



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

## BIOGAS3 project

International Congress and Expon on Biofuels and Bioenergy,  
August 25-27, 2015 Valencia, Spain

AINIA Technology Centre



Co-funded by the Intelligent Energy Europe  
Programme of the European Union

IEE/13/477/SI2.675801

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# Agenda

- Introduction. Small-scale biogas plants for self-sufficiency in agro-food industries
- Objectives of BIOGAS3 project
- Main results of BIOGAS3 project



# Introduction. Example of a farm small-scale biogas plant

## Dairy farm, Gießen (Germany)



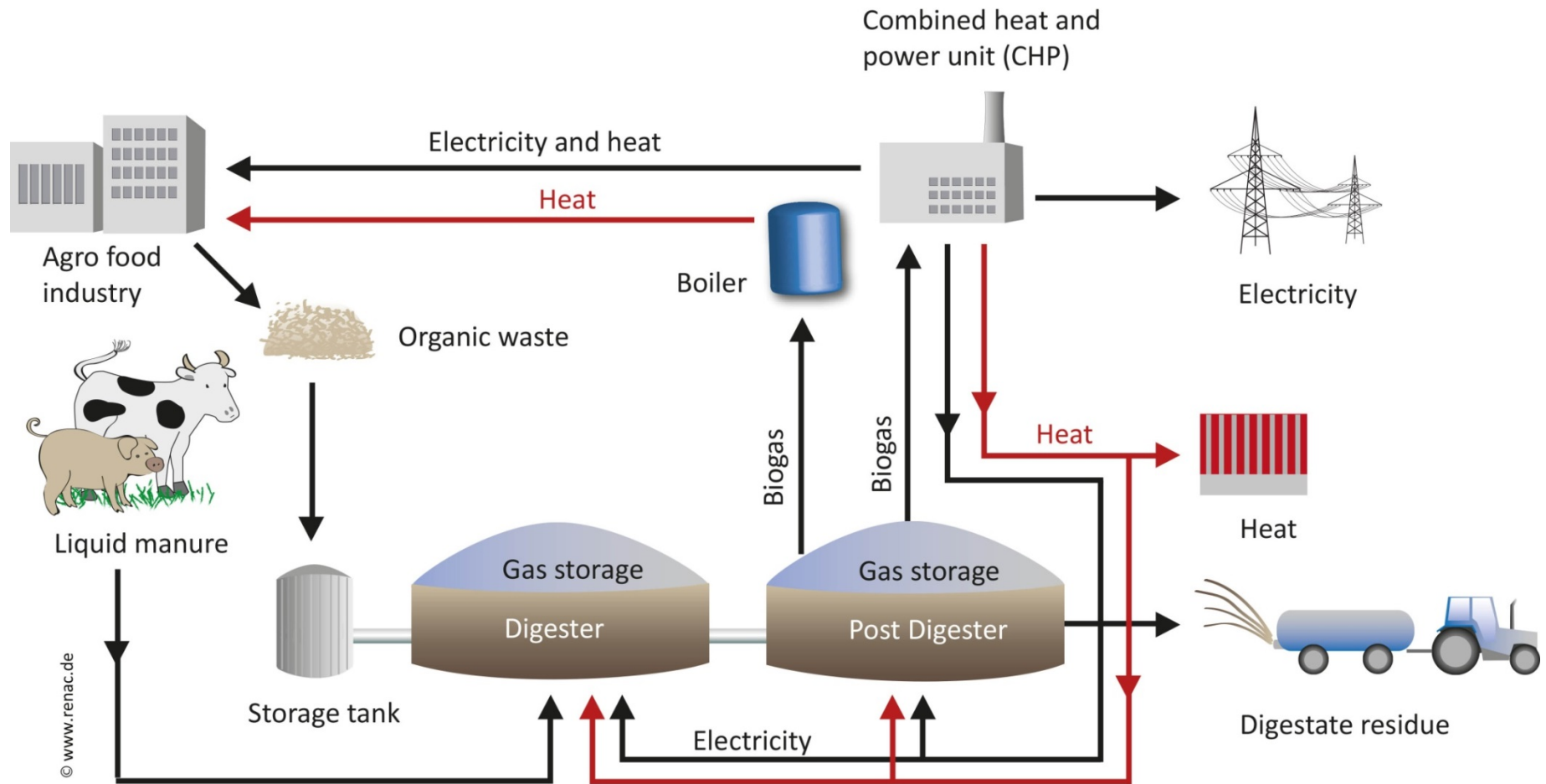
Data obtained from a report of Bio4Gas GmbH

**Small-scale biogas plant (installed capacity 75 kW).**  
**Feedstocks:** cattle slurry (10,950 m<sup>3</sup>/year)  
**Energy use:** heat for self-consumption,  
 electrical energy is fed into local power grid.

