RURAL BIOENERGY

Training Plan on Bioenergy for the agri-food sector

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METHODOLOGICAL GUIDE

of professional qualification

"WORKER SPECIALIZED IN RURAL BIOENERGY"

CURRICULUM & METHODOLOGY

INTELLECTUAL OUTPUT 1 (IO1)
2017-2019

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

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PRESENTATION OF METHODOLOGICAL GUIDE

RURAL BIOENERGY

PRESENTATION OF METHODOLOGICAL GUIDE

RURAL BIOENERGY project pursues the development of a Training Plan and the professional competences of "Bioenergy Specialist" for the agri-food sector, which contributes to the professionalization in bioenergy in rural areas, through the elaboration of a methodological guide and other tools for training that contribute to the professional development of trainers, teachers and tutors while promoting lifelong learning and enhancing access to training and qualification for all, offering new training opportunities for rural communities that enable development of the rural economy.

RURAL BIOENERGY also intends to encourage the development of the use of bioenergy in the rural environment and contribute to the diversification of the rural economy by creating new employment niches, thus helping to:

- Increase the competitiveness of the agricultural sector through the training of rural population in order to allow the expansion of rural economic activities through the efficient use of natural and local resources.
- Promote quality youth work and professionalization in rural areas (where more than 60% of workers do not have qualifications and qualified professionals are required to implement bioenergy projects).
- Diversify the distribution of the population within the EU.

The project also seeks to promote innovative pedagogical methodologies for a successful transition to the labour market.

Therefore, the methodological guide is one of the main intellectual products of the project, being conceived as a manual for the professional qualification of a worker specialized in Bioenergy in the agri-food sector, which includes two parts:

1. The complete CURRICULUM of professional qualification, establishing the basic CONTENTS of the new training, which could be recognized in the future.
2. The METHODOLOGY based on innovative learning methods and principles that will contribute to the acquisition of basic skills and those necessary for the management, production and use of bioenergy.

In conclusion, the methodological guide will be an instrument to systematize in a conceptual, theoretical and practical way, on the one hand the professional competences of the new qualification of worker specialized in Bioenergy and, on the other, the use of the methodology proposed in the professional training; fundamentally the method called "Project-based learning" and "Work-based learning", with concrete examples of its application for this qualification but with general guidelines for its possible use in any other specialty of Vocational Training, allowing continuity of the project after completion.

RURAL BIOENERGY

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METHODOLOGICAL GUIDE

PART 1. CURRICULUM

"WORKER SPECIALIZED IN RURAL BIOENERGY"

INTELLECTUAL OUTPUT 1 (IO1)

1. CURRICULUM
"WORKER SPECIALIZED IN RURAL BIOENERGY"

1.1.- DESCRIPTION OF THE PROFESSIONAL QUALIFICATION

INTRODUCTION

There is a training gap in this field and in the following years training will be demanded when the development of rural bioenergy will step up. Currently, some professional qualifications cover certain needs regarding energy and the agri-food sectors.

We propose the professional qualification of a worker specialized in rural Bioenergy in the agri-food sector, developing basic professional skills and competencies for the management, use and exploitation of bioenergy in rural areas.

We propose the Curriculum of a professional qualification of level 1 (of activities and basic operations in Bioenergy in the rural environment) structured in four competence units, given that it is necessary to develop professional qualifications that integrate different aspects, since we are faced with a confluence of different sectors and areas of knowledge.

This structuring is also easily convertible into a single transversal competence that can complement different existing qualifications in several professional families, given that an analysis of the qualifications resolves that there are missing competences in Bioenergy in the qualifications of the professional families of Agriculture, Food Industries, Energy and water (renewable energy).

This level of qualification has been assessed as the most appropriate to support the use of such a broad spectrum of sources and types of bioenergy, from activities so diverse and applied to so many different sectors and uses, that it can be executed by workers of rural areas.

Therefore we propose several units of professional competence that do not currently exist, framed within the European strategies on agricultural policy, renewable energy, bioeconomy, circular economy, strategic framework for climate and energy for the period 2030, etc.

PROFESSIONAL PROFILE

Next, we describe the professional profile, that is, the different jobs that can be filled with professional training, for whose identification the occupational analysis or inventory of the set of tasks that make up the occupation has been used. The identification of the final competences is based on the results and objectives of the professional profile, and ultimately, on the tasks, knowledge, skills and abilities necessary for its development.

GENERAL COMPETENCE

Carry out activities and auxiliary operations necessary for agroforestry bioenergy production (agricultural crops) and the reuse of waste and by-products from the agri-food sector (agricultural, livestock, forestry and food industries) for the purpose of energy production; as well as performing basic operations in the operation and maintenance of bioenergy facilities, mainly biomass and biogas, of small-medium power in rural areas; all this following the established procedures and instructions of a technician of superior level, applying criteria of efficiency and respecting the applicable regulation: prevention of labour risks and security for the people as for the environment.

COMPETENCE UNITS

1. Carry out activities for the management and reuse of waste from the agri-food and forestry sectors for energy purposes.
2. Perform basic operations in the working and maintenance of biomass facilities, both of industrial production of biomass fuels (chips, pellets, briquettes, etc.) as well as facilities for the use of biomass.
3. Perform basic operations in the working and maintenance of biogas systems.
4. Carry out activities for the agricultural production of energy crops (land preparation, sowing, care, irrigation, fertilization and harvesting) mainly for biomass production or biofuels.

PROFESSIONAL FIELD

Professional surroundings

Develop professional activities in agricultural, livestock and/or forestry farms as well as in small agri-food industries or in production or maintenance departments of companies, public and private, related to the operation and maintenance of bioenergy facilities, mainly biomass and biogas, depending functionally and hierarchically on a senior manager.

Productive Sectors

- *Agrarian and forestry sector* in the following productive activities:
  - Agricultural and livestock farms.
  - Forestry companies.
  - Companies that make use of energy crops, agricultural and livestock waste, wood and firewood fundamentally.
- *Food sector:*
  - Food production companies that make use of waste and food by-products.
- *Energy sector,* in economic activities:
  - Solid biofuel manufacturing companies (chips, pellets, etc.).
  - Production and use of biomass and biogas (mainly for the production of hot water, heating systems or production of electricity).

RELEVANT JOBS

The most relevant occupations and jobs are the following:

- Worker in agricultural, livestock or agrifood activities specialized in bioenergy use of sub-products and waste of these activities.
- Auxiliary worker in forestry work and use of firewood and by-products for energy purposes.
- Agricultural worker in energy crops.
- Worker of companies manufacturing solid biofuels (chips, pellets, briquettes, etc.).
- Assistant of operation and maintenance for biomass facilities.
- Assistant of operation and maintenance for biogas systems.

ASSOCIATED TRAINING

480 hours

Training Modules

MODULE I.- Activities for the use of agricultural, livestock, forestry and from agrifood industries waste and by-products for their use as sources of bioenergy. (120 hours)

MODULE II.- Basic operations of operation and maintenance of biomass systems. (120 hours)

MODULE III.- Basic operations of operation and maintenance of biogas systems. (120 hours)

MODULE IV.- Auxiliary activities for the use of energy crops and the production of biofuels. (120 hours)

TRAINING PLAN

It is necessary to develop basic professional skills and competencies for the management of bioenergy in rural areas, so that, in addition to the curriculum, a basic training plan with didactic and methodological orientations is included in the development of the competencies of specialists in bioenergy, which will be further developed in a second part of the methodological guide (as educational instruments for trainers, teachers and tutors).

RURAL BIOENERGY proposes an innovative methodology that will also contribute to the promotion of skills considered by the EU as a key to lifelong learning, with special attention to skills for active citizenship and employment (mainly: teamwork, entrepreneurship and innovation, as more determining competences of the employability of VET students, according to the opinion of educational centres, companies and organizations that work with young people and the unemployed).

1.2.- GENERAL DEVELOPMENT OF THE CURRICULUM

MODULE I.- ACTIVITIES FOR THE USE OF WASTE AND BYPRODUCTS OF AGRICULTURE, LIVESTOCK, FORESTRY ACTIVITIES AND AGRIFOOD INDUSTRY AS SOURCES OF BIOENERGY IN RURAL AREAS. (120 h)

M.I.1.- Introduction to Bioenergy and its economic and environmental implications in rural areas

M.I.1.- A. GENERAL OBJETIVES

- Understand the importance of using Bioenergy as a new opportunity for sustainable economic development in rural areas and a source of renewable energy that respects the environment more than conventional sources.
- Know the different raw materials or sources of biomass of forestry, agricultural, livestock and industrial origin and the technologies for their transformation into bioenergy.
- Know the new energy uses in the agricultural, forestry and food industry sectors and its future projection in the context of European Union policies.

