TECHNICAL RESEARCH REPORT / 29 OCTOBER 2026

When Is It Better to Sacrifice Existing Wafer Production Than Build Another Factory?

A constrained-capacity model of UMC's 8-inch thin-film lithium niobate conversion decision.

Abstract

United Microelectronics Corporation (UMC) reported 92% foundry utilisation in Q3 2026 while simultaneously converting part of its existing 8-inch manufacturing footprint toward thin-film lithium niobate (TFLN) photonics. The decision is economically more complex than substituting a higher-value wafer for a lower-value one: conversion requires capital, interrupts established output, changes processing throughput and yields, and consumes scarce tool capacity. A separate new line preserves legacy output but is slower and more capital intensive. We use UMC's disclosed capacity and management statements to identify the industrial decision, then evaluate it with an explicitly hypothetical 96-month cash-contribution model. Under the reference assumptions, conversion exceeds continued legacy production by USD 51.9 million of present value. That benefit disappears if the effective TFLN ASP falls to roughly USD 2,142 per saleable wafer, if mature saleable yield falls below approximately 69.9% under the specified ramp relationship, or if legacy wafer ASP rises around 10%. These thresholds are conditional results, not estimates of UMC's actual profitability.

MODEL CASE	RESULT	INTERPRETATION
Convert less keep	$51.9m PV	Reference-case premium over keeping legacy production
TFLN break-even ASP	$2,142 / good wafer	At modeled yield, mix, throughput and conversion cost
Conversion capex ceiling	$131.9m	Maximum spend that preserves parity with keep

Scope: a notional 10,000-start/month slice of 8-inch production, not an identified UMC fab. Project economics are invented sensitivity assumptions; company financial disclosure is used only for the physical decision and framing. See Sections 3–8 and source register.

1 The industrial decision

UMC's October 2026 operating results create an unusually clean capacity-allocation question. The foundry shipped 1.212 million 12-inch-equivalent wafers in the quarter and reported 92% aggregate utilisation. Management said several 12-inch sites were fully loaded and noted a mismatch between customer requirements and configured factory capacity. During its earnings call, UMC described the conversion of one 8-inch fab to expand TFLN capacity. [1–3]

The broader industrial programme is not the unit of analysis. Management separately described capacity aspirations by 2030 of approximately 18,000 silicon-photonics wafers/month, 22,000 capacitor-related wafers/month and 20,000 TFLN modulator wafers/month. The company also approved an additional approximately USD 3.2 billion of expansion capital, while maintaining its USD 2.0 billion 2026 cash-capex budget. Neither amount was assigned publicly to the particular 8-inch conversion. [2–3]

UMC's March partnership with HyperLight and its subsidiary Wavetek establishes a commercially identified TFLN manufacturing route using 6-inch and 8-inch wafers. A separate July announcement concerns 12-inch silicon-photonics production with SILITH. The two process families should not be combined into one fungible output number. [4–5]

Why 92% utilisation does not imply 8% convertible capacity

UMC reports the network in 12-inch-equivalent wafer area. One 8-inch wafer contributes (8/12)^2 = 0.444 of a 12-inch wafer equivalent, a geometric conversion rather than equivalence of process tool-hours. The firmwide ratio of shipments (1.212 million) to quoted quarterly capacity (1.325 million) is approximately 91.5%, consistent with the rounded reported utilisation. It says little about available TFLN-compatible deposition, etch, bonding, metrology or photonics test steps. [1]

OBSERVED UMC FIGURE	Q3 2026	CORRECT USE
Wafer shipments	1.212m, 12-inch eq.	Aggregate activity, not a local tool bottleneck
Rated quarterly capacity	1.325m, 12-inch eq.	Area-normalised manufacturing scale
Reported utilisation	92%	Not a share of interchangeable idle tools
8A fab rated capacity	215k, native 8-inch/qtr	One site example; not identified as converting
8N fab rated capacity	250k, native 8-inch/qtr	Different 8-inch site, also not identified
Target TFLN capacity	20k native 8-inch/month by 2030	Future programme, not converted-line size

Sources [1,3]. Native 8-inch site capacity cannot be translated into good TFLN wafer output without process-specific cycle times, qualified equipment and yield.

