

# Businessplan for the „LRG Bioheat GmbH“

Businessadministration  
WS2013/14

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What 's the idea?

Conditions and Decissions

Generell Calculations

System, Investments & Co

Financing & Refunding

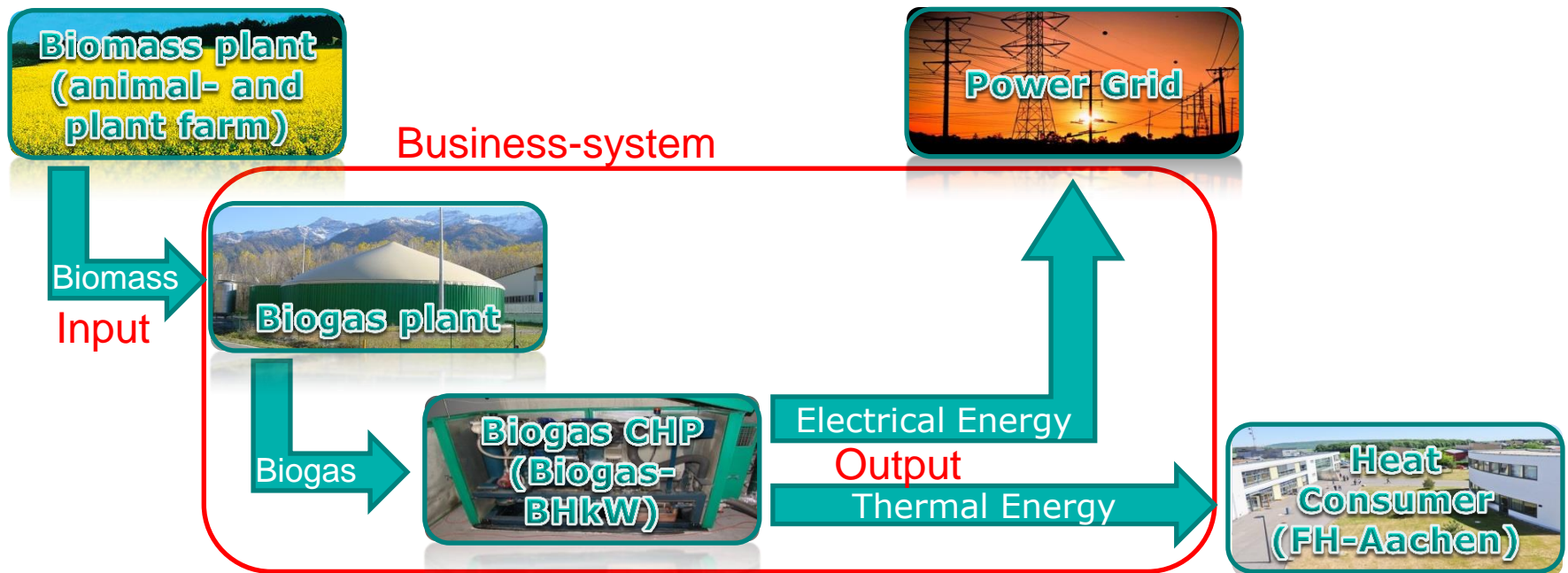
Cost Calculation

Conclusion

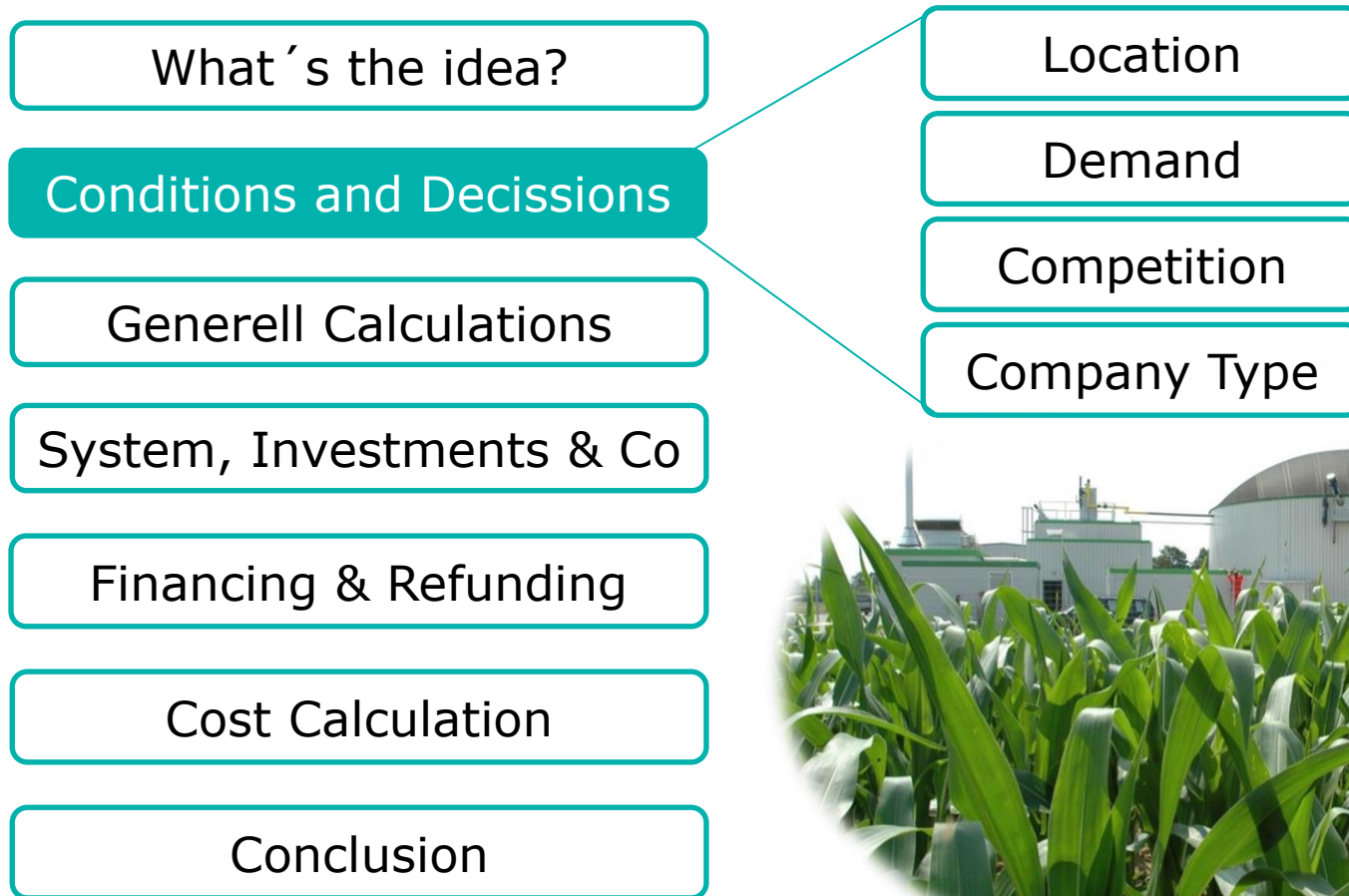


# What 's the idea?

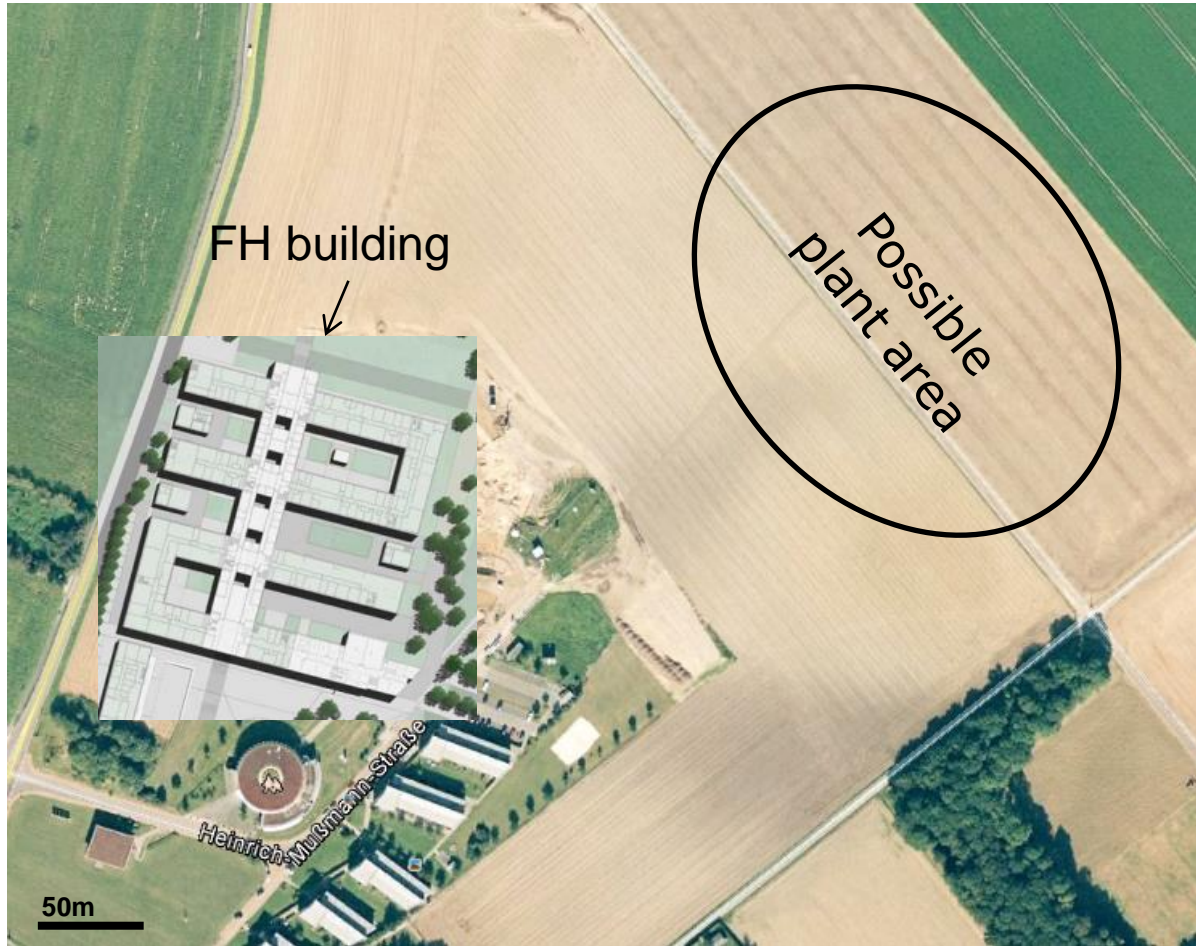
- Providing heat with a biogas plant
- Customer: FH-Aachen (Jülich)
- Considering the following system:



# Agenda



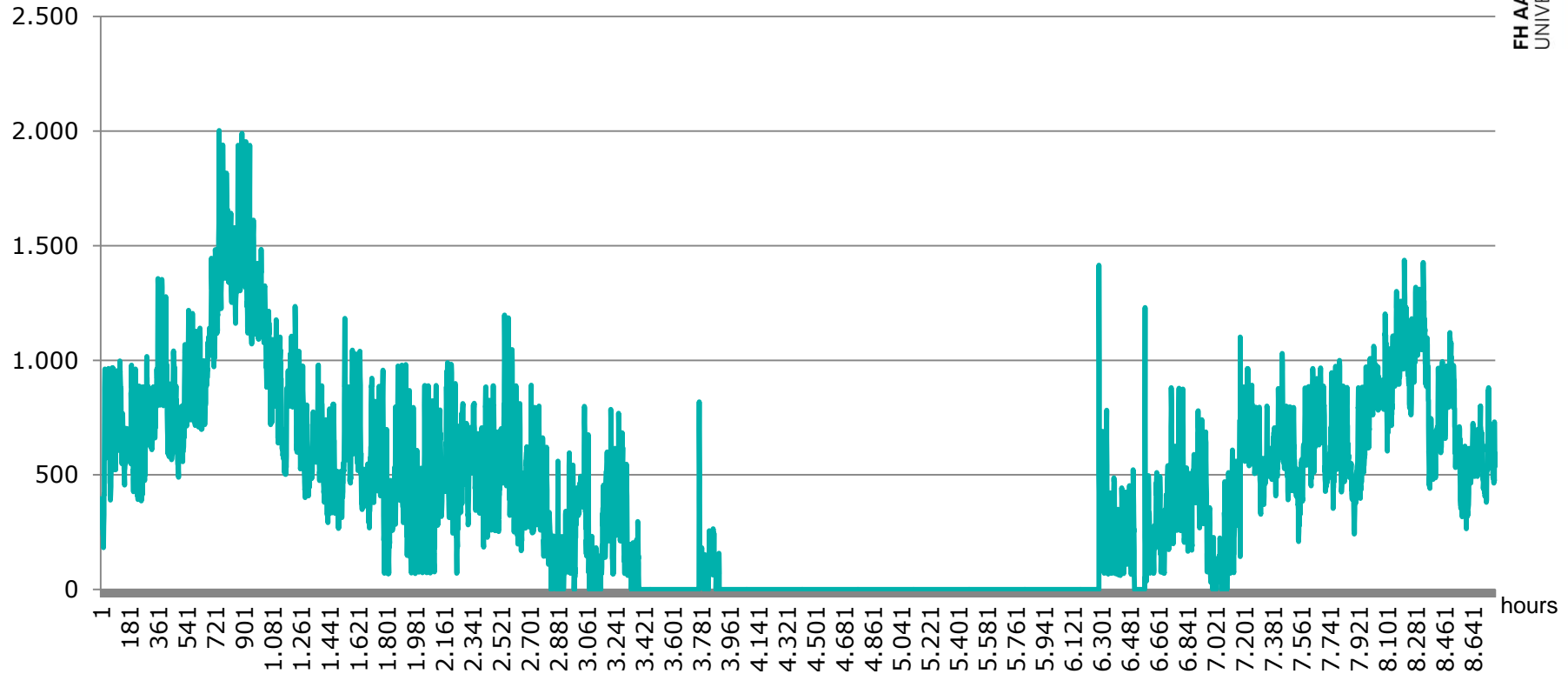
# Location of the FH-Aachen



[Google Earth]

# The demand of heat

hour values of heat consumption 2012 [kW]



Total heat consumption in 2012: 3.505 MWh

(in 2011: 2.654 MWh; 32 % higher in 2012)

- The FH-Aachen is getting their heat via two gas condensing boilers
- Usual price for the heat (roughly)
  - > 2011: 83 €/MWh
  - > 2012: 90 €/MWh

The usual heat price increases over the years