M.I.1.- B. CURRICULUM ELEMENTS

Final Abilities	Evaluation criteria
Understand the concepts of bioeconomy and circular economy and value the new uses of natural resources and energy sources that this makes possible.	• Explain the concept of circular economy and be able to give examples. • List new uses that appear in rural areas in relation to bioenergy. • Describe some of the main uses of bioenergy.
Understand the concept of biomass or bioenergy and the main processes and technologies of existing biomass transformation.	• Describe the main uses of biomass and the technologies associated with bioenergy.
Know the general environmental implications of the circular economy and the use of bioenergy.	• Describe some of the main environmental benefits of the bioenergy. • List the main environmental impacts derived from the production and use of bioenergy.
Analyse the types of bioenergy sources and understand why they are renewable.	• Understand the difference between renewable and no renewable energy sources. • Describe the main types of bioenergy sources that exist around agriculture, livestock, forestry and agrifood industry. • Describe the advantages and disadvantages of energy sources based on bioenergy versus conventional ones.
Know the main policies and strategies about Bioenergy of the European Union about energy, climatic change, agriculture, livestock, rural development and the relationship with the impulse of Bioenergy in Europe.	• List the main European policies and strategies in relation to agriculture, energy, climate change and rural development. • Describe the main strategies of the European Union about bioenergy.
Understand the relation between bioenergy and rural development and value the opportunities that its use offers in rural environment.	• List some opportunities that the use of bioenergy open in rural areas.

M.I.1.- C. CONTENT PROGRAMME

introduction to bioenergy in the rural environment

- Bioeconomy and circular economy.
  - Concepts and examples.
  - Environmental implications.
- Bioenergy as a source of renewable energy.
  - Concept of renewable energy.
  - Renewable and non-renewable energy sources.
- Introduction to Bioenergy.
  - Classification of Bioenergy sources.
  - Types of biofuels: solid, liquid and gaseous.
  - Processes of transformation of biomass into heat and/or electrical energy.
  - Advantages and disadvantages compared to conventional energy sources.

political and strategic context of bioenergy in Europe

- Europe 2020 strategy. Common Agricultural Policy. Directives for renewable energy.
- Strategic framework on climate and energy for the 2030 period.
- Reindustrialization of EU 2030: of a rural economy and a circular economy based on rural areas.
- Energy route map for 2050.

bioenergy as a new opportunity for rural development

- Main uses in the agri-food and forestry sectors.

M.I.2.- Tasks for the use and management of animal and vegetable waste in the agri-food sector as sources of energy in rural areas

M.I.2.- A. GENERAL OBJETIVES

- Know the classification of waste of plant and animal origin with bioenergy potential of the agri-food sector.
- Understand the basic management measures necessary for the different types of waste and by-products from agricultural, livestock, forestry and agro-food activities.
- Develop tasks for the specific management of each type of waste in agricultural and forestry operations as well as in agro-food factories.

M.I.2.- B. CURRICULUM ELEMENTS	
Final Abilities	**Evaluation criteria**
Understand the potential for energy use of the different organic waste in the agri-food sectors.	• Describe the types of bio-energetic use of solid and liquid waste from agricultural, forestry and agri-food industries.
Know the different types of waste of biological origin from agricultural, forestry and food activities as well as their associated energy uses.	• Know the classification of agrifood wastes and by-products (vegetable and animal). • Describe the main peculiarities of each type of waste or by-product with energy possibilities. • Associate the different waste with its uses as bioenergy.
Understand the importance of proper management of waste derived from each of the activities in rural areas for its use as bioenergy.	• Explain and give examples of the economic potential of the bioenergy residues for the rural areas. • Describe in a general way the management of the vegetable waste and by-products derived from agricultural activities and forestry activities. • Describe the management and management of the waste of different types of livestock.
Ability to perform the necessary management tasks for the reuse of agricultural waste as energy sources complying with the regulations for the prevention of occupational risks and the environmental laws.	• List and describe the basic principles and the agricultural tasks necessary for proper management of forest residues and by-products. • Carry out wood and firewood use to facilitate and expedite the disembarkation. • Be able to perform auxiliary tasks of collection, storage and conservation of the remains of different agricultural crops.
Ability to perform management tasks for energy use of these forest remains, complying with the regulations for the prevention of occupational risks and environmental laws.	• List and describe the basic forestry activities and tasks necessary for an adequate management of the waste and byproducts of wood activities, forest maintenance and forest bioenergy production. • Be able to perform the auxiliary tasks of collection, storage and management of the remains of forestry treatments and products and forest bioenergy by-products.
Ability to perform management tasks for the energy use of livestock waste complying with the regulations on prevention of occupational risks and environmental.	• List and describe the necessary activities and tasks to a proper management of the different types of excrements and other livestock waste. • Be able to carry out the main auxiliary works of gathering, storage and management of livestock waste.
Know the management of residues from small agri-food factories for its energy use complying with the environmental regulations and laws on prevention of occupational risks.	• Describe on a general way the management and use of the organic residues coming from the food industry. • List, describe and be able to do the activities and tasks for a proper management of the different types of food waste.

M.I.2.-C. CONTENT PROGRAMME

introduction

- What are waste and by-products?.
- Classification of agro-food waste:
  - Types of waste from farms, farms, food industries and forestry.
  - Classification of waste according to its properties.
- Main energy uses of each type of waste.

management and management of animal and vegetable residues as sources of energy in the agricultural and agri-food sectors

- Plant waste management of:
  - Agriculture (tree pruning waste products, young cleaning sprouts, agricultural waste products...).
  - Forestry activities (stumps, waste, small dry branches...).
- Management of livestock and poultry waste.
- Waste management of small agro-food factories.

auxiliair work to management and reuse of waste in rural areas

- Basic tasks of collection, storage and management of waste and by-products of each type of activity for its proper energy use.
- Cleaning and conservation measures of facilities, machinery and tools used.
- Compliance with regulations on the prevention of occupational and environmental risks.

MODULE II.- BASIC OPERATIONS OF WORKING AND MAINTENANCE OF BIOMASS PLANTS. (120 h)

M.II.- A. GENERAL OBJETIVES

- Know the characterization of the biomass and its energy properties according to the different activities of origin.
- Master the strategies of the biomass energy cycle in order to be able to perform auxiliary tasks of organization and maintenance of production.
- Know the industrial facilities for the production of biomass fuels and be able to develop the necessary tasks for their operation and maintenance and develop the operations for the production of chips, pellets, briquettes, etc.
- Know the different types of facilities for the use of biomass energy and its operation to perform basic works of operation and maintenance in them.

M.II.- B. CURRICULUM ELEMENTS

Final Abilities	Evaluation criteria
Know the basic characterization of the biomass coming from different activities: its properties, its uses and the strategies for its better use and its lower environmental impacts.	• Describe the biomass as a natural resource and its characteristics according to the different origins. • Describe the properties of the wood fuels linking each type to the more appropriate use. • Describe the most relevant environmental impacts associated to the production of energy from de biomass in the rural areas. • Analyse the cycle of production of energy from the Wood in order to improve its efficiency.
Carry out auxiliary tasks of operation of industrial plants for production of biomass fuels (chips, pellets, briquettes, etc.) and be able to perform the basic maintenance of them.	• List the different types of industrial fuels manufactured from wood. • Know the structure and operation of industrial plants for the production of biomass fuels. • Describe the different treatments and production processes of industrial biomass (chips, crushing, shavings, pellets, briquettes, etc.). • Describe the operation of industrial plants for the production of different biomass fuels. • Understand the measures of maintaining the order and cleanliness of the facilities according to the established work procedures. • Describe and master the basic maintenance operations of industrial biomass production plants (collecting and preparing the materials, tools and other technical resources required for every action taken according to the instructions received and established work procedures).

M.II.- B. CURRICULUM ELEMENTS (continuation)	
Final Abilities	**Evaluation criteria**
Be able to carry out the auxiliary tasks of operating as well as the basic operations of maintenance of biomass boilers and of heating and hot water installations from biomass.	• Enumerate the types of facilities for calorific use and electrical use of biomass. • Know the basic structure and operation of the heat production facilities as well as their subsequent use (heating and hot water) of biomass fuels. • Describe the basic operation of boilers and circuits for production and distribution of heat for heating and hot water uses from biomass. • Understand the importance of proper operation for maximum energy efficiency of the facilities, in accordance with the regulations of energy efficiency. • Perform auxiliary maintenance operations of the biomass heating installations following the instructions and established procedures: - The work area, materials, tools and other technical resources necessary in the maintenance process are selected, assembled and prepared properly. - The cleaning and disinfection operations of the facilities are carried out according to the procedures and instructions. - The installation is inspected detecting possible anomalies or malfunctions that are reported to the higher manager. - The repair of leaks and breakdowns and other basic corrective maintenance operations are carried out following established instructions and procedures.
Use and maintain correctly the equipment, materials and machinery suitable for the different operations, in accordance with the instructions and established procedures and complying with the applicable regulations regarding the prevention of occupational risks and environmental protection.	• Define the main measures to prevent occupational and environmental risks, related to the operations described previously. • Describe the tasks of cleaning and basic maintenance of the facilities, equipment and tools used. • Use and maintenance operations are carried out in accordance with the plan for the prevention of occupational risks and environmental protection. • Generated waste is collected and classified according to the established waste management plan.

