



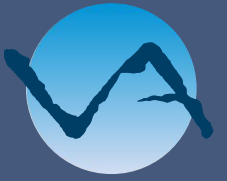
VISTA  
ANALYSE

# The financial aspects of biogas production

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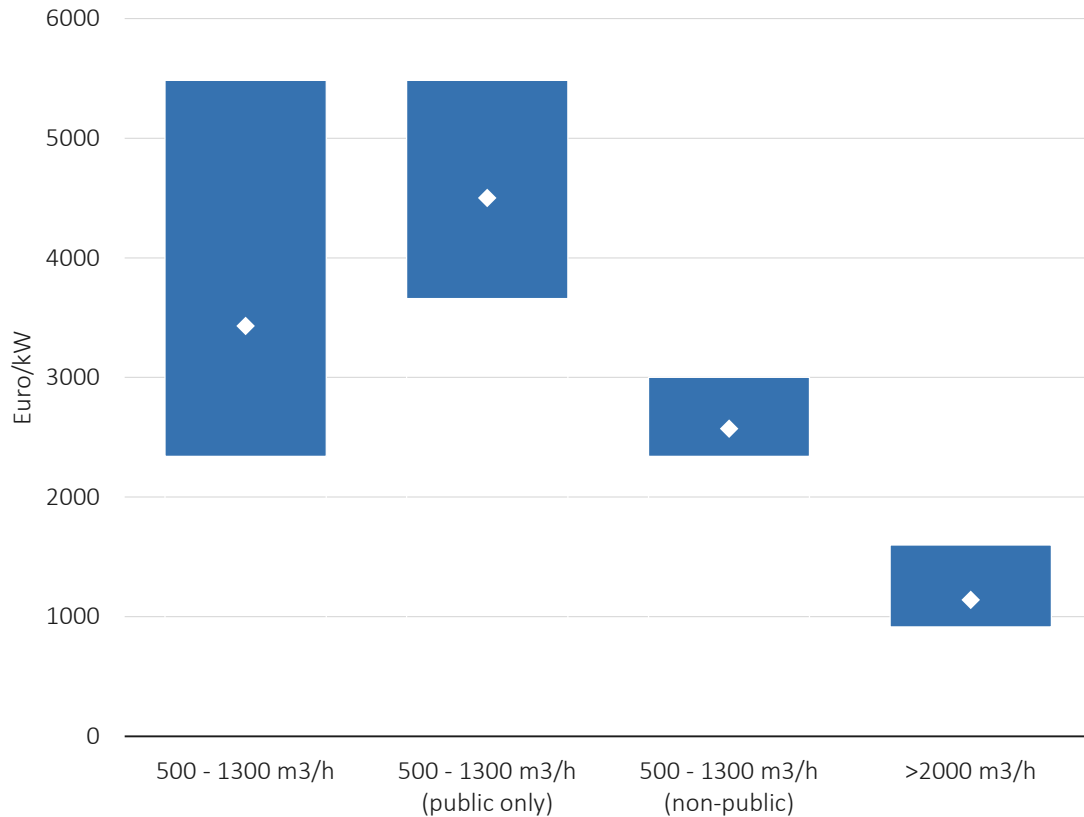
# Financial aspects of biogas production



The financial aspects of biogas production are influenced by capital (CAPEX) and operational (OPEX) costs, which vary across different facility sizes and feedstock types. Capital expenditure (CAPEX) refers to the funds a company allocates to acquire and upgrade physical assets, such as buildings, equipment, machinery, and vehicles. Operating expenditure (OPEX) include the ongoing costs that a company incurs for running its day-to-day operations, such as maintenance and repair of production equipment and facilities, expenses related to electricity, heat and other inputs, labor costs, pre-treatment of feedstock, etc.

