

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

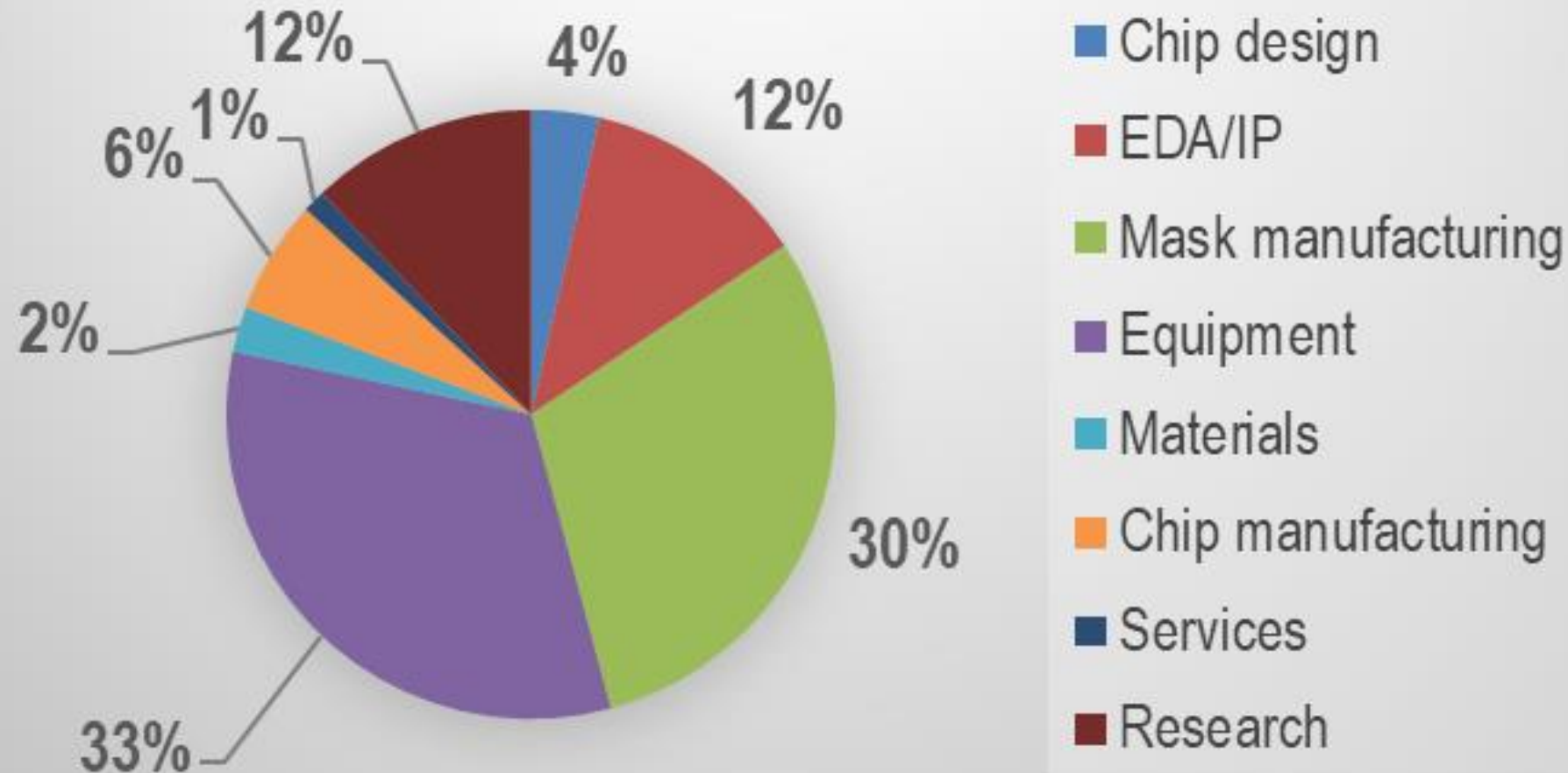
Luminaries survey results available on www.ebeam.org

NOTE: this PDF was updated in July 2025 to correct plots on page 18

84 Luminaries Participated in the 13th Annual Survey

Representing 49 different companies in July 2024

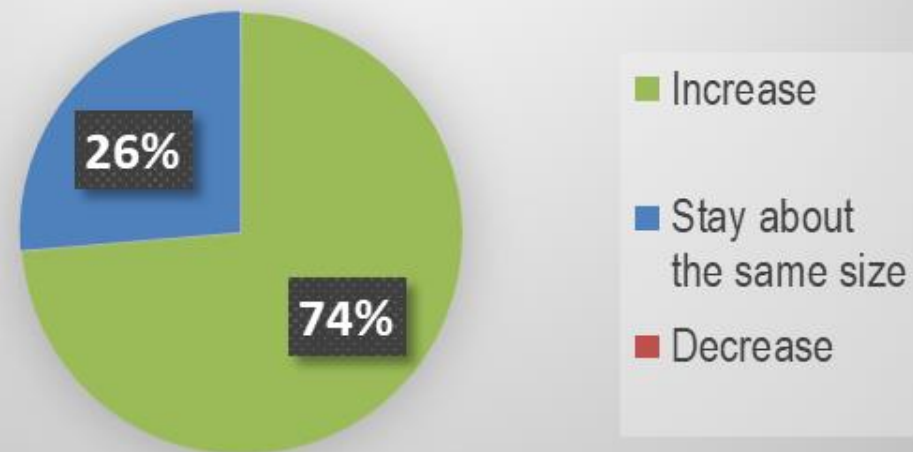
What part of the semiconductor ecosystem
is your primary focus?



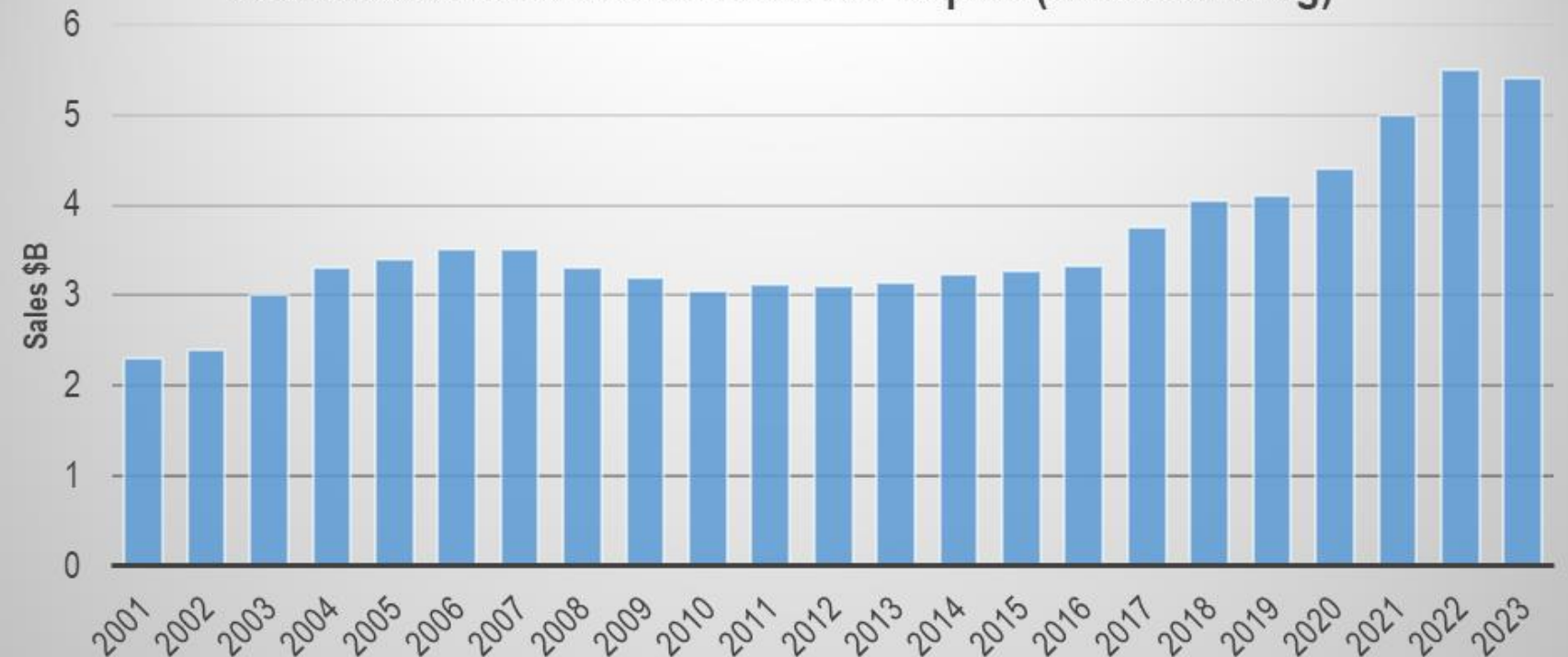
74% Say 2024 Mask Revenues Will Increase Over 2023

