NIKON RESEARCH CORPORATION OF AMERICA

450 mm and Nikon Advanced Lithography

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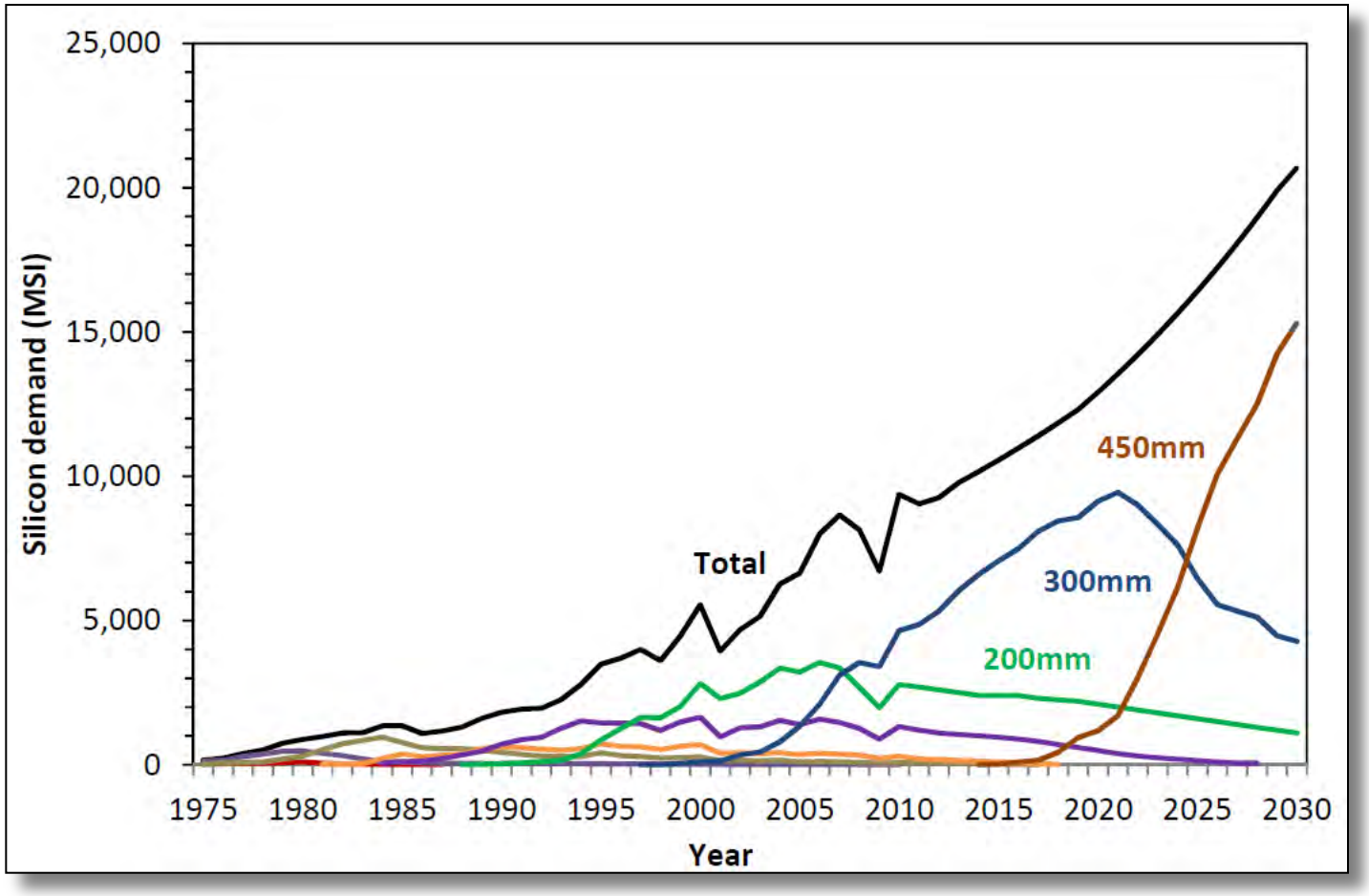
Outline

- **Drivers and Current 193 nm Evolutionary Advances**
- **450 mm Economics and Technology**
- **Nikon and 450 mm**