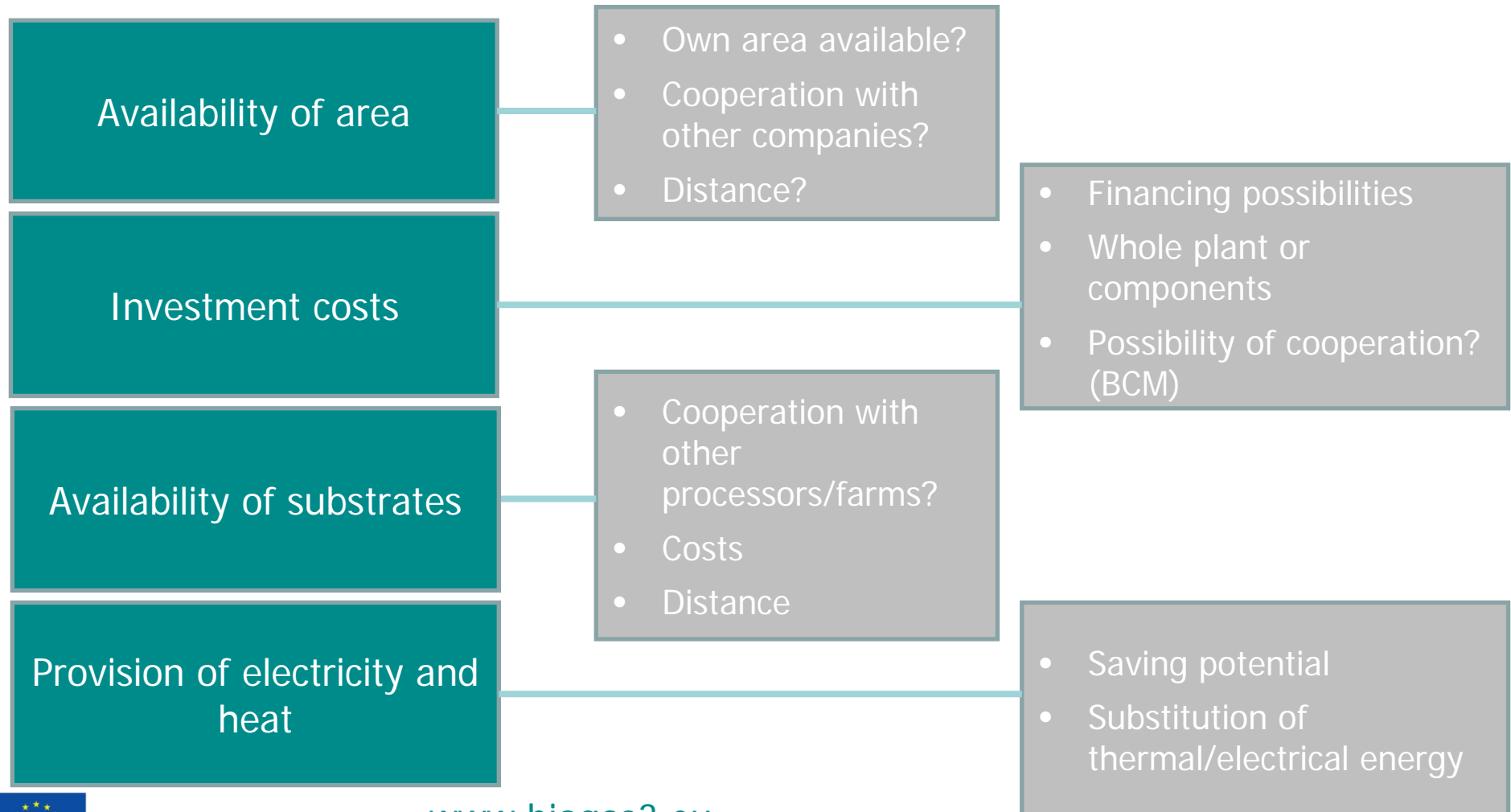
<b>Digester:</b>	<b>600 m<sup>3</sup></b>
<b>Biogas valorisation unit:</b>	<b>75 kW</b>
<b>Energy production:</b>	<b>630 MWh<sub>el</sub>/a; 740 MWh<sub>th</sub>/a</b>
<b>Investment:</b>	<b>€500,000</b>