- There are no other significant biogas plants nearby



- To provide heat as a product out of a business, a GmbH Company will be founded
- The decision to found a limited Company is linked to certain risks shown in *the conclusion*
- Administration Office: *FH Aachen, Campus Jülich* Heinrich-Mußmann-Straße 1 52428 Jülich
- We (the founders) will bring 30.000 € to register the company and lead the company as the board of directors.  
As shown later, more money needs to be collected to run the business. All shareholders will be the owners assembly



- The „LRG Bioheat GmbH“ will be founded to provide heat out of Biomass
- Therefore, we invest in a biogasplant and in a CHP to produce the heat. The electricity will be fed into the powergrid to get a refunding with respect to the EEG
- Customer of this business is the FH-Aachen in Jülich, which had a heat-demand of more than 3.500 MWh in 2012

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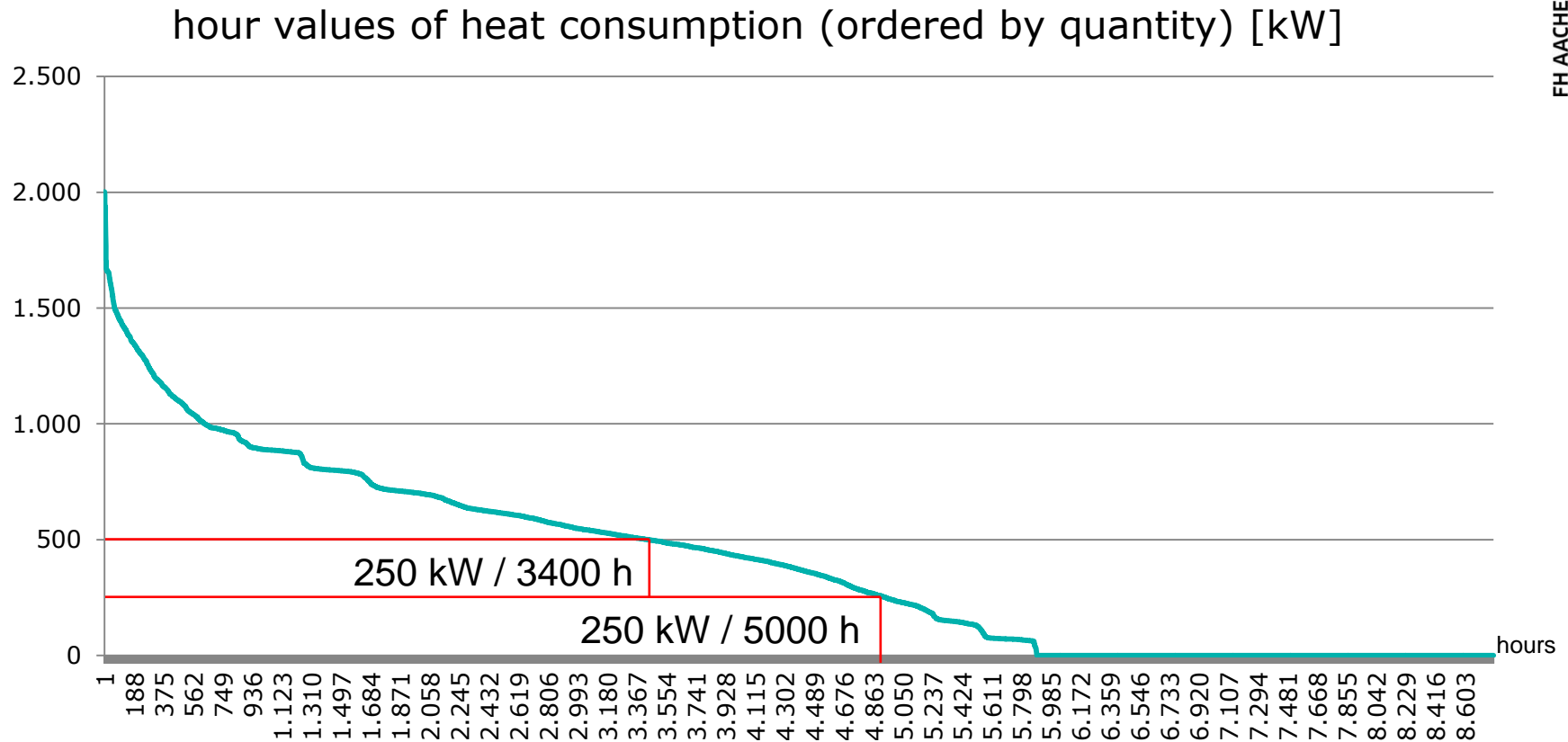
Conclusion

