PLANET

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PLANET – PLan for Agriculture reNewable Energy Training

D1.3 - Guidelines on pedagogical methodology	
Document description:	The document will present the pedagogical methodology guidelines to be followed by the consortium when developing the learning materials.
Partner responsible:	AERES
Due date:	Saturday, 30 June, 2018
Work package title:	Needs identification and training design
Task title:	Task 1.3: Definition of the pedagogical methodology for trainees (learning objectives, online based, in-class activities and field training periods) and trainers
Status (F: final; D: draft; RD: revised draft):	F

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1 Task description

This task consists in defining the pedagogic approach that will be used to develop the training programme. The methodology will be designed so as to tackle in the most appropriate manner the skills gap observed and analysed during the task 1.1, and with regards to the existing good practices and training materials identified during the task 1.2. The methodology will be described in dedicated guidelines.

In this task, we will apply the reverse design: we will start with learning objectives, what the learner should be able to perform in order to be able to demonstrate his knowledge, the conditions in which he will be able to carry out the action, that will be verified through an assessment, and finally the training material developed in function of learning objectives and assessment of the knowledge.

Also, the scheduling of the classes will be defined in these tasks, as well as the visits and the work-based period activities. AERES that has a lot of experience in practical teaching will follow this task. In this task, the criteria to select trainers and trainees will be decided by the partners.

2 Didactical approach of courses

2.1 Target groups

The modules for renewable energy will be used in different settings and for different target groups. The target groups we have identified are:

- Students
    - Students at Higher vocational education institutes
- Farmers

2.2 What is didactical possible for different target groups

Students:

Students are used to learn. They will be able to learn in theory as well as in Practice. Not in every EU country students are used to practical education.

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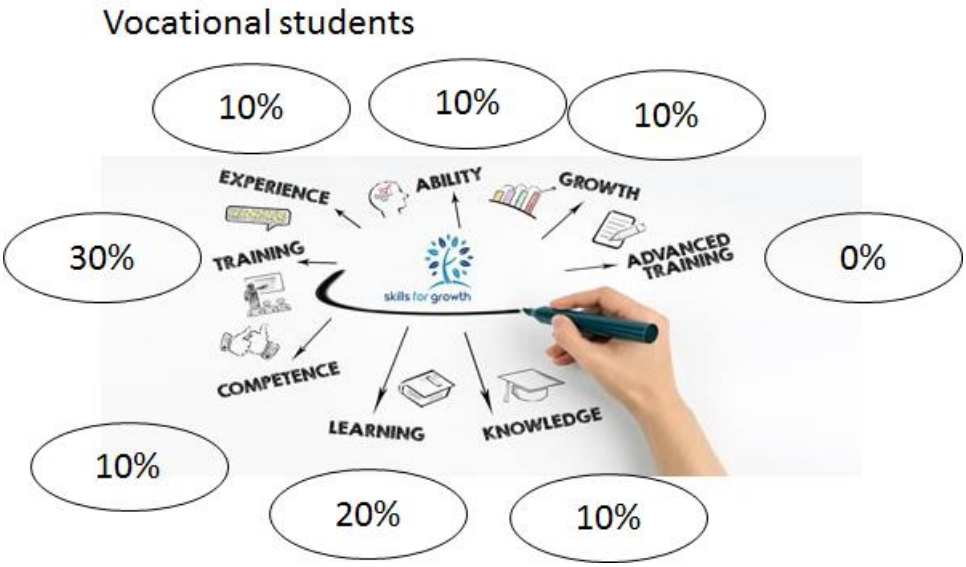
There is also a big difference in the didactical approach is we look at the education level. Students on vocational level need to learn more in practice, that theory consumption is limited. In opposite of that university students are used to learn from books, they are not used to learn in practice.

This picture gives insight in learning possibilities for the target groups students and farmers.

If we apply this circle of learning for our target groups than we can see what is needed to make a nice balanced approach.

First group, the students:



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In this picture we see that students have a lack in experience. The students have better abilities to learn, because they are still active in education. Important for this target groups is that we need to add enough "training time".

Second group, the farmers:

Farmers are very practical oriented. Of course we are talking about the mainstream of farmers. You will find farmers with good learning abilities. Because we have to focus on the mainstream to set up our didactical approach we decided to develop our approach related to the above picture.

2.2.1 Suggestions for Didactical approach:

In the previous overview you can see that each target group needs more or less a slightly different approach for learning. Both Vocational students and farmers like to learn when they are in practice, so called learning by doing,

With our courses we create a model where we mix the learning styles and adapt the necessary online learning with practical courses.

Basically we can summarize:

- that Farmers and Vocational students can't make long sessions in Online learning.

- Farmers are not interested in all agricultural renewable energy systems, they want to be trained in one of the systems/modules developed in this PLANET project.
- -Vocational students and students from higher level (Higher education and university) can study all 3 systems (next to ICT)
- ICT skills are important for farmers, Students in all levels are ICT skilled and only need education in ICT management of the different systems.

Here an example of course organisation focused on target groups:

Farmers:

Important remarks:

- Make online time as limited as possible
- Make a good balance in self-study and study on the job, study days
- Test and evaluate in time (in Theory and Practice) that motivates.
- Provide daily modules, so the farmer can follow each module separately.

Vocational students:

Important remarks:

- Online time must be monitored.
- Make clear instructions for Practical learning in farm.
- Make tasks to do while looking at the online material.
- Make the testing in real life

3 Pedagogical approach

Online learning has been broadly recognized as strategically important to address global needs of education. As early as 1998 UNESCO articulated a vision and framework for priority action for change and development in higher education (UNESCO, 1998). As information technology (IT) made access to information ubiquitous, its importance to support and enable strategic actions at national levels became evident. The US National Technology Plan (US Department of Education, 2010) presented a model for learning powered by technology based on the premise that advances in learning sciences and understanding how people learn coupled with rapidly evolving developments in technology create new challenges and opportunities for higher education. The European Commission (2010) articulated the importance of innovation and modernization as fundamental to transform Europe into a competitive and inclusive economy. In a similar manner, EU countries and China (World Bank, 2007) have incorporated IT into their education strategy as well as programs enabled by IT to improve outcomes of research and education institutions.