**Estimated payback period = 6 years**

# Introduction. Cost reduction possibility: Integration of biogas plant



# Introduction. To consider



# Why BIOGAS<sup>3</sup> project?

## Background:

Small-scale anaerobic digestion (AD) is an economically feasible and environmentally sound solution for agro-food waste.

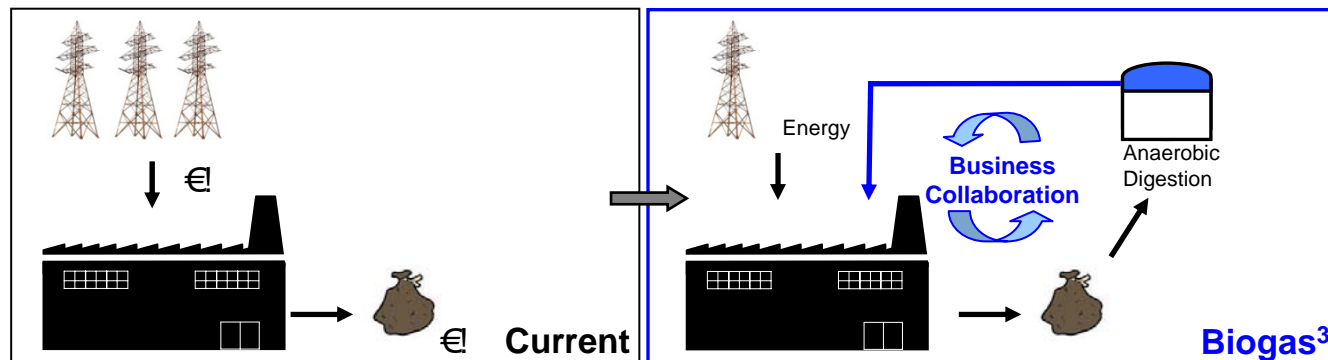
**However, AD is not widely implemented in the agro-food sector yet. Why?**



The following non-technological **barriers** have been identified:

- *Need of new business models to reduce the high dependency on governmental support to renewable energy.*
- *Need of scale-adapted technology models.*
- *Need of energy demand management models.*
- *Lack of knowledge, skills and confidence in small AD technology*

# About BIOGAS<sup>3</sup>



**Objective:** Promote the sustainable production of renewable energy from the biogas obtained of agro-food wastes in small-scale concepts for energy self-sufficiency.

