

# Advancing Industry Productivity

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Joint Productivity Working Group Session

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think it. apply it.™

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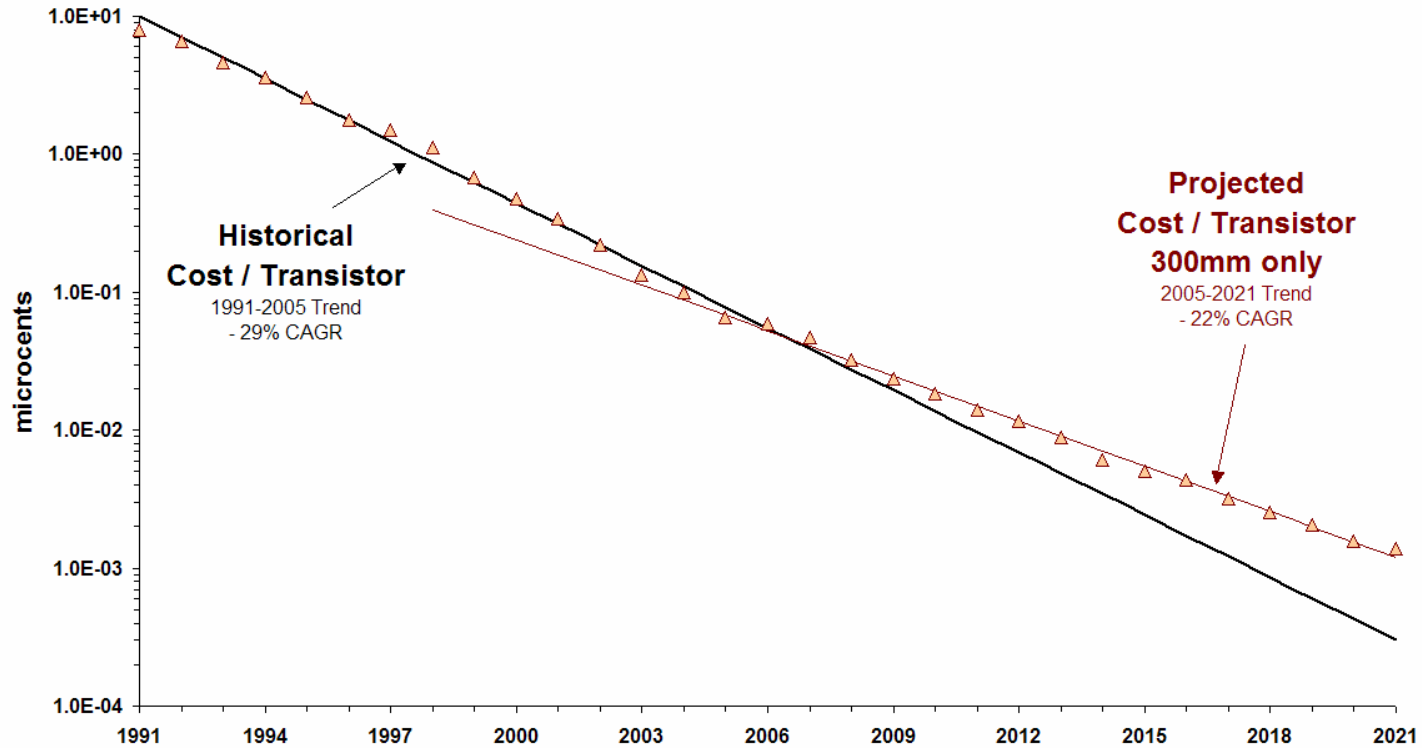
# Agenda

- Why are we here?
- What have we done?
- Is there a basis for moving forward?