CHP Type

Amount of Biomass



# The demand of heat in order



- CHP engines have to run constantly for proper operation
- Two CHP's will be installed

# The power of the CHPs?

- 250 kW<sub>th</sub> for one CHP in 2012
- An 15% increase of heat consumption is predicted  
-> 250kW<sub>th</sub> /0,85 ≈ 294 kW<sub>th</sub>
- The plant needs 25% for itself  
-> 294kW<sub>th</sub> /0,75 ≈ 392 kW<sub>th</sub>

Chosen CHP type:

Company:	IET Energy GmbH
Type:	IET BIO 400 V01
Motor:	Otto-Motor
el. Power:	400 kW <sub>el</sub>
th. Power:	398 kW <sub>th</sub>
gas Power:	941 kW

=>

	CHP 1	CHP 2	Total
Load hours [h]	5000	3400	
Heatproduction [MWh <sub>th</sub> ]	1.990	1.353,2	3.343,2
Can be provided [MWh <sub>th</sub> ]:			2.507,4
Electricity production [MWh <sub>el</sub> ]	2.000	1.360	3.360
Gas Energy [MWh]	4.705	3.199,4	7.904,4

el: electrical    th: thermal

# How much Biogas and Biomass to use?

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- The Biogas plant will be a NawaRo-Biogas plant  
=> 10% manure, 90% corp (Methancontent: 52%)
- Heatvalue of Methane:  $9,94 \text{ kWh}/_{\text{N}}\text{m}^3$   
=> Heatvalue Biogas:  $9,94 \text{ kWh}/_{\text{N}}\text{m}^3 * 52\% = 5,169 \text{ kWh}/_{\text{N}}\text{m}^3$
- Gas energy production: 7.904.400 kWh
- Specific Biomass demand:  $0,2161 \text{ }_{\text{N}}\text{m}^3/\text{kg}$   
=>  $7.904.400 \text{ kWh} / (5,169 \text{ kWh}/_{\text{N}}\text{m}^3 * 0,2161 \text{ }_{\text{N}}\text{m}^3/\text{kg}) = 7076,6 \text{ t}$

7076,6 tons of Biomass are required per year

NawaRo: Nachwachsende Rohstoffe (renewable resources)

$_{\text{N}}\text{m}^3$ : Normkubikmeter (1 bar, 273 Kelvin, 0% Luftfeuchtigkeit [humidity])

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The System

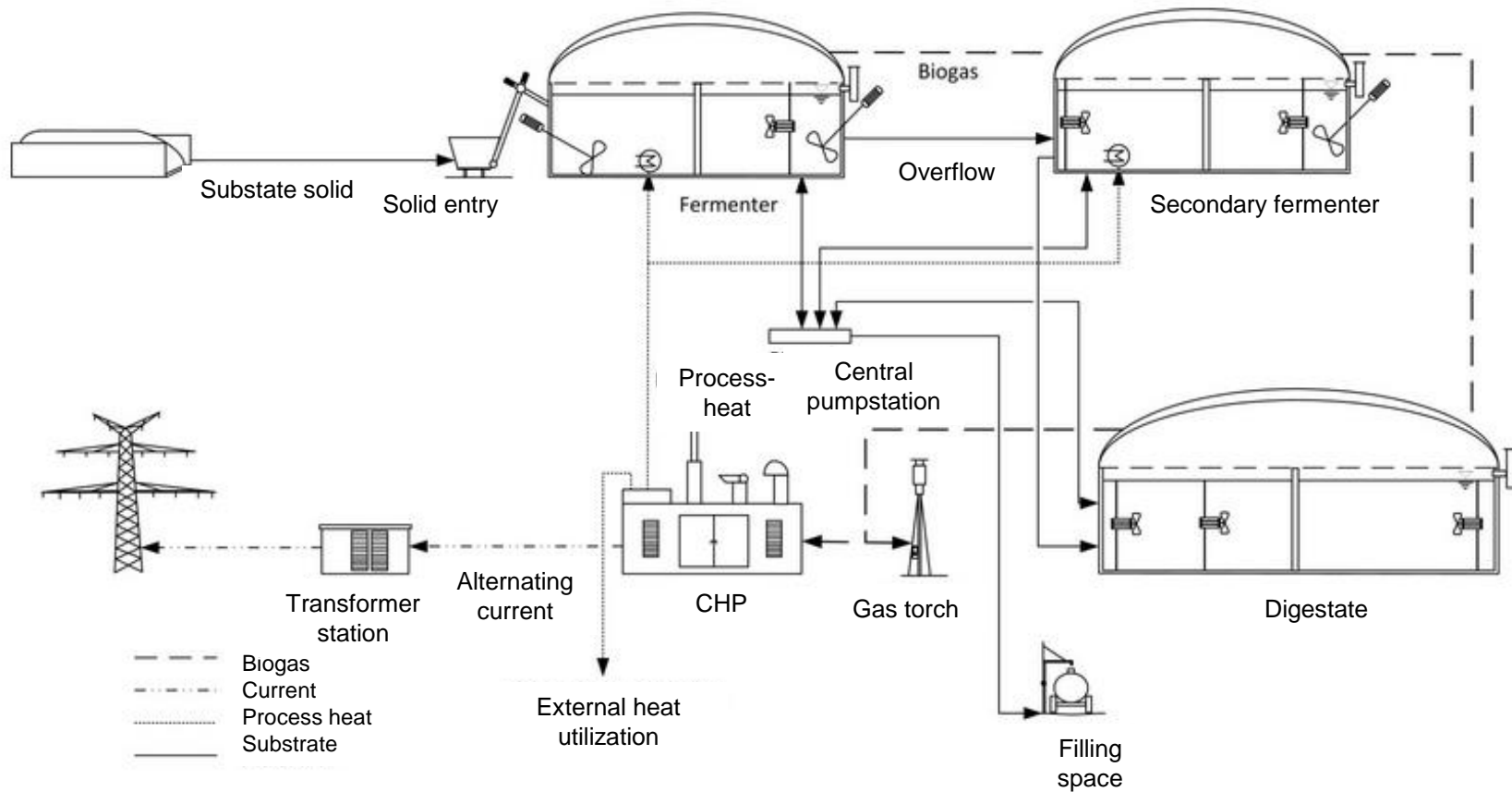
Investment

Other annual costs

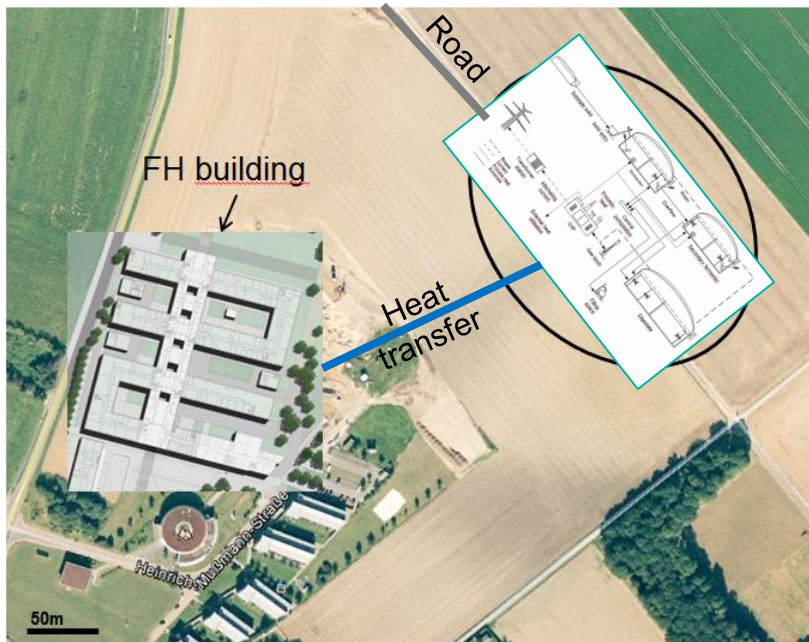
Consumption costs



# Biogas plant system



# Investment: Estate and Exterior installations



<b>Exterior installations:</b>	
Grading work	50.000,00 €
Roads	60.000,00 €
Foundations	20.000,00 €
Outlight	10.000,00 €
Fence	2.000,00 €
Heat transfer pipes incl. Connection	76.000,00 €
<b>Total of Exterior installations</b>	<b>142.000,00 €</b>