2 Decision alternatives and causal mechanism

The valuation isolates three mutually exclusive uses of the same incremental capital-allocation opportunity. "Keep" preserves established 8-inch output. "Convert" displaces that output, pays an up-front equipment reconfiguration cost, suffers a period of reduced loading and then sells TFLN output. "Build" preserves existing output while financing new, separate TFLN capacity, but with a longer commissioning delay and greater capital requirement.

STRATEGY	PRODUCTION PATH	ECONOMIC TRADE-OFF
KEEP	Legacy line operates throughout horizon	No incremental conversion capital; forgoes TFLN value
CONVERT	Legacy output ceases; TFLN begins after downtime	Lower capital and faster market entry, but sacrifices legacy contribution
BUILD	Legacy continues; new line starts after long construction	Higher capital and delayed ramp, but both output streams remain available

The process constraint is a complementarity, not merely a physical wafer count. TFLN saleable output requires compatible starting material, qualified process flow, trained technicians, acceptable optical performance and downstream integration capacity. The same building can contain idle capacity in one tool group while another is fully booked. The optimal objective is therefore contribution per constrained productive resource, adjusted for switching costs and schedule risk.

3 Model specification

The companion workbook computes nominal, pre-tax, unlevered operating cash contribution for months 1–96 (January 2027–December 2034), with an annual discount rate applied monthly. No terminal value, subsidy, working-capital release, taxes, financing structure or expansion-option value is included. The calendar is a controlled illustration: UMC's separate large capacity expansion is expected to begin ramping in late 2028, so the reference model is not a forecast of its real commissioning schedule. [3,6]

3.1 Reference-case inputs

INPUT	REFERENCE VALUE	EVIDENCE CLASS
Notional legacy line	10,000 wafer starts/month	Scenario, not disclosed converted-fab size
Legacy utilisation / saleable yield	90% / 95%	Scenario
Legacy ASP / variable cost	$900 per good wafer / $470 per start	Scenario
Legacy fixed cash cost	$0.25m per month	Scenario
TFLN relative throughput / mature utilisation	0.85x / 85%	Scenario
TFLN initial → mature good-wafer yield	60% → 75%	Scenario
TFLN ASP / variable cost	$2,300 per good wafer / $850 per start	Scenario
TFLN converted fixed cash cost	$0.45m per month	Scenario
Conversion downtime / capex	4 months / $80m at t = 1	Scenario
Greenfield delay / capex	30 months / $300m (staged)	Scenario
Horizon / discount rate	96 months / 10% annually	Scenario

Source: original accompanying workbook [6]. None of the scenario prices, yields, processing costs, downtime or project budgets is a UMC disclosure. "Good wafer" is an analytical saleability unit, not a claim about TFLN die-level or optical-module acceptance.

3.2 Production and contribution equations

For each month t, the model first applies utilisation to wafer-start capacity, then applies saleable yield. Production cost is charged per started wafer; selling price applies only to good output. The new process has a throughput factor relative to the notional legacy line. Discounts are applied at time (t − 1)/12, so the first cash flow is not discounted.

