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D4.5 Report on the Online Training Modules

BIOGAS³

**Sustainable small-scale biogas production from agro-food
waste for energy self-sufficiency**

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With the collaboration of all project partners

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1 Introduction

With a view to promoting the sustainable production of renewable energy from the biogas obtained of agricultural residues and agro-food wastes for self-sufficiency purposes, BIOGAS3 was designed to spread around the EU member states information on how to implement small-scale biogas plants through several channels and venues.

Along with informative Webinars, a series of Workshops and Face-to-Face Trainings were carried out during the project period. In addition, an Online Training was implemented on RENAC's e-learning platform in order to make accessible and broadcast more exhaustively, the multiple benefits of small-scale biogas plants' implementation.

Unlike the Workshops and Face to Face Trainings, the Online Training rendered wider range of diffusion and participation due to the availability of the material to all applicants, irrespective of their location. Furthermore, it also allowed for each participant to shape their learning process speed as convenient.

The Online Training was a reflection of the BIOGAS3 Handbook and deepened its contents in separable units or chapters that were aimed at providing a structure that would ease the learning process. In turn, each chapter possessed a self-assessment test, tailored to let participants verify their understanding of each Module.

Participants also had access to an Online Forum, where they could post their inquiries and share their thoughts and experiences, as part of the mutual enrichment that the project allowed for.

At the end of the Online Training, participants had the opportunity to take a voluntary final exam at which end, provided that they passed it, a BIOGAS3 Certificate was issued for each successful participant.

This report will endeavour to portray the details of the BIOGAS3 Online Training in accordance to the descriptions of these brief lines.

2 Online Modules

The Online Modules of BIOGAS3 were launched on September 14th 2015. They were designed for a learning time of three months, but nevertheless they remained available for participants until February 29th 2016 on RENAC's e-learning platform, with the aim of allowing participants to perform further self-studies and access to the forums in case other questions emerged.

The Online Training consisted of a total of six modules, each of them was available for participants in seven different languages, according to the respective languages of our foreign partners, namely: English, French, German, Italian, Polish, Spanish and Swedish.

Such a diversity of languages reported two main benefits. On the one hand, it allowed RENAC to reach out to a broader range of participants' and in turn, the content of the Training availed from the collaboration of our partners, for instance, their expertise in their respective countries legislations, industry characteristics and financing possibilities. The benefits of the strategy were easily grasped, given that Online Training outstretched its expected amount of participants, achieving a total of 460 registrations.

2.1 Outline of the Online Modules

Methodologically, the Online Training was divided into six chapters aimed at providing a general background to those participants who were learning the subject matter from scratch and allowed them to enhance their expertise to the same extent than that of those whose knowledge was already more comprehensive.

Accordingly, the BIOGAS3 Online Modules encompassed the following topics and were offered under the following structure:

- 1. Introduction to Biogas:** provides a general view of biogas' benefits and its chemical composition, indication of the important parameters for biogas composition and a preview of the anaerobic digestion process.
- 2. Small-Scale Biogas Plants in the Agro-Food Industry:** includes an overview of the potential substrates for biogas production and means of utilisation of agro-food residues for biogas plants to portray how the biogas plants can be integrated to the agro-food production.
- 3. Technology for Small-Scale Biogas Plants:** it delivers an introduction to biogas plant technology such as the pre-treatment of raw materials, types of digesters and the possibility of utilizing CHP units for self-consumption or integration to the electrical grid.
- 4. Economics of Small-Scale Biogas Plants:** it assesses different aspects that a potential feasibility study shall encompass, elaborating on the risks, investments, costs and revenues. It also displays some business collaboration models. In this chapter, the smallBiogas software was introduced and linked in order to allow participants to perform their own feasibility and sustainability study through this tool.
- 5. Legislative Framework and Financing Possibilities:** it details the special regulations that Germany (and partner countries as applicable) has enforced regarding biogas production, whether they entail sanitary or environmental standards. It also offers some outlooks on project financing possibilities, such as leasing or contracting.
- 6. Best Case Examples of Small-Scale Biogas Plants:** it develops some of the success stories that have taken place in all partner countries.

Further details on the exact content of each chapter can be found in the Report on Training Material D4.1

2.2 Contents of the Online Modules

Given the characteristics of the Training and the dissimilar locations of participants, RENAC's e-learning platform afforded the most suitable means of conveyance for its content.

Participants had several tools at their disposal through the e-learning platform that made the Online Training as dynamic as they wished it to be.

Accordingly, two forums were set up. One was destined to swiftly address all organizational questions that may arise, and the second one was exclusively built for participants to discuss ideas, experiences or questions related to the content of the Training and avail from each other's knowledge.

