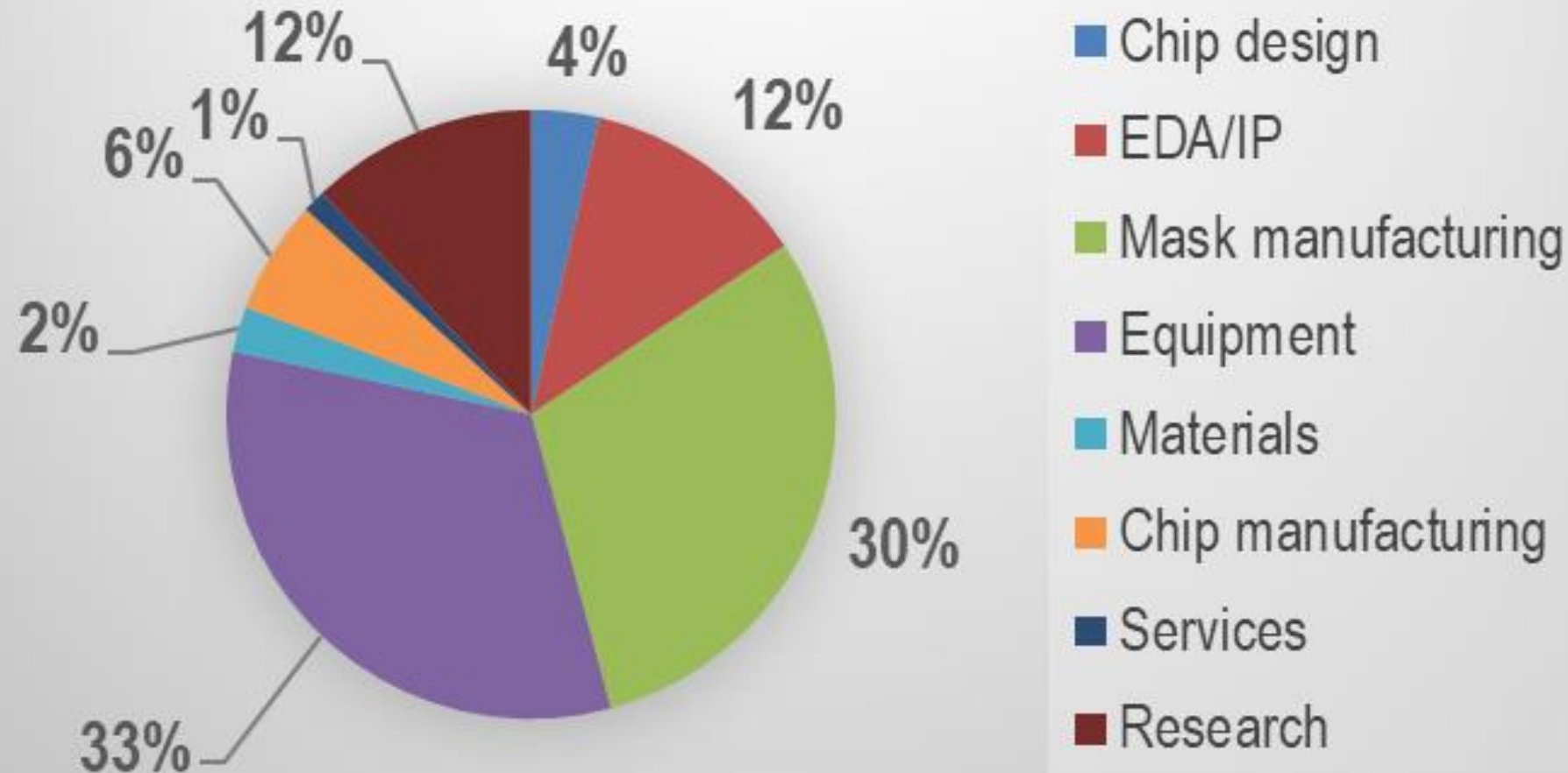


# 84 Luminaries Participated in the 13<sup>th</sup> Annual Survey

Representing 49 different companies in July 2024

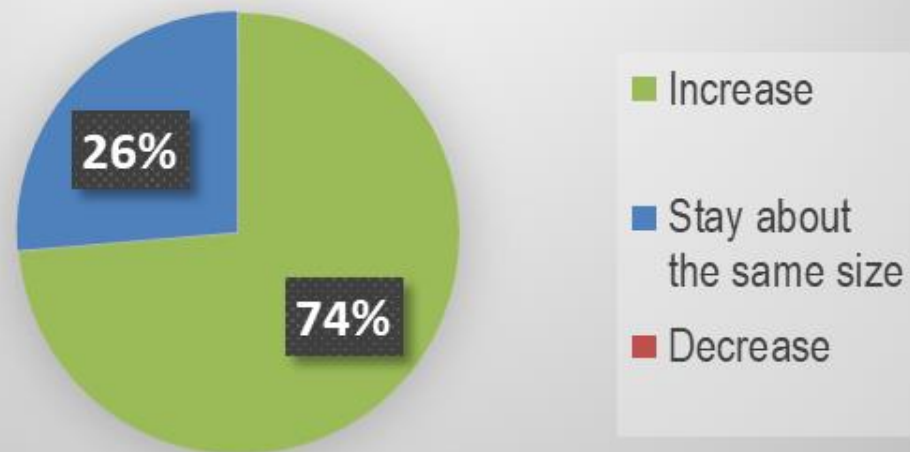
What part of the semiconductor ecosystem  
is your primary focus?



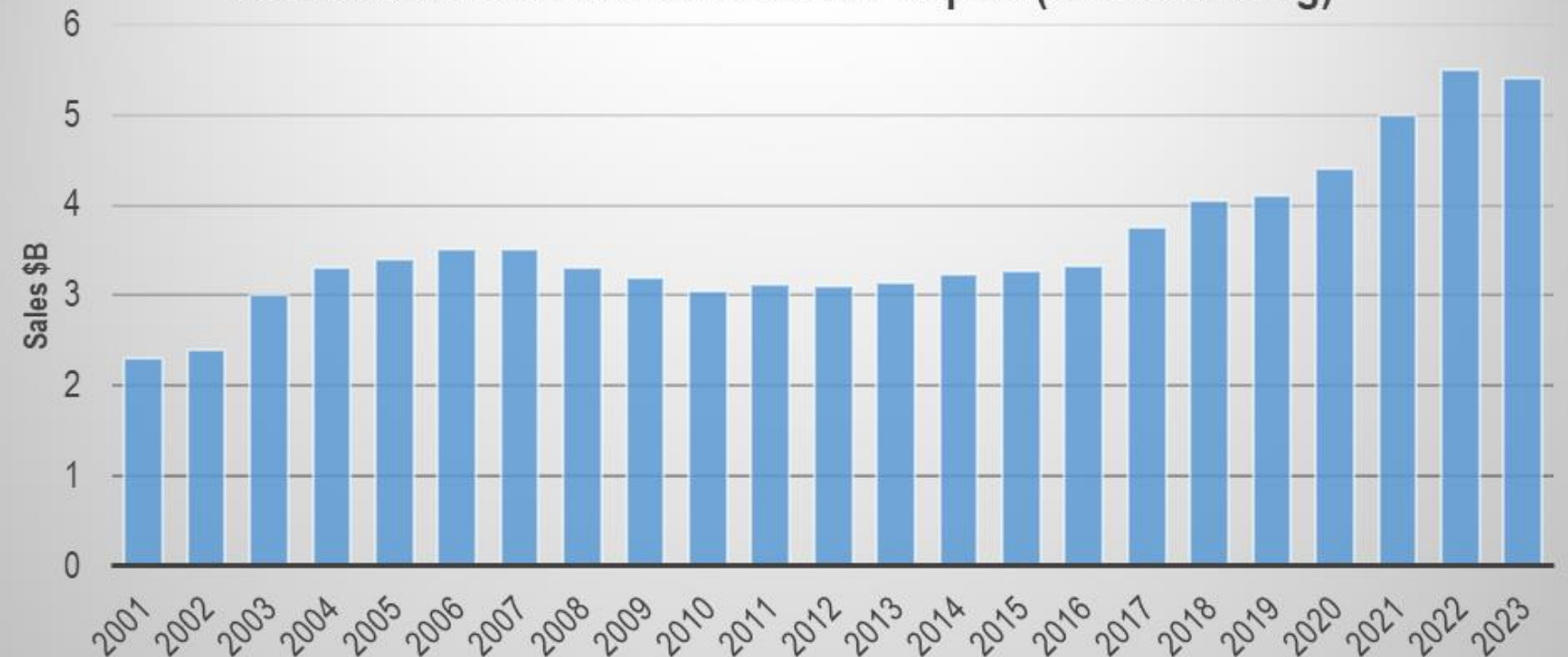
# 74% Say 2024 Mask Revenues Will Increase Over 2023

SEMI reported \$5.4B for 2023 – 7.2% CAGR since 2016!