Legacy good wafers = legacy nameplate starts × legacy utilisation × legacy yield

Legacy contribution = good legacy wafers × legacy ASP − legacy starts × variable cost − fixed cash cost

TFLN starts(t) = min(nameplate × process throughput × utilisation(t), demand cap)

TFLN contribution(t) = TFLN starts(t) × yield(t) × TFLN ASP − starts(t) × variable cost − fixed cost

PV(strategy) = SUM over t = 1..96 of [cash contribution(t) / (1 + 10%)^((t − 1)/12)]

In the conversion case, TFLN contribution is replaced by a USD 150,000/month holding charge while the line is shut, and USD 80m of capital is charged at t = 1. After shutdown, utilisation and saleable yield rise linearly

over a 12-month ramp. In the greenfield case, the legacy line continues and new TFLN output begins only after 30 months; USD 300m is committed in three stages (50%, 25%, 25%). The greenfield line carries a higher fixed monthly operating charge. [6]

4 Reference-case results and break-even boundaries

The reference strategy comparison is a discounted sum of modeled project contributions, not a company valuation or project IRR. Under these settings, conversion ranks above continuing legacy production and constructing separate capacity. The greenfield result is especially sensitive to the finite eight-year horizon and absent terminal value.

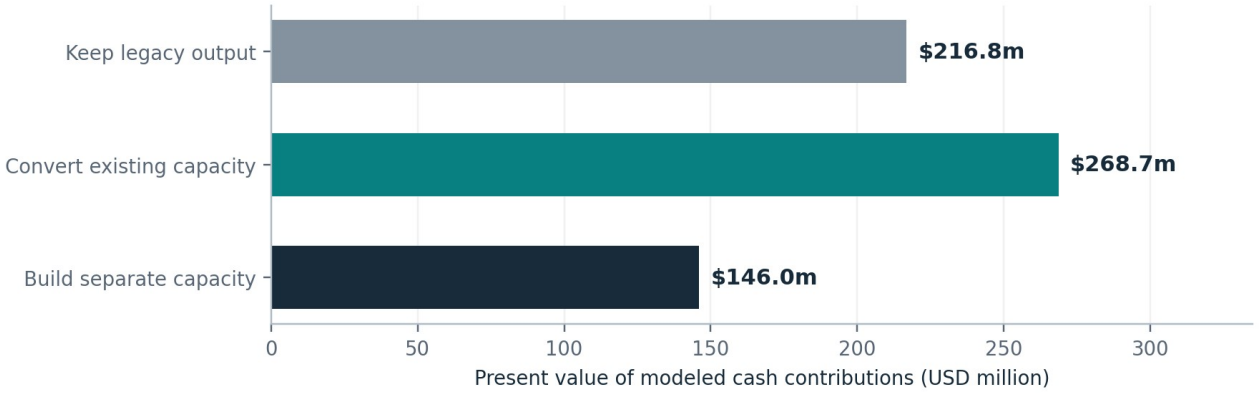


Figure 1. Present value of the three modeled strategies, 2027–2034, USD million. Source: independently replicated workbook [6].

STRATEGY	PV, USD m	DELTA VS KEEP, USD m
Keep	216.8	—
Convert	268.7	+51.9
Build	146.0	-70.8

Incremental cash-flow bridge: TFLN operating contribution has present value of USD 349.3m; legacy contribution forgone is USD 216.8m; conversion capital is USD 80.0m; and the discounted shutdown holding cost is USD 0.6m. The net conversion premium is USD 51.9m. This decomposition clarifies that high TFLN revenue by itself does not justify the investment: it must pay for both new operating costs and displaced legacy output.

4.1 Break-even TFLN wafer price

The reference-case converted line generates approximately 328,987 present-value-weighted good TFLN wafers over the horizon. Because the selling price enters linearly while yield and throughput are held fixed, the break-even saleable-wafer price is directly identified by solving for a zero premium versus keep:

Break-even ASP = current assumed ASP − [(PV(convert) − PV(keep)) × 1,000,000] / discounted good TFLN wafers

The result is USD 2,142 per good wafer. At the reference assumed USD 2,300, that leaves only USD 158 of sale-price headroom, around 6.9%. This is a conditional break-even selling price, not evidence of UMC's TFLN contract price.

4.2 Maximum conversion capital

With the same pricing, yield and schedule, the conversion expenditure could rise from USD 80.0m to approximately USD 131.9m before the conversion strategy loses its advantage over keep. This ceiling is not a forecast of actual 8-inch conversion costs; the company has not separately disclosed those costs.