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

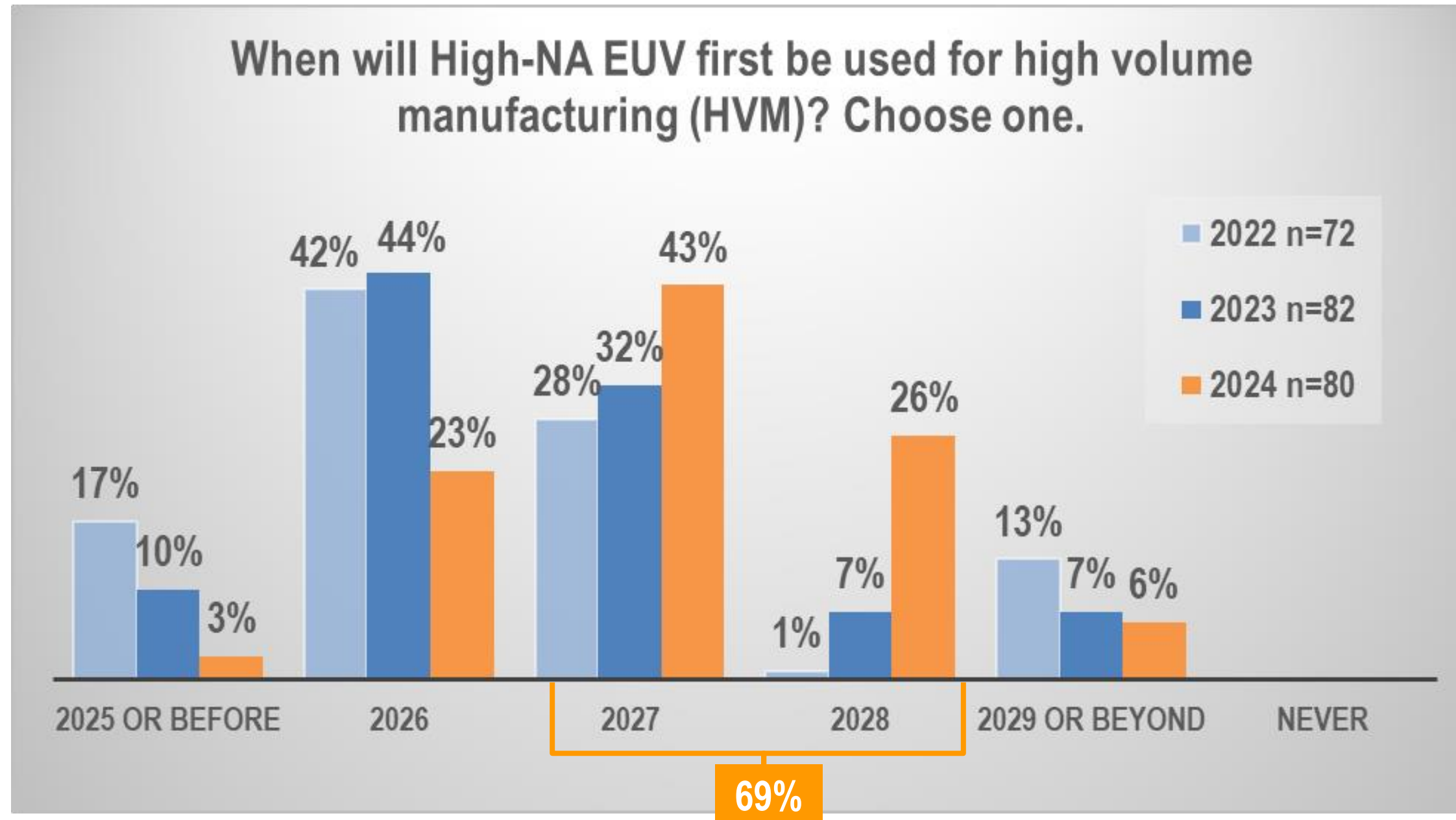


SEMI: Photomask Market 2001-2023
SEMI Photomask Characterization Report (www.semi.org)



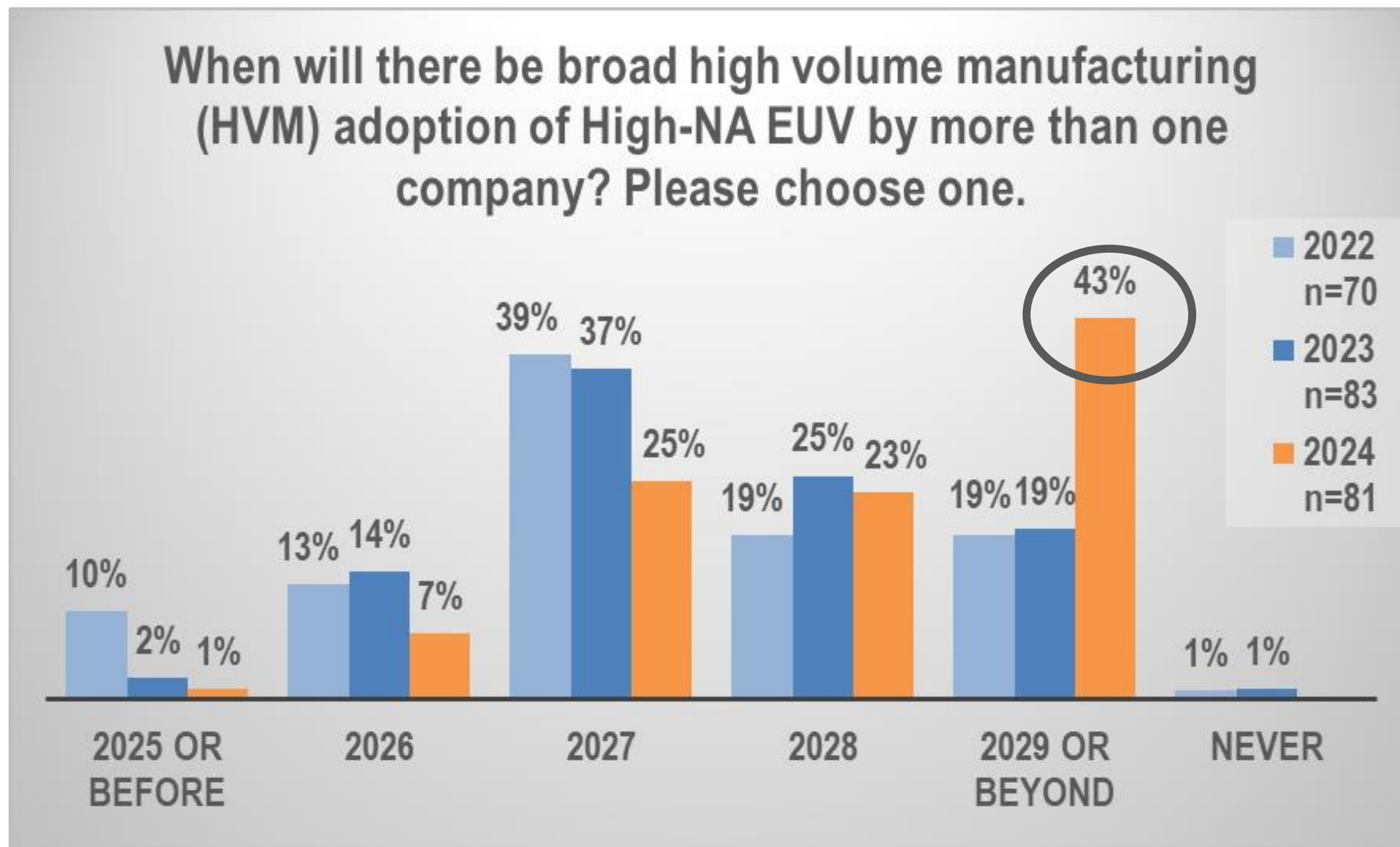
Opinion for High-NA EUV First HVM Usage is Clearer

