

# Biogas Technology GmbH

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# BioGas Technology GmbH

- *Current situation*
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## About Garcia GbR

- *Automated Farm Facility*
- *1000 milker Cows*
- *100 hectares*
- *Electricity*
  - *to drive the milking machines*
  - *illumination.*
- *In the winter*
  - *Barns must then be heated*



## About Garcia GbR

- *Lots of liquid manure accumulated!!!*

$$1000 \text{ Milkers} \times 55 \frac{\text{kg}}{\text{day}} = 55000 \frac{\text{kg}}{\text{day}}$$



35 kg/day  
Water

55 kg/day  
Liquid  
Manure

15 kg/day  
Milk

35 kg/day  
Food



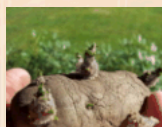
## About Schulz GbR

- *Potato Farm*
- *400 hectares*
- *Storage capacity of 20000 Ton*
- *Potatoes need*
  - *To be stored at a constant temperature ( 8 °C)*
  - *During a period of up to 9 months*
- *Electricity, Cooling and Heating Needed!!*



## About Schulz GbR

- *Biological Waste Produced:*



85-90% To Market



10-15% Rotten



Green parts of the potatoes

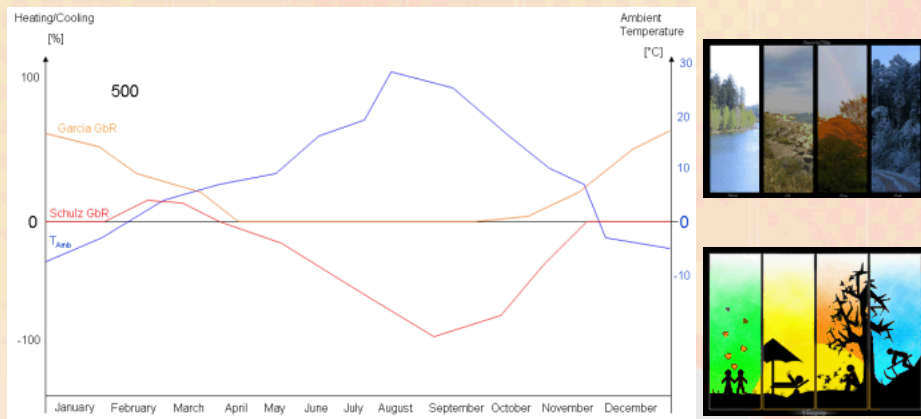
$$\text{Biomass Rotten} = 20000 \text{ Ton} \times \frac{5}{100} = 1000 \frac{\text{Ton}}{\text{year}}$$

$$\text{Biomass Green} = 20000 \text{ Ton} \times \frac{30}{100} = 6000 \frac{\text{Ton}}{\text{year}}$$

$$\frac{1000 \text{ Ton} + 6000 \text{ Ton}}{365 \text{ days}} = \frac{7000 \text{ Ton}}{365 \text{ days}} \approx 20 \frac{\text{Ton}}{\text{day}} \approx 0,8 \frac{\text{Ton}}{\text{hour}}$$



# Energy heating And Cooling



à A large amount of energy is needed for cooling and heating

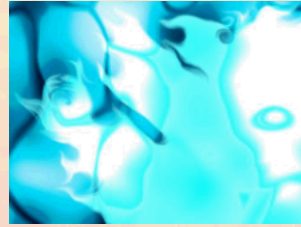
# Location

- Rumania- Few km from Bukarest.



## About Sonnek GmbH

- Carbon-Dioxide emission trading
- Consulting of affected companies
- Emission certificates
- Generates certificates from:
  - Reduction of emission Projects
  - Certificates are sold:
    - To investing companies for fixed prices
    - In European Market

