

# EUV

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INVESTOR DAY  
**ASML** **SMALLTALK** 2014  
LONDON



# Forward looking statements

This document contains statements relating to certain projections and business trends that are forward-looking, including statements with respect to our outlook, expected customer demand in specified market segments, expected sales levels and trends, our market share, customer orders and systems backlog, IC unit demand, expected or indicative financial results or targets, including revenue, gross margin, expenses, gross margin percentage, opex percentage of sales, tax percentage, cash conversion cycle, capex percentage of sales, credit rating and earnings per share, expected shipments of tools and the timing thereof, including expected shipments of EUV and DUV tools, productivity of our tools and systems performance, including EUV system performance (such as endurance tests), the development of EUV technology and timing of shipments, development in IC technology, including shrink scenarios, NAND technology development and cost estimates, expectations on development of the shrink roadmap across all of our systems, upgradeability of our tools, system orders, customer transition estimates, expected transition scaling, forecasted industry developments, including expected smartphone, tablet and server use in future years, and expectations relating to new applications including wearable devices and connected devices, expected investment pay-back time for foundries, expected construction of additional holistic lithography infrastructure, the continuation of Moore's Law, and our dividend policy and intention to repurchase shares. You can generally identify these statements by the use of words like "may", "will", "could", "should", "project", "believe", "anticipate", "expect", "plan", "estimate", "forecast", "potential", "intend", "continue" and variations of these words or comparable words. These statements are not historical facts, but rather are based on current expectations, estimates, assumptions and projections about the business and our future financial results and readers should not place undue reliance on them.

Forward-looking statements do not guarantee future performance and involve risks and uncertainties. These risks and uncertainties include, without limitation, economic conditions, product demand and semiconductor equipment industry capacity, worldwide demand and manufacturing capacity utilization for semiconductors (the principal product of our customer base), the impact of general economic conditions on consumer confidence and demand for our customers' products, competitive products and pricing, affordability of shrink, the continuation of Moore's Law, the impact of manufacturing efficiencies and capacity constraints, performance of our systems, the continuing success of technology advances and the related pace of new product development and customer acceptance of new products and customers meeting their own development roadmaps, market demand for our existing products and for new products and our ability to maintain or increase our market share, the development of and customer demand for multi-patterning technology and our ability to meet overlay and patterning requirements, the number and timing of EUV systems expected to be shipped, our ability to enforce patents and protect intellectual property rights, the risk of intellectual property litigation, EUV system performance and customer acceptance, availability of raw materials and critical manufacturing equipment, trade environment, our ability to reduce costs, changes in exchange rates and tax rates, available cash, distributable reserves for dividend payments and share repurchases, changes in our treasury policy, including our dividend and repurchase policy, completion of sales orders, the risk that key assumptions underlying financial targets prove inaccurate, including assumptions relating to market share, lithography market growth and our customers' ability to reduce production costs, risks associated with Cymer, which we acquired in 2013, and other risks indicated in the risk factors included in ASML's Annual Report on Form 20-F and other filings with the US Securities and Exchange Commission. These forward-looking statements are made only as of the date of this document. We do not undertake to update or revise the forward-looking statements, whether as a result of new information, future events or otherwise.

## Outline

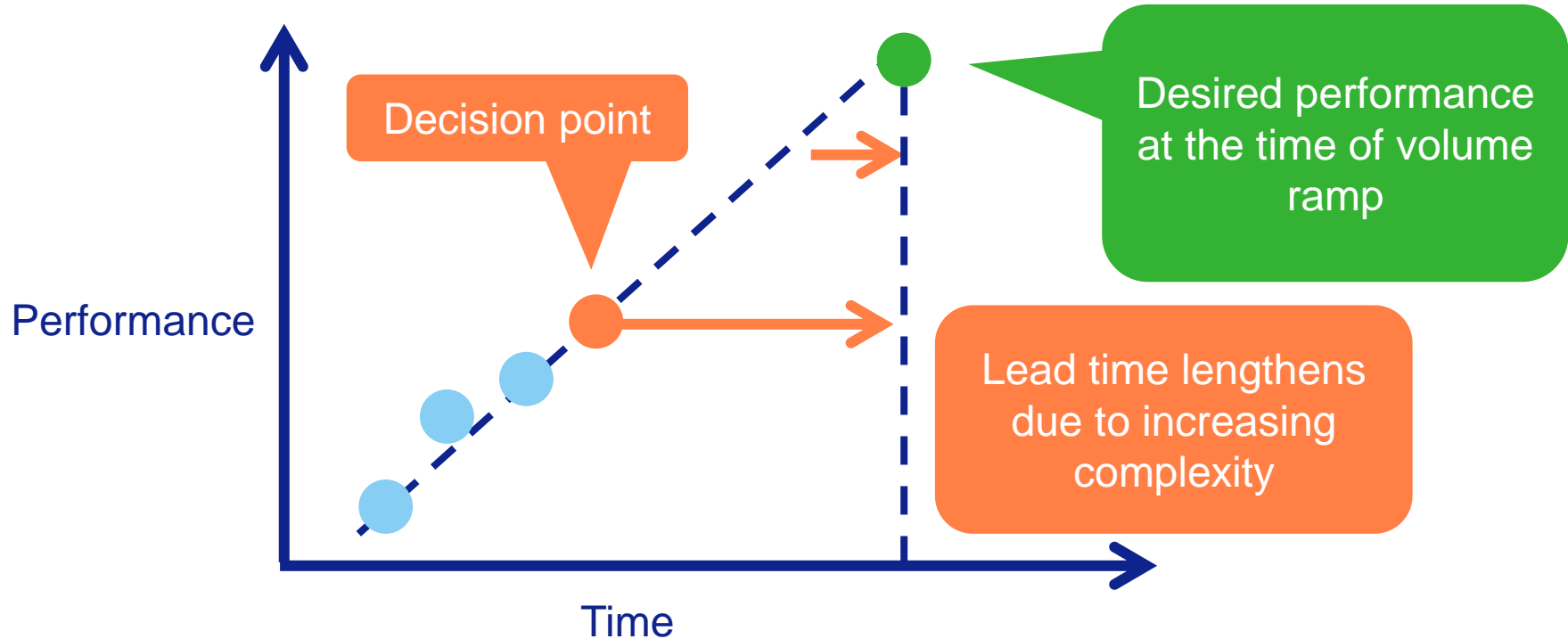
- **New technology transitions:  
customer perspective**
- EUV progress & plans
- EUV infrastructure
- EUV extendibility

# How customers approach new technology insertions

- Visionary/champion
- R&D enthusiastic
- First results
- Business manager “Shouldn’t we go for this?”
- Manufacturing push back
- Tough criteria, entrance hurdles
- Dynamics: progress vs. milestones
- 1.5 – 2 year lead time
- Business decision with up/down clicks
- Different risk appetite per customer and per segment

# Technology transitions: decisions based on early results

*"You have to move to where the puck will be, not where it is" (Wayne Gretzky)*



# Dilemmas when adopting a game-changing technology

|                   | It works  | It does not work  |
|-------------------|---|---|
| We have it        |  |  |
| We do not have it | ??  |  |

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- New technology transitions:  
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# EUV status:

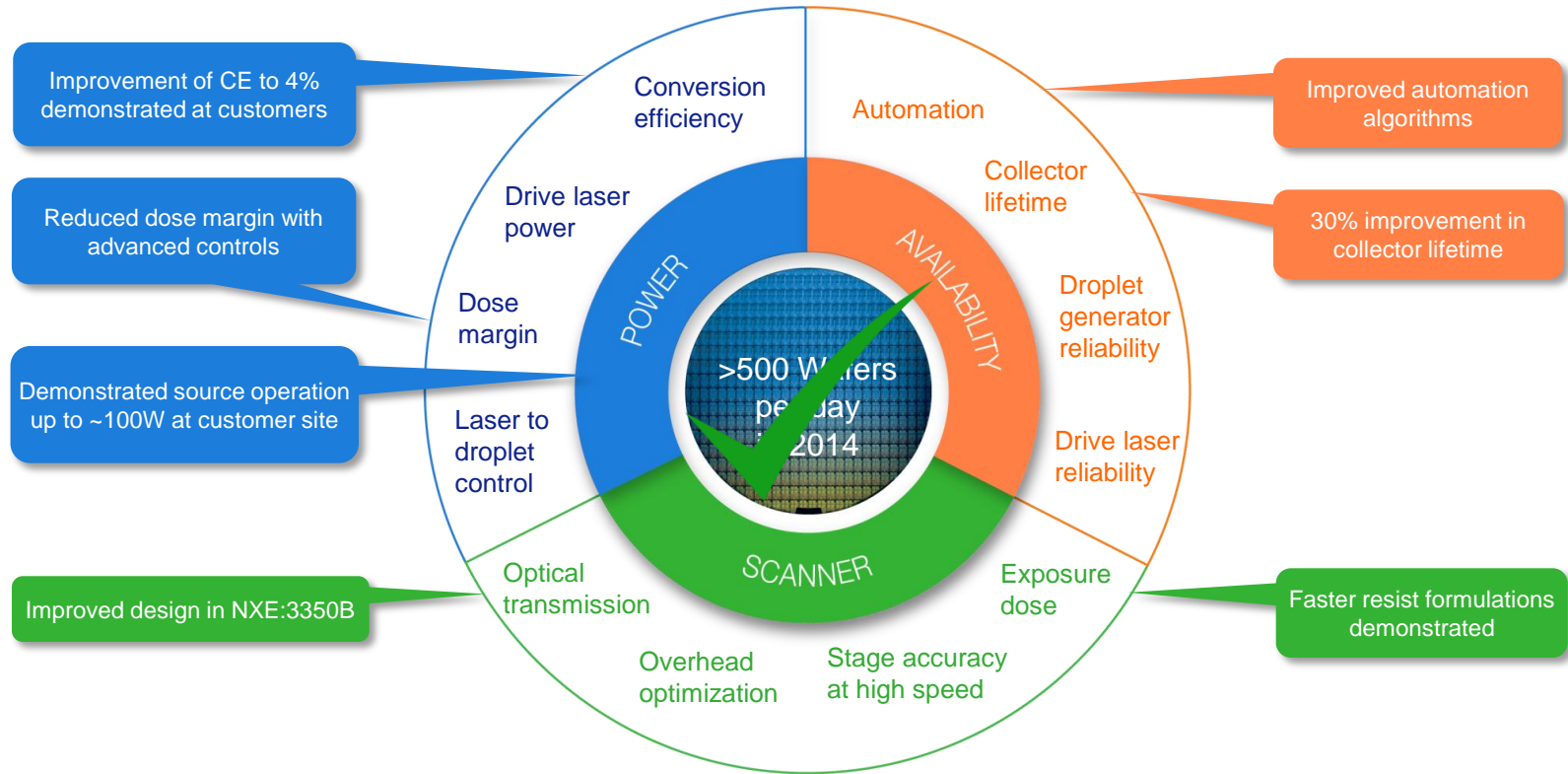
## Demonstrated >500 wafers per day at customer sites



- More than 500 wafers per day demonstrated during endurance tests at 2 customer sites
- 7 NXE:3300B systems qualified and shipped to customers
- 4 more NXE:3300B systems being manufactured, one more shipment planned for Q4 2014
- 4<sup>th</sup> generation NXE system (NXE:3350B) integration ongoing
- EUV cleanroom extension is under construction
- First production EUV orders received

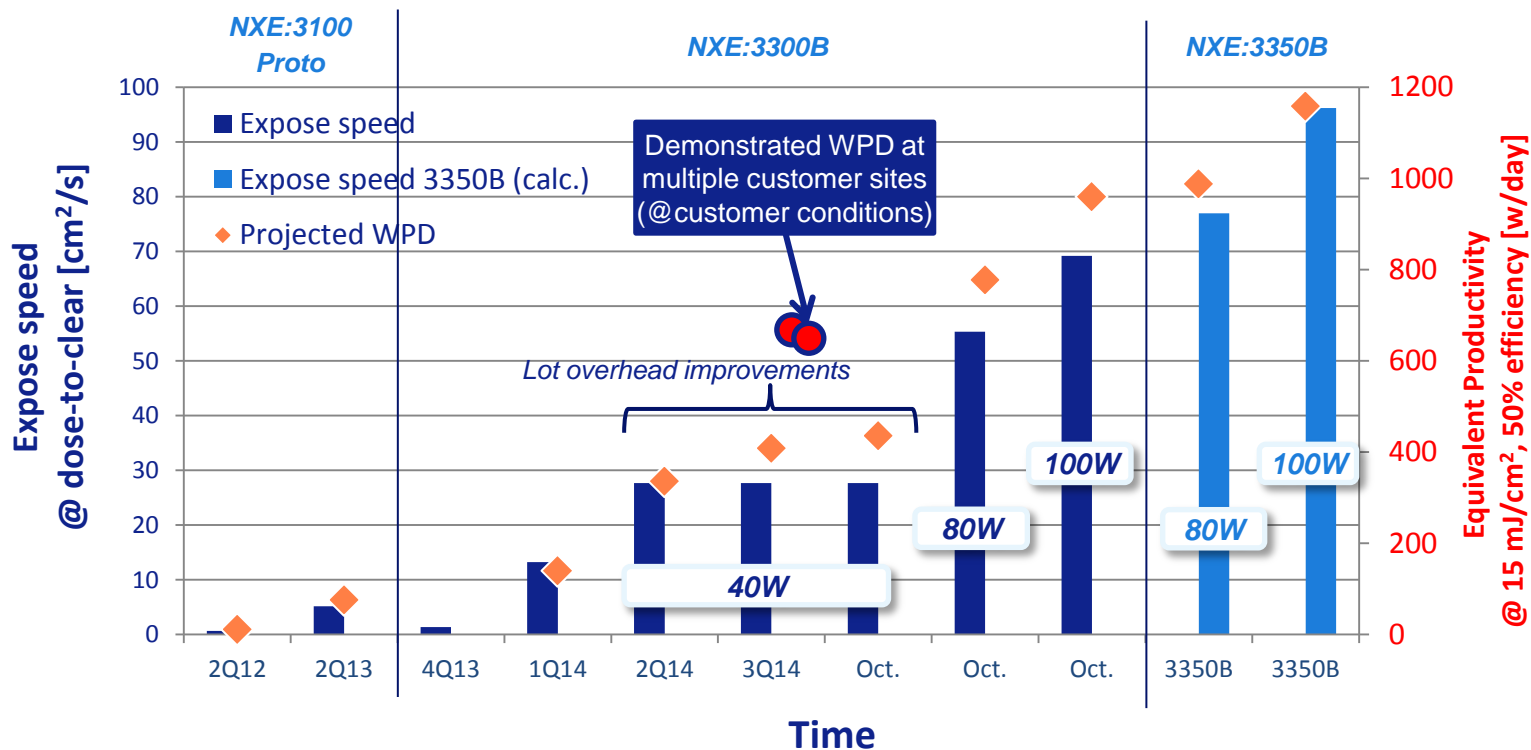


# Wafers per day program: Today



# NXE:33x0B demonstrated power supports >1000 wpd

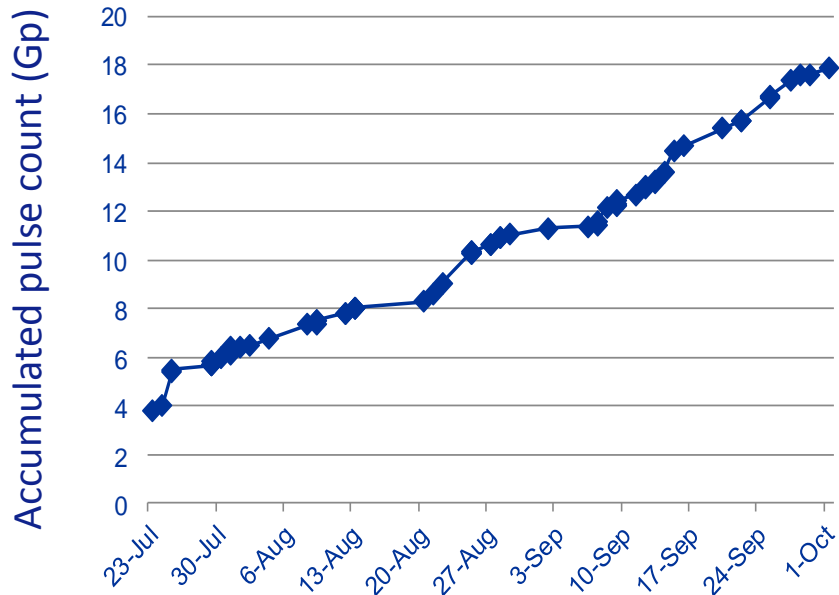
Up to 7 systems operational at >40W; 100W source operation demonstrated



