



IMPACT OF 450MM ON CMP

**MICHAEL CORBETT
MANAGING PARTNER
LINX CONSULTING, LLC
MORBETT@LINX-CONSULTING.COM**

**PREPARED FOR CMPUG
JULY 2011**



Outline

1. Overview of Linx Consulting
2. CMP Outlook/Drivers for 450
3. Conclusions



The Value We Bring To Clients

1. *We create knowledge and develop unique insights at the intersection of advanced thin film processes and the chemicals industry*

2. *We help our clients to succeed through our:*
 - Experience in global electronics and advanced materials and thin film processing industries:
 - Semi
 - LCD
 - Packaging
 - PV
 - Nano Technology
 - Other
 - Experience in the global chemicals industry
 - Experience at Device Producers
 - Experience at OEMs
 - Global network and capabilities
 - Advanced modeling capabilities



WE PROVIDE HIGH CONFIDENCE DECISION SUPPORT SERVICES – SINGLE CLIENT





Analysis Reports - Services Offered

CURRENTLY AVAILABLE INDUSTRY ANALYSIS REPORTS

1. CMP Technologies and Markets
2. Advanced Thin Films for FEOL and BEOL Applications
3. Advanced Materials and Chemicals for Photovoltaic Cells and Modules
4. Emerging Materials Opportunities for Advanced Semiconductor Devices
5. Advanced Cleaning and Surface Preparation: Technologies and Markets
6. Opportunities in Imprint Lithography
7. Specialty Abrasives in CMP
8. Advanced Patterning
9. Semiconductor Industry Direct Consumables Model