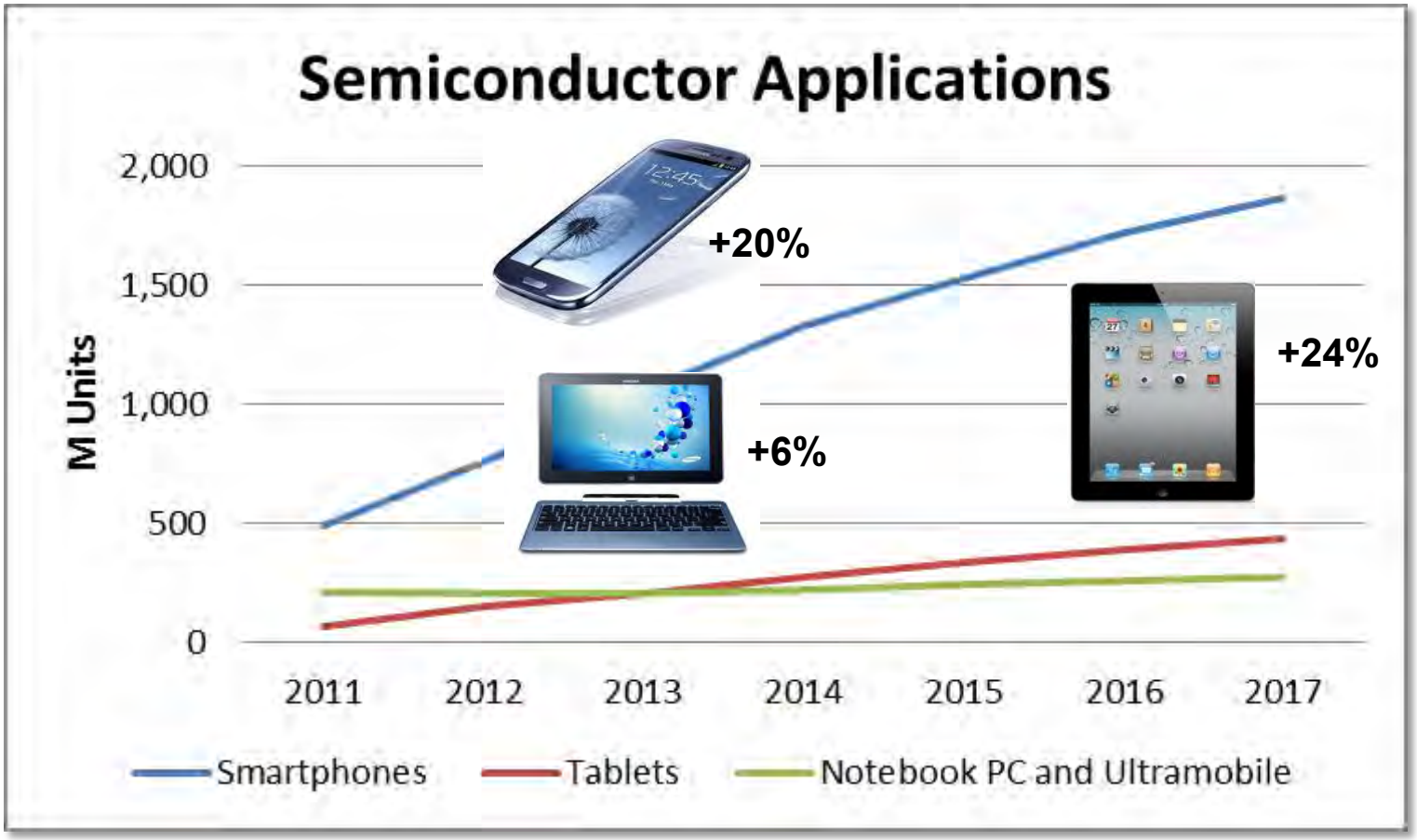
WW Silicon Demand Keeps Growing…



Ref: IC Knowledge 2012

Tremendous projected growth and opportunity

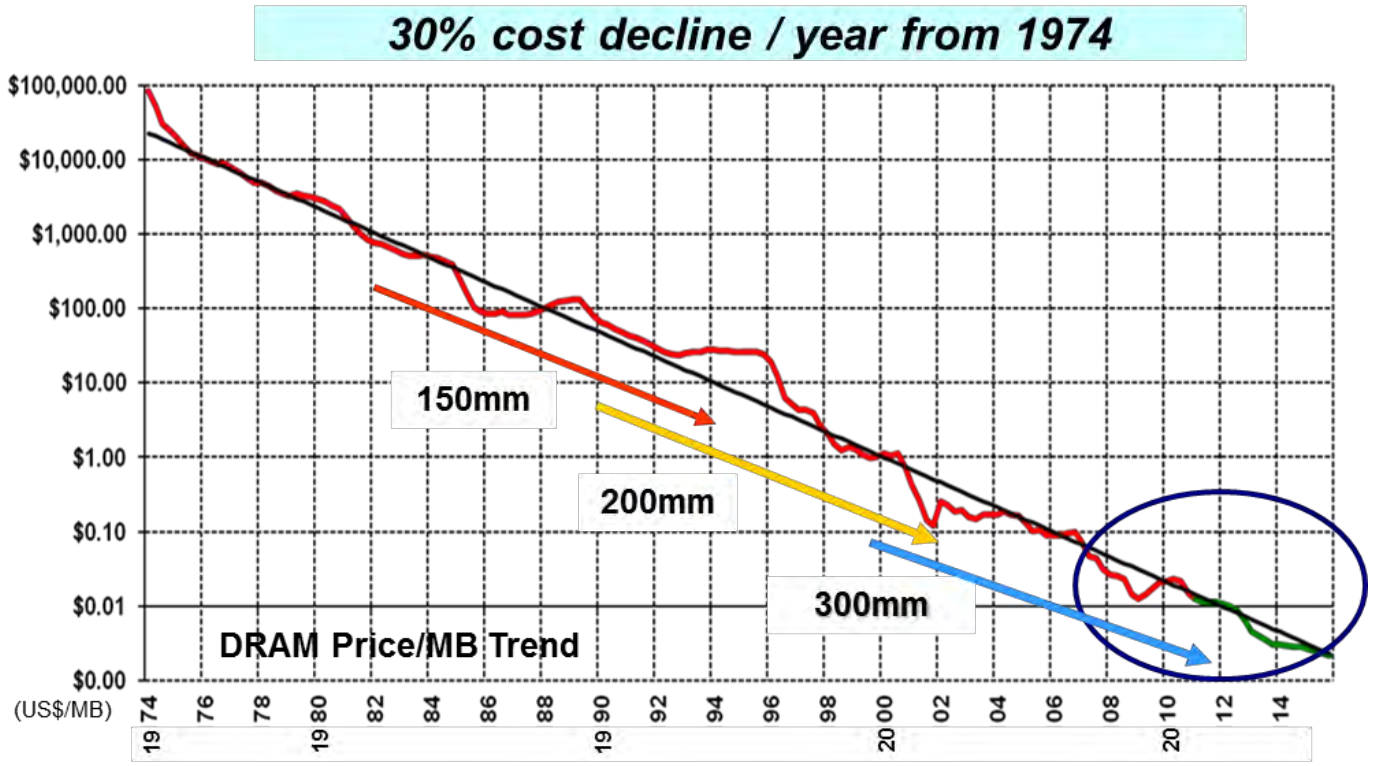
…Fueled by Increasing Applications



Ref: Gartner Q1'13 – CAGR: 5 years 2012- 2017

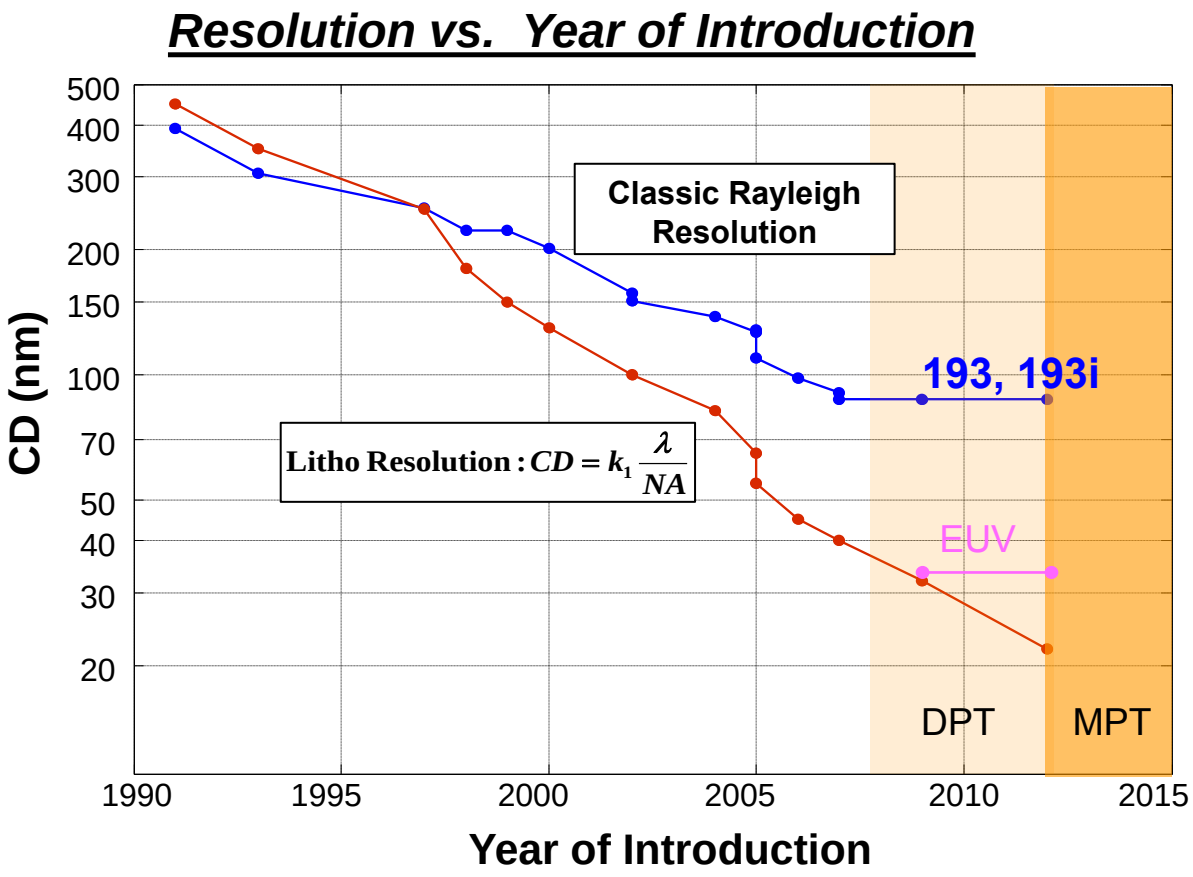
Driven by Mobile Applications

450 mm Motivation



Cost per MB has been a driver for industry success

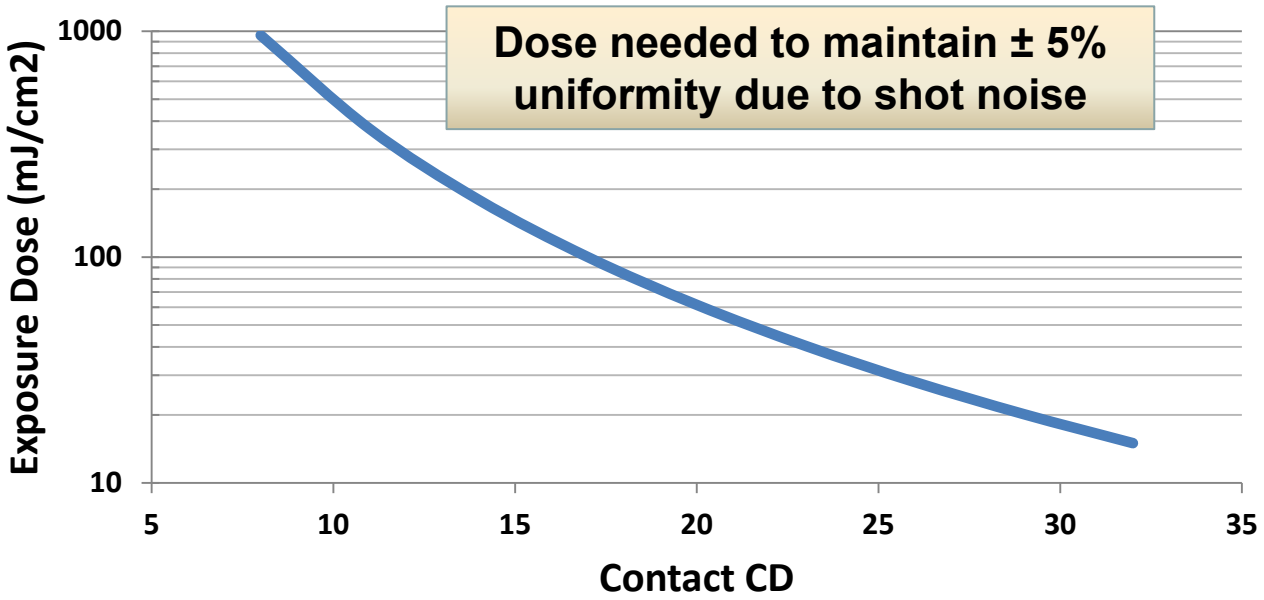
Lithography Resolution and Complexity



Resolution comes at the expense of increasing complexity and cost, especially with multiple processing and EUV

EUV and 193i Extension for HVM

- **EUV continues to face eco-system issues**
  - source power, photoresist and mask complexity continue to plague EUV



- 450 mm and EUV will need >500W at IF for throughput and image quality

- **Extending 193 nm immersion is a proven core technology with an established platform**
  - Provides a strong framework for innovation
  - Early pilot tooling availability and clear HVM strategy