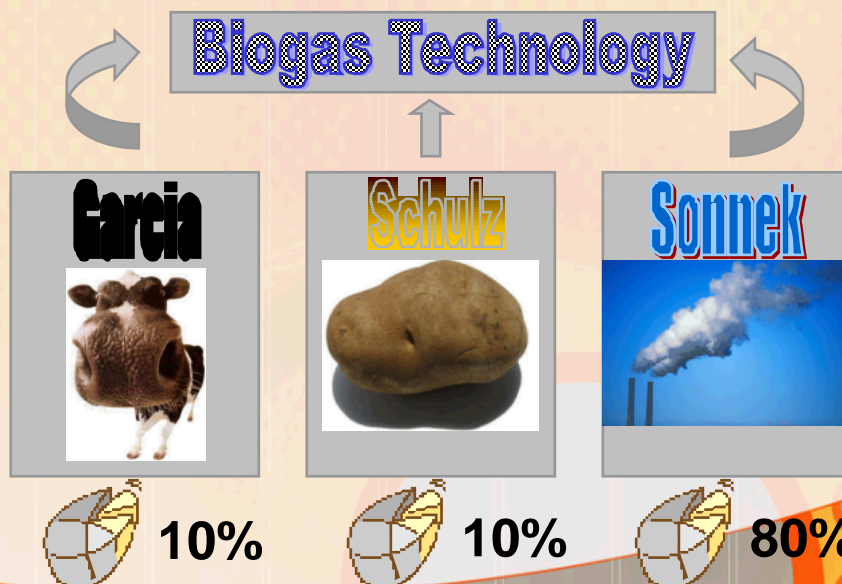


Fredric



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## About Biogas Technology GmbH



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**Processes &  
Technology**

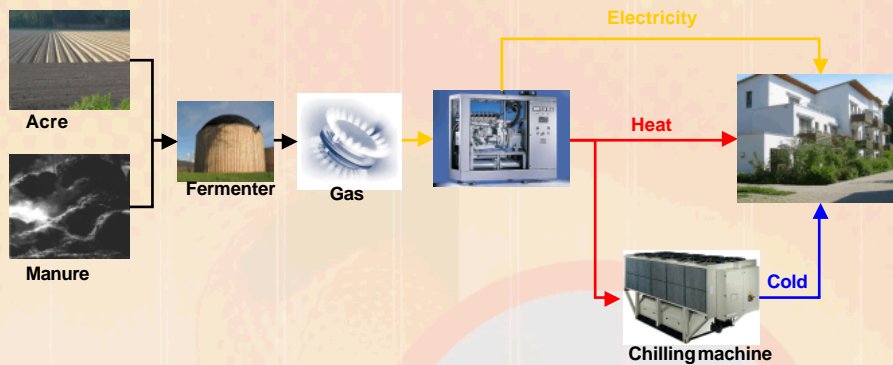


# Biogas Technology GmbH

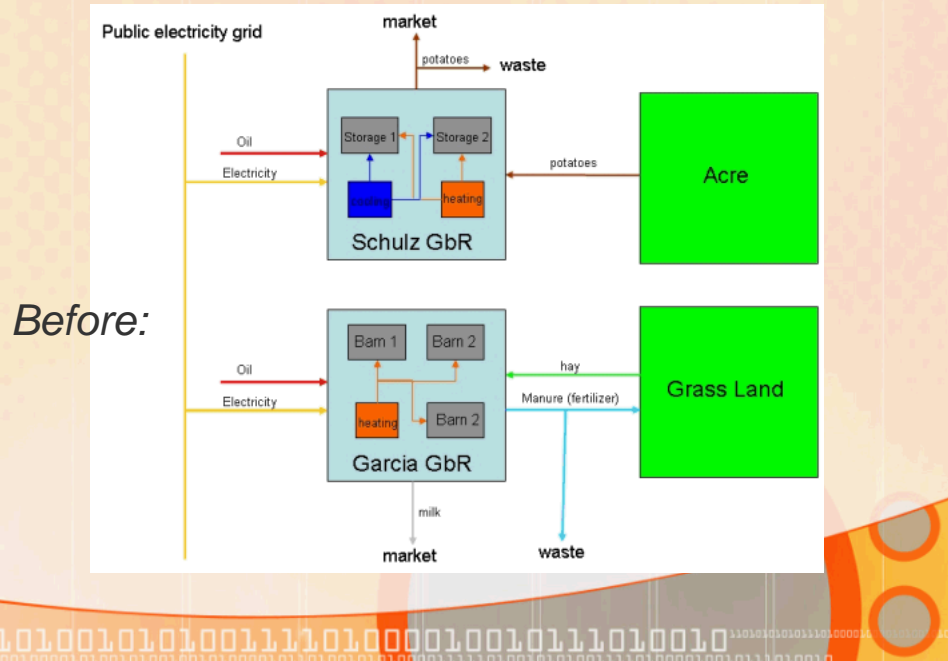
*Technical Background and investment costs*