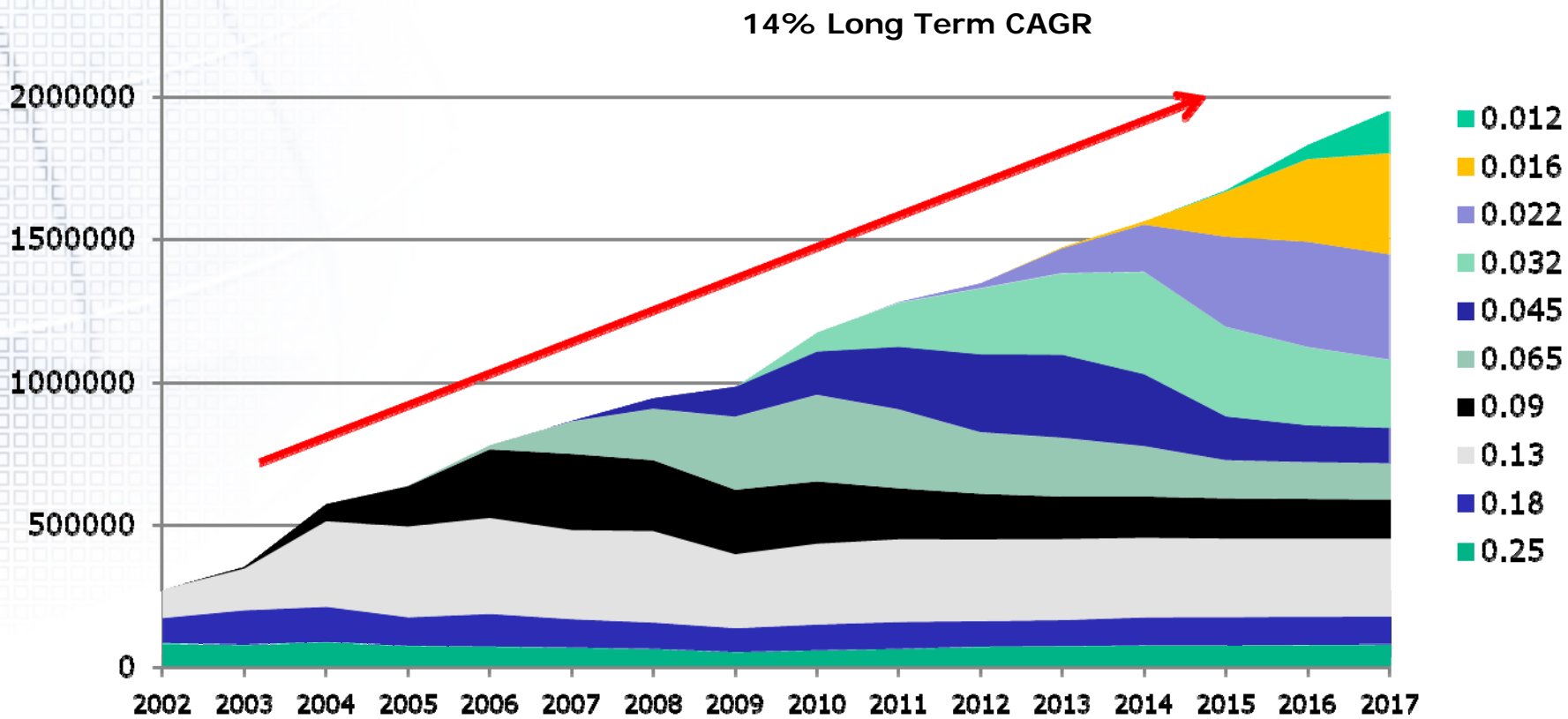
CMP Outlook/Drivers for 450



CMP Growth Remains Strong

Thousands of unit operations

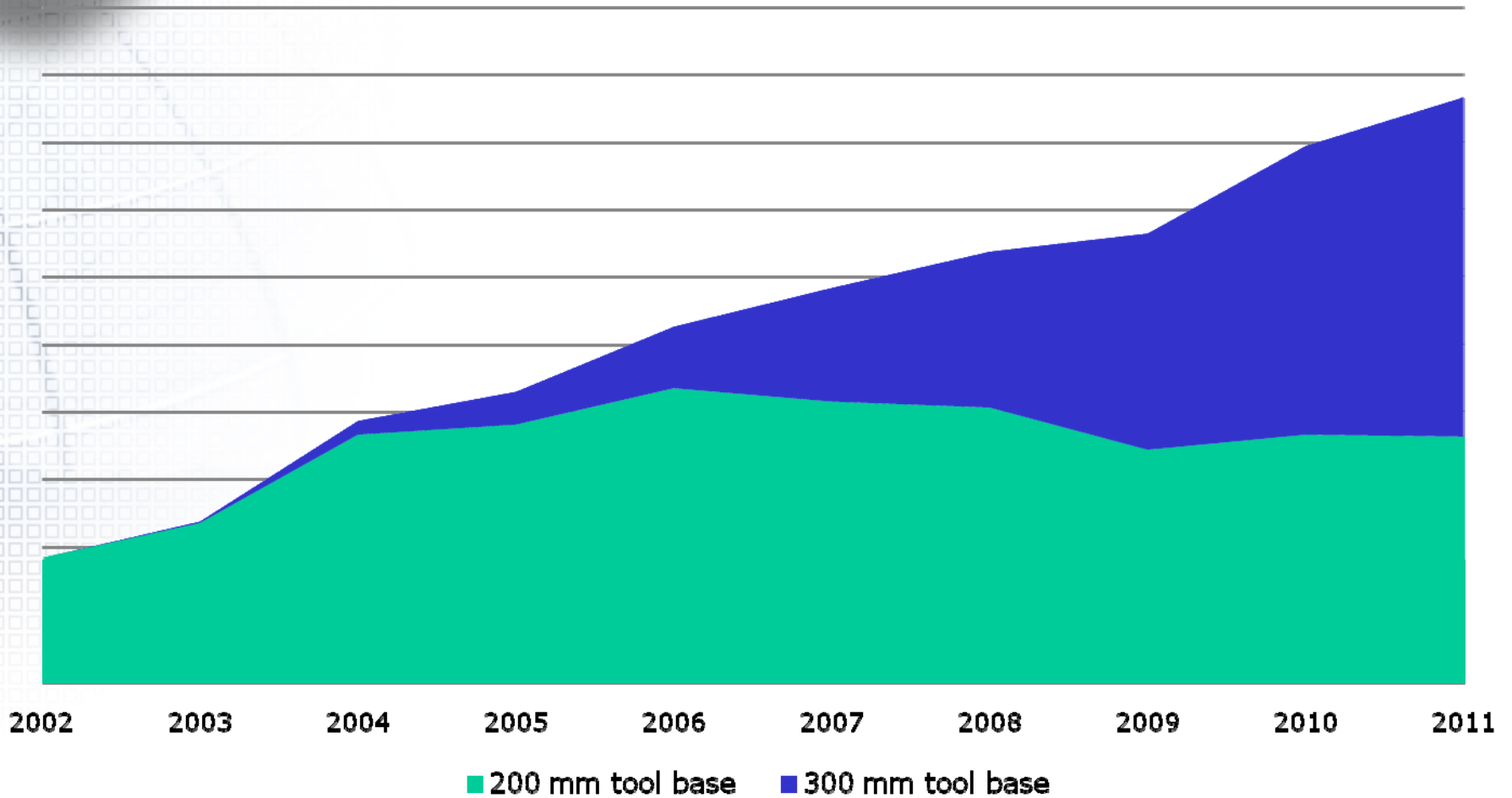
2500000



Source: Linx Consulting



