

450mm: What will it cost to get there?



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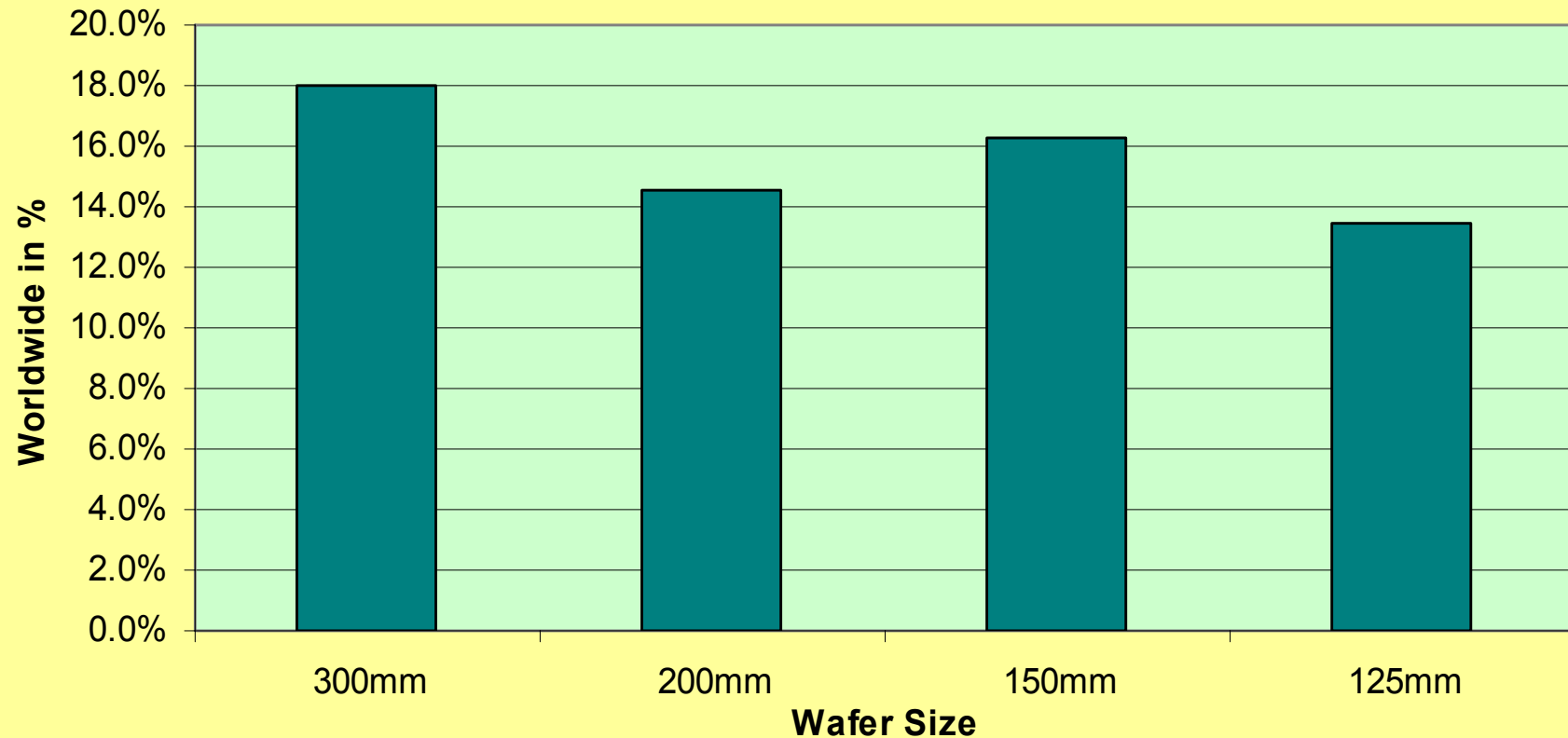
450mm Wafers



Modern IC history shows that:

- The industry always fights new wafer sizes
- Ultimately a leader picks up the flag
- Competitive pressures force other chip makers to follow
- Equipment suppliers resist
 - they are now
- Then competitive pressures force them as well
- Serious activity starts just after a new wafer size is moved into production

Share of Equipment Industry Development Spending Devoted to New Wafer Size Platforms