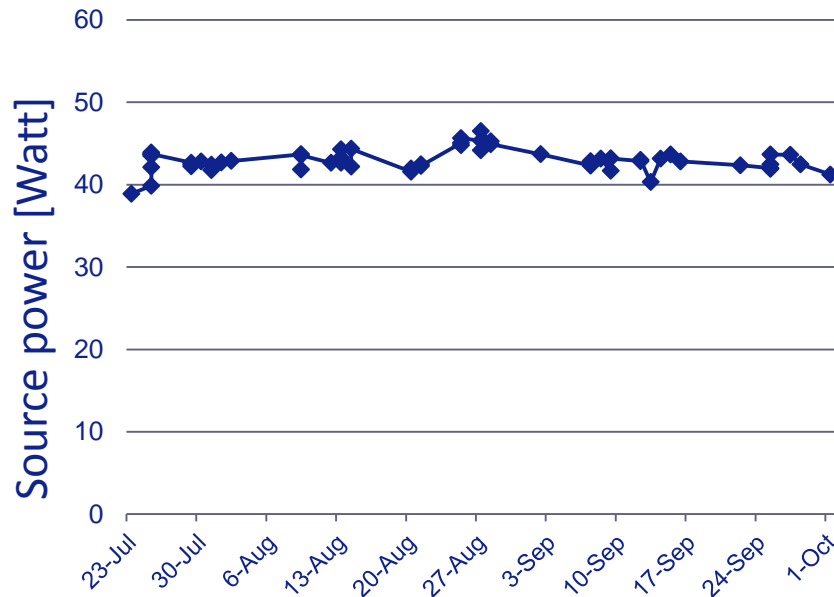
- o Dose-to-expose is 2.5x dose-to-clear
- o Productivity: field size 26x33 mm², 96 fields/wafer, 50% efficiency
- o NXE:3350B data calculated using measured transmission of last system