CMP Tool Base - Current

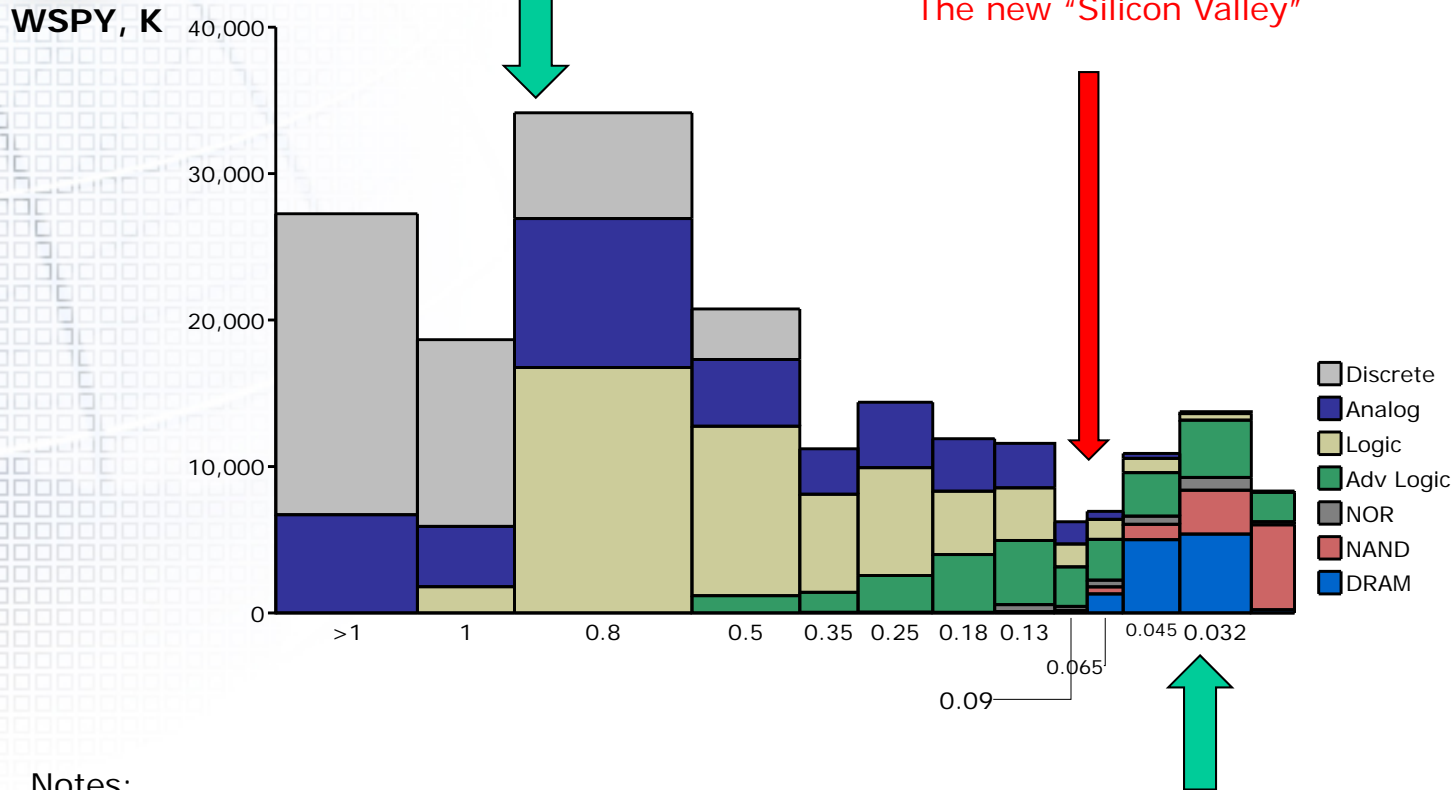


Source: Linx Consulting and Gartner



New Industry Structure, 2014

Business model changes required / desirable?