# Financial aspects of biogas production

## CAPEX



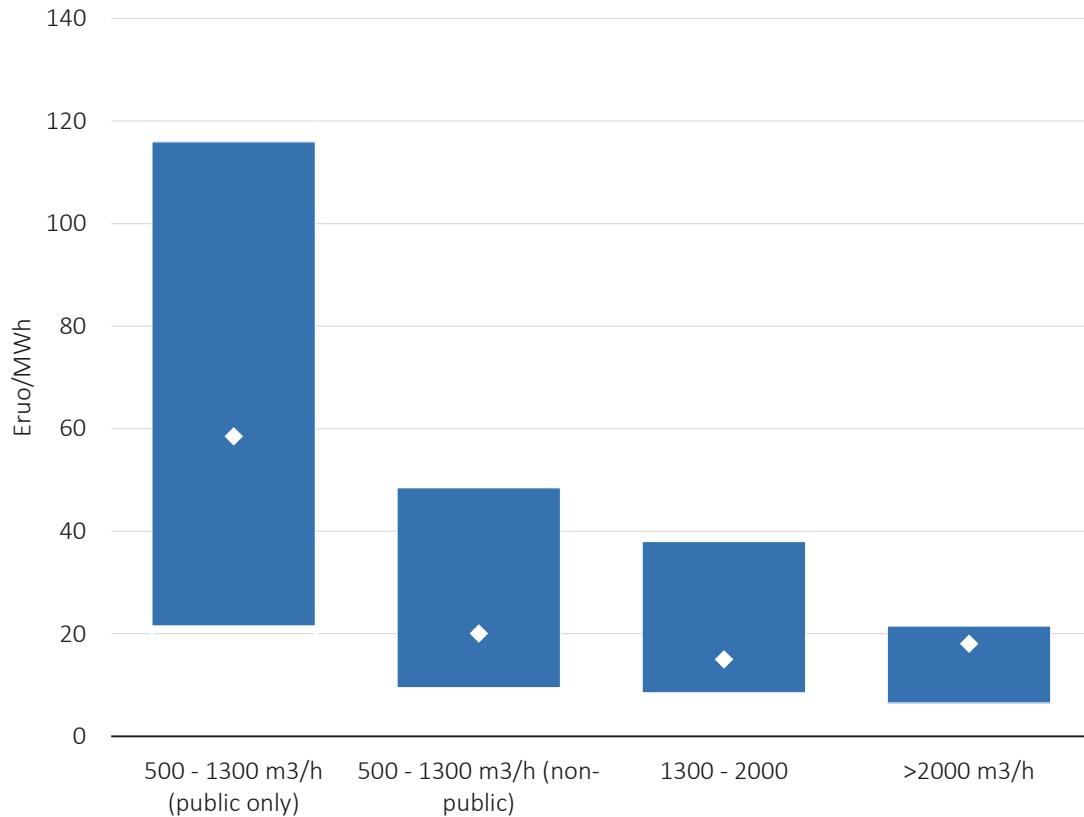
Based on figures from The Biomethane Industrial Partnership, 2023

- The Biomethane Industrial Partnership (BIP) collected financial data from European biogas and biomethane producers in 2023.
- CAPEX for plants with a capacity of 500 to 1300 m3/h vary greatly.
  - Higher capital costs for plants using public feedstock\*.
- Lower CAPEX observed for plants with production capacity >2000 m3/h.
- Economies of scale evident as capacity increases.

\*Includes municipal solid waste (MSW) and wastewater treatment plant sludge.