➤ Estate: 5000 m<sup>2</sup> ; 115 €/m<sup>2</sup>  
=> 575.000,00 €

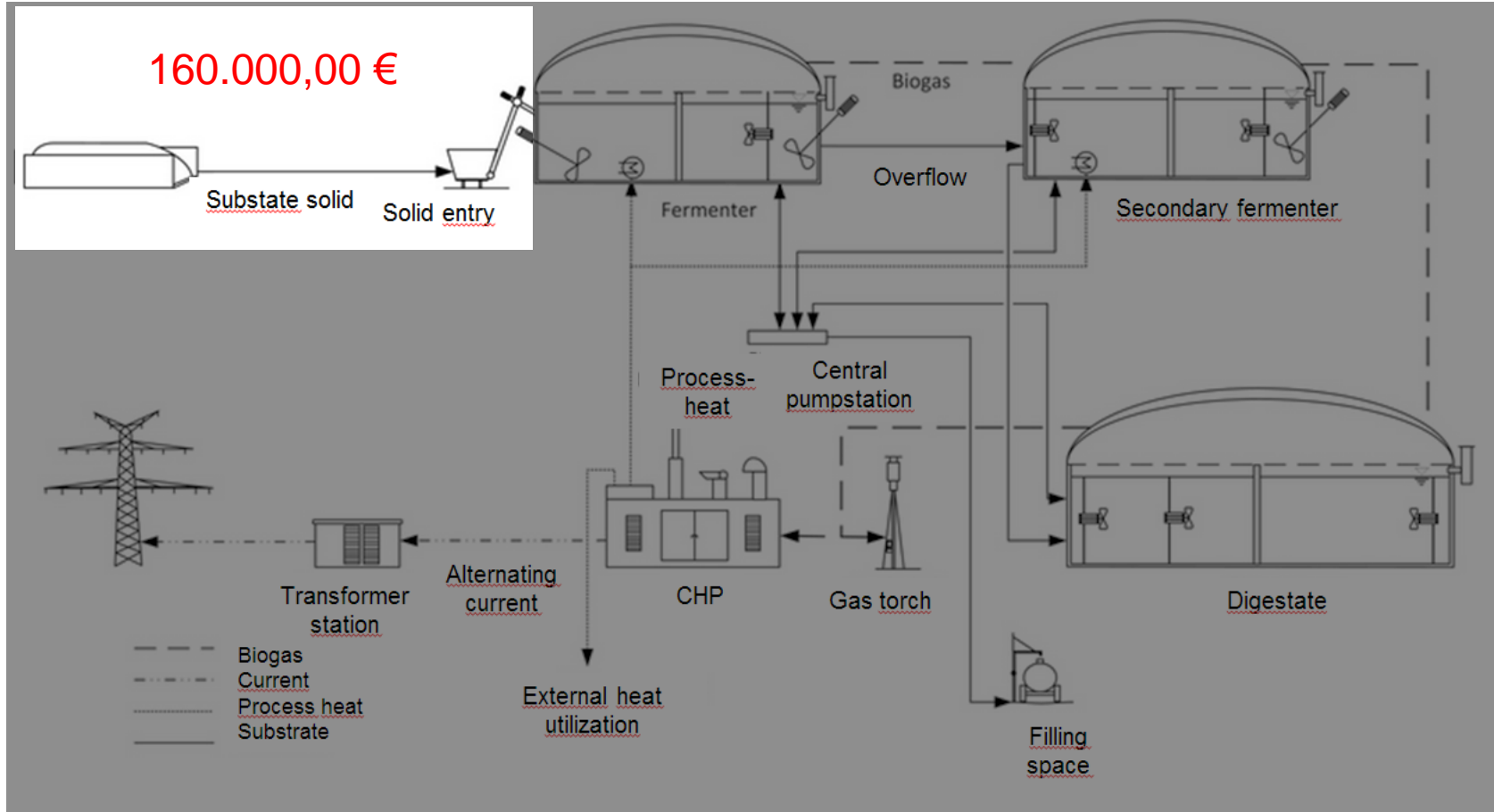
Additional expenses - 5% Tax and 3% other costs (notary, registration etc.)  
=> 46.000,00 €

