



“University - business alliance in modern biotechnology approaches for climate change mitigation solutions” - BIO-Save

R2. BIO-Save Educational Programme Implementation and Operational Plan

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Who we are and what is this guide for?

The BIO-Save partnership comprises four HEIs, four SMEs, and two NGOs from five European countries. It unifies a diversity of expertise, knowledge, and skills and a long experience in collaborative working. This consortium establishes a knowledge alliance that implements and maintains innovative education activities at the biotech level within different HEIs and business bodies. The consortium functions on mutual agreement and understanding the need for qualifications transparency within the HEIs' system.

Education has become a commodity in which people seek to invest for personal gain, to ensure equality of opportunity, and as a route to a better life. Through training, we can transfer or modify any knowledge, skills, and attitudes through learning experiences. Furthermore, people may require training for different reasons, including acquiring new knowledge, successful future professional realization, or the need to maintain competence levels and respond to the demands of changing circumstances and new approaches and technologies, etc. Training cannot solve structural, organizational, or policy problems. However, supportive supervision and motivational strategies application can help sustain performance improvement derived from training. Furthermore, the rapid growth in e-learning, particularly experienced during the COVID-19 pandemic, has overcome many of the barriers Higher Education meets, providing traditional universities an opportunity to meet the changing worldwide demand for education.

Overview of the BIO-Save training

The BIO-Save project fosters the alliance between higher education and business, answering the well-defined and timely increasing need for engagement of Universities with Industry. Higher education institutions (HEIs) are steadily fighting to educate as many as possible industry-relevant graduates. At the same time, the industry's high-level research and development (R&D) initiatives strongly need industrial support. A key clause for both needs' successful realization is the collaboration and partnership building between universities and industry. Many industry practitioners are convinced of the value of an effective working relationship with universities. However, the key to a successful and long-term partnership that brings tangible benefits to both parties is the creation of Knowledge Alliances that are unifying their efforts.

The following steps are implemented to realize the BIO-Save project's potential to foster the operation of the current alliance between higher education and business.

- ✓ Design of a blended learning programme based on biotechnology as a platform technology significantly contributing to climate change mitigation and adaptation and

constituting two main parts - 'Biotechnology for climate change mitigation' and 'Biotechnologies for climate change adaptation in agriculture'. The core subjects of the programme contribute to the main goals of the European Green Deal to make the EU climate-neutral by 2050.

- ✓ Introduction of a learner-centred approach in the programme design through implementing target groups activities;
- ✓ Programme structuring through combining learning methods and specific content and using an innovative approach based on EQF/NQF/HE¹ and ECTS principles;
- ✓ An innovative model establishment to describe learners' qualifications in modern biotechnology for climate change mitigation. The b-learning model proposed makes the BIO-Save project a gateway to Education 4.0, offering innovation-based education and 21st-century learning skills such as critical thinking, communication, collaboration, and a growth mindset that fit the Industry 4.0 technological requirements;
- ✓ A multilingual cloud-based platform development with convenient operational functionality to interactively host modules and short intensive courses, learning outcomes (LOs) & units; introduced 3D imaging technology in the learning material;
- ✓ Writing training materials for biotech graduates at EQF/HE levels 6, 7, and 8 and making them available in EN, BG, GR, TR, and IT languages;
- ✓ Outline of integrated prospect for the mobility of biotech professionals within the EU labour market, designed on the basis of ECTS and recognition of newly adopted competencies;
- ✓ Transfer of the innovation process transfer with respect to ENQA² and the target audience, considering the requirements of the new model for the description of learners' qualifications;
- ✓ BIO-Save structural model piloting within target audience from universities, enterprises, and related sectors and feedback data collection;
- ✓ A two-level partnership with sectorial organisations setting up to embed the programme into EU / national training establishments for better valorisation and post-project life assurance.

Objectives of the BIO-Save programme

The BIO-save training aim is to bridge the gap between teaching in the academic/higher education world and continuous professional development in the biotech sector concerning climate change. Thus, the project promotes the best climate change mitigation practices based on modern biotechnology approaches. Its key objectives are to:

¹ <https://europa.eu/europass/en/description-eight-efq-levels>

² <https://www.enqa.eu/>

1. Link higher education, research, and business for excellence and regional development in the area of climate change mitigation and adaptation;
2. Improve attitudes about the importance of finding and applying timely measures for climate change mitigation and adaptation, thus improving the environment for change;
3. Increase knowledge about the special considerations related to advanced biotech strategies for climate change mitigation;
4. Build and strengthen skills in the specific tasks required to combat climate change;
5. Stimulate the development of entrepreneurial, creative, and innovation skills and promote innovation in higher education through more interactive learning environments.

These objectives aim to boost entrepreneurship and motivate HE to offer new knowledge of climate-saving strategies and realising a positive impact on clean environment and agriculture technologies. Thus, BIO-Save also helps encourage modern biotechnology education and biotech companies' innovation concerning climate change mitigation.

BIO-Save training route

The first step in the design of BIO-Save project training involves an assessment of training needs. The assessment comprises:

- ✓ Measurement of skills gap (analysis) - data collection;
- ✓ Review of the current state of the art in the field of modern biotechnology approaches for climate change mitigation;
- ✓ Appraisal of the status of contemporary biotech practices and national peculiarities in identifying new skills and competencies and their actual uptake by various industrial sectors;
- ✓ Analysis/assessment of the existing national policies and employment prospects in bio-save relevant economic sectors;
- ✓ Integration of factors for a clean environment in the economy;
- ✓ Alignment with national/EU HE priorities: summary of the existing education curricula integrating modern biotechnology tools / educational needs/gaps in the project subject area;
- ✓ Review of the available competence models and competence assessment schemes and formulation of the needs for the development of suitable e-training programmes in the field;
- ✓ Skills gap analysis assessment.

The second step involves defining the training programme's **learning objectives**. The learning objectives, derived from the needs assessment, specify the observable, measurable actions that each learner will be able to demonstrate as a result of participating in the training activities.

The third step is creating and implementing a training programme to improve performance, taking into account the experience and educational levels of the trainee and the time and resources available for training. Options range from Short Intensive (SICs) and Postgraduate (PGC) courses to long-term M.Sc. Programme.

The BIO-Save educational programme is developed employing the strategy of Nicholls' five phases of curriculum design (Nicholls, 2002³) (Fig. 1):

1. Selecting or identifying LOs;
2. Selecting or developing learning skills that will help students achieve the LOs;
3. Selecting or identifying content that is relevant to LOs;
4. Identifying or developing assessments to ensure the learner is progressing towards LOs;
5. Evaluating the effectiveness of the learning skills for leading learners to the LOs.

³ Nicholls G (2002) Developing teaching and learning in higher education. London, UK: Routledge.

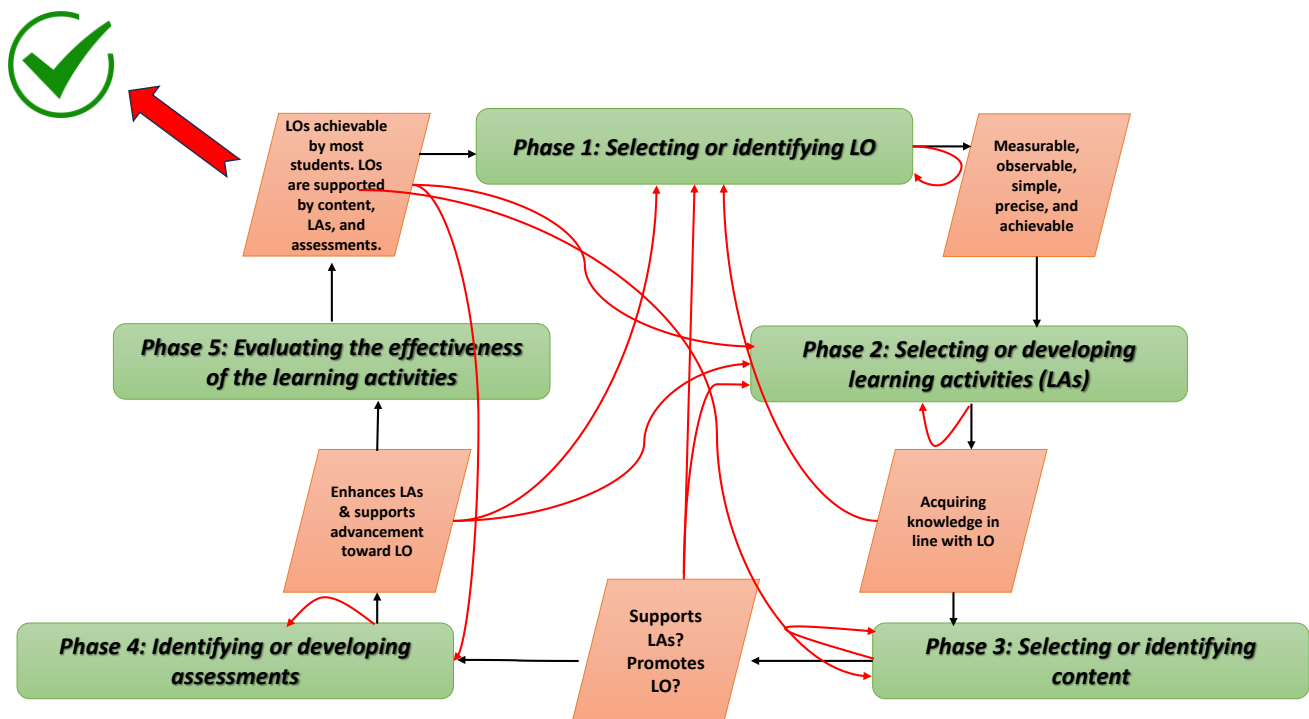


Figure 1. Nicholls' five phases of curriculum design and their dependencies. For each phase (rectangles), the key questions that should be asked are shown (diamonds). Where the questions haven't been satisfied, that phase or previous phases or the LOs should be revisited (red arrows); once they have been satisfied, this feeds forward into the next phase(s) (green arrows). When all questions are satisfied, the curriculum or instruction can be characterized, with concrete evidence, as successful (star).