At the end of every chapter participants could take a self-assessment test, aimed to allow them to keep track of their learning progress. Participants could take said exams for an undetermined amount of times and their records were personal rather than an institutionalized evaluation method.

Said self-assessment tests were generally composed by multiple choice questions, but some other activities were introduced in order to make them dynamic. Among others, questions required participants to drag and drop answers, to match elements from opposite sides or order sequences.

Image 1 illustrates how the e-learning platform looks like when logging into the course and how to access each of the components above mentioned.

Biogas 3 English



[Dashboard](#) > [Interactive](#) > [Biogas 3](#) > [Biogas3EN](#)

-  [News forum](#)
-  [Organisational Questions](#)
-  [Discussion Forum](#)



Please post your comments and questions concerning the course content to the BIOGAS3 team and other participants here.

We further would like to invite you to use this forum to exchange your experiences and network with other agro-food companies or biogas stakeholders.

Topic 1

-  [Chapter 1 - Introduction to Biogas](#)
-  [Chapter 1 - Self assessment](#)

Topic 2

-  [Chapter 2 - Small-Scale Biogas Plants](#)
-  [Chapter 2 - Self assessment](#)

Topic 3



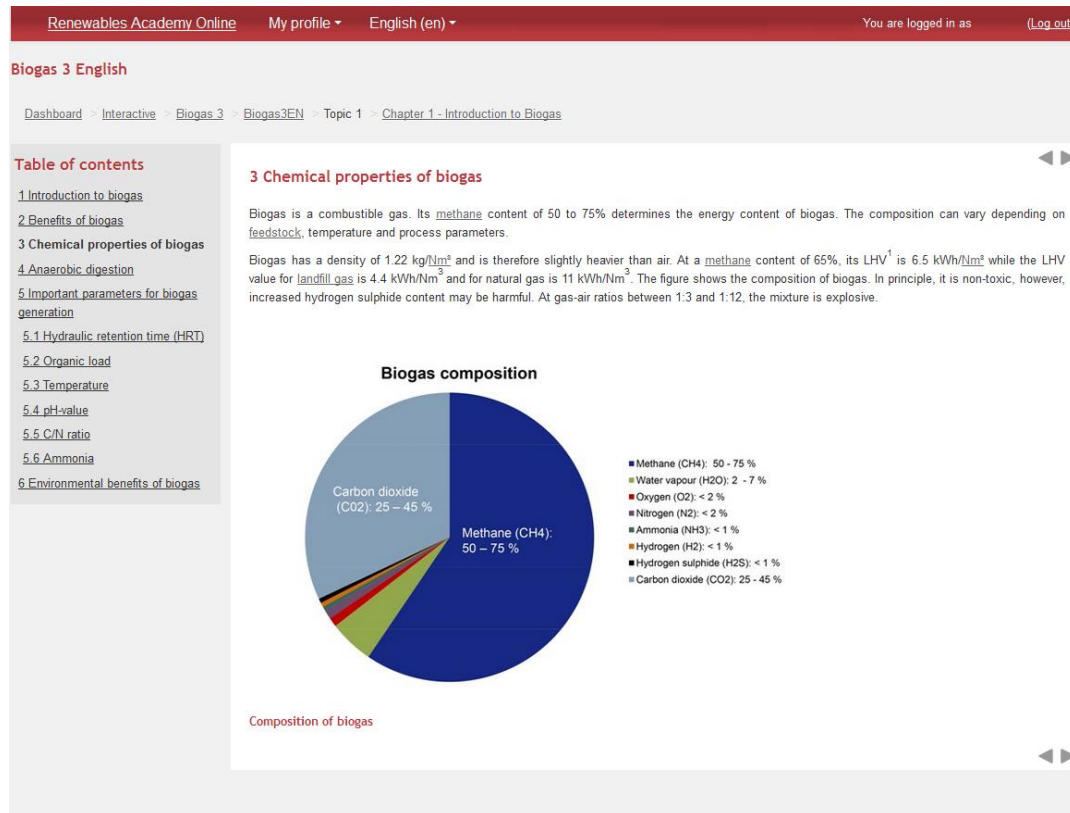
-  [Chapter 3 - Technology for Small-Scale Biogas Plants](#)
-  [Chapter 3 - Self assessment](#)

Image 1: Overview of RENAC's e-learning Platform

Inside each chapter, a table of contents would disclose the topics that to be developed and facilitate the navigation throughout them. Please see *Image 2 below*.