# Stable operation at customer site: continuous use at power level during more than 2 months operation at >40W

System pulse count

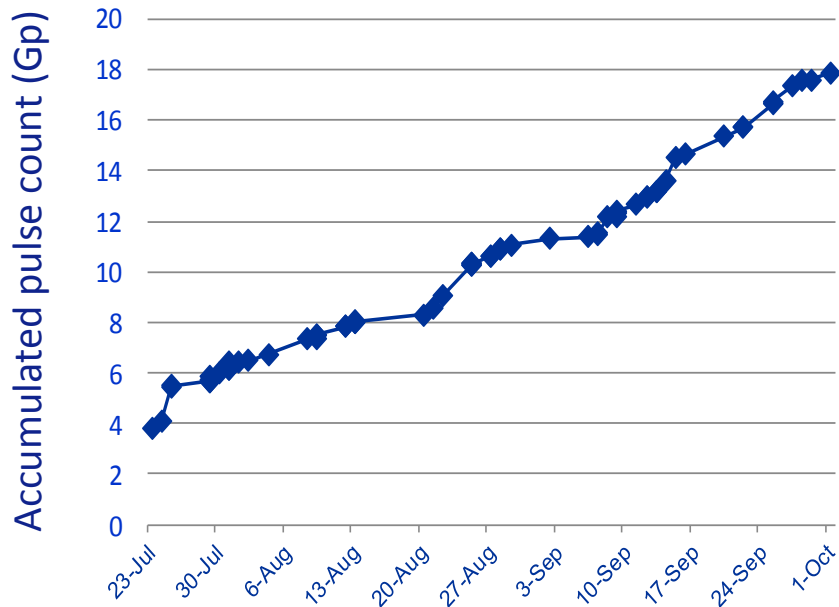


Power of >40W  
since start use system

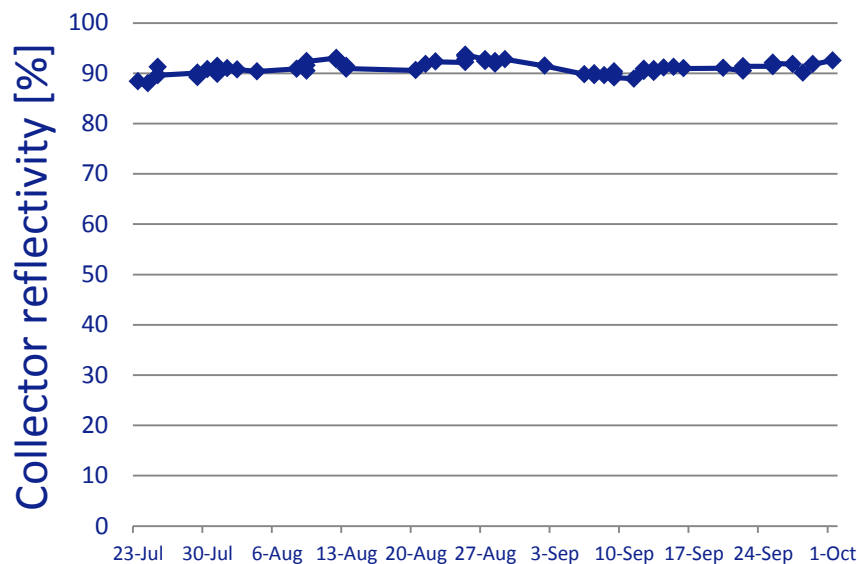


# Excellent collector performance - remains clean during more than 2 months operation at $>40\text{W}$

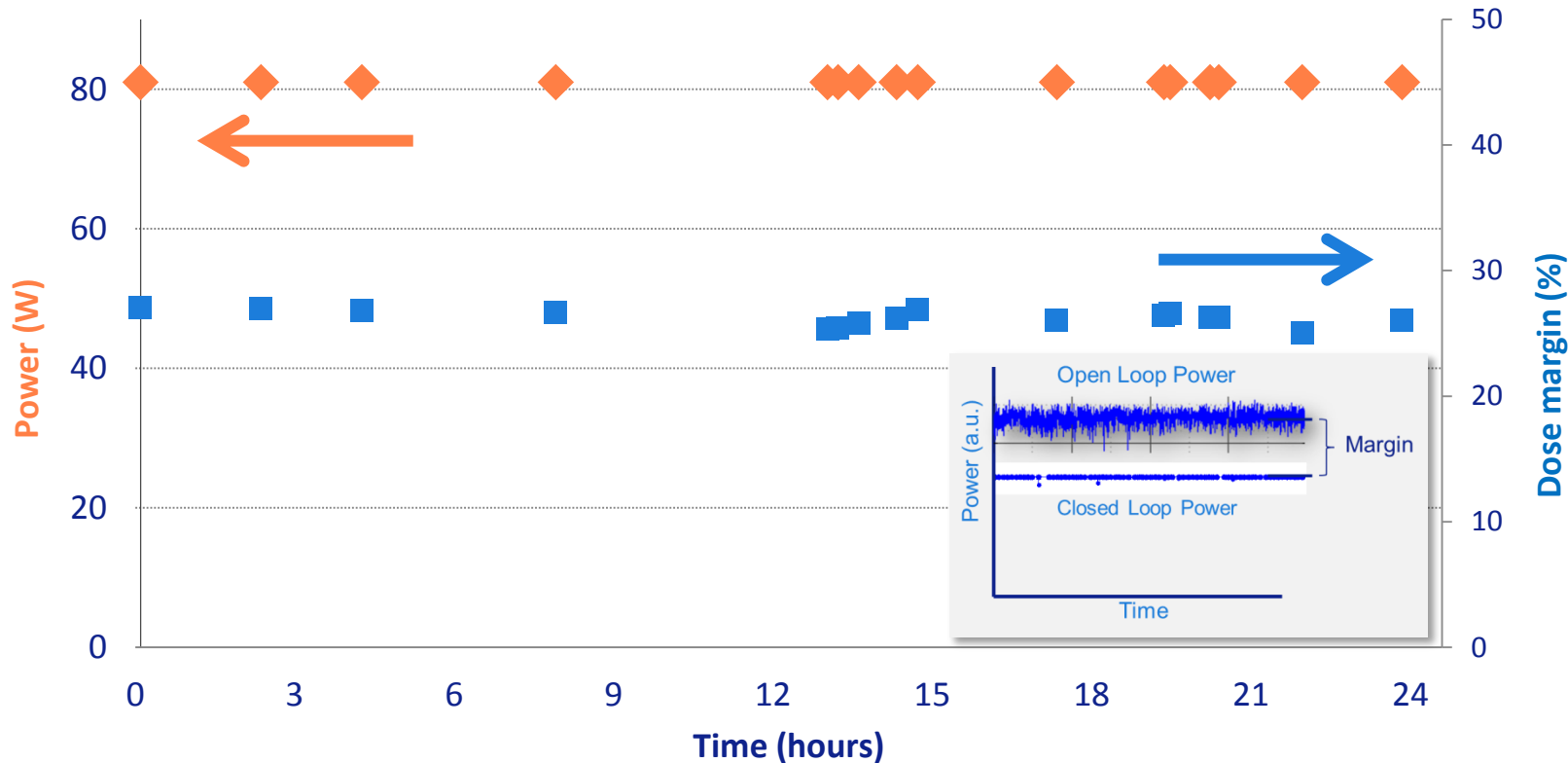
## System pulse count



## Stable collector reflectivity

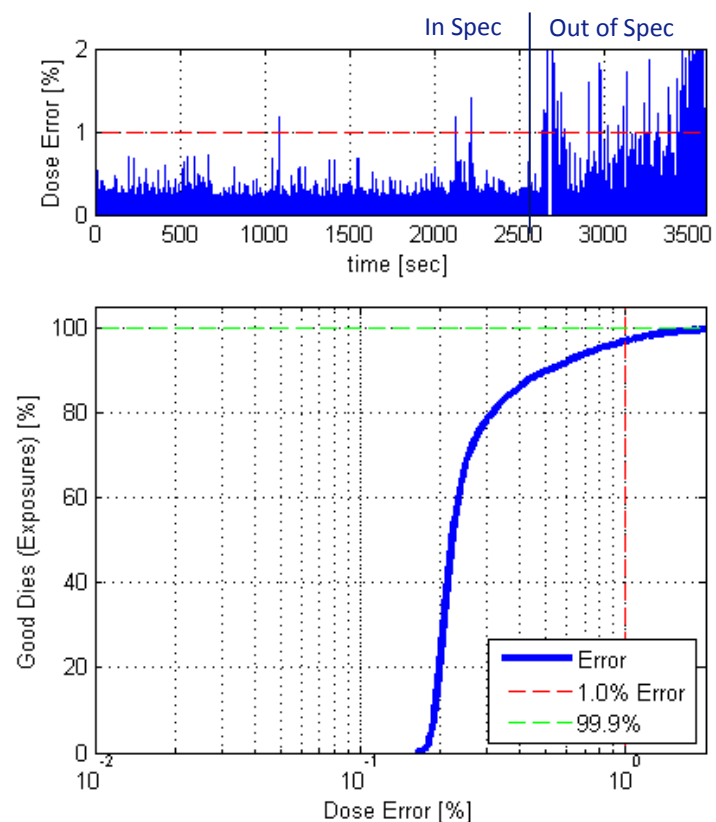
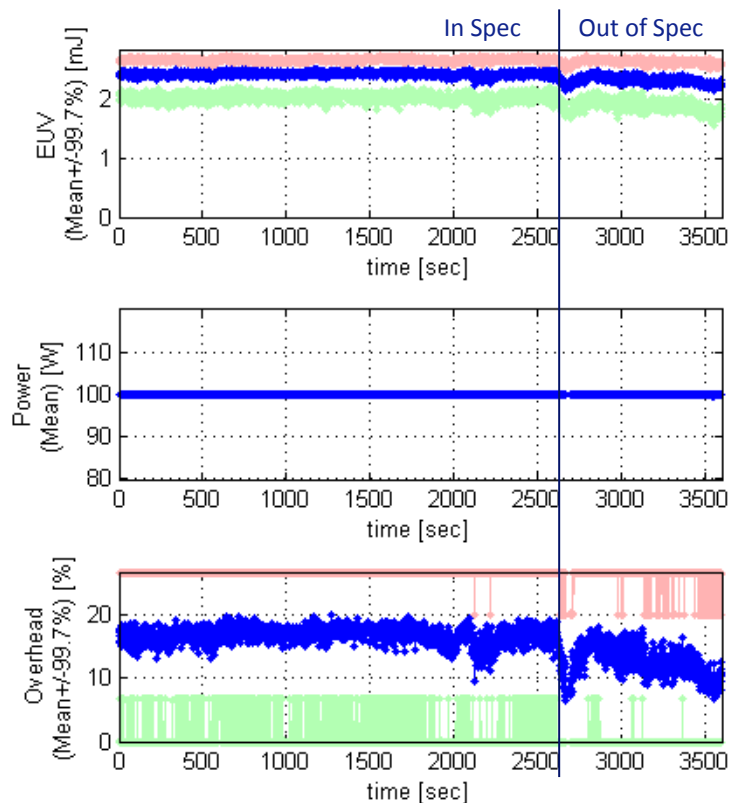


# Continuous stable source operation at 80W for 24 hrs.

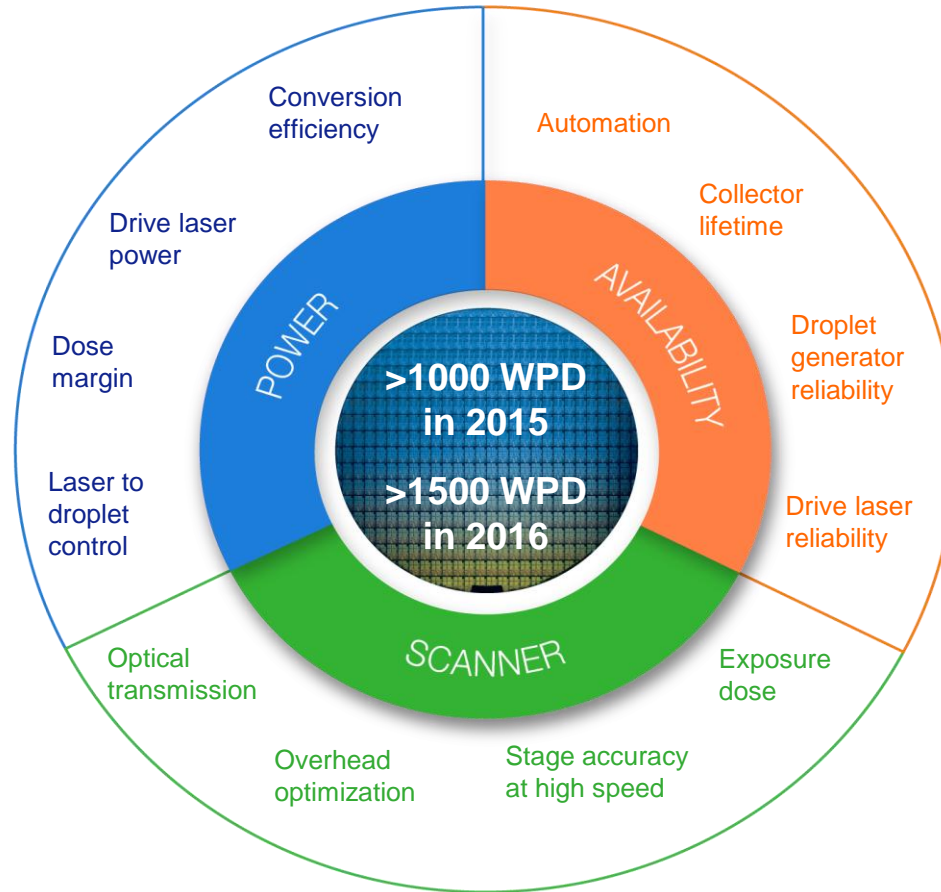


# 100W Power demonstrated

60 min run 96% die yield (45min 99.9% yield)