450 mm litho readiness thru ArF immersion extension

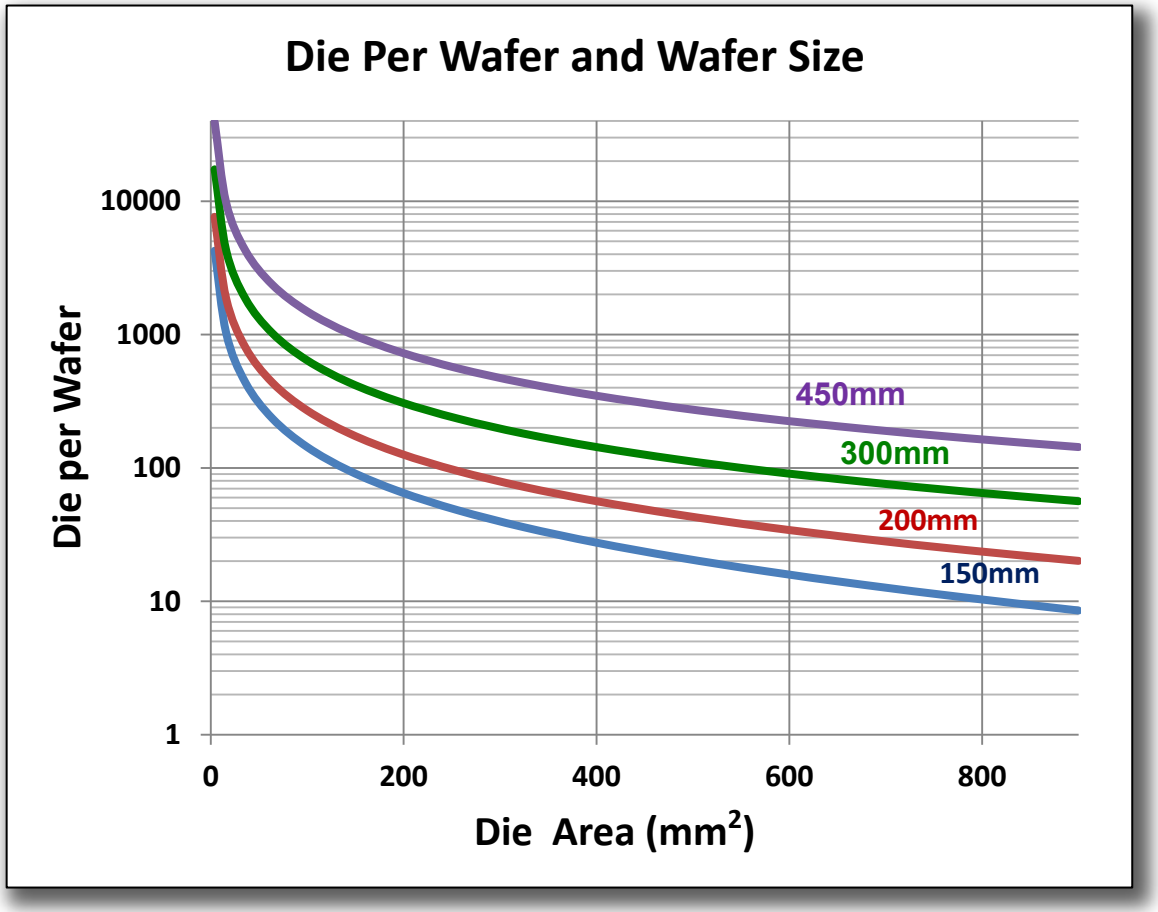
450 mm: Economics and Technology

Maintaining Moore's Law in a cost-effective way

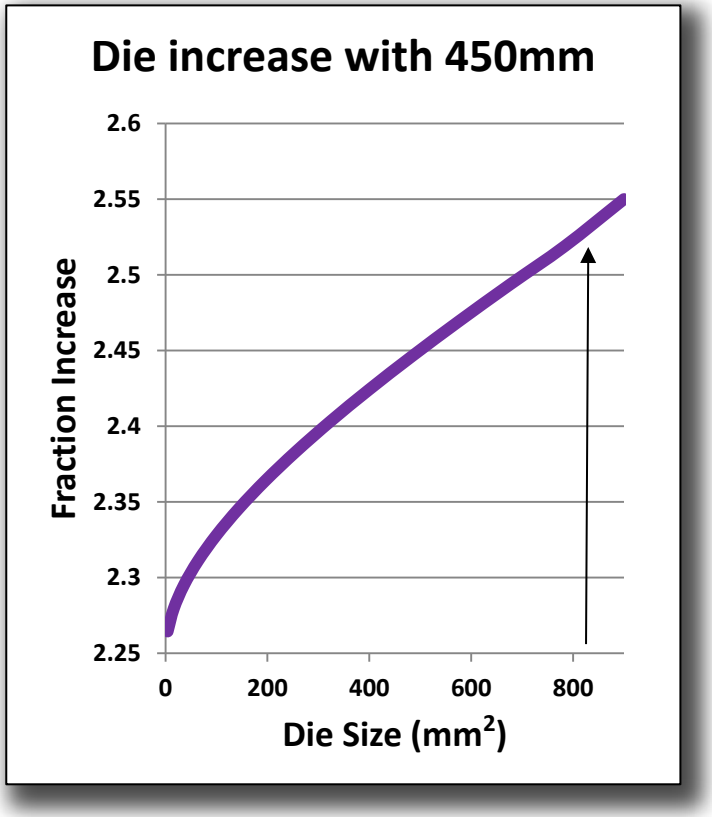
Wafer Area +2.25X and Effective Chip Area +2.4X

Reduces increase in per unit area process costs associated with the technology evolution