The description of BIO-Save LOs has been performed based on Bloom's taxonomy⁴ of cognitive complexity, which is hierarchical in the sense that learners need to have demonstrated achievement of prior levels before advancing to more complex ones (Fig. 2). In this way, BIO-Save LOs were formulated using the most appropriate (measurable, active) verbs that express expected behaviours of individuals at the relevant Bloom's level. All LOs have been weighed in corresponding credit points.

⁴ Adams NE. Bloom's taxonomy of cognitive learning objectives. J Med Libr Assoc. 2015 Jul;103(3):152-3.

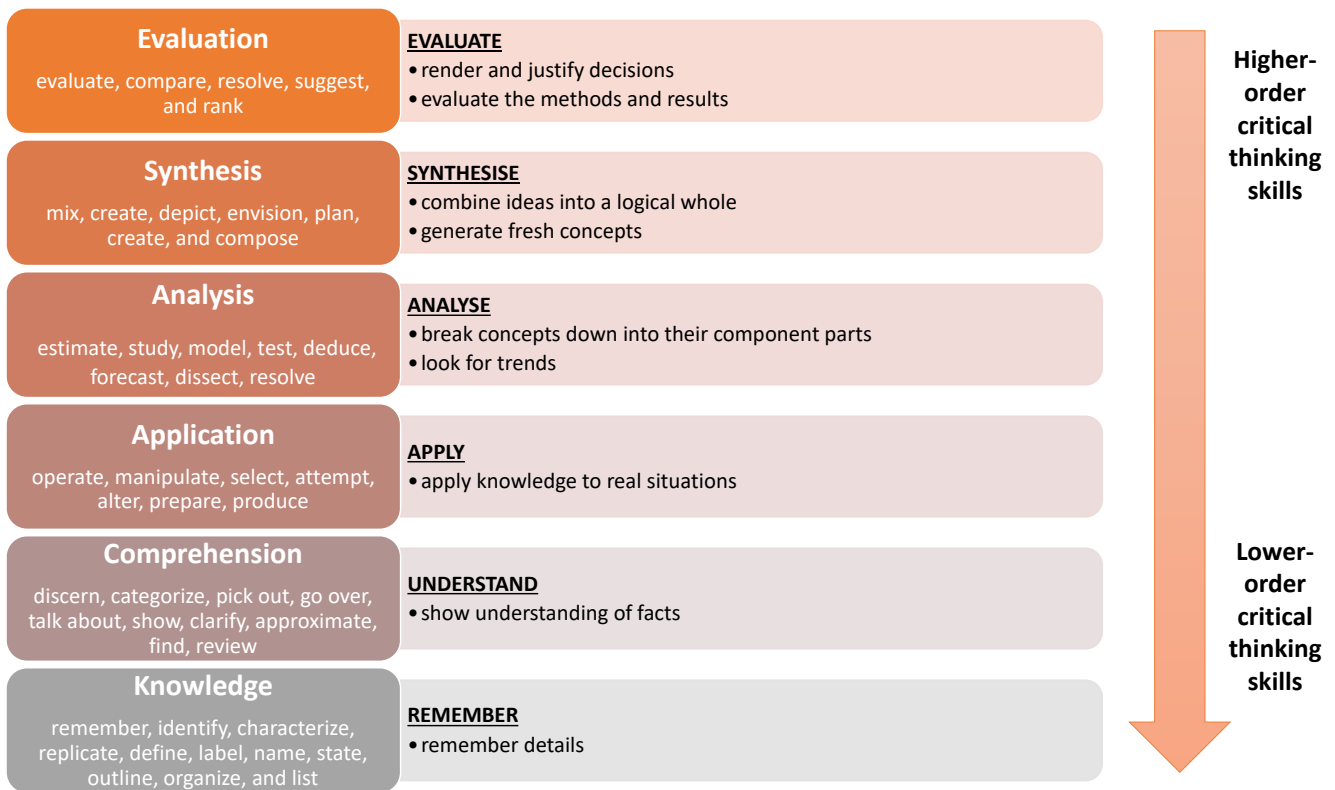


Figure 2. Bloom’s taxonomy of cognitive complexity and associated verbs that can be used to create LOs. The verbs reflect a developmental trajectory from lower- to higher-order thinking skills. They should be concrete and observable and relate to how instructors will assess achievement of target LOs.

The learning outcomes that must be achieved, along with the training environment, audience characteristics, and the trainer experience, determine the mix of learning methods and media selected to achieve maximum effectiveness. The training methods and media include online/offline training materials, project-based learning, inquiry-based learning, and digital learning through cloud-based learning with web links, videos, QR codes, and 3D images.

The BIO-Save training programme development also includes the training evaluation design, which could be carried out during the course training process (when H5P presentations are used) and at its completion (when online learning is preferred). BIO-Save training evaluation implemented Messick’s assessment criteria formulated as three questions:

1. What are the Knowledge, Skills, and Abilities (KSAs) that learners have to possess at the end of the curriculum?
2. What actions or behaviours by learners will reveal these KSAs?
3. What tasks will elicit these specific actions or behaviours?

At the end of the course training process, trainers should collect data on how well the learners achieved the course objectives and how satisfied they were with the training

experience through specifically designed self(assessment) tests and reply cards. Data collected can help identify the need for additional training or reinforcement of newly acquired skills. They inform about the need to review and/or revise the training materials.

BIO-Save training modules

Modern Biotechnology is crucial for climate change mitigation and the sustainable growth of the green economy. It is in the focus of the BIO-Save multidisciplinary curriculum. It comprises 12 comprehensive LOs, along with three guidelines for trainers and 1 for young entrepreneurs, aiming to enhance the capacity of different stakeholders to understand climate change better. It explains several frameworks, tools, and techniques for planning and designing community-based adaptation projects. It is expected to strongly impact job growth, raise awareness, and support the global environmental problems solution. LOs are designed to ease their use by professionals from different sectors, such as environmental science and engineering, genomics, biomanufacturing, and agricultural science. They are enabling them to understand the issue's intersectoral nature and, jointly with other sectors, address climate change impacts. Furthermore, the BIO-Save Learning Curriculum implements several innovative concepts:

- ✓ It highlights the potential of modern technologies to increase productivity and meet the rapidly growing demand for energy, food, nutrition, and health;
- ✓ It presents the impact of Modern Biotechnology approaches in climate change mitigation for improving quality of life.

The BIO-Save educational curriculum is directed to two key areas:

Part I: Biotechnology for climate change mitigation:

1.1. Reduction of GHGS emission – describing the innovative measures needed to drastically reduce greenhouse gas emissions and the role of biotechnology for the reduction of GHGs;

1.2. Use of energy-efficient farming – presenting the best practices for improving energy efficiency in farming and their importance for reducing energy demands and costs;

1.3. Carbon sequestration – explaining the new biotechnological methods for carbon sequestration in terms of using the cyanobacteria, enzymes, and microalgae technology;

1.4. Reduced use of synthetic fertilizer – focused on how to minimize the use of agrochemicals, what are the new agricultural approaches and how they could contribute to sustainable agriculture, environment protection and species preservation;

1.5. Adaptation to abiotic stresses and evaluation of adaptation measures – describing how abiotic factors affect living organisms and the ecosystem's functioning, and how organisms change to conform better to new environmental conditions.

Part II. Biotechnologies for climate change adaptation in agriculture

2.1. Biotechnology approach to solve agricultural and natural resources problems and restore degraded ecosystems – presenting how modern biotechnology can help mitigate environmental change, including temperature increases, altered rainfall patterns, and the prevalence of pests and diseases, profoundly impacts agricultural production, productivity, and quality.

2.2. Enhancing adaptive capacity of crops: Innovation in plant breeding to develop more resilient to climate change crop varieties for agriculture – outlining various adaptation strategies, including altering food consumption and waste, changing land and cropping practices, producing improved crop varieties, etc., in order to adapt to the considerable influence of climate change on agriculture and food security.

2.3. Agroecosystem responses to combination of elevated CO₂, ozone, salt and heat changes resulting from global climate change – focusing on changes in agricultural productivity due to the direct effects of climate change factors at the plant level or indirect effects at the system level.

2.4. Crop diversification and opportunity for climate change resilience – describing the implementation of new diversification biotechnology for the introduction of newly improved crop varieties that enhance plant productivity, quality, health, and nutritional value and promoted as a strategy to achieve climate resilience.

