

**BIN2BEAN training series -
Attracting private investment
for biowaste-to-soil improver
innovations
Webinar**

*Unit 4: Calculation of an
investment in a bio-waste
processing plant*

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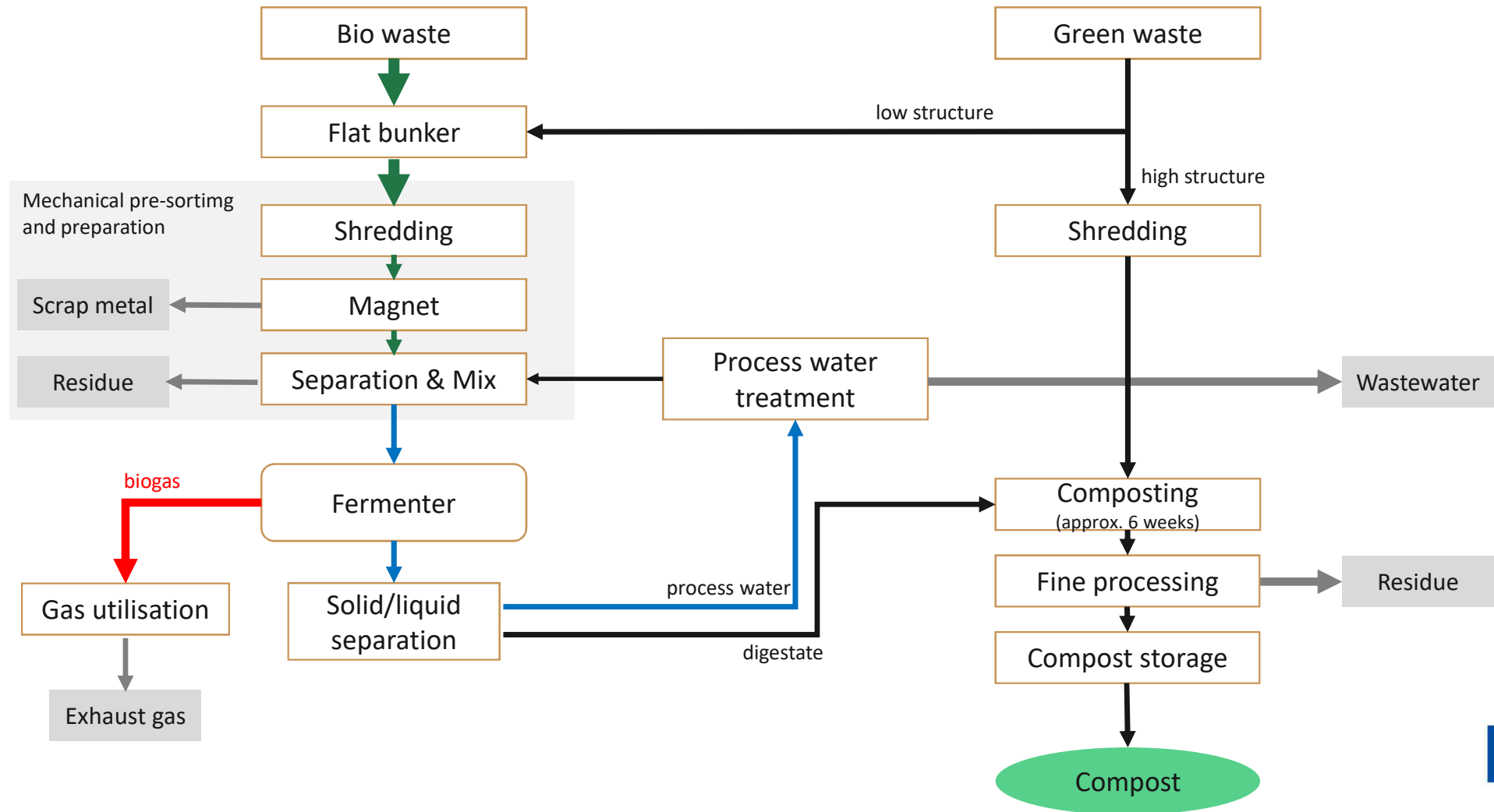