Net of all effects, what will happen to the size of the 2024 total mask revenues compared to 2023? n=76

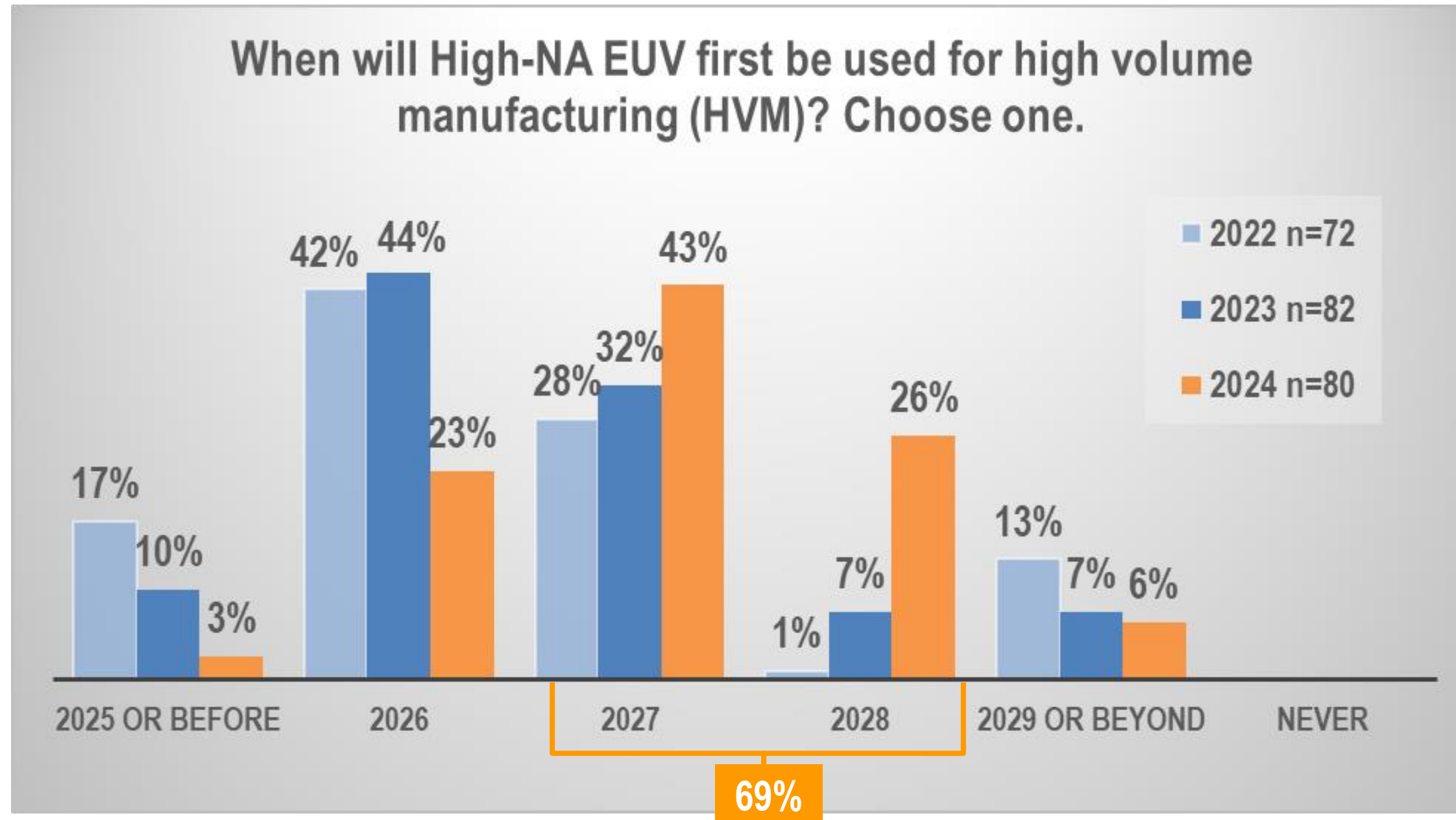


SEMI: Photomask Market 2001-2023  
SEMI Photomask Characterization Report ([www.semi.org](http://www.semi.org))



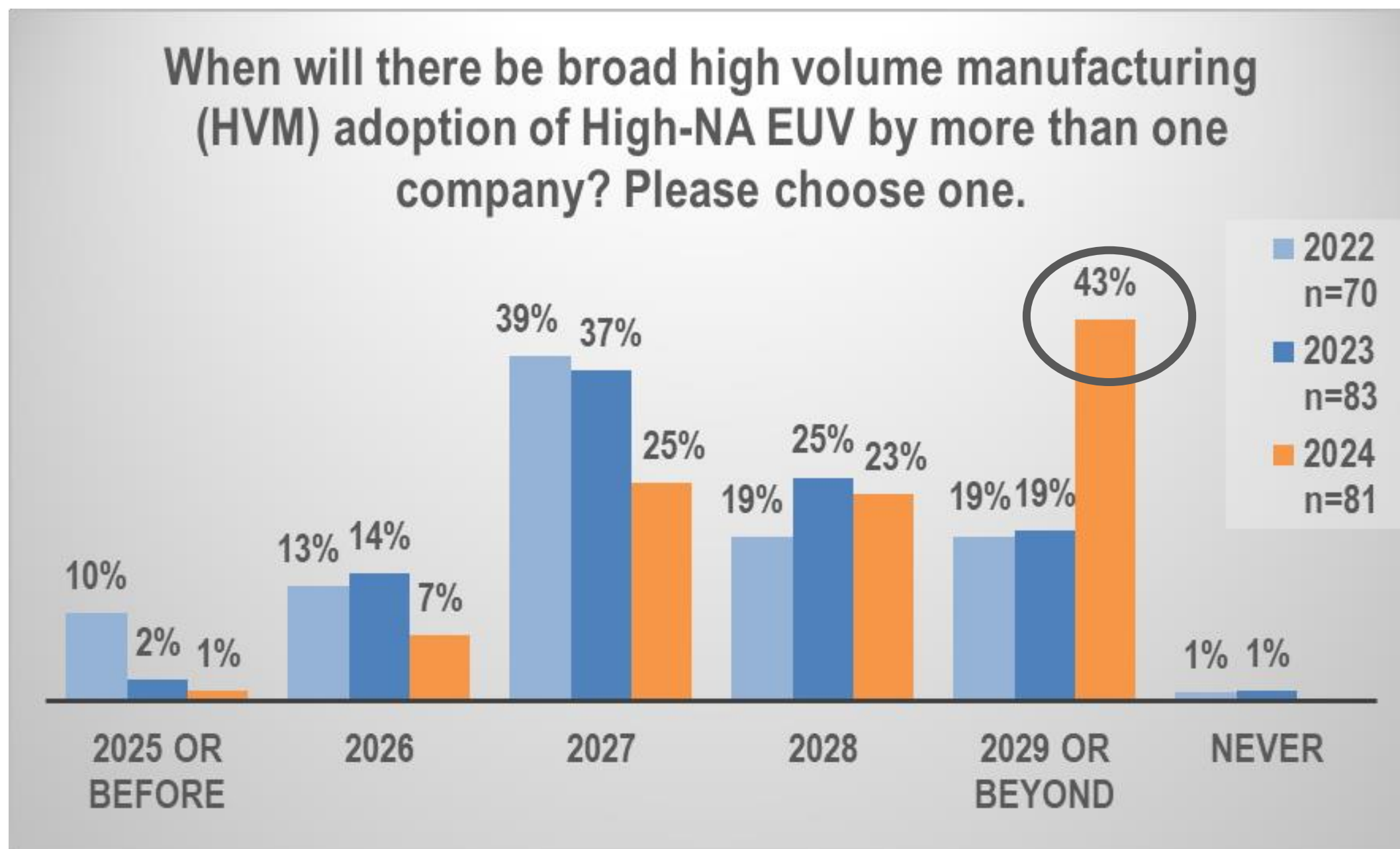
# Opinion for High-NA EUV First HVM Usage is Clearer