➤ Sum Purchase of Land  
=> 621.000,00 €



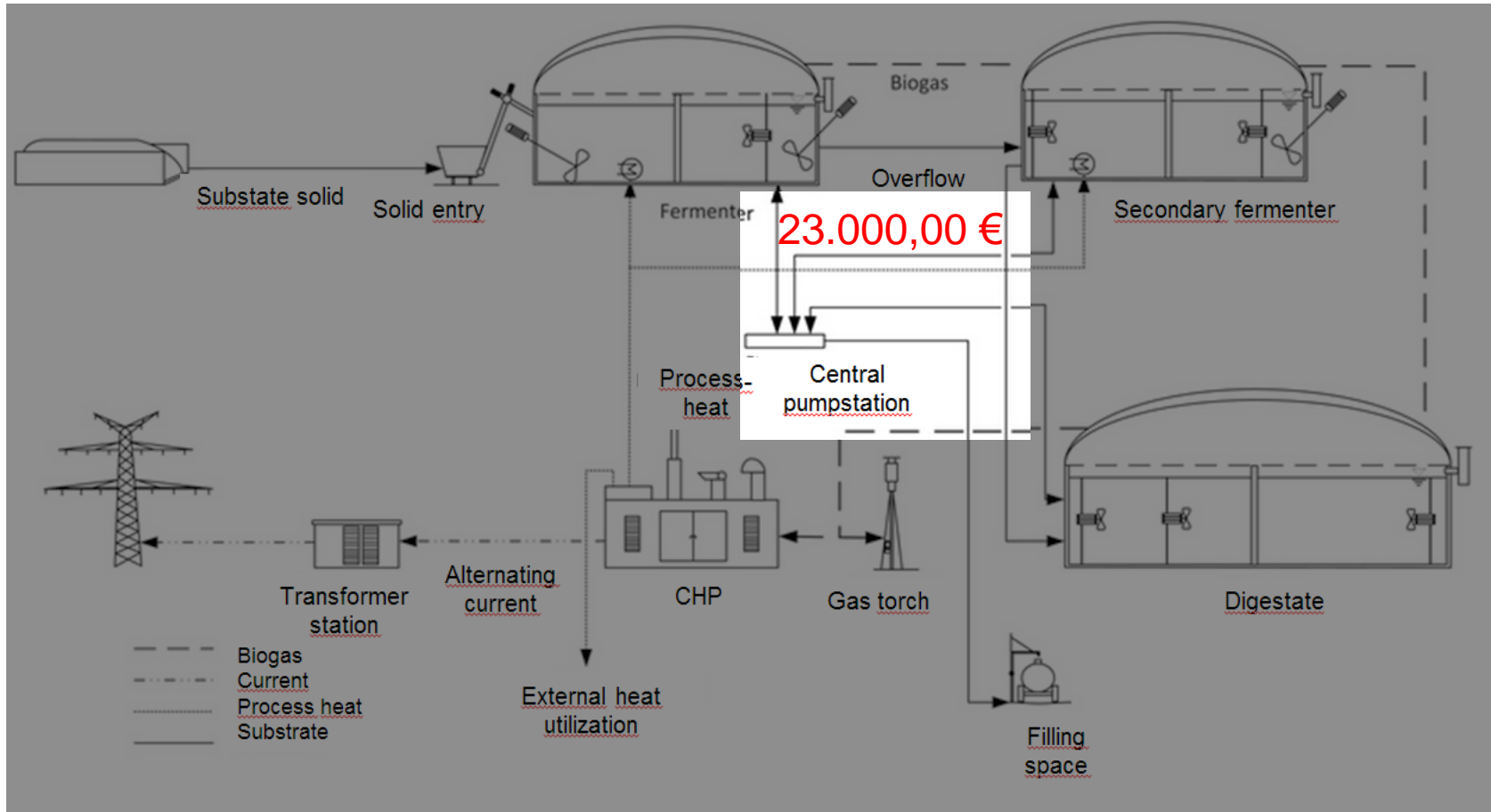
# Investment: Machinery

## Solid entry and mobile technology



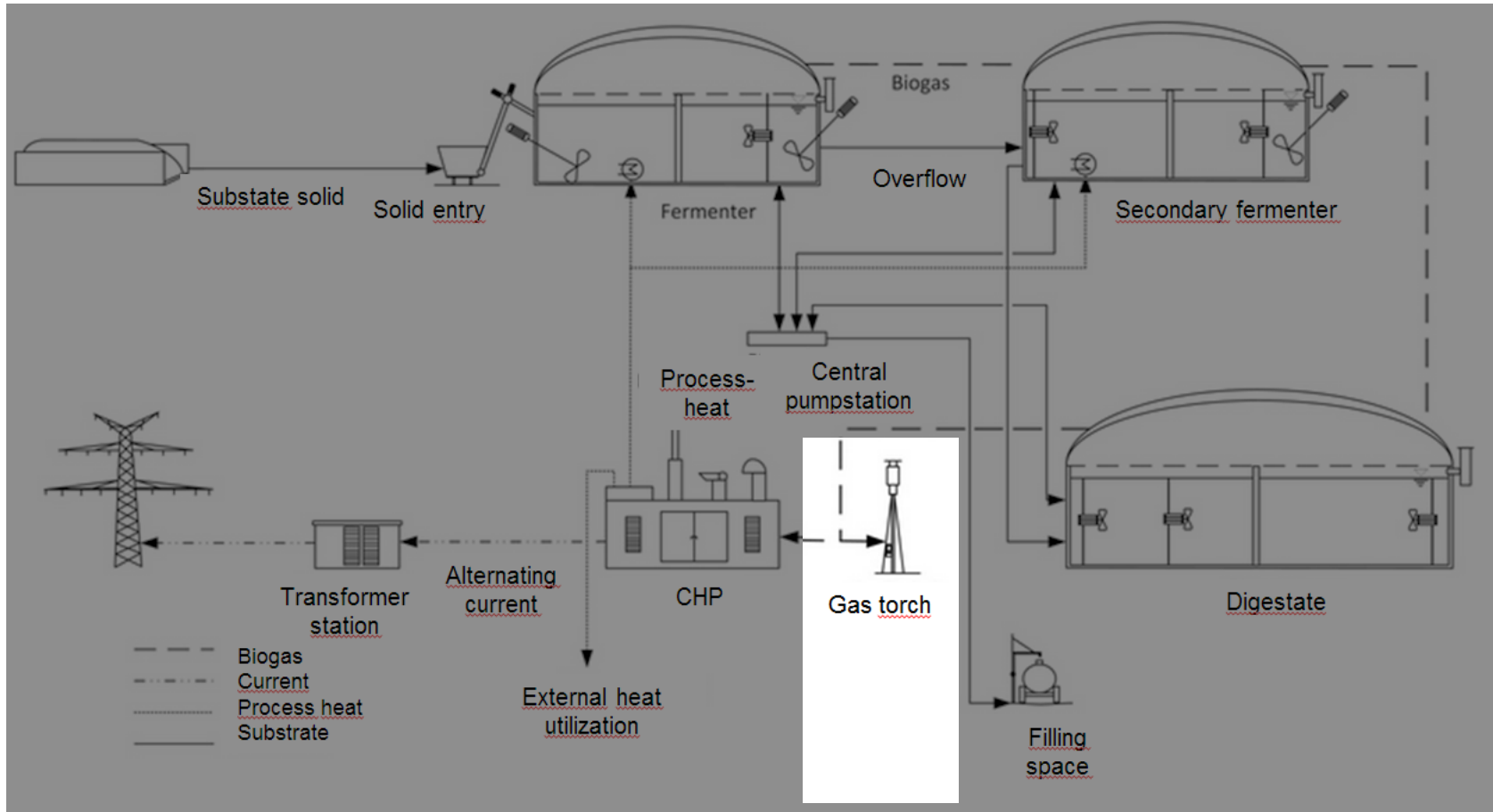
Content: Original container, entry system, vehicle-level, mobile technology

