ENERGY 4 FARMING

# TEACHERS' DOSSIER: PROJECT-BASED LEARNING

Module 2: Implementation in VET schools

**INTELLECTUAL OUTPUT 2**

2020-1-ES01-KA202-082440

With the support of the Erasmus+ Programme of the European Union

*This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.*

Authors:

Fundación de la Comunitat Valenciana para una economía baja en carbón

Area Europa scrl

Eszterhazy Karoly Egyetem

Federación EFAS CV la Malvesía

Järvamaa Kutsehariduskeskus

Stowarzyszenie Edukacji Rolniczej i Lesnje EUROPEA Polska

2021

**METHODOLOGY** ..... **1**

**IMPLEMENTATION PROCESS IN EFA LA MALVESIA (SPAIN)** ..... **1**

PREPARATION: DESIGN AND PLANNING ..... 1

*Learning plan* ..... *1*

*Calendar* ..... *2*

IMPLEMENTATION ..... 3

*Process* ..... *3*

*Basic driving questions* ..... *4*

*Practical example created in the class with project-based learning: greenhouse* ..... *5*

**IMPLEMENTATION PROCESS IN JÄRVAMAA KUTSEHARIDUSKESKUS (ESTONIA)** ..... **6**

PREPARATION: DESIGN AND PLANNING ..... 6

*Learning plan* ..... *6*

*Calendar* ..... *6*

*Practical example created in the class with project-based learning: biogas digester for collecting biogas* ..... *9*

BIBLIOGRAPHY ..... 14

# METHODOLOGY

This chapter will explain how the project-based learning has been applied in two different Vocation and Training Education Schools related with farming. Both schools have used the previous information written in the first chapter together with the first Intellectual Output created.

This part pretends to encourage other schools in using this material, with a more visual and practical information on how all these materials can be applicated in a real class situation.

# IMPLEMENTATION PROCESS IN EFA LA MALVESIA (SPAIN)

## Preparation: design and planning

### Learning plan

| | | |
|---|---|---|
| **Subjects and teachers involved** | Farming Production (Agricultural facilities and infrastructure<br>Internships<br>English<br>Gardening (Agricultural facilities and infrastructure)<br>Internships<br>English<br>BASIC VOCATIONAL TRAINING<br>Internships<br>English | José Luis Sebastià Barriel<br>Jorge Viñas Piquer<br>Antonio Arbona<br>Francisco Forner |
| **Classes involved and number of students** | 1º Gardening: 18 students<br>1º Farming Production: 8 students<br>Basic Vocational Training: 9 students | 35 students and 4 teachers |
| **Resources (access to information)** | IN THE SCHOOL:<br>Computers, books, internet, tablets, laptops, and mobiles devices. | |
| **Learning objectives and key competences** | 1. Sustainability in farming | 1. Communication skills |

| | |
|---|---|
| 2. Application of renewable energies in farming<br>3. Climate change awareness | 2. Social skills<br>3. Teamwork<br>4. Negotiation and leadership skills<br>5. Creativity |

## Calendar

| WEEK | TOPIC | ACTIVITIES / TASKS | MATERIAL | EXPECTED RESULTS | EXPECTED DURATION |
|---|---|---|---|---|---|
| **1**<br><br>**[10/01/22 – 14/01/22]** | SUSTAINABILITY | Watch the movie<br>Kahoot<br>Write 5 questions about the climate change and sustainability | TV<br>Phone<br>Computer<br>Pen and paper | Groups of four<br>Raise questions related to sustainability | 4 hours |
| **2**<br><br>**[18/01/22 – 21/01/22]** | CLIMATE CHANGE AND RENEWABLE ENERGIES | Discussion on:<br>Climate change (real/ no real; what we know; evidences)<br>Renewable energies vs fossil energies<br>Benefits of using renewable energies<br>How do you imagine the planet in 50 years? | Classroom | Raise awareness about climate change<br>Understanding of what renewable energies<br>Ideas on how to fight climate change | 2 hours |
| | SUSTAINABLE AGRICULTURE | Discussion and research on: | Classroom with computers | Understand sustainable agriculture | 3 hours |

| | | | | | |
|---|---|---|---|---|---|
| | | What is sustainable agriculture?<br>Energy concept<br>Types of energies<br>Sources of energies<br>Renewable and fossil energies<br>Pollution in the world and Europe | | Know sustainable practices | |
| | EUROPEAN ACTIONS | Green deal<br>2030 climate energy framework | Classroom with computers | Research skills | 3 hours |
| **3**<br>**[07/02/22 – 11/02/22]** | GAMIFICATION | Gamification - WIX | Classroom with computers | | 3 hours |
| | IMPLEMENTATION PBL | Sustainable techniques applicable in farming | Classroom with computers | Critical thinking<br>Project design<br>Creativity | 4 days |
| **4**<br>**[07/02/22 – 11/02/22]** | REAL EXAMPLES with the Estonian students | Visit to different companies linked with renewable energies | Bus, contacts | Broaden the knowledge<br>Foster English communication<br>Exchange opinions | 5 days |

