

HBM Memory Future

Technology, Cost, and Market Size

Rev 2

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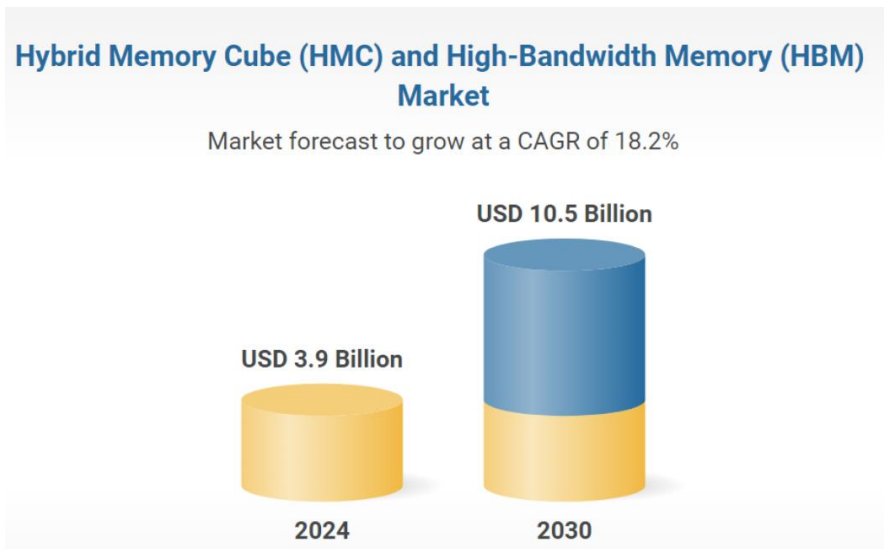
What Does AI say about the Revenue for HBM Memory that makes AI?

- AI Responses: \$2.3B-2.5B in 2024. \$11B by 2030
 - AI may have referenced a company that used AI to generate a report
 - It used HBM and HMC interchangeably with incorrectly labeled diagrams
 - It got the numbers wrong for 2023, 2024 by >80%
- “Real” Analysts are still needed to deal with obviously incorrect AI generated data (which may have been generated by AI or a Google search).

AI Models for Revenue.... It really is “Artificial”

In all fairness, AI says data may be incorrect

what was HBM market revenue in 2024



In 2024, estimates for the global High-Bandwidth Memory (HBM) market revenue generally range between **\$2.3 billion and \$2.5 billion**, depending on the research source:

- **\$2.3 billion** according to a recent report by Global Market Insights [gminsights.com +12](#).
- **\$2.514 billion** (approximately \$2.51 billion) as reported by Cognitive Market Research [cognitivemarketresearch.com](#).
- **\$2.36 billion** cited by The Business Research Company [thebusinessresearchcompany.com](#).

Overall, a solid consensus emerges that the HBM market pulled in roughly **\$2.3–2.5 billion in revenue for calendar year 2024**.

If your needs require refining by application, region, or memory generation (e.g., HBM2, HBM3), I can dig deeper into those specifics—just let me know!

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Our Forecast for HBM (Obviously AI not used)