M.II.- C. CONTENT PROGRAMME

introduction to biomass

- Biomass as a natural resource: characterization and uses.
- Properties of wood fuels.
- Biomass from forests and agriculture, from human activities (wood for recycling) and from industrial activities for the production of biomass fuels.
- Development prospects and strategies for the wood energy production cycle:
  - Strategies for the production of wood heat.
  - Wood energy production cycle and rural development. Environmental impacts.
  - Characteristics and productivity.
  - Organization of production.

plants of industrial production of biomass fuels

- Industrial production of biomass: chips, crushing, shavings, pellets, briquettes, etc.
- Prevention and correction of environmental impacts.
- Prevention of occupational risks.

facilities for the energy use of biomass

- Types of facilities for the use of biomass:
  - Thermal: boilers for heating and hot wáter.
  - Electric production.
- Basic operation, working and maintenance in thermal heating and/or hot water installations.
- Energy Efficiency of installations.
- Prevention and treatment of environmental impacts.
- Prevention of occupational hazards.

MODULE III.- BASIC OPERATIONS OF WORKING AND MAINTENANCE OF BIOGAS FACILITIES. (120 h)

M.III.- A. GENERAL OBJETIVES

- Understand the origin and formation of biogas from different organic waste from various activities in the agri-food sector.
- Understand in a basic way the biological processes that take place for the production of biogas.
- Know the different types of production facilities and energy use of small and medium-scale biogas systems interesting in rural farms of the agri-food sector.
- Know the auxiliary tasks of operation and maintenance of the biogas facilities.

M.III.- B. CURRICULUM ELEMENTS

Final Abilities	Evaluation criteria
Understand and know the basic characterization of biogas and its properties coming from different rural activities.	• Describe the biogas concept and its composition. • Enumerate the different types of organic waste from agriculture, livestock, forestry, food industry, etc. from which biogas can be obtained in rural areas. • Describe in a basic way the biological and biochemical processes of biogas production. • List and describe in a general way the environmental impacts associated with the production of biogas in rural areas.
Ability to carry out the tasks of auxiliary tasks of operating as well as the basic maintenance operations of small and medium scale biogas production systems, interesting in rural farms.	• Describe the basic cycle of biogas production. • Detail the types of facilities of biogas production (biogas digester), its structure and basic functioning. • Describe the auxiliary operations of working and maintenance of biogas digesters. • Understand the importance of a proper design and functioning for the highest energy efficiency of the systems. • Perform auxiliary maintenance operations of biogas facilities following the instructions and established procedures. • Basic inspection of the installation to detect possible anomalies or malfunctions that will be reported to the superior manager. • The repair of basic maintenance faults are carried out following established instructions and procedures.
Use and maintain correctly the equipment, materials and machinery suitable for the different operations, in accordance with the instructions and established procedures and complying with the applicable regulations regarding the prevention of occupational risks and environmental protection.	• Define the main measures to prevent occupational and environmental risks, related to the operations described previously. • Describe the tasks of cleaning and basic maintenance of the facilities, equipment and tools used. • Use and maintenance operations are carried out in accordance with the plan for the prevention of occupational risks and environmental protection. • Generated waste is collected and classified according to the established waste management plan.

M.III.- C.	CONTENT PROGRAMME

introduction to biogas

- What is biogas?.
- Vegetable residues after agricultural activities, primary treatment and environmental maintenance.
- Livestock manure.
- Organic food waste and industrial production.
- Forest residues.
- Biological treatments of organic waste (anaerobic digestion). Biochemical and microbial processes for the production of biogas.

systems of production of biogas

- Anaerobic digesters. Types of production facilities and energy use of interesting small and medium-scale biogas in rural farms in the agri-food sector.
- Basic tasks of operation, working and maintenance.
- Energy efficiency of the facilities.
- Prevention and treatment of environmental impacts.
- Prevention of occupational hazards.

MODULE IV.-	OPERATIONS FOR THE EXPLOITATION OF ENERGY CROPS (PLANTING-SOWING, CARE AND HARVESTING) FOR BIOMASS AND BIOFUELS PRODUCTION. (120 h)
M.IV.- A.	GENERAL OBJETIVES

- Know the main types of energy crops and their uses.
- Understand the difference between lignocellulosic cultures, destined for herbaceous biomass, and those destined for the manufacture of liquid biofuels.
- Understand the advantages and risks of energy crops.
- Know and master the tasks of land preparation, sowing, care and harvesting of biomass crops and crops for production of biofuels.
- Know the types of biofuels and their uses and understand in a basic way the processes and reactions that take place for the production of biofuels from agricultural energy crops and/or certain agri-food waste.

M.IV.- B. CURRICULUM ELEMENTS	
Final Abilities	**Evaluation criteria**
Know the main types of energy crops and their uses.	• Enumerate and know the types of energy crops for biomass. • List and know the types of crops for biofuel production. • Describe in a general way the environmental impacts caused by energy crops.
Perform land preparation operations and apply necessary fertilizers for energy crops.	• Distinguish soil types and fertilizers and amendments and their method of application. • Describe and perform the tasks of land preparation, cleaning tasks and basic maintenance of equipment, tools, facilities and machinery used.
Apply the operations for sowing or planting crops.	• Describe the work, the different forms and methods of sowing and planting. • Identify the techniques of preparation, conditioning and conservation of plant material. • Describe the measures of cleaning and conservation of facilities, equipment, machinery and tools.
Use the different elements of the irrigation system and their operating conditions.	• Describe the optimal use of manual irrigation elements and the correct handling of the elements that are part of simple mechanisms so that their application does not cause damage to the crop. • Describe the basic maintenance tasks of an irrigation installation. • Describe the cleaning and conservation tasks.
Perform the application of phytosanitary treatments according to established indications.	• Describe the general characteristics of a product for phytosanitary treatment, by the information collected in the container. • Detail the tasks of cleaning, handling and basic maintenance of the tools, equipment and facilities used in the treatments, according to the mode of application and the type of product used. • Define the measures for prevention of occupational and environmental risks, related to auxiliary operations in the application of treatments. • Apply phytosanitary treatments in a uniform manner, at the time and with the indicated equipment.
Associate the main cultivated species, their cultivation techniques and maintenance operations.	• Identify the main plant species of energy crops and their main characteristics and requirements. • Describe the routine cultural operations applied to the soil and the plant that are carried out for the maintenance of the crop.
Carry out the techniques of collection, storage and packaging of agricultural products and by-products, using the established means and complying with applicable environmental regulations.	• Describe the collection tasks. • Describe the conditions and operations necessary for the conditioning and transportation of products and by-products. • Describe the storage techniques necessary for conservation. • Describe the operations of handling and treatment of plant waste.

M.IV.- B. CURRICULUM ELEMENTS (continuation)	
Final Abilities	**Evaluation criteria**
Use and maintain correctly the equipment, materials and machinery suitable for the different operations, complying with the applicable regulations in matters of prevention of occupational risks and environmental protection.	• Define measures to prevent occupational and environmental risks, related to operations. • Describe the tasks of cleaning and basic maintenance of the facilities, equipment and tools used. • Apply environmental and occupational risk prevention measures with the correct use of individual and general protection equipment in all described operations.
Know the types of biofuels and its uses.	• Describe the characteristics of the different biofuels. • Know the different origins of biofuels. • Associate each type of fuel with the different agricultural products from which it can be obtained.
Understand the processes that take place for the production of biofuels from agricultural energy crops. Know the different types of facilities for bioethanol and biodiesel production.	• Describe in a basic way the different mechanical and chemical processes for the production of biofuels. • Understand in a general way the reactions that take place to obtain biodiesel and bioethanol. • Identify the different facilities that make up the biofuel production process.
Know the environmental impacts of biofuel production processes and prevention and correction measures.	• Describe the main contamination points of the biofuel production facilities. • Describe the environmental control measures linked to these facilities.

M.IV.- C. CONTENT PROGRAMME

introduction to energy crops

- What characteristics must a crop have to be considered energy.
- Advantages and disadvantages of energy crops.
- Crops for biomass production and crops for obtaining biofuels.

main species for energy crops

- Lignocellulosic cultures: cereals, thistle, Brasica caricata, Sorghum, etc.
- Oilseed crops: sunflower, rapeseed and others.
- Crops for bioethanol: cane, corn, sorghum, beet, etc.

herbáceos crops for biomass and agricultural work

- Herbaceous biomass and its energy uses.
- Sowing, care and harvesting of biomass crops.

crops for production of biofuels and agricultural work

- Energy crops for biofuel production.
- Sowing, care and harvesting of crops for biofuel production.

introduction to the production of biofuels

- Introduction to subsequent biofuel production processes: transesterification, distillation, pressing.