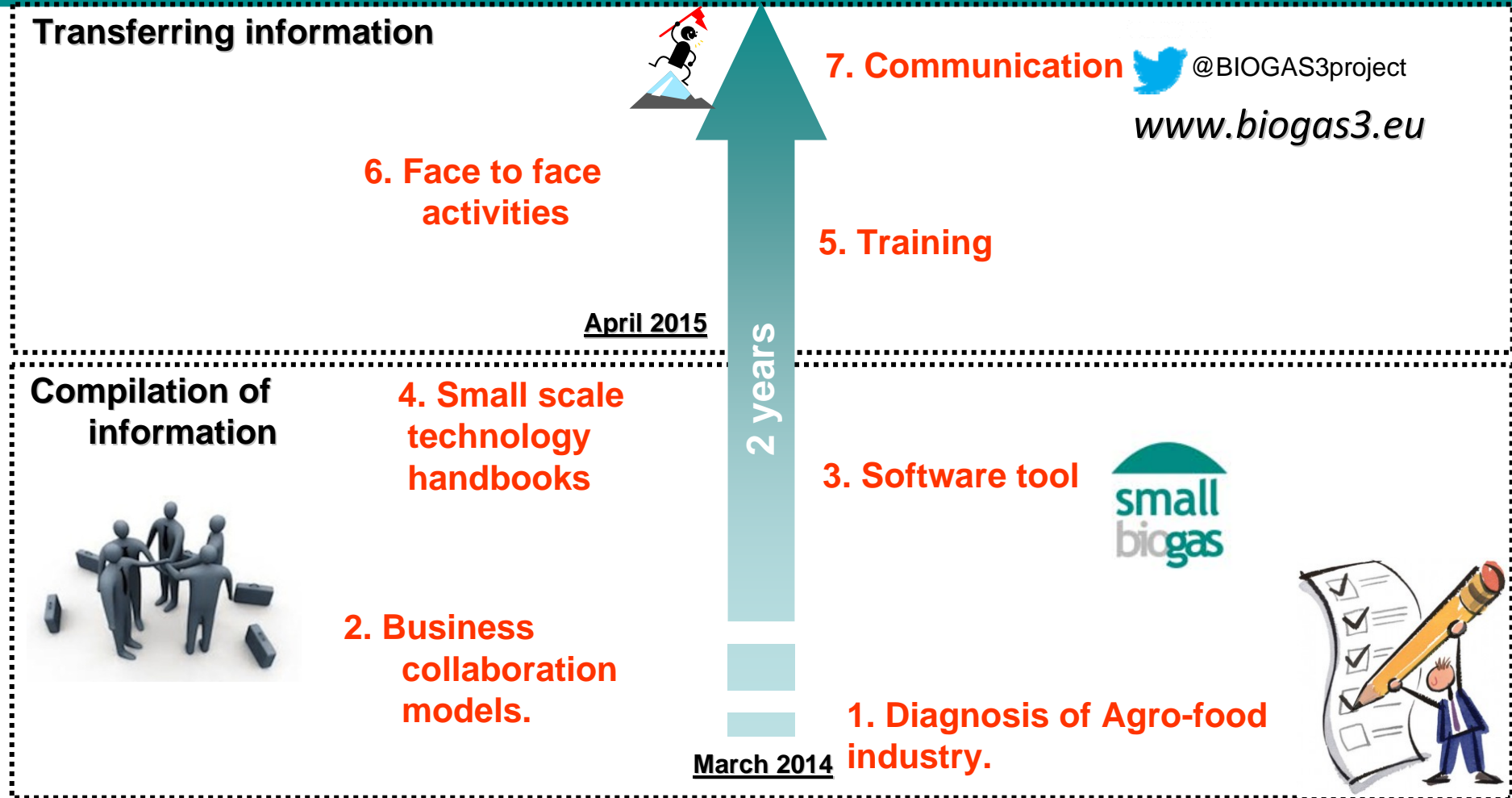
### Main results:

- Small-scale AD model.
- Business collaboration models.
- Build-up of skills and awareness on small-scale AD.
- Set the ground for new investments.
- Webpage.

### Main impacts:

- Enabling policy: diagnosis of target groups, improvement of public bodies and policy maker's awareness.
- Preparing the ground for investment.
- Building capacities and skills.
- Changing behaviour & informing stakeholders

# About BIOGAS<sup>3</sup> . Activities



Transferring information



7. Communication  @BIOGAS3project  
[www.biogas3.eu](http://www.biogas3.eu)

6. Face to face activities

5. Training

April 2015

2 years

Compilation of information



4. Small scale technology handbooks

3. Software tool



2. Business collaboration models.

1. Diagnosis of Agro-food industry.



March 2014



## Main results

- Publications (Reports, Handbooks)
- Software tool feasibility studies
- Webinars + Workshops + Visit tours
- Video + Website

### *Ongoing :*

- On-line training + Face-to-face **training**
- Set the ground for new investments of small-scale AD (**feasibility studies** with the software tool and networking between AFI and biogas plant providers)

# BIOGAS<sup>3</sup> publications

- Report small-scale AD in agro-food companies: potentials and barriers



The image shows the cover of a report titled "Small-scale AD in agro-food companies: potential and barriers". At the top left is the "biogas<sup>3</sup>" logo, and at the top right is the European Union flag with the text "Co-funded by the Intelligent Energy Europe Programme of the European Union". The title is centered in a bold, teal font. Below the title, it says "BIOGAS<sup>3</sup> Sustainable small-scale biogas production from agro-food waste for energy self-sufficiency". The "Date:" section lists "30 May 2014 (first version)" and "30 August 2014 (updates)". The "Authors:" section lists "Mar Mesas and Federico Morais (FIAB)" and "With the collaboration of all the BIOGAS<sup>3</sup> consortium". At the bottom, there are two columns of text: "DATA OF THE PROJECT:" and "CONTACT:". The "DATA OF THE PROJECT:" column includes Programme (Intelligent Energy Europe (IEE) - ALTENER), Key action (Promotion and dissemination projects), Grant Agreement (IEE/13/477/S12.675801), and Start / end date (1<sup>st</sup> March 2014 – 28<sup>th</sup> February 2016). The "CONTACT:" column includes Coordinator (Begoña Ruiz (AINIA)), Telephone (+34 961366090), E-mail (bruiz@ainia.es), and Website (www.biogas3.eu).