It is thus necessary that investments in IT in education not only improve learning outcomes, but also reduce the cost of instruction. Past experience demonstrated that this is achievable given the right investments and adoption of IT in education. A review of 156 redesigned courses involving 195 institutions and ~250,000 students showed that in 72% of the courses learning outcomes were improved, while in 28% there were no improvements. In addition, the cost of instruction was reduced on average by 34% instruction (NCAT, 2014). Online delivery is now commonplace in strategic plans related to teaching and learning in higher education for top-ranked universities. This is often associated with improving learning outcomes, reducing the cost of instruction and innovation in teaching/learning (Williams et al., 2012).

It is clear that online teaching/learning works. Online teaching/learning is generally accepted as a direction for higher education institutions as an opportunity to modernize their work and create new channels that improve creative, entrepreneurial and critical thinking skills of students. The issues that remain are related to finding the most effective and efficient ways to deliver this form of instruction (Bateman & Davies, 2014). In PLANET the focus is mainly on Higher Vocational students and farmers. Both target groups are served by partly online learning and efficient skill training.

3.1 Passive and Active Learning

Passive learning occurs when students are engaged solely in taking in information. Examples of this include: Reading materials, listening to a lecture, watching a video, and looking at the photos, diagrams or

PowerPoints. Passive learning is primarily an individual activity in which students learn by assimilating the information presented.

Active learning occurs when students are focused on doing, with the course content and activities designed to increase and enhance their understanding of a topic. Some examples of activities that encourage active learning are Online discussions/debates, group projects, concept mapping, role-playing, content related games, and problem-solving. Active learning includes activities that encourage the application, deeper understanding, and discovery of new knowledge. In engineering, for example, this may take the form of providing a solution to an engineering problem or designing a system.

Social activities are particularly suited for active learning. Where students critique, collaborate and generate a deep understanding of the knowledge acquired. In this context, the role of the instructor is one of directing and supporting.

3.2 The Flipped Classroom

Advances in technology and learning theory and practice have created new directions and opportunities for pedagogy in engineering education. A pedagogy currently receiving much attention is the flipped classroom. The flipped classroom is unique in its combination of active, problem-based learning constructive ideas and direct instruction methods based on behaviourist principles (Bishop & Verleger, 2013). This pedagogical approach is enabled by technological advances that permit the transmission and duplication of information at very low cost and various means, and the trend in education to make learning student-centred.

Consensus on a flipped classroom definition is lacking (Chen et al., 2014). A simple definition of the inverted classroom is given by Lage (2000). By this definition, activities that traditionally take place in the classroom, take place outside the classroom in a flipped classroom, and vice versa. Thus, a flipped classroom is one in which learning activities not requiring human interaction take place outside the classroom (enabled by technology) and learning activities requiring human interaction take place in the classroom (virtual or physical). Figure 4 illustrates this definition of the flipped classroom. Note that by this definition of a flipped classroom activities requiring human interaction may occur face-to-face or virtually and in synchronous and asynchronous manners.

In this work, the focus of activities not requiring human interaction is for the student to understand and apply basic concepts related to the subject matter of the course in preparation for activities requiring human interaction that focus on higher levels of learning in Bloom's taxonomy (Krathwohl, 2002).

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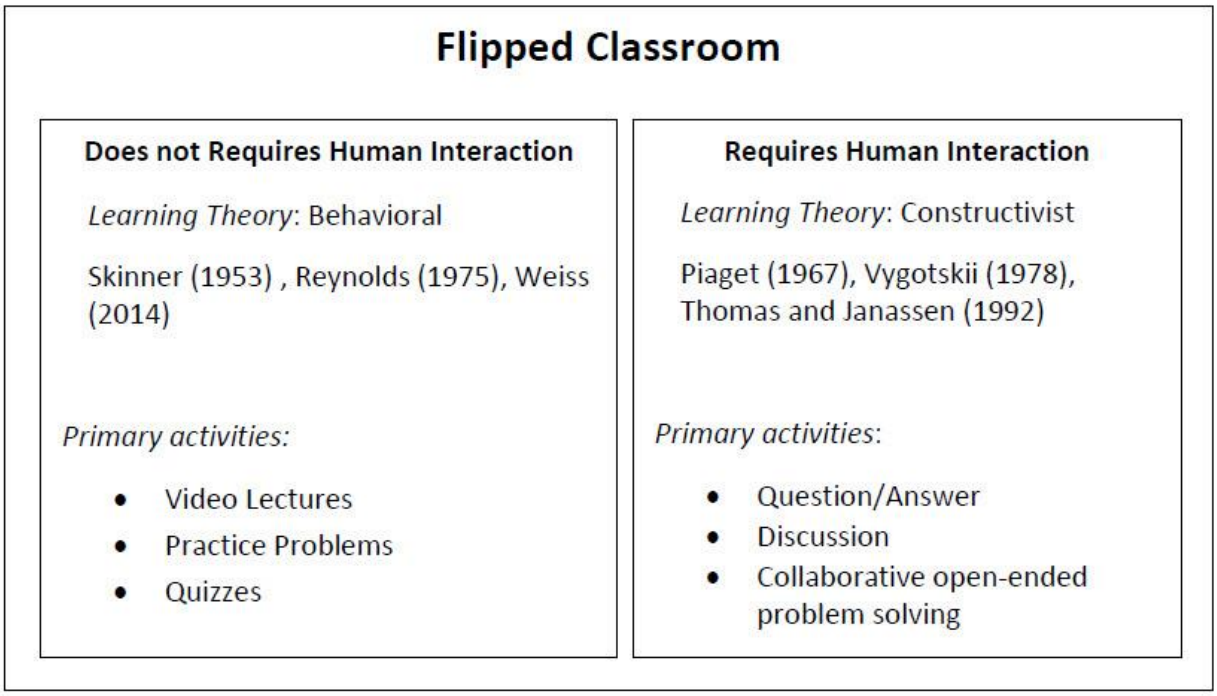