Renewables Academy Online My profile ▾ English (en) ▾ You are logged in as (Log out)

Biogas 3 English

Dashboard > Interactive > Biogas_3 > Biogas3EN > Topic 1 > Chapter 1 - Introduction to Biogas

Table of contents

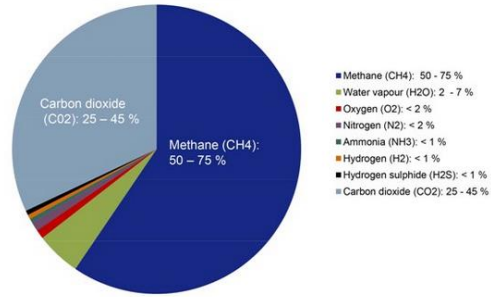
- 1 Introduction to biogas
- 2 Benefits of biogas
- 3 Chemical properties of biogas
- 4 Anaerobic digestion
- 5 Important parameters for biogas generation
 - 5.1 Hydraulic retention time (HRT)
 - 5.2 Organic load
 - 5.3 Temperature
 - 5.4 pH-value
 - 5.5 C/N ratio
 - 5.6 Ammonia
- 6 Environmental benefits of biogas

3 Chemical properties of biogas

Biogas is a combustible gas. Its methane content of 50 to 75% determines the energy content of biogas. The composition can vary depending on feedstock, temperature and process parameters.

Biogas has a density of 1.22 kg/Nm³ and is therefore slightly heavier than air. At a methane content of 65%, its LHV¹ is 6.5 kWh/Nm³ while the LHV value for landfill gas is 4.4 kWh/Nm³ and for natural gas is 11 kWh/Nm³. The figure shows the composition of biogas. In principle, it is non-toxic, however, increased hydrogen sulphide content may be harmful. At gas-air ratios between 1:3 and 1:12, the mixture is explosive.

Biogas composition



- Methane (CH₄): 50 - 75 %
- Water vapour (H₂O): 2 - 7 %
- Oxygen (O₂): < 2 %
- Nitrogen (N₂): < 2 %
- Ammonia (NH₃): < 1 %
- Hydrogen (H₂): < 1 %
- Hydrogen sulphide (H₂S): < 1 %
- Carbon dioxide (CO₂): 25 - 45 %

Composition of biogas

Image 2: Overview of Chapter's navigation system.

3 Final Exam

At the end of the Online Training a final exam was offered for those who desired to take it. By reaching a passing grade (70%), participants obtained a BIOGAS3 certificate (Please see *Image 3*), which was extended in their names as evidence of their completion of Training in a satisfactory manner.

RENAC first organized a pole in which participants were asked to answer whether they would like to perform a final exam. Given the positive feedback on the topic, the exam was offered on a voluntary basis for each language which response was equal or higher than 5 participants expressing interest. For those who did not reach the threshold, an invitation was nevertheless extended to participate in the English exam if so they wished.



Image 3: BIOGAS3 Certificate Template

This voluntary exam was only available for them on the day of its performance and only for the time awarded via a special link. Local partners were available for participants in case they were facing technical or other problems during the time of their respective exams, to be able to assist them as soon as possible.

The following picture illustrates the view participants had on the e-learning platform in order to access the exam and how the information for the second instance was reminded (apart from the serial e-mail send out).

Below, *Image 4* shows the exam itself looked like can be observed. In there, the amount of questions and remaining time was at all times visible.

Biogas3 Final Exam

Important Information - Second Attempt

- 11/02/2016
- 11:00 hs (CET)
- 20 questions

Contact Details

- martinovic@renac.de (Alejandra Martinovic)
- hartmann@renac.de (Katharina Hartmann)
- (+49) (0) 30-526 895 8 - 95



[Biogas3 Final Exam](#) 

Available from **11 February 2016, 11:00 AM** (hidden otherwise)

Image 4: View of the access to Biogas3 Voluntary Final Exam

The exam consisted of 20 questions that participants were expected to answer during the 20 minutes the test was available. The test took place on the 3rd February and a second opportunity for those who could not assist on the first call or did not reach the above mentioned grade was offered on the 11th February.

Image 5 down below displays an overview of the first page of the Exam in the English language. All tests were visualized in the same manner.

Biogas 3 English

[Dashboard](#) > [Interactive](#) > [Biogas 3](#) > [Biogas3EN](#) > [Biogas3 Final Exam](#) > [Biogas3 Final Exam](#) > [Preview](#)

Quiz navigation

1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20

[Finish attempt ...](#)

Time left 0:19:54

[Start a new preview](#)

Question 1

Not yet answered

Marked out of 1.00

[Flag question](#)

[Edit question](#)

Benefits of Biogas

Match the elements from the right with the elements from the left.

