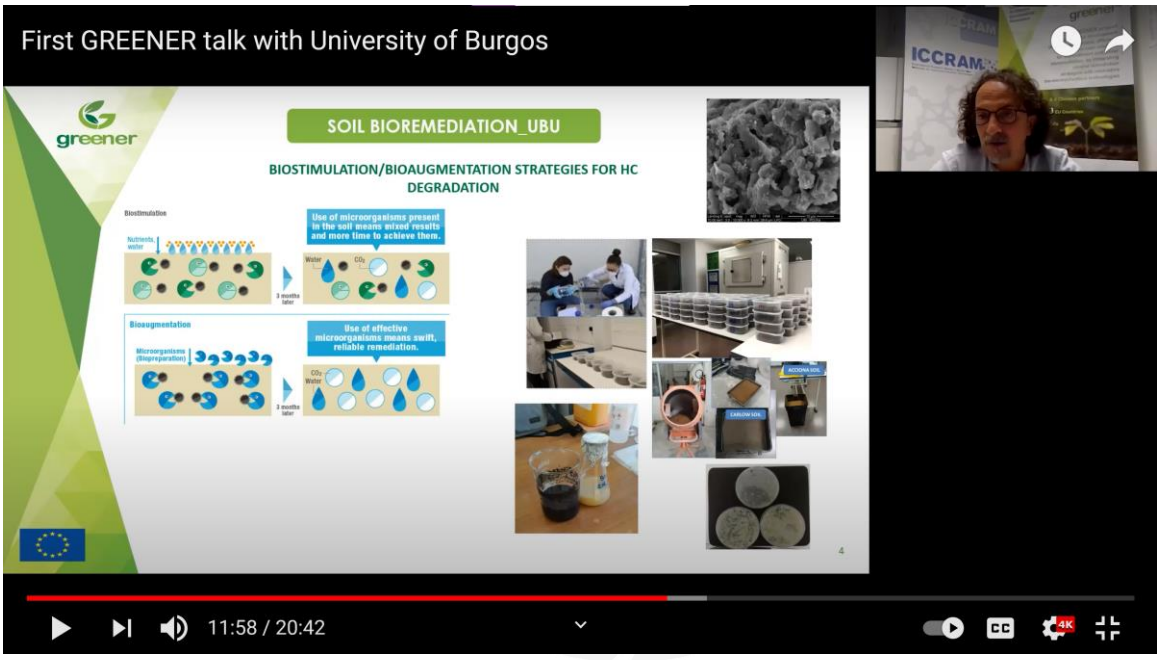

Figure 6. *The first GREENER talk.*

Prof. Carlos Rad, with a specialization in Soil Biochemistry, and with involvement in the GREENER project in tasks related to characterization, soil bioremediation and phytoremediation strategies´ design and testing. And finally, Dr. Blanca Velasco, with a PhD in Plant Biotechnology, working on bioremediation and phytoremediation technologies, as well as on the coordination and management of the GREENER project.

The first GREENER talk video can be found here.

3. Future work

More GREENER talks are going to follow and we have already identified several partners that are wishing to participate in this initiative, among with LEITAT, SIE, TAUW and University of Bath.

The purpose is to engage more stakeholders over time to the GREENER events and to interact with them. The videos will be shared with the network that is already built under the umbrella of our clustering activities including sister projects, similar projects, similar associations and organisations in the field of water and soil management, as well as to the GREENER newsletter subscribers.

Moreover, any other training activities initiated by the consortium partners will be also monitored and included in the future version of this deliverable.

4. Conclusions

The reported Training Modules refer to training activities targeting to i. academic students, ii. young individuals, iii. the wider scientific community, and iv. industrial stakeholders.

They include different trainings to students, to youth and the GREENER talks. So far, the first GREENER talk is already completed while 4 additional ones are planned for the future.