# Implementation

## Process

The implementation will be both, theoretical and practical. In order to achieve this, the students will carry out different activities in the classroom to obtain answers to the driving questions (explained in the following section). To make sure that the students develop different key skills, they will work in *groups of four*, promoting the development of the following *soft skills*, such as:

- **Communication skills** "refer to the specific types of communication used in the workplace, and include oral, written, non-verbal, and listening skills. Strong general communication skills contribute to the development of other soft skills, like social skills. However, the communication skills referred to in this paper are a distinct set, important for workplace success across sectors. There is evidence that communication skills are related to three of the workforce outcomes studied for youth, they are the most frequently sought skill among employers, and they were strongly endorsed by stakeholders in this project. The strong support for communication holds true across regions of the world, for both formal and informal positions, and for entry-level employees" (Child trends, 2015).

  This skill also support the development of other skills such as:

  - Negotiation

- **Social skills** "help people get along well with others. This ability includes respecting others, using context appropriate behaviour, and resolving conflict. Social skills are universally important. They predict all four types of workforce outcomes (employment, performance, income/wages, and entrepreneurial success), are sought by employers, and are seen as critically important by experts in the field. Social skills were supported across types of evidence, in all regions of the world, and within both formal and informal employment. Indeed, it is hard to imagine a position in which social skills would not be an asset" (Child trends, 2015).

  This skill helps developing other skills such as:

  - Emotional Intelligence
  - Conflict management

Working in teams is a challenge for the students as it includes many complex tasks and it takes more than one person. Teams sometimes struggle to coordinate efforts and team building is necessary to make the team work together. But it has many beneficial aspects. For example, they improve the peer learning, as when working in teams one of the team members can show others some digital or research tools the other group did not know.

After creating the teams, the students had to do several tasks to complete the activity:

1. Search for information about one renewable energy
2. Sources of the information that they are using
3. Which targets do we have?
4. Conclusions

Moreover, the students had to complete a technical report in which they could detail what they were doing in the practical activity. This report was also useful for the reflection of the students in the practical activity and it included several parts such as components, programming, steps, etc.

## Basic driving questions

| | |
|---|---|
| ❖ What is sustainable agriculture? | ❖ What can we do? |
| ❖ Energy concept. | ❖ How can we help? |

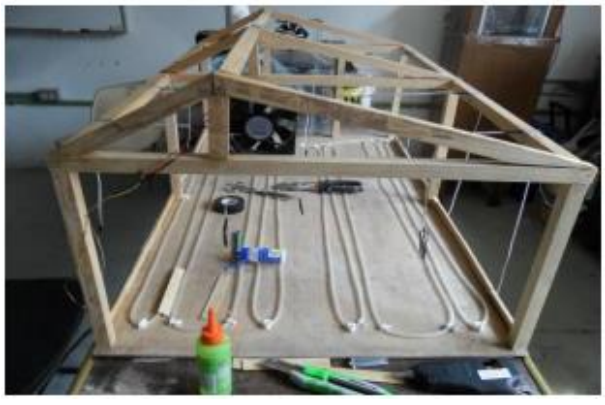
- ❖ Kinds of energy
- ❖ Sources of energy
- ❖ Renewable, non-renewable energy
- ❖ Pollution values in the world and Europe
- ❖ Sources of renewable energy

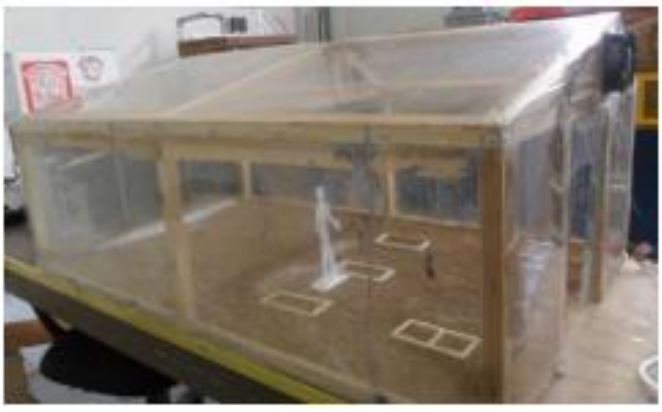
- ❖ Is it profitable using renewable energies in farming?
- ❖ Are there any other opportunities?