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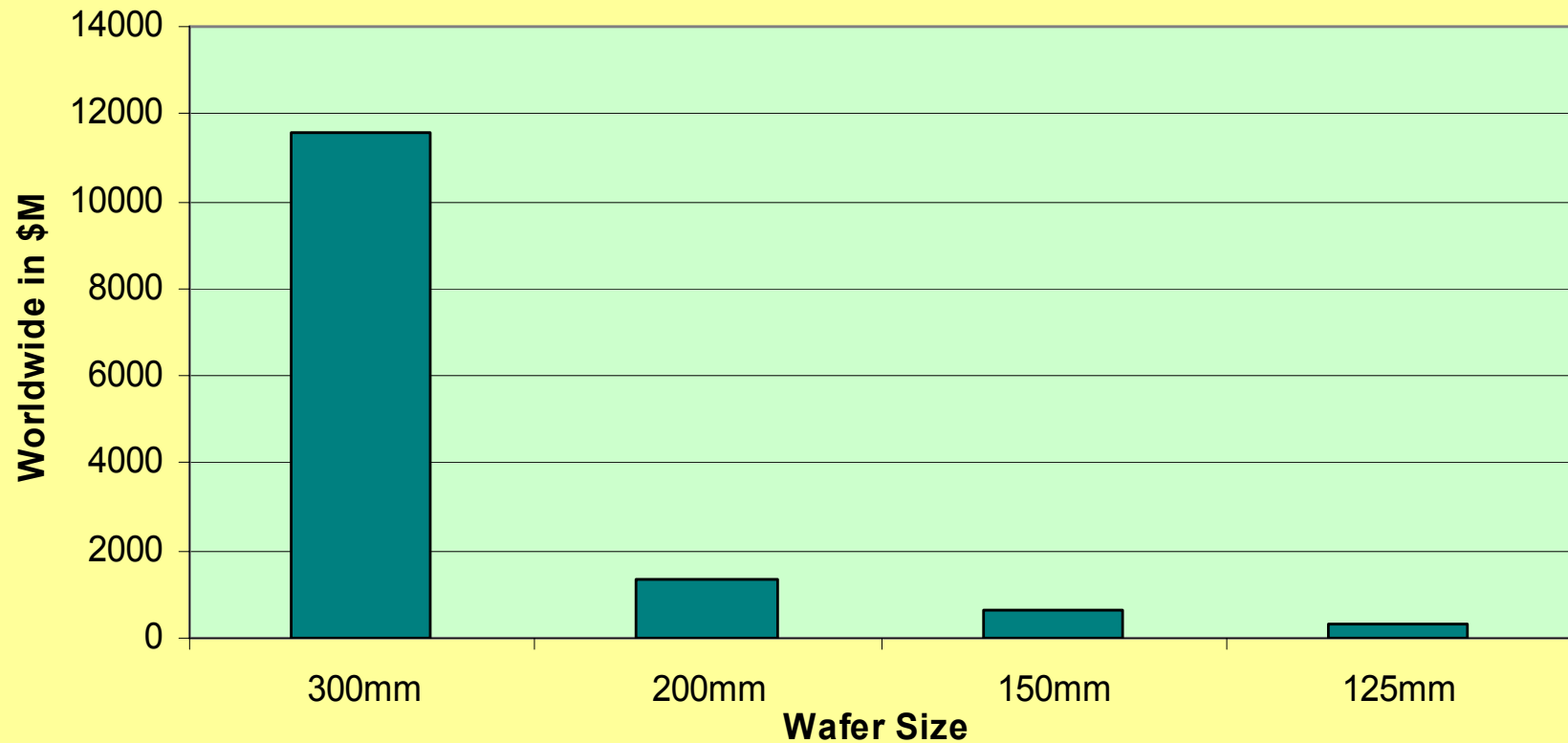
450mm Wafers

Competitive Pressure:

- If the alpha customer says they want it
 - the rest of the pack will follow for fear of being left out in the cold
- The productivity advantages of a wafer size change are just too great to ignore
- Customers hunt in packs
 - so equipment makers will fall easy prey
 - or risk loosing current orders if they are perceived as not being responsive to future needs