# Financial aspects of biogas production

## OPEX



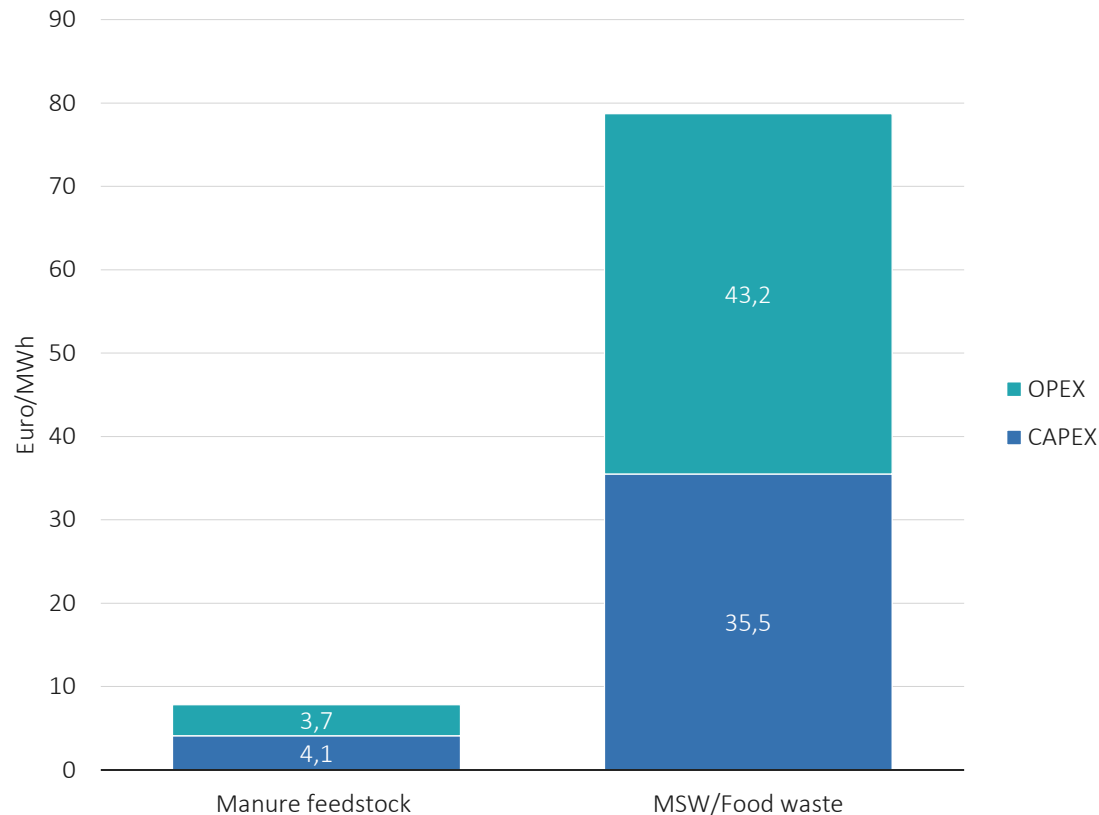
- Larger biogas plants have lower OPEX per MWh produced.
- Economies of scale less pronounced than for CAPEX.
- Average OPEX around 20 euros/MWh for all sizes using non-public feedstock.
- Public feedstock leads to significantly higher OPEX.
- Plants using public feedstock (500-1300 m<sup>3</sup>/h) has an average OPEX three times higher than those using non-public feedstock.

Based on figures from The Biomethane Industrial Partnership, 2023



# Financial aspects of biogas production

## Pre-treatment of feedstock

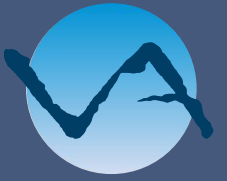


- Higher costs for facilities using public feedstock (municipal solid waste – MSW oraz food waste) due to extensive pre-treatment requirements.
- Both CAPEX and OPEX are significantly higher for public feedstock.

Based on figures from The Biomethane Industrial Partnership, 2023

# Biogas at the Tomaszów Mazowiecki Wastewater Treatment Plant (WWTP)

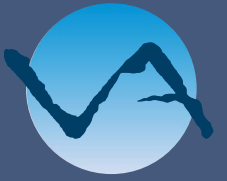
## A business case



- Biogas production in 2 phases:
  - **Phase 1:** Construction of a biogas plant at the wastewater treatment plant in Tomaszów Maz. with sewage sludge as a substrate.
  - **Phase 2:** Expansion of the biogas plant at the wastewater treatment plant in Tomaszów Maz. to use biodegradable waste as a supplementary substrate.

# Biogas at the Tomaszów Maz. WWTP

## Phase 1: Options



### Option 1A

The biogas is used to produce electricity and heat, replacing electricity from the grid; the digestate is treated by an external company.

### Option 1B

Part of the biogas is used to dry digestate and produce a soil-improving product sold to farmers. The remaining biogas is used for electricity and heat production, replacing electricity from the grid.

### Option 1C

The biogas is used for electricity and heat production, replacing electricity from the grid. Digestate is dried using gas from the grid and the soil-improving product is sold to farmers.

# Biogas at the Tomaszów Maz. WWTP

## Phase 1: OPEX



- The operational costs vary between the different options for phase 1.
- The main difference between the options lay in the digestate treatment.
- Operational expense for option 1A, 1B, and 1C totals to approximately **7.5 million**, **4.7 million** and **6.3 million**, respectively.