## Barriers identified in the implementation of biogas production in the agri-food sector

*The following aspects have been identified through the conducted **surveys** as the most important **barriers** for the **development and financial viability** of a biogas plant*

- **Variability on characteristics** and production time of the residues and other organic substances
- **Logistic costs**. Intermediate stages (e.g. collection, transportation to the plant, storage...)
- Diversity of technologies for Biogas Plants and perception **available commercial plants are too big**.
- **Competition with other products** (compost, landfill, alcohol production, etc.)
- **Energy needs** are sometimes different that energy produced by biogas plants and there are not incentives to sell energy to the grid
- In some countries, **lack of regulation and financing** or subsidies to biogas plants

# BIOGAS<sup>3</sup> publications

- Small-scale Anaerobic Digestion Business Collaboration Models (BCM)



## Success stories



Success stories related with the construction of small-scale biogas plant are identified in the countries that comprise the Biogas3 project



## Success stories: Spain

BCM: Private investment. A synergic model is applied for operation of the biogas plant between agri-food companies close to the biogas plant

**BCM: Private investment. A synergic model is applied for operation of the biogas plant between agri-food companies close to the biogas plant.**

	Description	Characteristics
ISCAR BIOGAS PLANT	<p>Biogas plant Located in Iscar (Valladolid).</p> <p>This plant treats agri-food by-products from processing industries of vegetables and potatoes.</p> <p>Thermal energy produced is used for self-consumption and the rest is sent to poultry slaughterhouse.</p> <p>Operator: Santibáñez Energy. Customer: Grupo Hidalgo</p> 	<p><b>Substrate treated:</b> 2 800 tonnes/year of by-products from processing industries of vegetables and potatoes.</p> <p><b>Biogas valorisation unit:</b> 100 kW<sub>th</sub></p> <p><b>Energy production:</b> 950 MWh per year.</p> <p><b>Installation:</b> Pre-treatment tank: 30 m<sup>3</sup> Digester: 570 m<sup>3</sup> Postdigester: 300 m<sup>3</sup> Gasholder: 533 m<sup>3</sup> Digestate tank: 900 m<sup>3</sup></p> <p><b>Investment:</b> 0.41M €</p> <p><b>Funding by:</b> Own resources. A Synergic model is applied for operation of the biogas plant.</p> <p><b>Estimated payback period:</b> 6 year.</p>
		
<p><b>Strong points for success:</b></p> <ul style="list-style-type: none"> <li>o Valorisation of thermal energy.</li> <li>o Digestate is used as fertilizer in agricultural activities.</li> <li>o Reducing cost of residue treatment.</li> </ul>		

# SmallBiogas Software Tool & Usage Guide

[New study](#) | [My studies](#) | [Logout](#)

## New study

1
2
3
4
5

### Where?

**General data**

Name:

Country: Ireland

- Spain
- France
- Italy
- Germany
- Poland
- Ireland
- Sweden

**Administrative division**

Annual average temperature (°C):

The results obtained from the use of the tool provide to the user an orientation about the viability of a small-scale biogas plant. For this reason, the authors recommend further consultation with expert centres before carrying out a project of biogas plant and are not responsible for any damages resulting from the use made of the tool smallBIOGAS.

