



Probe Card Market Dynamics in a Turbulent World



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Hsinchu, Taiwan, October 26-28, 2022

Overview

- **These are turbulent times!**
- **Probe card market dynamics in a fast-changing environment**
- **Navigating the way through the next few quarters**

Semiconductor Super Cycle

Long-term market drivers still intact

It's a data centric world:

Data collection, processing,
and storage = monetisation

Electrification

Connectivity

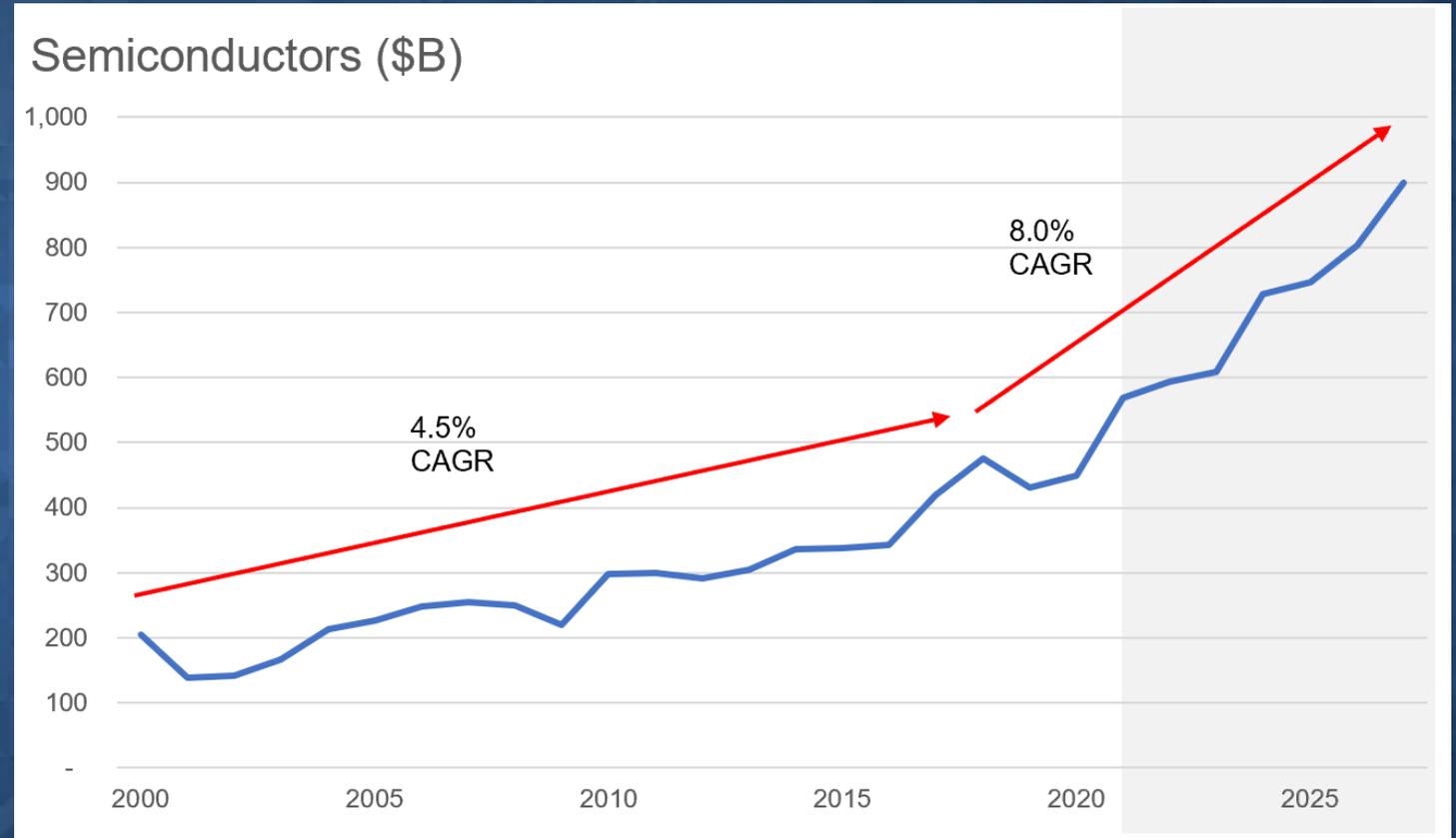
Clear technology roadmap to 1nm

Semiconductor Outlook:

2022 – growth between 5% and 10%

2023 – flat, but uncertain

2024 – recovery



2023 is going to be tricky

Multiple factors in play

- **Decoupling of high-tech trade between US and China**
 - Supply chain disruptions
 - Higher costs
- **Cost of living crisis**
 - Higher energy costs
 - Higher interest rates
 - Inflation
- **Strong US Dollar**

Memory

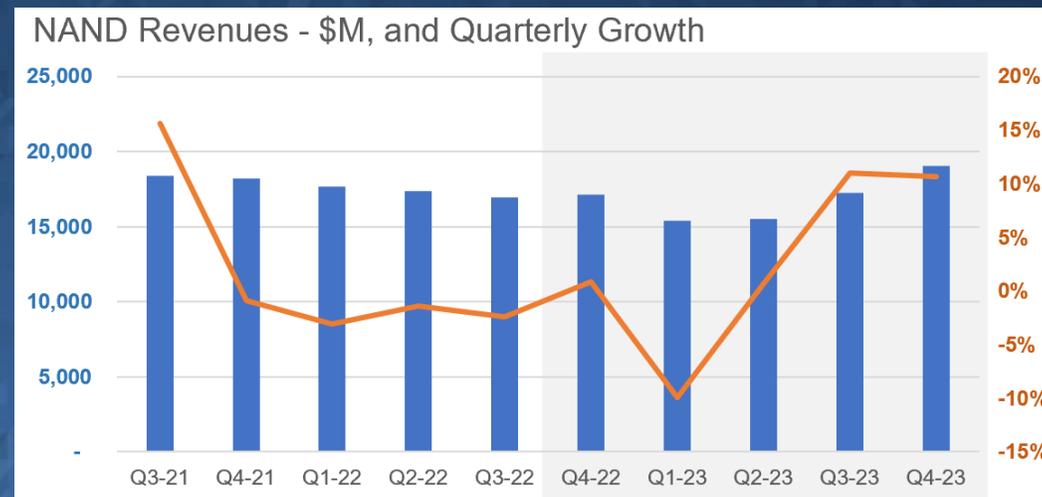
Recovery underway from Q2 2023 onwards

NAND:

- Volatile unit shipment demand Q/Q
- Very weak pricing environment until 2H 2023
- 18% CapEx reduction in 2023
- Annual growth: 2022 = -3%
2023 = +3%
2024 = +20%

DRAM:

- Unit shipments growing low single digit rates Q/Q
- Weak pricing and inventory corrections
- 25% CapEx reduction in 2023
- Annual growth: 2022 = +0.5%
2023 = -0.3%
2024 = +43.8%