Figure 1 - Definition and theoretical framework of a flipped classroom

Some tools that do not require human interaction are video, closed-problem solving and quizzes. Early studies show that quality video lectures outperform traditional lectures (Cohen et al., 1981). Also, online homework is equally effective as paper and pencil (Bonham et al., 2003; Fynewever, 2008). These, coupled with quizzes for self-evaluation (Stallings & Tascoine, 1996) provide a solid basis for the student to engage in activities requiring human interaction focused on higher level skills such as communicating effectively; identify, formulate and solve engineering problems; and work in teams.

Specific activities requiring human interaction include the use of face-to-face and online discussion boards used to post and answer questions (students and faculty alike) and carefully crafted open-ended problems. This approach provides an opportunity to develop activities for active learning (Michael, 2006), cooperative learning (Foot & Howe, 1998), peer-assisted- learning (Topping & Ehly, 1998), and problem-based learning (Barrows, 1996).

It is important to note that activities are not limited to those shown in Fig. 4. The number and type of activities can be diversely provided they focus on efficiently achieving a learning outcome and the learning style of the students (Zimmerman et al., 2006).

3.2.1 Best Practices

- Create quality pre-recorded lectures that relay the course content effectively (substantial pre-planning and prep work required before pilot semester).
- Reduce lectures to manageable segments (about 15 minutes)
- Develop classroom activities that promote Active Learning. Students should be applying the knowledge gained from lectures and readings. (i.e., case studies, debates, discussions, group projects, problem-solving, presentations, individual assignments, educational games)
- Avoid “busy work” to simply fill the time.
- Be available during class time to assist and facilitate. Circulate, be prepared to guide and encourage active learning in a student-centred environment. Interact with the class.

3.3 Learning objectives classification - bloom's taxonomy

Bloom’s Taxonomy

To promote higher forms of thinking in education a taxonomy was created (Bloom, et al., 1956) in three domains of educational activity. Over time, Bloom’s cognitive taxonomy was revised into its current form (Anderson et. Al, 2001):

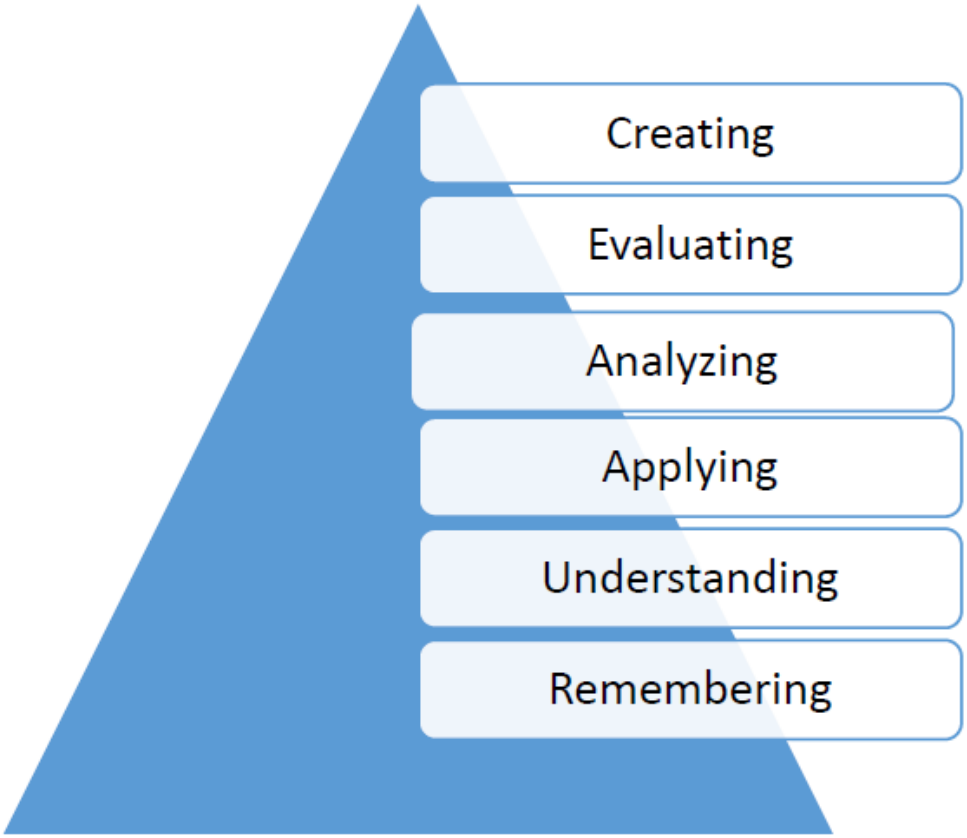

Figure 2: Revised Bloom's Taxonomy in the Cognitive domain

A description of each level of the taxonomy and examples of related behaviour follows below.

Remembering: Recall or retrieve previous learned information. (The student defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states).

Understanding: Comprehending the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words. (The student comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives an example, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates).

Applying: Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the workplace. (The student applies, changes, computes, constructs,

demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses).

Analysing: Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences. (The student analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates).

Evaluating: Make judgments about the value of ideas or materials. (The student appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports).

Creating: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure. (The student categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes).