### OPEX for phase 1

	Option 1A	Option 1B	Option 1C
Labor cost biogas facility	720 000	720 000	720 000
Maintenance biogas facility	200 000	200 000	200 000
Electricity for WWTP operation	3 811 500	3 811 500	3 811 500
Digestate treatment by external company	2 800 000	-	-
Digestate treatment at the plant	-	-	1 582 718
<b>Total</b>	<b>7 531 500</b>	<b>4 731 500</b>	<b>6 314 218</b>

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)





# Biogas at the Tomaszów Maz. WWTP

## Phase 1: Income and reduced expenses

- Neighboring WWTPs pay a fee to deliver their sludge.
- If the WWTP treats the digestate themselves, they can sell the resulting product outside.
- The biogas will be used to produce electricity and heat with a combined heat and power system.
- The amount of produced electricity depends on whether they use biogas to treat digestate or not.

### Income and reduced expenses for phase 1

	Option 1A	Option 1B	Option 1C
Income from treating sludge from the neighbouring wastewater treatment plants	500 000	500 000	500 000
Income from selling the soil improvement product	-	57 500	57 500
Reduced electricity expenses	1 818 065	456 570	1 818 065
<b>Sum income</b>	<b>2 318 065</b>	<b>1 002 844</b>	<b>2 375 565</b>

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)



# Biogas at the Tomaszów Maz. WWTP

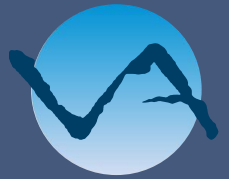
## Phase 1: Annual cash flow

- Since the variable costs and income differ, these are the decisive components for which option is the most profitable.
- All options have a negative annual cash flow.
- Can make sense to implement one of the options if they are a better option than the baseline (present situation).

### Annual cash flow for phase 1

	Baseline	Option 1A	Option 1B	Option 1C
Total investment cost	-	65.19	65.19	65.19
Total variable cost	8.81	7.53	4.73	6.31
Total income	-	2.29	1.00	2.35
Annual cash flow	- 8.81	- 5.24	- 3.73	- 3.97
Annual cash flow compared to baseline	-	3.57	5.1	4.8

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)



# Biogas at the Tomaszów Maz. WWTP

## Phase 1: Net present value (NPV)

- Option 1A has a lower NPV than the baseline, which means this option is less profitable than the baseline.
- Both option 1B and 1C has a higher NPV than the baseline, when we set the discount rate to 4 percent.
- Option 1B is the obvious best option with a NPV 3.89 million PLN higher than the baseline.

### Net present values for phase 1

	Baseline	Option 1A	Option 1B	Option 1C
10 %	-	-34.82	-21.92	-23.96
8 %	-	-30.16	-15.29	-17.64
6 %	-	-24.27	-6.89	-9.65
4 %	-	-16.70	3.89	0.62

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)

# Biogas at the Tomaszów Maz. WWTP

## Phase 2: Options



### Option 2A

- Scenario 1 Addition of food and kitchen waste as substrate
- Scenario 2 Addition of food and kitchen waste as substrate (25% of potential)
- Scenario 3 Addition of food and kitchen waste as substrate (50% of potential)
- Scenario 4 Addition of food and kitchen waste as substrate (75% of potential)

### Option 2B

Addition of food, kitchen and industrial biowaste in the anaerobic digestion (AD) process

# Biogas at the Tomaszów Maz. WWTP

## Phase 2: CAPEX



- Investments in phase 1 is a requirement for phase 2.
- Addition of municipal bio-waste as a substrate requires a pre-treatment facility.
- Higher volumes of substrates require additional digesters.
- Total capital investments in phase 2 is **69 million PLN** (2A1, 2A2 and 2A3) or **71 million PLN** (2A4 and 2B).

### CAPEX for phase 2

	Option 2A1, 2A2 and 2A3	Option 2A4 and 2B
Phase 1 investment	65 190 000	65 190 000
Pre-treatment facility for municipal bio-waste	1 000 000	1 000 000
Additional digesters	2 800 000	5 600 000
<b>Total capital expenses</b>	<b>68 990 000</b>	<b>71 190 000</b>

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)



# Biogas at the Tomaszów Maz. WWTP

## Phase 2: OPEX

- Assume same labor and maintenance as in phase 1.
- In phase 2 of the project the digestate will be treated using biogas and there are therefore no direct costs associated with this process.
- The total operational expenses for all options in phase 2 is **4.7 million PLN.**

### OPEX for phase 2

	All options in phase 2
Labor cost biogas facility	720 000
Maintenance biogas facility	200 000
Electricity for WWTP operation	3 811 500
<b>Total operational expenses</b>	<b>4 731 500</b>

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)

# Biogas at the Tomaszów Maz. WWTP

## Phase 2: Income and reduced expenses



- Accepting municipal bio-waste generates income through a gate fee.
- Since the WWTP treats the digestate themselves, they can sell the resulting product outside.
- The income increase as the amount of substrate increase.