Decreases usage of

Reduction of emissions of

Can be used to produce

As a fuel

Its by-product (digestate)

[Next](#)

Image 5: Overview of the first page of the voluntary final exam.

Table 1 contains the schedule after which the tests in the different languages were held in both opportunities:

Table 1: Exams Schedule

TEST LANGUAGE	TIME (CET)
German	09:00
Spanish	10:00
English	11:00
Italian	13:00
Polish	14:00
Swedish	17:00

3.1 Test Results (First and Second Call)

Language	N° of Participants	Pass	Fail	Average Grade
German	5	5	0	87,55%
Spanish	14	13	1	86%
English	19	14	5	76,2 %
Italian	19	19	0	88,72 %
Polish	4	3	1	75,18%
Swedish	7	6	1	85,33 %
TOTAL	68	60	8	83,16 %

Table 2: Test Results - Global View 1

4 Participants

The wide range of diffusion that the BIOGAS3 project gained was due to the constant marketing endeavours in all partner countries that began in its early stages and kept going even after the Online Training had started.

The webinars that were held as introductory webinars to the Online Training and the aid of local partners with dissemination of information were crucial: agro-food companies, agro-food and biogas associations, universities as well as producers and technology providers -actual or potential- were targeted and the response was positive.

The benefits of the strategy were portrayed not only by the amount of participants, but their origin as well. Participants were not only nationals of the respective countries of our partners, such as Germany, France, Ireland, Italy, Poland Spain and Sweden; we also received registrations from several other countries around the globe, such as Algeria, Angola, Argentina, Cameroon, Check Republic, Chile, China, Colombia, Egypt, Finland, Ghana, Kenya, Morocco,

Mexico, Montenegro, Mozambique, Netherland, Nicaragua, Niger, Northern Ireland, Peru, Portugal, Senegal, Serbia, South Africa, Tanzania, Thailand, Tunisia, UAE, Uganda, UK, Venezuela and Zambia.

This uniform geographical distribution and representation of participants was also echoed by the diverse background where participants came from.

Participants emanated from both, the private and public sector. For instance, participants came from the agri-food industry such as for example vegetable production, meat production, dairy industry, agricultural farms, wheat and bakery production. Other sectors related to the agri-food industry were among others, the Spanish *Asociación Española de Biogás*; the French *Ministère de l'industrie de l'énergie et des mines*; the Italian *Ministerio Pubblica Istruzione*, the Polish *Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej w Warszawie*, from the public sector and from the private one: *Biogasview* and *Cooperative agricole CAVAC* from France; *Bioenergia Agricola* and *Agencia de Gestión Agraria y Pesquera*, *Aczia Biogas* from Spain; *Garten und Landschaftspflege*, *Bert Energy GmbH* and *Argos Biogas UG & co. KG* from Germany; *Foodmark Sweden AB*, *Bioelectric Sweden AB Swedish*, and the *Institute of Agricultural and Environmental Engineering from Sweden*; *Renewable Project Management Greengas AD*, *Agro-Food & Biosciences and Institute for Northern Ireland* from Northern Ireland; *Tecno Project Industriale Srl*, *CNR - Istituto di Biologia e biotecnologia agraria*, and *Agroils Technologies SpA* from Italy; and *Centrum Doradztwa Rolniczego w Brwinowie Oddział w Radomiu*, *EkoEnergia*, and *Podlaski Ośrodek Doradztwa Rolniczego w Szepietowie* from Poland.

Universities seemed to have succeeded at engaging their student body with BIOGAS3, as RENAC received registrations from students from almost 20 different Universities. Likewise, States' public sector had a good response, with

many applicants working at National Ministries and even some representatives of the civil society belonging to NGOs.

Table 3 reveals the amount of participants that registered for each language. Tables thereafter (subchapters 4.2 - 4.8) display at large the background of each participant, according to their nationality and as shown, some participants have registered for more than one language of training.

4.1 Participants per Language

Language	N° of Participants	Expected Target N°
French	24	20
English	96	15
German	56	40
Polish	60	15
Swedish	80	10
Spanish	74	50
Italian	69	30
TOTAL	459	180