69% of Luminaries say 2027 or 2028

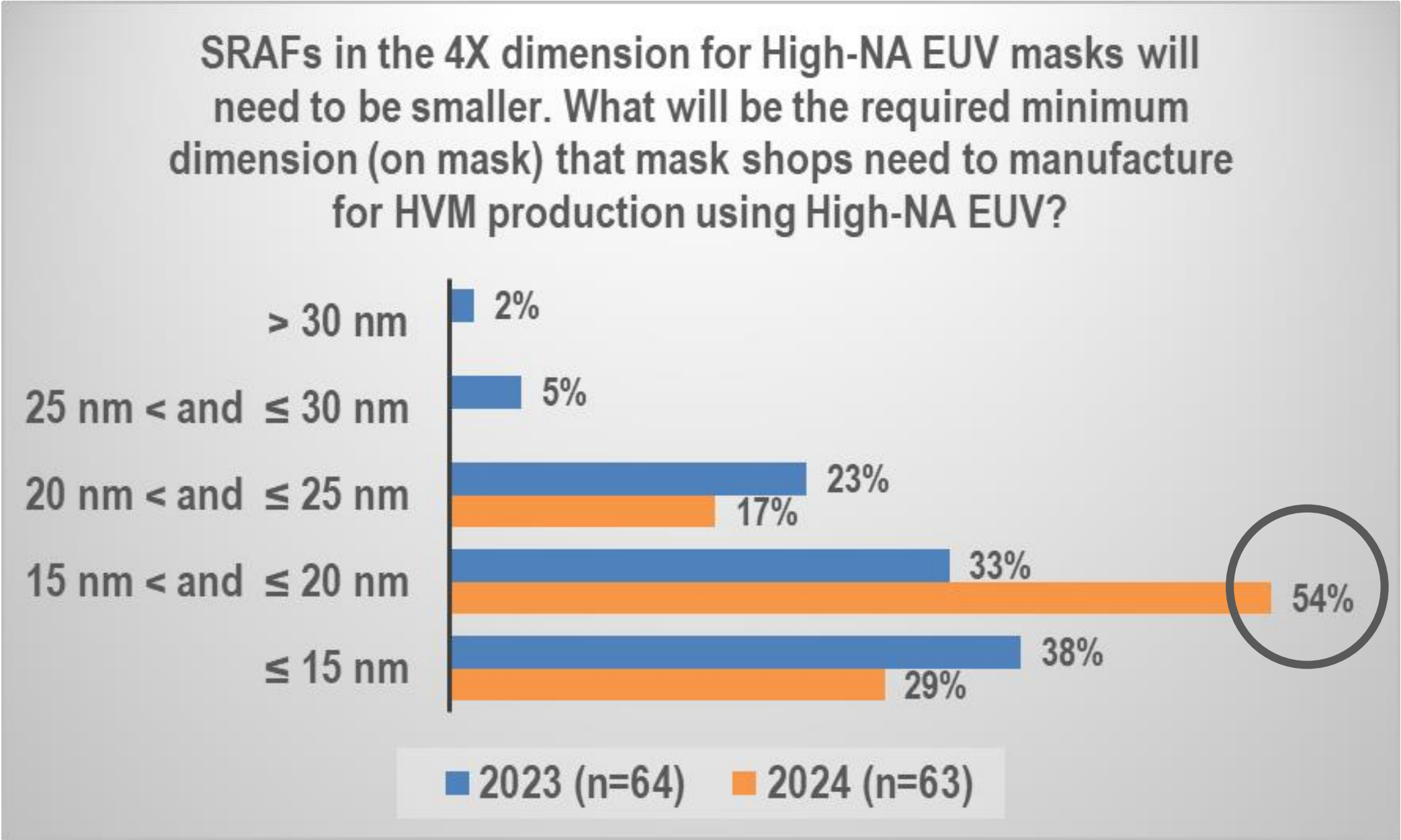


# Estimates of High-NA EUV Broad Usage Shift to 2029 or Beyond

19% said that in 2023 and 43% in 2024, but no one says “never”



54% Say Min Mask Dimension High-NA EUV >15nm and ≤20nm  
33% said that in 2023



# New Questions on Stitching for High-NA EUV Masks

81% Disagree with “stitching won’t be a problem”

73% Agree some layout constraints acceptable to designers to avoid stitching

83% Agree stitching portion requires different design rules

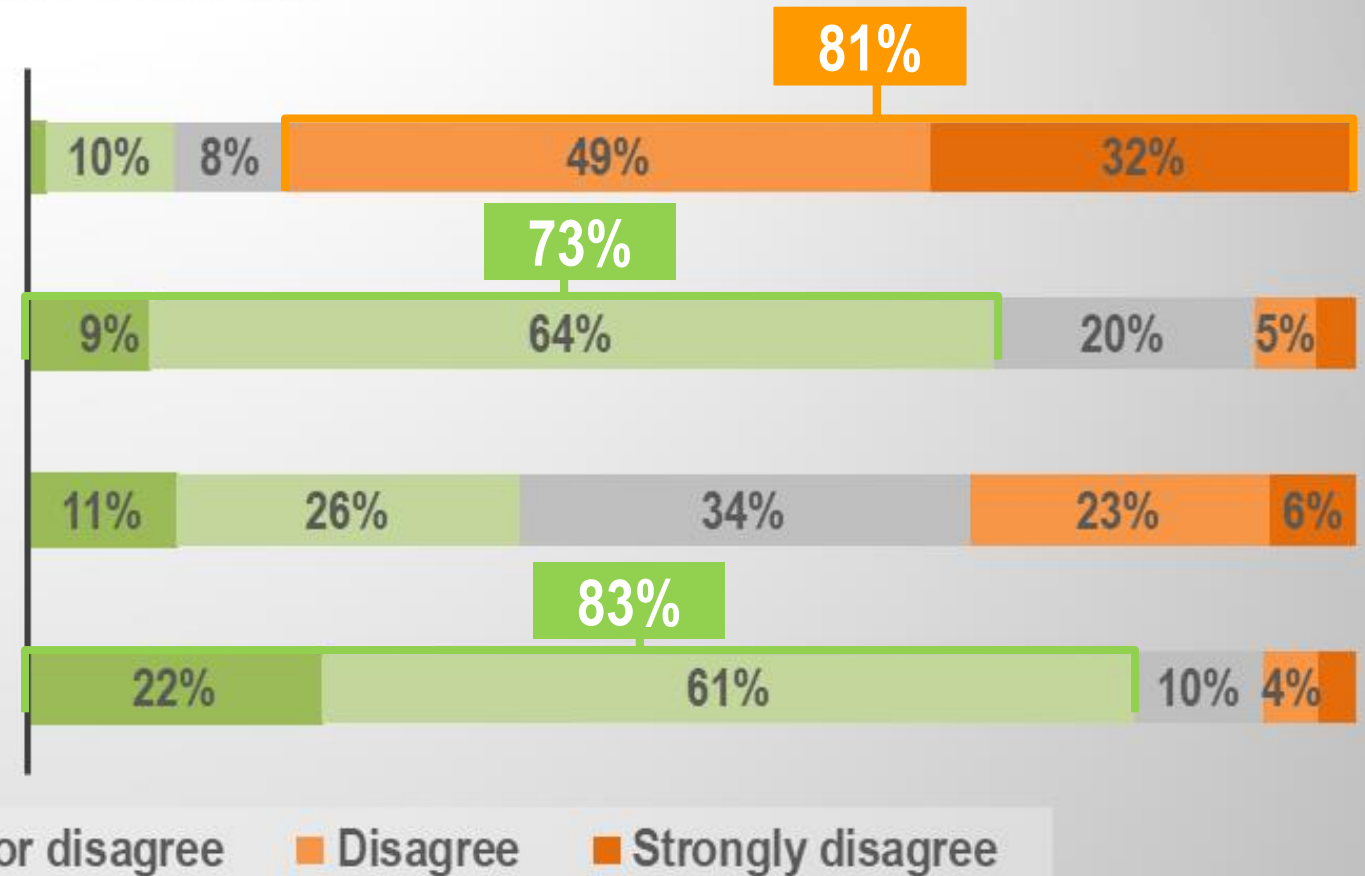
Please indicate your level of agreement or disagreement with the following statements:

Stitching won't be a problem. Designers will be able to design without knowing about the half-field boundaries. n=72

Some layout constraints, for example in floor planning, may be required to avoid stitching of minimum width features across stitching boundaries, but they will be acceptable to the designers. n=66

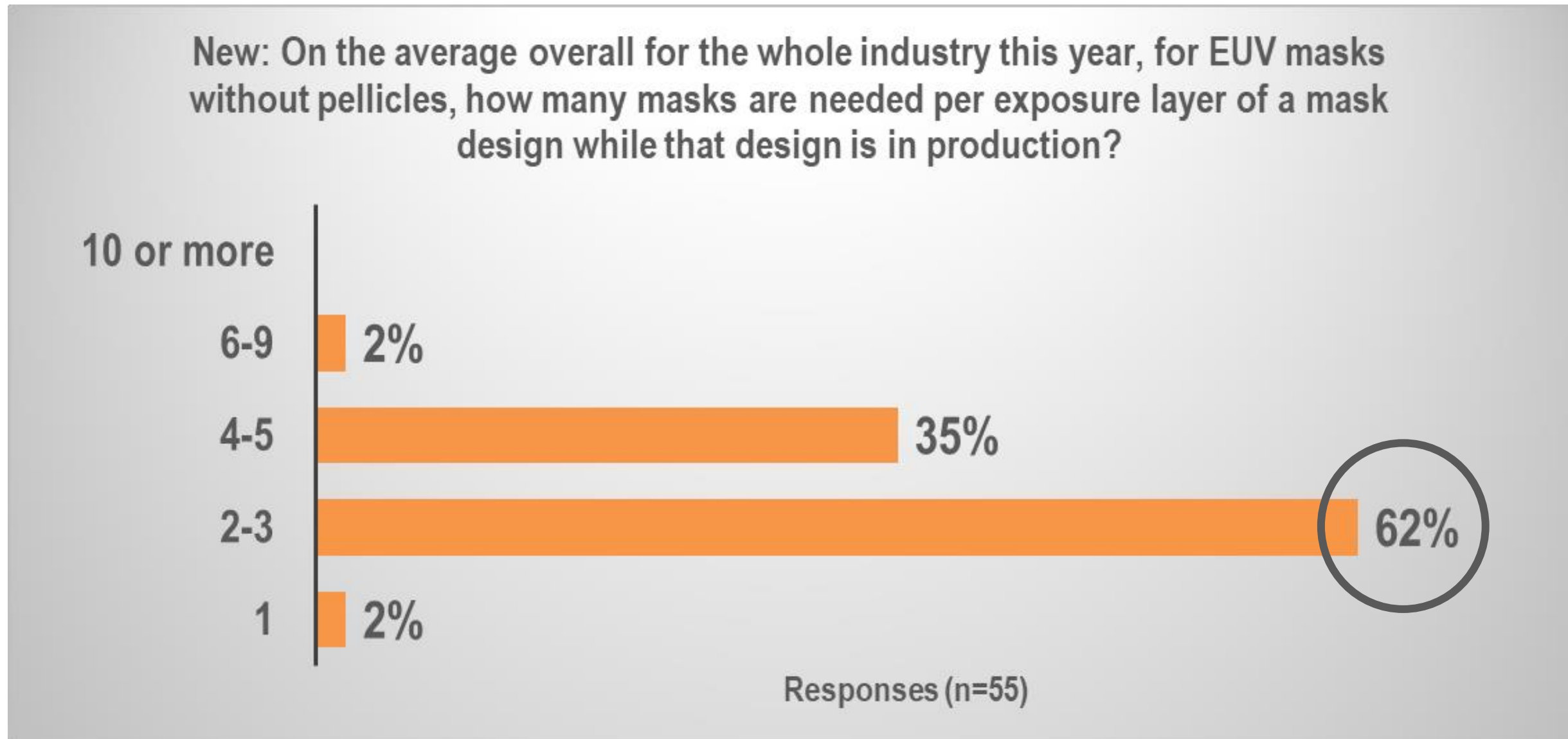
Restricting metal 1 and below layers not to have features crossing half-field boundaries will be acceptable to designers. n=62