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METHODOLOGICAL GUIDE

PART 2. METHODOLOGY

"PRACTICAL AND PROJECT BASED LEARNING"

INTELLECTUAL OUTPUT 1 (IO1)

2.- PROPOSED METHODOLOGY

2.1.- INTRODUCTION. METHODOLOGICAL PRINCIPLES

The RURAL BIOENERGY project aims to be innovative, not only for the creation of a new professional competence in bioenergy (which, with a transversal focus and framed in the EU strategies, fills gaps in training in the FP system), but also has an **INNOVATIVE PEDAGOGICAL APPROACH** based on a methodology that obtains more lasting results because it is a practical learning and with greater involvement of the student:

- **Project-based learning**, a learning model based on the creation of a real context to motivate the interest of students to learn, very interesting in different educational levels and according to the opinion of the experts also for the FP, formative stage in which can also rely on the study of cases or practical examples.
- **Work-based learning** (alternative pedagogical methodology based on learning between companies and the classroom) as a successful recipe for a successful transition to the labor market.
- **Autonomous and practical learning**: students are the real protagonists and actively participate during the process putting into practice the techniques and skills learned.
- **Cooperative learning** as a fundamental pillar of project-based learning, prioritizing collaboration against the competition at any time of learning.
- **The use of ICT** in teaching and learning as a means of motivation for students and teachers.

General principles of methodological action

As important methodological orientations to apply, we list below some general principles to take into account when developing the didactic programming of the different training modules:

- Adaptation to students based on prior knowledge of the group.
- Consideration of students' prior knowledge as a starting point for the acquisition of new learning.
- Adaptation of the language to the characteristics of the students.
- Orientation of the group regarding their situation in the learning process, through comprehension controls and class activities.
- Use of educational resources and materials varied and appropriate.

- Connection of students' learning with the reality of their social and professional environment in order to achieve competence learning.
- Realization of competence learning applying theory to practice.
- Creating a climate of trust that encourages the active participation of the group in the educational context of the classroom.
- Promotion of initiative, autonomy and group work.
- Teaching/learning of personal and professional attitudes that lead to its internalization by students.
- Variety of activities and assessment instruments, using them as part of the learning process.
- Use of ITCs as a teaching educational resource and as a means of searching and selecting information and updating knowledge.

RURAL BIOENERGY also contributes to the promotion of **key competences for permanent learning** (knowledge, skills and attitudes, appropriate to the context, especially necessary for training as people, social integration, active citizenship and employment), in particular the following: *autonomy and personal initiative, learning to learn, social and civic competence, information processing and digital competence.* Special attention will be paid to the development of **competences for labor insertion: teamwork and entrepreneurship and innovation**, as competences valued as especially important for the employability of students of vocational training.

In order to respond to all the above approaches, we now develop two fundamental forms of work in the teaching-learning process:

a) **LEARNING BASED ON PROJECTS**, as it is a little-known methodology with little implementation in VET, **which also includes the principles of practical, autonomous, cooperative learning that incorporates the use of new technologies**, so we will focus especially on the so that this intellectual product shows its advantages and provides the necessary tools to know how to design and use this teaching-learning model.

b) **LEARNING BASED ON WORK.** The specialization of the positions and the needs to train professionals in a specific and integral manner, has crystallized in a new form of relationship Educational Center - Enterprise: **Dual Vocational Training**. Articles 6 and 11.3 of Organic Law 5/2002, of 19 June, on Qualifications and Vocational Training, specify that the collaboration of companies in the development of the National System of Qualifications and Vocational Training will be developed among other areas , through their participation in the training of students in work centers, favoring the realization of professional practices of students in companies and other entities (for which mechanisms and aids are necessary so that training can be offered in work centers or companies, through concerts, agreements, grants or other procedures).

2.2.- LEARNING BASED ON PROJECTS (PBL)

This methodological guide tries to guide a new form of action, which has been shown to be highly effective in practice, based on the model called PROJECT-BASED LEARNING (hereinafter PBL), in which students can participate in the planning, implementation and evaluation of projects that have a real application, creating in this way a more motivating context for the students, being aware of the value outside the classroom, and obtaining more lasting results.

We recommend this methodology not only for the specific training developed by the RURAL BIOENERGY project, but also for training in any professional qualification. "The PBL methodology is considered ideal for application to professional training cycles, through cooperative work, in which students learn to discern the different skills that each of them possesses and to assimilate what each one can contribute to the project, in different facets, always from a constructivist paradigm of learning ". Leal, G. and Lambán, M.P. (2016, Master's Degree Teaching Staff, University of Zaragoza).

The legislation that regulates the VET establishes that this will contribute to the students obtaining a learning that allows the development of the **competences of each qualification and to understand the organization of the corresponding productive sector** (as well as the mechanisms of professional insertion, the security conditions and health at work and how to prevent environmental risks). But it also establishes that professional training should encourage those competences that allow:

- **Learning for themselves and working as a team, training in the prevention and resolution of conflicts and in the promotion of equality, in all areas of personal, family and social life.**
- **Develop a professional identity that motivates future learnings and adaptations to the evolution of productive processes and social change.**
- **Strengthen the entrepreneurial spirit for the performance of business activities and initiatives.**
- **Prepare students for their progression in the education system.**

The PBL facilitates the development of all the mentioned competences, both those that have to do with the qualification and professional development and those that facilitate the personal and social development, the enterprising spirit and the permanent learning. PBL fosters an entrepreneurial spirit, which must transcend the business world and be synonymous with creativity and critical thinking initiative.

Although PBL may seem to be an isolated or specific teaching method, its characteristic elements must be really common in all teaching-learning processes and it is not necessary to strictly follow this methodology to incorporate elements of it into the training process. Sometimes this methodology called PBL is used as an equivalent of "experiential learning" or "learning by discovery".

KNOWING THE PBL METHOD

Project-based learning is a learning model in which students actively work, plan, implement and evaluate learning projects that have real-world application beyond the classroom (Blank, 1997, Harwell, 1997, Martí, 2007). With this method, students acquire knowledge and skills while working on a topic to answer a question, a problem or a real challenge that is as attractive as possible to them, involving them in the project from the beginning, even from the moment of the choice of topic. This is one of the reasons why this methodology motivates them to learn because it allows them to select subjects that interest them (Katz & Chard, 1989).

It has its origins in constructivism, a relatively new teaching method although based on the works of Dewey and Piaget many years ago. It has its application in all levels of education, from primary to university, but is not just implemented and even less in VET even though this form of learning can be transformative for students and especially for those who have greater learning difficulties.

There are many students, especially those with fewer opportunities, who are not prepared for the modern economy and the challenges of today's world. As already mentioned the PBL prepares students not only for academic and professional success, but also on a personal level and prepares young people to face the challenges of the real world.

Students work on a project for a prolonged period of time, from a few days to several months, which commits them to solve a problem or answer a question, of practical application. They also demonstrate their knowledge and skills when developing a product or public result or making a presentation for a real audience.

In this way, students acquire a deep knowledge of the content, while developing critical thinking, the ability to relate different aspects, creativity, as well as communication skills, in the context of realizing an authentic and meaningful project. These general competences are very interesting in professional training, especially in the thematic area of bioenergy exploitation that concerns us, in which this capacity for analysis, relationship and innovation is important to be able to carry out new energy uses in rural areas.

Some of the main characteristics of this learning methodology are: the development in realistic contexts and the construction of knowledge by the student himself, while reflecting on the scope of the problem and on the solutions to adopt. In this sense, there is no more realistic context than the real production environments of farms or agricultural, livestock, food, etc.

ESSENTIAL CHARACTERISTICS OF PBL
• Confront the student with the challenge of a big open question, challenge or problem to investigate, answer and/or solve.
• It is based on research, self-discovery and innovation.
• Use 21st century skills such as critical thinking, creativity, communication and collaboration, among others.
• It incorporates the students' choice in the educational process.
• Provides opportunities for feedback and review of the project and work plan.
• Requires students to present and present their problems, research processes, methods and results.
• Prepares for the world of work and to participate actively in economic, social and cultural life.

BENEFITS OF PBL

Too often, traditional learning does not leave the purely academic field. PBL better connects students to the real world, prepares them to accept and face the challenges in the world today and to know what professionals do every day. Although there is a practical part of vocational training, the part developed in the classroom is usually approached in the traditional way, although the use of PBL is not usual despite the advantages it has.