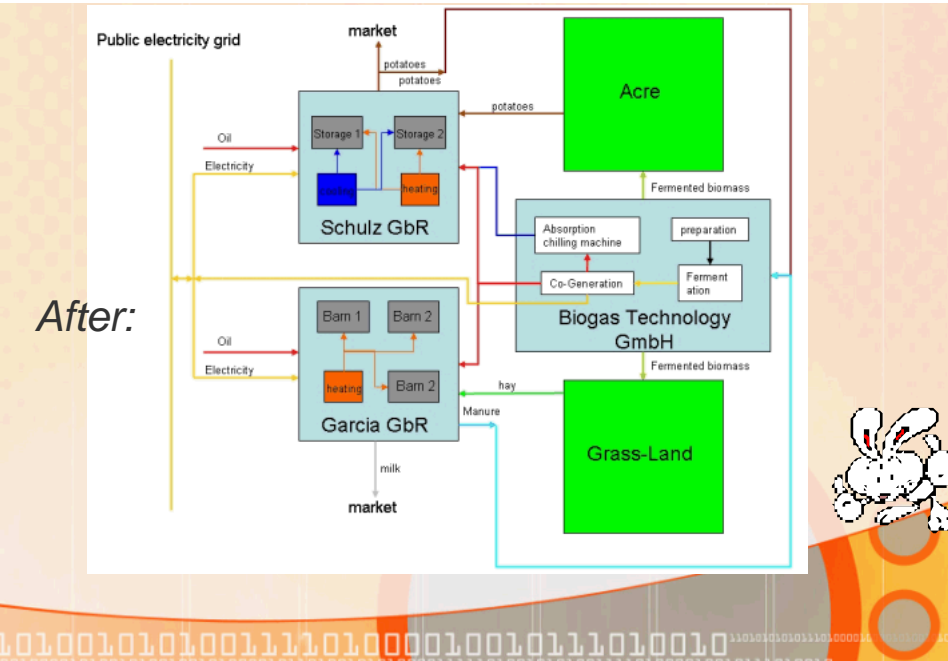
## Biogas production process



# Old Scenario



# New Scenario



## Biogas Facilities



© Schmack Biogas AG



## Fermenter

Rotten potatoes:  $2,52 \frac{\text{m}^3}{\text{days}} \times 40 \text{ days} = 100 \text{ m}^3$

Potato haulm:  $12,3 \frac{\text{m}^3}{\text{days}} \times 50 \text{ days} = 615 \text{ m}^3$

Liquid manure:  $46 \frac{\text{m}^3}{\text{days}} \times 30 \text{ days} = 1380 \text{ m}^3$

Theoretical Volume =  $2095 \text{ m}^3 \approx 2100 \text{ m}^3$



## Investment Costs (I): Building

	Cost Position		
<b>Building</b>			
1	Granular subbase		
2	Bio-reactor		
3	Heat insulation		
4	Gas line		
5	Gas storage		
6	Substrate line		
7	Granary		
<b>Techniques</b>			
8	Heating		
9	Pump		
10	Gas preparation		
11	Electrical installation		
12	Tube extruder		
13	Sensors		
14	Controller		
=	$23182 \text{ €} + 98 \frac{\text{€}}{\text{m}^3} \times \text{Fermenter Volume}$		
<b>Total fermenter costs</b>	$23182 \text{ €} + 98 \frac{\text{€}}{\text{m}^3} \times 2100 \text{ m}^3$		<b>228 982,00 €</b>
<b>Depreciation costs</b>	<b>16 years</b>		<b>14 311,38 €</b>



## Produced Biogas

Rotten potatoes:  $1000 \frac{\text{ton}}{\text{year}} \times 180 \frac{\text{m}^3}{\text{ton}} = 180'000 \frac{\text{m}^3}{\text{year}}$