Bloom's revised Taxonomy also added the concept of a knowledge matrix to add a cognitive dimension (Table 1):

Table 1 Cognitive Processes and Knowledge Level Matrix (examples)

	Levels of Knowledge					
Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Facts	*List*					
Concepts		*Explain*				
Processes			*Solve*			
Procedures						*Develop*
Principles				*Rank*	*Justify*	
Metacognitive			*Use*			*Create*

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Action Words for Bloom's Taxonomy					
Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
define	explain	solve	analyze	reframe	design
identify	describe	apply	compare	criticize	compose
describe	interpret	illustrate	classify	evaluate	create
label	paraphrase	modify	contrast	order	plan
list	summarize	use	distinguish	appraise	combine
name	classify	calculate	infer	judge	formulate
state	compare	change	separate	support	invent
match	differentiate	choose	explain	compare	hypothesize
recognize	discuss	demonstrate	select	decide	substitute
select	distinguish	discover	categorize	discriminate	write
examine	extend	experiment	connect	recommend	compile
locate	predict	relate	differentiate	summarize	construct
memorize	associate	show	discriminate	assess	develop
quote	contrast	sketch	divide	choose	generalize
recall	convert	complete	order	convince	integrate
reproduce	demonstrate	construct	point out	defend	modify
tabulate	estimate	dramatize	prioritize	estimate	organize
tell	express	interpret	subdivide	find errors	prepare
copy	identify	manipulate	survey	grade	produce
discover	indicate	paint	advertise	measure	rearrange
duplicate	infer	prepare	appraise	predict	rewrite
enumerate	relate	produce	break down	rank	role-play
listen	restate	report	calculate	score	adapt
observe	select	teach	conclude	select	anticipate
omit	translate	act	correlate	test	arrange
read	ask	administer	criticize	argue	assemble
recite	cite	articulate	deduce	conclude	choose
record	discover	chart	devise	consider	collaborate
repeat	generalize	collect	diagram	critique	collect
retell	give examples	compute	dissect	debate	devise
visualize	group	determine	estimate	distinguish	express
	illustrate	develop	evaluate	editorialize	facilitate
	judge	employ	experiment	justify	imagine
	observe	establish	focus	persuade	infer
	order	examine	illustrate	rate	intervene
	report	explain	organize	weigh	justify
	represent	interview	outline		make
	research	judge	plan		manage
	review	list	question		negotiate
	rewrite	operate	test		originate
	show	practice			propose
	trace	predict			reorganize
	transform	record			report
		schedule			revise
		simulate			schematize
		transfer			simulate
		write			solve
					speculate
					structure
					support
					test
					validate

Figure 3 - Bloom's Taxonomy verbs

3.4 How to write a Learning Objective:

A learning objective is a clear statement describing what a student is expected to learn from a lesson. It provides details of what the student will do after completing the instruction process. A learning objective is composed of the following:

1) An action verb that identifies the behavior of the student.

2) A description of the condition under which the behavior is to be performed

3) A criteria or standard defining acceptable performance by the student.

The importance of learning objectives goes well beyond indicating to the learners what they will know and be able to do at the successful completion of some learning activity, well-crafted learning objectives guide the rest of the course development process. Course materials, assignments or activities, and assessments should all be selected to reflect the learning objectives.

A question to consider when building a course from learning objectives is: How any element of the course (video, discussion, project, etc.) relates back to one or more of the learning objectives? Learners should not be asked to read or review material that is not relevant to one of the objectives. Nor should they be assessed on skills or knowledge which is not in one or more of the objectives.

When writing a learning objective it is important for the course designer to have a clear understanding of what level of performance is required from the student in the cognitive and knowledge domains. Figure 3 provides useful examples.

4 Methodology

4.1 Blended Learning

The Pedagogical methodology that is designed is covered under the name Blended Learning. Because Blended Learning makes time and place independent learning possible, this form of knowledge transfer can be attractive for a broad target group. In any way for the target groups that we have identified for this project. However, the introduction of online and blended learning is much more than the (partial) digitization of knowledge offering. Successful implementation of Blended Learning for the development of both target groups therefore requires a well-considered system and a methodology of knowledge sharing.

Blended Learning is a mix of online learning with face to face instruction learning. By using online interactive study materials in a training, the learners can grow independently. During the Face to Face instruction classes, all knowledge can be shared and most important, the instruction time is much shorter (like mentioned before).

An overview of the courses with the number of days for each module, divided between in-class, on-line and in-field is presented here below:

Module	In class	On line	In field	Total
Module Zero - Gender issues, safety	3			3
ICT - information and communication technology	7	3		10
Biomass	5	2	1	8
Biogas	5,5	2,5	2	10
Solar	8	2	2	12
Final Test	2			2
Internship			30	30
Total	**30,5**	**9,5**	**35**	**75**

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Important details to be remember:

1. Course duration is different also related to the complexity of each individual RES system
2. Because of the practical oriented target groups we focus on a maximum “online time” of 12-15% of the total study time. The way the content is build will allow to change this percentage according to user needs.
3. There is mandatory internship/stage with a duration of 30 days. This part is essential since we talk about complex systems both from a technical point of view as for integrating the systems in daily management and data management. These are complex issues, for that sufficient time in practice is needed.
4. For Assessment/ examination we calculate 2 days. The assessment is partly theory and practical competence based testing.

5 Learning objectives

5.1 Module 0

According to the development of a training course recognized at European level, the course structure has been revised to add a list of topics necessary to achieve the Certification by its competent authority (Regione Piemonte).

The request of the course certification according to VET protocols required the adaptation of topics unforeseen in the original proposal. In particular, the following topics have been added to fulfil requirements necessary for the application eligibility:

- Job Guidance: Skills assessment and coaching
- Sustainable development: Anthropic impact, Global warming, Oil reserve and natural resources, EU Energy Market; Specific issues: Benefits and impacts of energy production from renewable resources: Biomass, Biogas, Solar.
- Equal opportunities: Discrimination, Interculturalism, Gender, Empowerment, Harassment
- Occupational Safety and Health: General Education (EU Framework, General principles, National Legislation, Risk Assessment, Prevention and Protection, Safety Organization, Signs) Specific Education.