# Investment: Machinery Central pumpstation



Content: Pump, Substrate wiring and fittings, pump room

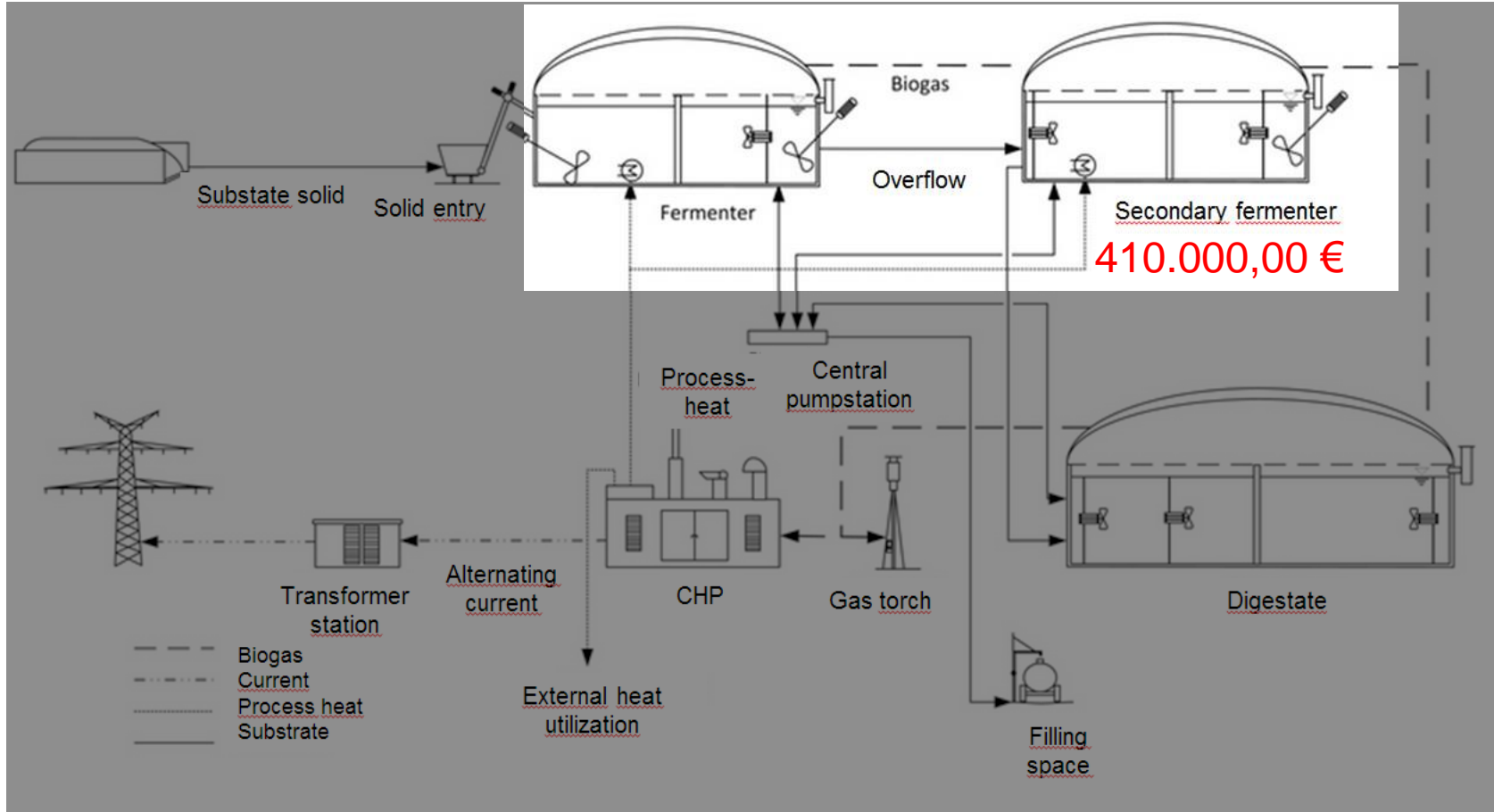
# Investment: Machinery Gastechnology



150.000,00 €

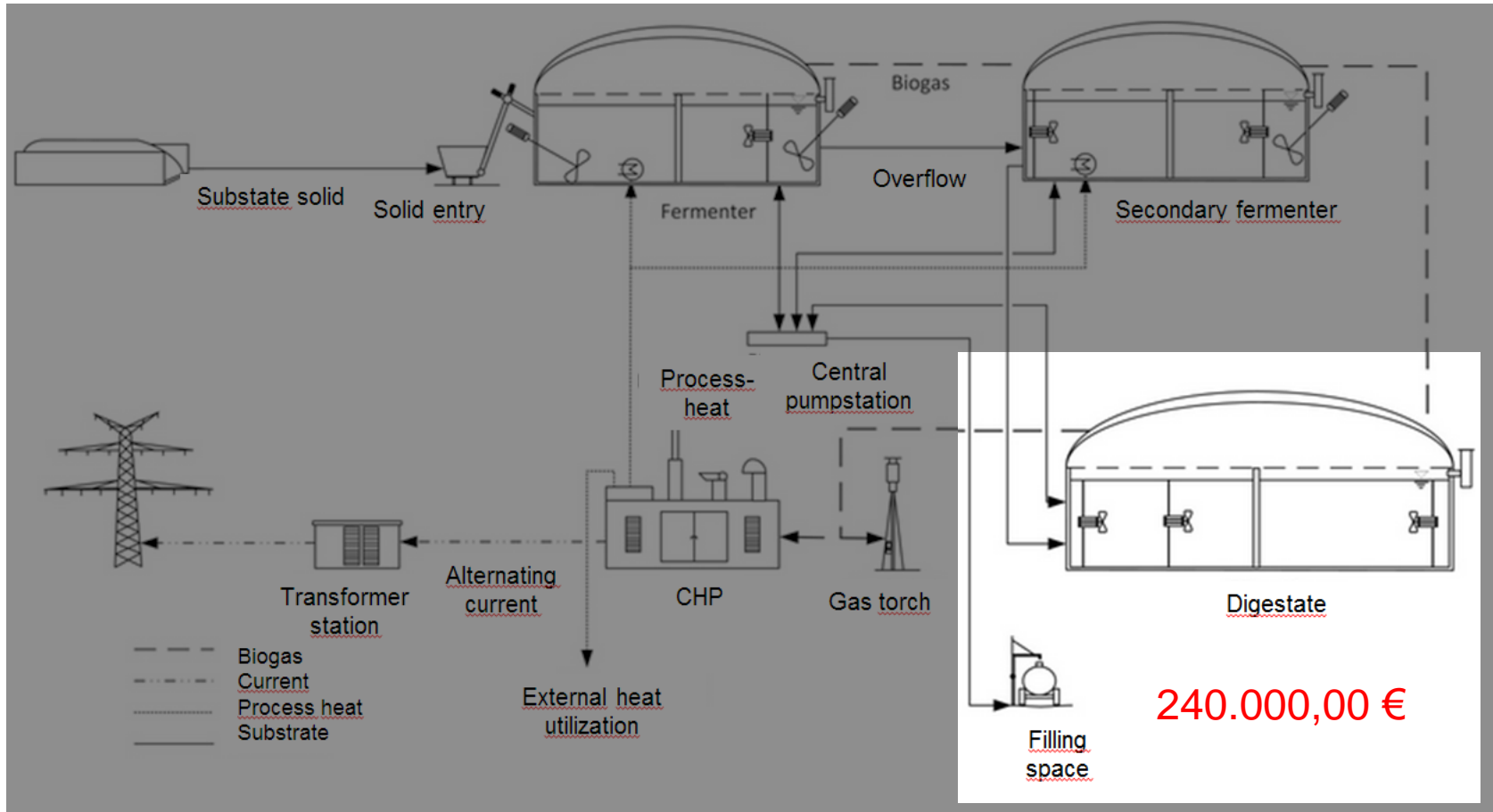
Content: Container, gas drying, desulfurization, System control and gas analysis, Gas torch

# Investment: Production Fermentation tanks



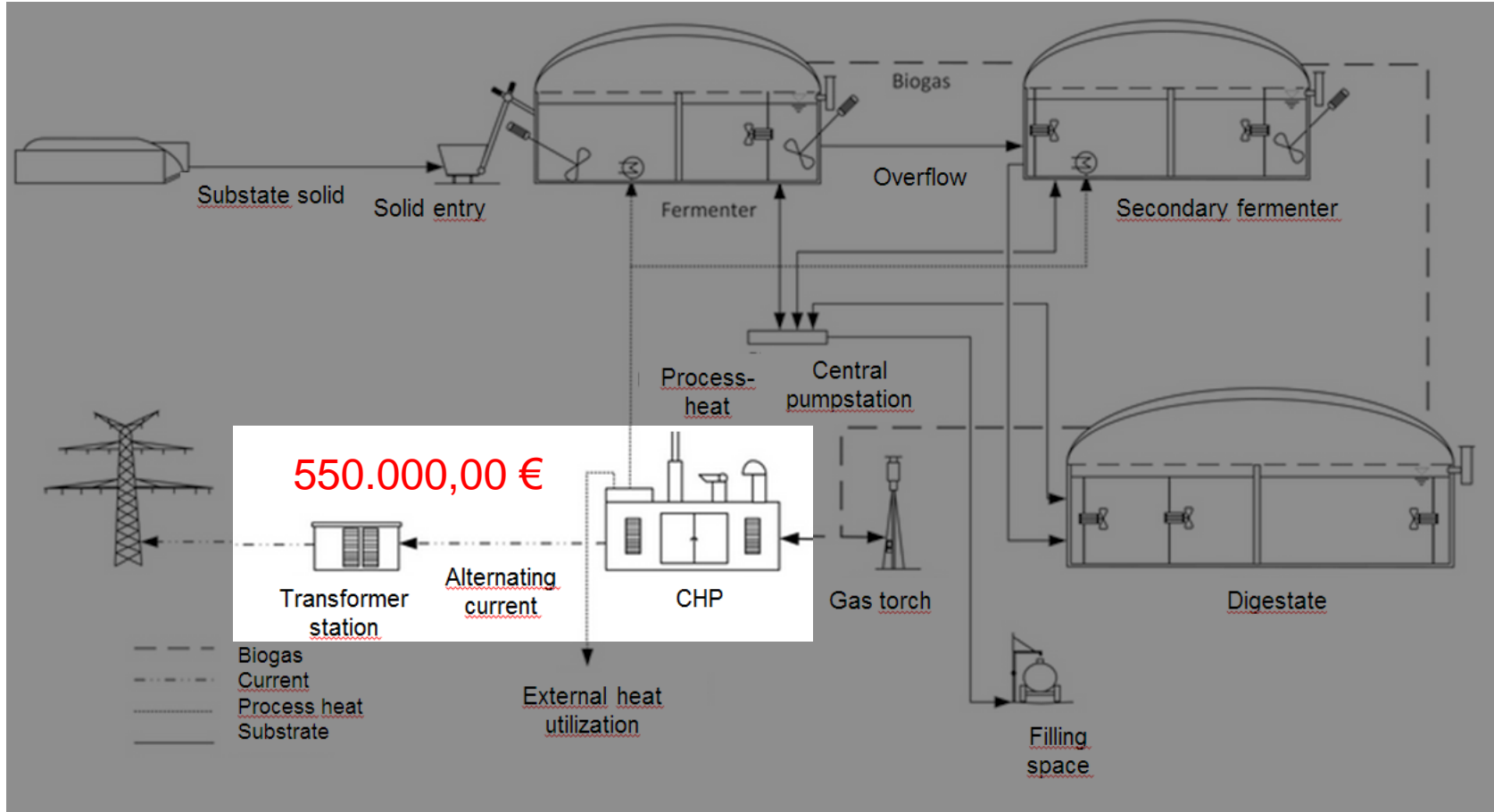
Content: Fermenter, secondary fermenter, 2 heating, 2 Gas storages as a cover, 2 Container basic equipment, mixing technology

# Investment: Production Digestate



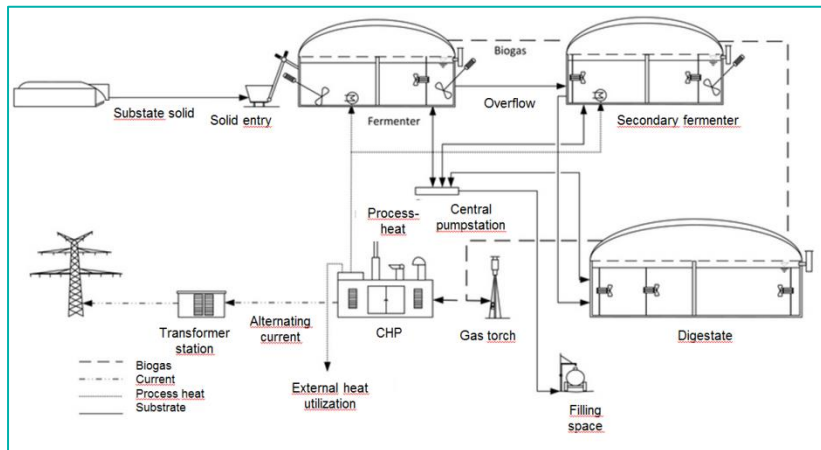
Content: digestate storage, Container cover (gas storage) incl. desulfurization, Container basic equipment, mixing technology