# The “Productivity” Challenge

## Average Fab Costs per Transistor

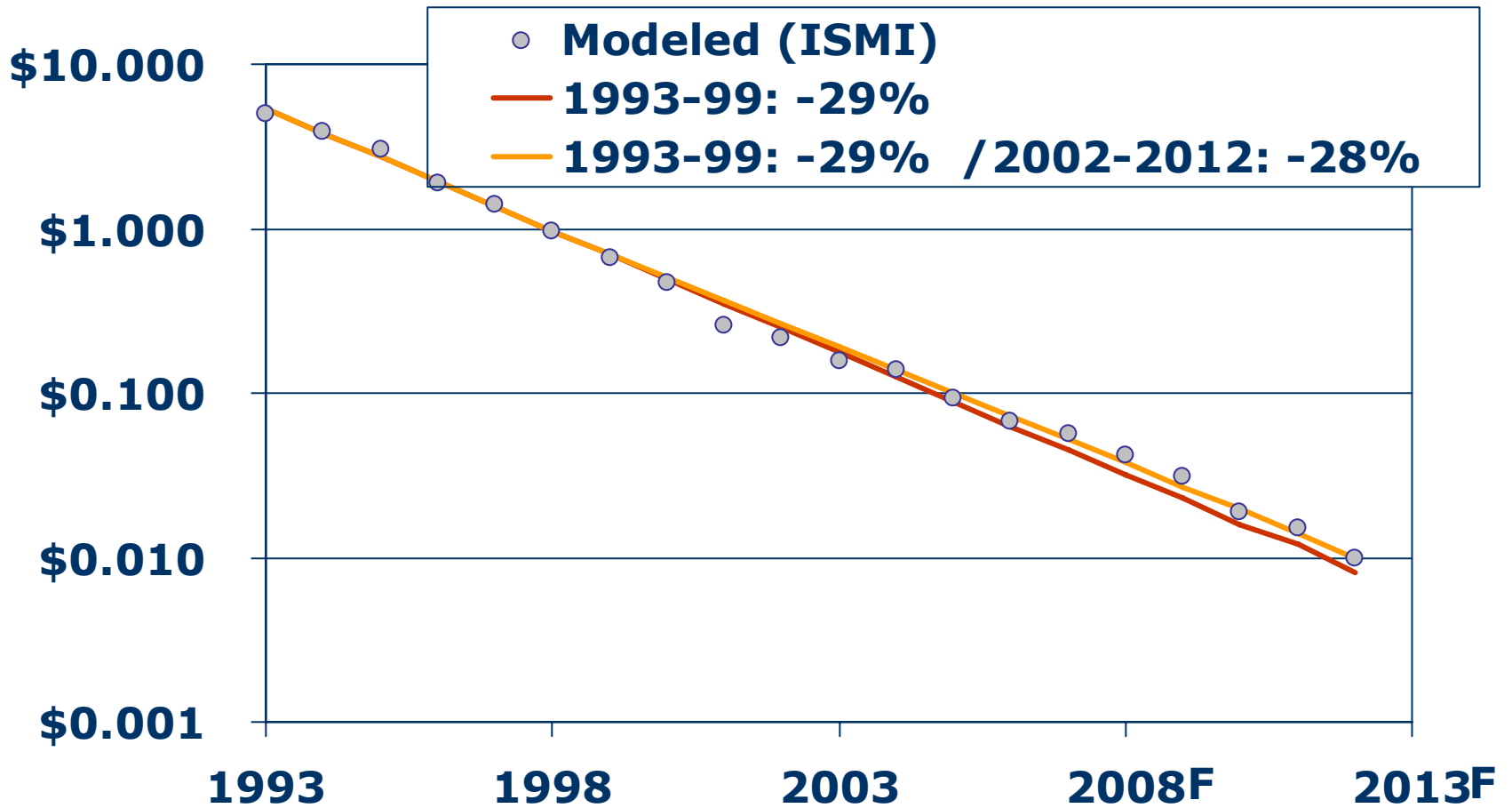


Source: ISMI



# The Challenge... Revisited

## Average Fab Costs ( $\mu$ -¢/transistor)



Source: Applied analysis of ISMI's Economic Model



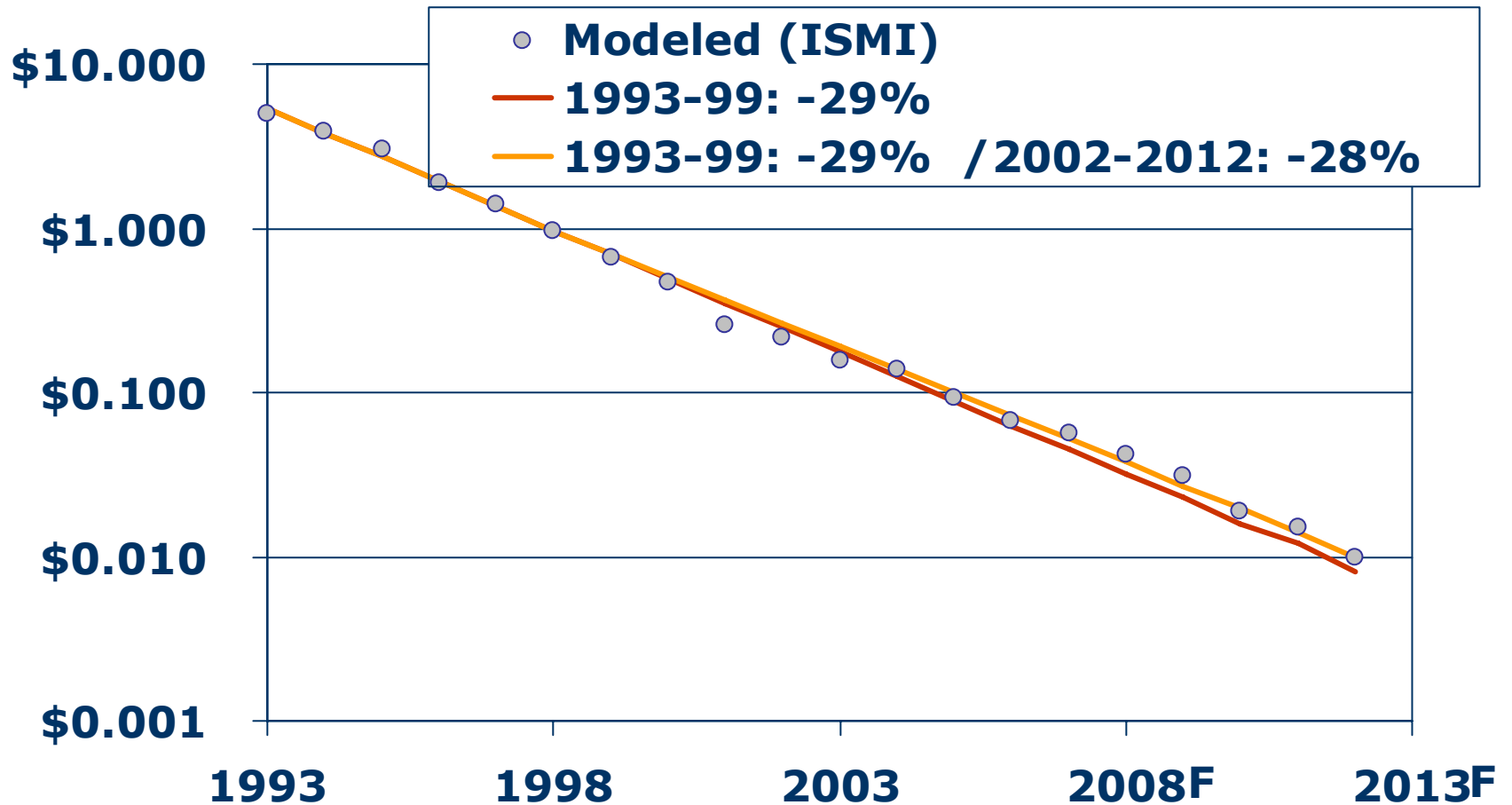
# Oh, By the Way

- The standard deviation of the annual transistor cost trend is 12%
- A 1%-2% difference in slopes is **statistically insignificant**
- A 1%-2% difference in slopes is also minuscule compared to the level of uncertainty in the thousands of assumptions built into the ISMI Economic Model