2.5. Use of new technologies and practices (e.g., soil and water conservation, pest and disease control) – presenting the most recent methodologies and techniques for achieving sustainable soil and water use management, their usability, advantages and disadvantages, and some insights about the adoption motives and barriers.

2.6. Conservation and exchange of plant genetic resources – discussing the need for conserving genetic resources of crop plants and the main principles and procedures of in-situ and ex-situ conservation.

2.7. Addressing climate changes with ISO standards – focusing on how ISO climate change standards assist organizations in complying with expanding regulatory requirements and assessing their environmental influence.

Furthermore, to raise awareness and promote a better understanding of environmental risks and the development of green business opportunities a Guide “Green biotech business for young entrepreneurs” has been developed. It aims to present new approaches for manufacturing sustainable products and offering sustainable technologies. The guide is designated for young entrepreneurs, aiming to raise their awareness and promote a better understanding of environmental risks and the development of green business opportunities. It enriches their knowledge with information about green technology applications to combat climate change through biotechnology innovations implementation towards a sustainable bioeconomy.

The implementation strategy at a glance

The educational implementation strategy of the BIO-Save project focuses on the organization and delivery of an innovative educational programme dedicated to biotechnological approaches for climate change mitigation based on the integration of various ICT scenarios and EQF/NQF/HE strategic systems for the organization of the educational process. The BIO-Save multidisciplinary curriculum is developed by blending different learning methodologies and digital resources.

BIO-Save Learning Portal encompasses various b-learning opportunities designed for the project target groups – academics/research professionals (Ph.D. – EQF8), students (M.Sc. – EQF7 and B.Sc. – EQF6) and biotech practitioners (EQF6, EQF7, and EQF8). Three types of training using LOs from the BIO-Save educational knowledge pool are designed:

- ✓ One-year M.Sc. programme;
- ✓ Short intensive programme for SMEs;
- ✓ Postgraduate qualification courses.

The BIO-Save training offers are designed for academics, students, and biotech SME practitioners interested/working in Environmental science and protection, Environmental engineering, Genomics/Genetics counselling, Biomanufacturing/up- and downstream processing, and Agricultural science. In compliance with the Education 4.0 concept focused on the technology infiltration into the educational process, relevant hyperlinks, videos, PPTs, and 3D images are provided for the training topics. A blended learning approach is applied, giving opportunities for personalised training and selecting the most appropriate way of gaining knowledge. All training materials are accessible as online lectures and offline textbooks (pdf format).

The BIO-Save M.Sc. programme provides students with expert knowledge and international skills that prepare them for doctoral studies and/or professional industrial careers in the biotech approaches for climate change mitigation. It aims to enrich and expand students' knowledge in modern biotechnology applications and provide abilities to shape a better future by fighting the negative impacts of climate change. Integrating various IC technologies into the study process complies with Education 4.0 priorities⁵. It further supports the academic practice, infrastructure, and ways of higher education delivery in a digital age.

The short intensive programme for SMEs comprises four specific short intensive courses focused on the multiple impacts of climate change on business.

- SIC 1 Towards Climate Change Resilience;
- SIC 2 Biotech applications in agriculture to solve CC problems;
- SIC 3 Agroecosystem responses and adaptation to CC;
- SIC 4 Climate change & bioeconomy.

⁵ <https://education.ec.europa.eu/focus-topics/digital-education/action-plan>

These SICs are intended to show how modern biotechnology approaches can help assess, value, and manage business decisions and achieve compliance with environmental standards and certification schemes. Each SIC offers innovative knowledge, skills, and competencies equipped with opportunities for project-based learning and career guidance. Developed short intensive programme for SMEs also supports the companies' green business management systems implementation. The programme is expected to raise awareness of adopting sustainable strategies and business practices for climate change mitigation in company policies.

Postgraduate courses represent a selection of topics that raise the importance of biotechnology and its applications for climate change mitigation by supporting the European Green Deal and Education 4.0 key priorities. Their key objective is to contribute to the increase of skilled and educated HE staff and young graduates working in different European economic sectors.

A Specific Competence catalogue for different occupations for the given professional areas is also offered. It could be used as a model giving detailed information for required competencies and skills to apply effectively the latest advancements in different technological fields. The application of the BIO-Save Competence Catalogue is in three main directions:

- ✓ In formal education – to mainstream the MSc curriculum learning towards occupation/career advancement;
- ✓ In the Short intensive programme for SMEs – to support the assembly of personal portfolios for better positioning in the labour market;
- ✓ In CVET – to encourage the attendance of post-graduate courses for knowledge upgrading and up/re-skilling.

It represents a solid tool for better recognition of the skills and competence of graduates seeking a business career. It also helps the easy transfer from academic to business environment and supports the national strategies for improving societal demands. It will comprise two parts. Part I provides a scheme for acquiring competencies in common within the BIO-Save project career domains/occupations and professionals in compliance with EQF levels 6, 7, and 8. It is based on the accumulated findings of Result 1 'Skills gap demands biotech expertise in climate change mitigation' with respect to the national/EU HE priorities, teaching strategies in Biotechnology and Education 4.0, and available educational programmes in each partner country. Part II establishes common criteria and qualification standards for the delivery of sample documents certifying achievements one has realized during a defined period of university education and provides a detailed view of job-specific, digital, and soft skills required for students, academic/research professionals, and biotech practitioners in the selected BIO-Save professional areas. grounded

Each training offer is supported with corresponding digital elements (3D images, H5P interactive presentation, and/or short animation or other digital learning approaches). BIO-Save b-learning curriculum structuring, a Learning Outcomes-based approach, is reinforced by corresponding Learning Plans and Self-assessment Tests. A systematic procedure for the international transfer of acquired qualifications in the BIO-Save project field is also created. It

is based on the recognised EU instruments EQF/HE/ECTS to establish a joint and user-friendly 'language' for transparency, transfer, and recognition of learning outcomes. As a result, ECTS points have been identified and granted for each learning scenario.

Key actors

With the rapid growth of industries worldwide and the tendency to develop and apply novel green technologies for climate change mitigation, modern biotechnology in agriculture, food, and the environment has become inevitable. In the BIO-Save partners' countries, biotechnology is being used for both research and commercial applications, but various technologies presented may still be at an early stage of development. The up-skilling and re-skilling of the labour force, which will promote the greening of the economy and broader use of energy-efficient technologies, gaining more importance. Implementing the BIO-Save training programme will help young entrepreneurs and practitioners willing to do business in the biotech sector to acquire innovative knowledge, skills, and competencies. It will also support the implementation of companies' green business management systems.

Key actors that could be involved in the strategic implementation of the BIO-Save training programme are those that are interested in the organization success, based on learning improvement and development of science and technologies that provide technical solutions for climate change mitigation. Their role will be focused on helping the BIO-Save training programme effective performance in compliance with the project strategic objectives.

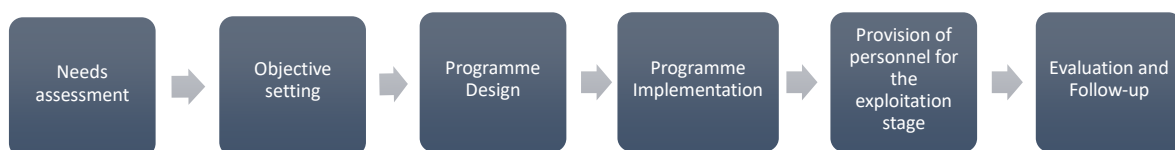
The main actors for the BIO-Save training programme implementation in the partners' countries include:

- ✓ Universities - provide B.Sc., M.Sc., and Ph.D. degree courses in the various fields of Biotechnology; host and participate in Technology Innovation Centres; participate in collaborative projects;
- ✓ Various specialized research institutes - develop new applied scientific knowledge; take part in collaborative projects; and perform students' training;
- ✓ Ministries and Government Agencies – support scientific, research, and development activities in the universities and the industry; contribute to the government's R&D needs by providing input on programmes
- ✓ Public and private research organizations – carry out research projects in biotechnology and apply the results for the country development; organize short courses and certificate programmes in biological sciences.
- ✓ R&D centres - create new scientific knowledge and develop innovative biotech technologies; support and participate in collaborative R&D projects in the relevant sector;
- ✓ VET centres - offering education and training in biotechnology;

- ✓ Biotech SMEs - offering employees enhancement of their skills set, introduce them to their role or the industry, and advance within the company.

Steps in Implementing BIO-Save Training

BIO-Save training will enable the target users to adapt to the technological advancements in modern biotechnology approaches for climate change protection and, respectively, to the industry changes, ensuring that the workforce remains competent and competitive. Furthermore, the well-designed training programme will enhance individual performance and contribute to the overall success and growth of the organizations (HEIs, biotech SMEs, VET-providing organisations, etc.) that prepare people for work and develop job-related skills to remain employable and respond to the needs of the economy. The point of implementing a training programme is to make it accessible and usable by end users. The successful implementation of the BIO-Save training, which meets the project objectives, must be carried out through an effective systematic process using digital tools. This implementation is crucial, given the growing demand for remote workplaces and the capacity to provide training virtually. The BIO-Save training implementation depends fundamentally on the transnational partnership activity and represents an overall planned and coordinated process, the execution of which focuses on the following tasks:



The BIO-Save training programme implementation comprises planning, engaging, and evaluating. To focus on and create strategies for these steps fulfilment, the BIO-Save target users/organisations will be supported by the elaborated BIO-Save R2: BIO-Save Educational Programme Implementation and Operational Plan. This guide describes how the implementation is managed and which are the main tasks involved in the implementation process.