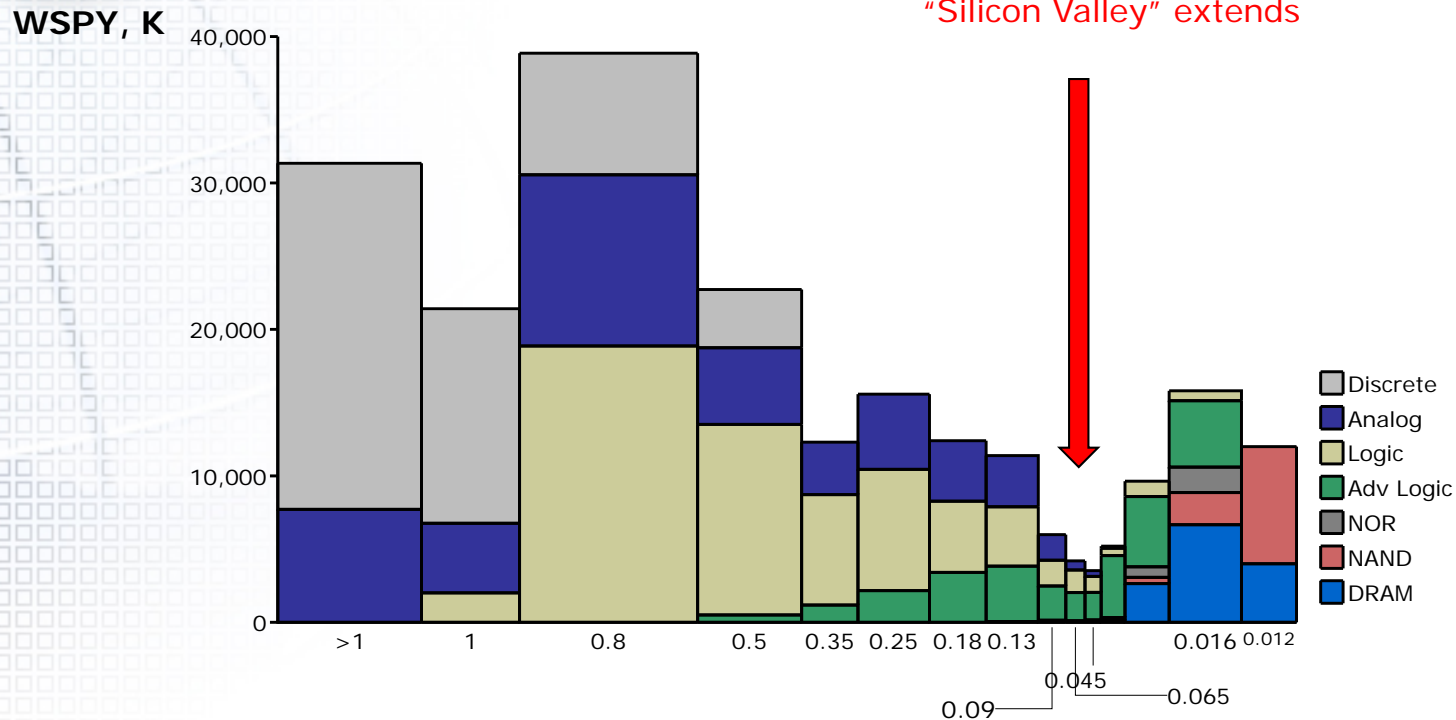
Notes:

1. Bottom axis is on a percentage basis
2. Size of box is proportional to # wafer starts
3. Source: Semico and Linx estimates