Exemplary facility: Anaerobic digestion and aerobic treatment of residues

- Combi plant: static fermentation (biogas) and composting of the residues (compost)
- Capacity 40.000 Mg/a
- Material derived from biowaste bin after
 - pre-sorting of impurities
 - screening (<80 mm)
 - adding of undersize fraction from screening green waste
- at best prevention of liquid residues / secondary composting
- Usage of biogas for electricity and heat

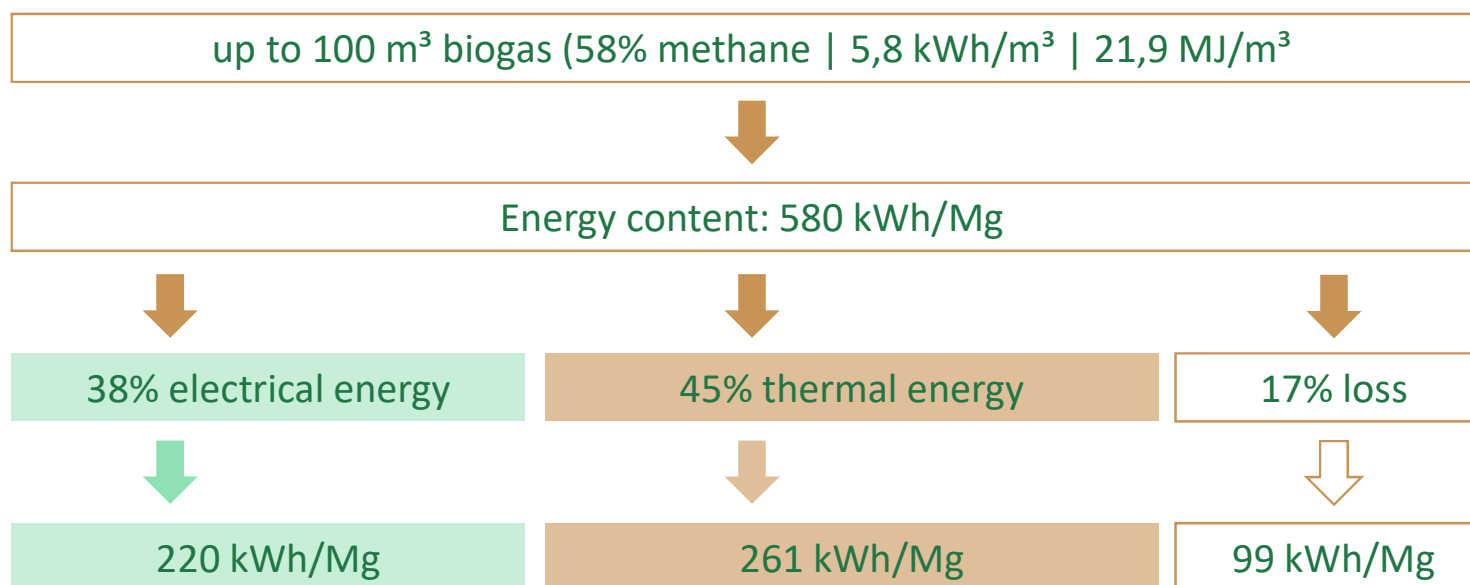
Process diagram of a combi plant

(Adapted from a graph by Martin Kranert, ISWA, University Of Stuttgart)



Technical considerations (rule of thumb)

1 Mg Biowaste (Fermentation)



Technical data: Input and Output

Important data to consider

- Input: 40.000 Mg, With 3% impurities
= 38.800 Mg
- Gas yield of bio waste 80 Nm³/Mg
Gas yield of green waste 60 Nm³/Mg
→ Blended average yield (75/25 mix assumed) = 75 Nm³/Mg
- Methane content of biogas 58%
- Lower heating value (LHV) of methane 9.97 kWh/Nm³
- Combined heat and power plant
 - Efficiency factor electricity 38%
 - Efficiency factor heat 45%
- approx. 8.300 operating hours/a
- Internal consumption:
 - 323,000 electrical kWh/a
 - 2,300,000 thermal kWh/a