1. Plan

The purpose of the realization of this first implementing step is to:

- ✓ Assess the need for the BIO-Save training, and
- ✓ Determine the type of training the end users prefer to use for maximum knowledge retention and engagement.

The questions are: What skills or knowledge the target end users would like to acquire to succeed, and what are the trainees' various learning styles and preferences? The ambition of the BIO-Save project is to improve the quality of education for students, teachers, and

practitioners in up-to-date aspects of climate-protective biotechnology approaches according to the Industry 4.0 training needs. The developed ICT-based flexible BIO-Save training programme is structured as transferable Learning Outcomes and Learning Offers, thus providing opportunities for diverse HEI and business stakeholders to shift to EQF/HE/ECTS competency-based learning. Exploiting the blended learning part of the BIO-Save platform, the target users have three learning options – an M.Sc. programme, a Short Intensive Programme for SMEs, and Post-Graduate Courses. However, they must first decide what they want to learn regarding their career needs. They can focus on the areas from the BIO-Save training programme and achieve meaningful outcomes, thus aligning their training objectives with the organization's strategic goals and further professional development. The BIO-Save users can benefit from the interactive training environments on the one hand because of the engaging educational material containing short videos, H5P presentations, 3D images, etc. On the other hand, the blended learning training approach encompasses a combination of e-learning and in-person instruction.

2. Engage

When it comes to increasing the participants' engagement with the BIO-Save training programme, the solution is not only in the programme's content but also in the time commitment and the training approach. There are two basic approaches to implementing the BIO-Save training programme: one is centred on the trainer, who controls learning contents and experiences; the other is on the learner, with the trainer acting as a guide and providing resources. The second approach assumes that people are able and willing to learn if given the proper materials in an atmosphere conducive to learning. This method is preferred when implementing a BIO-Save educational curriculum because it is participatory, learners' experiences are shared, and participants have more freedom to learn at their speed.

The users could decide when to conduct training depending on their time commitments. This approach in implementing the BIO-Save HE curriculum provides a solution to the end users to fit the training into their study/workday without sacrificing productivity.

An important aspect included in a training package is the follow-up support to the participants. This support will be in the form of supervision, coaching, mentoring, setting up a network support group, or simply providing a source of ongoing information. Follow-up activities will be conducted in person but may also be provided remotely using the BIO-Save Learning Platform.

3. Evaluate

The Trainee -Trainer interaction is a proper approach to evaluating learning success using the BIO-Save training platform. Trainers communicate regularly with their students/SME staff so they can see how training has influenced individual performance and the participants' general productivity, effectiveness, and engagement. This feedback information could be gathered by conducting an anonymous online survey or face-to-face discussions and polls. The trainers could evaluate the knowledge attained by the trainees by viewing how many courses each participant has completed, which are still in progress, and the final assessment test scores to show their engagement in the BIO-Save training.

Before implementing the BIO-Save Training programme, the listed below essential issues must be considered.

Identifying sectors or clusters

Choosing the ideal professional career requires trainees' consideration of their knowledge, skills, and interests. It's a choice that could potentially impact their further education and training. Reaching the right career sectors and clusters interested in the BIO-Save education could help the BIO-Save target users to respond to three main questions: What's important to me? What do I want next? What should I do now?

According to the National Career Clusters® Framework, created by the Career Technical Education (CTE) organisation, the careers are grouped into 16 clusters. The agriculture, food, and natural resources cluster, involving everything related to creating agricultural products, is the main cluster whose further development could be influenced by the BIO-Save training. The career pathways that could benefit from the BIO-Save training offer include Agribusiness systems, Environmental service systems, Food products and processing systems, Natural resources systems, and Plant systems.

Modern biotechnology has the potential to change the present agricultural practices with innovative biotech approaches directed to the mitigation of climate change and adaptation in agriculture. The BIO-Save training programme promotes the latest innovations and practices and advances knowledge and skills in the said area. It is adapted to actual challenges and needs of biotech professionals and designed to support young entrepreneurs and practitioners in the biotech sector in gaining innovative knowledge, skills, and competences. In this respect, the principal sectors interested in the BIO-Save educational offer are Agricultural Biotechnology, Environmental Biotechnology, Energy, Food Biotechnology, Industrial Biotechnology, and Chemistry.

Agriculture sector: The implementation of the BIO-Save training programme will provide support for any public or private institution (universities, research institutions, SMEs, and centres for agrarian science) in the partners' countries which have a proven experience in leading projects in the areas related to agricultural science and technologies. The most studied agricultural biotechnology topics are stress tolerance, regeneration and propagation, and pharmaceutical and molecular markers. The BIO-Save training will provide additional knowledge and insights to the participants on various facets of biotech application in agriculture to solve problems related to climate change and bioeconomy.

Environment Biotechnology sector: this growing and applied branch of biotechnology mainly focuses on the microorganisms' application for environmental improvement. The BIO-Save training programme could support the research laboratories in the environmental biotechnology in the partners' countries, where graduate students, visiting scholars, postdoctoral researchers, and interns' work. The BIO-Save project provides training in modern sustainable technologies in biotechnology (genomics, nanotechnology, etc.) and specific skills for handling

new advanced biotech technologies. The introduction of some topics from the BIO-Save Learning curriculum, which covers eco-friendly technologies in addressing climate change and restoring ecosystems, into the Universities` B.Sc., M.Sc., and Ph.D. formal programmes will provide trainees with knowledge and skills tailored to the biotech industry needs who work with environmental concerns. The project could also contribute to boosting some of the cutting-edge research performed in centres addressing the environmental issues such as bioenergy sources, genomics, biomicroelectronics, molecular microbial ecology, etc.

Energy sector: Biotechnology is applied to generate various sustainable solutions, and in compliance, the BIO-Save project training curriculum is directed to professionals engaged in the energy sectors. Benefits could be derived from both SME practitioners and policy-decision makers involved in the development and implementation of green energy technologies, such as the production of biofuels (biodiesel, bioethanol) sourced from plant materials like corn stalks and grass, as well as launching renewable fuel alternatives for the reduction of carbon footprints of fossil fuel production. Furthermore, students, academics, and researchers could enhance their current knowledge about the future of the biotechnology industry and the role of microbial conversion of hydrocarbons and its dramatic impact on increasing the amount of energy recovered from depleted/uneconomical petroleum and coal deposits, particularly in combination with CO₂ utilisation.

Food Biotechnology sector: Key advancements in technology, particularly in biotechnology, have significantly redefined the needed knowledge and skills base and broadened the potential applications of biotechnology to foods. The learning content of the BIO-Save training programme will provide opportunities for undergraduate and graduate students, academic teachers and professionals, environmental technology professionals, food technology experts, and tech-minded farmers to increase their perception and knowledge about the use of new biotechnological approaches for achieving health and food safety and directing food production in a resource-efficient and environmentally friendly way. Innovations in plant breeding to develop more resilient to climate change crop varieties for agriculture are considered a breakthrough in biotechnology. The BIO-Save training programme includes this topic. Food scientists, SME practitioners, and farmers skilful in developing and producing adaptive crops could benefit from its use. The BIO-Save training programme enhances the current knowledge of students, academics, and researchers about the latest biotech applications in agriculture and food production to solve CC problems.

Industrial biotechnology sector: Protecting the environment is becoming increasingly crucial to the future of the biotech industry. Modern biotechnology will play a key role in finding innovative ways to deal with waste and developing fermentation and biological reactive technologies. The elaborated BIO-Save training curriculum offers advanced knowledge to students, scientists, and biotech practitioners whose field of research encompasses developing novel products from raw biomaterials with microbial/enzymatic transformation techniques. R&D centres and biotech SMEs, as representatives of the industrial biotechnology sector, and various laboratories in the universities and academic institutes, whose research focuses on developing green technologies, can be potential beneficiaries of the innovative BIO-Save curriculum. The production of green chemicals (ethyl alcohol, citric acid, acetic acid, carboxylic

acid), bread yeast, starter culture, biopreparations (biocontrol agents, biofertilisers, biocleaners), microbial enzymes (textile/leather, detergents, and cosmetics) industry), biomaterials (bioplastics, biopolymers), biofuels (bioethanol, biodiesel), environmental technologies (biogas, bioremediation), natural intermediates (pharmaceutical raw materials, cosmetic intermediates products, volatile compounds) and vaccines are the directions that would benefit from innovations in the biotech research and development.

Chemical sector: Chemical sector has positively impacted contemporary society by providing affordable goods for daily necessities. The biotechnology development, grounded on the latest advancements in molecular biology, biochemistry, and synthetic biology, offers reinvention in how the chemicals are produced using less energy and water, demonstrating higher performance and reducing environmental footprint. Implementing the BIO-Save training programme in universities and SMEs, practicing bio-based products and processes research and innovations, will benefit academic practitioners, researchers, environmental managers, and engineers with additional theoretical knowledge and practical skills to create and implement green-oriented technologies. Policy-decision makers involved in circular bio-based innovative solutions development directed to the environmental pollution and greenhouse gas emission reduction in the chemical industry, will benefit from the training programme offered.