Non-Memory

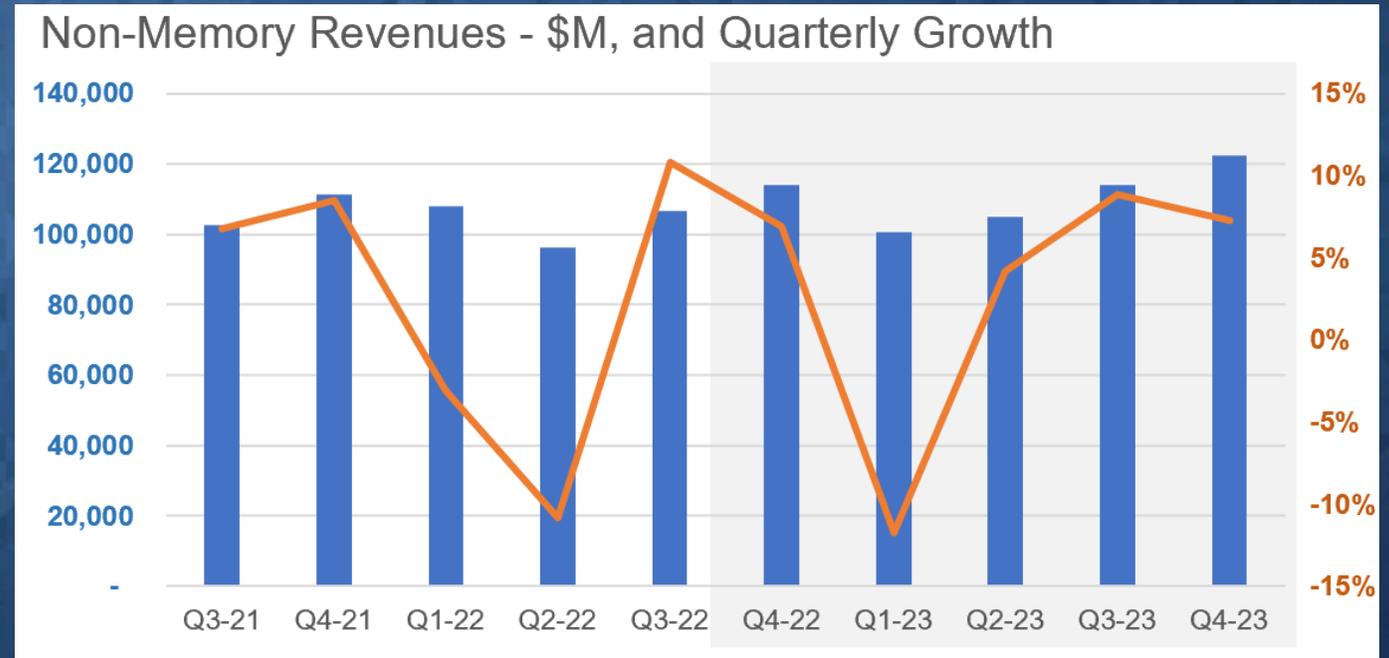
Uncertain times ahead, but recovery from 2H 2023 onwards

Negatives:

- Macro-economic headwinds putting pressure on consumer electronics
- US export controls

Positives:

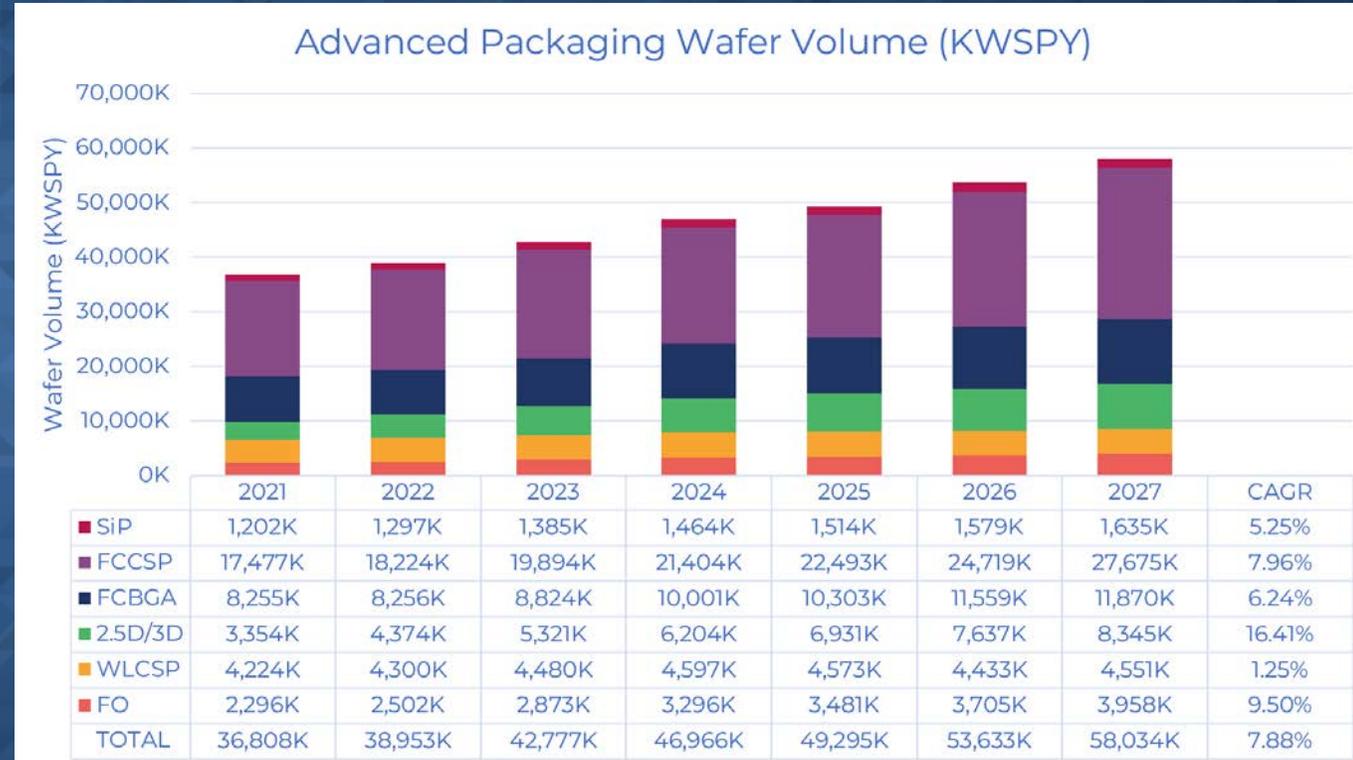
- RF Chips
- Power ICs
- Image Sensors
- Advanced Packaging
- Increased number of chip designs



Advanced Packaging

2.5D/3D and FO leading growth

- **Wafers for advanced packaging a strong driver for probe card growth**
 - Longer test times
 - Lower yields
- **2.5D/3D and FO small but growing fast**