Potato haulm:  $6000 \frac{\text{ton}}{\text{year}} \times 90 \frac{\text{m}^3}{\text{ton}} = 540'000 \frac{\text{m}^3}{\text{year}}$

Liquid manure:  $1000 \text{ milkers} \times 1,1 \frac{\text{m}^3}{\text{milkers-days}} \times 365 \text{ days} = 405'150 \frac{\text{m}^3}{\text{year}}$

Total gas Production:  $540000 \frac{\text{m}^3}{\text{year}} + 180000 \frac{\text{m}^3}{\text{year}} + 405150 \frac{\text{m}^3}{\text{year}} = 1'125'150 \frac{\text{m}^3}{\text{year}}$

Power =  $1'125'150 \frac{\text{m}^3}{\text{year}} \times 6 \frac{\text{kWh}}{\text{m}^3} \times \frac{91,78}{100} = 6'195'976 \frac{\text{kWh}}{\text{year}}$

à Energy consumption of a normal house = 30'000 kWh





## Investment Costs (II): Machinery

		Cost Position	
<b>Co-Generator equipment</b>			
1	Engine equipment		
2	Heat line		
3	Electrical installation		
4	Sonic insulated site		
5	Emergency cooling system		
=	$23182 \text{ €} + 283 \frac{\text{€}}{\text{kW}} \times \text{rated engine power}$		
<b>Equipment costs</b>	$11870 \text{ €} + 283 \frac{\text{€}}{\text{kW}} \times 375 \text{ kW}$		<b>117995,00 €</b>
<b>Tri-Generator</b>			
1	Gas-Engine (300 € x kW) with Generator		112 500,00 €
1	200 kW Absorption freezing machine		50 000,00 €
<b>Tri-Generator costs</b>			<b>162500</b>
<b>Machinery costs</b>			<b>280 495,00 €</b>
<b>Depreciation costs</b>			
Equipment	16 years		10 500,00 €
Engine	10 years		11 250,00 €
<b>Depreciation costs</b>			<b>21 750,00 €</b>



## Co-Fermentation

- Using other biomass than liquid manure is called **Co-Fermentation**
- Biomass that is used as **Co-Substrates** often needs special treatment:
  - Crushing
  - Preparation
  - Pasteurization



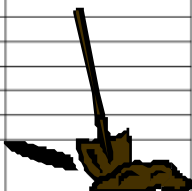
à Additional installations are required to process all parts of the potato in the biogas facility

à **This leads to additional costs**

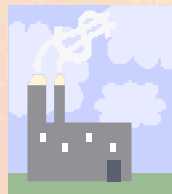


## Investment Costs (III): Co-Fermentation and Off-Sites



	Cost Position	
1	Storage room	
2	Substrate preparation	
3	Substrate crushing	
4	Pasteurizing	
5	Additional pumps	
=	$10983 \text{ €} + 4055 \frac{\text{€}}{\text{m}^3 \cdot \text{day}} \times \text{volume co-substrate}$	
<b>Total Co-Fermentation and Off-sites</b>	$10983 \text{ €} + 4055 \frac{\text{€}}{\text{m}^3 \cdot \text{day}} \times 14,8 \text{ m}^3 \cdot \text{day}$	<b>70 997,00 €</b>
<b>Depreciation costs</b>	16 years	<b>4 437,31 €</b>

## Total Investment Costs



<b>Cost Position</b>			
Fermenter costs	228 982,00 €		14 311,38 €
Machinery costs	280 495,00 €		21 750,00 €
Co-Fermentation costs	70 997,00 €		4 437,31 €
Unexpected	10 000,00 €		-
<b>Total investment costs</b>	<b>590 474,00 €</b>	<b>Total depreciation costs</b>	<b>40 498,69 €</b>

## Investment analysis



# Biogas Technology GmbH

## Emission Trading



## Generated Emission Reduction Units

Business as usual scenario:

Emittent	CO <sub>2</sub> -Emissions [tCO <sub>2</sub> ]
Schulz GbR	1423,35
Garcia GbR	451,6 tCO <sub>2</sub>
<b>Total Emission</b>	<b>1875 tCO<sub>2</sub></b>