Job Guidance

The Job Guidance session aims to help trainees to develop skills related to understanding personal abilities and individual aspirations, choosing professional goals, developing a specific job search project.

Trainers will work to build a first balance of professional and training experiences, in order to:

- make explicit the technical-specifics, operational and transversal skills acquired;
- develop a moment of reflection on individual motivation;
- promote an exchange with the class group for shared planning.

This will be done by exploring issues such as: intellectual curiosity, the spirit of research, knowledge of one's own interests and attitudes.

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Sustainable development

Sustainable development is the key to enable the economy to grow. The environment shall be perceived not as a constraint, but as an opportunity with respect to which to rethink policies, production and consumption systems. Education and training play a fundamental role in the process of transition to sustainability. In particular, the training system is recognized as one of the most important subjects able to contribute to social efforts to achieve sustainability. This goal will be achieved through the skills and knowledge that the students will learn and will be able to put into practice, through the exchange of knowledge with professionals and researchers, as well as through the implementation of their own strategies and operational activities. For this reason, education for sustainable development is a central theme in the proposed training course. Indeed, any profession, even if not directly aimed at protecting the environment, uses natural resources and services, directly influencing their quality, availability and integrity in the ecosystem.

Equal opportunities

Mainstreaming, empowerment, positive actions are fundamental elements for a better society where anyone can deal with an equal level of opportunities. Gender and intercultural differences are not the main distinctive variables involved in orientation processes, but they ares the basis of many other differences. The gender approach applied to orientation, training and work emphasizes the desire to put the person with his/her specific characteristics at the center of the process. Attention to gender differences can help to consolidate values in a new way, without denying or renouncing equality, but reinterpreting the strength of differences by pointing out the benefits of interculturalism context. Attention to interculturalism takes on considerable importance in interventions aimed at people in training, as an aid in overcoming stereotyped path choices and supporting a project, which helps discriminated people to give themselves diversified personal and professional goals, but never penalizing them.

Occupational Safety and Health

Training is a very effective tool for creating the necessary awareness of the importance of the issue of safety at work. It allows to increase knowledge and skills of company organizational systems and improve the management of processes in order to safeguard the well-being of workers in the workplace.

- Occupational safety and health is a discipline with a broad scope involving three major fields:
- Occupational safety deals with understanding the causes of accidents at work and ways to prevent unsafe acts and unsafe conditions in any workplace. Safety at work discusses concepts on good

housekeeping, proper materials handling and storage, machine safety, electrical safety, fire prevention and control, safety inspections, and accident investigations.

- Occupational health is a broad concept which explains how the different hazards and risks at work may cause an illness and emphasizes that health programs are essential in controlling work-related and/or occupational diseases.
- Industrial hygiene discusses the identification, evaluation, and control of physical, chemical, biological and ergonomic hazards.

The training on Occupational Safety and Health will be issued in two stages:

The first stage will address general issues regarding the European Framework and National Legislation. It will last 4 hours. Learners will be aware about procedures and persons involved in risk management.

The second stage will consider specific training on specific hazards and risks an operator can encounter in renewable energy plant production. This part will be delivered within technical modules (Biomass, Biogas, Solar). It will last 12 hours (4 hours per module).

Module 0	**PLANET Introduction, Gender equality and safety training course**	**Bloom Taxonomy level**	**Test type**
Day1	**Introduction to the Planet Course**		
LO1	Know the educational tools, the training rooms, and the trainers.	remembering	Multiple questions
LO2	Understand the structure of the course.	understanding	Interview
LO3	Be aware of personal competence (Core, technical and soft skills).	understanding	Multiple questions
Day2	**Renewable energy: Environmental sustainability and market potential**		
LO1	Be aware of the general issue on environmental sustainability	Remembering	Multiple questions
LO2	Know the impact of the RES on environmental protection	remembering	interview
Day 3	**Horizontal principles and occupational safety and health**		

Module 0	PLANET Introduction, Gender equality and safety training course	Bloom Taxonomy level	Test type
LO1	Understand the concept of equal opportunities and gender equality and how to create a positive work environment.	understanding	Interview
LO2	Understand the general education on occupational safety and health.	understanding	Multiple questions

5.2 ICT Module

Topics covered within the ICT module will allow the learner to proficiently use computers and digital devices, internet networks, the main application programs and IT communication tools. The main aim is to respond to the changing conditions of the technological and IT reality and the way in which we interact with it. The extraordinary diffusion of mobile devices, the possibility of using remote applications and even storing their data on the network, the "social" use of technologies have changed the connotations of the main market players and their way of competing.

Examples will be focused on calculation related to RES production and use.

Module 1	PLANET ICT training course	Bloom Taxonomy level	Test type
Day1	**Basics on ICT**		
LO1	Use the physical parts or components of information technology equipment such as monitor, mouse, keyboard, storage devices, printers or scanners.	understand	Multiple question
LO2	Use computer equipment or digital devices to facilitate quality control, data management, and communication. Follow instructions given by a computer programme, create computer files or documents.	understand	Multiple question
LO3	Use the functions and tools provided by the operating system to access resources and run applications.	apply	Multiple question