Table 3: Participants per language

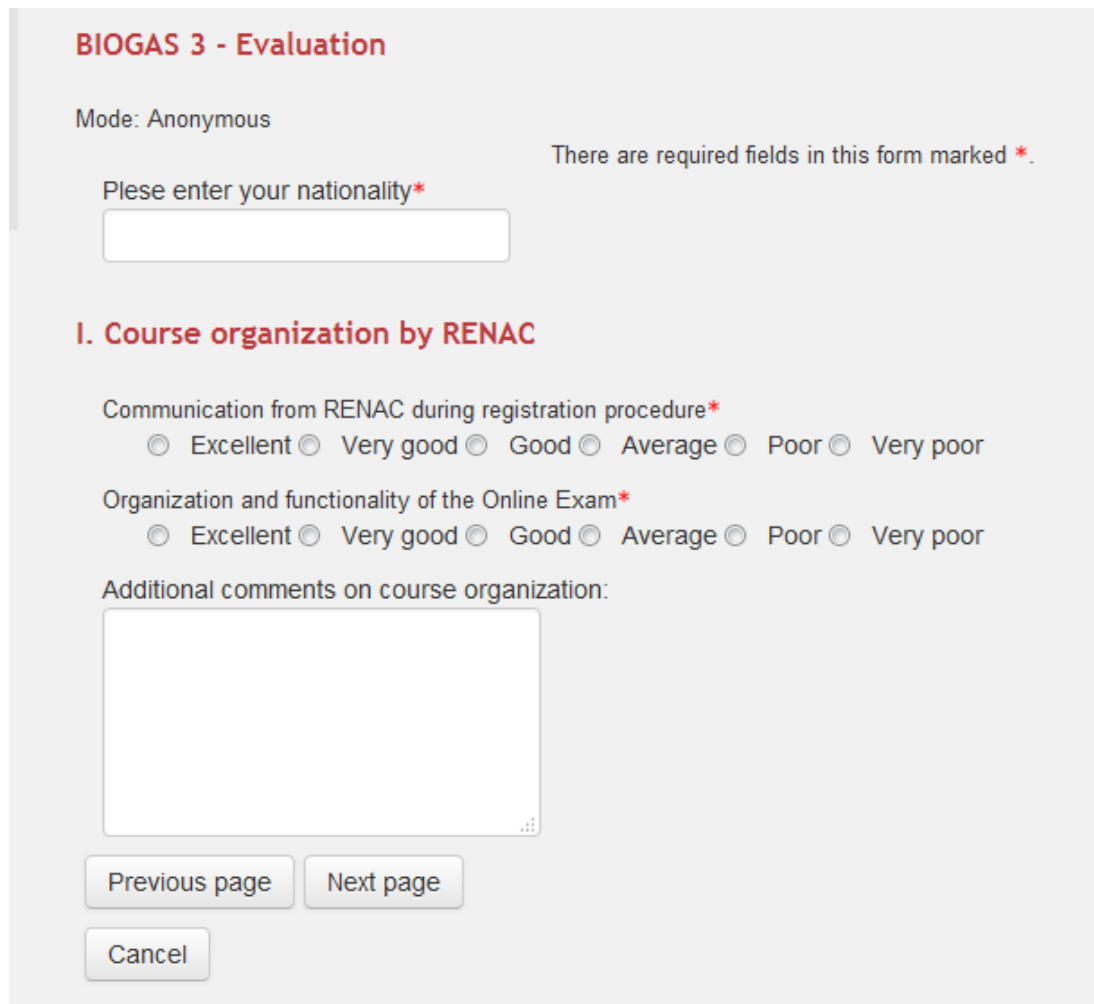
5 Evaluation

Insofar the evaluation of the Online Training, RENAC implemented a short survey that participants were requested to answer in order to gain feedback from concerned parties and use their constructive criticism to boost future projects.

The survey consisted of 16 questions, mostly multiple choice typed, but with sufficient space to receive general comments where applicable, in particular regarding participant's opinion on what could be improved in further instances. The questions encompassed the following topics: organization and

communication by RENAC, implementation of the Online Training, structure and content of the course and time consumed for studying, amongst others.

The survey was conducted through the e-learning platform participants have been using for the Online Training as well and was available from the 17th February until the 26th February 2016. *Image 6* provides an overview of how the survey looked like.



BIOGAS 3 - Evaluation

Mode: Anonymous

There are required fields in this form marked *.