# The Challenge... Revisited

## Average Fab Costs ( $\mu\text{-}\phi$ /transistor)



Source: Applied analysis of ISMI's Economic Model

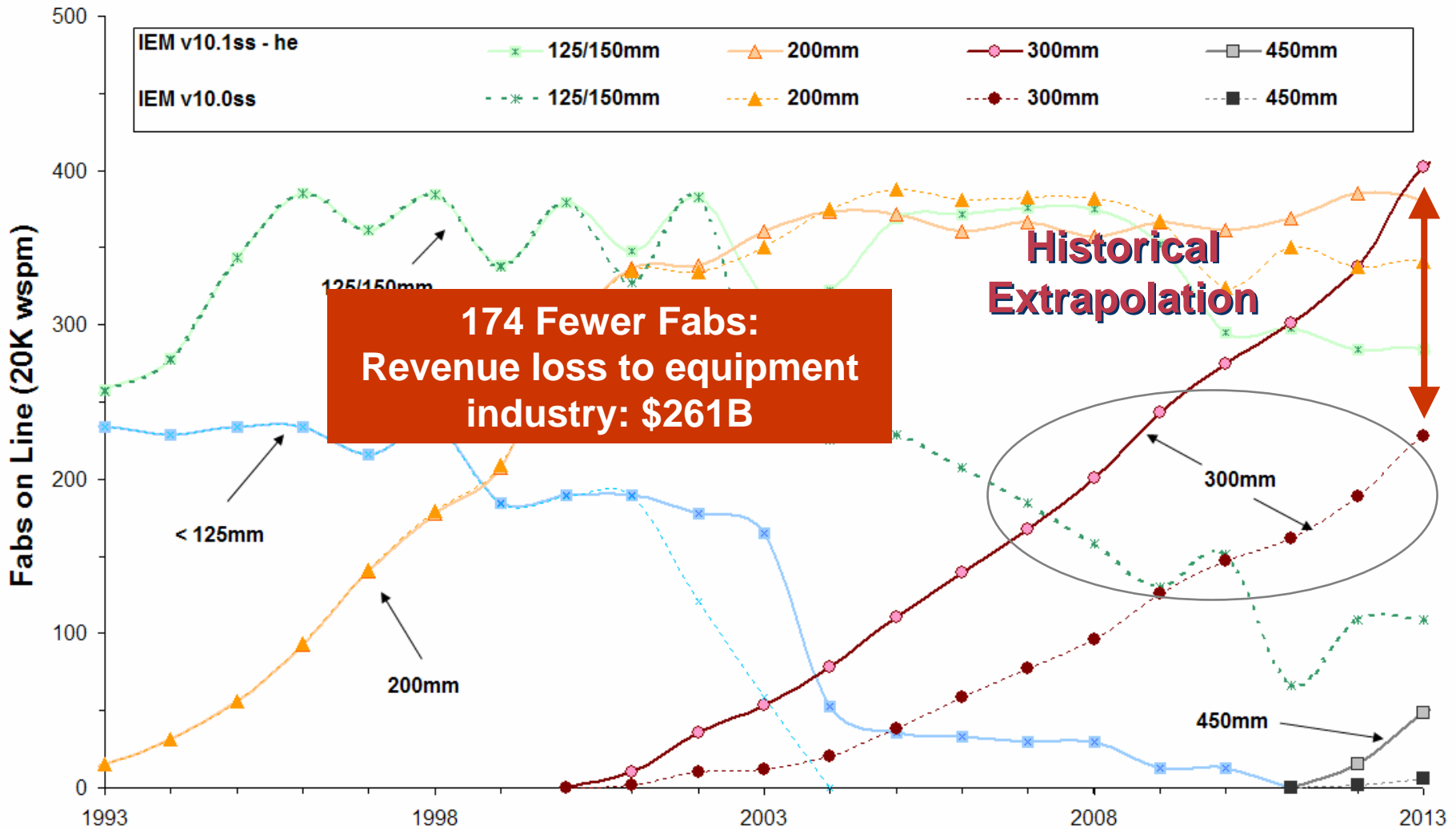


# The Challenge... Interpreted

- We have “discovered”—and confirmed via sensitivity analysis—the root cause of the (minor) shift of the 2000’s
- In order to extend the extraordinarily rapid rate of reduction in cost/transistor during the late 1990’s...