69% of Luminaries say 2027 or 2028

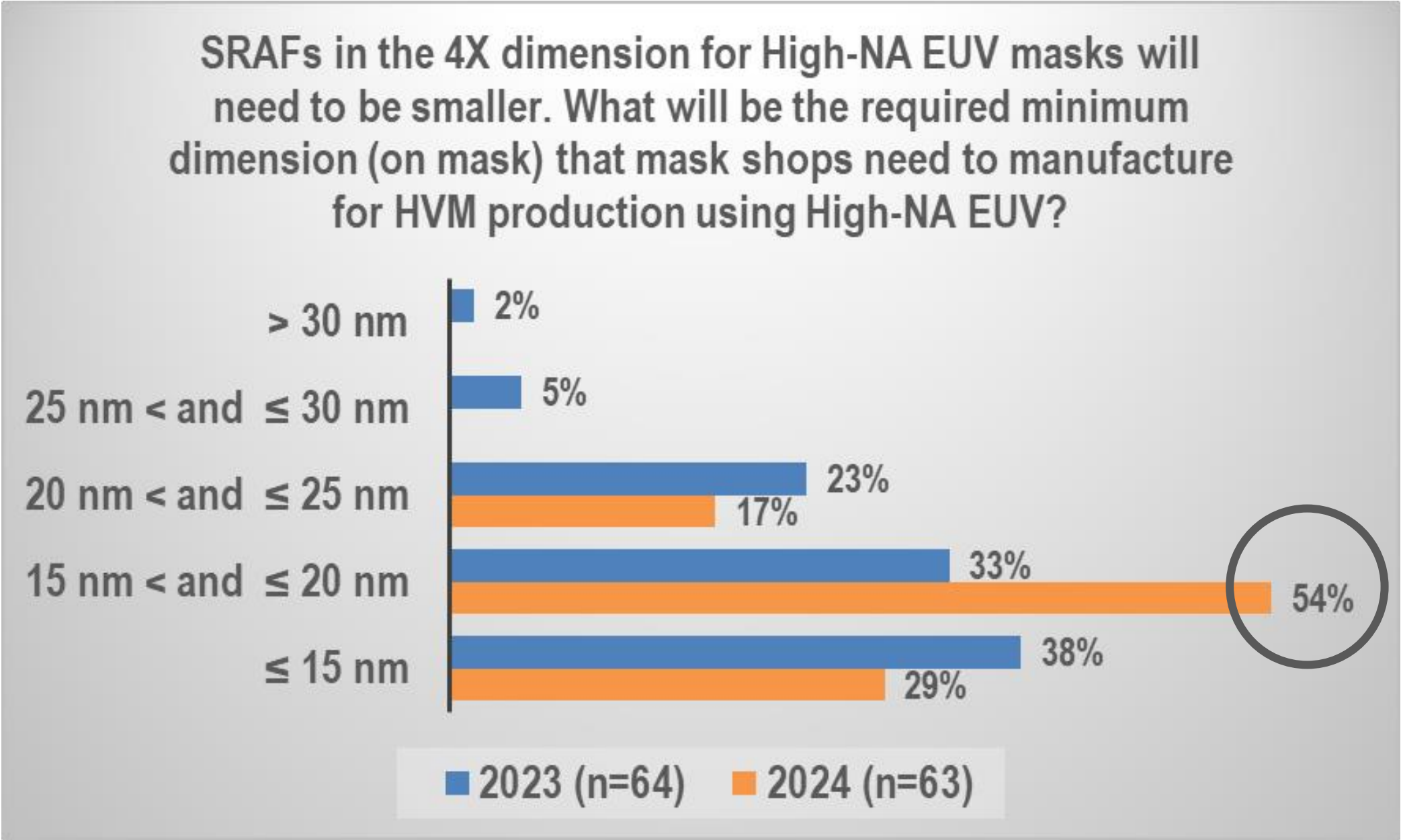


Estimates of High-NA EUV Broad Usage Shift to 2029 or Beyond

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

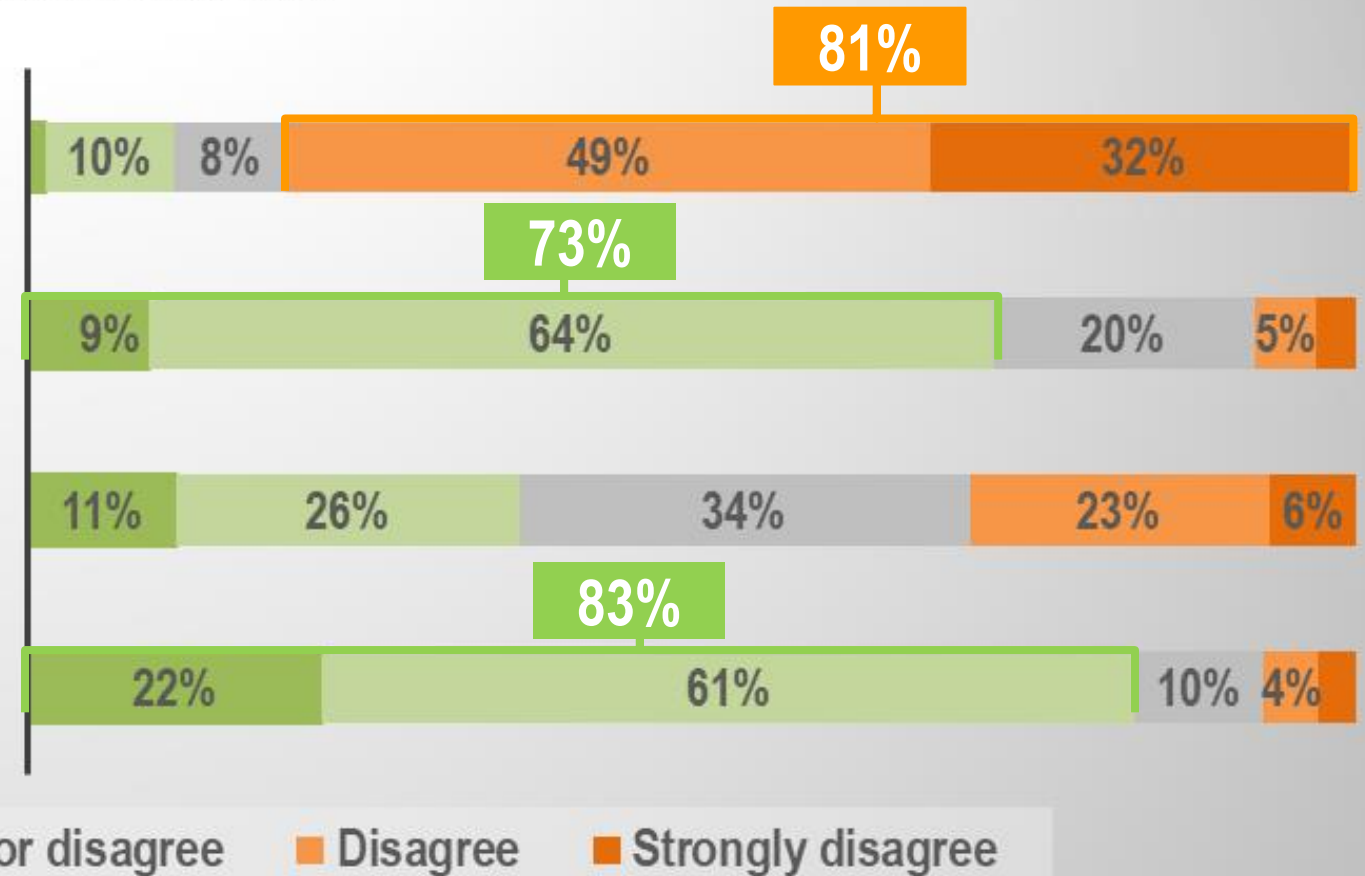
Please indicate your level of agreement or disagreement with the following statements:

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

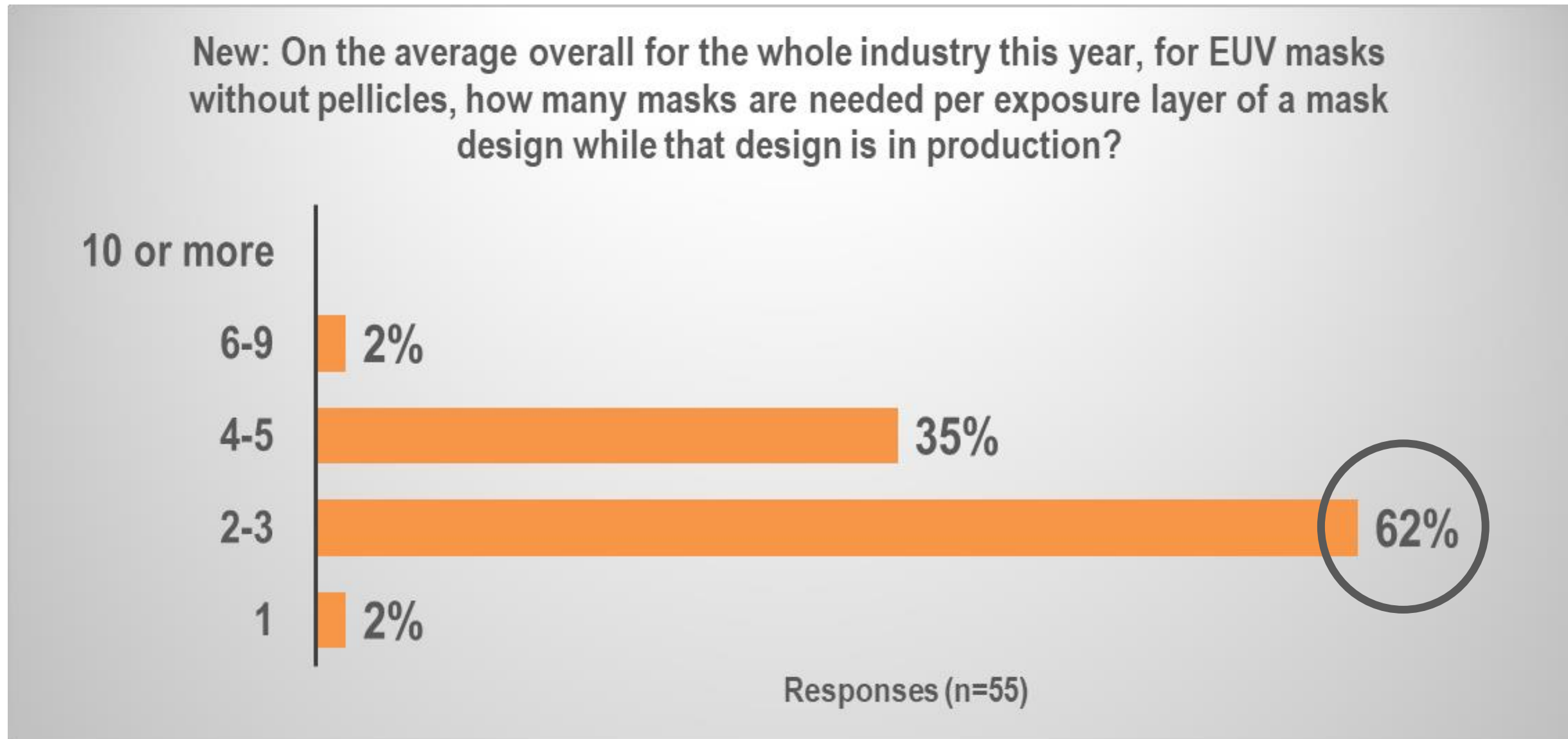
Restricting metal 1 and below layers not to have features crossing half-field boundaries will be acceptable to designers. n=62

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

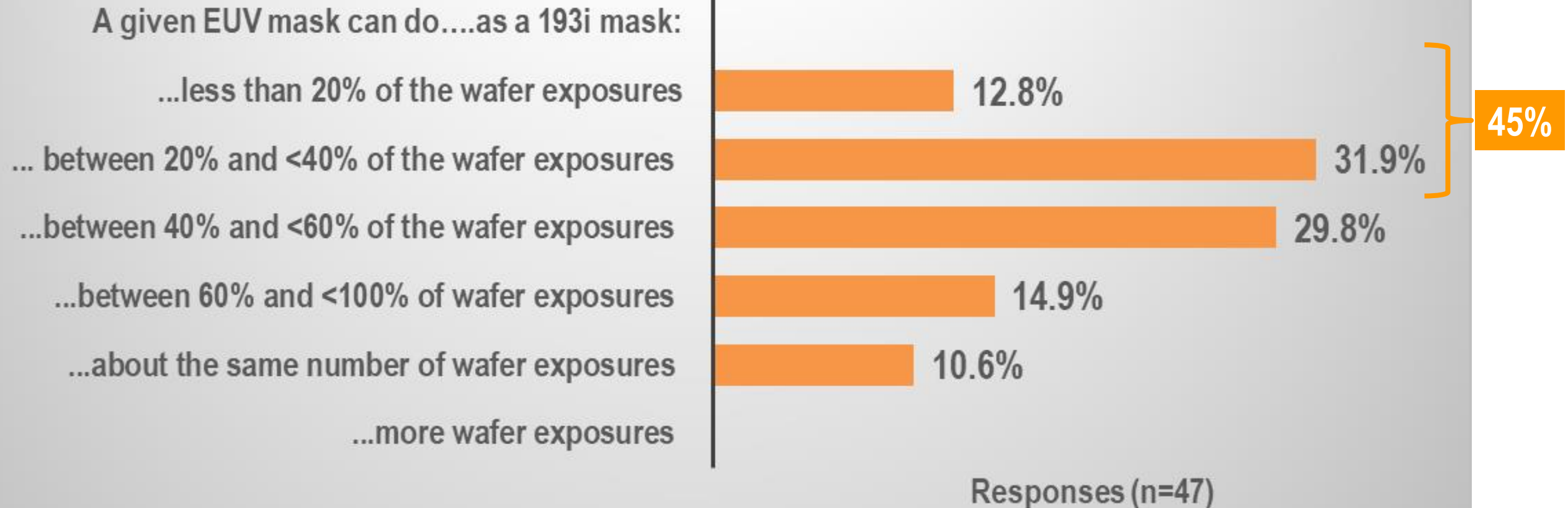
While design is in production (question reworded from 2023)