Please enter your nationality*

I. Course organization by RENAC

Communication from RENAC during registration procedure*

Excellent Very good Good Average Poor Very poor

Organization and functionality of the Online Exam*

Excellent Very good Good Average Poor Very poor

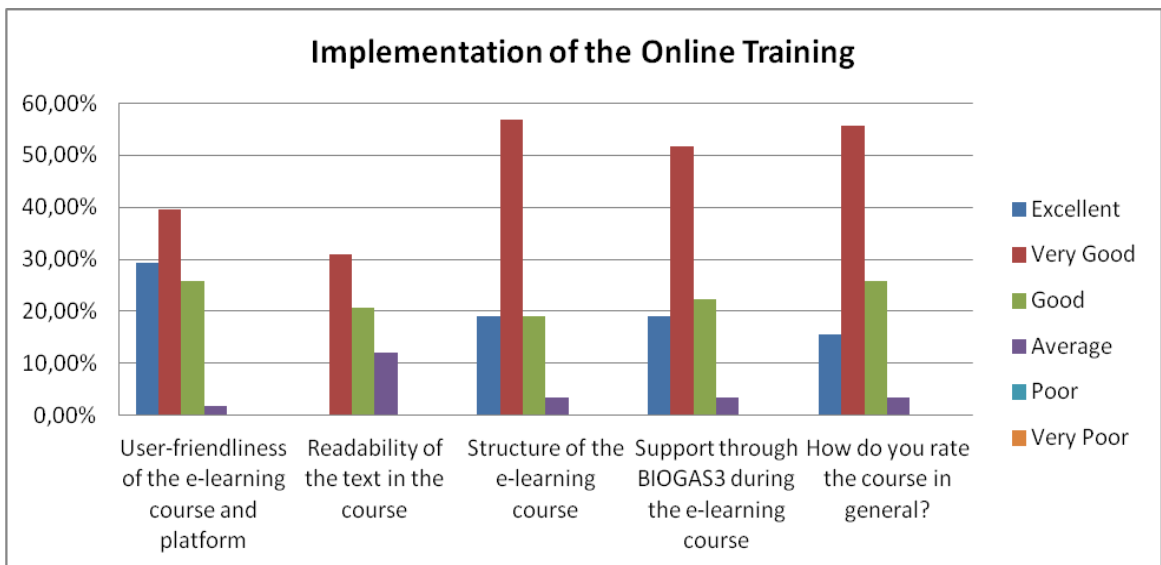
Additional comments on course organization:

Image 6: Overview of the Online Training Evaluation Survey

5.1 Results

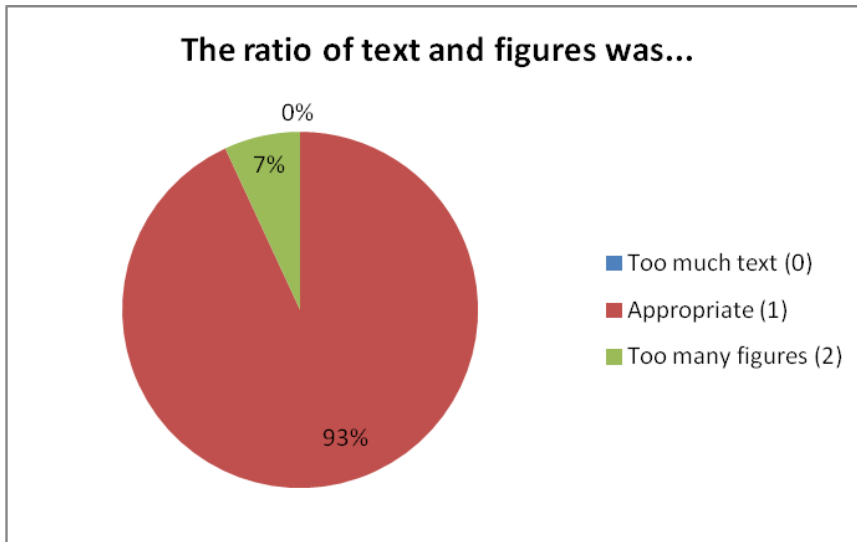
A total of 58 participants undertook the survey.

From the information that RENAC was allowed to collect, it can be said that the implementation of the Online Training was very well received. *Graphic 1* portrays the positive reception of the course in terms of the friendliness of the e-learning platform, structure and readability of the course and in particular, the general rate of the course.