Accept conditions

[next >>](#)

Co-funded by the Intelligent Energy Europe Programme of the European Union

### 'smallBIOGAS'

Usage guide to use the software and interpret the results

BIOGAS<sup>3</sup>  
Sustainable small-scale biogas production from agro-food waste for energy self-sufficiency

Date:  
August 2014

Authors:  
BIOGAS<sup>3</sup> Consortium

<b>DATA OF THE PROJECT:</b>		<b>CONTACT:</b>
Programme	Intelligent Energy Europe (IEE) - ALTENER	Coordinator
Key action	Promotion and dissemination projects	Telephone
Grant Agreement	IEE/13/477/SI2.675/01	E-mail
Start / end date	1 <sup>st</sup> March 2014 – 28 <sup>th</sup> February 2016	Website
		Begoña Ruiz (AINIA)
		+34 961366090
		bruiz@ainia.es
		www.biogas3.eu

## Feasibility of small-scale biogas plants to promote the installation of small scale biogas plant (ongoing)

### smallBIOGAS tool

*On-line tool, acces through website of the project [www.biogas3.eu](http://www.biogas3.eu)*

- Interface
- Report
- Functions

*Smallbiogas allows to analyze the technical, economical, environmental feasibility of a small biogas plant.*

*The tool generates a report that will serve the user in making decisions*





# BIOGAS<sup>3</sup> publications

## Handbook of small scale AD technology model

SUSTAINABLE SMALL-SCALE BIOGAS FROM AGRI-FOOD WASTE FOR ENERGY SELF-SUFFICIENCY

biogas<sup>3</sup>

Co-funded by the Intelligent Energy Europe Programme of the European Union  
Contract No: IEE-13-477

> HANDBOOK <

organic matter in the input materials: from 5 to 15%.

Main technical parameters:

- a rectangular, welded and airtight carbon steel tank (inside dimensions: 2.5 x 2.5 x 12 m;

Nominal power (kWel)	Price range (€)	O&M cost (Euro/year)
10 kW	75.000 - 100.000	3.000 - 6.000

biogas<sup>3</sup> 52

all-in-one

egmina, Infrastruktura, Energetyka Sp. z o.o.  
Established since: 2006

Zlota 54, 45-643 Opole  
POLAND

Tel/Fax: +48 77 416 70 84  
Mobile: +48 662 389 472

www.egie.pl  
kontakt@egie.pl

Number of small-scale plants sold this far: < 5

biogas<sup>3</sup> 98

> NITRATE LEACHING

EG91/676/EWG, Nitrates Regulation  
Wasserhaushaltsgesetz (WHG, §2, 44, 47)  
Oberflächengewässerverordnung (OGewV)  
Grundwasserverordnung (GrWV)

> RISK OF EMISSION OF METHANE AND AMMONIA DURING APPLICATION

DügemittelV (§6-Schadstoffgrenzwerte  
Contamination limits)  
Bundes-Immissionsschutzgesetz (BImSchG)

> ODOUROUS COMPOUNDS

Bundes-Immissionsschutzgesetz (BImSchG, §3)  
Codice Civile (gute landwirtschaftliche Praxis)

> TRANSPORT SYSTEM

Düngemittelverkehrskontrolle (DVK)  
Verordnung über das Inverkehrbringen und Befördern von Wirtschaftsdünger (WdüngV)

> REGULATIONS RELATED TO USE OF HEAT

Kraft-Wärme-Kopplungsgesetz (KWKG-Gesetz, §3  
Abs. 2; §4 Abs. 1, 4)  
EEG 2014 (§23)

Bundes-Bodenschutzgesetz (BBodSchG)  
Bundesnaturschutzgesetz (BNatSchG)  
Düngegesetz (DüngeG)

# Results from the use of the tool

*Some models of small biogas plants were made with help of the software tool developed in the project*

*The models were made with the same substrates and technology*

*It may show different results in different countries since the tool calculates parameters based on each country*

## > MODELS

WET Model (with CHP)	PAYBACK PERIOD (years)						
	Italy	Spain	Ireland	France	Sweden	Germany	Poland
30 kW no subsidies self consumption	no data*	no data*	no data*	no data*	no data*	no data*	no data*
30 kW no subsidies sale of energy	4,56	>15	11,40	>15	>15	>15	>15
30 kW 30% subsidies self consumption	no data*	no data*	no data*	no data*	no data*	no data*	no data*
30 kW 30% subsidies sale of energy	3,19	>15	7,98	11,01	>15	10,54	13,36
60 kW no subsidies self consumption	8,80	8,29	>15	>15	>15	14,14	>15
60 kW no subsidies sale of energy	5,33	>15	13,30	>15	>15	14,37	>15
60 kW 30% subsidies self consumption	6,16	5,80	12,26	>15	>15	9,90	>15
60 kW 30% subsidies sale of energy	3,73	>15	9,31	12,90	>15	10,06	>15
100 kW no subsidies self consumption	10,94	6,47	12,79	>15	>15	9,01	>15
100 kW no subsidies sale of energy	7,00	>15	10,17	>15	>15	9,09	>15
100 kW 30% subsidies self consumption	7,66	4,53	8,96	>15	>15	6,31	>15
100 kW 30% subsidies sale of energy	4,90	>15	7,12	11,71	>15	6,37	>15