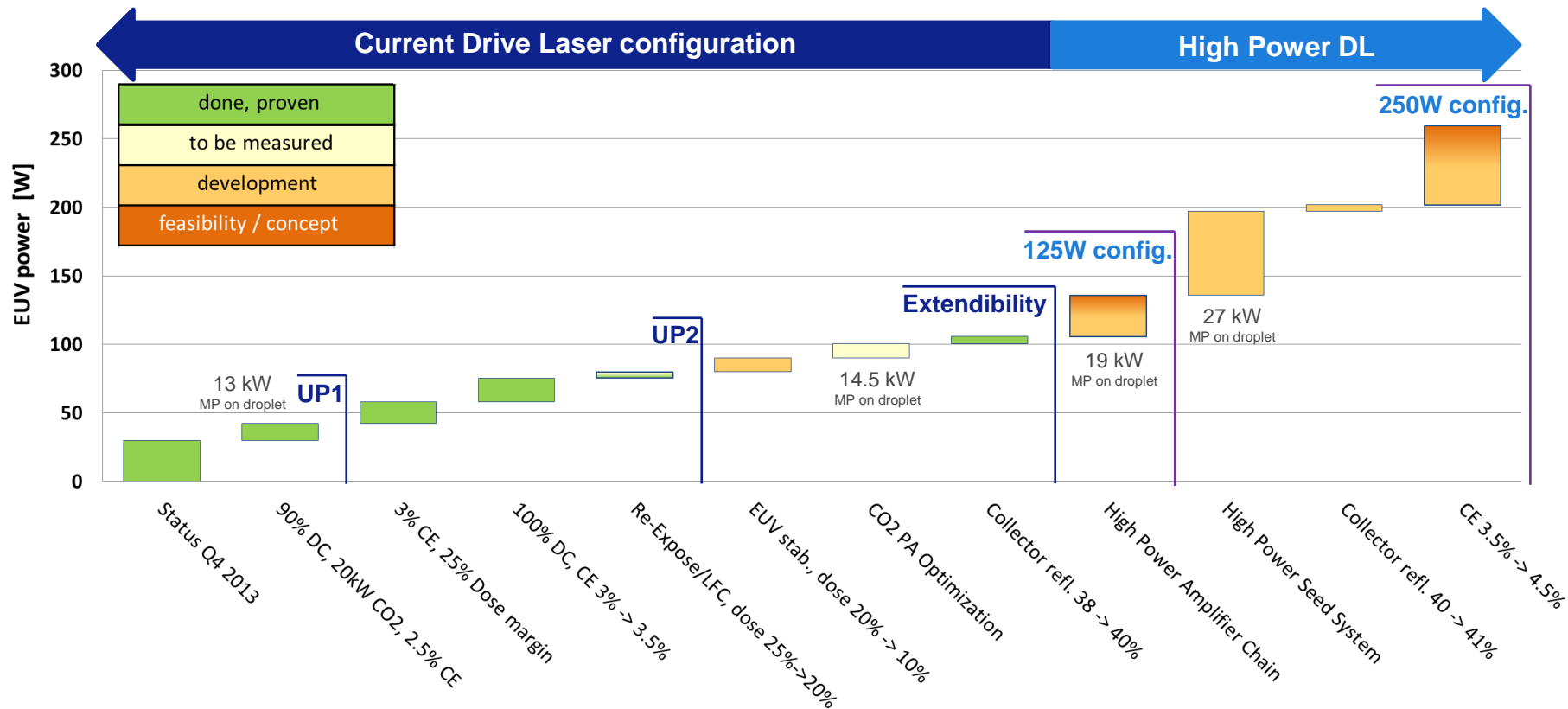


# Wafers per day program: Next steps



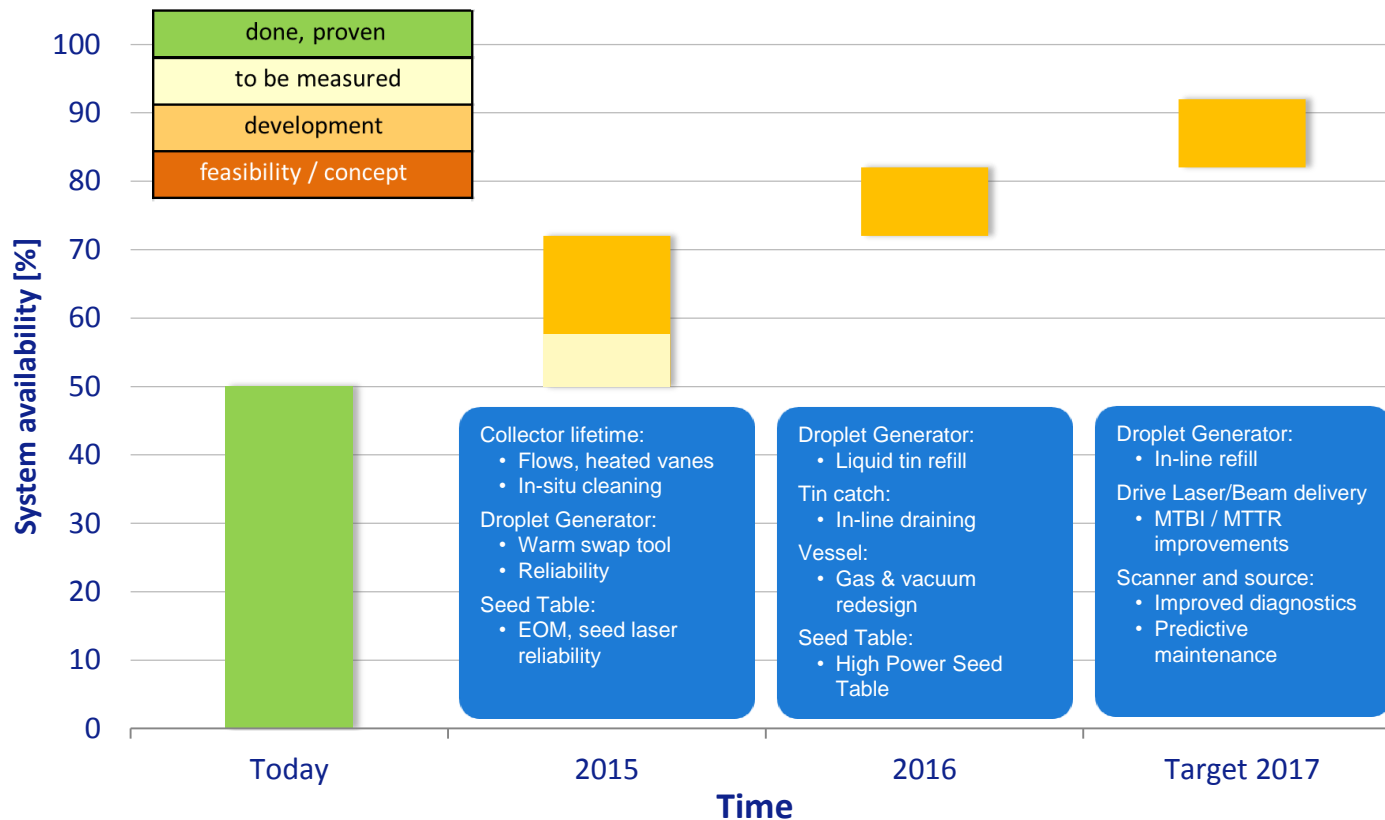
# Source power roadmap in place for 250W

- Modular upgrades extend current performance to 80W and beyond
- 250W achievable while reducing HW changes / upgrade complexity