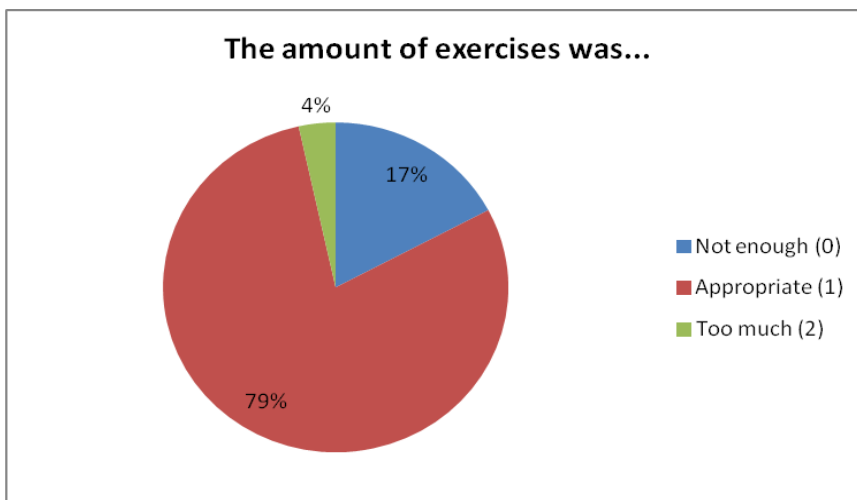


Graphic 1: Implementation of the OT

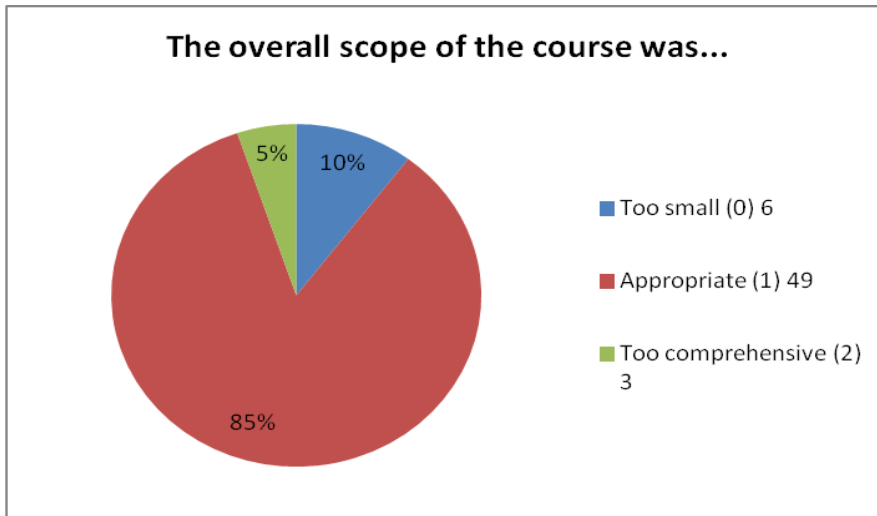
Participants were also asked to rate more specific features of the Online Training, such as the proportionality between theory and practice, the scope of the content and the amount of figures included in the training material. *Graphics 2 to 4* show the answers RENAC received through the implemented survey.