Identifying training providers

In the 21st-century fast-developing world, HEIs and biotech organisations have difficulties with keeping the content of the educational curriculums and the knowledge and skills level of their students and professionals up to date on the latest technologies and trends. The correctly selected training provider will supply the BIO-Save trainers with the knowledge and skills relevant to the latest practices and problem-solving solutions in biotech industry. The BIO-Save b-learning opportunities for the trainers (target users from universities, biotech enterprises, R & D, and VET centres), will be revealed in each partner country. The training provider will also offer access to online (cloud-based web platform, self-paced learning, e-tutoring) and offline methods (face-to-face and workplace learning; printed materials distribution). The operational functionality of the BIO-Save cloud-based web platform, as a broad multilingual tool for HE in Modern Biotechnology, will be realized, and the LOs' knowledge content and IT-based training tools will be utilized.

The foreseen training providers that could implement in future the BIO-Save training programme (M.Sc., SICs, PGCs) could be:

ACADEMY-UNIVERSITIES

The experienced and specialized professionals comprise academics, researchers, and up-and-coming scientists focused on innovative biotechnological advancements, as well as experts well-versed in the realm of information technologies, could be involved in BIO-Save training curriculum implementation.

These training providers could be part of the team in the following university departments and research institutes in the partners` countries, performing graduate education and research activities in biotechnology and related fields:

University departments: Agricultural biotechnology, Bioengineering, Engineering and Natural Sciences, Chemical and Biological Engineering, Genetics and Bioengineering, Biomedical Engineering, Molecular Biology and Genetics, Biotechnology, Department of Biotechnology in the Agricultural University of Athens (GR), Department of Biotechnology and Biochemistry at the University of Thessaly (GR), General and Industrial Microbiology (BG), General and Industrial Hydrobiology (BG), Food, Chemical, Environmental, Aquaculture and Agricultural Engineering departments (IT).

Research Institutes: Institute of Biomembranes, Bioenergetics and Molecular Biotechnology (IBIOM) (IT), Institute of Biochemistry and Cell Biology (IBBC) (IT), Institute of Agricultural Biology and Biotechnology (IBBA) (IT), Institute for Biological Resources and Marine Biotechnology (IRBIM) (IT), AgroBioInstitute (BG), the “Stephan Angeloff” Institute of Microbiology – BAS (BG), Institute of Molecular Biology "Acad. Rumen Tsanev" – BAS (BG), Institute of Plant Physiology and Genetics – BAS (BG), Jožef Stefan Institute and National Institute of Chemistry (SI), Research Institute for Genetic Engineering and Biotechnology (TR), Biotechnology Research Institutes (TR) and Istanbul University Biotechnology and Genetic Engineering Research and Applications Centre (TR).

R&D Centres: Systems Biology Advanced Research Units (IT), Plant System Biology and Biotechnology Centre (BG), Centre for Applied Research and Innovation (BG), Plant Biotechnology Information Centre in AgroBioInstitute (BG).

PUBLIC INSTITUTIONS

Public institutions, such as national research centres, national agencies, and companies engaged in Ph.D. students and researchers training, could play an essential role in the BIO-Save training courses (SICs and PGCs) implementation and provision.

In Italy, 58 State Research Centres (34 agricultural, 13 aquacultures, and 11 veterinary-livestock) carry out studies in biotechnology-related areas.

In Bulgaria, the Business Foundation for Education (BFE) is a non-government organization, a leader in lifelong learning and career guidance. The foundation has profound experience in programmes development for linking businesses and higher education institutions in Bulgaria and training delivery. Their cooperation with universities' career centres, regional career development centres, private companies, public institutions, and NGOs could support the involvement of appropriate training providers in the BIO-Save programme implementation.

VET PROVIDERS

VET centres and colleges with a scope of activities directed to education and vocational training in biotechnology, food technology, nature protection, agriculture, and nature conservation could provide the BIO-Save educational courses. Higher education students and professionals in the biotechnology industries could upgrade their basic professional and digital skills and qualifications through the provided BIO-Save flexible, distance learning system, offered in the form of learning paths and subject to a competency-based learning approach. Four centres provide VET in the biotechnology field in Slovenia, and one of the ten biggest educational centres is the Biotechnical Educational Centre in Ljubljana. In Bulgaria, the VET centres providing professional education and training in agriculture, information technologies, and healthcare could be involved as providers of the BIO-Save training courses. The Ministry of Labour and Social Policy, as the leading organization in the field of vocational education and training, could support the implementation of the training programme as a provider of data from performed research and analysis regarding the need for training in the BIO-Save project area.

IN-COMPANY TRAINING DEPARTMENTS

Success in the dynamic and inventive field of biotechnology depends on staying one step ahead of the competition. Organizations must make ongoing investments in the training and development of their biotech professionals in order to improve their skills, encourage innovation, and propel scientific breakthroughs as the industry is continually reshaped by advancements. Biotech companies, research institutions or R&D organizations with extensive experience in the application of biotechnology and engaged in life sciences research, develop drugs and products, or provide services could implement the BIO-Save training programme for their staff development. The provision of in-company training will improve the workplace to be more adaptive and flexible and will promote the acquisition of new skills in relation to the needs for innovations for climate change mitigation. The implementation of the BIO-Save training in the biotech departments provides the opportunity for continuous professional development through learning with a focus on digital skills and competencies. The novel biotechnology approaches for climate change mitigation will be promoted and hands-on experience with technology solutions (system biology, omics, biofertilizers etc.) will be proposed. Employees increasingly expect informative and applicable training, which satisfies their needs both as workers and as up-to-date, informed professionals.

Identifying target users

University professors, young researchers, post-doctorate researchers, and experts in new biotechnologies and information technologies could be assigned teaching activities in the different BIO-Save training scenarios.

Professionals in environmental and food technologies, next-generation farmers interested in new technologies, next-generation researchers in plant systems biology and biotechnology, and Bachelor and Master students are the potential target groups that can benefit from the BIO-Save training.

Experts working on the listed below subjects might be potential target groups:

- ✓ Enzymes - production, optimization, characterization, separation-purification, biotransformation, immobilization;
- ✓ Environment - biodegradability, bioremediation, bioaccumulation and biosorption;
- ✓ Agricultural biotechnology - cell, callus, and organ culture, plant biochemistry, plant cell biotechnology, plant metabolomics, micro propagation techniques, crop genetics, abiotic stress;
- ✓ Biomaterials - production, characterization, improvement of functional properties;
- ✓ Food science and technology – fermentation, crop yield, cereal processing, oil refining, dairy and confectionery products processing, foods and microorganisms, nutritive genomics, and development of functional foods;
- ✓ Nanotechnology - nanomaterials, devices for further technological development.

Role of the training providers

Training providers occupy an intermediate position between, on the one hand, the state which funds and regulates their work and, on the other, the learners to whom the providers are expected to be ‘responsive’. The role of Training providers is often unrecognised and under-researched, especially in technical and vocational education and training (TVET) provision. However, they contribute towards global development priorities as set out in the UN Sustainable Development Goals – particularly concerning:

- ✓ Provision of quality education;
- ✓ Elimination of poverty by creating jobs via sustainable economic growth;
- ✓ Revitalising global partnerships for sustainable development.

Moreover, training has become a critical part of any company’s investment strategy if they want to continue growing long-term. Training promotes employee loyalty and retention, improves performance levels, and increases employee independence, among many other benefits. That’s why it is of critical importance the approach used for the proper selection of training providers that will offer the BIO-Save educational content and offers.

Capacity building for training providers

Capacity-building at the institutional, systemic, and individual levels remains central to successfully implementing the BIO-Save training programme. This approach comprises further

training for persons already working as HE professionals and VET providers who lack specific job- or field-related knowledge and skills/qualifications in the BIO-Save project area. They already have national job positions in research centres/institutes, universities, or vocational training centres. Effective capacity-building depends on the cooperation and coordination between these affiliates, providing training in various fields, such as biotechnology and agriculture, that have to offer solutions to problems related to global climate change and the lack of food. Training and human resource development at the level of academic professionals, research scientists, and VET is fundamental to an effective biotech and agricultural research and technology transfer system. Areas that required attention included GHG inventories, reporting, implementation of adaptation measures, development and transfer of technology, education, integrated ICT solutions, training and public awareness, agriculture, wastewater, and renewable energy. Building capacity in teaching and training is a step-by-step approach to fulfilling the need for trained, competent individuals. However, strengthening the relationship between national climate change agencies and other ministries and enhancing coordination among agencies at all levels of government needs more effort.