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Module 1	PLANET ICT training course	Bloom Taxonomy level	Test type
Day2	**Safety Surfing and Communication**		
LO1	Execute efficient search on the internet in order to gather relevant information and share it with others.	understand	Multiple question
LO2	Use digital tools which enable various forms of communication over the Internet, such as email, instant messaging, Voice over Internet Protocol, social networks, while following netiquette rules and protecting one's reputation and digital identity.	apply	Multiple question
LO3	Know The general principles, categories, requirements, limitations, and vulnerabilities of smart connected devices, most of them with intended internet connectivity.	remembering	Multiple question
LO4	Know Personal protection, antivirus, data protection, digital identity protection, security measures, safe and sustainable use.	remembering	Interview +
LO5	Use software tools to archive data by copying and backing them up, in order to ensure their integrity and to prevent data loss.	applying	Test case
Day 3	**MS Office applications**		
LO1	Use computer software applications for composition, editing, formatting, and printing of any sort of written material.	applying	
LO2	Use software tools to create digital presentations which combine various elements, such as graphs, images, text and other multimedia.	applying	
LO3	Use software tools to create and edit tabular data to carry out mathematical calculations, organize data and information, create diagrams based on data and to retrieve them.	applying	Report

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Module 1	PLANET ICT training course	Bloom Taxonomy level	Test type
Day 4	**General in-class activity**		
LO1	Understand and apply the most efficient strategy to manage documents and data	understanding	Multiple question
LO2	Be able to share and synchronize directories to prevent data loss	applying	Multiple question
Day 5	**Word practice and tasks**		
LO1	Create a technical report using Microsoft Word	applying	Report
Day 6	**Excel practice and tasks**		
LO1	Creation of an operational, economic and financial planning Template for RES production Plant with Microsoft Excel	applying	Report including excel file
Day 7	**Excel practice and tasks**		
LO1	Monitoring and Controlling RES Plant Efficiency with Microsoft Excel	applying	Test case
Day 8	**Creating reports for investors and stakeholders**		
LO1	Create data outputs with Power point	applying	
LO2	Be able to prepare a report on RES production	applying	Report including PowerPoint file
Day 9	**Informatic RES plant management tools**		
LO1	Know specific software for RES plant management	remembering	Multiple question
LO2	Understand the implications of Internet of Things on RES production	applying	Multiple question

5.3 SOLAR photovoltaic Module

The Solar Photovoltaic training course consists of 6 days of training, both in-class, online and on-field (with a site visit of a operating power plant). The module starts with an introductory chapter which should allow the students to understand the applications of solar energy as well as the roles of all actors involved in a solar plant project. The module continues with a presentation of technical equipment of a power plant and the influence of the local law and regulation on the applications. The students will then learn the basic rules of design of a power plant. Day 4 consists of a site visit where students will discover an operating plant and how the information learned in the previous days are applied on-field. They will also apprehend safety and health regulation as well as the steps of Operations and Maintenance. Day 5 presents the method for evaluation of the economical benefits of a power plant and, finally, Day 6 is a presentation of how to run a power plant through troubleshooting, maintenance and recycling phases. With the knowledge of the course, the student get the ability to review the design of a solar power plant according the present framework to allow a sustainable economical operation of the plant.

Module 2	**PLANET Solar photovoltaic training course**	**Bloom Taxonomy level**	**Test type**
Day1	**Entrance Test & Introduction**		
LO1	Know the best solar applications for farmers and the influence of the regulation	remembering	
LO2	Know the necessary health, safety, hygiene, and environmental standards and legislation rules in the solar PV sector.	remembering	
LO3	Understand the steps of design of a solar power plant: from the feasibility study to the project supervision.	understanding	Multiple questions
Day2	**Renewable energy: Environmental sustainability and market potential**		
LO1	Know the Equipment and Implementation of a Solar photovoltaic plant	remembering	
LO2	Know the Law & Regulation behind of a Solar photovoltaic plant	remembering	Multiple questions

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Module 2	PLANET Solar photovoltaic training course	Bloom Taxonomy level	Test type
Day 3	**Equipment, Law & Regulation and Design**		
LO1	Check with Day 2 "Equipment" is understood	remembering	
LO2	Check with Day 2 "Law & Regulation" is understood	remembering	
LO3	Be able to pre-sizing a solar PV plant and choosing the optimal valorization scheme	applying	Practical test
Day 4	**General and Specific education on Safety and Health**		
LO1	Understand how to run a solar photovoltaic power plant	understanding	Practical test with interview
Day 5	**Design & Economy**		
LO1	Evaluate the opportunity and the economy of a solar photovoltaic plant	evaluating	Report
LO2	Design a solar PV plant as a group assignment	applying	group assignment
Day 6	**Run of a power plant**		
LO1	Identify, troubleshoot and report equipment damage and malfunctions; know the major failures of the system and how to react and understand the Compliance with Environmental Legislation	applying	Practical competence test

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5.4 SOLAR thermal Module

The Solar Thermal training course consists of 6 days of training, both in-class, online and on-field (with a site visit of a operating power plant). The module starts with an introductory chapter which should allow the students to understand the applications of solar energy as well as the roles of all actors involved in a solar plant project. The module continues with a presentation of technical equipment of a power plant and the influence of the local law and regulation on the applications. The students will then learn the basic rules of design of a power plant. Day 4 consists of a site visit where students will discover an operating plant and how the information learned in the previous days are applied on-field. They will also apprehend safety and health regulation as well as the steps of Operations and Maintenance. Day 5 presents the method for evaluation of the economical benefits of a power plant and, finally, Day 6 is a presentation of how to run a power plant through troubleshooting, maintenance and recycling phases. With the knowledge of the course, the student get the ability to review the design of a solar power plant according the present framework to allow a sustainable economical operation of the plant.