450 mm Die Fundamentals



~2.4X Gain for Each Generation



Exact gain will depend on die size and scanner field utilization

Process Step and Cost Comparison

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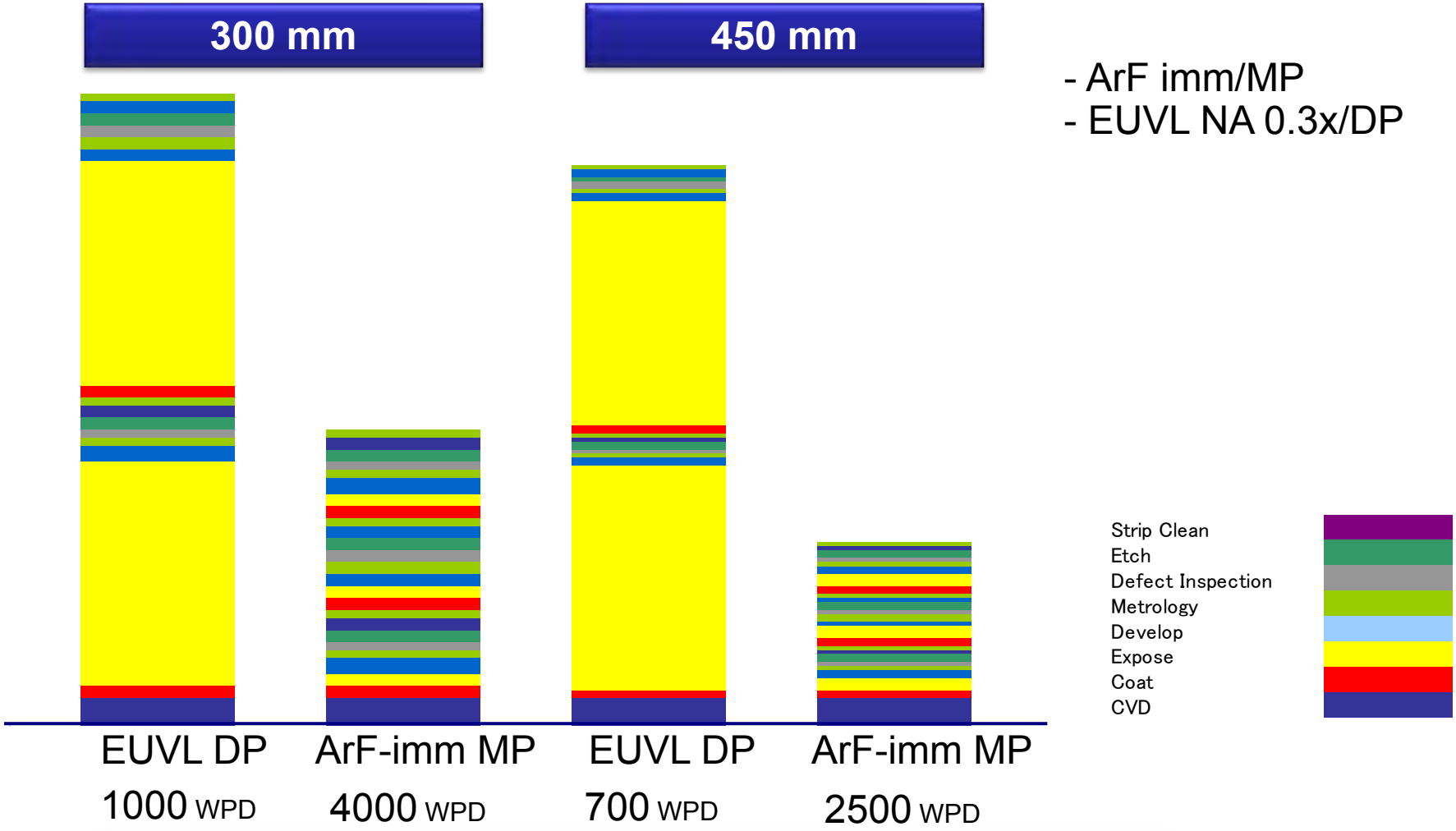
In case of N10