- ... we need to extend the extraordinary market/economic conditions of the late 1990’s
  - Rapid demand growth
  - ... funding accelerated technology progress
- We can’t extrapolate the **effect** – without extrapolating the **cause!**



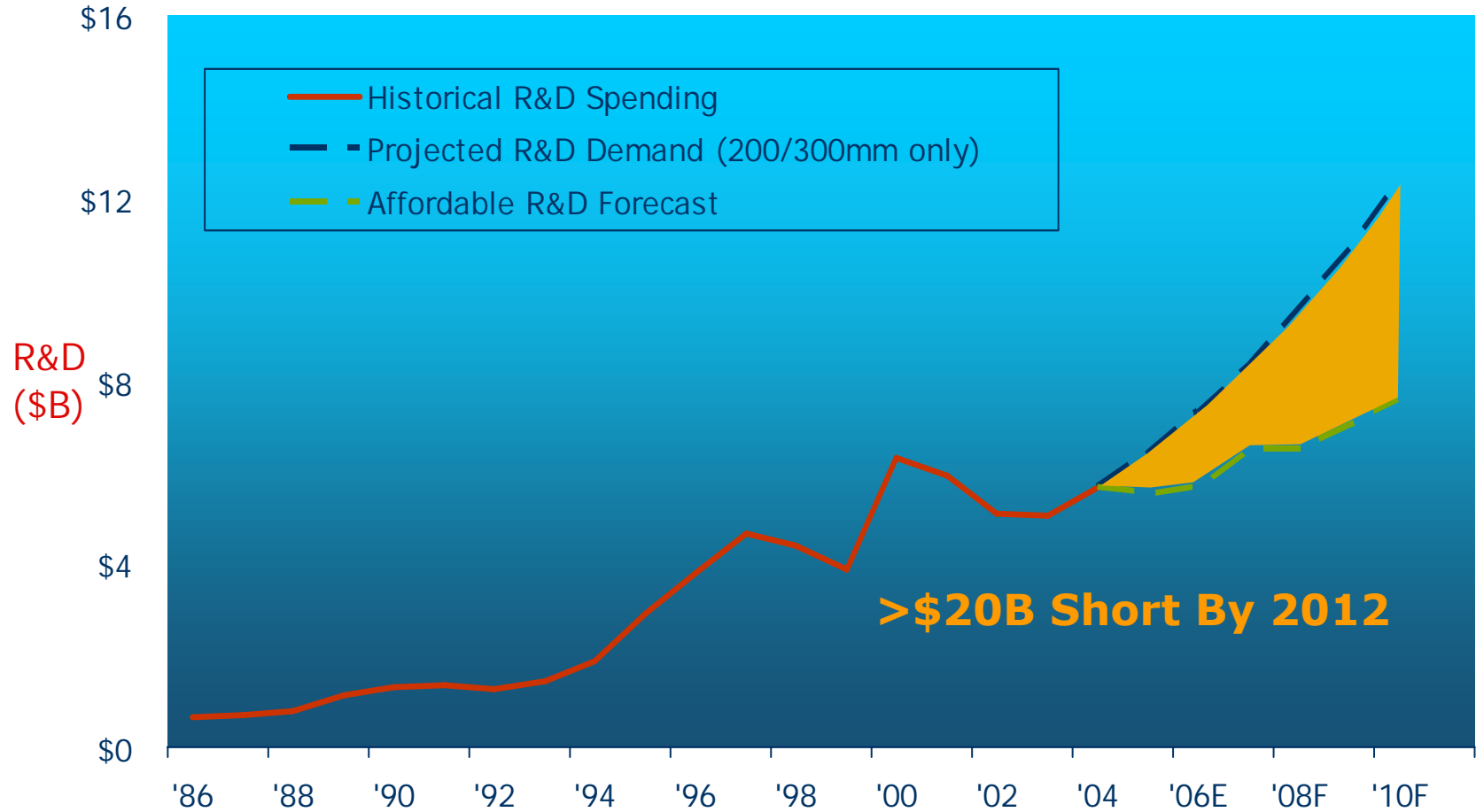
# Economic Implications



Source: ISMI analysis, JPWG, May 2006



# Equipment R&D Gap



Note: Affordable R/D forecast assumes 14% of equipment industry revenues  
Sources: S&P, SIA, SEMI, Infrastructure Advisors