# Availability roadmap in place towards >90%



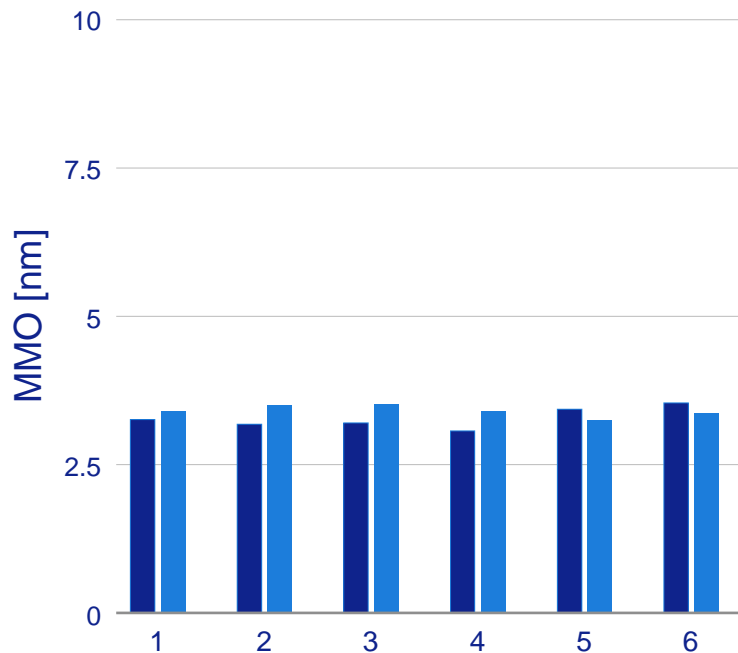
# NXE:33x0B Industrialization Roadmap supports >1500 wafers per day in 2016

| Timing | Source power<br>[W] | Throughput<br>[Wafers/hr] | Efficiency*<br>[%] | Productivity<br>[Wafers/day] |
|--------|---------------------|---------------------------|--------------------|------------------------------|
| 2014   | 80                  | >55                       | <50%               | >500                         |
| 2015   | 125                 | >75                       | >50%               | >1000                        |
| 2016   | 250                 | >125                      | >55%               | >1500                        |

\*Efficiency = system availability x customer utilization x customer rate efficiency  
Illustrative numbers used for WPD model

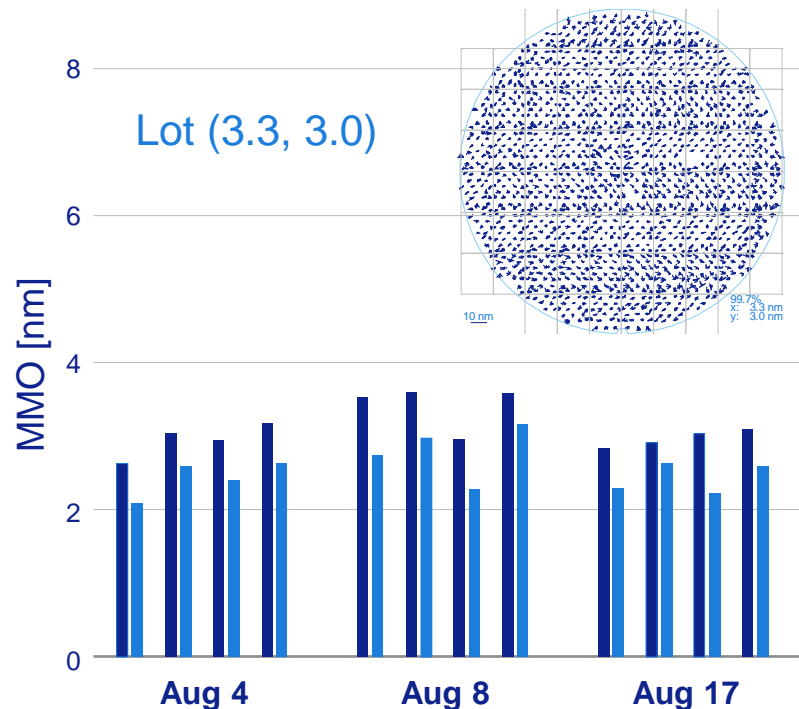
# Excellent and stable overlay matching to immersion

## Full-wafer matched machine overlay < 4nm at 40W, stable over 2 weeks



Wafer – one day after setup

Customer A

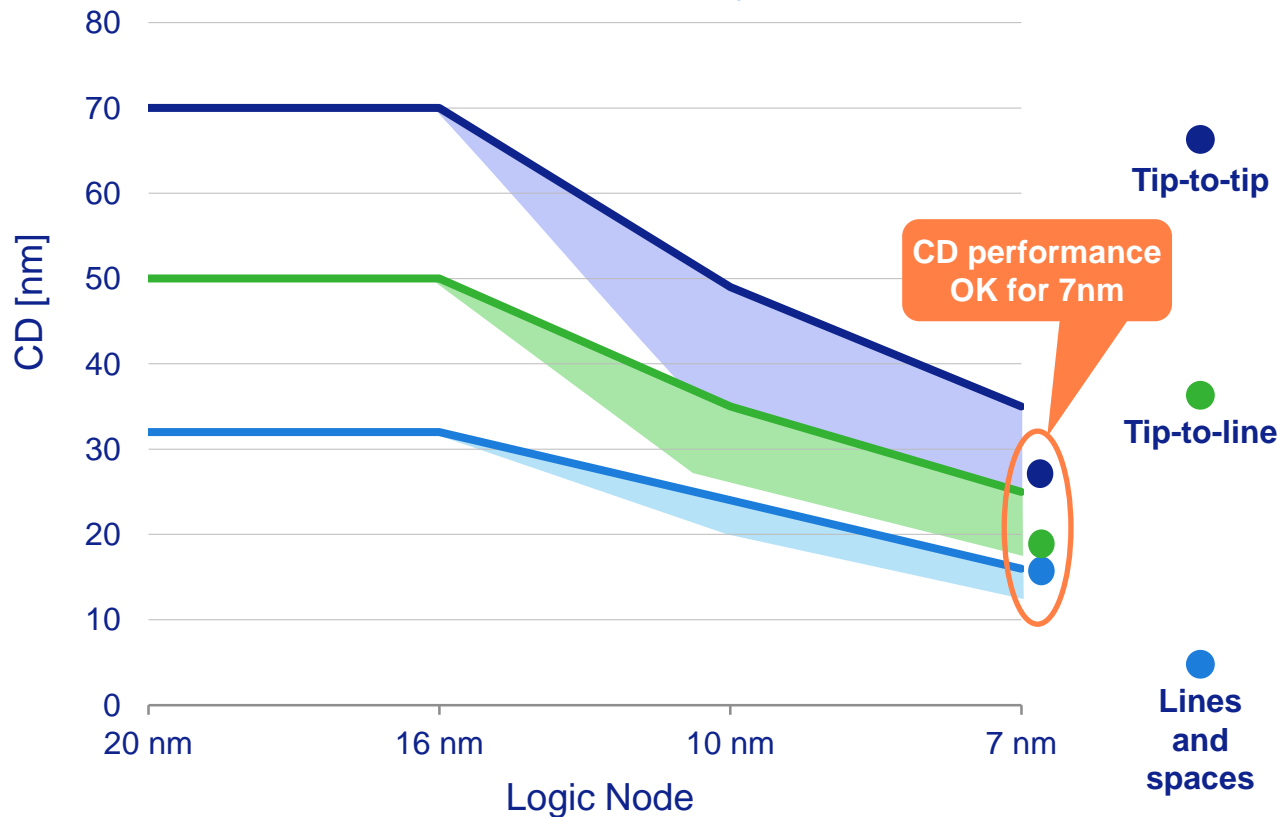


Wafer – Baseline controlled

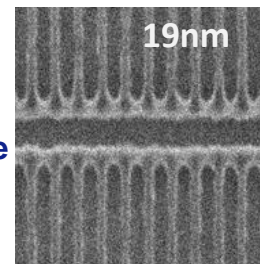
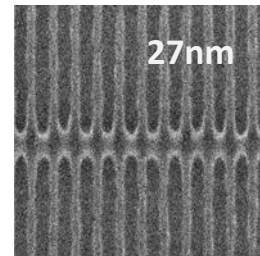
Customer B: 6par/field; field fingerprint and flyers removed