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

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

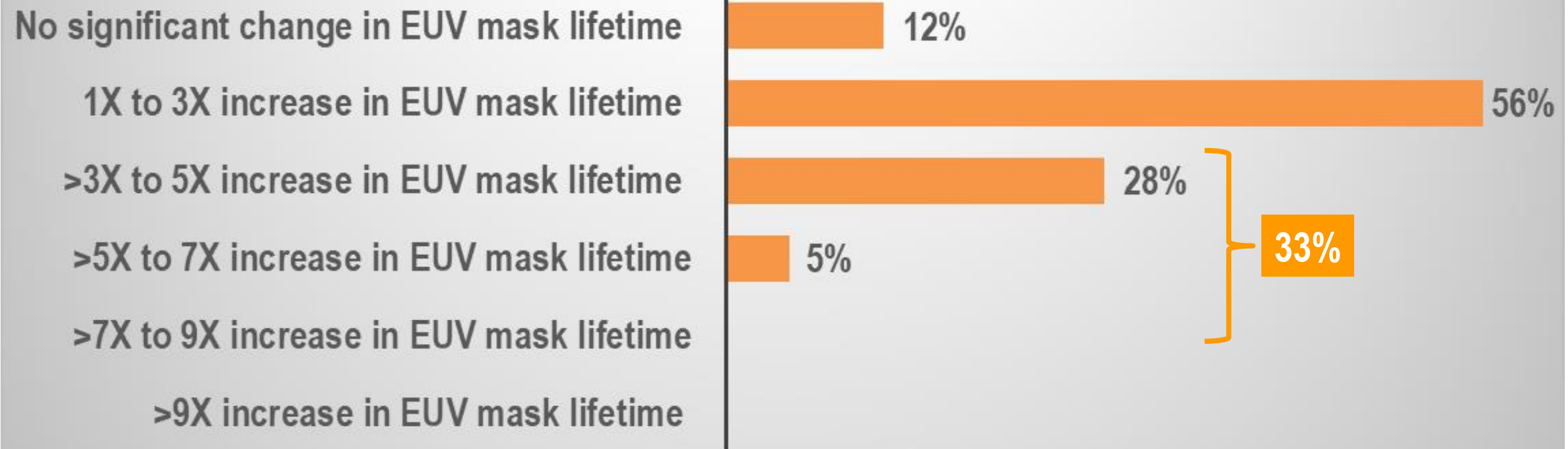
New: Relative to 193i mask lifetime (based on the number of wafer exposures), what is the average EUV mask lifetime (without pellicles) today?



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?



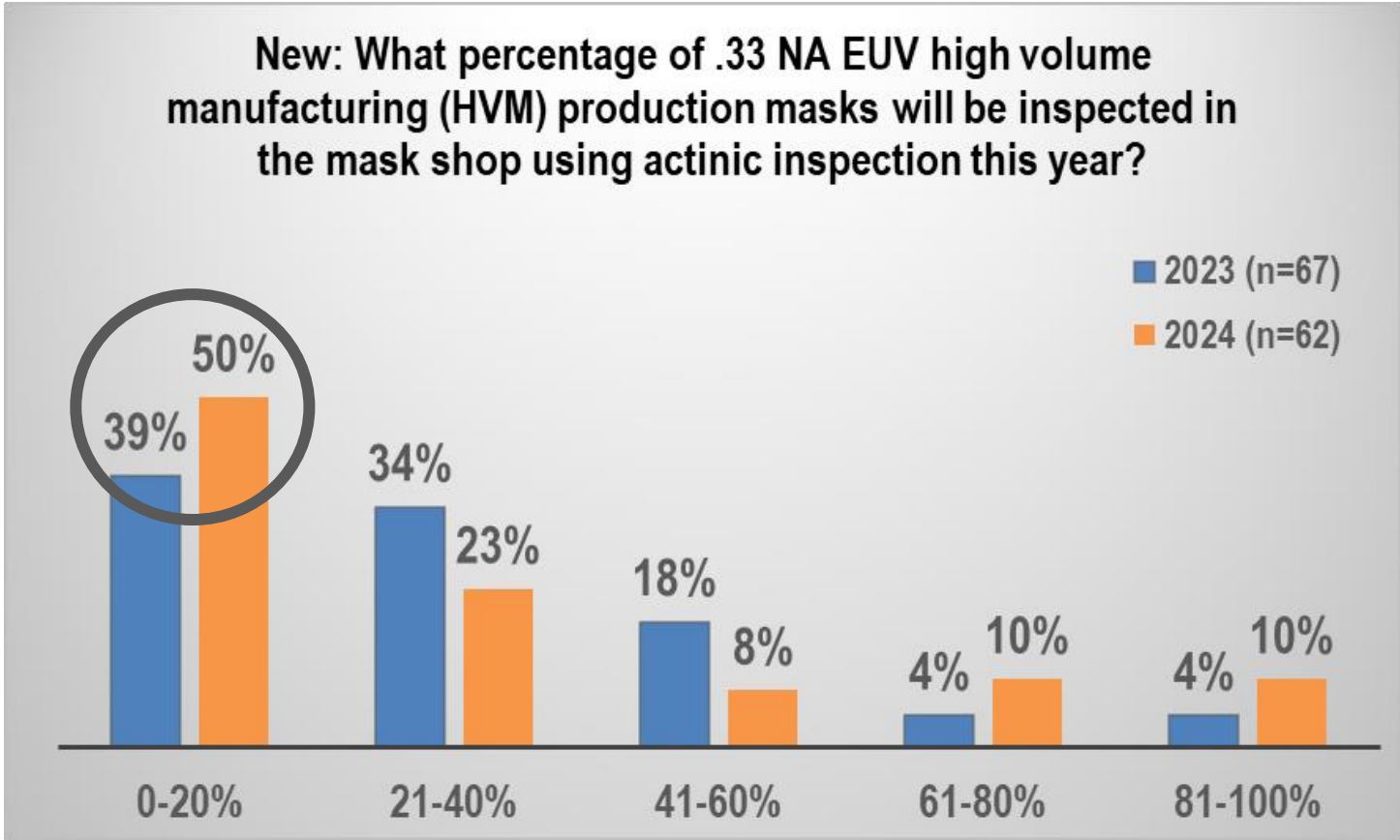
Responses (n=43)