No matter how great a solution, stitching across the half fields will require the design rules to be wider/different for the features crossing the half-field boundaries. n=72



# 62% Say 2-3 EUV Masks Per Layer Needed if No Pellicles

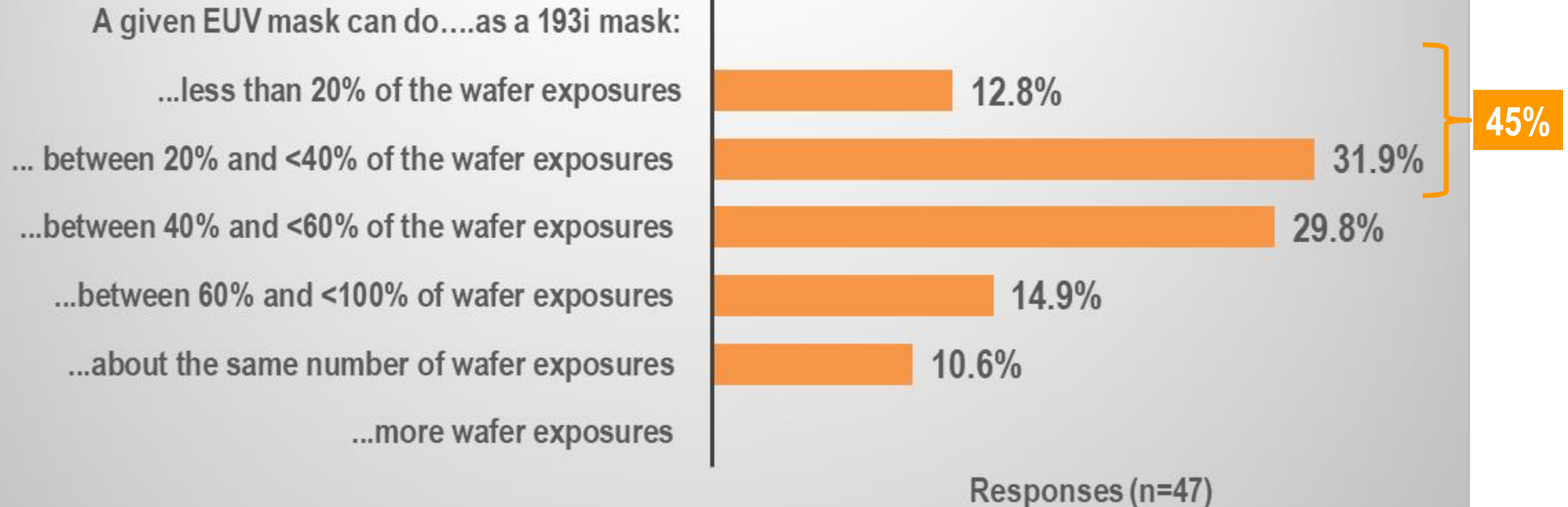
While design is in production (question reworded from 2023)



# 45% Say EUV Masks w/o Pellicles Have <40% Lifetime of 193i

New question (n=47) asks about pellicle impact on lifetime

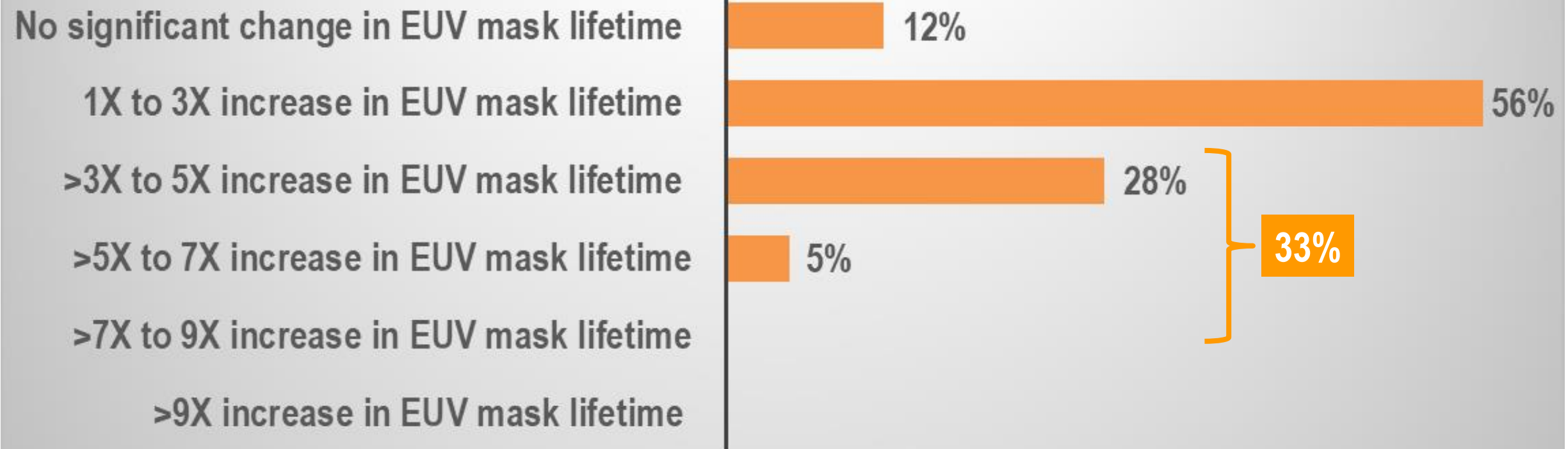
New: Relative to 193i mask lifetime (based on the number of wafer exposures), what is the average EUV mask lifetime (without pellicles) today?



# 33% Say Pellicles Increase EUV Mask Lifetime at least 3X

New question in 2024 (n=43)

New: How much does a pellicle affect EUV mask lifetime today?



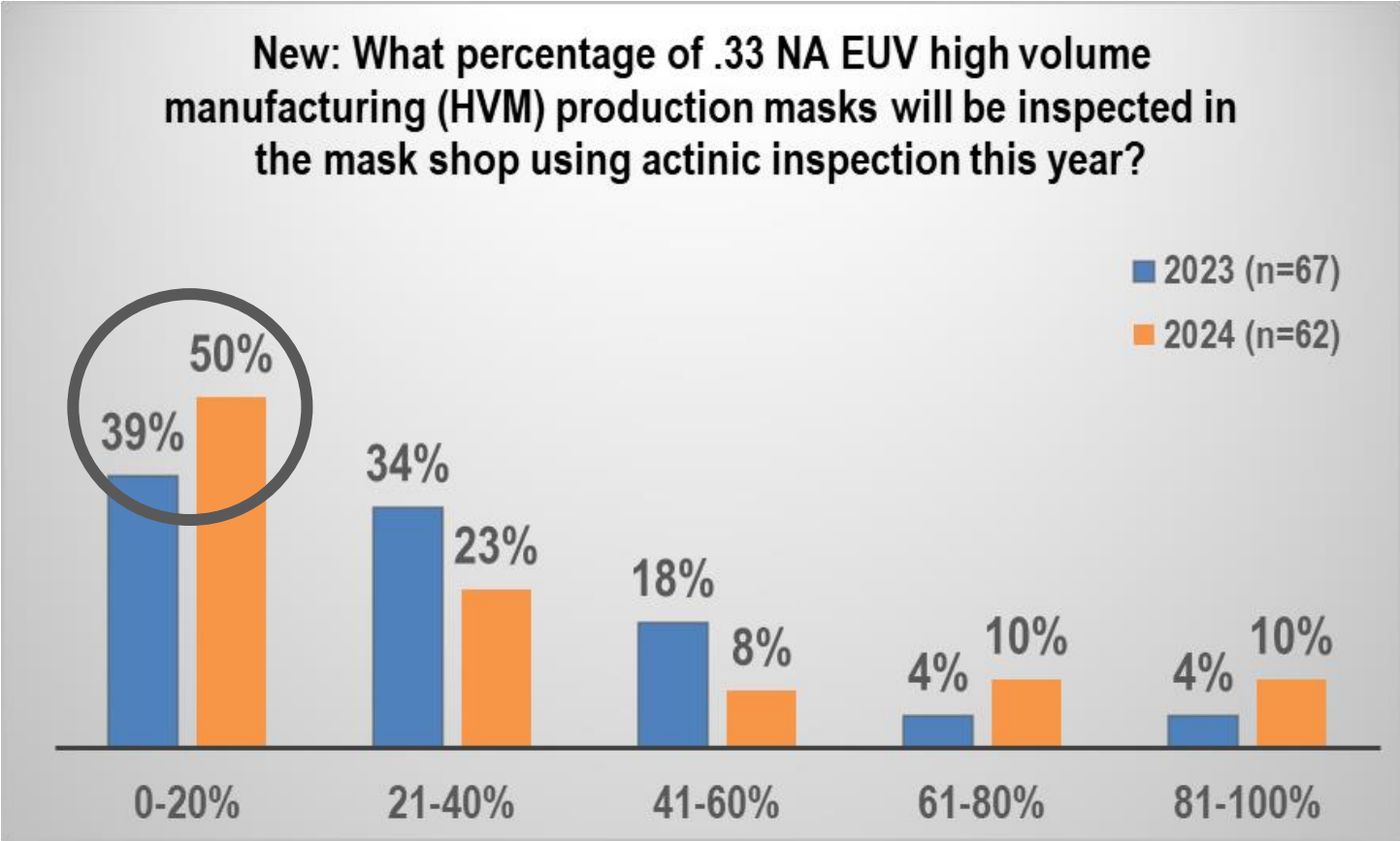
Responses (n=43)