DRY Model (with CHP)	PAYBACK PERIOD (years)						
	Italy	Spain	Ireland	France	Sweden	Germany	Poland
30 kW no subsidies self consumption	3,56	3,08	4,83	5,94	10,27	7,57	3,82
30 kW no subsidies sale of energy	2,25	6,40	3,82	2,90	9,97	6,68	3,09
30 kW 30% subsidies self consumption	2,49	2,15	3,38	4,16	7,19	5,30	2,68
30 kW 30% subsidies sale of energy	1,58	4,48	2,67	2,03	6,98	4,68	2,16
60 kW no subsidies self consumption	>15	>15	>15	>15	>15	>15	>15
60 kW no subsidies sale of energy	3,15	>15	>15	8,34	>15	>15	>15
60 kW 30% subsidies self consumption	>15	>15	>15	>15	>15	>15	>15
60 kW 30% subsidies sale of energy	2,21	>15	>15	5,84	>15	>15	>15
100 kW no subsidies self consumption	no data*	no data*	no data*	no data*	no data*	no data*	no data*
100 kW no subsidies sale of energy	3,73	>15	10,93	11,21	>15	11,72	>15
100 kW 30% subsidies self consumption	no data*	no data*	no data*	no data*	no data*	no data*	no data*
100 kW 30% subsidies sale of energy	2,61	>15	7,65	7,85	>15	8,21	>15

\* the defined needs of energy are higher than the production of energy from biogas (the software SmallBiogas does not generate results in such cases)

# Biogas<sup>3</sup> On-line Training



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

**Biogas 3 Español**

Dashboard > Interactive > Biogas\_3 > biogas3ES > Topic 4 > Capítulo 4 - Economía de las plantas de biogás a pequeña escala

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**Administration**

**7. Modelo digestión por vía húmeda - 30 kWel**

Las dos secciones siguientes representan modelos teóricos de plantas de biogás a pequeña escala, y han sido desarrollados por la herramienta de cálculo de BIOGAS3 smallBiogas. Esta herramienta permite desarrollar un estudio de viabilidad, para evaluar el rendimiento económico antes de implementar una planta de biogás en una granja. Para realizar un estudio de viabilidad, visite por favor este [LINK](#) y pida asesoramiento al socio en su país de BIOGAS3.

Se estudia un modelo para una granja de queso. Los sustratos disponibles son las deyecciones de cien vacas lecheras (estiércol y purín) así como los subproductos industriales y los residuos de la producción de queso de dichas vacas (suero de queso y residuos del queso). Estos sustratos alimentan un digestor de tecnología húmeda. El biogás obtenido se utilizará como combustible en un motor [CHP](#), cuya producción de energía eléctrica y térmica se venderá a la red de distribución.

Los sustratos introducidos anualmente en el digestor son:

- 785 t de estiércol de vaca lechera
- 1507 t de purín de vaca lechera
- 819 t de suero
- 6 t de residuos del queso

La siguiente tabla muestra la cantidad de residuos introducidos en el digestor, y los parámetros más importantes relacionados con la producción de biogás, los costes, los ingresos, el plazo de amortización y la contribución al ahorro de emisiones de CO<sub>2</sub>.

Análisis de un modelo digestión por vía húmeda - 30 kWel		
Input	Cantidad de residuos en el digestor (material fresca)	3.117 ton/año
	Cantidad de residuos en el digestor (material seca)	391 ton/año
	Cantidad de residuos en el digestor (material seca orgánica)	319 ton/año
Características de la planta	Volumen del digestor	401 m <sup>3</sup>
	Tiempo de Retención Hidráulica	45 días

**REGISTER TO THE ON-LINE TRAINING THROUGH PROJECT WEBSITE (IN SEPTEMBER)**







Website: [www.biogas3.eu](http://www.biogas3.eu)



**WEBSITE: Follow-up of all the activities of the project**



Co-funded by the Intelligent Energy Europe Programme of the European Union

[www.biogas3.eu](http://www.biogas3.eu)

Thank you for your attention



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