5 Sensitivity and robustness

The baseline premium is material but not robust to modest changes in economically decisive parameters. All sensitivities hold the rest of the modeled assumptions constant. They are stress tests, not confidence intervals or estimates of realistic probabilities.

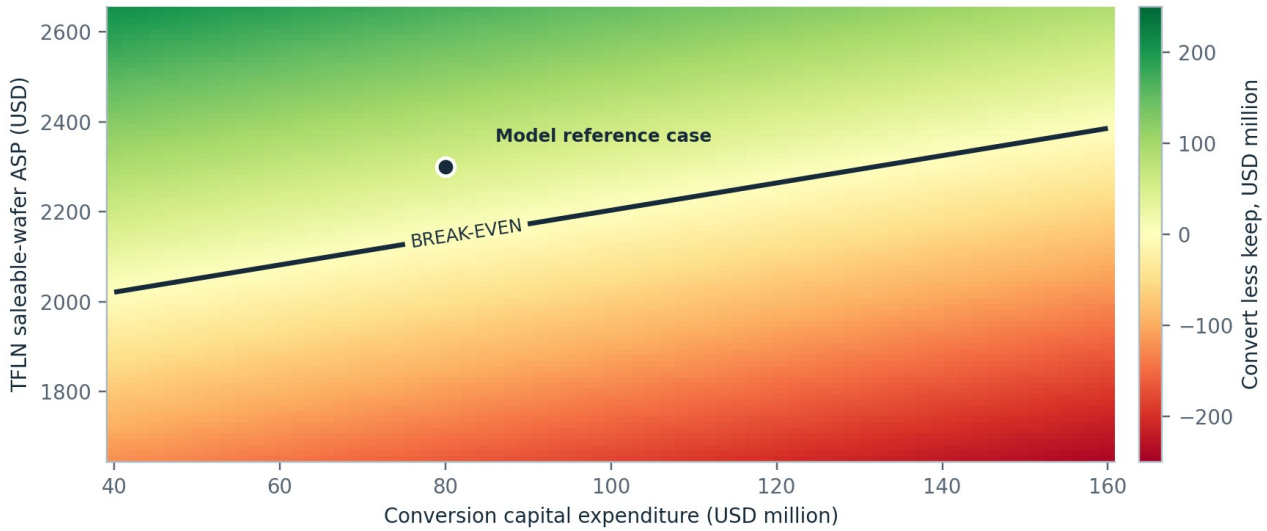


Figure 2. Conversion minus keep, USD million, as a function of hypothetical TFLN ASP and conversion capital cost. Dark isoline marks the zero-premium frontier. Dot shows the reference case. [6]

The contour is a break-even frontier. Moving to the upper-left improves conversion economics; falling product prices or higher conversion expenditure make keeping legacy capacity more attractive. The frontier's near-linearity is mechanical because yield, throughput, demand, ramp and operating costs are fixed in this two-variable plot.