450 mm will enable continuation of Moore's law and further extend 193 nm immersion

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Greater Economies of Scale for IC Manufacturing:

Boost property, plant, equipment (PPE) and employee productivity, and reduce associated costs

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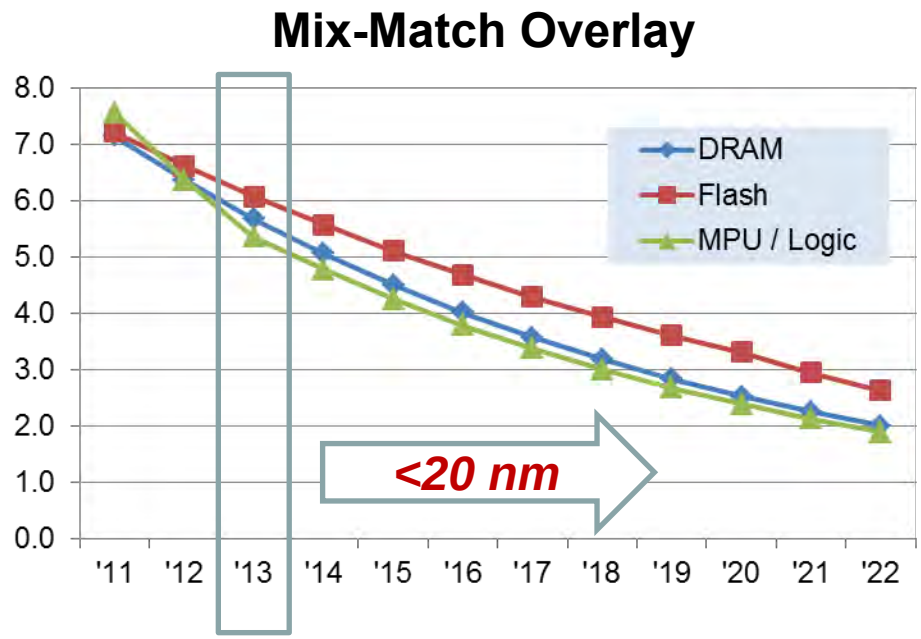
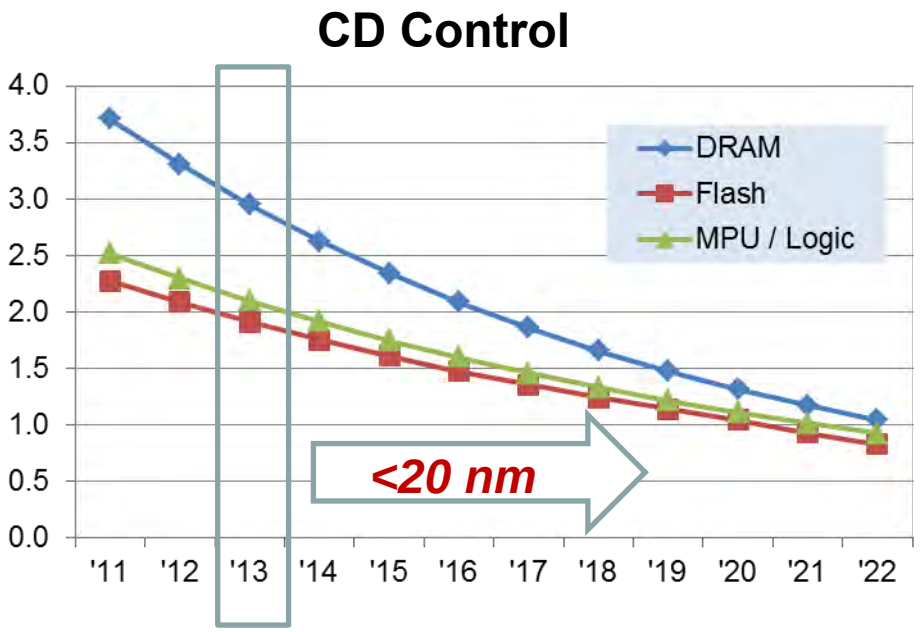
Stimulate Industry Innovation:

Designers have the chance to think outside of the box

Litho Requirements: CD and Overlay





On-going improvements to productivity, overlay, and CD control are essential for future scaling and 450 mm

450 mm Challenges

- **The equipment of the 450 mm generation will have to meet:**
  - Currently unknown high yield manufacturing ramp rates
  - Challenging levels of defect free operation and extreme reliability performance
  - Specifics to Scanners: demanding throughput, overlay and CD specifications
- **A series of research and development efforts will have to be invested into equipment innovation and improvements**
- **Example of a Stage Size Challenge**
  - Let's assume linear scaling (big simplification), then increasing wafer diameter 1.5x means the stage mass is diameter^3≈ 3.4X , and hence motors need 3.4X greater force, but motor heat scales with force^2

Innovation is occurring at Nikon to meet these challenges

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Many Opportunities for Invention and Expanded Industry Collaboration:

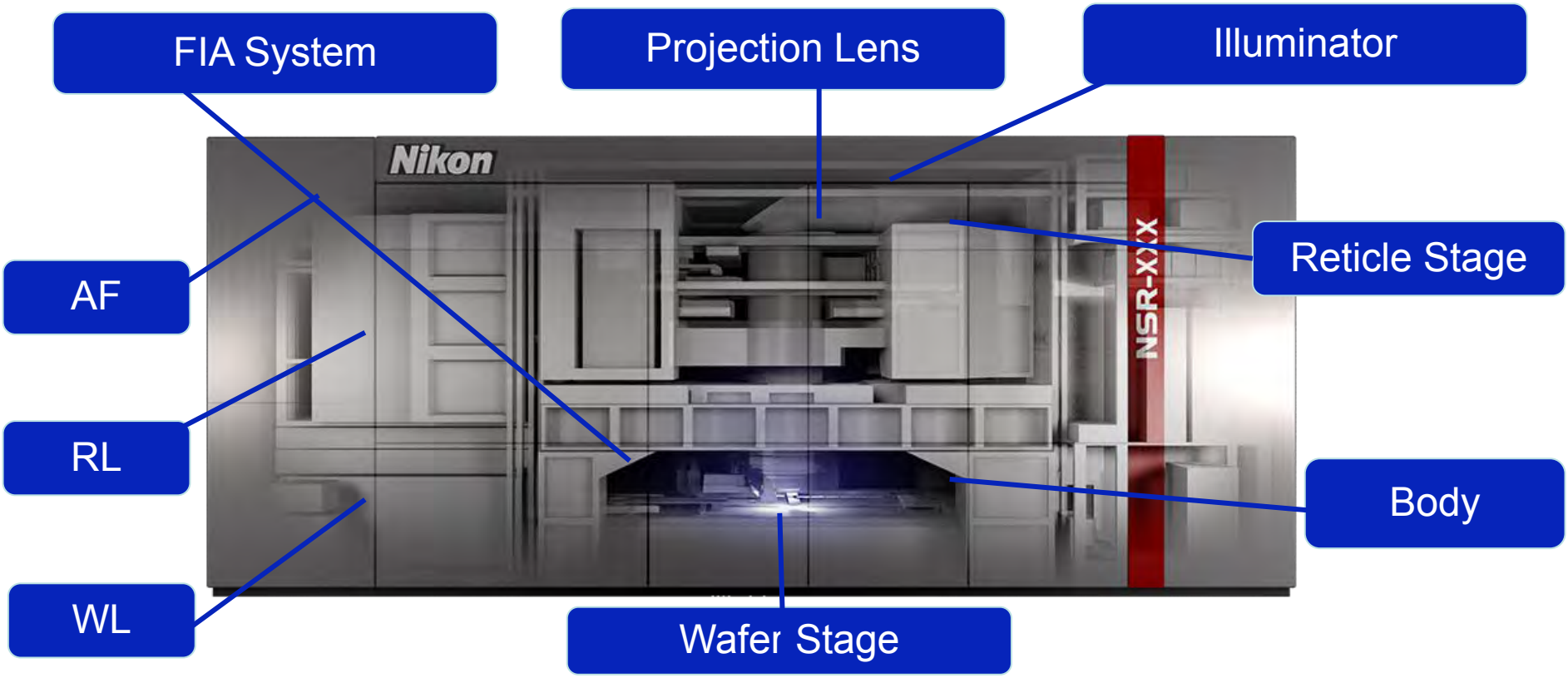
Tooling, automation, IC manufacturing processes, green tech, etc.

450 mm: Cost and Technology Innovation

Nikon 450 mm Machine

- Large scale corporate program utilizing top worldwide engineering talent to develop and build the 450 mm scanner system
- Nikon leading tools S621/S622D(immersion), and S320F(dry) have high overlay accuracy and throughput
- The proven *Streamlign* Platform provides an effective foundation for the 450 mm system

Modular Overview



- Enhanced overlay and throughput
- Improved AF stability/edge performance
- High-speed/precision technologies for larger wafers + improve total productivity

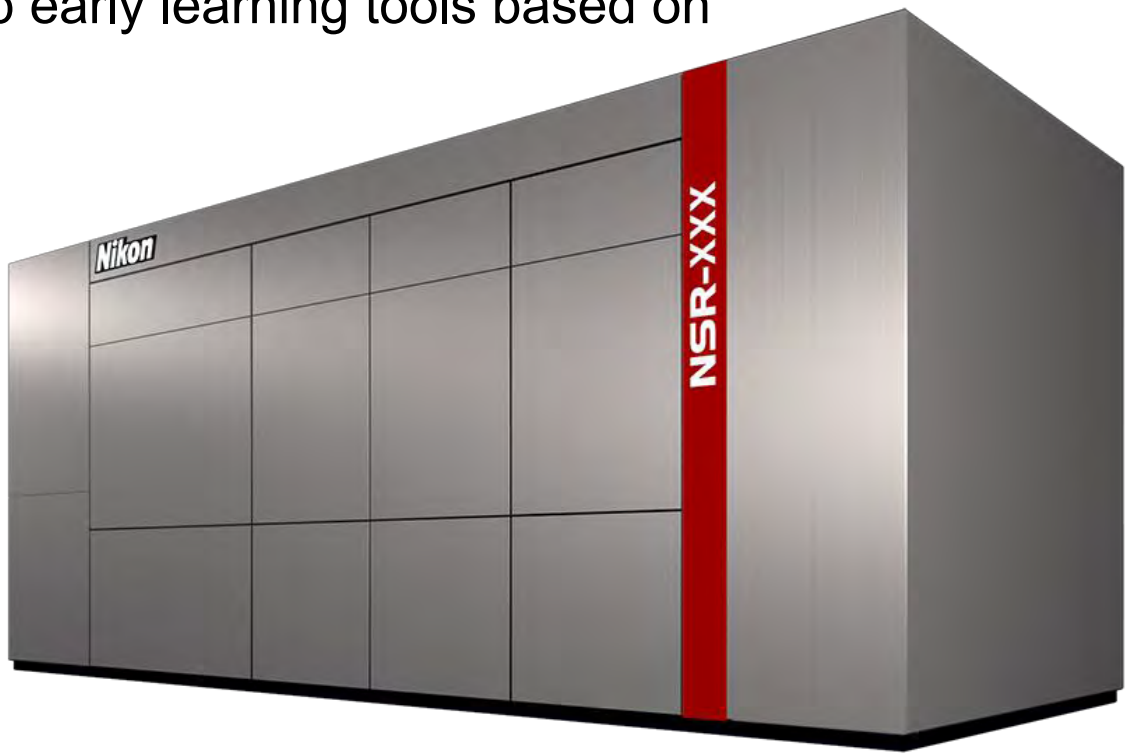
Opportunity to innovate in all modules

Nikon 450 mm Plans

- Nikon will leverage our experience with the transition to 300 mm and our *Streamlign* Platform