# Opinions on Actinic EUV Mask Inspection Clear for Today

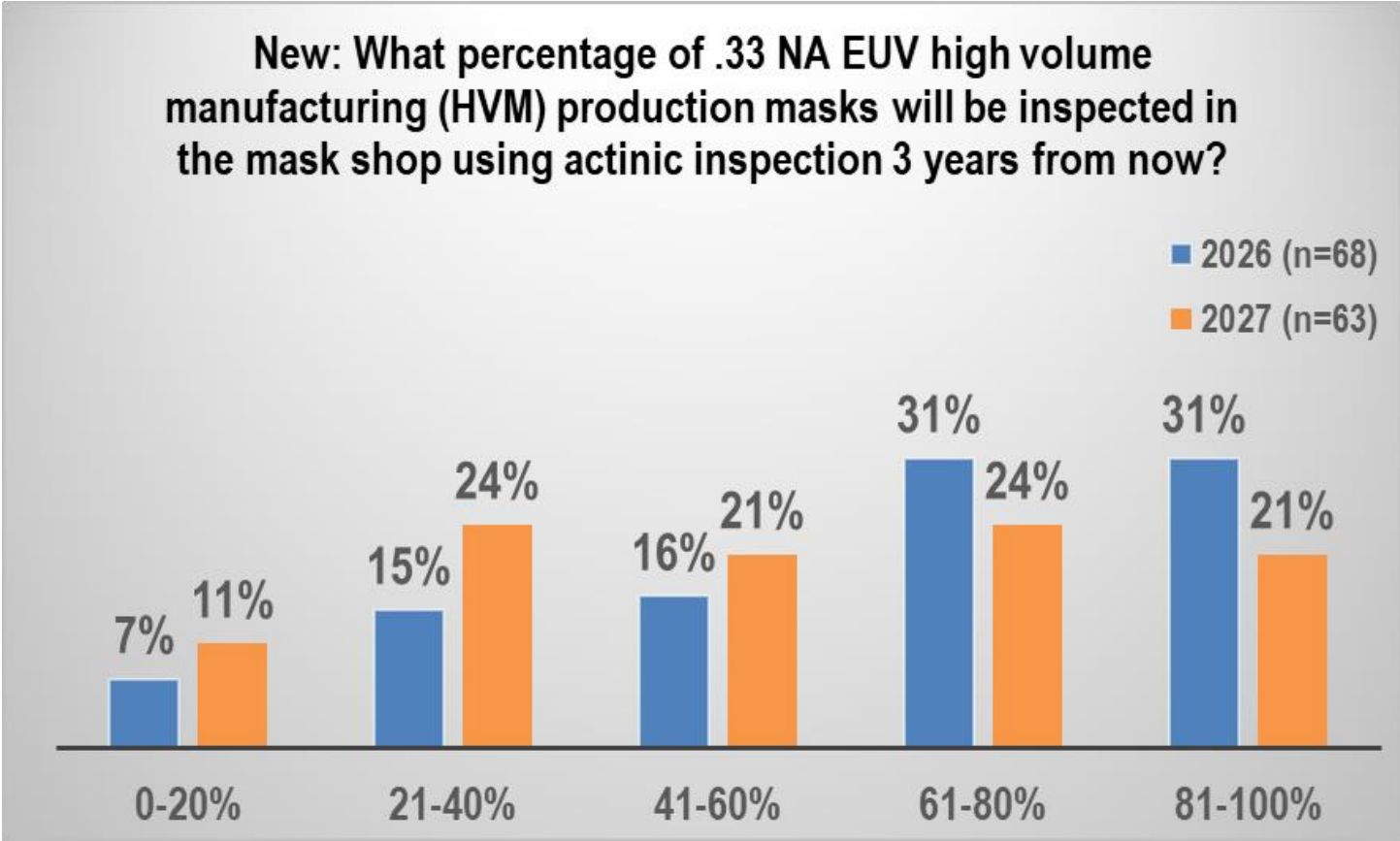


50% say  $\leq 20\%$  of HVM masks vs 39% last year; no clear trend in 3 years

## Predictions for Today

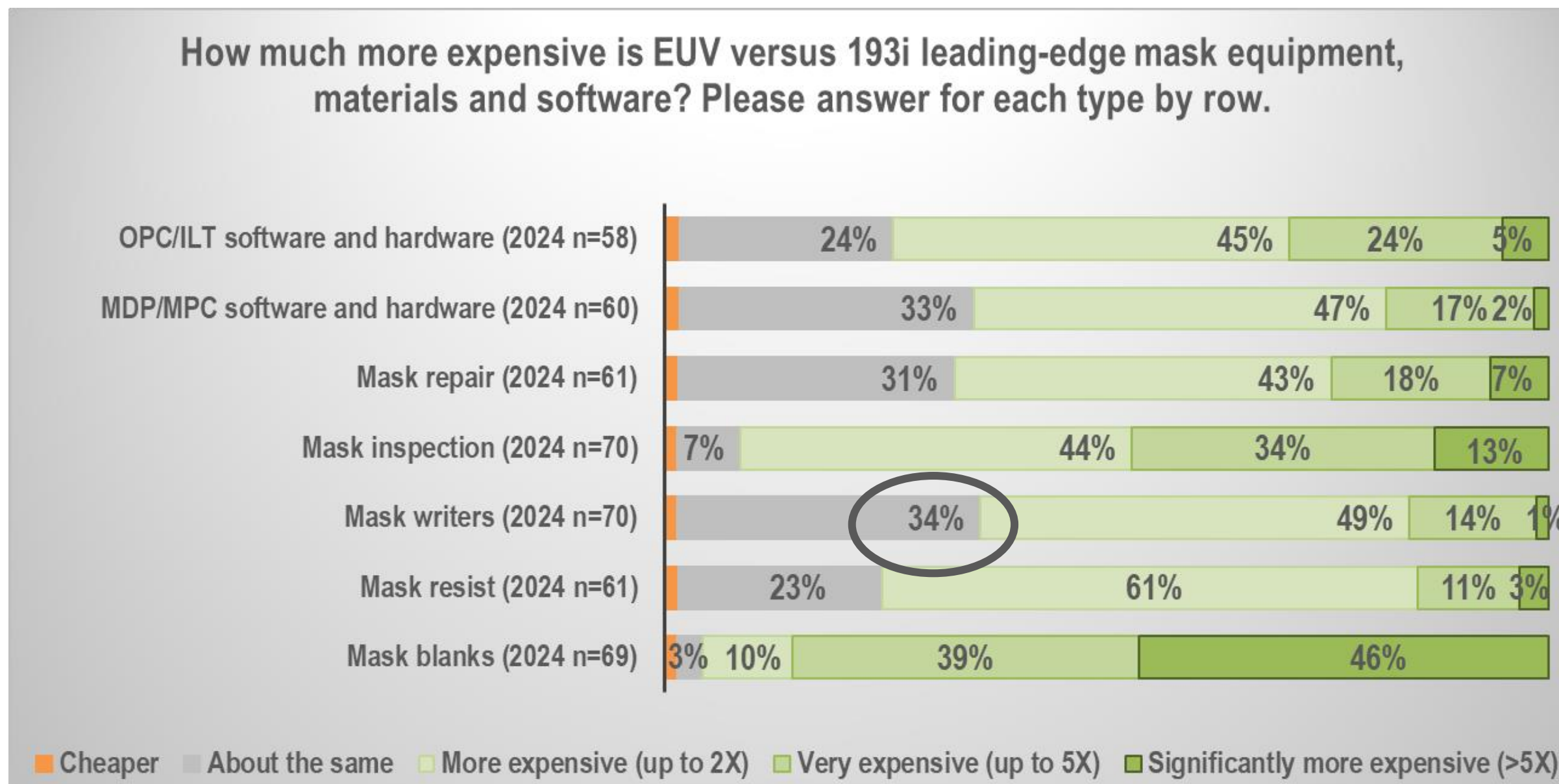


## Predictions in 3 Years



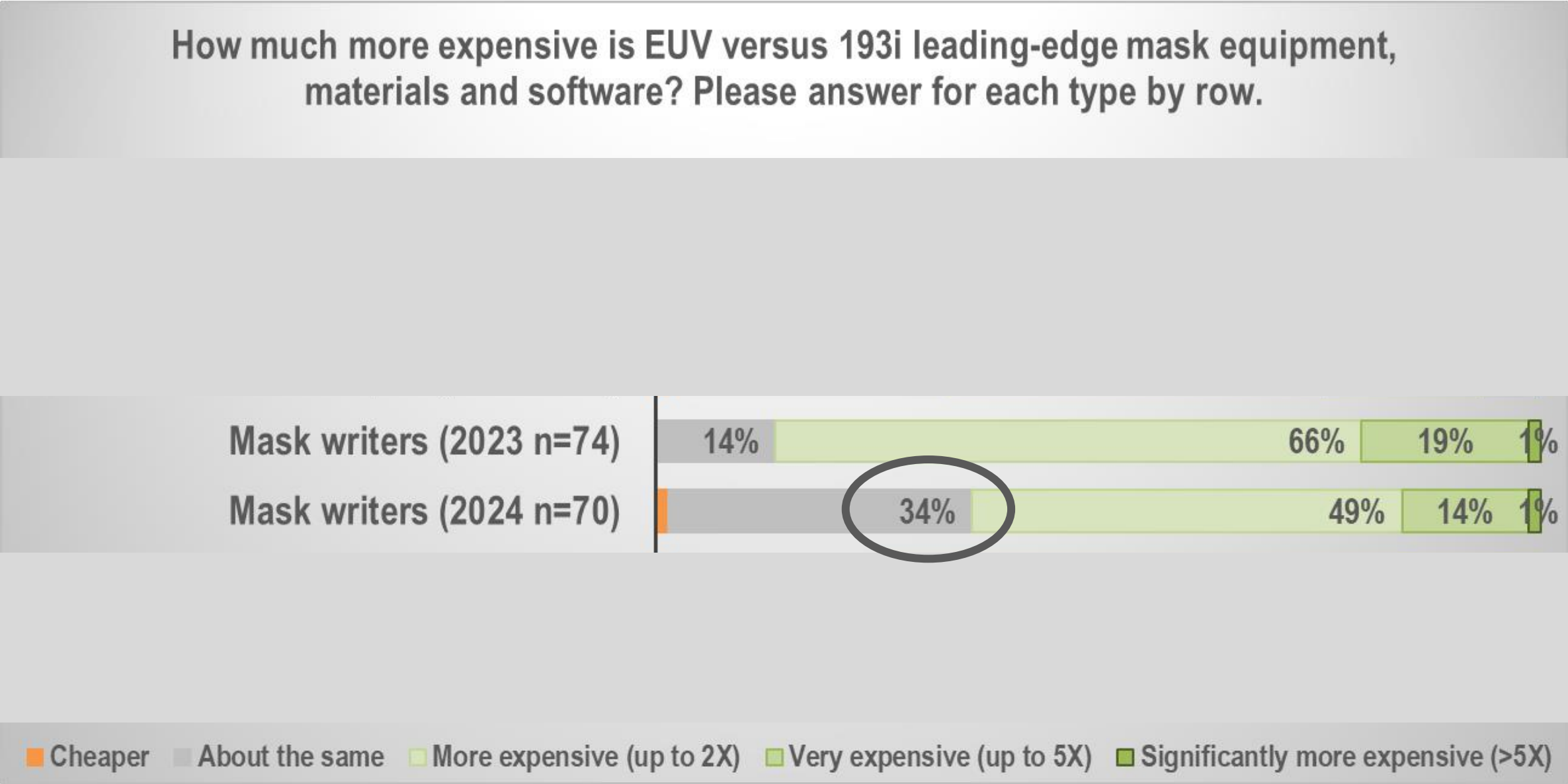