# Investment: Production Energy technology



Content: 2 CHPs incl. Periphery, mains connection

# Total Investment: Production and Machinery



<b>Machinery</b>	Amounts of investment	Depreciation rate in years	Depreciation in € p.a.
solid entry & mobile technology	160.000,00 €	10	16.000,00 €
Central Pumpstation	23.000,00 €	10	2.300,00 €
Gastechnology	150.000,00 €	10	15.000,00 €
<b>Sum of Machinery</b>	<b>333.000,00 €</b>		<b>33.300,00 €</b>

<b>Production</b>	Amounts of investment	Depreciation rate in years	Depreciation in € p.a.
fermentation tanks (1500 m <sup>3</sup> )	410.000,00 €	14	29.285,71 €
digestate storage (3200 m <sup>3</sup> )	240.000,00 €	16	15.000,00 €
CHP incl. Periphery	550.000,00 €	8	68.750,00 €
<b>Sum of Production</b>	<b>1.200.000,00 €</b>		<b>113.035,71 €</b>

# Other investments



<b>Off-sites/Extra Investment</b>	Amounts of investment	Depreciation rate in years	Depreciation in € p.a.
Tools	30.000,00 €	10	3.000,00 €
Spareparts	15.330,00 €	10	1.533,00 €
Supply lines	10.000,00 €	10	1.000,00 €
<b>Sum of Offsites</b>	<b>55.330,00 €</b>		<b>5.533,00 €</b>

Spareparts is 1% of Machinery and Production



<b>Expenditure/planning</b>		Depreciation rate in years	Depreciation in € p.a.
Licenses, Planning ...	235.133,00 €	10	23.513,30 €
<b>Sum of Engineering</b>	<b>235.133,00 €</b>		<b>23.513,30 €</b>

Licenses, Planning, etc. is 10% of the sum of Land, exterior, machinery, production and off-sites



# Investment: Total



Investment goods	Investment expenditures	Depretiation in %	Depretiation costs
Land	621.000,00 €	0	0,00 €
Exterior installations	142.000,00 €	5	7.100,00 €
Machinery	333.000,00 €	10	33.300,00 €
Production	1.200.000,00 € dif		113.035,71 €
Off-sites/Extra Investment	55.330,00 €	10	5.533,00 €
Engineering	235.133,00 €	10	23.513,30 €
Unexpected	300.000,00 €	0	0,00 €
<b>Total Investment</b>	<b>2.886.463,00 €</b>	<b>Total Depreciation costs</b>	<b>182.482,01 €</b>

# Other annual costs

Office rent:  $12 * 700 \text{ €/month}$

=> 8.400 € per year



Labour costs:

<b>Personal costs</b>	Specific costs €/h	Workhours p.a.	Personnel direct costs
Controll, Data collection, office	15	250	3.750,00 €
Maintenance	15	180	2.700,00 €
Fault Elimination	15	80	1.200,00 €
Administration	30	400	12.000,00 €
<b>Total labour costs</b>			<b>19.650,00 €</b>

# Consumption costs

Calculation of consumption costs	Calculation of specific consumption	specific consumption	specific price	Costs in € per kWh <sub>th</sub>
<b>Raw materials:</b>				
Biomass	7076,6 t / 2.507,4 MWh <sub>th</sub>	2,82 kg/kWh <sub>th</sub>	0,038 €/kg	0,107
<b>Utilities:</b>				
el. Energy	3.360 Mwh <sub>el</sub> * 0,08 / 2.507,4 MWh <sub>th</sub>	0,107 kWh <sub>el/Ic*</sub> /kWh <sub>th</sub>	0,06 €/kWh <sub>el</sub>	0,006
Maintenance costs				0,03
supply for biomass	7076,6 t / 2.507,4 MWh <sub>th</sub>	0,00282 t/kWh <sub>th</sub>	1,25 €/t	0,00353
digestate transportation	5000 t / 2.507,4 MWh <sub>th</sub>	0,00199 t/kWh <sub>th</sub>	1,25 €/t	0,00249
<b>sum of raw material costs per kWh<sub>th</sub></b>				<b>0,150</b>

el: electrical    th: thermal  
Ic : Internal Consumption

- 8 % of the electricity amount produced is used for the plant (the plant doesn't use it's own electricity. it's just for comparison and calculation)
- 5000 t digestate is produced and must be removed



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# Financing

<b>Total investment</b>	2.886.463,00 €
40% own capital funds	1.154.585,20 €
60% outside financing	1.731.877,80 €



- Interest rate: 7%
- Running time: 10 years

<b>Financing costs:</b>				
year	balance of debt	Interest rate(%)	Interest Costs Paid p.a.	Repayment / Paying back loan p.a.
1. year	1.731.877,80 €	7%	121.231,45 €	173.187,78 €
2. year	1.558.690,02 €	7%	109.108,30 €	173.187,78 €
3. year	1.385.502,24 €	7%	96.985,16 €	173.187,78 €
4. year	1.212.314,46 €	7%	84.862,01 €	173.187,78 €
5. year	1.039.126,68 €	7%	72.738,87 €	173.187,78 €
6. year	865.938,90 €	7%	60.615,72 €	173.187,78 €
7. year	692.751,12 €	7%	48.492,58 €	173.187,78 €
8. year	519.563,34 €	7%	36.369,43 €	173.187,78 €
9. year	346.375,56 €	7%	24.246,29 €	173.187,78 €
10. year	173.187,78 €	7%	12.123,14 €	173.187,78 €
<b>Total interest paid</b>			<b>666.772,95 €</b>	
	<b>Total Repayment</b>			<b>1.731.877,80 €</b>



EEG-Bonus (ct/kWh) with 2% depression:

In general:

In our case:

Year 1:

14,01 ct/kWh for 150 kW  
12,05 ct/kWh for 150 – 500 kW

=>

37,5 % share (150 kW)  
62,5 % share (150 – 400 kW)

$$\Rightarrow 0,375 * 14,01 \text{ ct/kWh} + 0,625 * 12,05 \text{ ct/kWh} = 12,79 \text{ ct/kWh}$$

	1. year	2. year	3. year	4. year	5. year	6. year	7. year	8. year	9. year	10. year
basic refund (ct/kWh)	12,79	12,53	12,28	12,03	11,79	11,56	11,33	11,10	10,88	10,66
Utilization of capacity (%)	84%	95%	100%	100%	100%	100%	100%	100%	100%	100%
Electrical Production (kWh):	2.822.400	3.192.000	3.360.000	3.360.000	3.360.000	3.360.000	3.360.000	3.360.000	3.360.000	3.360.000
total refund:	360.844 €	399.935 €	412.565 €	404.313 €	396.227 €	388.303 €	380.537 €	372.926 €	365.467 €	358.158 €

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Self costs

Price and revenue

Cash flow and dividend

FH money saved

Equity profability

# Selfcosts

Self costs per kWh <sub>th</sub>	1. year	2. year	3. year	4. year	5. year	6. year	7. year	8. year	9. year	10. year	11. year	12. year
Utilization of capacity (%)	84%	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Quantity in kWh <sub>th</sub>	2.106.216	2.382.030	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400
Costs	costs per year	costs per year	costs per year	costs per year	costs per year	costs per year	costs per year	costs per year	costs per year	costs per year	costs per year	costs per year
Depreciation costs	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €
Financing costs	121.231 €	109.108 €	96.985 €	84.862 €	72.739 €	60.616 €	48.493 €	36.369 €	24.246 €	12.123 €	0 €	0 €
Labour costs	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €
Office rent	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €
Raw material costs	315.299 €	356.589 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €
EEG-Bonus	-360.844 €	-399.935 €	-412.565 €	-404.313 €	-396.227 €	-388.303 €	-380.537 €	-372.926 €	-365.467 €	-358.158 €	-350.995 €	-343.975 €
Sum of costs	286.219 €	276.294 €	270.309 €	266.437 €	262.400 €	258.201 €	253.844 €	249.332 €	244.667 €	239.854 €	234.894 €	241.913 €
Costs per kWh <sub>th</sub>	0,1359 €	0,1160 €	0,1078 €	0,1063 €	0,1047 €	0,1030 €	0,1012 €	0,0994 €	0,0976 €	0,0957 €	0,0937 €	0,0965 €

	first year	10th year	18th year
selfcosts (ct/kWh <sub>th</sub> )	0,1359 €	0,0957 €	0,1121 €

- Selfcosts are rising again after 11 years due to the decrease of the EEG-Bonus





# Price setting and revenue

	first year	10th year	18th year
<b>selfcosts (ct/kWh<sub>th</sub>)</b>	0,1359 €	0,0957 €	0,1121 €

- We set the price at 0,1150 € per kWh<sub>th</sub>  
(This decision is also linked to the money the FH could save [shown later in the presentation])