Materials innovations required



New Industry Structure, 2018

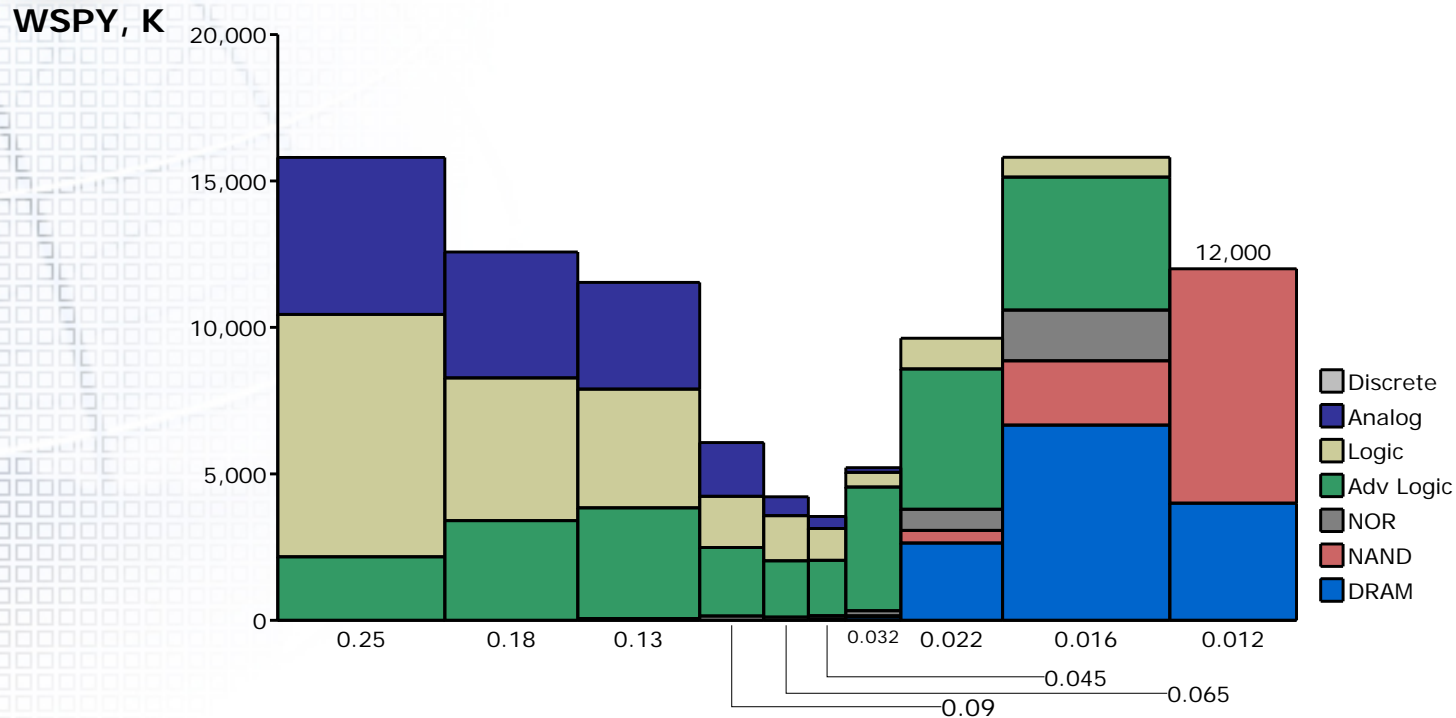


Notes:

- 1. Bottom axis is on a percentage basis
- 2. Size of box is proportional to # wafer starts
- 3. Source: Semico and Linx estimates



CMP Industry Structure, 2018

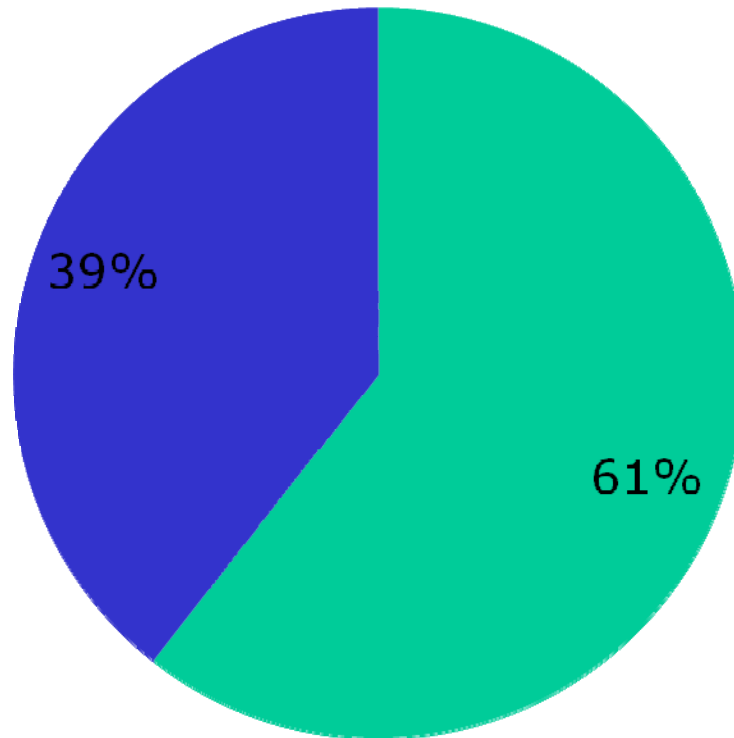


Notes:

- 1. Bottom axis is on a percentage basis
- 2. Size of box is proportional to # wafer starts
- 3. Source: Semico and Linx estimates



CMP Wafer Distribution in 2018



■ 250nm - 32nm ■ 22nm - 12nm



Opportunities for CMP Keep on Increasing

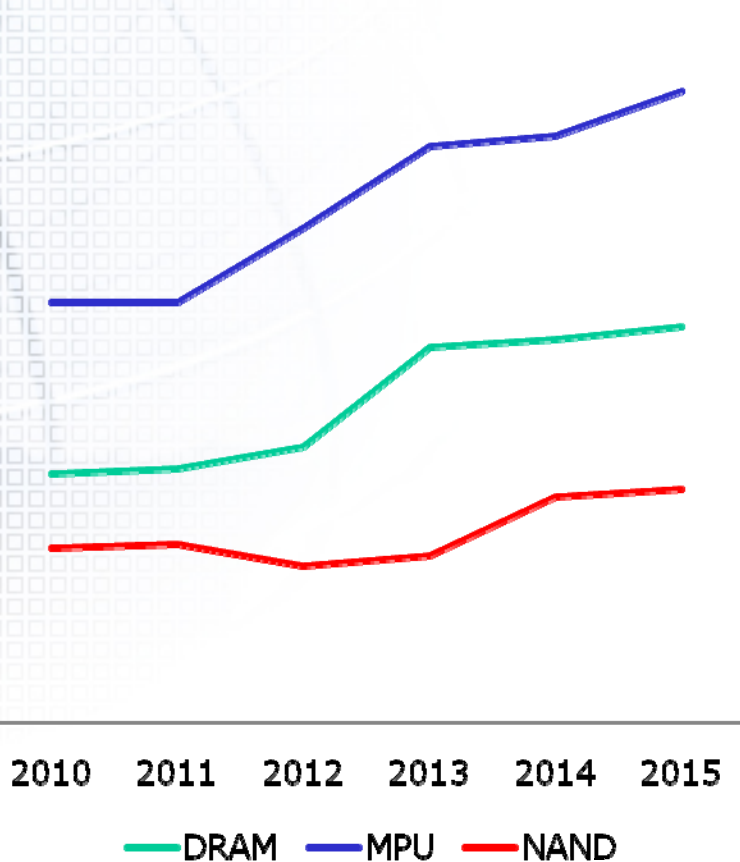
Application	CMP Enabling Aspect	Potential Challenges
FUSI RMG	CMP used to expose p and n gates independently	Inadvertent exposure of opposing gate
Novel FUSI MG	Enables differential silicidation of poly-Si gate	Requires CMP of dissimilar materials
FINFET devices	Planarization of Poly	PolySi thickness variations result in patterning problems
FINFET devices	Damascene approach to FINFET formation	Thickness variation caused by CMP
3D Chip Stacking	Oxide CMP post Cu CMP	Smearing Cu bumps
3D Stacked NAND	3D integration	Ultra flat topography required to layer
Novel Memory – Ferroelectric Media	CMP eliminates roughness of ferroelectric material	Device layer thickness control
PCM	Planarize PC element	Thickness control of small device region

Reference: **Chemical Mechanical Polish: The Enabling Technology**, Steigerwald



Wafer Costs Keep Increasing

Wafer Costs (\$/cm²)