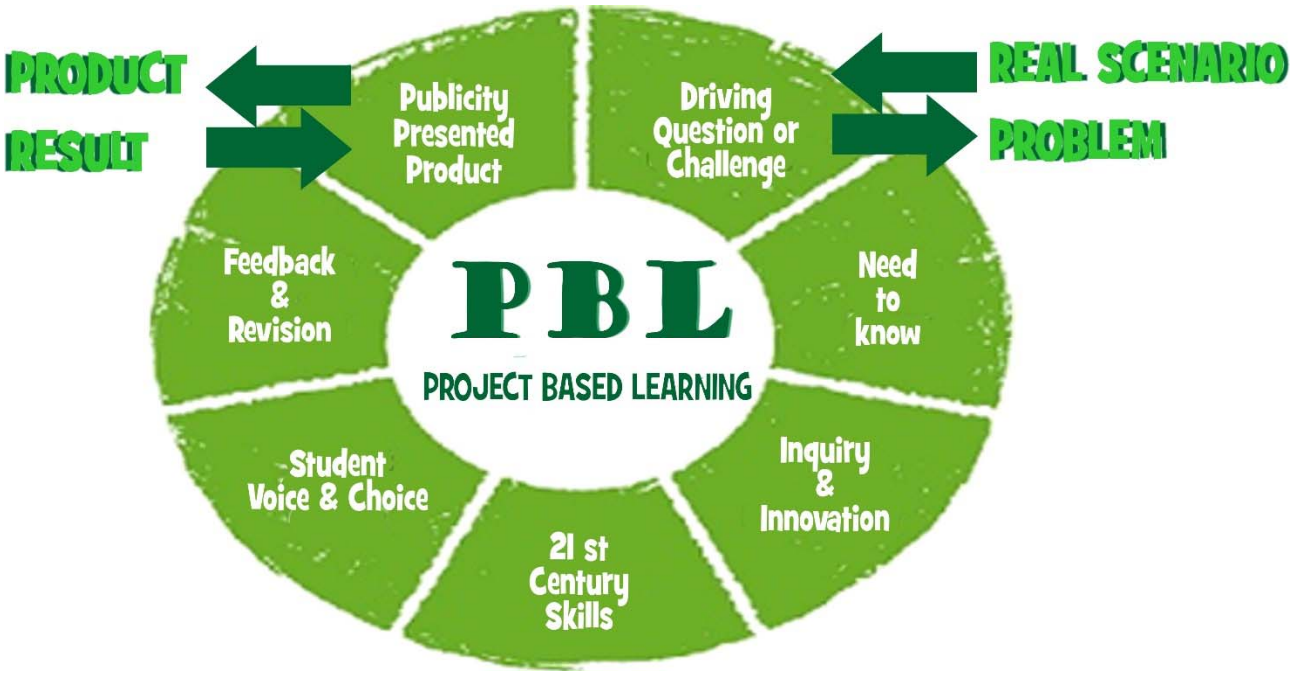
Instead of short-term memorization strategies, project-based learning offers an opportunity for students to become deeply involved with the content under study, which facilitates understanding and long-term retention.

PBL also improves the attitude and commitment of students towards training. The structure of PBL lends itself to develop an intrinsic motivation because it focuses students' learning around an essential central question or problem and a significant result.

A recent study conducted by the University of Michigan suggests that the implementation of project-based learning correlates positively with student achievement, particularly in schools in disadvantaged areas.

The PBL model also improves students' technological skills, as well as teamwork and problem solving skills, along with the ability to communicate effectively with others. The projects are interdisciplinary, collaborative, self-directed and motivating. They are based on research and the use of new technologies, addressing the full range of student learning needs and styles and the objectives of digital citizenship.

The collaborative nature of the projects also reinforces the socio-emotional learning programs and, in general, the standards of modern learning, so that, in addition to specific training on different topics, it helps the integral formation as people and citizens for the current world.



Therefore, summarizing, the main advantages or benefits of PBL are the following:

Development of skills: increases the level of knowledge and skills in a discipline or in a specific area, and can achieve high levels of skill in that area. Besides, the project improves students' aptitudes for research, analysis, synthesis, extraction of conclusions and for self-learning.

Contact with the working world: through PBL, students interact with adults, businesses and organizations, and their community, and can develop professional interests.

Commitment: students actively participate in projects that provide real relevance for learning. Students can solve problems that are important to them and their communities and the results are of greater commitment.

Deep and applied learning: PBL projects lead to a deeper understanding and greater retention of content knowledge and enables them to better apply what they know to new situations.

Sense and purpose of learning: A great project can be transformative for students. Seeing an impact in the real world gives them a sense of action and purpose.

Skills for today's world: beyond basic knowledge, students learn to take initiative and responsibility, solve problems and **communicate** ideas.

Inspiring: teachers work closely with active and committed students, who perform a significant job, being very motivating to share with them the illusion for the teaching-learning process.

Creativity and technology: students learn to use a spectrum of technological tools and communication during the process, from research and collaboration to the creation and presentation of products. ICTs are an important part of current educational processes and especially in project-based learning, which makes it a fundamental tool for individual learning and group knowledge creation.

Improvement of the formative performance: especially of the students with greater difficulties.

DIFFERENCES BETWEEN "PROJECT" AND "LEARNING BASED ON PROJECTS"		
PROJECTS	Vs	**LEARNING BASED ON PROJECTS**
It can be done alone		Requires collaboration
The important is the product		The important is the process
The protagonist is the teacher		The protagonist is the student
Missing context with real world		Based on real world experiences/problems
It takes place after real learning		Real learning takes place during the process
All projects have the same objective		The students choose the objective

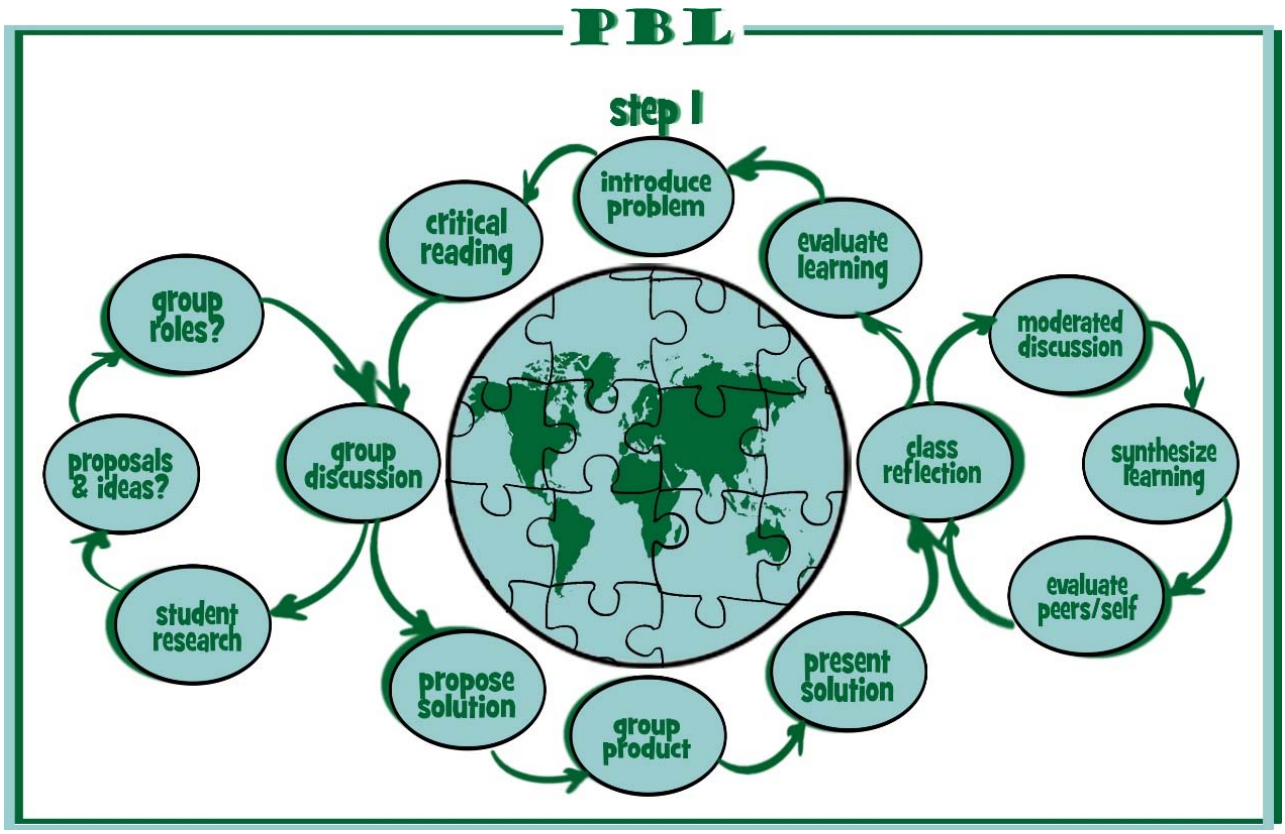
DESIGN AND DEVELOPMENT OF PBL

After the reviews made by some entities of training experiences accumulated after many years, several essential elements for the PBL have been identified that must be taken into account at the time of project design. Together, **these elements are called "PBL Gold Standard"**. According to the Buck Institute for Education (BIE), the key elements for project design that must be considered for students to learn and understand key knowledge and acquire skills and competencies for success are the following:

- A challenge, problem or challenging question
- Sustained research
- Authenticity
- Voice and student's choice
- Reflection, criticism and review
- Public result or product

Students must develop a critical thinking that allows them to identify and justify the strengths and weaknesses of a content or work, whether performed by themselves, their peers or by third parties, while remaining curious and investigating. Leal, G. and Lambán, M.P (2016).

It is also important to keep in mind the typical conceptual scheme of project-based learning, such as the one shown in the following figure, from the introduction to the problem, to the evaluation of learning, through criticism and group discussion and the presentation of the solution.