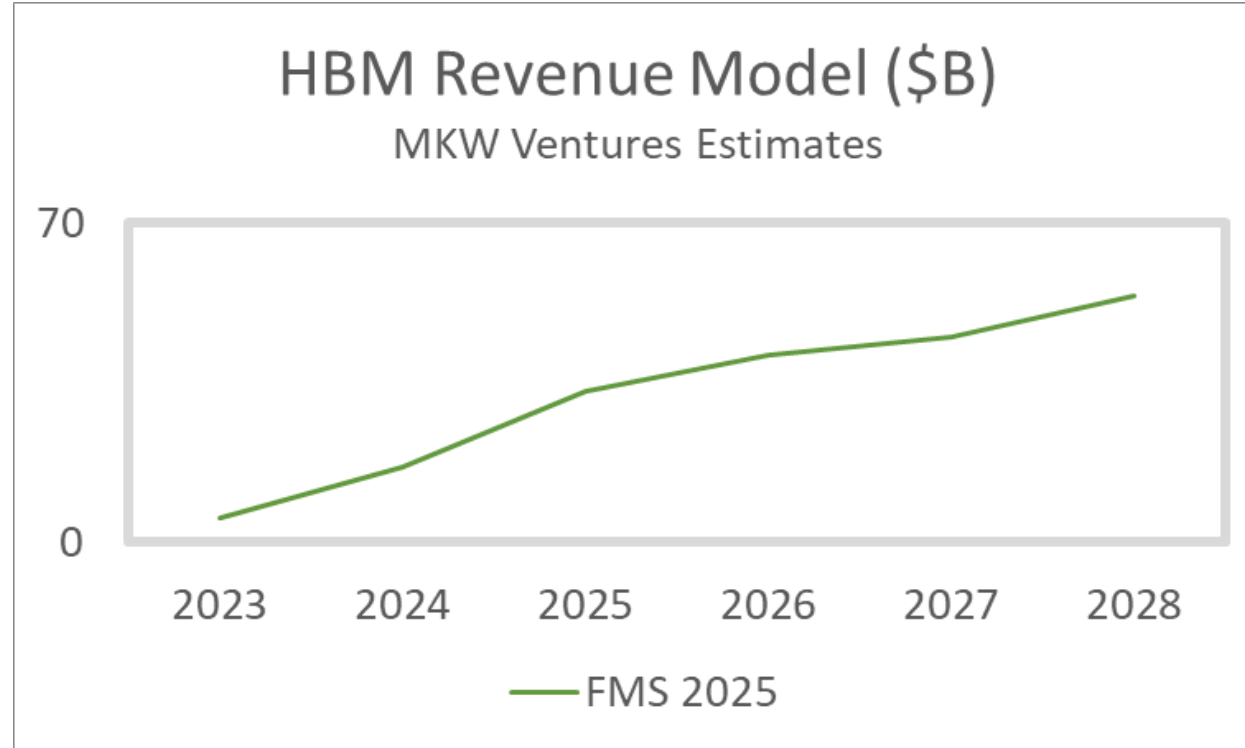
Reasons for HyperGrowth Today

- HBM clearly is enabling technology for HPC AI Servers. HBM4 is coming in late 2026
- Nvidia is delivering, AMD is Delivering, Hyperscalers are Delivering
 - 12+ die stacks and HBM4 is real and coming. Hype is still through the roof.
- We still see only minor amounts of traditional server cannibalization
 - AI servers are huge net adder to spending.

CAVEAT

- When a new technology hits the peak of the Gartner hype cycle, the growth predictions are ALWAYS exaggerated (OK... 2025 was not exaggerated)
- When Hypergrowth slows, the effect on supply market is >3x
 - Less growth, no backup orders, no inventory build, excess inventory burn. 10% down becomes 30% down (See FMS 2023 presentation on why market is always cyclical)
- 100% growth in 2024/5 drops to 20% growth in 2026 (Total year).
- Digestion phase is a cornerstone of Server market volume trend

The HBM Revenue Model (FMS 2025)