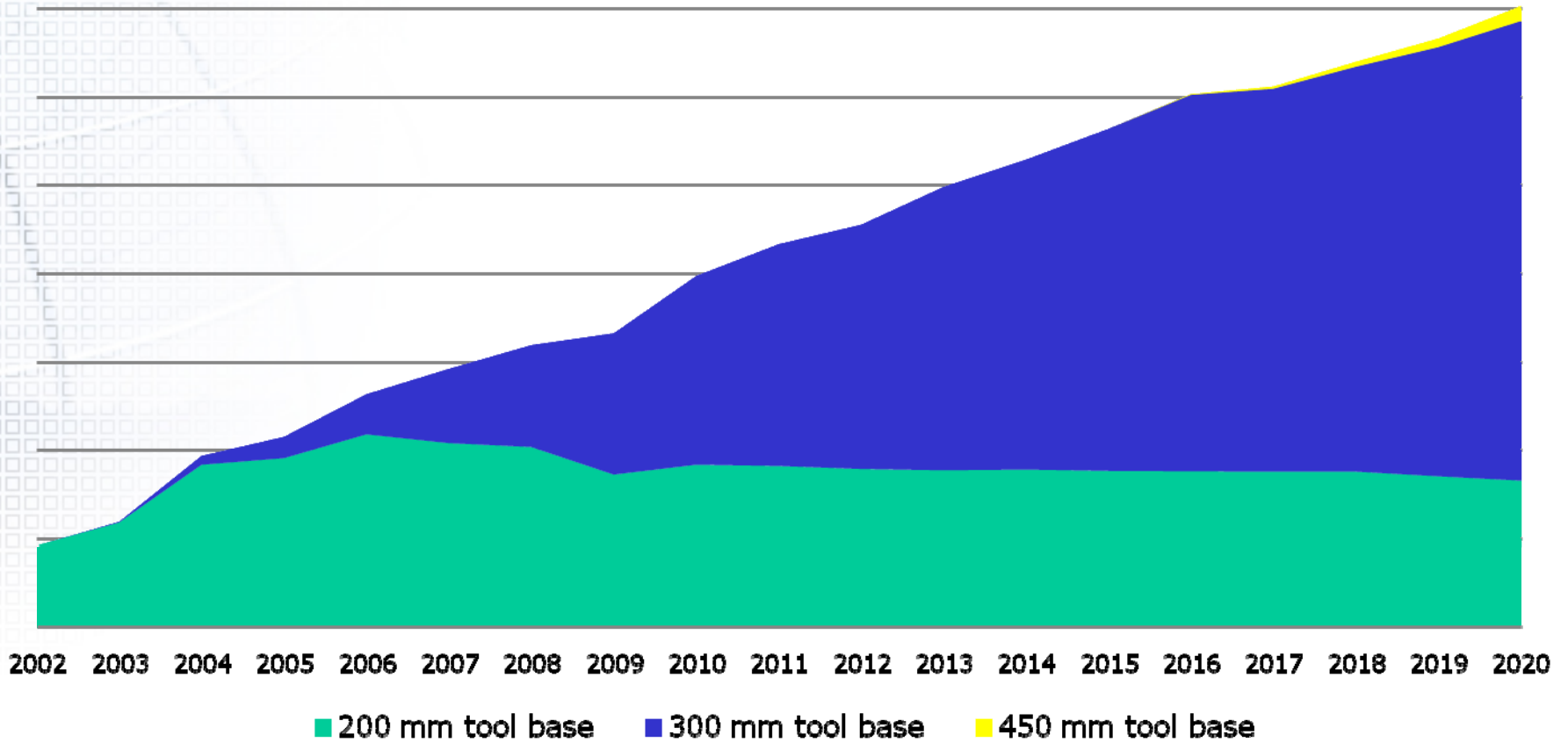


- Processing costs increase over the next five years as follows:
 - DRAM – 59%
 - MPU – 50%
 - NAND – 34%
- Although some of this can be blamed on the costs associated with double, triple and quadruple patterning, device producers will still have problems passing these increases along