Equipment Industry Development Spending on New Wafer Size Platforms

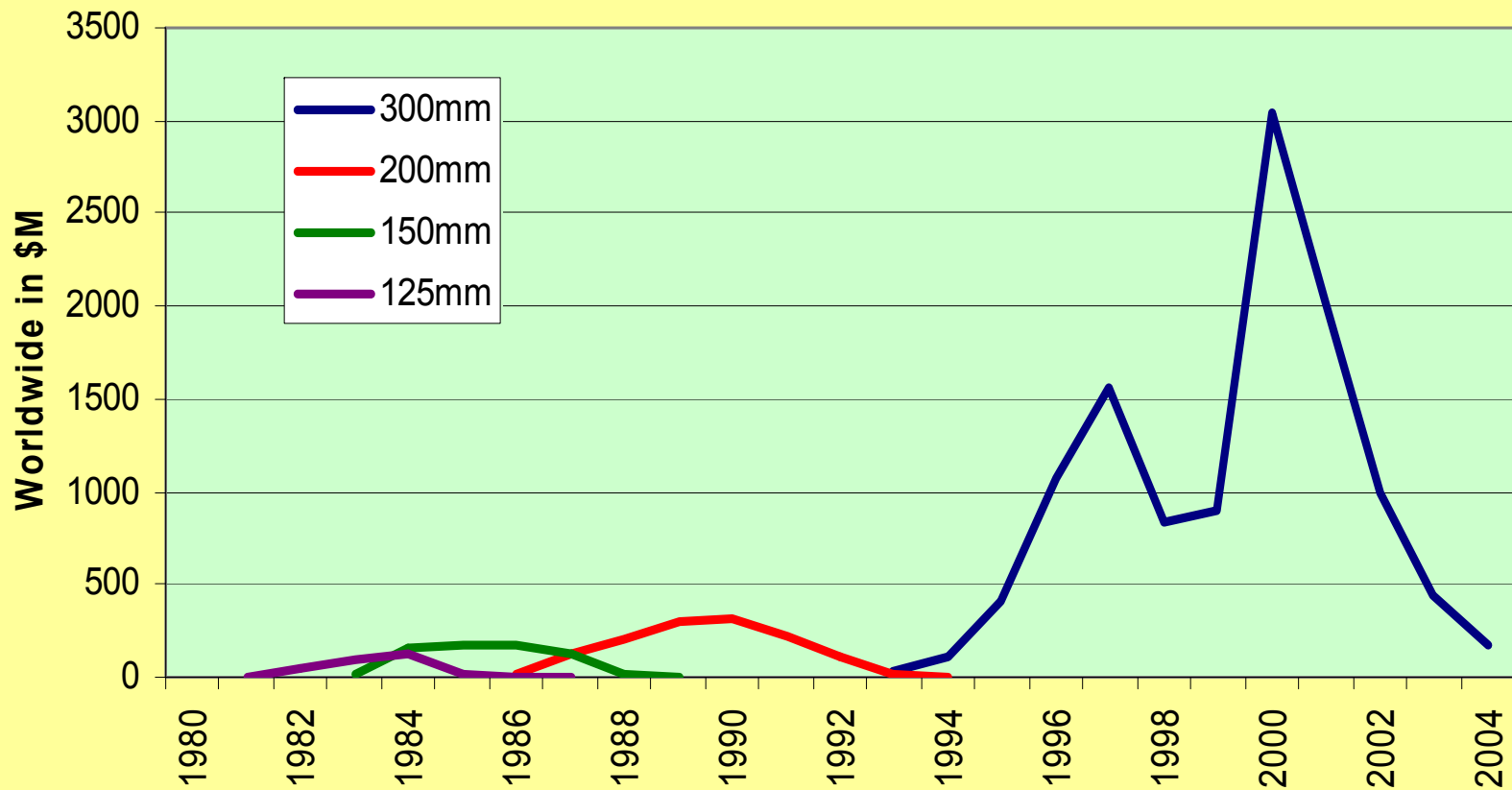


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300mm Proved to be Incredibly Painful for the Equipment Industry

- Development cost dwarfs previous generations
--it was 9x 200mm cost
- It took too long
 - first development cost incurred in 1993
 - lack of bridge tools
 - consortia management of wafer transition