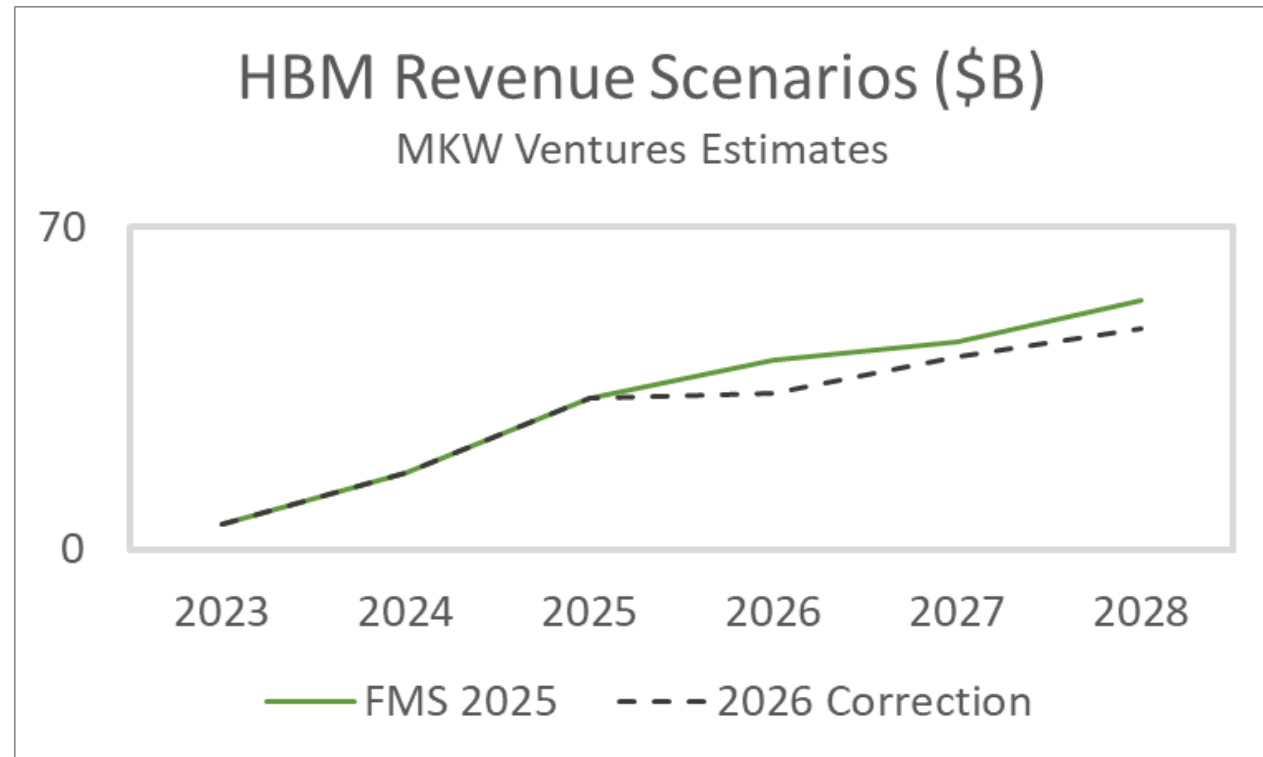


- 100% CAGR growth in 2024 and 2025 (\$33B in revenue in 2025)
- Leveling off and slow down to 20% CAGR growth in 2026/27 with digestion
- Growth at 25% in 2028 and beyond
- Other analysts and companies are 23-30% CAGR through 2030

2026-2027 Possible Correction Scenario

Corrections are common... ESPECIALLY in the fastest growing markets.

- Better supply leads to correction
 - Hynix leads, Samsung is qualified, Micron adds capacity
 - Inventories and orders adjusted
 - A correction could end up in reduced margins as well
 - Bits up but pricing down
- Trade barriers and Tariffs are not included
- Impacts require quick adjustments



How to see ANY correction coming

- Any glitch in end customer (NOKIA) revenue growth for any reason
- Inventory growth at end customer or memory company
- Bit growth up, margin growth slows at memory company (Price erosion due to competition)
- Sudden increase in supply (Samsung qualified/Micron Plants come online)
- Use of the word “Digestion” at a hyperscaler or Nvidia
- Comments like “this is short term adjustment, segment still is strong” from CFO at memory company.
- If there is an oversupply in late 2026, pricing will become aggressive.
- HBM has unique supply chain, minimal/slow flex between DDR and HBM
- HBM Gross Margins would drop to at least 40% range or lower