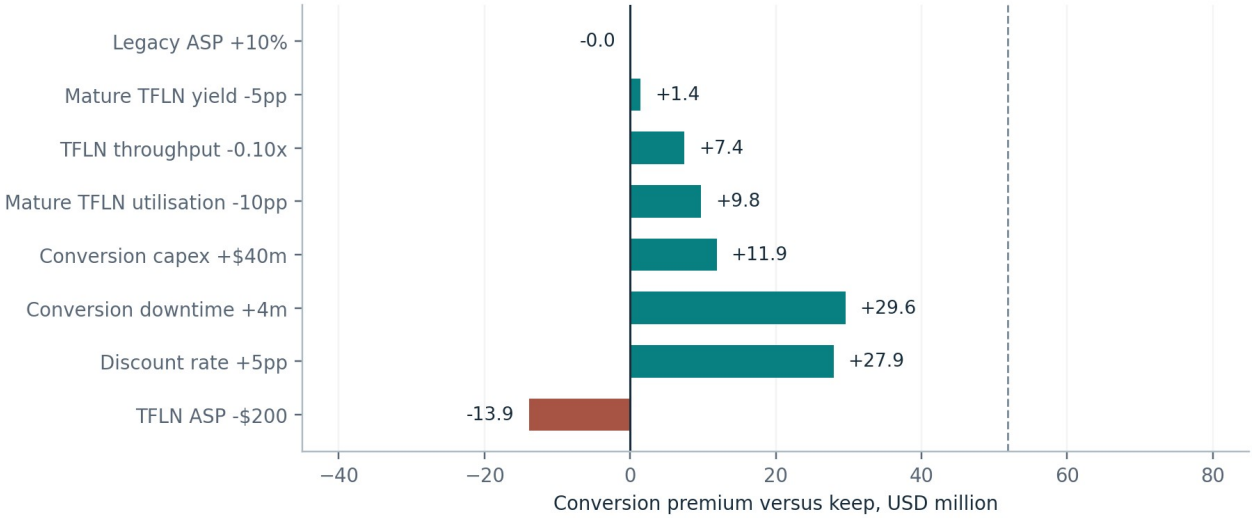


Figure 3. One-at-a-time downside sensitivities. Dashed vertical line marks the USD 51.9m reference premium; yield scenario scales initial and mature yield together. A negative bar means keep wins. [6]

The most consequential downside is not the capital cost alone. A USD 200 reduction in assumed TFLN ASP turns the reference premium negative. A 5 percentage-point reduction in mature yield, with initial yield adjusted proportionately, nearly removes it. Reducing relative TFLN throughput from 0.85x to 0.75x or mature utilisation from 85% to 75% materially compresses the advantage. Meanwhile, raising legacy ASP by 10% roughly eliminates the premium even though TFLN economics remain unchanged. The 10% stress is a modeling illustration, not an assertion that UMC's legacy 8-inch contracts will reprice by 10%.

5.1 Quantity and timing thresholds

PARAMETER	ILLUSTRATIVE PARITY THRESHOLD	INTERPRETATION
Mature TFLN good-wafer yield	~69.9%	Initial yield held at 80% of mature yield
TFLN throughput vs legacy	~0.733x	Same process-tool-footprint assumption
Mature TFLN utilisation	~72.7%	All other productivity assumptions fixed
Legacy wafer ASP	~$990 per saleable wafer	10% above illustrative $900 baseline
Model horizon	~60 months	Without salvage, terminal value or tax effects

The legacy ASP and model-horizon thresholds are particularly instructive. A conversion strategy can appear attractive when existing products are assumed to earn too little, or when enough future periods are included to amortise the new investment. Neither condition can be confirmed using firmwide revenue or consolidated gross margin alone.