We can establish the following fundamental principles, and therefore work blocks at the time to plan a project as a learning unit:

1. **Connection with the real world.** The choice of the project must be as realistic, current and as close as possible to the students' area so that it awakens more their interest, is a real incentive and has a real application. You can take advantage of some news that appeared in the media in relation to the topic as an element of motivation and develop, at the beginning of the project, awareness activities with the problem and encouragement to students, which are considered necessary.
2. **Core for learning.** The project must be conceived as a nucleus around which to build the learning of a whole series of curricular contents (knowledge, techniques, attitudes, skills... and ultimately final competences).
3. **Structured collaboration.** The work is carried out in small groups but a support work must be carried out by the teachers so that a real cooperative work is carried out among the students and everyone actively participates.
4. **Driven by the student.** The teacher will have a role of facilitator and the students take control of the process, although they should be attentive accompanying the groups throughout the development by asking them questions, redirecting them if necessary, giving advice... but never providing the answers or solutions.
5. **Multifaceted evaluation.** The evaluation will be integrated throughout the whole PBL unit or project, different aspects are evaluated and students are also actively involved in the evaluation process.

If the aforementioned PBL principles can be understood, teachers can quickly imagine and devise projects to develop them in interaction with the students, making an adjusted and creative use of the needs and realities of each educational context, achieving them with educational effectiveness.

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The teachers role during the development of the project is that of facilitator of communication and learning. He participates with the group in the production of new knowledge as a result of the work that he develops there but acts as a mere companion.

His task is also to promote the link between the members and their objective is to generate new links between the experiential and the conceptual. His task is constant, since he must carry out a reading of the "group emergencies" (what is said, what is spoken, how to do what is done, what is not said or done). It must try to detect what they know and what they expect, to discriminate the moments of non communication from the silences, the bustle of moments of production, etc. He must be permanently alert and respect group times.

His role becomes active when he signals to the group what is happening, when he makes explicit what the participants, by living in the moment, cannot perceive. The teacher observes, registers and tells the group how to approach the tasks. He does not judge, he only provides for the work, without capitalizing neither the power nor the information, consciously moving away from the "dominant" place.

There are a number of key points for the development of successful project-based learning methodology that the teacher should keep in mind:

1. Involve students from the beginning, even at the moment of concretion of the themes and objectives of the project. It is important to know at the beginning what it is that the students want or need to know about the theme of the project.
2. Break down the theme into well-defined tasks that organize and facilitate the work to reach the final product.
3. Plan well, set goals and define results clearly.
4. Divide the classroom into work groups, and even the groups themselves with well-defined tasks. Establish a structured collaboration in the classroom.
5. Obtain a clear result (even tangible in some occasions).
6. Reach final conclusions.
7. Final presentation. Usually, when this methodology is used, the learning unit is finalized with a public presentation to an audience (peers, in the center or in the community) of the research and the work carried out and, above all, of the results obtained.

The planning of a project-based learning unit must consider at least the following aspects:

a. **Detection of needs** in the context or development environment, of the students and/or a specific topic.

b. **Curricular analysis:** to establish the objectives or purposes that are intended to be achieved, or what is the same, the competencies that are intended to be covered as well as the contents or educational standards, which do not have to be exclusively those specific to the subject (they can be taken into account the types cognitive, attitudinal, social, affective, etc.) although the main contents will be the topics of VET, in our case about bioenergy.

c. **Selection of groups:** establishment of working groups taking into account the characteristics of the students, especially according to their level of competence.

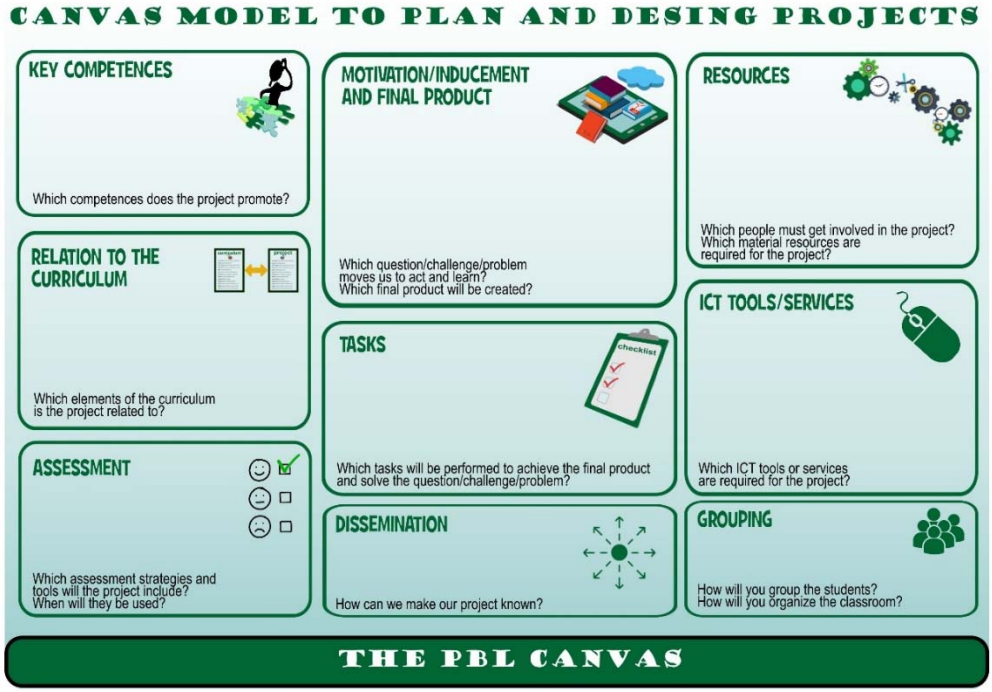
d. **Training and education of the educational community** to prevent and resolve the reluctance generated by the introduction of innovations in the academic methodology.

e. **Resources and materials.** A worksheet can be provided to guide students, without being a rigid structure that reduces the initiative and creativity of the participants.

f. **Establishment of tasks, sequencing and timing.**

g. **Monitoring and evaluation**.

CANVAS MODEL FOR PROJECT PLANNING



There are some tools that facilitate the design and planning of the PBL.

The CANVAS MODEL is a way of specifying the project in a general scheme or basic template that can help teachers to plan the PBL in a simple way.

Canvas is a word of English origin that is often used to refer to documents that help and guide creative design in any field. In our case, the PBL canvas allows us to draw our learning project considering all the key aspects of the PBL, in nine complementary steps, organized in three columns that gather all the essential elements:

Block 1) In the central part the base of the project is expressed, that is, the final product, the tasks that allow to reach it and the diffusion that could be made of the Project.

Block 2) The left column shows the relationship between the learning project and the curriculum, with the competences, learning standards, as well as defining the evaluation methods (the other great pillar of a good project).

Block 3) On the right, the basic structure of realization of the project is described through the necessary resources and the form of organization of students in working groups.

Obviously the teacher will decide how to use this tool, and introduce the changes you need for your own project. It is usually proposed that teachers design the project in a collaborative manner, developing an initial session of brainstorming, in which each teacher contributes ideas around each of the elements of the canvas to obtain a quick and visual way, a first Very visual sketch of the project.

In subsequent sessions, the teachers will detail more elements of the project asking what elements they want to replace, adapt, expand, minimize, use in another way, eliminate, etc. In this way, after several revisions we will have collected in a single document the main ideas as well as their development in different work cycles about our project.

EVALUATION

Evaluation is one of the fundamental pillars of a good PBL project and should be understood as a constant process of data collection in order to regulate learning. The PBL facilitates a comprehensive and comprehensive evaluation of the student that is expected to become the center of the learning process, solve problems and perform complex tasks, all of which should be evidenced in the evaluations.

A **multifaceted evaluation** is usually used in which the students clearly understand the rules of the evaluation, directed not only towards the product or result that is demanded or the presentation developed, but also towards the realization process itself.

As in any cooperative learning, all the aspects related to the interaction and active participation, the positive interdependence, the effort, the responsibility, the communication, the respect, the resolution of conflicts, that is to say the social and civic competences have a great transcendence, and as such they should be valued when evaluating the PBL.

The evaluation must be organized by the teacher, existing multiple and diverse tools (formal and informal). Among other strategies you can:

- Perform an initial test and a final test to check the academic progress and skills acquired by students.
- The teacher evaluates the students through the collection of partial results of tasks or activities and in addition to the observations and daily interactions maintained with the students. The program can also be finally evaluated through an exam or a final interview.
- You can keep a diary. At the end of the work sessions, through the diary, the students evaluate the progress and the issues to be improved. The students can also carry out an evaluation of the project through a final satisfaction questionnaire and/or discussion groups.
- The **self-evaluation**, that is, the evaluation of the degree of responsibility and involvement within the working group by each student and the co-evaluation (assessment of the work of all his/her classmates by each participant) are fundamental. The co-evaluation is a very important element that leads to the reflection on the own learning that the students have developed. (Moliner, 2011).

  An example of a guide for self-evaluation:

SELF-EVALUATION	NEVER	ALMOST NEVER	SOMETIMES	FREQUENTLY	ALWAYS
I listened and I respected the ideas of the rest of my classmates					
I contributed to work with my own ideas					
I listened, I respected and I accepted ideas, suggestions and opinions from my classmates					
I helped others in my group or in other groups					
I helped solve problems					
I focused on work					
I respected shifts and times					
I carried out the tasks entrusted					
I gave a reasoned opinion					
I arrived at commitments					
I encouraged and tried to make my classmates feel good					
I felt good working in the group					

- But also the teachers' role during the work sessions must be active and must observe everything that happens within the groups. The constant observation is fundamental for which it must have materials that allow it to monitor the behavior of the groups, the performance of the roles, and in short, record the process of the dynamics.