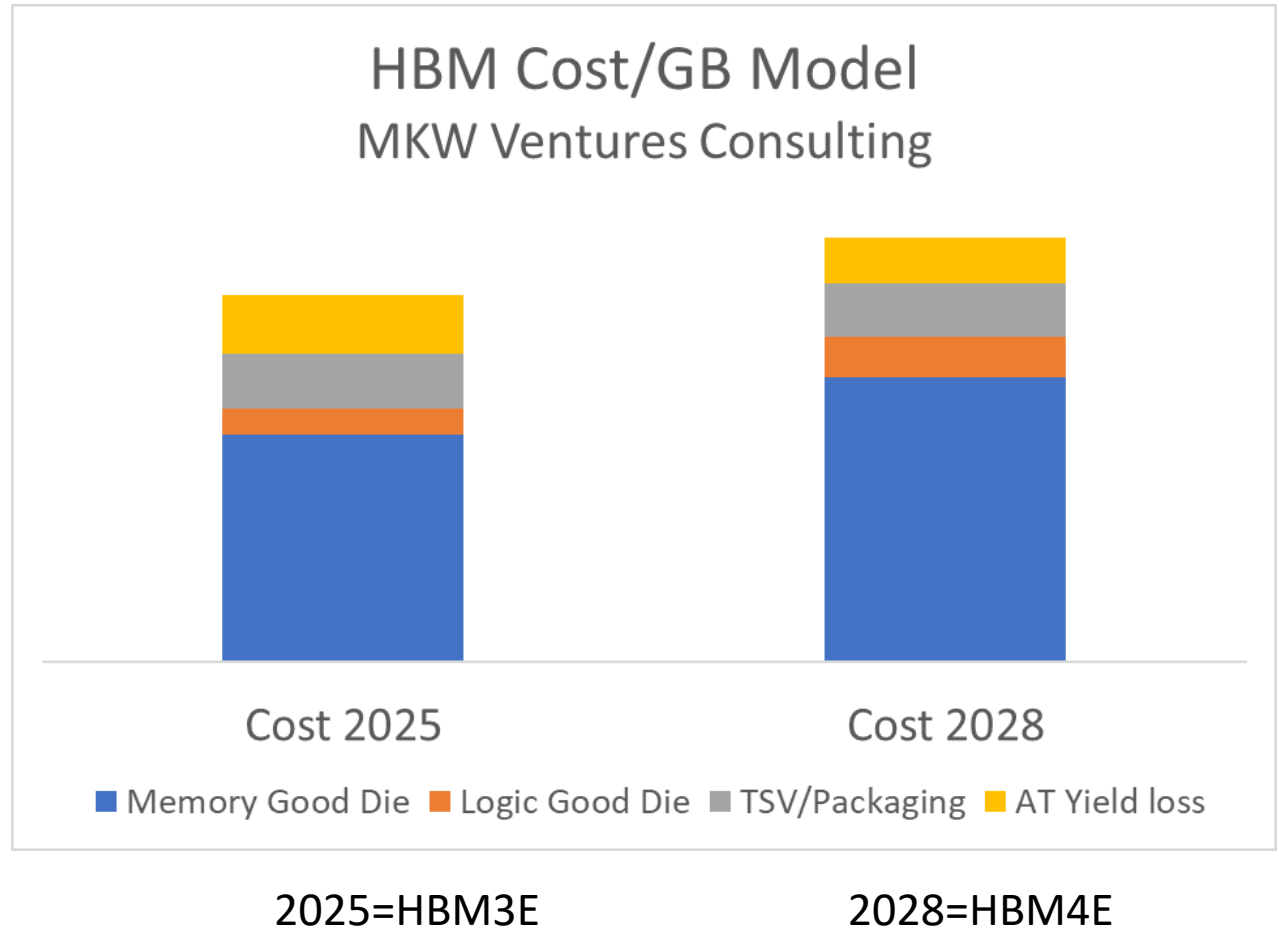
HBM Costs and Pricing

“No one cares about HBM costs, they just want more”