Turnover/ revenue			
year	output in kWh <sub>th</sub>	price per kWh <sub>th</sub>	Turnover/Revenue
1	2.106.216	0,115	242.215 €
2	2.382.030	0,115	273.933 €
3	2.507.400	0,115	288.351 €
4	2.507.400	0,115	288.351 €
5	2.507.400	0,115	288.351 €
6	2.507.400	0,115	288.351 €
7	2.507.400	0,115	288.351 €
8	2.507.400	0,115	288.351 €
9	2.507.400	0,115	288.351 €
10	2.507.400	0,115	288.351 €



# Cashflow and dividend: first five years



<b>Computation of cash-flow for 5 years in €</b>					
	1. year	2. year	3. year	4. year	5. year
Turnover/Revenue	242.215 €	273.933 €	288.351 €	288.351 €	288.351 €
Depreciation costs	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €
Labour costs	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €
Office rent	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €
Raw material costs	315.299 €	356.589 €	375.356 €	375.356 €	375.356 €
Financing costs	121.231 €	109.108 €	96.985 €	84.862 €	72.739 €
EEG-Bonus	-360.844 €	-399.935 €	-412.565 €	-404.313 €	-396.227 €
Loss carried forward		44.004 €	46.364 €	28.322 €	6.408 €
Profit before tax	-44.004 €	-46.364 €	-28.322 €	-6.408 €	19.543 €
Taxes (40%)	0,00 €	0,00 €	0,00 €	0,00 €	7.817 €
Profit after taxes	-44.004 €	-46.364 €	-28.322 €	-6.408 €	11.726 €
Cash-flow (net profit + depreciation)	138.478 €	136.118 €	154.160 €	176.074 €	194.208 €
Repayment credit	173.188 €	173.188 €	173.188 €	173.188 €	173.188 €
Dividend	-34.710 €	-37.070 €	-19.028 €	2.886 €	21.020 €

# Cashflow and dividend: ten years



Computation of cash-flow for 10 years in €										
	1. year	2. year	3. year	4. year	5. year	6. year	7. year	8. year	9. year	10. year
Turnover/Revenue	242.215 €	273.933 €	288.351 €	288.351 €	288.351 €	288.351 €	288.351 €	288.351 €	288.351 €	288.351 €
Depreciation costs	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €	182.482 €
Labour costs	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €	19.650 €
Office rent	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €	8.400 €
Raw material costs	315.299 €	356.589 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €	375.356 €
Financing costs	121.231 €	109.108 €	96.985 €	84.862 €	72.739 €	60.616 €	48.493 €	36.369 €	24.246 €	12.123 €
EEG-Bonus	-360.844 €	-399.935 €	-412.565 €	-404.313 €	-396.227 €	-388.303 €	-380.537 €	-372.926 €	-365.467 €	-358.158 €
Loss carried forward		44.004 €	46.364 €	28.322 €	6.408 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Profit before tax	-44.004 €	-46.364 €	-28.322 €	-6.408 €	19.543 €	30.150 €	34.507 €	39.019 €	43.684 €	48.497 €
Taxes (40%)	0,00 €	0,00 €	0,00 €	0,00 €	7.817 €	12.060 €	13.803 €	15.608 €	17.473 €	19.399 €
Profit after taxes	-44.004 €	-46.364 €	-28.322 €	-6.408 €	11.726 €	18.090 €	20.704 €	23.411 €	26.210 €	29.098 €
Cash-flow (net profit + depreciation)	138.478 €	136.118 €	154.160 €	176.074 €	194.208 €	200.572 €	203.186 €	205.893 €	208.692 €	211.580 €
Repayment credit	173.188 €	173.188 €	173.188 €	173.188 €	173.188 €	173.188 €	173.188 €	173.188 €	173.188 €	173.188 €
Dividend	-34.710 €	-37.070 €	-19.028 €	2.886 €	21.020 €	27.384 €	29.998 €	32.706 €	35.504 €	38.393 €

- Total dividend after 10 years  $\approx$  119.000 €
- After 10 years no repayment credit and financing costs  
=> Total dividend after 18 years  $\approx$  1.718.000 €



# How much money could the FH-Aachen save?

Calculation of what the FH-Aachen could save in future (prognosis):

$$\Rightarrow [ (\text{usual price} - 0,115 \text{ €/kWh}_{\text{th}}) * \text{heat demand} ]$$

	1. year	2. year	3. year	4. year	5. year	6. year	7. year	8. year	9. year	10. year
usual price prognosis (ct/kWh <sub>th</sub> ):	0,09	0,10	0,10	0,11	0,12	0,11	0,12	0,13	0,14	0,15
Quantity in kWh <sub>th</sub>	2.106.216	2.382.030	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400
FH-money saved:	-52.655 €	-35.730 €	-37.611 €	-12.537 €	12.537 €	-12.537 €	12.537 €	37.611 €	62.685 €	87.759 €
FH-money saved total:	-52.655 €	-88.386 €	-125.997 €	-138.534 €	-125.997 €	-138.534 €	-125.997 €	-88.386 €	-25.701 €	62.058 €

	11. year	12. year	13. year	14. year	15. year	16. year	17. year	18. year
usual price prognosis (ct/kWh <sub>th</sub> ):	0,14	0,14	0,15	0,14	0,16	0,15	0,15	0,16
Quantity in kWh <sub>th</sub>	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400	2.507.400
FH-money saved:	62.685 €	62.685 €	87.759 €	62.685 €	112.833 €	87.759 €	87.759 €	112.833 €
FH-money saved total:	124.743 €	187.428 €	275.187 €	337.872 €	450.705 €	538.464 €	626.223 €	739.056 €

The price is defined in a way, that there is a win-win situation for the „LRG Bioheat GmbH“ and the FH-Aachen

⇒

<b>set price (ct/kWh<sub>th</sub>):</b>	0,115
<b>Total dividend after 10 years:</b>	118.985 €
<b>Total dividend after 18 years:</b>	1.717.880 €
<b>FH-money saved after 10 years:</b>	62.058 €
<b>FH-money saved after 18 years:</b>	739.056 €

# Equity profitability

Equity	Profit after tax	Dividend	Interest made on equity	Interest made on equity (cumulated)	
1.154.585 €	-44.004 €	-34.710 €	-3,01%	-3,01%	1. year
1.154.585 €	-46.364 €	-37.070 €	-3,21%	-6,22%	2. year
1.154.585 €	-28.322 €	-19.028 €	-1,65%	-7,86%	3. year
1.154.585 €	-6.408 €	2.886 €	0,25%	-7,62%	4. year
1.154.585 €	11.726 €	21.020 €	1,82%	-5,79%	5. year
1.154.585 €	18.090 €	27.384 €	2,37%	-3,42%	6. year
1.154.585 €	20.704 €	29.998 €	2,60%	-0,82%	7. year
1.154.585 €	23.411 €	32.706 €	2,83%	2,01%	8. year
1.154.585 €	26.210 €	35.504 €	3,08%	5,08%	9. year
1.154.585 €	29.098 €	38.393 €	3,33%	8,41%	10. year
1.154.585 €	32.074 €	214.556 €	18,58%	26,99%	11. year
1.154.585 €	27.863 €	210.345 €	18,22%	45,21%	12. year
1.154.585 €	23.735 €	206.217 €	17,86%	63,07%	13. year
1.154.585 €	19.690 €	202.172 €	17,51%	80,58%	14. year
1.154.585 €	15.725 €	198.207 €	17,17%	97,75%	15. year
1.154.585 €	11.840 €	194.323 €	16,83%	114,58%	16. year
1.154.585 €	8.033 €	190.515 €	16,50%	131,08%	17. year
1.154.585 €	4.302 €	186.784 €	16,18%	147,26%	18. year



No repayment credit and financing costs anymore

Full Interest on own capital funds is reached

# Agenda

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What 's the idea?

Conditions and Decissions

Generell Calculations

System, Investments & Co

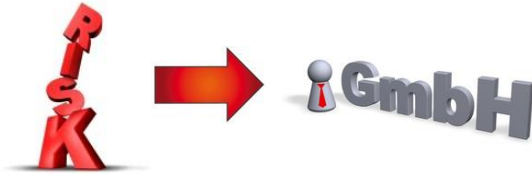
Financing & Refunding

Cost Calculation

Conclusion



# Conclusion



## positive

- + FH saves money
- + positive dividend

=> win-win  
profitable business



## risks

- reliability in Biomass supply
- EEG-Bonus goes down  
=> dividend decreases
- heat demand differs
- raw material-/ utility prices
- constant heat supply must be ensured

## chances

- + usual price for heat (oil/ gas) will probably rise
- + better technology in the future  
=> lower investment costs



- [biogas.fnr.de](http://biogas.fnr.de)
- [oekobit-biogas.com](http://oekobit-biogas.com)  
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- Lecture: Renewable Energy (Biogas) WS2013/14 Energy Systems
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