Training and capacity building with BIO-Save Training programme

The training programme is elaborated in response to the partner countries' needs for education in modern biotechnology approaches for climate change mitigation. To avoid climate-induced hazards, such as droughts, floods, and fires, further measures and new technologies must be used to reach the climate change targets. While various technologies presented may still be at an early stage of development, biotechnologies and modern biotechnologies, in particular, have an enormous potential to play a role in climate change mitigation. This potential may be revealed via a complex approach that reduces the impact of present human activities on the climate and promotes the development of climate-friendly technology. According to the data presented in R1 Skills Gap Demands Biotech Expertise in Climate Change Mitigation, B.Sc. and M.Sc. education programmes in biotechnology are available in the partners' countries' universities, but up-skilling and mobilisation of the human resource in biotechnology and generally in the field of natural sciences need to be strongly encouraged. These data indicate that the available capacity lacks the experts and facilities to meaningfully engage in biotechnology R&D. The data revealed insufficient numbers of trained personnel in modern biotechnology and relevant areas and a lack of better career opportunities, extended networking, healthier work conditions, easy access to high-tech infrastructure, etc. These issues' improvements will further positively affect the biotechnology and environmental protection sectors in the partners' countries. The BIO-Save training programme represents a joint effort to upgrade the HE in biotechnology to enhance biosafety, research, and capacity in students and training providers and to meet the challenges of modern biotechnology for the transition to a green economy and to create new employment opportunities in the biotech sector. Implementing BIO-Save training is expected to impact strongly the HE programmes in the Universities and the biotech sector. The elaborated BIO-Save modular education programme contains web-based learning/ training materials in modern biotechnologies approaches for

climate change mitigation and offers various e-learning opportunities, thus stimulating the development of entrepreneurial, creative, and innovative skills in the target users.

Guidelines for training adaptation

The BIO-Save Consortium elaborated an online user guide entitled b-Learning Guide in Modern Biotechnology for Higher Education Professionals to assist BIO-Save training providers and professionals from the biotech sector in delivering/acquiring the innovative project blended model (Result 4). This digital learning tool highlights the importance of ICT in higher education while sharing the most efficient, contemporary teaching, learning, and assessment practices. The Guide consists of three parts and provides opportunities to improve the teaching methods in Modern biotechnology and reinforce the target groups' ICT and educational skills and competencies for effectively using the BIO-Save innovative b-learning programme. Part 1 presents the new learning and teaching methods in HE programmes, and the main topics under discussion are the learning environment, Education 4.0 aligning teaching and processes with technological advancements: the main trends, Innovative key skill sets, and shifts in learning experiences, new learning delivery methods and assessment approaches. Part II deals with the specificity of the BIO-Save Project learning – the goals and objectives of the learning, the innovative LO-based training platform, and the modern methods applied, such as digital and cloud-based technologies, to support the training process. Part III of the Guide reviews the use of ICT in HE. The Guide presents various ICT media/technologies to develop/enhance professors' and practitioners' awareness and digital skills for technologies-enhanced learning. It outlines the essential digital skills (online, technical (work), and soft for remote teaching) embedded in HE teaching. It also shows the role of ICT in evolving and transforming the HE processes for students and teachers.

Thus, the developed easy-to-read BIO-Save b-Learning Guide promotes transferring knowledge, skills, and organisation of continuing educational offers. It affects in a positive and relevant way the quality of teaching in the Modern Biotechnology sector, helping the effective involvement of BIO-Save project target groups in the innovative b-learning programme.

Marketing and dissemination of BIO-Save Training to Universities and SMEs

Marketing and advertisement of BIO-Save Training

The ultimate dissemination goal for the BIO-Save partnership is to get BIO-Save project results into use by organisations whose job is to deliver effective training programmes – HEIs, in-company training departments, and VET organisations. Bio-Save Consortium designed marketing and distribution systems to meet this need and bring BIO-Save deliverables and training offers from development to use through a system of intermediaries. The selection of an appropriate chain of intermediaries is based on the already identified potential users, possibilities for promotion of delivered project products, and provision of easy access to the

BIO-Save training offered through multiple channels. Thus, the obtained outcomes evaluation will be easy, raising the project impact at national and European levels.

Some of the potential marketing and advertisement strategies and approaches intended to be used for promoting BIO-Save Training in the *next 2-year period* will be:

i. Events participation/organisation

- ✓ Participation in the 2024 UN Climate Change Conference and dissemination of the BIO-Save project opportunities for creating a better future.
- ✓ Organizing a round table with representatives from academic institutions and businesses to promote BIO-Save training offers during World Climate Day (May 2024).
- ✓ Participation in the Kliment's days and presentation of the BIO-Save project – an annual event organised by the Sofia University St. Kliment Ohridski, Faculty of Biology.
- ✓ Taking part in the BIOFEST at the Faculty of Biology, traditionally held annually in May. The event is attended by hundreds of students from first to 12th grade, organised by teachers for those with a profile in Biology, as well as self-organised students and parents. The main goal is to stimulate the young generation interest and raise awareness about the negative impact of climate change on our lives. Possibilities for transforming part of the training materials and making them available for schools also will be foreseen.
- ✓ Meeting teachers from high schools during the July Lecture in Natural Sciences and presenting the BIO-Save training opportunities.
- ✓ Continuing the established collaboration with the annually organised Seminar of Ecology and BIO-Save project.
- ✓ Participation in major industry-specific biotechnology, agriculture, and environmental science conferences to showcase the BIO-Save training success and relevance.
- ✓ Participation in the Researchers Night in Bologna. Citizens and families attend this event. It is an opportunity to talk to the general public. September 2024.
- ✓ Presentation of the BIO-Save project at the Green Week: a yearly event that addresses issues related to the Green Economy. Space can be booked to talk for the BIO-Save results. A peculiar section can be organised for Ph.D. students.
- ✓ Distribution of advertisement materials at the Open DISTAL, held once a year in September-October at the University of Bologna.
- ✓ A training section will be organized each year for the 3rd year students of the Bachelor's degree in Agricultural Technologies at the University of Bologna
- ✓ Participation and presentation of project outcomes at different seminars at Universities in Italy and possibly abroad. A quick but effective will be the addition of a couple of slides regarding the BIO-Save project at the end of each presentation made in any context (conferences, seminars, classes, events at companies).

- ✓ Organization of Seminar for MSc. And Ph. D students in Gazi University, Environmental Sciences Department to inform participants on BIO-Save training opportunities and learning outcomes (2024 Fall Semester).
- ✓ Inclusion in education-related fairs and expos to highlight the BIO-Save programme significance for students, professionals, and institutions.
- ✓ Organizing webinars and workshops post-project expiration to sustain engagement and share success stories from BIO-Save Training.
- ✓ Hosting regional seminars in key locations, focusing on the relevance of the training in specific geographic areas and industries.
- ✓ Online Events: Engaging in virtual events through partnerships with online platforms or organising exclusive events via social media or educational web portals.
- ✓ Collaborative Events: Partnering with educational institutions, industry stakeholders, and professional associations to co-host or participate in events, both locally and internationally

When executing these strategies, timing, location, and thematic alignment of the events will be planned to maximise their exposure and relevance. These activities will aim to sustain the visibility and value of BIO-Save Training beyond the project's expiration, ensuring its continued recognition and utility within the targeted industries and educational sectors.

ii. Advertisement materials issue

- ✓ Printing flyers and booklets to be delivered to target groups (total amount of about 500 for 2024 and 2024).
- ✓ Reproduction and distribution of BIO-Save bags and bookmarks in events and participated organisations (about 30 bags and 200 bookmarks in 2024 and 2025).
- ✓ Distribution of pens and notebooks among representatives of academic institutions and Biotech SMEs during participation/organization of different events (total amount 300 for 2024 and 2025).
- ✓ Announcements of the organised by BIO-Save events on the project website.
- ✓ Publication of BIO-Save project findings in recognised scientific journal of educational research (2024 – 2025).

Crafting additional to already prepared dissemination tools for targeted distribution will be an impactful way to showcase the BIO-Save initiative. These promotional materials will encompass programme details and engagement opportunities in Agricultural Biotechnology, Environmental Biotechnology, Food Biotechnology, and Industrial Biotechnology, dedicated to diverse sectors. Incorporating print and digital formats will provide quick access to online resources, event registrations, and interactive content, fostering broader engagement and interest in the BIO-Save project.

iii. Use of other dissemination channels

- ✓ Publication in the Yearbook of Scientific Research Projects at Sofia University (2024 – 2025) (more than 300 readers in Bulgaria).
- ✓ Publication in the newsletter of the Department of Agricultural and Food Science of the University of Bologna (more than 400 readers in Italy);
- ✓ Regular online publications in social media – FB, TW, LinkedIn, etc. – create social media networks that will connect students, academics, and SME practitioners and enable them to discuss climate issues and initiate climate change actions.
- ✓ Utilizing alternative dissemination channels such as industry-specific forums and relevant online publications or newsletters.
- ✓ Engagement through webinars, workshops, and collaborations with related academic or industry conferences to broaden the reach and impact of the BIO-Save initiative.

Both the short- and long-term marketing plan of the BIO-Save partnership is to implement various training initiatives that leverage the comprehensive resources offered by BIO-Save. These initiatives include short-term workshops, seminars, and specialised training sessions focusing on specific modules or aspects of the programme. For the long term, the intention is to develop in-depth courses or certification programmes that encompass the entirety or substantial portions of the BIO-Save curriculum, delivered to professionals, researchers, and students seeking advanced knowledge in Agricultural Biotechnology, Environmental Biotechnology, Food Biotechnology, and Industrial Biotechnology and their role in reducing climate change' negative impacts.