- Current model is that HBM will go from 3x the bit cost of DDR to 4x the cost with HBM4. Then cost improvements will kick in.
 - Cost improvement will be 15% per year for 2 years at given HBM generation (continuous improvement)
- Pricing is modeled at ~6x price of DDR. We expect nominal margins to continue until a correction: HBM4 Price will be ~8x Price of DDR
 - We have lots of excel spreadsheets and models to back this up
 - GM% is much higher than for DDR (Modeled at 70%*)
- Bit costs will decrease with scale and experience and increase with new technologies (HBM4/4E, Hybrid Bonding, etc)

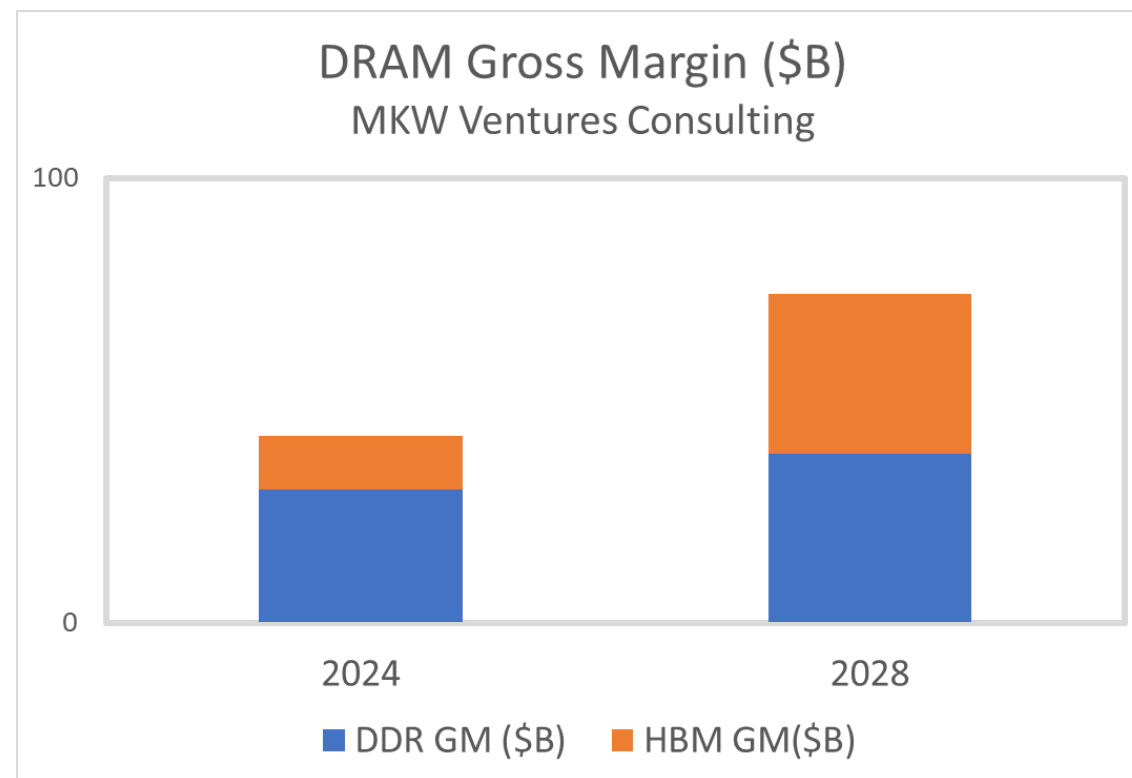
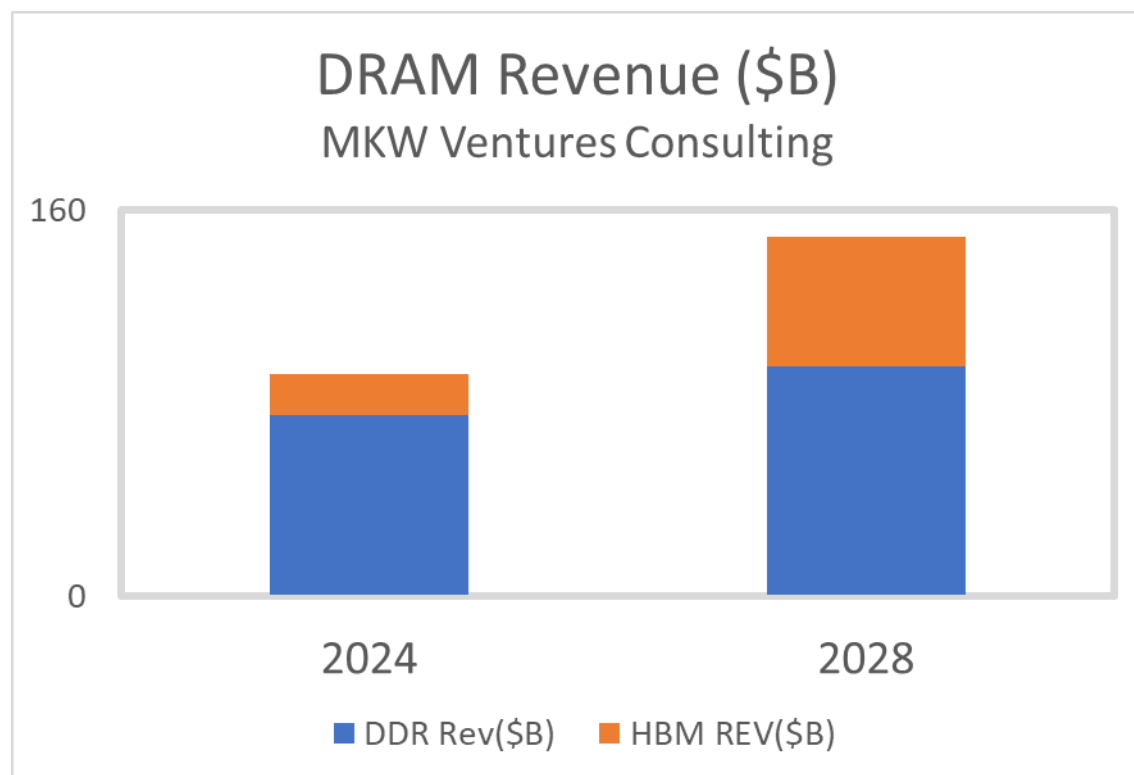
HBM Cost Model Components Evolution

- Many changes!
- Lower cost: DRAM Generation, Yields, Volume
- Higher cost: TSV density, Logic die, TSV/Packaging technology
- Yields and economies of scale offset some of the technical cost increases



Result of Bits, Price, Cost on DRAM Margins

HBM DOMINATES Margin growth...~50% of Margins post 2028



SUMMARY

- HBM revenue grows ~100% CAGR in 2024 and 2025
 - Incredible execution by suppliers and customers
- 2026 is the “Catch up Year”. Growth slows to 20% CAGR in 2026/7
- HBM becomes 35% of DRAM revenue and 50% of Margin in 2028
 - \$33B in revenue in 2025, \$55B in 2028
- Corrections/cycles are common, especially in fast growing markets.
 - There will be a correction in HBM Revenue sometime
- Companies can mitigate this by monitoring and reacting quickly and decisively

For More Information

- We have detailed modeled numbers for all aspects of HBM Market
- HBM bit cost over time including packaging and yield effects
- HBM technology timeline. UF, Hybrid Bonding, stacking, Die size
- Strengths and weaknesses of each company

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