### Annual income and reduced expenses for each option in phase 2

	Option 2A1	Option 2A2	Option 2A3	Option 2A4	Option 2B
Income from treating sludge from the neighbouring wastewater treatment plants	500 000	500 000	500 000	500 000	500 000
Income from treating biowaste	177 428	758 705	1 517 409	2 276 114	2 276 114
Income from treating industrial bio-waste	-	-	-	-	435 000
Income from selling the soil improvement product	58 699	64 019	70 856	77 692	98 431
Reduced electricity expenses	932 117	1 298 379	1 841 167	2 454 380	3 020 570
Sum income and reduced expenses	1 668 244	2 621 103	3 929 432	5 308 186	6 330 115

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)

# Biogas at the Tomaszów Maz. WWTP

## Phase 2: Annual cash flow



- All options in phase 2 have a negative annual cash flow.
- Compared to the baseline all options in phase 2 have a higher annual cash flow.
- To investigate which options would be more profitable than the baseline (including investment) we will have to look at the net present value.

### Sum costs, income and annual cash flow for phase 2 (in million PLN)

	Baseline	Option 2A1	Option 2A2	Option 2A3	Option 2A4	Option 2B
Total Investment Costs	-	68.99	68.99	68.99	71.79	71.79
Total Variable Costs	8.81	4.73	4.73	4.73	4.73	4.73
Total Other Income	-	1.23	1.53	1.95	2.41	3.15
Annual Cash Flow	- 8.81	-3.50	-3.20	-2.78	-2.32	-1.58
Annual cash flow compared to baseline	-	5.31	5.61	6.03	6.49	7.23

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)





# Biogas at the Tomaszów Maz. WWTP

## Phase 2: Net present value (NPV)

- If we assume a 6 percent discount rate non of the options in phase 1 is profitable compared to the baseline.
- Even the first two options (with the least substrate) in phase 2 is not profitable.
- According to these estimates they would need to collect at least 50% of the potential food waste for the project to be profitable.
- Adding industrial waste to the process significantly increases the profitability of investment.

### Net present value compared to the baseline

	Phase 1			Phase 2				
	Option 1A	Option 1B	Option 1C	Option 2A1	Option 2A2	Option 2A3	Option 2A4	Option 2B
<b>NPV</b>	-24.27	-6.89	-9.65	-8.09	-4.65	0.19	2.63	11.10

Source: Vista Analyse and IOŚ-PIB based on AL-PROJEKT (2023)



# Biogas at the Tomaszów Maz. WWTP

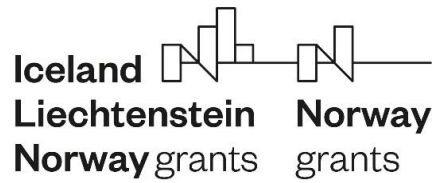
## Minimum grant for a 10-12 percent real rate of return

- Note from the table that a grant for phase 1 should be in the 22-29 million PLN range to secure an expected private return of 10-12 percent.
- The corresponding grant for phase 2 should be in the range of 10-23 million PLN.
- In other words, the grant for phase 2 is significantly lower than the grant for phase 1.
- This is another way of saying that the profitability of phase 2 is significantly higher than phase 1.

### Minimum grant for the two best options in phase 1 and 2 to be profitable, in millions PLN

	Phase 1		Phase 2	
	Option 1B	Option 1C	Option 2A4	Option 2B
12 %	27.22	29.02	23.33	17.81
10 %	21.92	23.96	16.55	10.26

Source: Vista Analyze and IOŚ-PIB based on AL-PROJEKT (2023)



The presentation was made as part of the project: *Green transition in practice: Demonstrating and disseminating the benefits of producing biogas from bio-waste.*

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<https://go4biogas.ios.edu.pl/>