Improved scenario:

Emittent	CO <sub>2</sub> -Emissions [tCO <sub>2</sub> ]
Schulz GbR	63,6
Garcia GbR	96,6
<b>Total Emission</b>	<b>160,2 tCO<sub>2</sub></b>



→ **1715** Emission Reduction Units per year will be generated



## Benefit from Emission Trading

- A JI-Projects runs over a maximal period of 7 years
- Consequently 7 times the annual amount of ERUs can be obtained:

$$1715 \frac{\text{tCO}_2}{\text{year}} \times 7 \text{ years} = 12005 \text{ tCO}_2 = 12005 \text{ ERUs}$$



- Taking into account a price of 20,00 € per ERU, the benefit can be calculated:

$$12005 \text{ ERUs} \times 20 \frac{\text{€}}{\text{ERU}} = 240'100,00 \text{ €}$$



- This profit is however not sold as a regular product
- But Sonnek GmbH is investing the 240'100,00 € into the company
- and will consequently obtain the exclusive rights on selling the ERUs

## Investment analysis



# Biogas Technology GmbH

## Financing & Cost Calculation

## Financing Costs

$$590474,00\text{€} - 240100,00\text{€} = 350'374,00\text{€}$$



Year	Remaining debt	Interest fee costs	Payback	Overall Pay
1	350,374.00 €	24,526.18 €	0.00 €	23,826.18 €
2	350,374.00 €	24,526.18 €	23,358.27 €	47,884.45 €
3	317,682.40 €	22,891.10 €	23,358.27 €	46,249.37 €
4	294,990.80 €	21,256.02 €	23,358.27 €	44,614.29 €
5	272,299.20 €	19,620.94 €	23,358.27 €	42,979.21 €
6	249,607.60 €	17,985.87 €	23,358.27 €	41,344.13 €
7	226,916.00 €	16,350.79 €	23,358.27 €	39,709.05 €
8	204,224.40 €	14,715.71 €	23,358.27 €	38,073.97 €
9	181,532.80 €	13,080.63 €	23,358.27 €	36,438.90 €
10	158,841.20 €	11,445.55 €	23,358.27 €	34,803.82 €
11	136,149.60 €	9,810.47 €	23,358.27 €	33,168.74 €
12	113,458.00 €	8,175.39 €	23,358.27 €	31,533.66 €
13	90,766.40 €	6,540.31 €	23,358.27 €	29,898.58 €
14	68,074.80 €	4,905.24 €	23,358.27 €	28,263.50 €
15	45,383.20 €	3,270.16 €	23,358.27 €	26,628.42 €
16	22,691.60 €	1,635.08 €	23,358.27 €	24,993.35 €

Financing costs = 220 735.62 €

## Raw Material Costs



	Cost Position	Price [€/m³]	Annual demand [m³/year]	Costs
1	Liquid manure	2	16 790	33580,00 €
2	Rotten potatoes	1	920	920,00 €
3	Potato haulm	0,5	4500	2250,00 €
<b>Total raw material costs</b>				<b>36 750,00 €</b>

## Labor Costs



	<i>Cost Position</i>	<i>Wage [€/h]</i>	<i>Annual demand [h/year]</i>	<i>Costs [year]</i>
1	CEO			18000,00€*
2	Labour	4	350	1400,00 €
<b>Total labour costs</b>				<b>19400,00 €</b>

## Additional Expenses



	<i>Cost Position</i>	<i>Price</i>	<i>Costs</i>
1	Assurance	0,5 [% of Investment costs]	2952,37 €
<i>Maintenance</i>			
2	Building	1 [% of Building costs]	2289,82 €
3	Equipment	1 [% of Equipment costs]	1179,95 €
4	Chilling machine	1 [% of machine costs]	500,00 €
5	Engine	10 [% of Engine costs]	11250,00 €
6	Rental fee	500 € per month	6000,00 €
<b>Additional costs</b>			<b>24 172,14 €</b>

## Estimated Production

For electricity

$$2063260 \frac{\text{kWh}}{\text{year}} \times 0,07 \frac{\text{€}}{\text{kWh}} = 144\,428 \frac{\text{€}}{\text{year}}$$