Equipment Industry Spending to Develop New Wafer Size Platforms



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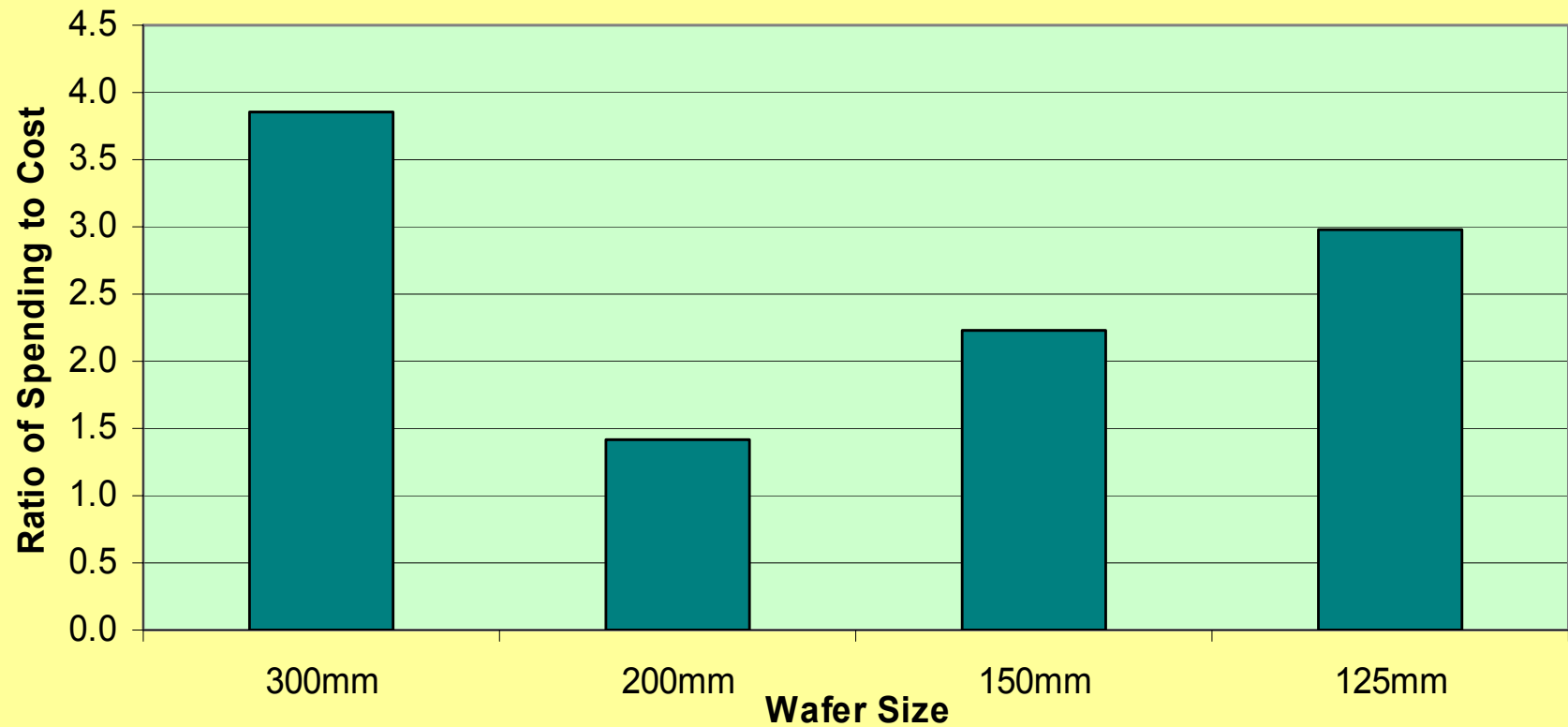
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Equipment Industry Development Spending on New Wafer Size Platforms versus the Cost of a Wafer Fab