5.2 The value of timing

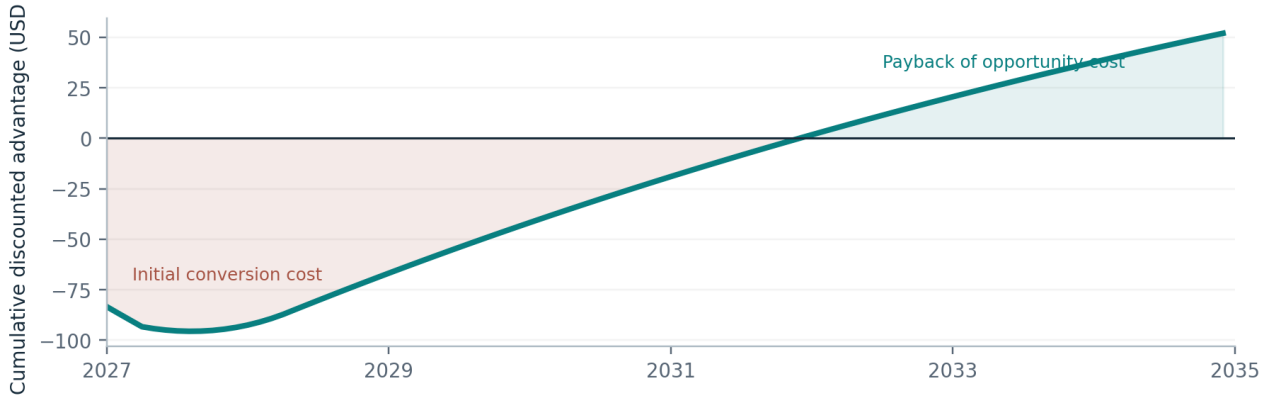


Figure 4. Cumulative discounted convert-versus-keep premium. The early negative balance reflects shutdown and up-front capex; the break-even crossover is a modeled payback time, not a real project schedule. [6]

A shorter time horizon reverses the ranking. Over 48 months, keeping legacy output exceeds conversion by roughly USD 20.8m; at 60 months the two approaches are approximately equal; by 96 months conversion leads by USD 51.9m. Build remains disadvantaged within the baseline horizon, but the comparison excludes all asset value beyond 2034 and thus penalises the later-commissioning asset. A full investment-committee model would need economic lives, end-of-horizon values and reinvestment cycles for both pathways.

6 Interpretation: the technology decision is an allocation decision

6.1 Scarce process steps matter more than nominal wafer area

Consolidated utilisation compresses distinct process technologies, tool groups and maturity states into one statistic. Management's capacity mismatch remark is consistent with this distinction. The relevant scarce resource for a conversion decision may be lithography, thin-film deposition, etch, bonding, metrology, optical qualification or engineering attention. Without step-level tool occupancy and qualified process recipes, estimating a plant's available TFLN output from its rated 8-inch wafer capacity would give false precision.

6.2 Saleable output is not technological capability

A successful photonics process requires more than completing a wafer start. Revenue-bearing output depends on optical performance, yield, acceptance tests and whether packaging and the customer's integration workflow are available at matching rates. The model represents this through a good-wafer yield. It does not explicitly represent die size, photonic die count per wafer, substrate input mix, module assembly yield or end-system acceptance, which could dominate the economics of specific TFLN products.

6.3 Higher-value technology can lose to repricing the incumbent

The most revealing counterfactual is not solely building another TFLN line. It is the opportunity to continue selling established products at an improved price or with better operating efficiency. In the model, a 10% increase in legacy ASP eliminates most of the conversion premium. When incumbent capacity is scarce, a technology upgrade must be benchmarked against the value of the displaced production at the margin, not against historical averages.

6.4 Investment timing creates option value

Conversion is faster but less reversible; building additional capacity is slower but preserves the old line. A staged option could also convert only selected tool groups, reserve expansion space or sequence customer qualification before full reconfiguration. The model does not assign value to these options. That omission matters whenever customer demand, process yield or input supply is uncertain.

7 Evidence gaps and research priorities

The model has reached the point where further precision depends on specific missing information rather than another set of speculative assumptions. The following requests would materially reduce uncertainty.

EVIDENCE TO OBTAIN	WHY IT MATTERS	BEST NEXT SOURCE
Fab identifier; convertible tool groups; actual wafer starts	Constrains displaced legacy output and throughput	UMC IR / fab-level operating disclosure
TFLN qualification and good-die economics	Tests yield, price and saleable-output assumptions	Foundry partners / optical module developers
Conversion capital and tool downtime	Distinguishes retrofitting from greenfield expenditure	Capital-budget disclosures / equipment contracts
Customer volume commitments and supply terms	Determines minimum sustainable utilisation	Customer and supplier agreements, where public
TFLN substrate and downstream integration constraints	Identifies bottlenecks outside the fab	Substrate suppliers / packaging and test providers
Alternative life and terminal value assumptions	Avoids biased greenfield comparison	Asset-life policy, capex schedules and engineering estimates