In *long-term perspectives*, several specific marketing and dissemination activities will be undertaken to mobilise young people and teach society about the pressing climate issues. They will raise the BIO-Save project's impact through a better understanding of the causes and effects of climate change, establishing new ways of limiting its impact and adapting to its inevitable effect. With the high-quality BIO-Save teaching materials, innovative B-learning methods, and a network of relevant stakeholders, the BIO-Save consortium aims to create conditions for more and improved climate change education and to bring about urgent environmental, societal, and economic transformation.

- ✓ Contacting policy-decision makers, bringing new knowledge of biotechnological approaches for climate change mitigation, and making them essential climate change advocates while strengthening climate resilience at the local and regional level.
- ✓ Performance of networking activities with other similar projects and promoting systemic, strategic, consumer behaviour, and lifestyle changes based on the principles of sustainable development.
- ✓ Organising technical meetings with European Universities representatives to discuss possible opportunities for accreditation of the BIO-Save M.Sc. programme.

- ✓ Launching inquiry/project-based and action-oriented learning by creating student clubs and competitions to engage young people in investigations and actions related to local climate impacts.
- ✓ Disseminating knowledge about the climate, climate protection, and mitigation measures and supporting individual and societal climate resilience at different dedicated events.

Tools for documenting good practices

Formative instruction is an essential element that ensures learning success. It involves the continuous gathering and recording of data regarding trainees' performance. BIO-Save training will employ several approaches for gathering and recording data about academic achievement. Direct behavioural observations, assessment rubrics, recording tools, broad curriculum-based outcome measures, goal achievement scaling, and performance graphing can be listed.

BIO-Save project target groups' achievement will be positively impacted by gathering and recording data on their performance. Their proper analysis will improve trainees' performance because it will help teachers/trainers to:

- (a) make decisions about the kinds of skills and content they will teach,
- (b) decide what level to start instruction at, and
- (c) decide how to teach both content and skills.

Furthermore, precise proof of learning enables teachers/trainers to identify whether pupils are on pace to satisfy BIO-Save performance requirements.

During the BIO-Save training, evidence will be gathered and documented recurrently, thus helping teachers/trainers make instructional judgments and adjustments more quickly and meet the requirements of their students. These reliable data on student learning will enable educators to decide whether to offer opportunities for enrichment as well as extensive supplemental training in small groups or one-to-one teaching.

The primary tool for documenting good practices will focus on student performance variables that are practically adjustable and connected to achievement outcomes. Acquisition, productivity, learning rate, maintenance, generalisation, and social behaviours are some of the aspects that affect how well students perform. During the training, the BIO-Save partnership will consider the wide range of variables representing radically different aspects of student learning when deciding what evidence to gather.

Methods for collecting evidence

There are several approaches to gathering data regarding students' performance. During the envisaged BIO-Save training, the following will be employed:

- ✓ **Direct Observation:** gathering information about what is the students' behaviour. It will be done by collecting evidence on students' level of task engagement and observing verbal academic responses. Partial-interval direct behavioural observation techniques and systematic time sampling can be used to track students' involvement in their studies and the quality of students' responses.
- ✓ **Teacher-Made Tests:** Apart from the BIO-Save developed assessment scheme, additional teacher-made tests can also be created that will be applied to demonstrate what has been learned or formatively to direct instruction and give students insightful feedback for the advancement in their learning. Data gathered will be on the final score and students' performance on specific items. This degree of feedback encourages students to reflect on their current learning and helps them identify where they stand.
- ✓ **Rubrics:** demonstrating students' knowledge on defined subject or acquired target skill through writing assignments, projects, and oral presentations. They will be used to guide students during the learning process and to evaluate their final achievements.

Methods of documenting good practices

Instructors must ascertain the student's current level of proficiency in achieving the learning objectives. Examining student performance on all assessments (rubrics, test scores, etc.) to determine whether or not students are meeting learning objectives can be time-consuming and laborious for educators and other stakeholders. As a result, each student's evidence of progress toward mastering learning objectives should be documented in a way that produces a meaningful visual display of data and is easy to analyse and evaluate to inform instructional decisions and stakeholders of performance outcomes. Different records will be used, including graphs, charts, and goal attainment scales.

Defining indicators

Training indicators are ways to measure and confirm the BIO-Save training programme's efficacy quantitatively. They will comprise an array of targeted, occasionally tailored metrics designed to gauge the effectiveness of a student's learning and development endeavours. Combined qualitative and quantitative measurements will assess the BIO-Save training programme efficiency. Thus, the implementing organisations can identify the developed programme's advantages and disadvantages by regularly evaluating its efficacy. The indicators to be applied in the evaluation of BIO-Save training efficiency are listed below:

1. Time to proficiency: Analysing the time to proficiency parameter is a functional approach to determine the effectiveness of the implemented training programme. The learners must be able to pick things up quickly for the BIO-Save training programme to yield the best results in the shortest time. The organisations can accomplish this goal by delivering explicit and attractive instructions. Trainers can set up focus groups and assess learners' performance

to determine the time to proficiency. The twice performance of this process (before and after training) helps find out how long it takes to become proficient at a given level.

2. Retention of Knowledge and Skills: Given the prevalence of information forgetfulness, it is imperative for organizations to devise strategies for ensuring trainees retain their knowledge and skills. Competency retaining can be organised through BIO-Save training that is brief, repetitive, and engaging at regular intervals. Trainers can evaluate learners' retention of knowledge and skills to ascertain the programme's efficacy assessed by comparing the trainee's performance prior to and following training.

3. Training Transfer: BIO-Save training's primary goal is to enable trainees to transform knowledge into skills to improve their final performance. This process will affect the University's overall performance. That is why it's crucial to arrange the M.Sc. programme and PGCs in a way to possess the tools necessary for good advancement (access to a database, hyperlinks to more detailed information, videos, 3D images, etc.). Several metrics, such as performance information, observation, and training follow-up, can be used to assess how well it is transferred.

4. Effect of BIO-Save training on Biotech SME Performance: Biotech SMEs can improve overall performance, service effectiveness, and productivity by offering efficient training through the BIO-Save SICs. They should compare their performance metrics before and after the training to assess the process's effect on performance.

Implementing the BIO-Save training programme

Strategies for implementation – long and short-term training

The implementation plan for BIO-Save includes the utilisation of a variety of learning opportunities - Master of Science (M.Sc.) programmes, Short Intensive Courses for SMEs (SICs), and Postgraduate courses (PGCs). These opportunities will be delivered to individuals at different stages of their academic or professional careers, allowing for diverse access points to the comprehensive knowledge and skill sets offered by BIO-Save in climate change mitigation and adaptation.

The BIO-Save training strategies are selected in accordance with the educational level predefined in R1: 'Skills gap demands biotech expertise in climate change mitigation' study target groups and the resources available in each partner country. The decision about the kind of training programme depends on the appropriateness, feasibility, and relevance criteria for the institution and country region (Table 1).

Table 1. Issues to consider when designing training programmes

<i>Audience</i>	<i>Mode</i>	<i>Length</i>	<i>Location</i>
Academic professionals	Train the trainer	Seminar (1 - 3 days)	Local college or University
In-company training personnel	Train the trainer	Courses (short term – 1 week)	Private organizations
B.Sc. and M.Sc. students	Face-to-face / blended	Long-term courses (six to twenty-four months)	Local college or University
Ph.D. students / Postdoctoral researchers	Courses (short or long term)	Short-term course (two weeks to three months)	Local college or University
Project Manager	Workshops and seminars	Seminar (1 - 3 days)	Government/ Private organizations
Biotech SME Manager	On-site job training	Short-term course (two weeks to three months)	Private organizations
Environmental Health & Safety Professional	Workshops and seminars	Seminar (1 - 3 days)	Government

Long-term training. The institutions of higher education (P1 SU, P5 UTH, P7 UNIBO, and P9 GU) envisage long-term training like the BIO-Save M.Sc. programme. Such training in academic settings is most useful for highly technical areas, such as research and development of new climate change mitigation approaches, benefits of sustainable agricultural practices, implementation of green energy solutions, improved and environmentally friendly manufacturing practices, or advanced crop diversification and innovative plant breeding. The future provision of experience exchange fellowships for students, academics, and other technical professionals, exploiting local and EU grants, could also be foreseen.

However, this approach is limited because implementing the whole curriculum and integrating a new accredited M.Sc. degree programme into the educational curriculum of a university is a sophisticated and time-consuming procedure. That is why each HEI participating in the BIO-Save programme will explore the future local possibilities for the BIO-Save M.Sc. programme "Modern Biotechnology Approaches for Climate Change Mitigation" recognition.

Future negotiations are foreseen to create a joint M.Sc. programme between partner universities with an option to include new HEIs not involved in the project development.

Educational curricula prepared by the BIO-Save project can be used to present information at regional conferences and seminars focused on particular subjects (e.g., the conservation and exchange of plant genetic resources). This approach is also an effective way to promote long-lasting development through project training materials and scenarios, information sharing among professionals in the area, desire for improvement, and general sensitization of policymakers to the importance of climate change mitigation issues.