It is important to design a monitoring system that includes **checklists, graduation scales, sections...** in short, "scoring guides used in the evaluation of the students performance that describe the specific characteristics of a project or task or the categories aspects of the work to be evaluated, in order to clarify what is expected of the student's work, to assess its execution and to facilitate the proportion of feedback". (Andrade, 2005; Mertler, 2001) through Fernandez, A University Teaching Journal Vol.8 (n.1) 2010.

This type of evaluation systems are very interesting in the teaching-learning by tasks or competences, and facilitate both the co-evaluation and the evaluation and monitoring carried out by the teacher.

Types of Sections:

Global or holistic section: makes an assessment of the whole task, by using descriptors that correspond to global levels. Errors can be admitted somewhere in the process/product. Oriented to acquire certain global information of the student and a general radiography of the group.

Analytical section: focuses on more concrete learning tasks and needs a more detailed design. They are used when it is necessary to evaluate the different procedures, phases, elements, components that constitute process/product.

Advantages of the use of sections for students (According to Goodrich Andrade and Martinez Rojas):

- Students have much more information than with other instruments (feedback).
- Promote learning and self-evaluation.
- Know in advance the criteria with which they will be evaluated.
- They help the global comprehension of the topic and the relation of the different capacities.
- Help students think in depth.
- They promote the responsibility of the students, that according to the exposed criteria they can revise their attitudes or works.

Advantages of use for teachers:

- They are easy to use and explain to students. Increasing the objectivity of the evaluation process.
- Offer feedback on the effectiveness of teaching methods that have been used.
- They are versatile and conform to the requirements of the competency assessment process.

What are the disadvantages of the sections? (Popham 1997: 72-75, cited by Esther Carrizosa Prieto)

- The design of a rubric implies time on the part of the teacher and knowledge of how it is done.
- Assessing by rubrics means time to reach similar results with other types of instruments.
- A bad design of the rubric can mean that the evaluation criterion is not identified with the task itself or, on the contrary, too general criteria make its evaluation unviable.
- Risk of turning the evaluation into something strenuous.
- Promotes the standardization of students with the risk that teachers become "graduation machines" or evaluate.

PRACTICAL APPLICATION. SOME EXAMPLES OF PROJECTS

Below we propose several examples of possible PBL projects carried out following the premise of choosing a situation or problem that currently exists to which students will be given a solution by inquiring and developing a final product, focused on techniques of production and exploitation of the different existing biomass or bioenergy resources.

The examples presented outline and describe in a general way an existing need and a final product or result to be developed; but several options could also be offered for the students to choose or even a participatory process could be carried out for the choice or determination of the topic by the students themselves on the subject.

It is interesting as a way of introducing the work project to rely on some news or actual report appeared in the media, as current as possible related to the need or problem that the project tries to solve so that the objectives and activities to be developed are the most Realistic and motivating for everyone.

As for the stages of development of the project and work methodology to be applied, it is described in a general way through the enumeration of the different tasks to be carried out. We do not go into detail some elements that structure the projects that must be developed by the teachers and by the students themselves, adapting the project to their own environment and work reality. We refer among others to:

1. Work schedule or calendar.
2. Action guidelines or special suggestions that can guide the work.
3. Resources and material and technical resources.
4. Human resources.

Finally, some suggestions are given on how the groups can be structured and on possible evaluation techniques, such as simple suggestions in order to facilitate the practical application of the proposed examples, but which can also be adapted to their own situation and learning environment.

PBL EXAMPLE 1:

"INFORMATION ON THE POSSIBILITIES OF USE OF ANIMAL AND VEGETABLE WASTE AS BIOENERGY"

1 Guide on useful waste as bioenergy

MOTIVATION, INDUCEMENT AND FINAL PRODUCT

Which challenge, question or problem will moves us to act and learn? Which final product will be created?

Develop an ***informative guide*** on the different residues and agrifood by-products existing in a certain geographical area (a region or a region) that may have an advantage as bioenergy and its possible uses.

Detected need:

There is a great lack of knowledge about the use of biomass or bioenergy from waste in rural areas.

TASKS

Which tasks will be performed to achieve the final product?

1. Make an inventory of agricultural, livestock, forestry, food industry activities that exist in the established area.
2. Make an inventory of the different organic waste associated to those activities that due to their characteristics could potentially have this use as energy sources.
3. Investigate the real possibilities of being used for energy production in existing plants in the same region, or by installing small plants in the agri-food farms themselves.
4. Investigate and describe the treatment or storage necessary at source for those uses.
5. Investigate the main environmental advantages and disadvantages of the energy use of this waste and make a brief report to include in the guide.
6. Design a model of informative sheet for each type of waste.
7. Collect photographs and images to illustrate the publication.
8. Develop the contents of the informative guide and design it.

DISSEMINATION

How can we make our project known inside and outside our educational centre?

Each group will present their project once it is finished to the classmates and teachers involved in the PBL. The guide can be made known to farmers, trade unions and other related organizations, even they could be invited to the exhibition or presentation of the guide in the educational centre.

2 Competences and Currciculum

COMPETENCES

Which competences does the project promote?

- Know the different types of waste of biological origin of agricultural, forestry and food activities as well as associated energy uses.
- Understand the importance of proper management of waste derived from each of the activities in rural areas for its use as bioenergy.
- Understand the importance of using Bioenergy as a new opportunity for sustainable economic development in rural areas and a source of renewable energy that respects the environment more than conventional sources.
- Transversal or basic competences:
  - Ability to learn to learn.
  - Ability to investigate, relate, explore and compare.
  - Capacity for initiative, leadership and entrepreneurial spirit.
  - Motivation for quality and effort.
  - Capacity for processing and management of information.
  - Ability to solve problems and conflicts.
  - Skill for cooperation and teamwork.
  - Ability for interpersonal relationships.
  - Capacity for analysis and synthesis.
  - Critical reasoning ability.
  - Ability to manage information through ICT.
  - Linguistic and creative competences.

ASSESMENT

- INITIAL EVALUATION to detect previous knowledge.
- RUBRIC OF EVALUATION of each one of the tasks that compose the project so that it serves them of guide and stimulus in the development of the project. In them you can see the different degrees of performance of each task or competence.
- OBSERVATION OF THE TEACHER.

3 Resources and organization

RESOURCES

Which people must be involved in the project?

Which material resources are required in the project? Any special facility?

Which CIT tools or services are required for the project?

GROUPING

How will you organize the students? How will you organize the space?

We propose dividing the classroom into groups of approximately 5 students. Each participant of the group will develop a different role (coordinator, spokesperson, critic, editor, designer).
Each group can develop an independent guide or can distribute the research work and the sections of the guide between the different groups by themes or sub-areas within the established geographical area, so that each group does a different job and finally all the groups must coordinate themselves for the development of a single guide.

PBL EXAMPLE 2:

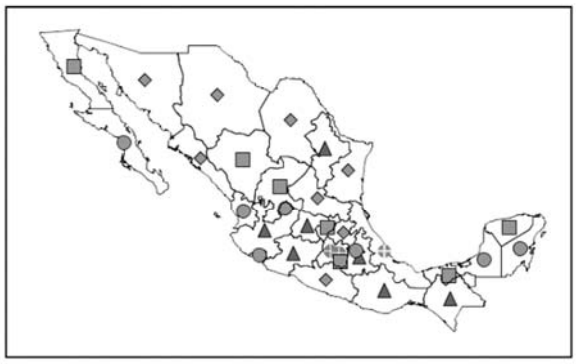
"LOCATION OF BIOMASS, BIOGAS AND BIOFUELS IN YOUR REGION"

1 Mapping out bioenergy plants

MOTIVATION, INDUCEMENT AND FINAL PRODUCT

Which challenge, question or problem will moves us to act and learn? Which final product will be created?

Prepare a ***list*** with the biomass, biogas and biofuel production and use facilities in a geographical area to be determined by the teacher and / or the students (a region or even the entire country) and a ***map with the location*** of the different plants.



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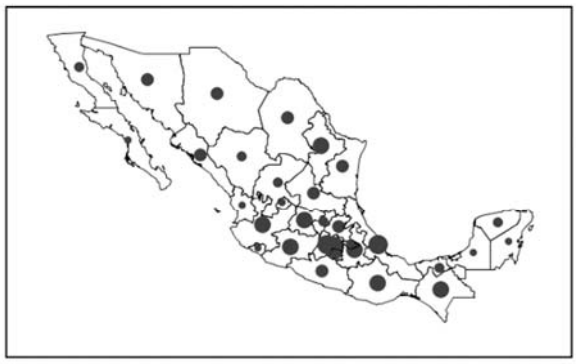

b)

Detected need:

There is a need of knowing bioenergy production centres exist in rural areas (biomass, biogas, biofuels producers in a region or country).

TASK

What do you have to do to get to the final product?

