General data

Company
LJMU
Date
29/10/2016

The aim of BIOGAS3 project is to promote the sustainable production of renewable energy from the biogas obtained of agricultural residues and food and beverage industry waste in small-scale concept for energy self-suffiency. This project is co-funded by the Intelligent Energy Europe Programme of the European Union, Contract Nº:IEE/13/SI2.675801.

smallBIOGAS is a software tool to develop economic and sustainability analysis in order to evaluate the viability of small-scale anaerobic digestion installations (ca. or less than 100 kWel; 372308 m3biogas/year, 65% CH4). The tool is adapted to the conditions of all participating countries of the project (France, Germany, Ireland, Italy, Poland, Spain and Sweden).

The results obtained from the use of this calculation tool are intended to provide the user with a guide about the viability of a small-scale biogas plant. The authors recommend further consultation with expert centres before investing in any biogas facility. The authors and promoters of this software tool accept no responsibility for any damages resulting from the use made of the tool smallBIOGAS.

Input from user

Output from smallBIOGAS tool

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

Country	Spain	
Administrative division	Cataluña | Lérida	
Annual average temperature	14,7	ºC
Percentage of wastes located at a distance equal or less than 10 km from the agro-food company	100	%
Percentage of wastes located at a distance higher than 10 km from the agro-food company	0	%

Biogas production process data

Anaerobic digestion process	Wet	
Annual amount of waste introduced in the digester (fresh matter)	13.150,00	t/year
Annual amount of waste introduced in the digester (dry matter)	4.152,70	t/year
Annual amount of waste introduced in the digester (dry organic matter)	3.260,32	t/year
Annual amount of organic matter degraded	2.416,08	t/year
Needs of dilution water (only for wet digestion processes)	12.384,11	m3/year
Digestate recirculation rate	16,44	%
Needs of waste in terms of dry matter to concentrate (only for dry digestion)	0	t/year
Total amount of digestate produced (fresh matter)	23.036,46	t/year
Volume of anaerobic digester	4.133,44	m³
Hydraulic retention time	50,17	days
Thermal energy required for the heating of the anaerobic digester	947,50	MWh/year
Gross methane production (annual)	1.086.705,52	Nm3/year
Gross biogas production (annual)	1.848.348,52	Nm3/year
Gross biogas production (average per hour)	211,00	Nm3/h

Excessive digestate recirculation (if recirculation rate is >30%)	No
Ammonia inhibition risk	No
C/N ratio out of range	C/N too low (15)

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Use of the biogas 1 (Co-generation)

Data of the biogas valorisation system

Use of biogas in	Co-generation	
Use of produced electric energy	Sale	
Use of produced thermal energy	Self-consumption	
Use of produced biomethane	No	
Needs of thermal energy near to the biogas plant	175,00	MWh/year
Needs of electric energy near to the biogas plant	0,00	MWh/year
Production of electricity in cogeneration	3.247,06	MWh/year
Electric power installed in cogeneration system (CHP)	426,18	kW
Thermal energy production in cogeneration	4.919,79	MWh/year
Unrecovered thermal energy in cogeneration system	3.797,29	MWh/year
Thermal recovery coefficient of the cogeneration system	0,416	
Energy efficiency coefficient of the cogeneration system	0,386	
Investment in cogeneration system	506.463,37	€
Income or savings (sale or use of the electricity)	162.352,99	€/year
Income or savings (sale or use of the thermal energy)	6.825,00	€/year

Energy storage

Volume of the gasometer	2531,98	m³
Self-consumed energy	0 e | 22,82 t	%

Comments

Storage volume calculated to cover hours in which biogas is not utilized. There is unused biogas in self-consumption by the agro-food company (Pe>Ne y/o Pt>Nt) and which could be assigned to sale to third parties

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Economic viability analysis. Investment project

Investment	1.787.290,80	€
Biogas plant	1.280.827,43	€
Biogas valorisation system	506.463,37	€
Other	0,00	€
Income	192.675,18	€/year
Sale of Electricity, Thermal energy	162.352,99	€/year
Energy savings	6.825,00	€/year
Waste management	0,00	€/year
Other incomes	0,00	€/year
Sale or saving (sale or use) of digestate	23.497,19	€/year
Selling price of electric energy	5,00	c€/kWh
Selling price of thermal energy	0,00	c€/kWh
Selling price of biomethane	0,00	c€/kWh
Expenses	122.513,14	€/year
Operating and maintenance (O&M)	38.535,04	€/year
Staff	10.178,10	€/year
Transport and handling of waste	36.300,00	€/year
Cost of waste (co-substrates)	37.500,00	€
Transport of digestate	0,00	€
Other expenses	0,00	€/year
O&M as percentage of the sale of products and energy savings	20,00	%
Labour intensity	0,0002	h/t·d
Labour cost	15,00	€/h
Days worked per year	258,00	working day
Unit handling cost	2,00	€/t

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Economic viability analysis. Financial study of the investment project.