Probe Card Revenues

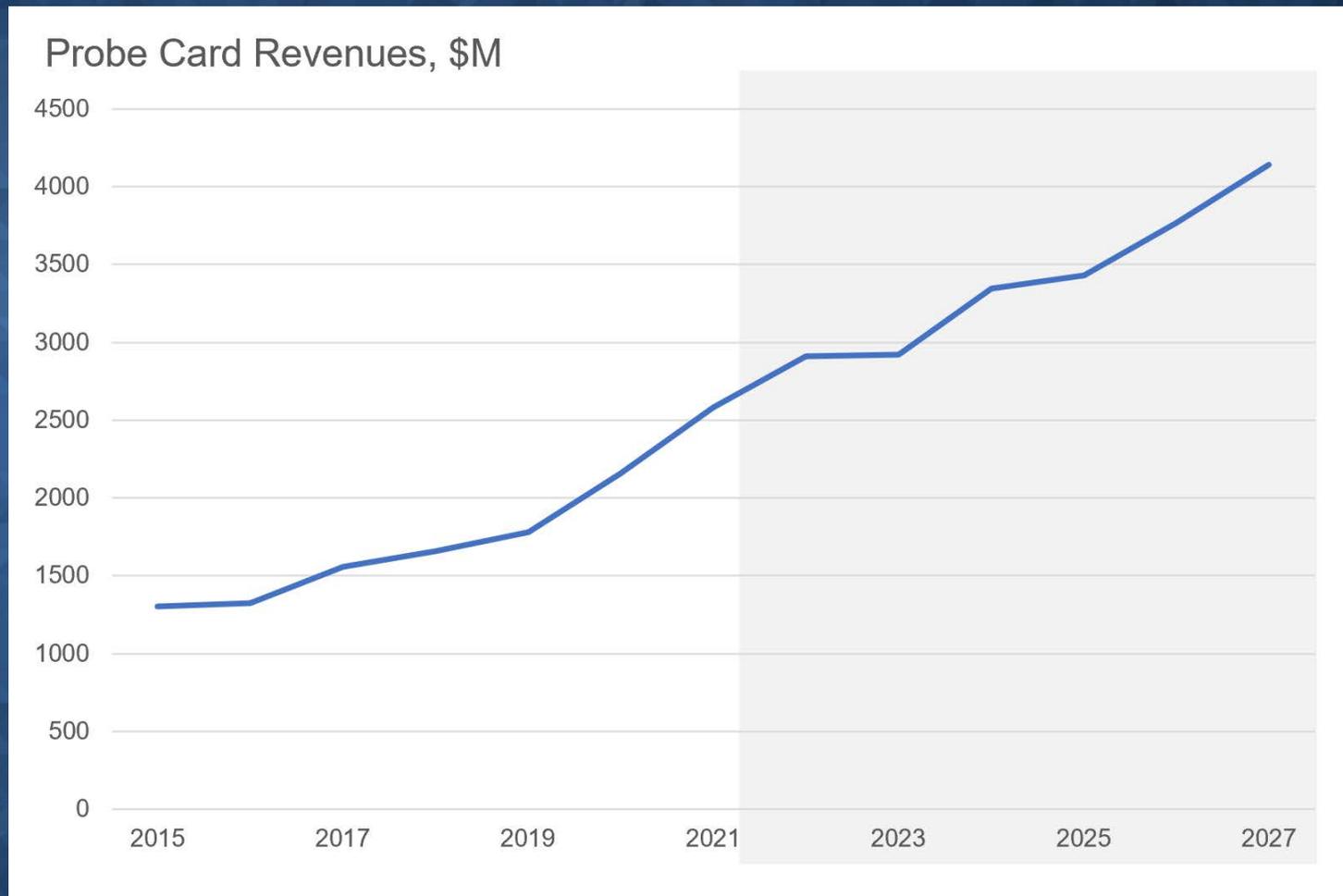
Overall outlook is positive

Market will be very choppy over next several quarters

Supply chain reconfiguration
Inventory corrections
Changing customer mix
Net sum zero in 2023

Probe Card Market Outlook:

2022 – growth between 10% and 15%
2023 – flat, but volatile for some (\$3Bn)
2024 – recovery
2027 - > \$4Bn



Probe Cards vs. Semiconductors

Chipmakers spending more on probe cards

Step change in 2020

Was this COVID related or something else?