Calculations

- Annual biogas volume
= 38,800 Mg x 75 Nm³/Mg = 2,910,000 Nm³/a
- Hourly flow rate
= 2,910,000 Nm³/a ÷ 8,300 h/a = 351 Nm³/a
- Gas yield total
= 327 Nm³/h x 58% x 9.97 kWh/Nm³
= 2,027 kW gas
- Electrical & thermal output
= 1,893 kW x 38% = 770 kW electrical
= 1,893 kW x 45% = 912 kW thermal
- Annual gross generation
Generated electricity = 6,396,484 kWh
Generated heat = 7,574,783 kWh



Technical data: Input and Output

Input	Output
40,000 Mg With 3% impurities = 38,800 Mg	• Generated Electricity (excluding internal consumption) 6,073,484 kWh • Generated Heat (excluding internal consumption) 5,274,783 kWh • Digestate total 37.000 Mg Leachate (fertiliser): 2.600 Mg Solid digestate (compost): 34.400 Mg



Investment costs (including depreciation period)

• Biogas plant	9.000.000 €	12 years
• Combined heat and power plant	1.130.000 €	15 years
• Material processing	200.000 €	10 years
• Exhaust air ducts	110.000 €	10 years
• Biofilter	250.000 €	12 years
• Composting unit	1.400.000 €	12 years
• Building works	420.000 €	20 years
• Liquid fertiliser storage	150.000 €	12 years
• Planning costs 10% of investment costs	1.266.000 €	
• Contingencies 5% of investment costs	696.300 €	

Total

14.622.300 €

Fixed costs (depreciation and interest)

1.562.149 €

40% equity at 8% interest, 60% debt at 2.5% interest

→ 12 years at 4.7% interest



Staff and operating costs

• Leasehold land (20 years)		300.000 €
• Staff	9 FTE at €50,000 each	450.000 €
• Vehicle leasing		100.000 €
• Diesel	80,000 l at €1.20	96.000 €
• Disposal of impurities	€90 per Mg	108.000 €
• Maintenance	4% of investment	557.040 €
• Other costs	2% of investment	292.446 €
Total		1.903.486 €