Module 3	**PLANET Solar Thermal training course**	**Bloom Taxonomy level**	**Test type**
Day1	**Entrance Test & Introduction**		
LO1	Know the best solar applications for farmers and the influence of the regulation	remembering	
LO2	Know the necessary health, safety, hygiene, and environmental standards and legislation rules in the solar thermal sector.	remembering	
LO3	Understand the steps of design of a solar power plant: from the feasibility study to the project supervision.	understanding	Multiple questions
Day2	**Renewable energy: Environmental sustainability and market potential**		
LO1	Know the Equipment and Implementation of a thermal photovoltaic plant	remembering	
LO2	Know the Law & Regulation behind of a thermal photovoltaic plant	remembering	Mulitple questions

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Module 3	PLANET Solar Thermal training course	Bloom Taxonomy level	Test type
Day 3	**Equipment, Law & Regulation and Design**		
LO1	Check with Day 2 "Equipment" is understood	remembering	
LO2	Check with Day 2 "Law & Regulation" is understood	remembering	
LO3	Be able to pre-sizing a solar TH plant and choosing the optimal valorisation scheme	applying	Interview and Practical test
Day 4	**General and Specific education on Safety and Health**		
LO1	Understand how to run a solar thermal power plant	understanding	Proof in practice
Day 5	**Design & Economy**		
LO1	Evaluate the opportunity and the economy of a solar thermal plant	evaluating	
LO2	Design a solar TH plant as a group assignment	applying	Group assignment
Day 6	**Run of a power plant**		
LO1	Identify, troubleshoot and report equipment damage and malfunctions; know the major failures of the system and how to react and understand the Compliance with Environmental Legislation	applying	Practical competence test

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5.5 BIOMASS Module

The Biomass training course consists of a technical part, operational management, raw material, design and economy, law, legal and safety issues and a site visit. The training content provides the student with a comprehensive, practice-oriented knowledge of the construction and operation of biomass local heating plants, starting with the basics of biomass heating plants, suitable ranges of raw materials and their extraction, the technical structure and their function, the operational management, the required contracts, safety and hazard information and compliance with the legal regulations. With the knowledge of the course the student get the ability to influence the design of a new biomass heating plant according the present framework to allow a sustainable economical operation of the plant.

Module 4	**PLANET Biomass training course**	**Bloom Taxonomy level**	**Test type**
Day1	**Technic part 1**		
LO1	Understand the set of biomass installations that are necessary and typical for biomass heating systems	understanding	
LO2	Understand the conversion process whereby biological material becomes heat through combustion or biofuel through chemical, thermal, and biochemical methods. - The power transmission systems that use the force of flowing liquids to transmit power.	understanding	
LO3	Understand the set of technologies that make a process, system, or apparatus operate automatically through the use of control systems.	understanding	Multiple questions
Day2	**Technic part 2**		
LO1	Operate sealed vessels which contain fluids which are heated or vaporized, not always up to boiling, for heating or power generation, such as in utilities. Ensure safe procedures by monitoring the blower auxiliary equipment closely during operations, and identifying faults and risks.	applying	
LO2	Monitor the flow of the workpieces on the conveyor belt as	applying	Practical test

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Module 4	PLANET Biomass training course	Bloom Taxonomy level	Test type
	they are processed by the machine to ensure optimal productivity.		
Day 3	**Operation management**		
LO1	Understand the preservation and restoration of products and systems and the methods and logistics of these practices.	understanding	
LO2	Understand the procedures to inspect a product or system to ensure that it is according to specifications and requirements.	understanding	
LO6	Use software tools to archive data by copying and backing them up, in order to ensure their integrity and to prevent data loss.	applying	
LO7	Selection of software that aids in estimating, managing and scheduling industrial processes such as design, workflow, and production improvement	applying	Practical operational test + multiple questions
Day 4	**Raw material**		
LO1	Understand the origins of wooden biomass products for energetic use.	understanding	
LO2	Understand the process used for reducing wood into wood chips.	understanding	
LO3	Understand logistic systems used to manage the reception and the transportation of the raw material.	understanding	
LO4	Understand the quality and quantity measurement systems.	understanding	
LO5	Understand the different possibilities in the residue management field.	understanding	Multiple questions

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Module 4	PLANET Biomass training course	Bloom Taxonomy level	Test type
Day 5	**Design & Economy**		
LO1	Know the practical process analysis and tools for designating financial resources of a biomass plant	remembering	
	Be able to analyse different kinds of information with regards to the management of a biomass plant business	analysing	
LO2	Understand how to synchronise the efforts, plans, strategies, and actions carried out in the biomass plant: the marketing and customer acquisition aspects	applying	Practical case
Day 6	**Law**		
LO1	Know the basic contract law, such as financing, lease, easement, raw material supply, community, heat supply contracts, etc.	remembering	Multiple Questions
Day 7	**Legal and safety issues**		
LO1	be able to interpret legal documents related to the Legal entity and liability issues	understand	
LO2	be able to issue construction and plant permission	applying	
LO3	To maintain liaison and exchange of information with regional or local authorities	applying	
LO4	Understand necessary health, safety, hygiene, and environmental standards and legislation rules in the sector of a particular activity.	understand	Multiple Questions
LO5	Understand the regulations concerning fire and explosion prevention, and the equipment, systems, and methods used in it.	understand	
LO6	Identify operating problems, decide what to do about it and report accordingly	evaluating	

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Module 4	PLANET Biomass training course	Bloom Taxonomy level	Test type
Day 8	**Site Visit**		
LO1	Understand the production process and how to assess product quality in a biomass plant	evaluating	report

5.6 BIOGAS Module

The biogas training course consists of the microbiology of digestion, technical plant lay-out, (operational) management of the biogas plant, business models, safety, environment and logistics. Site visits are combined with (group) assignments to apply the learned skills and knowledge. The training content provides the student with hands-on knowledge of the basic plant design, the operational management, safety and hazard information and compliance with the legal regulations.

This module focuses on small scale digesters, which you typically find among the agricultural premises around Europe. Small-scale digestion has many advantages. Basically it produces bio-energy out of manure and feed leftovers. The revenues of this give the farmers more income.

Besides to this manure digestion also reduces the emission of methane and nitrogen from the manure pits. Because the harmfulness of methane as a greenhouse gas this is a very huge, but still not valued, side-effect.

With the knowledge of the course the student get the ability to influence the design of a new biogas plant and is able to ensure technical, biological, sustainable and economical operation of the plant.