For heat

$$579396 \frac{\text{kWh}}{\text{year}} \times 0,040 \frac{\text{€}}{\text{kWh}} = 23\,175,84 \frac{\text{€}}{\text{year}}$$



For cooling energy

$$1075200 \frac{\text{kWh}}{\text{year}} \times 0,060 \frac{\text{€}}{\text{kWh}} = 64\,512,00 \frac{\text{€}}{\text{year}}$$



## Equivalent cost calculation

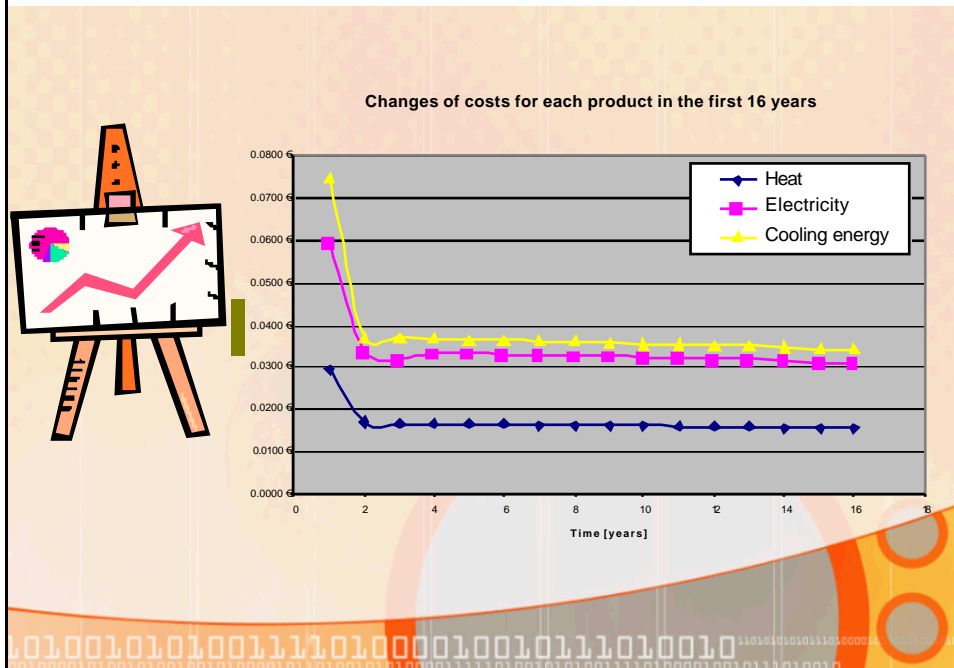
Division with equivalents for raw material costs for the first year					
Total costs: 36,750.00 €					
Sort	1 Equivalent	2 Qty. Produces [kWh]	3 Units of account 1*2	4 Units costs [€/kWh] Unit of all * 1	5 Total costs per sort
Heat	0.5	1,738,189.00	869,094.50	0.004	7,478.58 €
Electricity	1.0	2,063,260.00	2,063,260.00	0.009	17,754.41 €
Cooling energy	1.1	1,216,732.00	1,338,405.20	0.009	11,517.01 €
			4,270,759.70		36,750.00 €
Unit of all=	Total costs	36,750.00 €	=	0.01	
	Total Qty. Produced	4,270,759.70			

For the following cost calculation it is necessary to give all products equivalents

The division of the costs through the sum of all quantities times the respective equivalent gives the "Unit of all"

To get the cost of each unit one has to multiply the "Unit of all" times the given equivalents