Opinions on Actinic EUV Mask Inspection Clear for Today

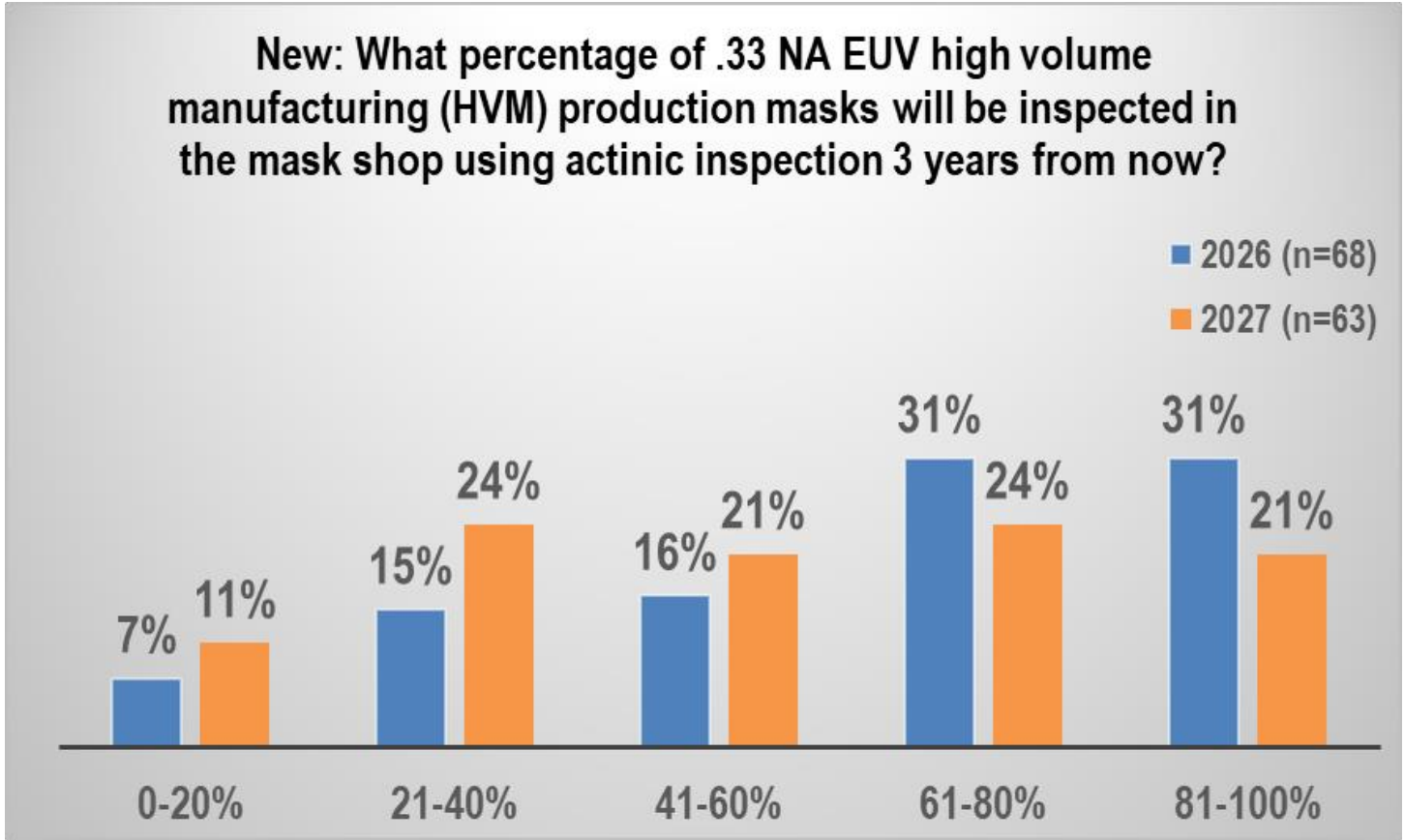


50% say $\leq 20\%$ of HVM masks vs 39% last year; no clear trend in 3 years

Predictions for Today

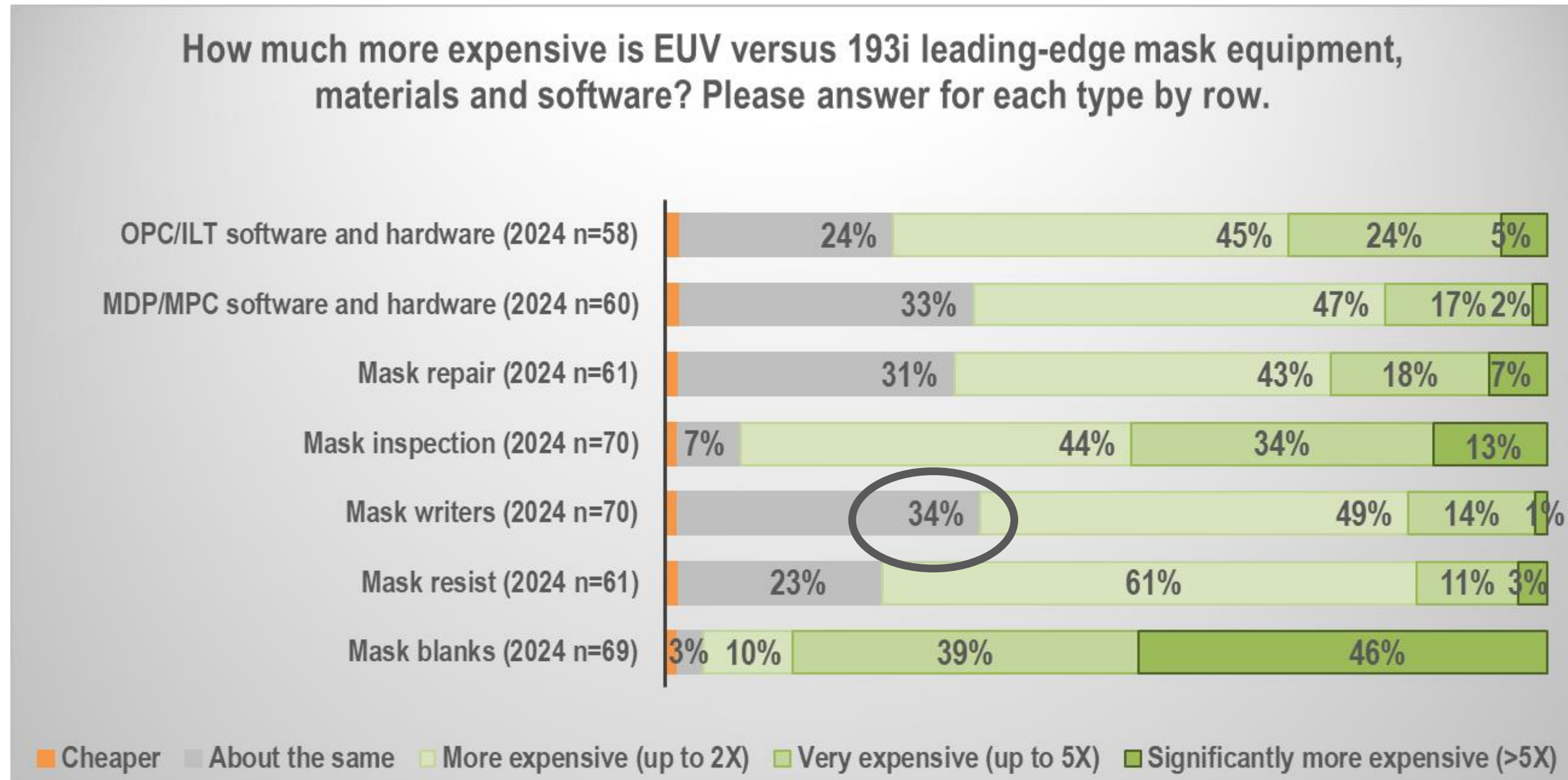


Predictions in 3 Years



Overall Trend for EUV > 193i Mask Costs Unchanged

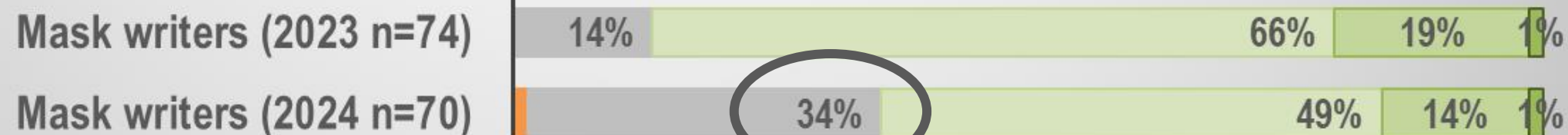
Opinion that mask writers are about the same cost increased to 34% from 14%



Overall Trend for EUV > 193i Mask Costs Unchanged

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

How much more expensive is EUV versus 193i leading-edge mask equipment, materials and software? Please answer for each type by row.

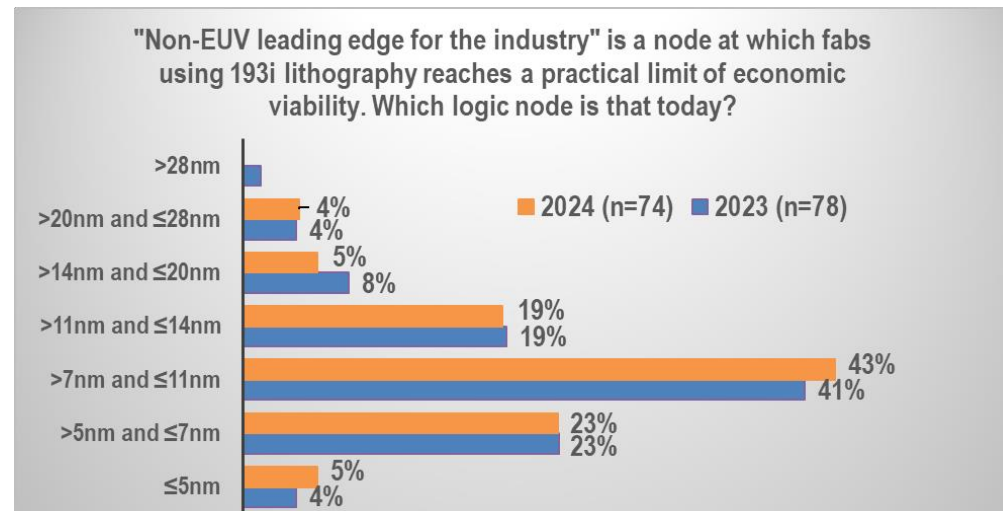


■ Cheaper ■ About the same ■ More expensive (up to 2X) ■ Very expensive (up to 5X) ■ Significantly more expensive (>5X)