1. Investigate and inventory bioenergy facilities of different types existing in the established area.
2. Design a model sheet with the interesting data to collect from each installation.
3. Develop a map in which the different plants are located with a legend code to indicate each type.
4. Draw conclusions about the distribution of plants and the possibilities that different areas can open to farmers, ranchers, foresters and rural areas in general.

DISSEMINATION

How can we make our Project known inside and outside our educational centre?

Each group will present their project once completed to the classmates and professors involved in the PBL. The inventory can be made known to organizations related to the sector, they could even be invited to the exhibition or presentation of the guide in the educational centre.

2 Competences and Currciculum

COMPETENCES

Which competences does the project promote?

- Understand the importance of using Bioenergy as a new opportunity for sustainable economic development in rural areas.
- Know the different types of production and energy use facilities (biomass, biogas and biofuels) that may be interesting for the agri-food sector.
- Transversal or basic competences:
  - Ability to investigate, relate, explore and compare.
  - Capacity for initiative, leadership and entrepreneurship.
  - Motivation for quality and effort.
  - Linguistic and creative competence.
  - Ability to learn to learn.
  - Ability to process and manage information.
  - Ability to solve problems and conflicts.
  - Skills for cooperation and teamwork.
  - Capacity for analysis and synthesis.
  - Critical reasoning ability.
  - Ability to manage information through new technologies.
  - Ability for interpersonal relationships.

ASSESMENT

- EVALUATION SHEET of each of the tasks that make up the project to serve as a guide and encouragement in the development of the project. In them you can see the different degrees of performance of each task or competition.
- LEARNING DIARY carried out by students.
- OBSERVATION OF THE TEACHER.

3 Resources and organization

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Which people must be involved in the project?

Which material resources are required in the project? Any special facility?

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How will you organize the students? How will you organize the space?

We propose to divide the classroom into groups of approximately 5 students. Each component of the group will develop a different role (coordinator, spokesperson, critic, designer).
Each group can develop an independent inventory and finally compare the results of the different groups. Research and development work can also be distributed among the different groups by types of facilities or by sub-areas within the established geographical area, so that each group performs a different job and finally all the groups must be coordinated for the preparation of the inventory and the map final.

PBL EXAMPLE 3:

"MODELS OF BIOGAS PLANTS"

1 Knowing biogas plants

MOTIVATION, INDUCEMENT AND FINAL PRODUCT

Which challenge, question or problem will moves us to act and learn? Which final product will be created?

Design and develop ***small scale models of biogas installations*** with their different components after first knowing the facilities through visits.

Detected need:

To a better knowing of the installations it is very interesting to visit them and try to build them by themselves in order to remember the different parts.

TASKS

What do you have to do to get to the final product?

1. Conduct visits to learn about some biogas production and exploitation facilities of different farms and dimensions.
2. In groups make a general project determining the use, characteristics, dimensions and the type of installation to be designed.
3. Make a sketch or drawing of the different parts of the plant.
4. Choose and prepare the materials with which to reproduce the installation on a small scale.
5. Make the model of the installation.
6. Conduct a joint exhibition with the different models developed by groups.
7. Conclusions.

DISSEMINATION

How can we make our Project known inside and outside our educational centre?

Each group will explain the model developed to the rest of the classmates and teachers (involved in the project or other classrooms and levels of the center) during the session (s) of visits to the joint exhibition of models of biogas installations.

2 Competences and Currciculum

COMPETENCES

Which competences does the project promote?

- Understand the origin and formation of biogas from different organic waste from various agricultural, livestock or agri-food industry activities.
- Understand in a basic way the processes for the production of biogas.
- Know the main parts that make up the production and energy use facilities of small and medium-scale biogas interesting in rural farms in the agri-food sector.
- Transversal or basic competences:
  - Ability to investigate, relate, explore and compare.
  - Capacity for initiative, leadership and entrepreneurship.
  - Motivation for quality and effort.
  - Linguistic and creative competence.
  - Ability to learn to learn.
  - Ability to process and manage information.
  - Ability to solve problems and conflicts.
  - Skills for cooperation and teamwork.
  - Capacity for analysis and synthesis.
  - Critical reasoning ability.
  - Ability to manage information through new technologies.
  - Ability for interpersonal relationships.

ASSESMENT

- EVALUATION SHEET of each of the tasks that make up the project to serve as a guide and encouragement in the development of the project. In them you can see the different degrees of performance of each task or competition.
- OBSERVATION OF THE TEACHER.

3 Resources and organization

RESOURCES

Which people must be involved in the project?

Which material resources are required in the project? Any special facility?

Which CIT tools or services are required for the project?

GROUPING

How will you organize the students? How will you organize the space?

We propose to divide the classroom into groups of between 3 and 5 students. All groups work with the same approach choosing themselves the type of installation to reproduce, organizing themselves the distribution of tasks and responsibilities within each group.

2.3.- WORK-BASED LEARNING

KNOWING THE METHOD

Work-based learning (WBL) is a teaching-learning method for the development of professional competences of a professional activity acquired largely directly from a workplace.

It is an educational strategy that provides students with real work experiences in which they can apply academic and technical skills facilitating their future employability. This teaching-learning method clearly integrates theory and practice, or what is the same "merges explicit and tacit forms of knowledge."

The WBL programs are especially interesting in vocational training, aimed at eliminating the gap between learning and practice, allowing the development of specific competencies in the activity sector as well as transversal competences (teamwork, planning and organization, communication, etc.).

The student complements the training developed in the training centres with a practical training in certain competences received in work centres or companies, where the student normally works with a tutor, during normal working hours, learning a profession in a real productive environment, which allows you to improve your qualification, develop your skills and increase your employability.

The objectives or needs that justify the application of work-based professional training are:

- Create more and better jobs and attractive career opportunities for our young people and reduce youth unemployment.
- Strengthen the quality and value of education at all levels, and improve student skills, creating an effective educational framework and reducing school dropout.
- Optimize the role of the company to help young people in the transition from school to the professional world, aligning the educational world with the needs of the working world.

Este modelo de aprendizaje está especialmente presente en la llamada Formación Profesional Dual, proceso para formar a los jóvenes, en profesiones y oficios, en el que participan de forma coordinada la empresa y los centros de formación.

BENEFITS OF WORK-BASED LEARNING

This learning model has important benefits for the student:

- He has a real contact with work, gaining experience and professional competitiveness and a real integration of theory and practice.
- He acquires professional responsibilities of the activity that develops, acquires teamwork skills and receives a specific and oriented training of their professional activity sector.
- They facilitate a first work experience in their sector of activity.
- They provide professional awareness and professional exploration opportunities helping to obtain a solid professional experience.
- WBL improves the employability by helping students obtain skills such as positive work attitudes and other interesting employability skills.
- The contact between the world of teaching and the productive system is strengthened, facilitating the acquisition of skills that are required in the labour market.
- Improves professional orientation from the training centres and enriches the training system of the centre.

SOME GUIDELINES FOR SETTING UP

This training process implies a close collaboration between: training centres, workplaces s and students.

Some of the key points for this form of learning to work are: the flexibility of the training centre with respect to the needs of the companies, its involvement in the definition of the training itineraries and the obligatory coordination for everything related to training. It is also necessary to communicate with the student about their expectations with the project and finally, a good monitoring model and the commitment of all the actors to make the project work.

It is especially important that the company and the training centres participate in a coordinated manner. The authorization to start a vocational training project that includes practical training in jobs, that is, between training centres and companies, is articulated through an agreement between the training centre and the company. If the one that signs this agreement is a group of companies, each one of the companies that offer positions must give their consent and express their commitment with the achievement of the formative objectives established in the project through a document of adhesion to the agreement.

Companies, therefore, must sign an agreement with the training centre and the body designated by the Education or Labour Administration that provides the training and with the worker. The company will inform the legal representation of the workers about the agreements signed, indicating, the people hired for training and learning, the job to be performed and the content of the training activity. In the event that the training is provided in the company itself, as contemplated in law, the agreement will be signed between the company and the worker, its content being adapted to this assumption. The Council of the European Union requested that the agreement with the student and the centres that offer the internship period include the didactic objectives, the working conditions, received or not, the rights and obligations of the parties under the legislation and duration National and European applicable.

SUGGESTIONS OF COMPANIES AND WORKPLACES

IN WHICH TO PERFORM PRACTICAL LEARNING OF THE PROPOSED BIOENERGY COMPETENCES

- AGRICULTURAL, LIVESTOCK AND FOREST SECTOR:

- Farms and/or livestock farms that take advantage of: energy crops, agricultural waste, livestock waste, wood and/or firewood for bioenergy production.
- Forest holdings and logging companies.

- AGRICULTURAL INDUSTRIAL SECTOR:

- Companies of diverse agro-food transformation (wineries, oil mills, dairy companies, breweries, slaughterhouses, etc.) where they take advantage of waste and food by-products for energy production.

- ENERGY SECTOR:

- Companies manufacturing solid biofuels (chips, pellets, etc.).
- Companies of production, use and maintenance of biomass and biogas installations (for the production of domestic hot water, heating systems and/or electricity).

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