# Overall Trend for EUV > 193i Mask Costs Unchanged

Opinion that mask writers are about the same cost increased to 34% from 14%



# Overall Trend for EUV > 193i Mask Costs Unchanged

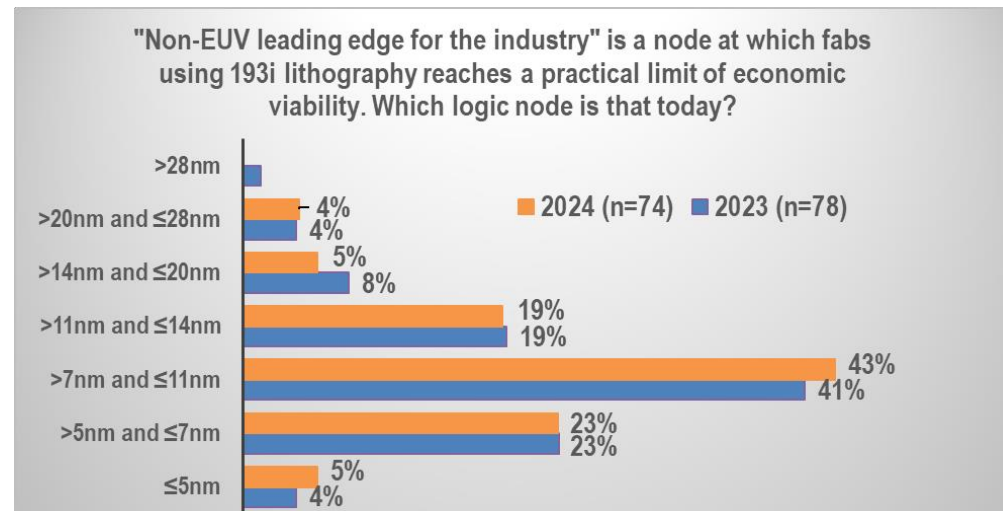
Opinion that mask writers are about the same cost increased to 34% from 14%



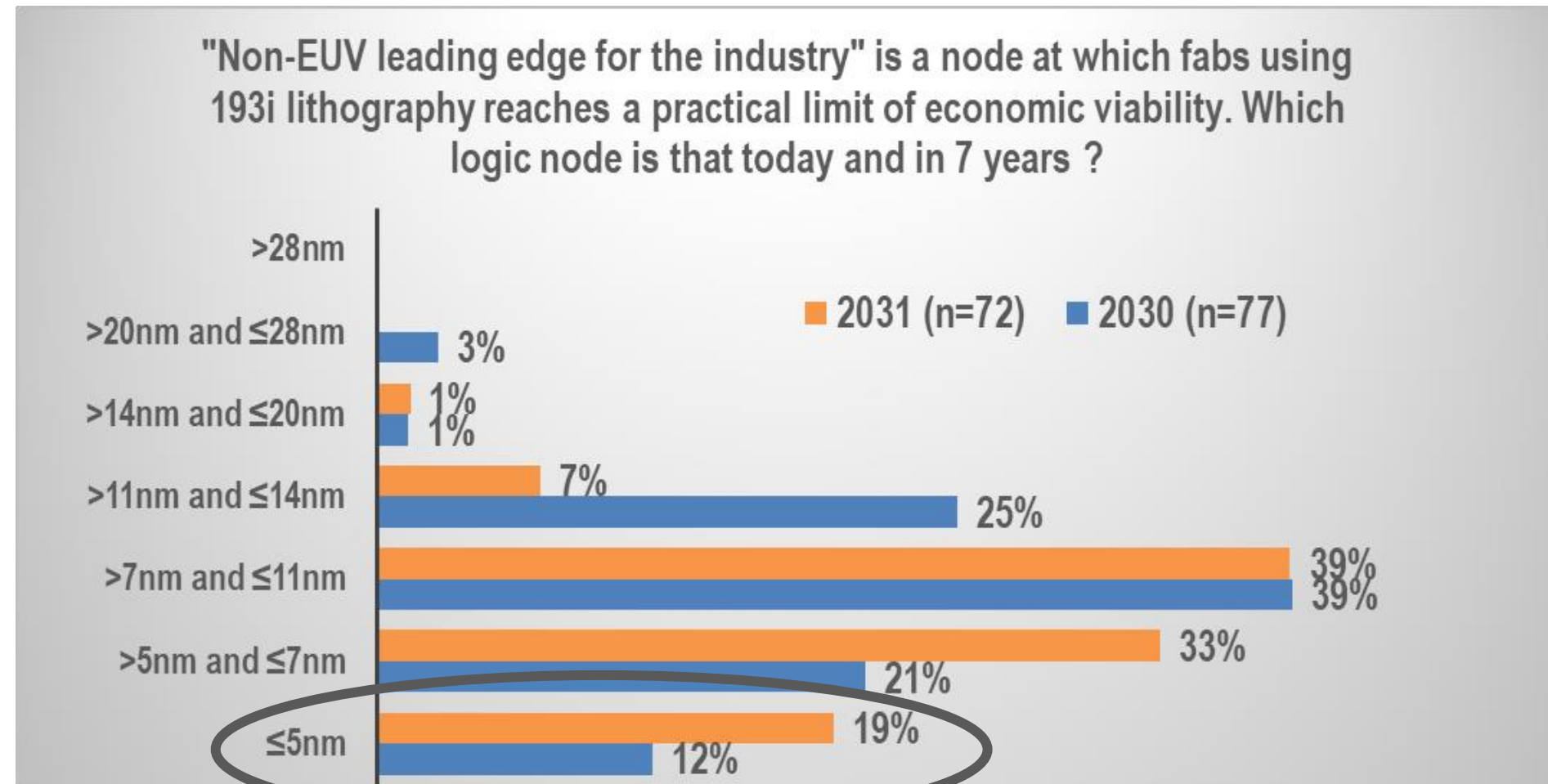
# Confidence Increased: Fabs w/o EUV Can Reach $\leq 5\text{nm}$ in 7 Years