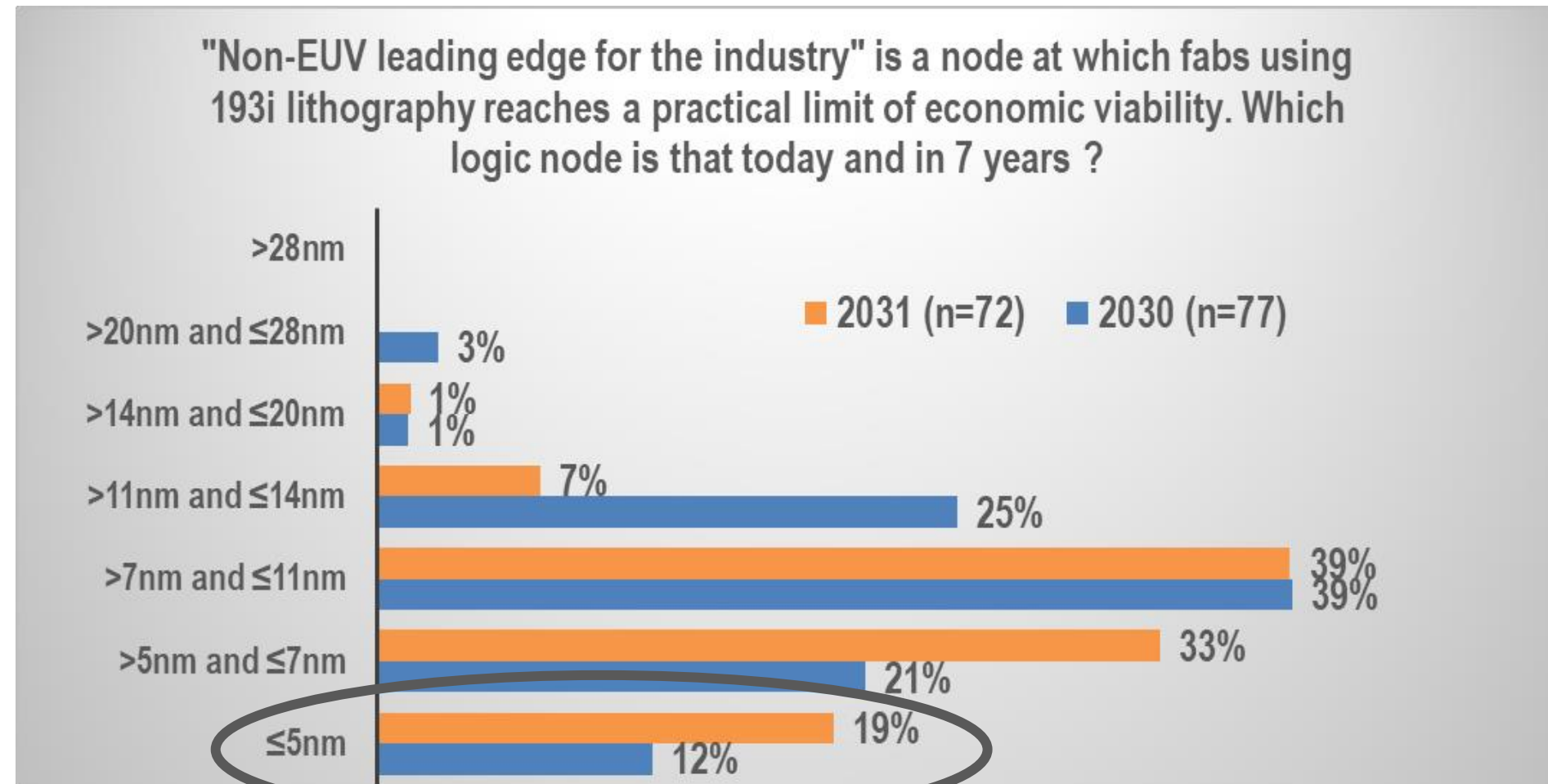
Confidence Increased: Fabs w/o EUV Can Reach $\leq 5\text{nm}$ in 7 Years

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

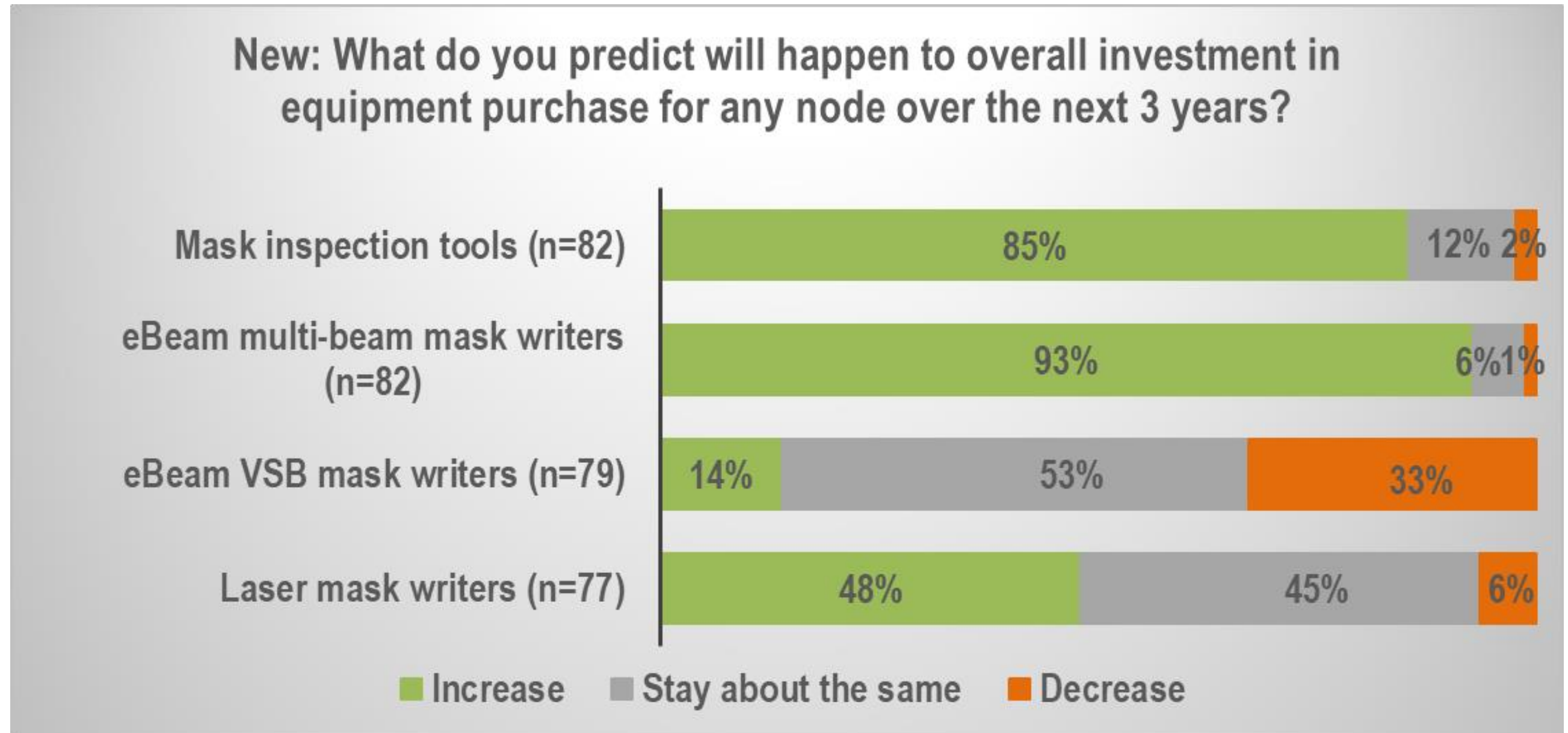
“Today”