Graphic 2: Ratio of text and figures

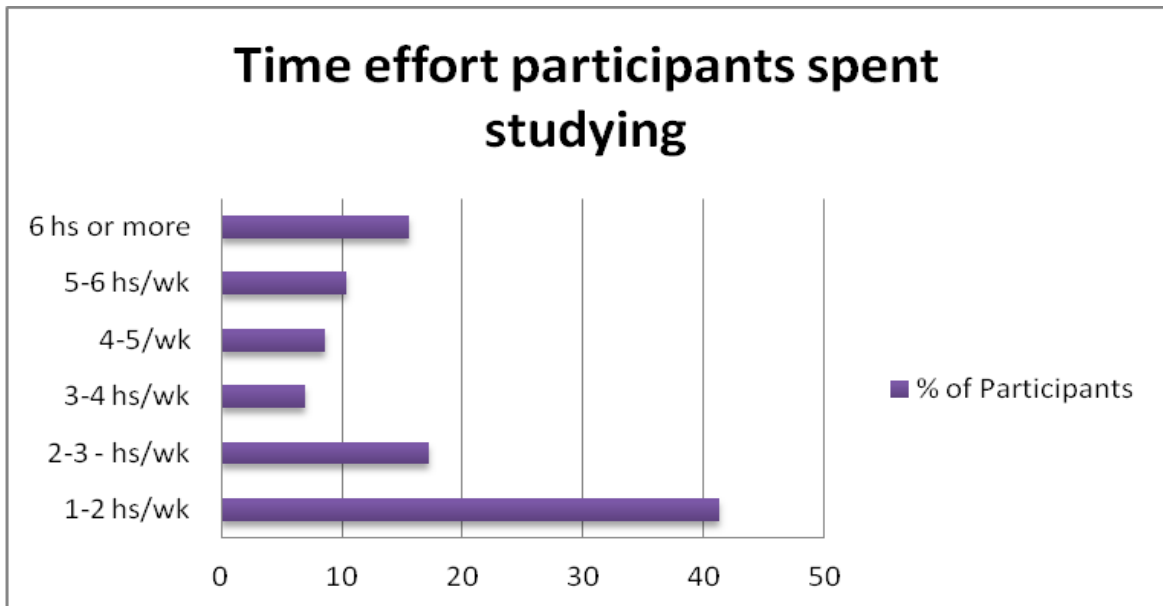


Graphic 3: Amount of exercises



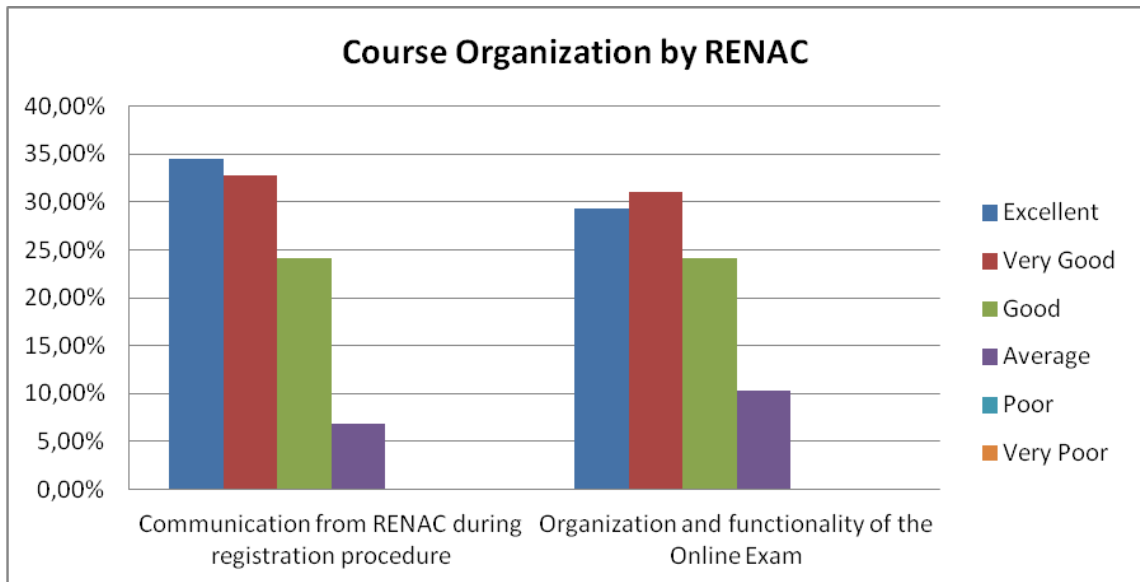
Graphic 4: Overall scope of the course

When asked regarding the amount of time per week that participants spent to prepare for the final exam, these were their answers:



Graphic 5: Study-time

RENAC also engaged the participants to answer some questions about the organization and communication during the Online Training, in order to obtain some feedback that may allow future improvement. In that regard, the general feedback was also very good, as shown below by *Graphic 6*.



Graphic 6: Course Organization by RENAC

The survey also afforded some space to further comment on what participants thought valuable to share and not yet addressed in the previous questions. These were some of the responses:

Additional comments on course organization:

- *"Keep it up with your good work. Bravo."*
- *"Clear instructions study material."*
- *"A good basic course of small-scale biogas production. I will use the knowledge in my work."*

6 Conclusion

The e-learning platform, where the Online Training was implemented, proved to be an excellent tool for the transfer of knowledge of small-scale biogas plants implementation in the agro-food industry for energy self-sufficiency.

Over 450 participants from a very wide range of professional and academic backgrounds were addressed. In the the Online Training counted with participants stemming from agro-food companies from Spain, Germany, Ireland, Poland and Sweden; agricultural farmers and consultants from Poland, Ireland, Germany, Italy and Sweden; waste management companies from Sweden, Spain and Germany; suppliers from Spain, Germany, France, Italy and Sweden; renewable energies consultants from Poland and Italy; biogas and renewable energies associations like those from Germany, France and Italy and other interested parties, such as Ministries and other National Authorities from France, Poland Swede and Italy; Polish, German and Italian researchers, and university students from Italian, Swedish, French, German, Polish and Irish public and private institutions.

The fact that all these people showed such an interest and commitment towards the topic underpins the benefits of modern mechanisms to address participants and the importance of facilitating accessibility in order to encompass and reach a wider community and broadcast more exhaustibly the contents of the project.

The diversity of audience enabled a dynamic and productive atmosphere during the other events linked to the Online Training, such as the Face to Face Trainings and the Workshops, since it facilitated the exchange of experiences among the participants and lecturers.

The overall positive feedback to the conducted survey demonstrated the satisfaction of the participants with the course and the conclusion that the events were interesting for them. This demonstrates the strong demand for

capacity building for small-scale biogas plants for self-sufficiency and in particular, in the agro-food industry, which can only speak for the contribution of the whole project to all State members of the European Union and beyond.