19% say  $\leq 5\text{nm}$  vs 12% who said that last year

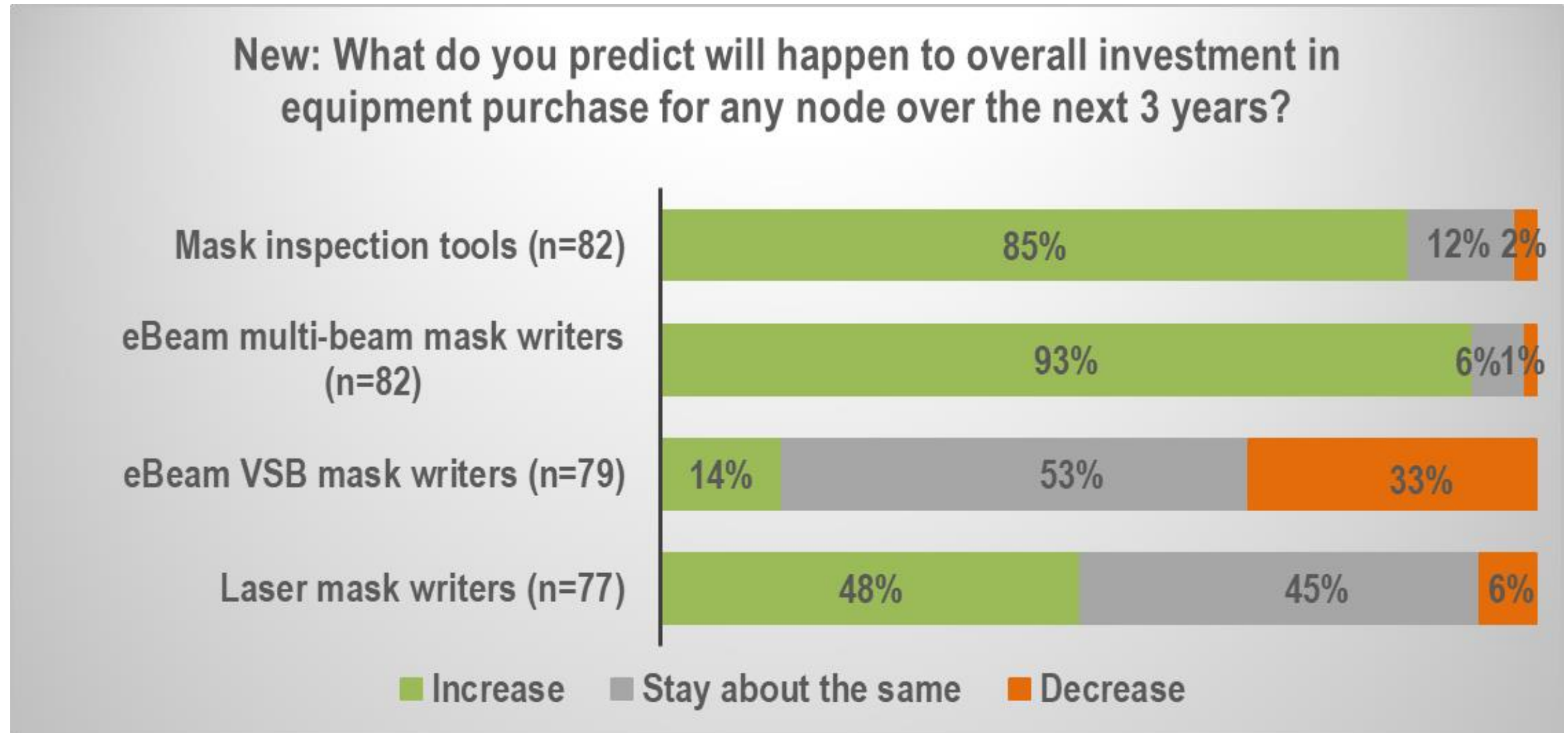
## “Today”



## “In 7 Years”



# Mask Inspection, Multi-beam and Laser Mask Writers: Positive Outlook for Purchasing New Equipment for Any Node\*

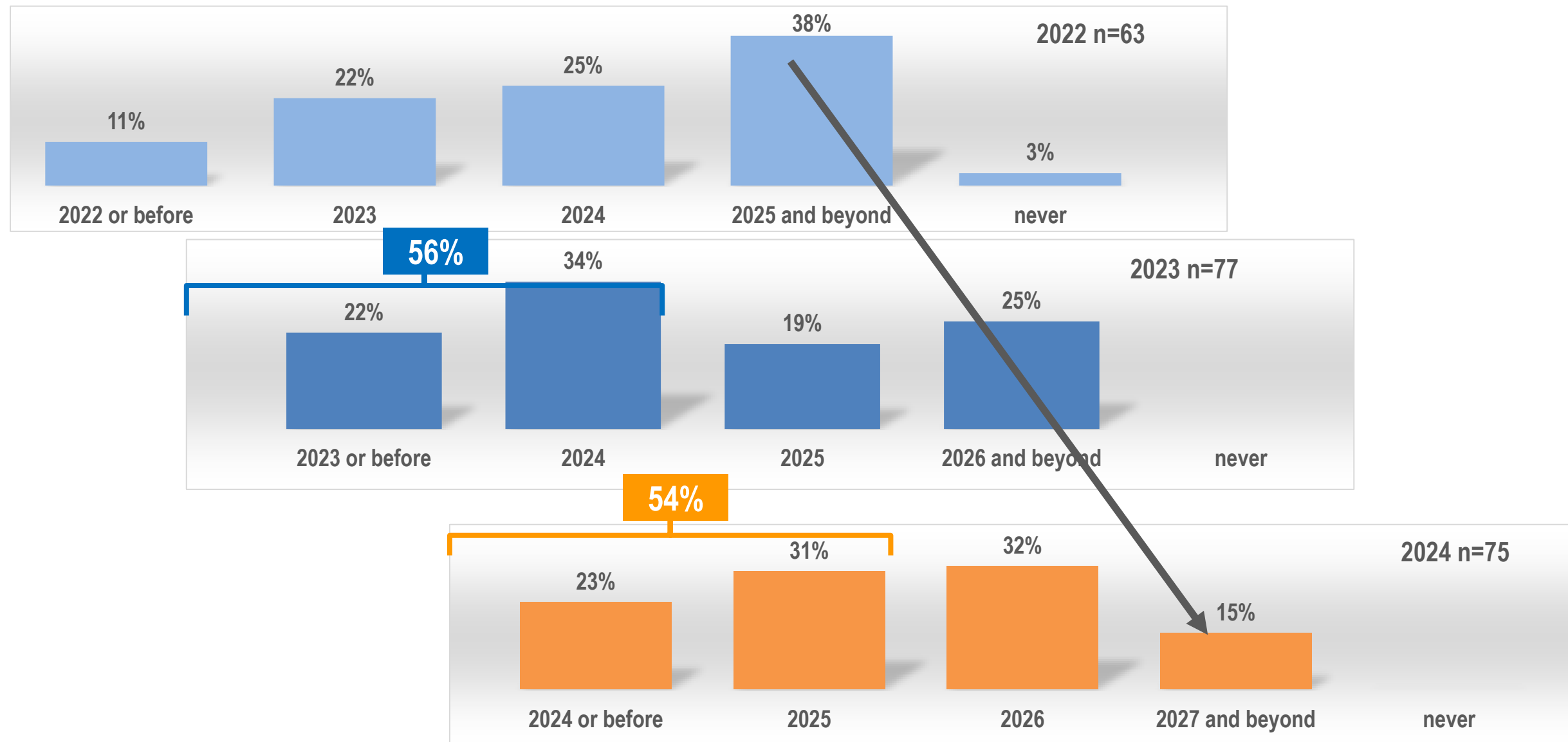


\* Note: Question was changed from last year which asked about 193i only purchases

# Predictions of Deep Learning Adoption Slip A Year

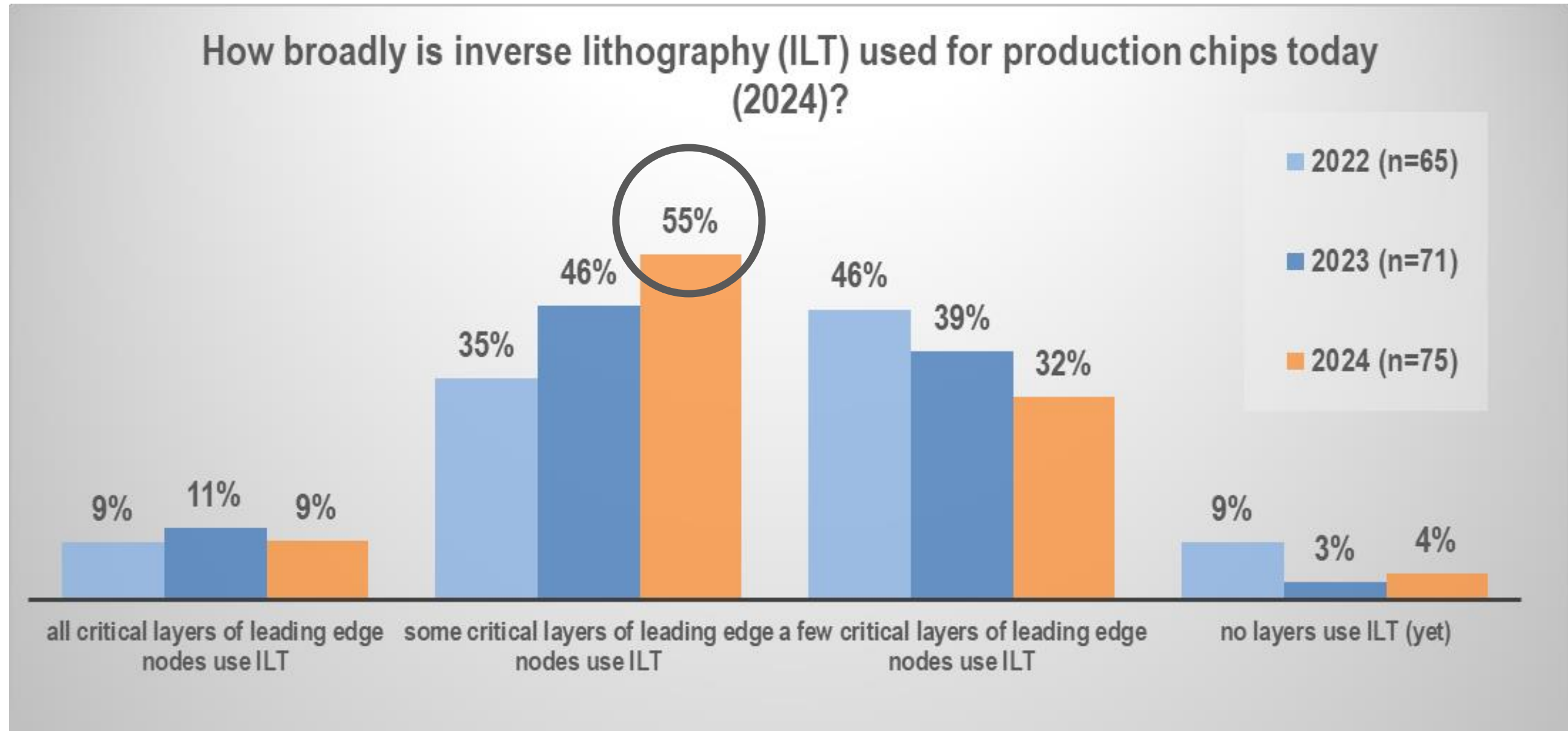
However, “three years from now” trend has decreased from 38% to 15%

In the mask industry, when will capabilities based on deep learning become a competitive advantage for any step in the mask making process?