# Spec for the Analytical Tool

- Simple, transparent models
  - few variables
  - less “precise” but more accurate... and correct
  - easy/quick to calculate and adjust
- Single vertically-integrated company
- Affordable investment based on cost/benefits and expected risks and return

# General Approach



**Economic Spec**

**High-Level Cost/Benefit**

**Screening**

**Cost/  
Benefit  
Evaluation**

**Total  
Affordability  
View**

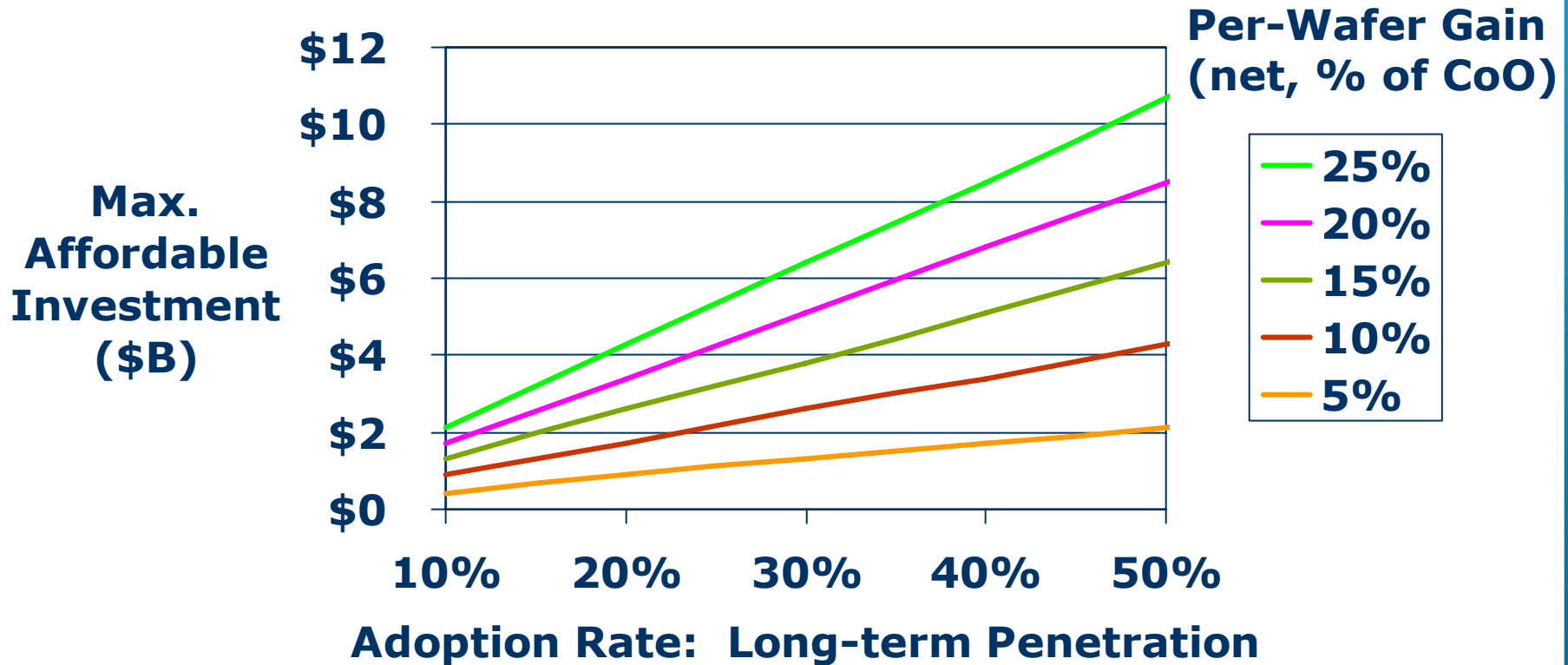
**Industry  
Development  
View**

**Experi-  
mentation/  
Demonstra-  
tion**

**Portfolio  
View**



## Economic Context for Fab Initiatives

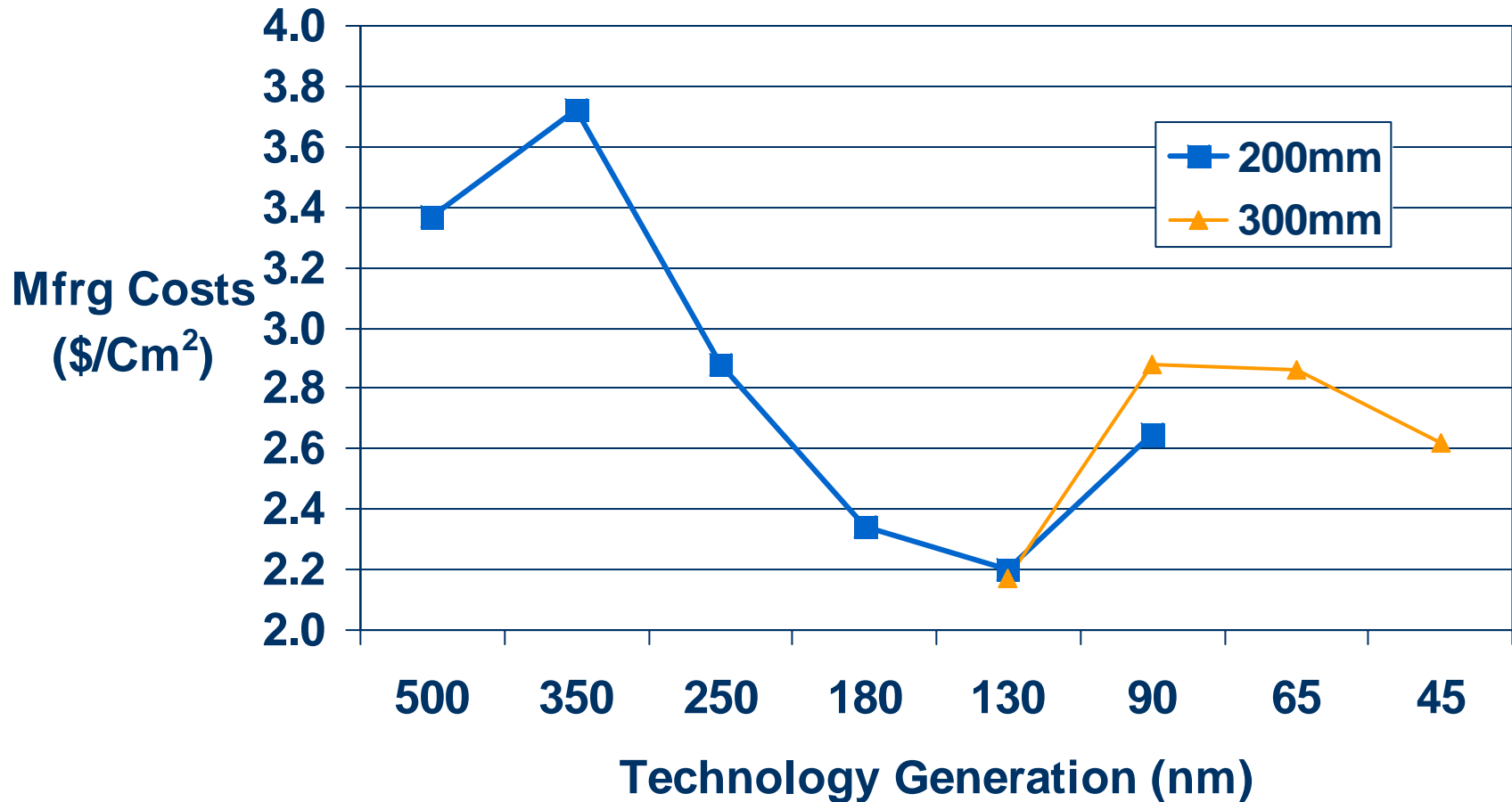


Note: 20% required rate of return; 7-year development time

# Economic Impact of Wafer Size Transition



## Manufacturing Cost Trend



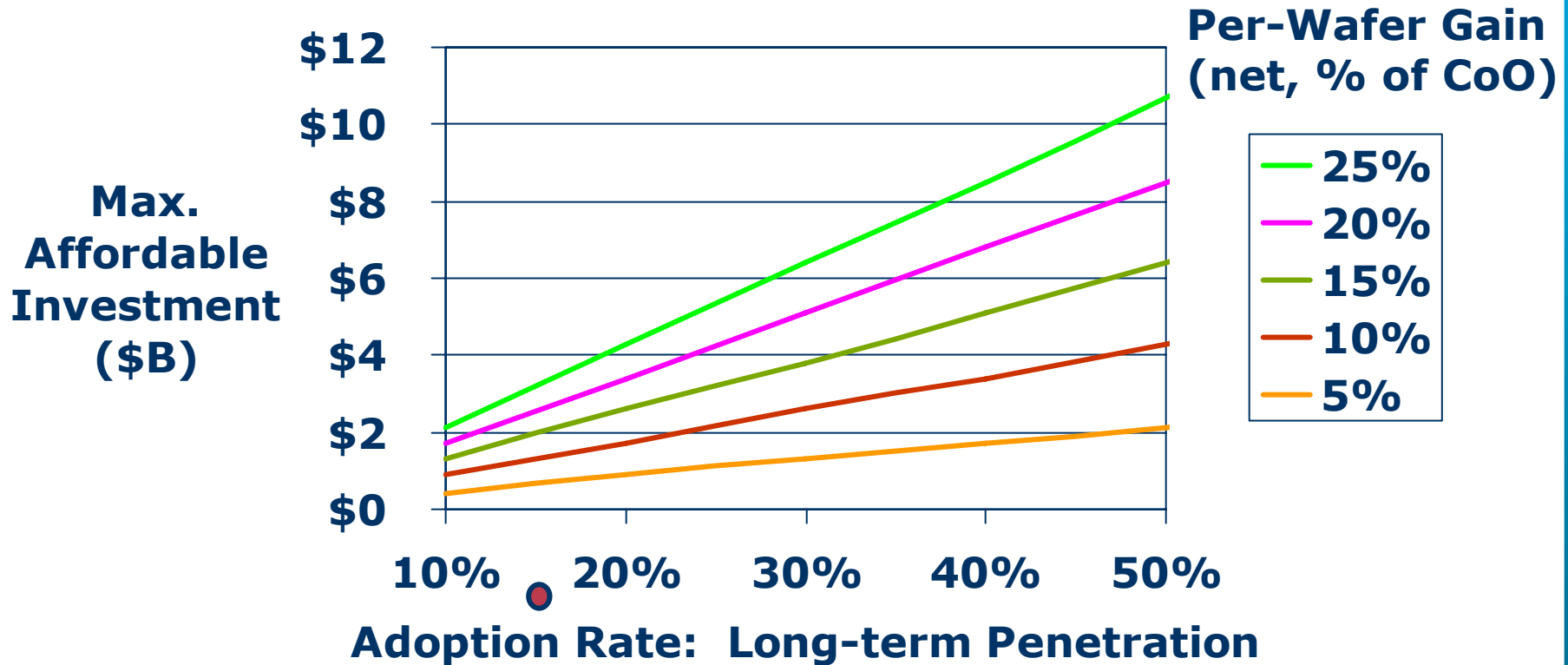
Note: Year 3 of production, Leading Edge Memory

