

ESS Solar Farm ROI Analysis Report

EXECUTIVE SUMMARY

This analysis evaluates the financial viability of adding a 3,850 kWh battery storage system to a 2,000 kW solar farm. The analysis covers 365 days from 2024-07-01 to 2025-06-30.

Key Finding: The battery system would generate an additional 660,977.86 PLN in profit (93.0% improvement over solar-only operation).

Investment Recovery: Simple payback period of 4.54 years.

Analysis Period	2024-07-01 - 2025-06-30
Days Analyzed	365 days
Solar Farm Capacity	2,000 kW
Battery Capacity	3,850 kWh
Battery Investment (Estimated)	3,000,000.00 PLN
Baseline Revenue (PV only)	710,900.26 PLN
Net Revenue (PV + ESS)	1,273,271.24 PLN
ESS Additional Profit	660,977.86 PLN
Revenue Improvement	93.0%
Annual ESS Profit	661,430.58 PLN
Simple Payback Period	4.54 years

FINANCIAL ANALYSIS

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## Baseline Revenue (Solar Only):

710,900.26 PLN

## Optimized Revenue (Solar + Battery):

1,371,878.12 PLN

## Battery Cycling Costs:

98,606.88 PLN

## Net Additional Revenue:

660,977.86 PLN

## Annualized Projections:

- Annual ESS Profit: 661,430.58 PLN
- ROI: 22.0% per year

## BATTERY PERFORMANCE

Total Battery Cycles: 263.0 cycles

Average Daily Utilization: 0.72 cycles per day

Actual Round-Trip Efficiency: 90.2%

Total Energy Cycled: 1,012,364 kWh

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## MONTHLY PERFORMANCE

Month	PV Only Profit (PLN)	ESS Profit (PLN)	Improvement (%)
2024-07	97,832	95,071	97.2%
2024-08	81,724	79,005	96.7%
2024-09	59,830	76,010	127.0%
2024-10	67,451	51,831	76.8%
2024-11	29,986	34,342	114.5%
2024-12	21,630	9,700	44.8%
2025-01	32,662	11,440	35.0%
2025-02	64,791	25,015	38.6%
2025-03	55,654	54,390	97.7%
2025-04	66,875	71,908	107.5%
2025-05	71,819	67,062	93.4%
2025-06	60,647	85,203	140.5%

## BATTERY DEGRADATION ANALYSIS

Battery Lifecycle Overview:

- Annual Battery Cycles: 263.0
- Projected Lifespan: 30.4 years
- Cycle Limit: 8,000 cycles to 70% capacity
- End-of-Life Capacity: 70%

Impact on Financial Performance:

The battery degradation analysis shows the impact of capacity reduction over time on investment returns.

Metric	Value
Simple Payback Period	4.5 years
Degradation-Adjusted Payback	4.7 years
20-Year Total Profit	11,858,958 PLN

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Average Annual Profit (with degradation)	592,948 PLN
20-Year NPV (5% discount)	4,519,249 PLN

10-Year Performance Projection:

Year	Capacity	Annual Profit	Cumulative
0	100.0%	0 PLN	0 PLN
1	99.0%	654,908 PLN	654,908 PLN
2	98.0%	648,386 PLN	1,303,295 PLN
3	97.0%	641,864 PLN	1,945,159 PLN
4	96.1%	635,342 PLN	2,580,501 PLN
5	95.1%	628,820 PLN	3,209,321 PLN
6	94.1%	622,298 PLN	3,831,618 PLN
7	93.1%	615,775 PLN	4,447,394 PLN
8	92.1%	609,253 PLN	5,056,647 PLN
9	91.1%	602,731 PLN	5,659,378 PLN

## INVESTMENT RECOMMENDATION

**HIGHLY RECOMMENDED:** Excellent ROI with payback under 5 years. Strong business case for immediate implementation.