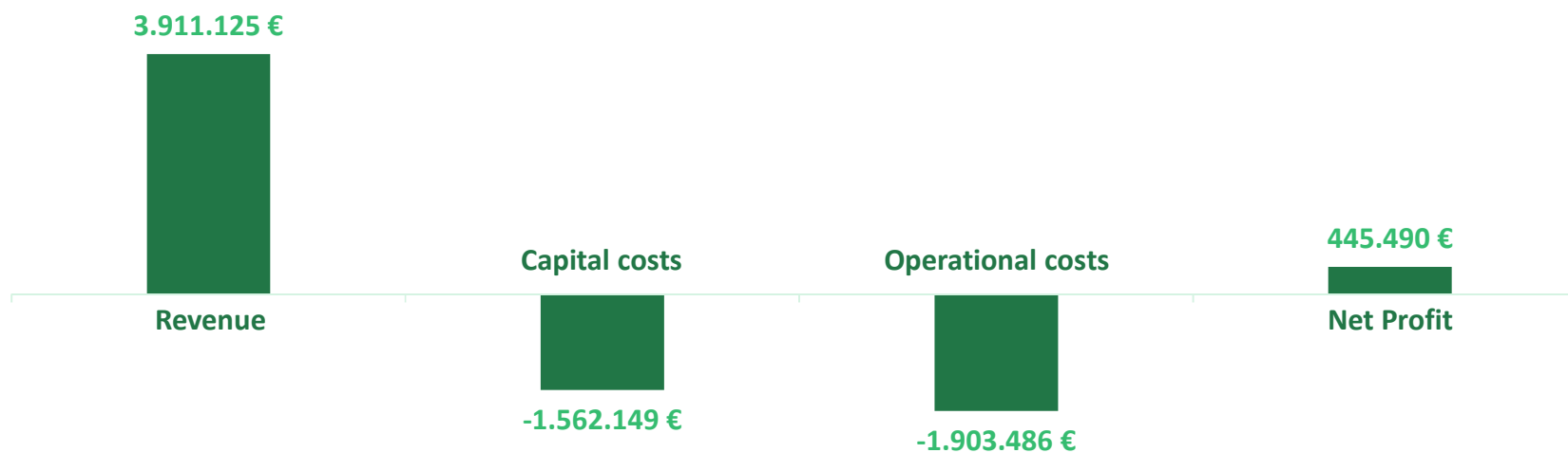


Revenue

• Electricity	14 ct/kWh	895.508 €
• Heat	3,5 ct/kWh	184.617€
• Fertiliser	25 €/Mg	65.000 €
• Compost	15 €/Mg	516.000 €
• Input bio waste	75 €/Mg	2.250.000 €
• Input green waste	40 €/Mg	400.000 €
Total		3.911.125 €



Annual costs and revenue



Net Present Value Calculation

$$C_0 = Z \cdot \frac{(1 + i)^n - 1}{i \cdot (1 + i)^n}$$

Initial investment (capital costs)	€14,622,300
Annual cash flow (revenue – operating costs) (Z)	€2,007,639
Financing	40% equity at 8% / 60% debt at 2.5%
Discount rate (i)	4.7%
Analysis period (n)	12 years

Step	Calculation	Result
Annuity present value factor	$[(1.047)^{12} - 1] / [0.047 \cdot (1.047)^{12}]$	9.0151
Present value of cash flows	$€1,976,954 \times 9.0151$	€18,099,066
Net Present Value (NPV)	$€17,822,500 - €14,622,300$	+€3,476,766

→ The plant generates a return above its capital cost, creating economic value — the investment is favorable.



Sensitivity Analysis

Scenario	Revenue	Annual cash flow (Z)	PV of cash flows	NPV
Revenue -10%	€3,520,013	€1,616,527	€14,573,153	-€49,147
Base	€3,911,125	€2,007,639	€18,099,066	+€3,476,766
Revenue +10%	€4,302,238	€2,398,752	€21,625,000	+€7,002,700
Costs +10%	€2,093,835	€1,817,290	€16,383,051	+€1,760,751
Base	€1,903,486	€2,007,639	€18,099,066	+€3,476,766
Costs -10%	€1,713,137	€2,197,988	€19,815,082	+€5,192,782

Revenue sensitivity

→ Revenue is the more critical driver: a 10% drop on its own is enough to push the project to roughly break-even (NPV ≈ -€49,147, essentially zero). The break-even revenue point sits just slightly above this -10% case.

Operating cost sensitivity

→ Costs matter, but the project stays comfortably NPV-positive even with a 10% cost overrun.



Break-even Analysis

Break-even Revenue (costs held at base: €1,903,486)

$$\text{Revenue}_{BE} = Z_{BE} + \text{Operating costs} = €1,621,979 + €1,903,486 = €3,525,465$$

→ Revenue can fall by just under **9.9%** before the project turns NPV-negative. This lines up with the earlier -10% revenue scenario landing just below zero (-€49,147).

Break-even Operating Costs (revenue held at base: €3,911,125)

$$\text{Costs}_{BE} = \text{Revenue} - Z_{BE} = €3,911,125 - €1,621,979 = €2,289,146$$

→ Operating costs would need to rise by over **20%** before reaching NPV; roughly double the cushion available on the revenue side.

$$Z_{BE} = \frac{\text{Investment}}{\text{Annuity present value factor}} = \frac{14,622,600 \text{ €}}{9,0151} = 1,621,979 \text{ €}$$





Thank you

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N³ Thinking Ahead

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