PREDAIOT

SIMULATION STUDY — ALL SOURCES CITED

Economic Optimization of a 500 MW Solar IPP in Oman

Sinaw-Class Asset — Economic Decision Gap Analysis

Scenario A	Scenario B	Scenario C
Solar Only	Solar + BESS Fixed	PREDAIOT Intelligence
7,375,230 OMR	8,962,012 OMR	9,921,262 OMR

Economic Decision Gap (C vs A): **2,546,032 OMR / year**

Intelligence Premium above standard BESS (C vs B): 959,250 OMR / year

OMR / year

Economic Decision Gap

per 500MW asset

Author: Chams Eddine Madi — Founder & CEO, PREDAIOT

Date: June 2026

Data Sources: Nama PWP MIS 2022 + APSR Annual Report 2024

Methodology: Published on Oman National Open Data Portal

Type: Simulation Study — Not a Live Deployment Measurement

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00 / SCIENTIFIC TRANSPARENCY

What This Study Is —
And What It Is Not.

IMPORTANT DECLARATION:

This is a simulation study. The modelled asset is hypothetical. Results are not measurements from a live deployment.
All input data is from official Omani government sources. All assumptions are explicitly stated and independently verifiable.

OFFICIAL DATA SOURCES

[1] APSR Annual Report 2024

Authority for Public Services Regulation. Financial data: economic cost 1,306.3M OMR, consumer revenue 765.1M OMR, government subsidy 602.3M OMR.

opendata.gov.om/ar/datasets/684b537a-adb3-4fc4-9bc7-ba0c9b476b66

[2] Nama PWP MIS Demand Data 2022

Nama Power & Water Procurement. Hourly electricity demand data for the Main Interconnected System (MIS) — 8,760 hourly observations.

omanpwp.om/PDF/MIS%20Demand%20Data%202013-2022.xlsx

[3] Ministry of Energy and Minerals — Oman 2025

Total renewable energy plants capacity data. Used to calibrate renewable penetration assumptions in curtailment model.

opendata.gov.om/ar/datasets/7b102b8a-351b-44cb-9608-95882f7edfec

[4] Sinaw Solar IPP — Nama PWP RFQ Announcement 2025

500MW Silicon PV, Wilayat Sinaw. Project cost ~111M OMR / USD 288M.
CO_2 reduction: 566,612 tons/year. Land area: 5,000,000 m².

omanpwp.com/tenders

[5] PREDAIOT Shadow Economic Engine — Published Methodology

Simulation methodology and economic decision gap framework published on Oman National Open Data Portal, June 2026.

opendata.gov.om/ar/use-cases/1d4a8d55-1b2a-4b72-baba-e1a3763e842f

01 / ASSET DEFINITION & PRICING MODEL

What We Modelled

A hypothetical Sinaw-class 500MW Solar IPP with optional co-located BESS. All parameters sourced from official data or industry standa

SOLAR ASSET PARAMETERS

Nameplate Capacity (DC)	**500 MW**	Nama PWP Sinaw announcement
AC Export Capacity	**450 MW**	DC/AC ratio 1.11 — industry standard GCC
Technology	**Silicon PV — Fixed Tilt**	Nama PWP announcement
Performance Ratio (PR)	**0.80**	Adjusted for Oman dust + heat (industry standard)
Annual Irradiation	**1,900 kWh/kWp**	Oman Meteorology Department — Sinaw region
Annual Generation (expected)	**855,000 MWh**	450MW × 1,900h (gross, before curtailment)
Project Life	**25 years**	Standard IPP contract duration
CO■ Reduction	**566,612 tCO■/yr**	Nama PWP RFQ announcement

BESS PARAMETERS (SCENARIOS B & C)

Power Capacity	**200 MW**	Sized at 40% of solar AC capacity
Energy Capacity	**800 MWh**	4-hour duration — industry standard
Round-Trip Efficiency	**87.5%**	IRENA 2023 lithium-ion benchmark
Annual Cycles (full)	**320**	Based on optimized dispatch calendar
Annual Energy Discharged	**224,000 MWh**	800MWh × 320 cycles × 87.5%

DYNAMIC PRICE MODEL — OMAN MIS

Formula:

Price(t) = SMP_base × (1 + α × σ_demand(t))

where SMP_base = 9.120 OMR/MWh [APSR 2024] | α = 0.15 (demand sensitivity)

σ_demand(t) = hourly demand deviation from daily mean [Nama PWP 2022]

00:00–05:00	**5.2 – 6.8 OMR/MWh**	Off-peak deep
06:00–09:00	**8.5 – 11.2 OMR/MWh**	Morning shoulder
10:00–15:00	**7.8 – 9.4 OMR/MWh**	Solar peak hours (price depressed by PV)
16:00–21:00	**11.8 – 15.6 OMR/MWh**	Evening peak — highest value window
22:00–23:00	**8.8 – 10.2 OMR/MWh**	Night decline

02 / THREE SCENARIOS

How dispatch decisions determine financial outcomes.

Scenario A

Solar Only, Standard Export

7,375,230 OMR

Annual Revenue

Curtailment	Arbitrage	Efficiency Index
42,750 MWh (5.0%)	None	74.3%

The plant exports every available MWh regardless of grid price. No storage. No economic optimization. Standard dispatch protocol.

· Exports during midday regardless of low solar prices

· No mechanism to capture curtailment

· No arbitrage capability

· Curtailment loss: 42,750 MWh × 9.08 OMR = 388,215 OMR/yr

Scenario B

Solar + BESS, Fixed Schedule

8,962,012 OMR

Annual Revenue

Curtailment	Arbitrage	Efficiency Index
27,360 MWh (3.2%)	1,447,040 OMR	90.3%

BESS added with a static charge/discharge schedule: charge 02:00–06:00 daily, discharge 17:00–21:00 daily. Better than A — but schedule ignores real-time price signals.

· Charges at avg 5.9 OMR/MWh even when price spikes above 8 OMR

· Discharges at avg 13.2 OMR/MWh even when peak is at 20:00 not 18:00

· Arbitrage revenue: 224,000 MWh × 6.46 OMR margin = 1,447,040 OMR

· Recovers 62.3% of the total economic gap

Scenario C

Economic Decision Intelligence (PREDAIOT)

9,921,262 OMR

Annual Revenue

Curtailment	Arbitrage	Efficiency Index
8,208 MWh (0.96%)	2,232,393 OMR	100%

Every hour, the engine evaluates: What is the economically optimal decision given current price, forecast demand, and SoC? Curtailment events are converted to arbitrage opportunities.

· Charge timing optimized: avg 5.2 OMR/MWh (vs 5.9 in B)

· Discharge timing optimized: avg 14.8 OMR/MWh (vs 13.2 in B)

· 70% of curtailment absorbed + resold: +247,753 OMR additional revenue

· Recovers 100% of the economic decision gap

03 / RESULTS & ECONOMIC METRICS

The Numbers That Matter

SCENARIO COMPARISON — FULL YEAR RESULTS

Metric	Scenario A	Scenario B	Scenario C
Annual Revenue	7,375,230 OMR	8,962,012 OMR	9,921,262 OMR
Curtailment Loss (MWh)	42,750	27,360	8,208
Curtailment Rate	5.0%	3.2%	0.96%
Arbitrage Revenue	—	1,447,040 OMR	2,232,393 OMR
Avg Charge Price	—	5.9 OMR/MWh	5.2 OMR/MWh
Avg Discharge Price	—	13.2 OMR/MWh	14.8 OMR/MWh
Economic Efficiency Index	74.3%	90.3%	100.0%
Value Recovery Rate	—	62.3%	100.0%

KEY ECONOMIC GAPS

C vs A — Total Economic Decision Gap

2,546,032 OMR/year

34.5% improvement

C vs B — Intelligence Premium

959,250 OMR/year

Value above standard BESS

B vs A — BESS Hardware Value

1,586,782 OMR/year

Storage hardware contribution

C vs A — Curtailment Recovery

34,542 MWh recovered

70% converted to revenue

NPV ANALYSIS — 25-YEAR PROJECT LIFE

Annual Intelligence Premium (C vs B)	959,250 OMR
Annual PREDAIOT Operating Cost (assumed)	80,000 OMR
Annual Net Benefit	879,250 OMR
Initial Investment (assumed)	500,000 OMR
Discount Rate	8% (GCC IPP standard)
NPV over 25 years	**~8,888,394 OMR**
Simple Payback Period	**< 8 months**
IRR of intelligence layer	**>120%**

04 / SENSITIVITY ANALYSIS & ECONOMIC FRAMEWORK

How Robust Are the Results?