*Some answers to the questions "what can we do?; how can we help" given by the students.*

## Practical example created in the class with project-based learning: greenhouse

The students, based on the Intellectual Output 1 ideas and the prototypes, created their own sustainable small greenhouse prototype, with wood for beams and structure, and plastic to cover it up.





To make the greenhouse more sustainable, the students used the following tools:

- Automatic control for ventilation, heating and irrigation with an Arduino.
- Opening mechanism for side and overhead windows

! All the electrical and electronic devices are powered by photovoltaic solar panels, calculated with the prototype example of module 3 of this intellectual output.

# IMPLEMENTATION PROCESS IN JÄRVAMAA KUTSEHARIDUSKESKUS (ESTONIA)

## Preparation: design and planning

### Learning plan

| | | |
|---|---|---|
| **Subjects and teachers involved** | Agriculture<br>Organic farming<br>Harvesting and storage of crops<br>Math, Physics & Chemistry (integrated)<br>Basics of Gardening<br>Internships<br>English | Karl Aru<br>Reelika Lippur<br>Ene Pener |
| **Classes involved and number of students** | 1º Farming Production:<br>26 students | 26 students and 3 teachers |
| **Resources (access to information)** | IN THE SCHOOL:<br>Computers, books, internet, tablets, laptops, and mobiles devices. | |
| **Learning objectives and key competences** | 1. Sustainability in farming<br>2. Application of renewable energies in farming<br>3. Sources of energy | 1. Communication skills<br>2. Social skills<br>3. Teamwork<br>4. Creativity |

### Calendar

| WEEK | TOPIC | ACTIVITIES / TASKS | MATERIAL | EXPECTED RESULTS | EXPECTED DURATION |
|---|---|---|---|---|---|
| 1<br>[14/03/22 – 18/03/22] | SUSTAINABILITY & SUSTAINABLE FARMING | Research (Google site); learning the basics and vocabulary | Phone/ tablet / Computer<br>Pen and paper | Work in groups<br>Knows about the sustainability and sustainable farming | 4 hours |
| 2 | RENEWABLE ENERGIES | Discussion on: | Classroom | Raise awareness about energy - | 4 hours |

| | | | | | |
|---|---|---|---|---|---|
| [18/04/22 – 21/04/22] | | Renewable energies vs fossil fuels<br>Benefits of using<br>renewable energies<br>How can school / farmer implement renewable energies and be more sustainable in their production? | | understanding of renewable energies<br>Ideas on how farmers can be more sustainable | |
| | SUSTAINABLE AGRICULTURE | Discussion and<br>research on:<br>What is sustainable<br>agriculture?<br>How does composting work, benefits of composting - energy independence: fertilizer and fuel (biogas) | Classroom with computers ; Pens, flip board | Understanding sustainable agriculture<br>Know sustainable practices | 3 hours |
| | SOURCES OF ENERGY ON THE SITE | Presentation/ video - the sources of energy that can be found (on the site) and how it could be used to produce energy | Phones/ tablets (either to record the sources outside or to solve a given task indoors); Classroom with computers (to prepare a | Is able to identify potential energy sources and find ways to obtain energy from them in a rational way. | 5 hours |

| | | | | | |
|---|---|---|---|---|---|
| | | | video or presentation) | | |
| 3<br><br>[16/05/22 – 20/05/22] | REAL EXAMPLES with the Spanish students | Visit to different companies linked with renewable energies | Field trips: bus, contact persons | Broader knowledge<br>Improved English (through integrated lesson) | 5 days |
| 4<br><br>[23/05/22 – 06/06/22] | IMPLEMENTATION PBL | Research, planning and building the composter that produces biogas | Classroom with computers | A prototype is built, together with this, many soft skills have been improved (e.g. teamwork, social skills, problem-solving, creativity) | 2 weeks |

# Implementation

## Process

The implementation should be both theoretical and practical. Although working in teams is a challenge for majority of the students, it seems that the most encouraging way for the student to complete this task is to work in teams and either in the classroom or out in the field/laboratory. This set up helps the working group to reach diverse solutions while students develop different personal skills, including *soft skills* such as:

- Communication
- Teamwork
- Problem-solving
- Time management
- Critical thinking
- Decision-making
- Creativity

It is not necessary to keep the same teams, but after creating the teams, it is necessary to make sure that the team understands the tasks and completes the activities:

1. Set the target
2. Search for information
3. Prepare the presentation

4. Write a conclusion or present results

While writing a report or presenting the results they could detail what they were doing in the practical activity. This is also useful for the reflection of the students.