Source: Applied analysis of ISMI's Economic Model

# Case 1: Implications: 450mm



## Economic Context for Fab Initiatives

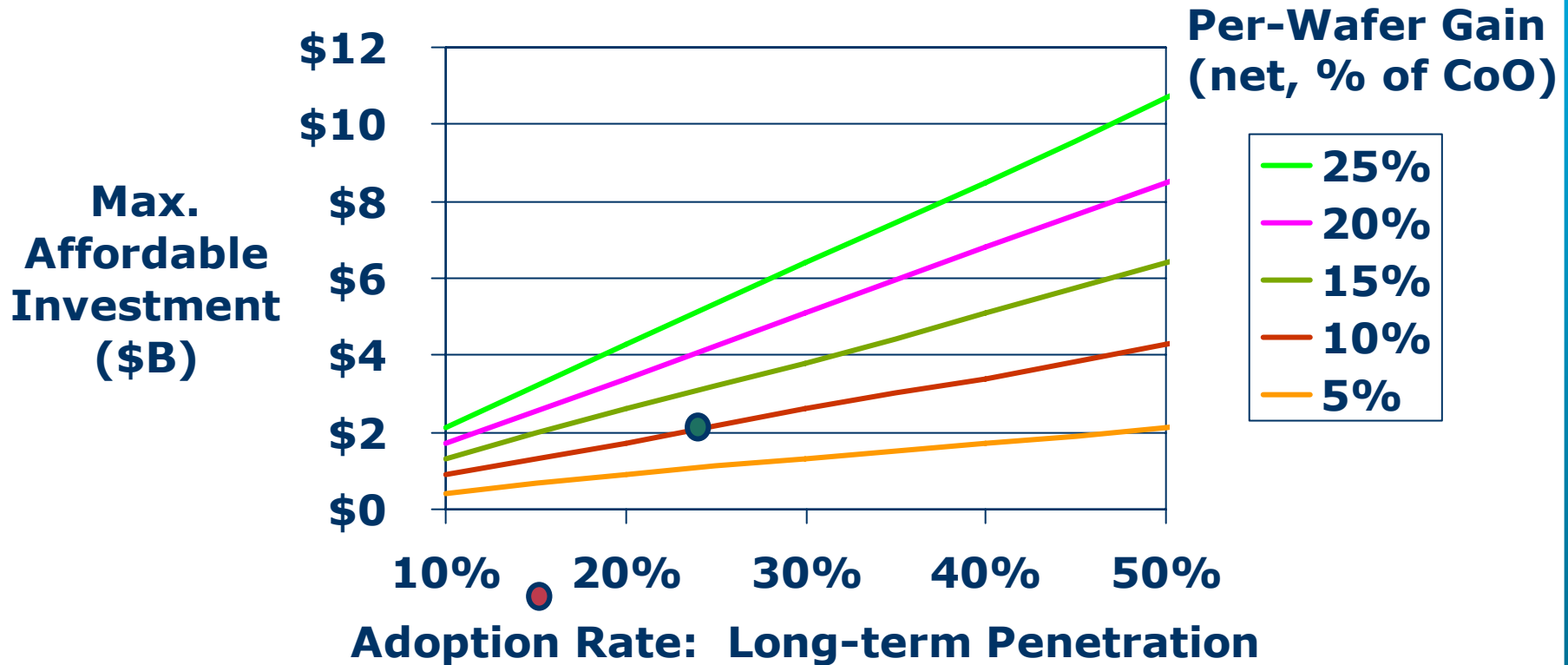


Note: 20% required rate of return; 7-year development time

# Case 2: 300mm Prime Cost/Benefit



## Economic Context for Fab Initiatives



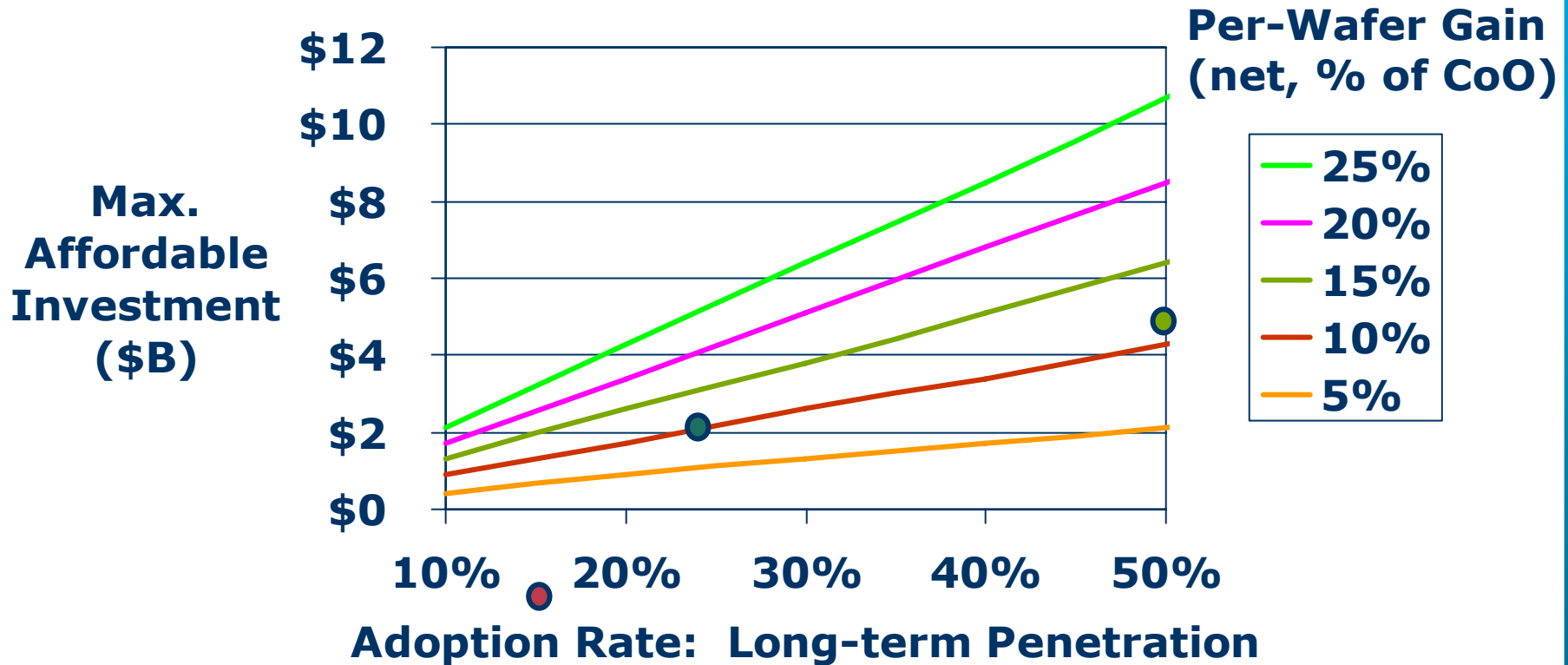
*Note: Illustration of small-lot impact*



# Case 3: Technology Cost/Benefit



## Economic Context for Fab Initiatives



*Note: Illustration of one-time, 1-year acceleration in pace of technology*

# Summary of JPWG Status (1/2)



Topic	Agreement	Disagreement
Slope of cost per xtor vs. time trend	Not changing from -29% to -22%	Changing to -26% or -28%
Root cause for slow down in decline of cost per transistor vs. time	Pace of technology advance (as funded by demand growth)	
R&D Funding Gap	R&D gap is increasing, requiring us to set priorities	What is key concern: Only IC maker R&D, or IC maker & equipment supplier
300 mm Prime	This should be the focus of the industry	300mm Prime is a 300mm productivity program, or a 450mm transition plan
New initiative proposals	Screen with simple, transparent model – intrinsic cost /benefit, rate of penetration and investment	Benefits: industry-wide or sector silo/parochial view IEM as golden standard, or as a tool to be tested/challenged

# Summary of JPWG Status (2/2)



Topic	Agreement	Disagreement
Industry Productivity	Continuous improvement is critical to the industry	Definition of “productivity” <ul style="list-style-type: none"><li>▪ Cost per unit area</li><li>▪ Cost per transistor</li><li>▪ Cost per function</li><li>▪ ...</li></ul> Entitlement: technology advancement, or other sources Productivity goals: edict or analysis



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# ISMI Economic Model

- Demand level & mix (from Semico)
  - + assumed technology & productivity trends
  - capacity allocation to installed base of fabs
  - invest to bridge gap
  - overlay business cycle
- Very large # of assumptions, some of which are not verifiable
- Fab owner perspective
- Static fab model
- Top-down, centrally planned, no competition
- Limited data for most advanced processes