Financing	1.787.290,80	€
Subsidies	1.697.926,26	€
Own funding	26.809,36	€
Loans	62.555,18	€
Percentage of subsidies	95,00	%
Percentage of own funding	1,50	%
Percentage of loan	3,50	%
Interest rate of loan	4,70	%

Financial indicators

Gross operating profit or earnings before interest, taxes, depreciation and amortization (EBITDA)	70.162,04	€/year
Net present value (NPV)	596.406,43	€
NPV/initial investment	6,674	-
Internal return rate (IRR)	68,55	%
Payback period	1,27	years
Weighted Average Cost of Capital (WACC)	5,90	%
Capital Recovery Factor (CRF)	10,23	%

Environmental viability analysis

Primary energy obtained from the recovery of the biogas	4.174,73	MWh/year
Savings of CO2 emissions	1.160,58	t/year
Savings in artificial fertilizers	108360	kgN/year
Utilization of the digestate in	Vulnerable area	
Cultivation area required for application of digestate	637,41	ha

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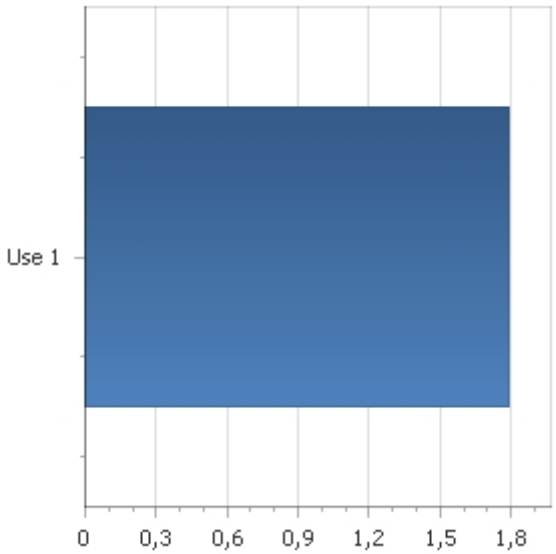
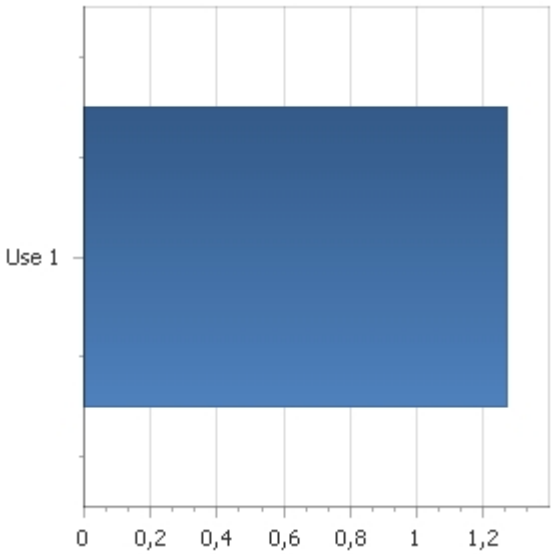
Overview

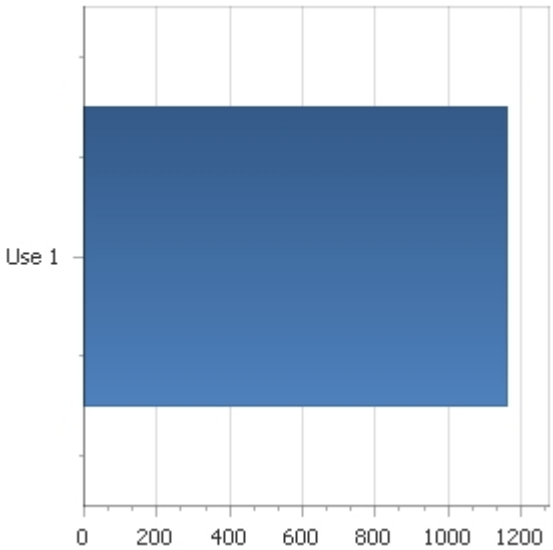
Investment (M€)



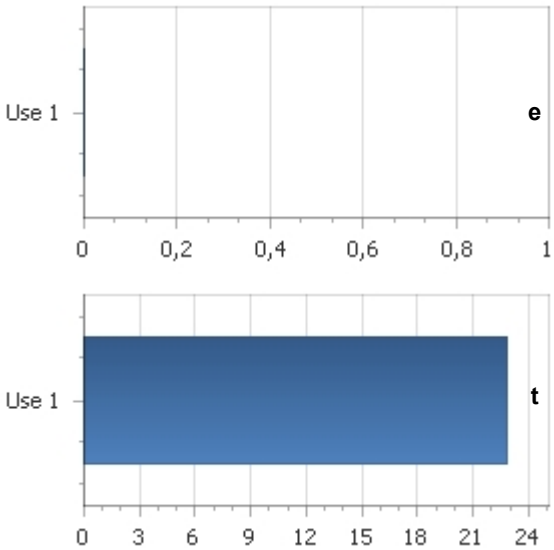
Payback period (years)



CO2-eq emissions savings (t/year)



Self-consumed energy (%)



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