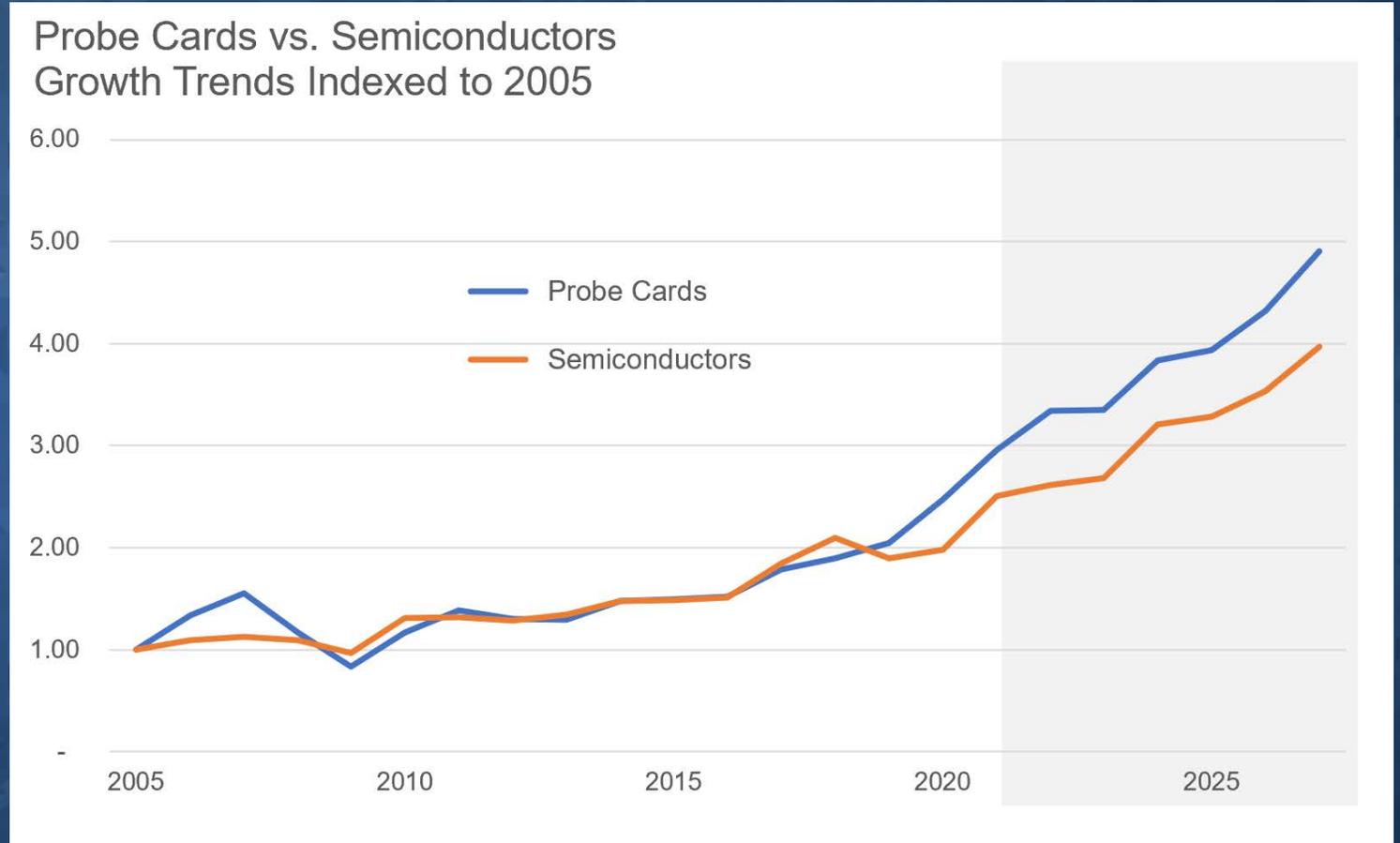
Chipmakers raised test capex intensity after a long period of decline

Test challenges are on the increase

Increase in wafer level burn-in

Increase in # of chip designs/re-designs

Sustained increase in spending from 2020 to 2022 – is this now a trend?