## Basic driving questions

- What is sustainable agriculture?
- concept of circular energy
- sources of energy - renewable vs. non-renewable
- Different types of farms (dairy, cereal, vegetable production etc.)
- Benefits of composting
- What can we do?
- How is using renewable energy beneficial to the environment and to the farmer?
- Is it profitable to use renewable energies in farming?
- How can farmers use the end product of composting?

*Digital tools that could be used to get the answers or feedback from students: menti.com, answergarden.com, quizizz.com, socrative.com, kahoot.com, learningapps.org, wizer.me etc.*

## Practical example created in the class with project-based learning: biogas digester for collecting biogas

### *Description*

A biogas digester is a device for recycling organic material. Through natural fermentation processes the organic material is transformed into digestate which is full of nutrients and can be used as a fertilizer. The process removes smell and helps the organic material to decompose. Through that process also the seeds of the weeds lose their ability to sprout harmful plants later on as through the process the temperature rises and the seeds lose their ability to germinate. To fuel the digester, we can use a variety of organic materials, such as manure, slurry, silage, food waste, wood chips etc.

Through the fermentation process methane rich biogas is formed and the goal is to collect that fuel for future use. It can be used to fuel a burner or a stove. Through more elaborate systems it can be also pressurized for transportation and can be used in biogas motors. Utilizing biogas is a way in the future for farmers to reach energy independence.

### *Pedagogical objectives*

- Teaching about composting
- Teaching about biogas

- Calculating volumes and energy
- Understanding how a digester works
- Applicable usages of biogas

*Required materials*

| # | MATERIAL | UNITS |
|---|---|---|
| *1.* | Bucket with a lid | 2<br>20 liters |
| *2.* | Inflating gun | 1 |
| *3.* | pipes<br>(16 mm) | 2 |
| *4.* | Pipe coupling connection | 1 |
| *5.* | Duct tape | 1 |

Figure 1. Materials

*Required tools*

1. Power drill
2. Tape, silicone or glue
3. Tube cutter
4. Flat-drill for creating a circular hole
5. Wrenches

*Construction step-by-step (with illustrations)*

1. Measure where to drill a hole for the overflow pipe. It should be 10-15 cm from the lid. Choose your drill size according to the pipe

2. Drill a hole for the overflow and then connect the pipe. The inner pipe should remain 5 cm from the bottom of the bucket. The outer side should be as long that it could flow to the second container. Seal the hole hermetically.

3. Drill a hole in the middle of the bucket lid. The drill size should be according to the connection used.

4. Plug the connector to the lid. Seal the opening hermetically. In this example we are using a tire inflator to ease the connection to the tire tube.

5. Insert biowaste into the digester. The mix should include animal manure or slurry to introduce helpful bacteria to start fermentation process. Fill the bucket so there will be 5-10 cm room to the lid.

6. Close the system hermetically and let the fermentation process begin. For precaution sealing the lid with duct tape can help you achieve that. Open the valve to the tire tube so the methane could move there.

7. After 7-10 days the process is completed. Close the valve to the tire tube, open the lid and add organic material to the digester. Extra gas will also be in the container. Through the overflow tube is collected nutrient-rich digestate which can be used as a fertilizer.

**Let's try it out!**

In order to test the biogas digester, place the prototype in place and let it be for a few days.

After few days you should see if the tire tube has filled with gas. If not, check your connections - everything needs to be hermetically sealed.

Caution! Be careful with open fire. If you have removed the tire tube, you can gently let out the biogas from the bucket and with open fire it will start to burn

*How does it work?*

In this simple prototype of a bio-digester, the organic material is going through anaerobic fermentation, and through the process methane is released.

Biogas is collected to a reservoir (tire tube) so it can be used afterwards and transported.

Digestate can be used as a nutrient rich fertilizer afterwards.

*Audio-visual material*

Examples of other prototypes that can be used as inspiration:

1. https://www.youtube.com/watch?v=pKZgnXQCp98 (Naveed Zahir , 2020)
2. https://www.youtube.com/watch?v=Cwm5Rm8uIsk (Culhane, 2016)

# Bibliography

Child trends. (2015, June). Workforce connections. Key "soft skills" that foster youth workforce success: toward a consensus across fields. United States.

Culhane, T. H. (Director). (2016). *Solar CITIES IBC Biogas System Tutorial Complete* [Motion Picture].

Naveed Zahir , C. (Director). (2020). *How To Make Free Gas from Fruit And Vegetables waste | Bio gas plant* [Motion Picture].