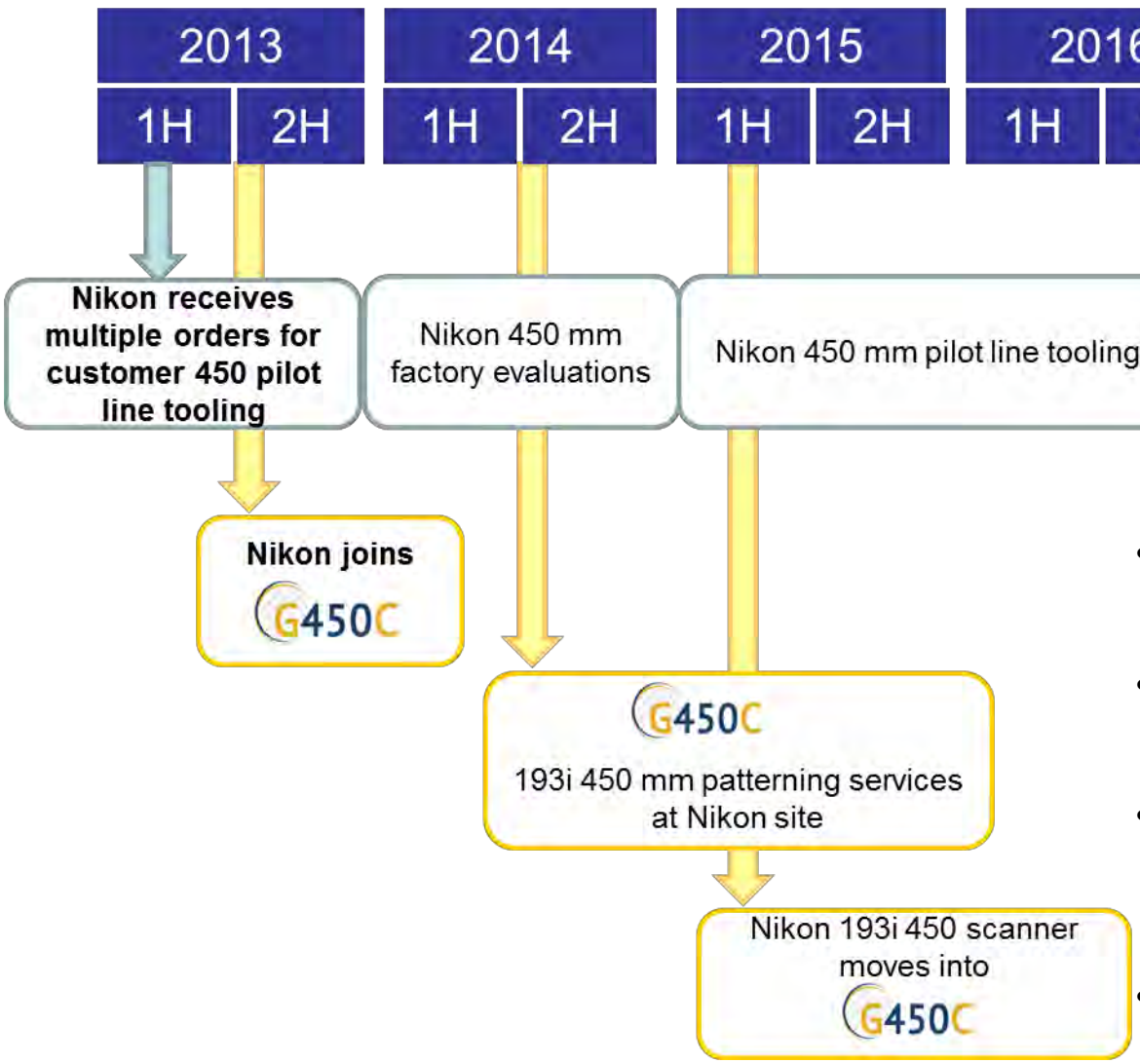
- By 2015, Nikon plans to ship early learning tools based on 193 nm immersion

- Nikon plans to ship 450 mm HVM tools in 2017 through our joint development effort with a chipmaker



Nikon is joining the Global 450 mm Consortium (G450C)

Nikon and G450C



- Nikon – G450C partnership formally announced
- Providing advanced 450 mm litho patterning from mid-2014
- Shipping advanced Nikon 450 mm ArF immersion scanner to Albany in April 2015
- Nikon timelines in sync with leading industry partners

Concluding Remarks

- **The need for 450 mm is driven by economic and productivity issues**
- **450 mm will mitigate increased costs due to lithography complexity for 193 nm immersion**
- **450 mm and EUV may prove to be a more difficult issue, especially in the sub-20 nm regime**
- **Nikon is building 450 mm systems based on the foundation of our proven *Streamlign* Platform**
- **Nikon has joined the Global 450 Consortium**
  - We will be delivering a 450 mm learning tool by 2015
- **Nikon will be delivering HVM tools by 2017**

Thank You

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