Source: IC Knowledge



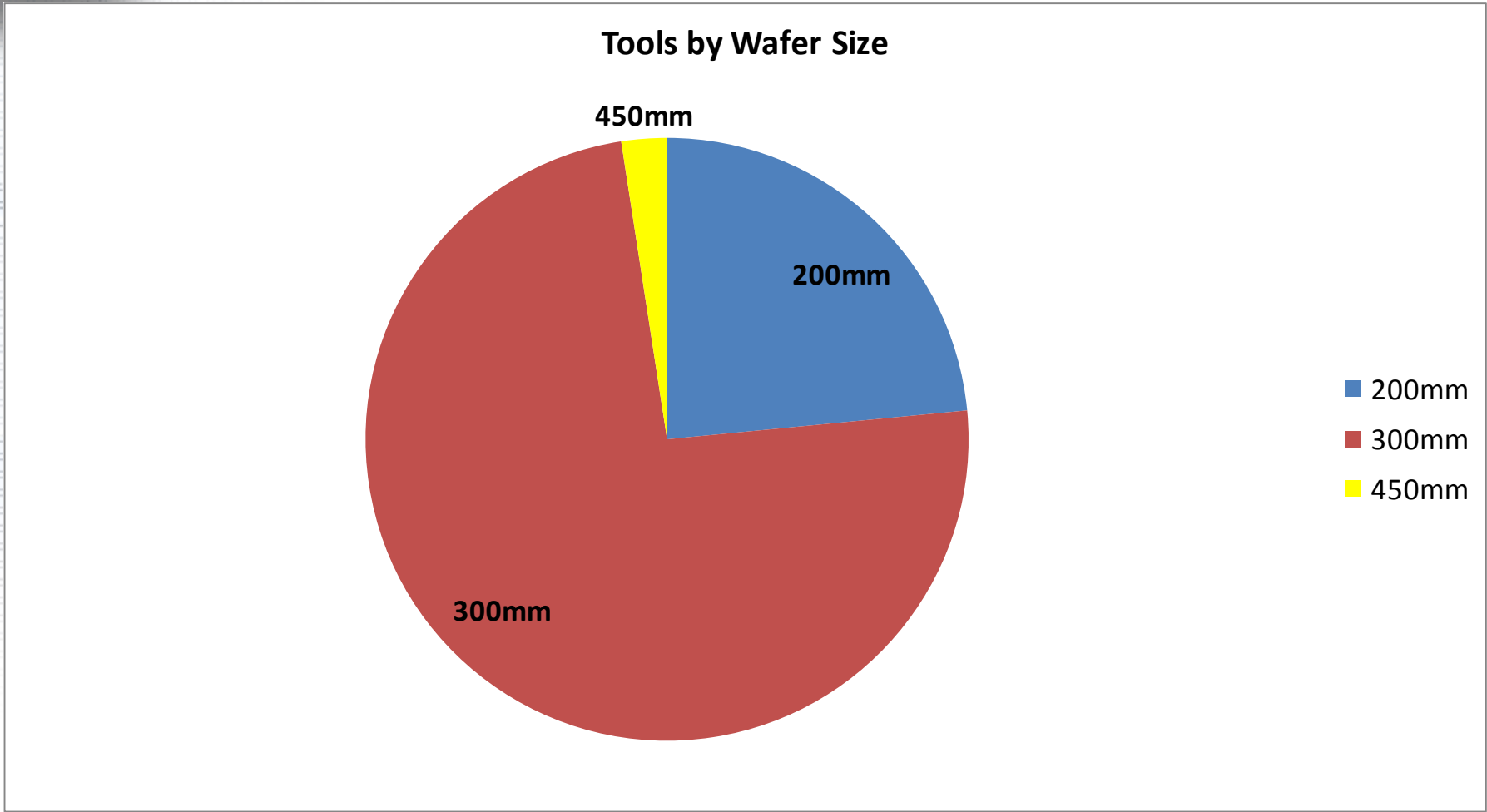
CMP Tool Base Extended View



Source: Linx Consulting, IC Knowledge and Gartner



Tool Distribution, 2020





450mm Trends

Trends Impacting Consumable Suppliers:

- Leading platforms are looking at 42" pads
- Pad composition is relatively similar between 300mm (30") and 450mm applications
- Slurry composition is also expected to be relatively stable with conversion to 450mm
- 450mm wafer is ~ 900 to 925 microns thickness; where as the 300mm wafer is 775 microns. This increases wafer bowing
- ROI/NPV concerns

Trends Impacting Tool Suppliers:

- Early tool development efforts are targeting 2015/2016 for HVM
- The number of zones per head may increase upwards from 5 zones for better control of uniformity
- Possible move from single point to multi-point dispensing systems to ensure uniformity of slurry distribution
- Potential within wafer variations may lead to multi-point endpoint detection



450mm Trends

Trends Impacting End-users:

- Greater emphasis on *truly* collaborative driven solutions will be required due to increased development expense
- Not all semiconductor producers can or will invest in 450mm technology
- Transition to 450mm will necessarily limit the supplier base over time, as not all suppliers can afford investment or will be selected to for PORs.
 - In addition, suppliers need large volumes for learning curve driven cost reductions



Conclusions

- 200mm is set and done -> work toward productivity improvements
- 300mm still has a long way to go
 - Work toward productivity improvements
 - Work towards innovation
- 450mm is coming, but is still a way off
 - Be sure to place bets at an appropriate time and not too early
 - Select the right partnerships
- 450mm may impact supplier selection criteria (need fewer, large suppliers) and supplier industry structure
- Collaborations and consortia become more important



Acknowledgements

- Thanks to:
 - Scott Jones, IC Knowledge
 - Dean Freeman, Gartner



QUESTIONS ?

- Please feel free to contact us:

Mike Corbett

mcorbett@linx-consulting.com

+1 973 698 2331

www.linx-consulting.com