# Optical performance meets 10nm & 7nm requirements

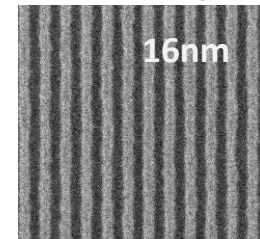
CD requirements by node



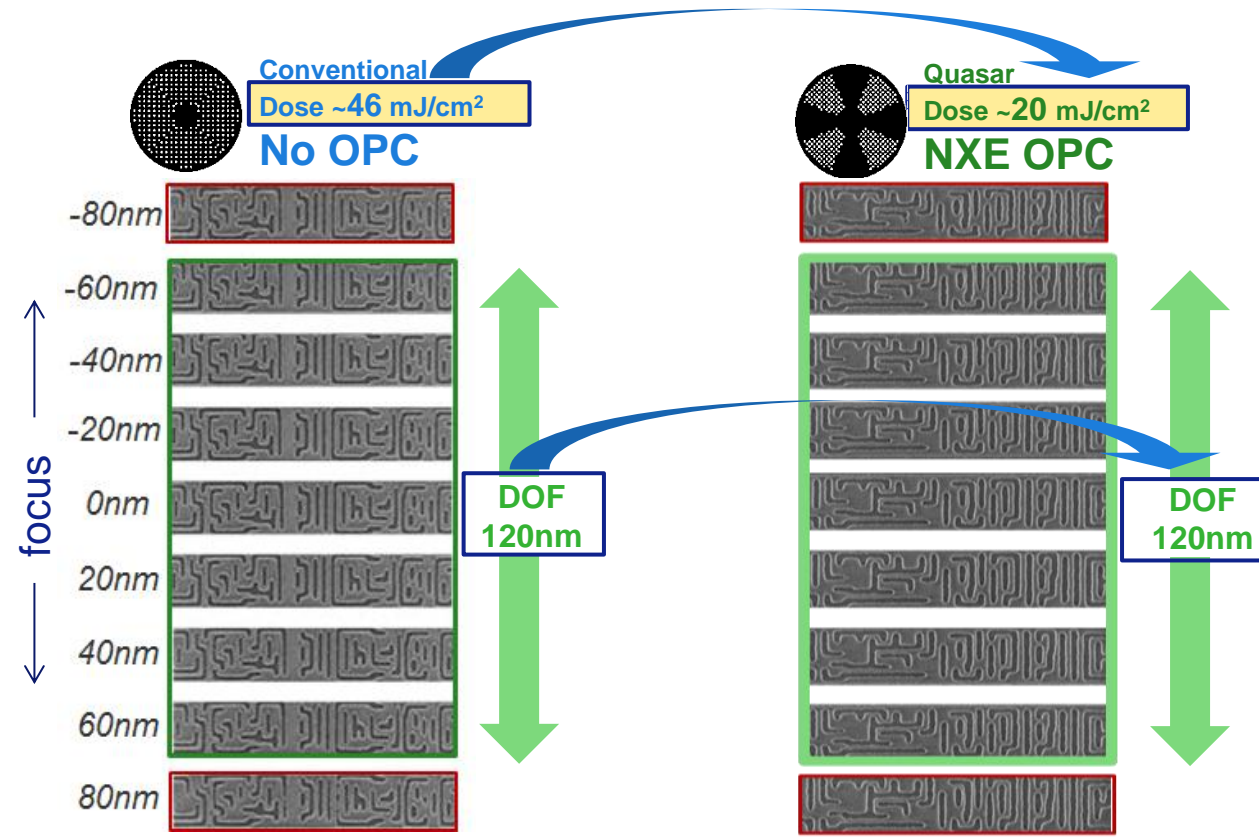
EUV (single expose)  
dose  $\sim 20\text{mJ}/\text{cm}^2$



dose  $\sim 45\text{mJ}/\text{cm}^2$



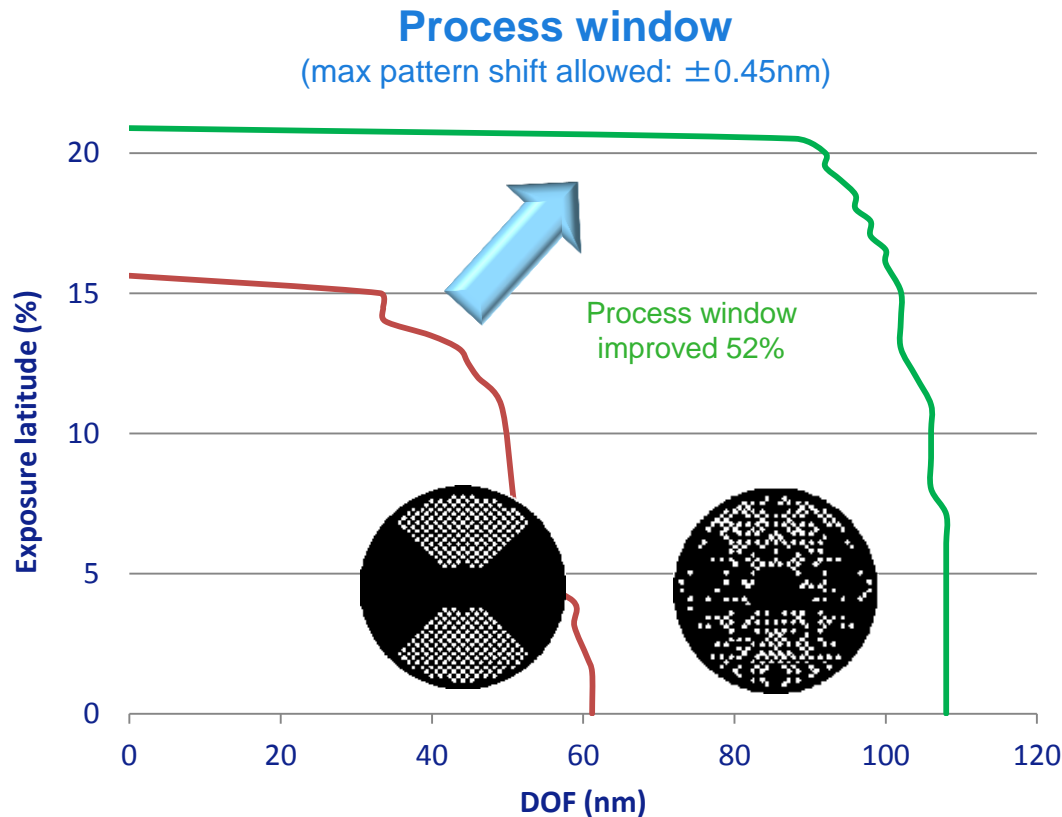
# Illuminator and mask optimization (Applications) allows productivity increase (lower dose) while maintaining imaging performance



NXE:3300B, 10nm logic metal 1 layer, 45nm pitch

OPC=Optical Proximity Correction  
DOF=Depth of Focus

# Source Mask Optimization and FlexPupil maximize process window (Holistic Applications)



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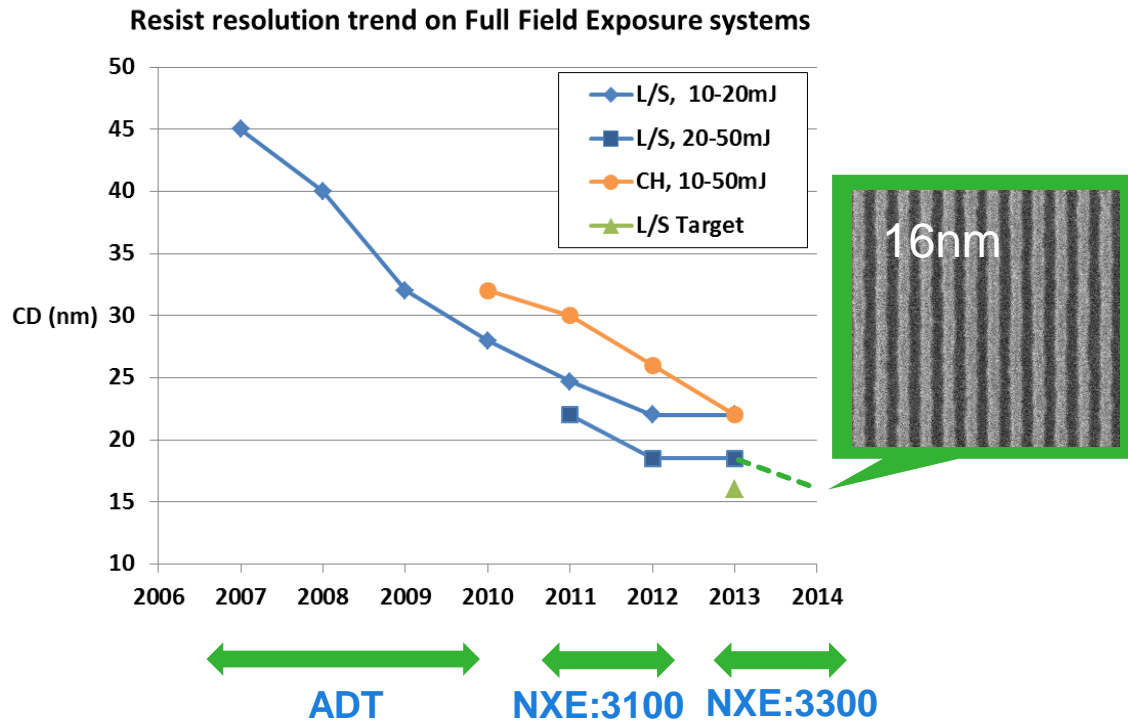
# EUV mask infrastructure viable for 10nm, improvements required for 7nm