Business organisations being part of the BIO-Save project consortium with specific expertise in aspects like sustainable agriculture, ISO certification, contemporary educational policies, and innovations will organise on-site training with their staff members and business partners. Such consultancies will focus on a specific activity (for example, implementing ISO standards for climate change mitigation in practice) and are expected to contribute to the sustainable transition to a low-carbon economy and preserved ecosystem services.

Short-term training. BIO-Save foresees Short-term training (SICs and PGCs) conducted for one to three months in an academic or non-academic setting. This approach is appropriate for most training needs in the project subject area, especially for the biotech business sector, as the prerequisites for efficient short-term training are easily achievable.

- ✓ A sufficient supply of people with appropriate background or education.
- ✓ Courses available in the language of the participants.
- ✓ Course design that uses training modules to allow for flexible curricula to meet the needs of target groups.
- ✓ Intensive training for a short time allows one to gain a good mix of information and skills.
- ✓ Adequate follow-up of graduates, including the provision of continuing education programmes, to ensure that they continue to function effectively.

In addition to training the target groups outlined in Table 1, VET courses are suitable for training trainers who will train others in the new knowledge and skills they have learned. Thus, short-term training should include pedagogical and leadership skills and provide institution-building capacities.

Examples of innovative types of training foreseen after the project expiration are:

1. Part of the course “Microbiology Applied on the Environmental Remediation and Bioenergy”, an Agricultural Technology course at the University of Bologna, will use the training material developed within BIO-Save until they can be considered updated.
2. Opening a new course under the M.Sc./Ph.D. programme in the Environmental Sciences Department of Gazi University is the most convenient way to use BIO-Save learning opportunities and transfer them smoothly into practice.
3. Establishing collaborations with the Ministries in Türkiye for SICs organisation.

4. Integrating LO2 “Use of energy efficient farming”, LO7 “Enhancing adaptive capacity of crops”, LO9 “Crop diversification and opportunity for climate resilience”, and LO11 “Conservation and exchange of plant genetic resources” as PGCs in the curricula of the Sofia University, Biological Faculty.
5. Using the course “Addressing climate changes with ISO standards” in the MSc degree programme “Quality and safety of foods” of Sofia University ‘St. Kliment Ohridski’, Biological faculty.
6. Implementing part of the courses LO8 “Agro-ecosystem responses to the combination of elevated CO₂, ozone, salt, and heat changes resulting from global climate change” and LO10 “Using new technologies and practices” into the B.Sc. programme “Agrobiotechnologies” of the Sofia University ‘St. Kliment Ohridski’, Biological faculty.
7. Launching SMEs’ specific courses for farmers on sustainable agricultural practices implementing LO2 “Use of energy efficient farming” and LO4 “Reduced use of synthetic fertilisers”.

Training and presentation tools

A trainer is expected to be knowledgeable, possess excellent communication skills, and be able to communicate at the level and in the language of the trainees. To be effective, the trainer should consider the nature of the target group or audience (who are they?) and their level of knowledge and skill (have participants been trained in the subject or related subjects to be presented?). In this respect, BIO-Save presented various training offers for end-users with different expectations and scientific backgrounds.

The time used to prepare certain BIO-save training activities will depend on the length of the educational event envisaged. For example, a one-week course would require four weeks of preparation. After looking up the information available on the BIO-Save web platform and consulting manuals and other resources (Career guidance documentation, Sustainability guidance studies and reports, and BIO-Save project database) that are relevant to the subjects (identified in the needs assessment), the BIO-Save trainers could choose appropriate learning offers and put together a session plan. They can use all the participants guides (the three parts of R4 “B-Learning Guide in Modern Biotechnology for HE Professionals”), the interactive H5P presentations, and the audiovisual aids integrated into the training materials (hyperlinks, 3D images, and videos). A trainer could also contact both the coordinator and the developers of the BIO-save website to receive technically competent help in the subject area. Also, if possible, the trainer should be well acquainted with all the functionalities available in the BIO-Save training, comprehensively described in the Sustainability guidance/BIO-Save project learning guidelines.

A short H5P file is developed for each LO in the frame of the BIO-Save project as a presentation tool. It allows a brief and interactive overview of the training material, including short videos and quizzes. Furthermore, the knowledge part of the LO is available both for

online learning and downloadable offline as a PDF document. There are also several other functionalities:

- ✓ Multilingual learning – each LO is available in 5 EU languages: EN, BG, GR, IT, and TR.
- ✓ Text-size-adjust property without affecting the appearance of text, figures, and tables.
- ✓ Depending on light conditions and the personal preference of the student/academic professional, training material is available in both day and night mode. Day mode uses a colour scheme that displays dark text on a light background. Night mode uses the opposite mode (a light text on a dark background).
- ✓ Possibility to take notes on the educational content during the learning process.

The project partners' countries will use BIO-Save learning opportunities in various ways:

- ✓ The Sofia University will use the developed BIO-Save PGCs and implement all functionalities in combination with the Career Guidance and Sustainability Guidance resources in the official Postgraduate and Lifelong education of the Biological Faculty of Sofia University,
- ✓ The University of Thessaly's future training activities will be related to implementing in full or partially the MSc programme and PGCs together with the developed BIO-Save Career Guidance resources, using all the functionalities in the BIO-Save cloud-based web platform.
- ✓ The Bologna University teaching activities will be directed mainly at integrating BIO-Save educational curriculum into the regular training practice of the Department of Agricultural Sciences, applying all the functionalities available in the M.Sc. programme.
- ✓ The Gazi University will be focused on the implementation and further improvement of the BIO-Save M.Sc. programme and SICs and apply in its training practice the described new training and digital approaches together with the developed Career profiles, especially in the field of Environmental Engineering and Environmental science and protection.
- ✓ The NGOs involved in BIO-Save project development (Biognosis and Intellect Foundation) will offer “observation tips” training, presenting to interested policy-decision makers and SME representatives, practical examples for already implemented climate change sustainable approaches in different bio-manufacturing companies.
- ✓ The training activities of the SMEs participating in the BIO-Save consortium (Bulgap Ltd., Eko-Znanie GT Ltd, and Planart Ltd.) will be mainly focused on promoting the Short intensive programme for SMEs establishing common criteria and qualification standards in the Biotech business sector complying with the developed BIO-Save career profiles and Education 4.0 thus promoting new educational standards and digitalization in contemporary VET.

Monitoring and evaluation tools

A strategic feedback mechanism will be integrated to ensure continuous improvement and effectiveness of the BIO-Save training initiatives. It will involve various approaches, including post-training surveys and assessments for participants to express their experiences, suggestions, and areas for enhancement. Additionally, structured feedback sessions with trainers and coordinators and periodic reviews involving stakeholders and industry experts will be conducted to gather diverse perspectives and insights. The aim is to create a feedback loop that facilitates ongoing refinement and adaptation of the BIO-Save training to meet the participants evolving needs and industry standards. All BIO-Save project partners will participate in the implementation of the relevant procedures of monitoring. The organisation in charge of training should ensure consistency and coverage.

The most essential monitoring activities are:

- ✓ Routine monitoring within the implementing organisation. BIO-Save educational programme implementation has to be monitored through structured meetings of teaching staff involved in the training process. Similar monitoring procedures need to be implemented at the levels of management.
- ✓ Periodic reviews by the preliminary assigned monitoring team or monitoring unit. Short, standardised performance reports will be produced and submitted to the BIO-Save PMB and PSC.
- ✓ Reporting on annual plans and budgets. This activity checks that the implementation is aligned to the preliminary assumptions (including effective resource allocation, absorption capacity, effectiveness, and efficiency).
- ✓ Annual reviews with stakeholders.

BIO-Save PMB should prepare a consolidated annual performance report. It will serve as the base document for the joint sector review, which should assess achievements and shortcomings and agree on improvements in the BIO-Save training programme. The same indicators should be measured consistently from one annual review, to the next.

Several approaches will assure to get feedback and perform evaluations in the future BIO-Save training:

- ✓ Brief interviews and brief questionnaires of evaluation after the events
- ✓ From the students taking the course opened in line with BIO Save training materials
- ✓ From the participants to SICs organised in collaboration with related SMEs and public research centres (especially with the Ministries of Agriculture, Ministries of Education, and Ministries of Environment) (if possible).

Final remarks

There are numerous concerns about the current state of climate change education. The quality of information about pressing climate issues is called into doubt by the 70% of young people surveyed who claim they cannot explain climate change but its general concepts or know nothing about it. The BIO-Save initiative can aid in better understanding climate change and taking appropriate action, thereby recognizing the role of humans in the self-contained environment and ecosystem sustainability. In order to address the complexity and interconnections of this significant topic, the BIO-Save training curriculum presents many elements of biotechnological approaches utilized for climate change mitigation and adaptation in an interdisciplinary manner. Learner-cantered approaches that are interactive and reflective are used to make climate change education more engaging, problem-solving, and action-oriented. The main goal of BIO-Save teaching about climate change is to provide students, academic professionals, and Biotech SME employees with the tools they need to take action and improve society, thereby enabling them to confront the climatic crisis. This action-oriented approach enables BIO-Save target groups to use what they have learned, interact with their local communities, and get them a voice in decision-making processes.

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