# Sum of Costs



## Cash-Flow Calculation

Cash flow calculation: 16 years

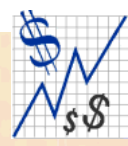
	1. Year	2. Year	3. Year	4. Year	5. Year	6. Year	7. Year	8. Year
Turnover	185,479.84 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €
Depreciation costs	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €
Raw material costs	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €
Labor costs	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €
Additional costs	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €
Financing costs	23,826.18 €	47,894.45 €	46,249.37 €	44,614.29 €	42,979.21 €	41,344.13 €	39,709.05 €	38,073.97 €
Brutto	111,107.17 €	118,254.40 €	119,889.48 €	121,524.56 €	123,159.64 €	124,794.72 €	126,429.80 €	128,064.88 €
Corporate tax (50%)	0.00 €	59,127.20 €	59,944.74 €	60,762.28 €	61,579.82 €	62,397.36 €	63,214.90 €	64,032.44 €
Netto	0.00 €	59,127.20 €	59,944.74 €	60,762.28 €	61,579.82 €	62,397.36 €	63,214.90 €	64,032.44 €
Cash flow (net+depr.)	39,331.52 €	99,625.89 €	100,443.43 €	101,260.97 €	102,078.51 €	102,896.05 €	103,713.59 €	104,531.13 €
Repayment credit	0.00 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €
DIVIDEND	39,331.52 €	76,934.29 €	77,751.83 €	78,569.37 €	79,386.91 €	80,204.45 €	81,021.99 €	81,839.53 €

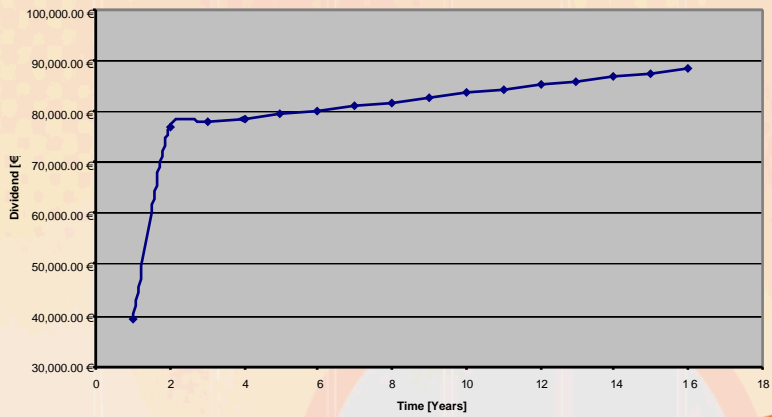
Cash flow calculation: 16 years

	9. Year	10. Year	11. Year	12. Year	13. Year	14. Year	15. Year	16. Year
Turnover	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €	286,959.68 €
Depreciation costs	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €	40,498.69 €
Raw material costs	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €	36,750.00 €
Labor costs	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €	19,400.00 €
Additional costs	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €	24,172.14 €
Financing costs	36,438.90 €	34,803.82 €	33,168.74 €	31,533.66 €	29,898.58 €	28,263.50 €	26,628.42 €	24,993.35 €
Brutto	129,699.95 €	131,335.03 €	132,970.11 €	134,605.19 €	136,240.27 €	137,875.35 €	139,510.43 €	141,145.50 €
Corporate tax (50%)	64,849.98 €	65,667.52 €	66,485.06 €	67,302.60 €	68,120.13 €	68,937.67 €	69,755.21 €	70,572.75 €
Netto	64,849.98 €	65,667.52 €	66,485.06 €	67,302.60 €	68,120.13 €	68,937.67 €	69,755.21 €	70,572.75 €
Cash flow (net+depr.)	105,348.67 €	106,166.21 €	106,983.75 €	107,801.29 €	108,618.82 €	109,436.36 €	110,253.90 €	111,071.44 €
Repayment credit	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €	22,691.60 €
DIVIDEND	82,657.07 €	83,474.61 €	84,292.15 €	85,109.69 €	85,927.22 €	86,744.76 €	87,562.30 €	88,379.84 €

## Evolution of the dividend



Evolution of the dividend



## Equity profitability

Equity profitability			
	1. Year	2. Year	3. Year
Partners equity	300,100.00 €	300,100.00 €	300,100.00 €
Net-profit	0.00 €	59,127.20 €	59,944.74 €
Total	300,100.00 €	359,227.20 €	360,044.74 €
Dividend	39,331.52 €	76,934.29 €	77,751.83 €
Profit made in % Partners equity	13.11	21.42	21.60



## Conclusion

- *The overall costs and profit calculation shows that the company BiogasTechnology GmbH is a profitable organization*

Thank you for your attention!