# Photoresist progress on full field exposure systems

Resist is at an acceptable performance level for the 10nm chip generation



Resolution w/o post-processing

- C/H with <15% LCDU
- L/S with <20% LWR

Status L/S:

- 22nm OK
- No progress last year
- 16nm OK

Status C/H:

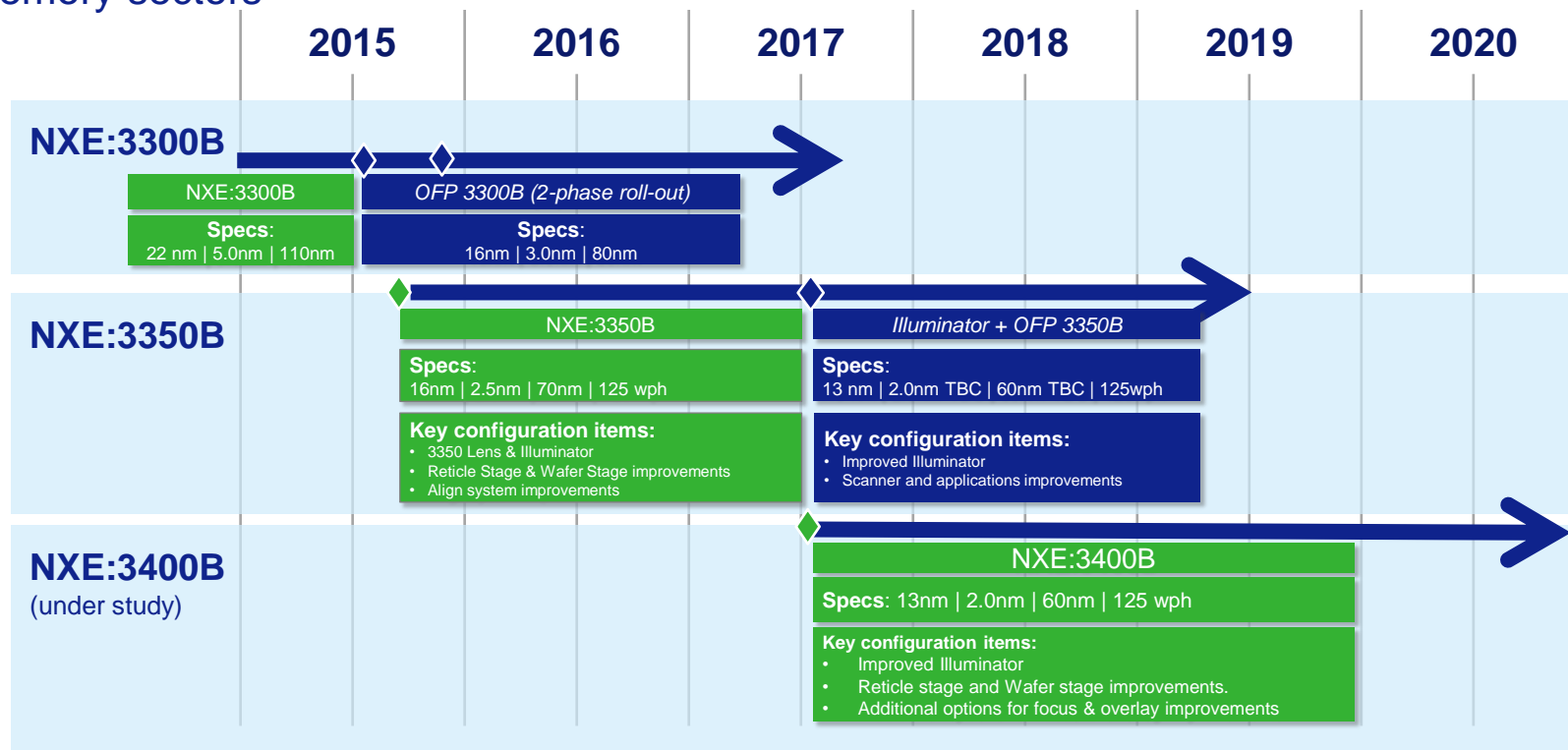
- 22nm OK

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# NXE product strategy includes extendability of installed base

Estimate 50-60 systems/year by 2020 based on broad adoption in both logic & memory sectors



Version Sep '14

**Product**  
Specs: Resolution | Matched Machine Overlay  
| Focus budget | Throughput

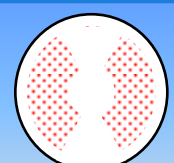
**Upgrade Product**  
Specs: Resolution | Matched Machine Overlay  
| Focus budget | Throughput



Product Release milestone  
green : system  
blue: upgrade

OFP=Overlay Focus Package

# EUV roadmap has extendibility through many nodes

|   |              |                            |              |              | Under study      |                          |                   |          |   |
|---|--------------|----------------------------|--------------|--------------|------------------|--------------------------|-------------------|----------|---|
| Node [logic]  |              | 22/20                      | 14           | 10           | 7                | 5                        | 5                 | 3        | 2   |
| Resolution HP [nm]                                    |              | 32                         | 27           | 22           | 16               | 13                       | 10                | 7        | <7  |
| Extend NA 0.33 to below 10nm                          | Lens         | NA                         | 0.25         |              | 0.33             |                          | 0.33NA DPT        |          |   |
|   |              | flare                      | 8%           |              | 6%               | 4%                       |                   | >0.50 NA |   |
| Improved lens and illuminator performance             | Illumination | coherence                  | $\sigma=0.5$ | $\sigma=0.8$ | $\sigma=0.2-0.9$ | Flex-OAI                 | Extended Flex-OAI |          |   |
|   |              |                            |              |              |                  | reduced pupil fill ratio |                   |          |   |
| Imaging / Overlay performance match node requirements | Overlay      | DCO [nm]                   | 7            | 4.0          | 3.0              | 1.5                      | 1.2               | 1.0      | <br>pupil fill ratio defined as the bright fraction of the pupil |
|   |              | MMO [nm]                   | -            | 7.0          | 5.0              | 2.5                      | 2.0               | 1.7      |   |
| Increased throughput at higher dose                   | TPT (300mm)  | Dose [mJ/cm <sup>2</sup> ] | 5            | 10           | 15               | 20                       | 20                | 20       |   |
|   |              | Power [W]                  | 3            | 10 - 105     | 80 - 250         | 250                      | 250               | 500      |   |
|   |              | Throughput [w/hr]          | -            | 6 - 60       | 50 - 125         | 125                      | 125               | 165      |   |

# “WHEN” not “IF”

- Customers have different approaches & criteria regarding adoption of new technology which provides differences in exact timing of “WHEN” EUV will go to volume production
  - EUV will be used in 10nm Logic, systems 2H15 for 2016 production
- EUV is making good progress on WPD roadmap
  - 500wpd demonstrated at multiple customers
  - Roadmap in place to deliver 1500 WPD in 2016 when this performance is needed in manufacturing
  - Continuing to focus on consistency to drive Availability to >90%
- EUV imaging & overlay performance meeting customer requirements for 10nm and 7nm nodes
- EUV infrastructure making significant progress, currently acceptable for 10nm node. Improvements required for volume production at 7nm node
- EUV roadmap in place to provide extendibility into next decade
- Estimated 50-60 systems per year by 2020 based on broad adoption in both logic & memory sectors

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