Module 5	PLANET Biogas training course	Bloom Taxonomy level	Test type
Day1	**Introduction of biogas**		
LO1	Understand the purpose of the module	understanding	
LO2	Understand the basic biology of the anaerobic digestion process	understanding	

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Module 5	PLANET Biogas training course	Bloom Taxonomy level	Test type
LO3	Understand the basic characteristics of biogas	understanding	
LO4	Understand what the possibilities and advantages of biogas are	understanding	
LO5	Understand what digestate is and what the value of digestate is compared to undigested manure.	understanding	
LO6	Know milestones in the history of biogas and the current situation of biogas in your country	remembering	Multiple questions
Day2	**Layout of a biogas plant**		
LO1	Understand the different types of digesters on farm-scale and the construction of a CSTR digester	understanding	
LO2	Understand the different components of a biogas installation	understanding	
LO3	Understand the various gas treatments and monitoring of the gas composition	understanding	
LO4	Understand basic logistics of a biogas plant	understanding	
LO5	Understand the characteristics of the different biogas utilization techniques	understanding	Multiple questions
Day 3	**Process**		
LO1	Understand the basics of the biology of biogas generation	understanding	
LO2	Understand the influence of process parameters on the process	understanding	
LO3	Understand the influence of substrates on biogas formation	understanding	
LO4	Understand the laws of conservation of energy	understanding	Multiple questions

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Module 5	PLANET Biogas training course	Bloom Taxonomy level	Test type
Day 4	**Site visit**		
LO1	Be able to recognize the type of digester and components, the type of substrate feeding the digester, and calculate the biogas yield and process conditions of the visited biogas plant, according to theoretical values	applying	Report
Day 5	**Business models for biogas plants**		
LO1	Know how to sizing the components of a biogas plant	remembering	
LO2	Understand the Operational costs of a biogas plant	understanding	
LO3	Understand the Income & Subsidies of a biogas plant	understanding	
LO4	Be able to compile a business model of a biogas plant	applying	Exercise + open end question
Day 6	**Safety and Environment**		
LO1	Be able to recognize the hazards in a biogas plant	applying	
LO2	Be able to ensure compliance with environmental legislation	applying	
LO3	Be able to assess what to do in a dangerous situation	analysing	Multiple questions
Day 7	**Logistics and Management**		
LO1	To manage plants for the utilisation and storage of digestate	applying	
LO2	Know the requirements and rules that must be compliant for a permits and licences	remembering	
LO3	Be able to maintain professional records in a biogas plant	applying	open end question

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Module 5	PLANET Biogas training course	Bloom Taxonomy level	Test type
Day 8	**Operation of biogas plant**		
LO1	Know how to operate a biogas plant	understanding	
LO2	Understand hot to collect and preserve samples for analysis	understanding	
LO3	be able to resolve equipment malfunctions	applying	Practical assessment
Day 9	**Maintenance**		
LO1	Know how to maintain biogas plant	understanding	
LO2	Ensure rotation equipment maintenance	applying	
LO3	Monitor heaters and CHPs	applying	
LO4	Ensure static equipment maintenance	applying	
LO5	Maintain records of maintenance interventions	applying	multiple questions + Practical assessment
Day 10	**Site visit**		
LO1	be able to apply all the learning objects in the field	evaluating	Practical assessment

6 Knowledge assessment

The assessment of learners' involvement will be carried out through the analysis of Participation, Completion and Placement rates directly gauged by the training centres during in class activity. Rates for the on-line classes will be assessed by the reporting system of the Planet learning platform.

The effectiveness of the learning program will be assessed at the end of the course, by the learners' filling of the course program satisfaction survey and by the evaluation of the learning material provided. Ongoing, to allow the smoothness of the learning process, each lesson foresees a self-assessment assignment to verify the progress of skills acquirement.

The regularly evaluation of outcomes and processes, supported by measurements, will eventually allow the review of the Planet learning program to adequately fulfil evolving requirements coming from the labor market in renewable energy production.

7 Final remarks

The Planet project, through the development of a training course on renewable energy production, aims to implement a multiple-faceted approach to raise empowerment and social inclusion of disadvantaged people such as unemployed people or farmers, raising green actions towards environmental sustainability and the preservation of natural resources. Farmers attending the training program will have the opportunity to integrate their income through the realization of renewable energy plant, while unemployed vocational learners will have the opportunity to raise their employability in a fast-growing economic sector.

The planning and development of the Planet Training program has been implemented through a bottom-up approach focusing the attention to learners needs. The outline defined by partner experts has considered all demands and remarks coming from stakeholders and external evaluators during face-to-face meetings, workshops and online questionnaires. The needs analysis has highlighted the future learners view on skills necessary to operate in renewable energy production plant accordingly. This approach has been the basis for a pedagogical methodology learner centred. In the design of the learning program, project experts have given great consideration on learners' remarks. Moreover, since the objective to develop a training course recognized at European level, the outline design of the learning program has been affected by the competent VET certification body in Italy (Regione Piemonte). Indeed, the social inclusion process in the lifelong learning process requires the opportune implementation of Job Guidance, Environmental sustainability, Equal

opportunities and Occupational Safety and Health classes to allow learners empowerment in an evolving system, creating the conditions for a successful settlement in the labour market.

The resulting outline has been globally assessed by independent auditors, to underline eventual shortcomings or overlapping. The task has allowed the implementation of an early warning system to control the risk of course inconsistency. Indeed, at national level, partners have organized specific workshops to aware attendees about the program content. Stakeholders and future learners have had the opportunity to evaluate the program outline, by reinforcing the need for a comprehensive range of cognitive and practical skills to be considered in the Planet program. Workshops have risen the necessity to develop competences able to identify solutions and abstract problems in the running of renewable energy production plant. Overall, the quality insurance has ensured the fulfilment of program content with learners needs by the matching to the most up to date educational material.