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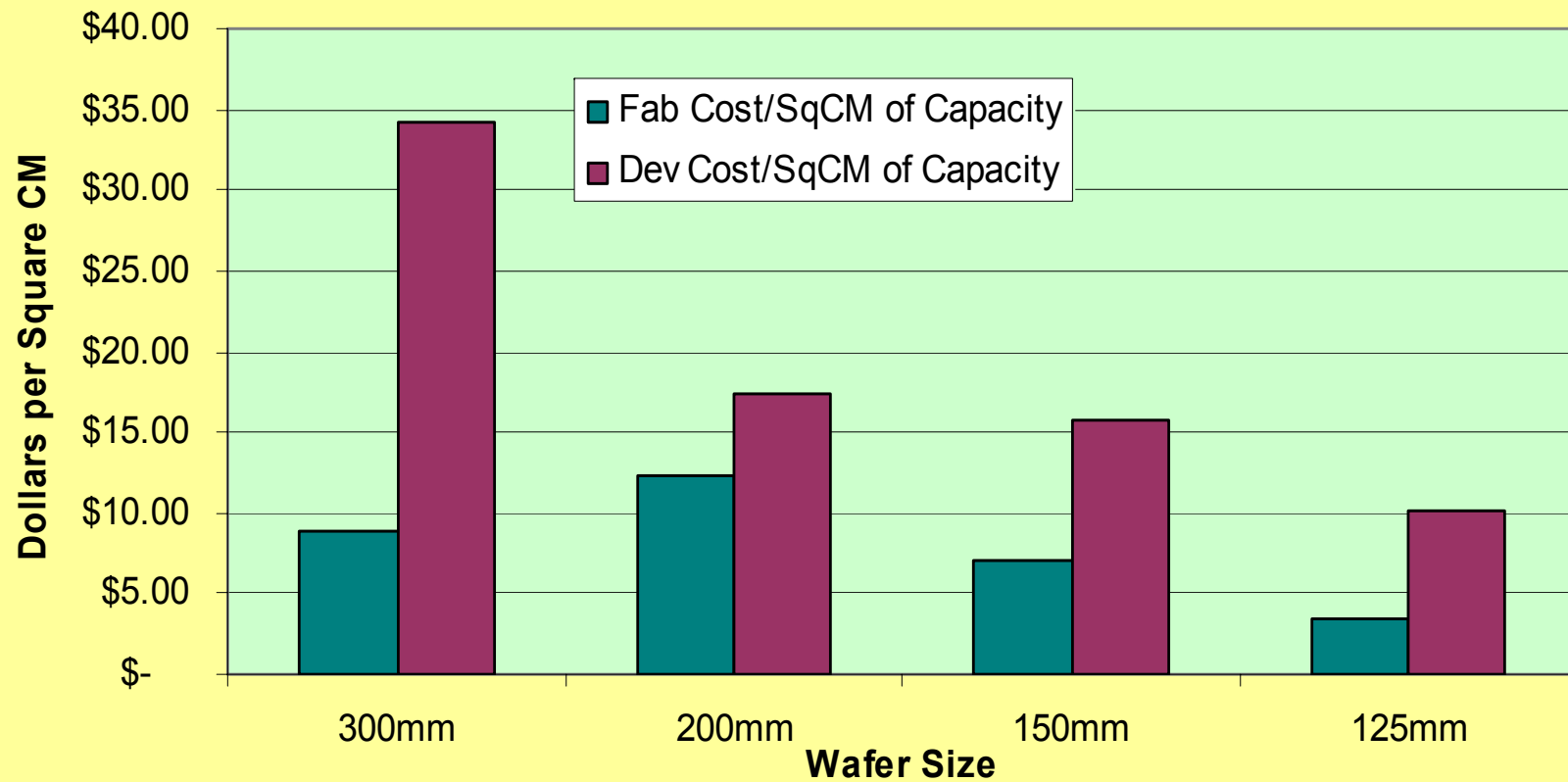
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Revenue Growth in Equipment Industry during Wafer Size Development

	300mm	200mm	150mm	125mm
Revenues at start (\$M)	13059	5063	3777	2442
Revenues at end (\$M)	52957	13059	8174	5747
Ratio	4.1	2.6	2.2	2.4
Years taken for transition	9	8	6	5

Relative Areal Cost of Capacity

(versus a typical fab of the period)



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450mm Wafers



Lessons to be learned from 300mm:

- Don't insist on 450mm only tools.
 - Bridge tools exert competitive pressure
 - Save development costs
 - Focuses equipment suppliers on the next wafer size
- Don't ask what the cost will be
 - Ask what the exact timing should be
 - Cost of wafer size upgrade is minimal
 - The costs lie in the process and automation
- If the litho jocks aren't in the game, there is no game.

When will 450nm Happen?

- Never: Inertia makes it possible. Moore's Law slows, curving industry growth
- Between 2020 and 2025: Most likely
 - should be plenty of funding and time
 - allows errors in management
- 2012: Least likely. Looking back to 300nm, this is unrealistic

When will 450mm Cost?

- Perfect execution: < \$10B
- Simple extrapolation: \$102B
- 300mm repeat: ~\$1T

- 2006-2012: About \$12B in R&D should be available.

450mm Wafers



Barriers that may emerge:

- Rule of one generation size too far
 - 747, Concorde, UP DDX 40
- 300mm fabs have proven hard to fill
- Interest in 200mm is hanging in there much longer than other generations
 - 300-only created 200mm capacity competition
- Yet, Technology barriers are probably greater
 - So, 450mm will be needed for Moore's Law

450mm Wafers



Lessons to be learned from 300mm:

- Chance to re-engineer the fab
 - 300mm solved cyclicity induced by Ohmi-fab
- 300mm automation constrained
 - Failed to believe in Moore's Law
 - Missed opportunities for flexible fabs
 - Long cycle times create ASP erosion



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Where the Chip Making Industry Clicks to Find its Weather

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