SENSITIVITY TABLE — INTELLIGENCE PREMIUM (OMR/YEAR)

Variable	Pessimistic	Base Case	Optimistic
Curtailment Rate	3%	5%	10%
Arbitrage Spread (OMR/MWh)	5.0	7.4	10.0+
BESS Annual Cycles	250	320	365
Dispatch Optimization Gain	5%	9.1-15%	18%+
■■■ **Intelligence Premium** ■■■	**541,000 OMR**	**959,250 OMR**	**1,847,000 OMR**
Economic Efficiency Index	96.2%	100%	100%
Payback Period	< 14 months	< 8 months	< 5 months

ECONOMIC EFFICIENCY INDEX (EEI) — FRAMEWORK

Definition:

EEI = Actual Annual Revenue / Maximum Achievable Revenue (Scenario C)

This metric measures how much of the economic potential is being captured.

EEI = 1.00 (100%) → Full economic optimization — every decision is optimal

EEI = 0.90–0.99 → Good — standard BESS with reasonable optimization

EEI = 0.75–0.89 → Moderate — some optimization, significant gaps remain

EEI < 0.75 → Poor — schedule-based, no economic intelligence

PREDAIOT DISPATCH DECISION LOGIC (PSEUDOCODE)

```
FOR each hour (t) in operational year:
    price_now    = get_market_price(t)
    price_future = forecast_peak_price(t+1 to t+8)
    soc          = battery.state_of_charge
    solar_gen    = forecast_solar_output(t)
    curtail_risk = assess_grid_saturation(t)

    # Economic value of each action
    V_charge    = price_future × efficiency - price_now
    V_discharge = price_now - weighted_avg_charge_cost
    V_absorb    = price_future × efficiency  # curtailment → free energy

    IF curtail_risk AND soc < 95%:
        action = ABSORB_CURTAILMENT  # convert waste to arbitrage
    ELIF V_charge > max(V_discharge, 0) AND soc < 90%:
        action = CHARGE(optimal_rate)
    ELIF V_discharge > max(V_charge, 0) AND soc > 10%:
        action = DISCHARGE(optimal_rate)
    ELSE:
        action = HOLD
```

What This Means for Sinaw Solar IPP

THE ECONOMIC GAP — THREE LEVELS

Level 1 Loss from no storage

1,586,782 OMR/year

Adding BESS to a solar-only asset captures this value. BESS hardware is the enabler.

Level 2 Loss from unoptimized storage

959,250 OMR/year

BESS with a fixed schedule leaves this on the table. Economic intelligence captures it.

Level 3 Total Economic Decision Gap

2,546,032 OMR/year

The full gap between baseline solar and fully optimized solar + BESS + intelligence.

FOUR STRATEGIC RECOMMENDATIONS

01 Integrate BESS at Project Design Stage

Economic optimization requires storage. The ROI of BESS at design stage far exceeds retrofit costs. For a 500MW asset: Level 1 gap alone (1,586,782 OMR/yr) justifies storage investment.

02 Define Economic Dispatch in EMS Specification

EPC and EMS contracts must explicitly specify Economic Dispatch capability — not just Fixed Schedule. This single clause determines whether the asset operates at 74.3% or 100% economic efficiency.

03 Include Economic Efficiency Index as KPI

Standard IPP performance metrics measure technical availability. Add EEI as a contractual performance indicator. Target: EEI ≥ 0.95. This aligns operator incentives with investor returns.

04 Evaluate Economic Intelligence Before Financial Close

The cost of embedding economic decision intelligence at design stage is a fraction of post-commissioning retrofit. Payback: under 8 months. 25-year NPV: ~8.9M OMR.

Request a customised Economic Decision Gap analysis for your asset.

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Full methodology published: opendata.gov.om/ar/use-cases/1d4a8d55-1b2a-4b72-baba-e1a3763e842f

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