Probe Cards vs. Semiconductors

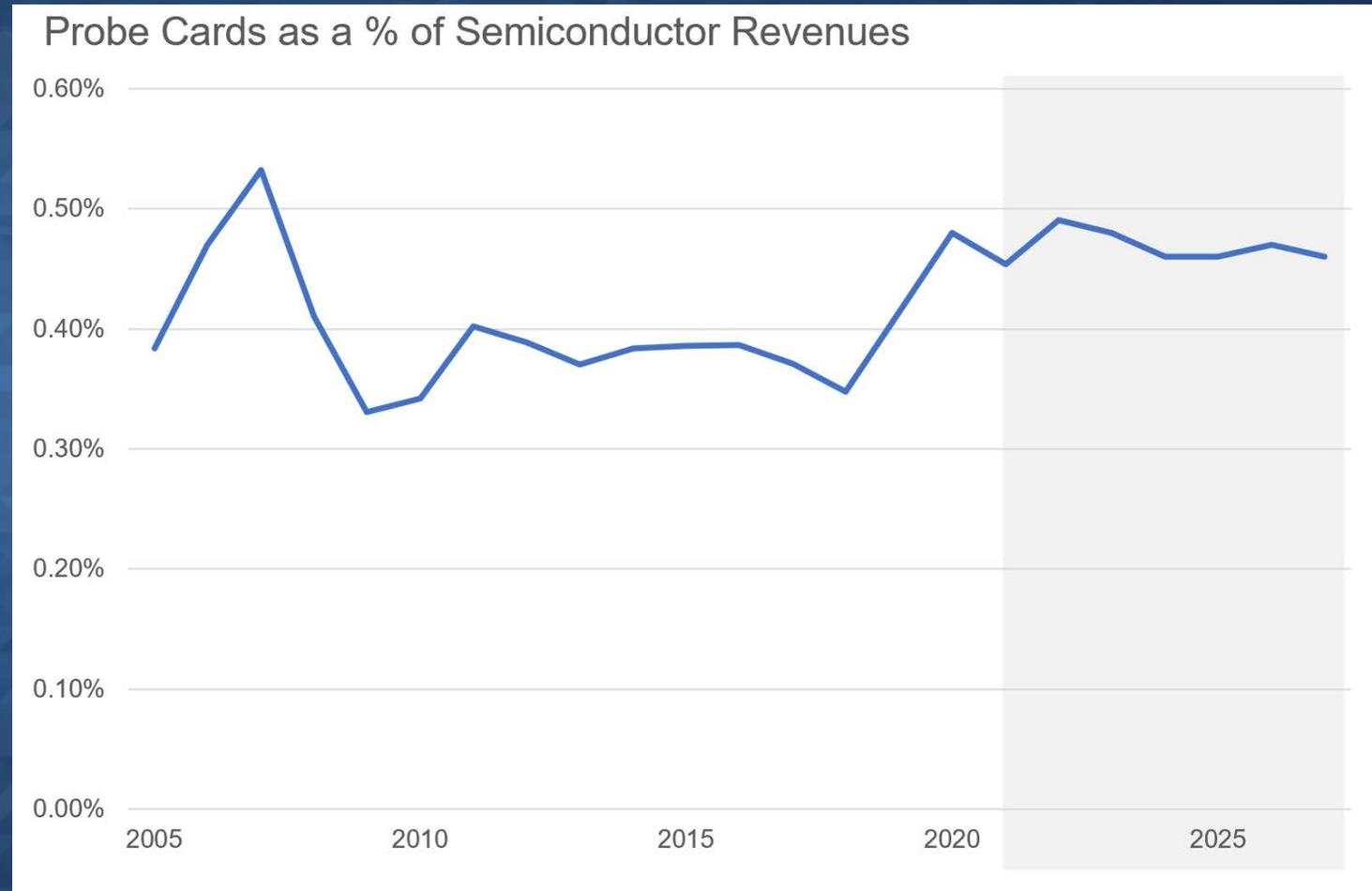
Chipmakers spending more on probe cards

Spend as a % of Semiconductor Revenues Jumped up from an average of 0.38% to 0.48% in 2020

However, this is only the value of the probe card market from the probe card suppliers' perspective

Does not include the value of probe card PCBs and space transformers purchased directly by chipmakers

Accounting for "all" expenditure on probe cards means the industry is spending in excess of 0.55% of revenues on probe cards



2023 is going to be tricky

Winners and losers by device type

- **Winners**

- RF
- Power IC
- Image Sensors
- Die for use in 2.5D/3D and FO advanced packages

- **Losers**

- Memory
- Graphics Chips ???
- Microprocessors

Market is fluid and fast-changing

But some things are clear...

- **Western countries' policies are set for the long-term**
 - Short to medium-term disruption
- **Fundamental market drivers are intact**
 - Long-term growth is assured
- **Technology road map is clear for next 5 to 7 years**
 - No show stoppers

Summary

Change is good...

- **Short-term market turmoil will drive change in the competitive landscape**
- **Chipmakers are under pressure to find solutions so are more open to working with smaller suppliers**
- **Test strategies are constantly evolving**
- **This is a great time to be a probe card supplier!**

Thanks

- **Get to up-to-date market research**
- **Be pro-active**
- **Think big, act smart**