Key threats to inference

1. Ecological fallacy: the 92% corporate figure cannot locate the marginal tool constraint in the specific 8-inch fab.
2. Endogenous commercial variables: higher TFLN prices may coincide with lower volume or altered product mix, so one-at-a-time sensitivities can overstate achievable pricing.
3. Over-optimistic demand: the reference workbook assumes sufficient customer demand to sell the modeled wafer output; falling qualification volumes can overturn the decision.
4. Incomplete economic life: no terminal value, future replacement capex, inventory changes or tax effects is applied; greenfield rankings are especially vulnerable.
5. Scope mixing: the USD 3.2bn company investment approval is not the model's USD 80m conversion expenditure and must never be substituted for it.

8 Conclusion and publishable claim

UMC has made a real manufacturing allocation decision: it is reconfiguring existing 8-inch operations for TFLN at a time when consolidated utilisation is already high. That event supports a rigorous economic question but not a plant-level return estimate. The model demonstrates a conditional finding: conversion can outperform both continued legacy production and a new factory when it enters production materially

earlier and earns enough contribution to replace forgone legacy output, recover reconfiguration capex and absorb a yield ramp.

In the reference case, the conversion premium is USD 51.9m and the parity TFLN price is USD 2,142 per saleable wafer. Those are properties of transparent assumptions. The deeper insight is the narrow boundary: a higher incumbent price, lower new-process yield or slower effective throughput can change the preferred strategy without any change in headline technological performance. For investment decisions, semiconductor capacity should be valued by product-qualified contribution per constrained process step, together with the option value of when and how to redeploy it.

Research status: the investment mechanism and model arithmetic are independently reproducible; company-specific economic calibration is not yet supported. The work is suitable as a technical research note or conditional scenario study, not as a claim that UMC's announced conversion will achieve these monetary returns.

Appendix A Reproducibility and model audit

The workbook is organised into Start Here, UMC Evidence, Inputs, Monthly Model, Decision, Sensitivity, and Sources & Limits. All reference-case financial outputs have been reproduced independently from the model's monthly production, ramp and discount formulas; discrepancies against cached spreadsheet values are below USD 1. The discount factor is (1 + r)^[-(t−1)/12], with first-period capex at month 1. The linear price threshold is exact within the modeled output schedule. [6]

CHECK	WORKBOOK OUTPUT	INDEPENDENT REPLICATION
Keep PV, USD m	216.8078	216.8078
Convert PV, USD m	268.6903	268.6903
Build PV, USD m	145.9937	145.9937
Break-even TFLN ASP, USD	2142.30	2142.30
Max conversion capex, USD m	131.8825	131.8825

The replication verifies consistency, not the plausibility of confidential process parameters. No company-derived TFLN prices, yield data, line-level capital costs or financing assumptions have been inserted.

Sources and model documentation

[1] UMC, Q3 2026 Financial Review. 28 October 2026. Quarterly utilisation, wafers shipped, fab-level capacity and capex baseline. Open source

[2] UMC, Q3 2026 financial results (Chinese-language release). 28 October 2026. Capacity conversion and board-approved broader expansion budget. Open source

[3] UMC, Q3 2026 earnings call (reproduced transcript). 28 October 2026. CEO management remarks on 8-inch conversion, capacity mismatch, mature TFLN target and proposed schedule. Transcription is third-party. Open source

[4] UMC / HyperLight / Wavetek, TFLN manufacturing partnership. 12 March 2026. 6-inch and 8-inch manufacturing relationship and photonics application. Open source

[5] UMC / SILITH, silicon photonics manufacturing update. 14 July 2026. Separate 12-inch silicon PIC manufacturing programme. Open source

[6] Rokin Research, UMC conversion model v1. 29 October 2026. The accompanying calculation workbook. All plant-specific prices, process yields and capital costs are explicitly illustrative. *Companion Excel: rokin_umc_conversion_model_v1.xlsx*