# Survey Results Point to More Critical Layers Using ILT

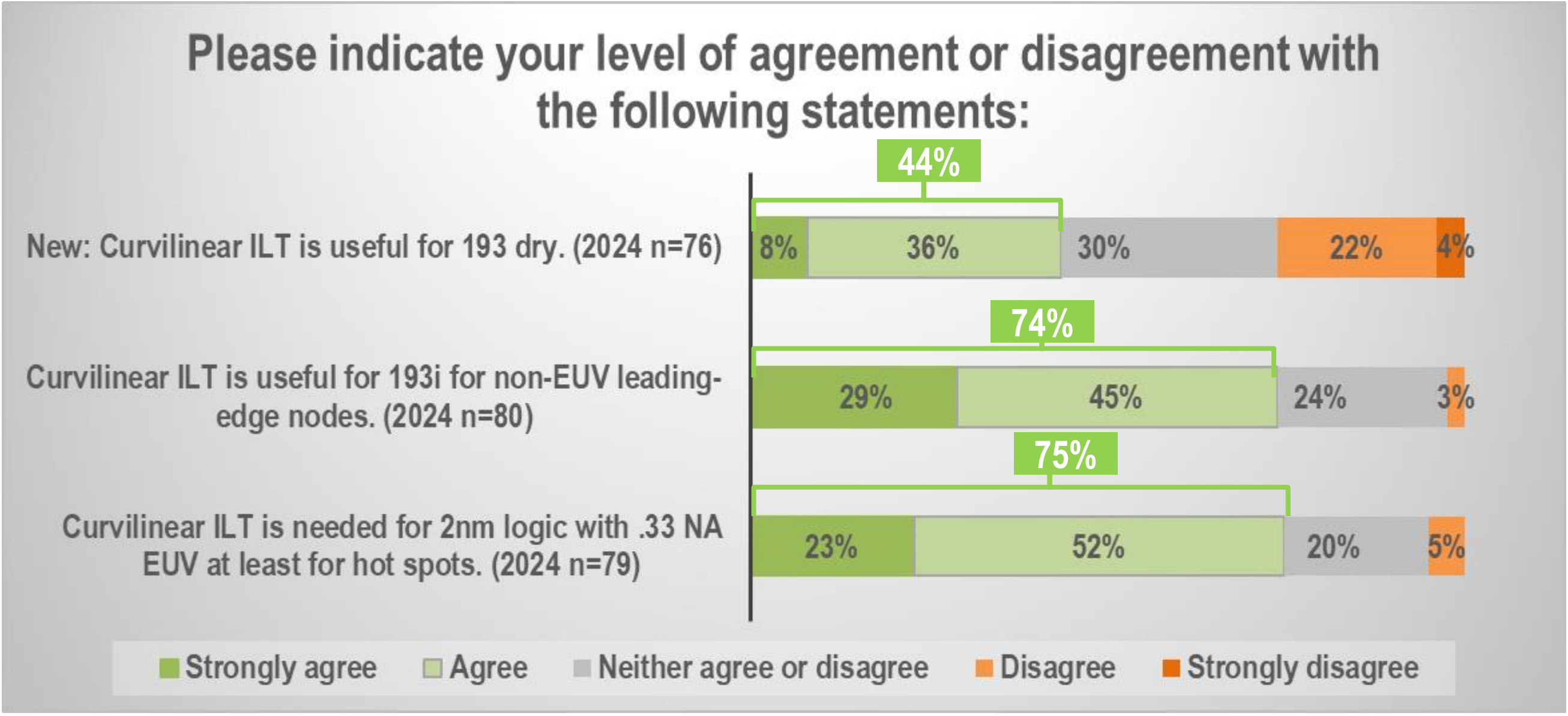
55% say “some critical layers” in 2024 vs 46% in 2023



Note: Repeat question since 2017 but only showing most recent 3 years in this chart

# New Question: 44% Agree Curvilinear ILT Useful for 193 Dry

74% “agree” useful for 193i, “strongly agree” up 5% to 29%; EUV is similar to 2023



# Mask Shop Software Infrastructure Top Curvilinear Concern



Difference in opinions on mask inspection, access to MBMW, mask repair

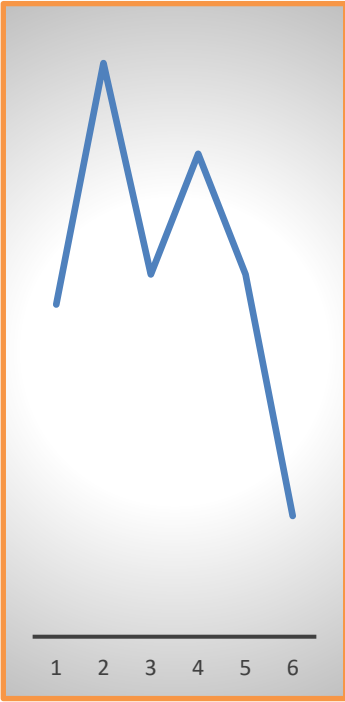
Please rank your biggest concerns in producing masks with curvilinear\* shapes. n≥73

#1: Mask shop software infrastructure



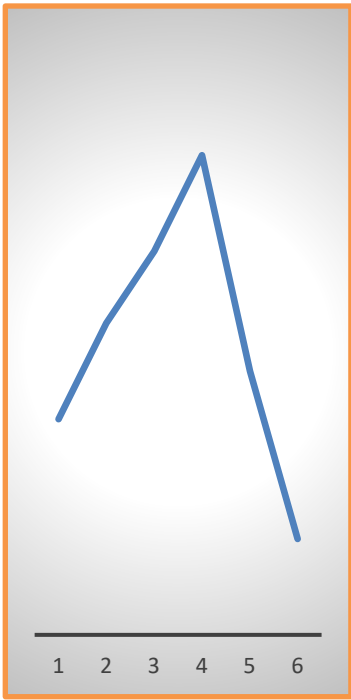
N/A=10%

#2: Mask Inspection



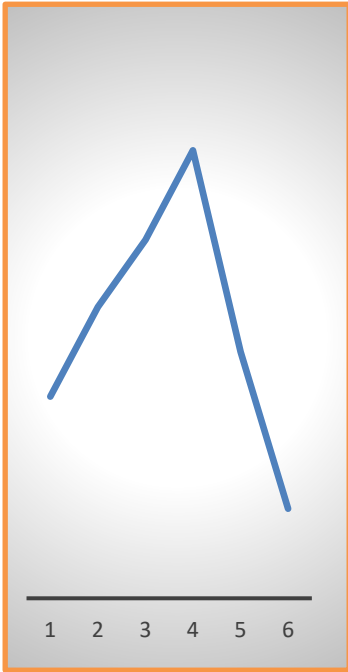
N/A=10%

#3: ILT software



N/A=13%

#4: Mask Metrology



N/A=10%

#5: Access to Multi-beam Mask Writers



N/A=13%

#6: Mask Repair



N/A=11%

Note: 1-6 on X-axis indicate # of respondents that ranked that question as that ordinal number with 1 = highest; height of chart = weighted avg

\* The survey question included "Curvilinear shapes can be piecewise linear polygons of some resolution, Bezier, B-spline or other curved-edge descriptions, but excludes shapes that only contain Manhattan or 45-degree straight edges."

# 78% Say Mask Shops Can Handle Curvilinear Masks by 2025

## Versus 87% who said that last year for the end of 2023



# eBeam Initiative Luminaries Predict 2024 Mask Market Growth

13<sup>th</sup> Annual Luminaries Survey - July 2024



- 100% of Luminaries say **2024 mask revenues will increase (74%) or stay the same (26%) over 2023** revenues of \$5.4B reported by SEMI.
- **Positive outlook for purchasing new equipment** in the next 3 years with increases predicted for multi-beam mask writers (93%), mask inspection (85%) and laser mask writers (48%).
- Confidence increased that **fabs without EUV can reach 5nm in next 7 years** with 19% who say that this year compared to 12% last year.
- 81% of Luminaries surveyed think that stitching for high-NA EUV masks will require **designers to be aware of the stitching boundaries during design.**

**Thank you to those who participated  
in the survey!**

**Luminaries survey results available on [www.ebeam.org](http://www.ebeam.org)**