“In 7 Years”



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

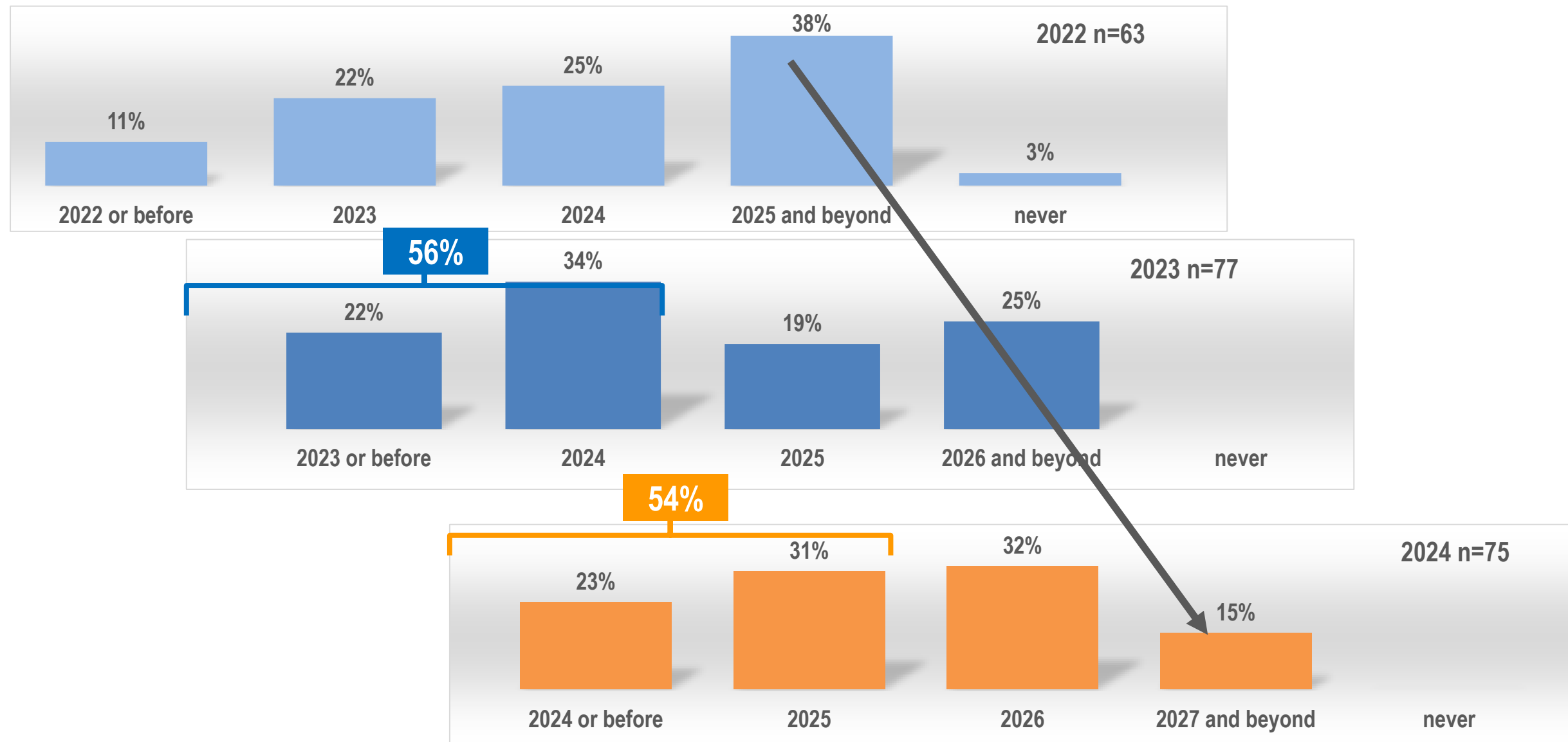


* Note: Question was changed from last year which asked about 193i only purchases

Predictions of Deep Learning Adoption Slip A Year

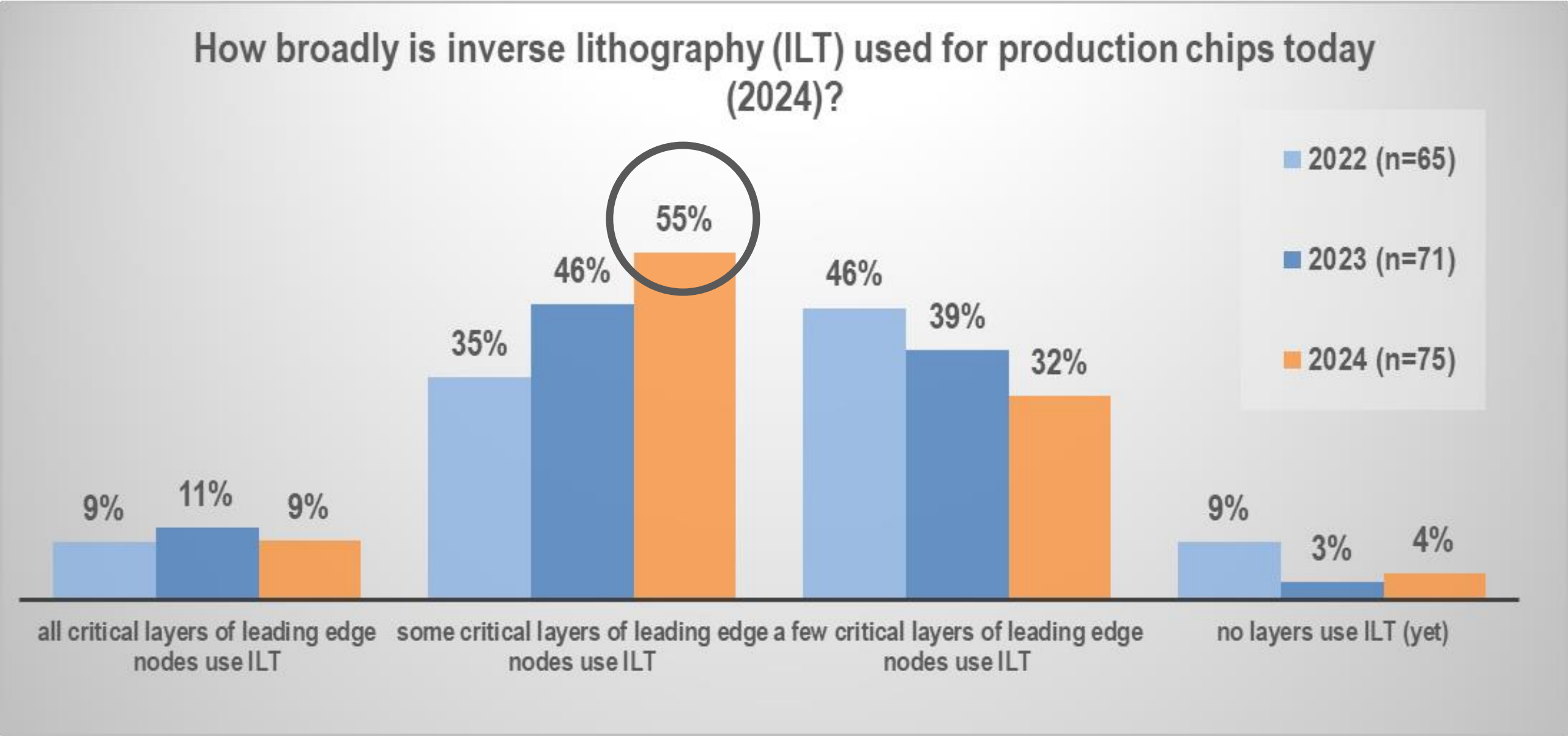
However, “three years from now” trend has decreased from 38% to 15%

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

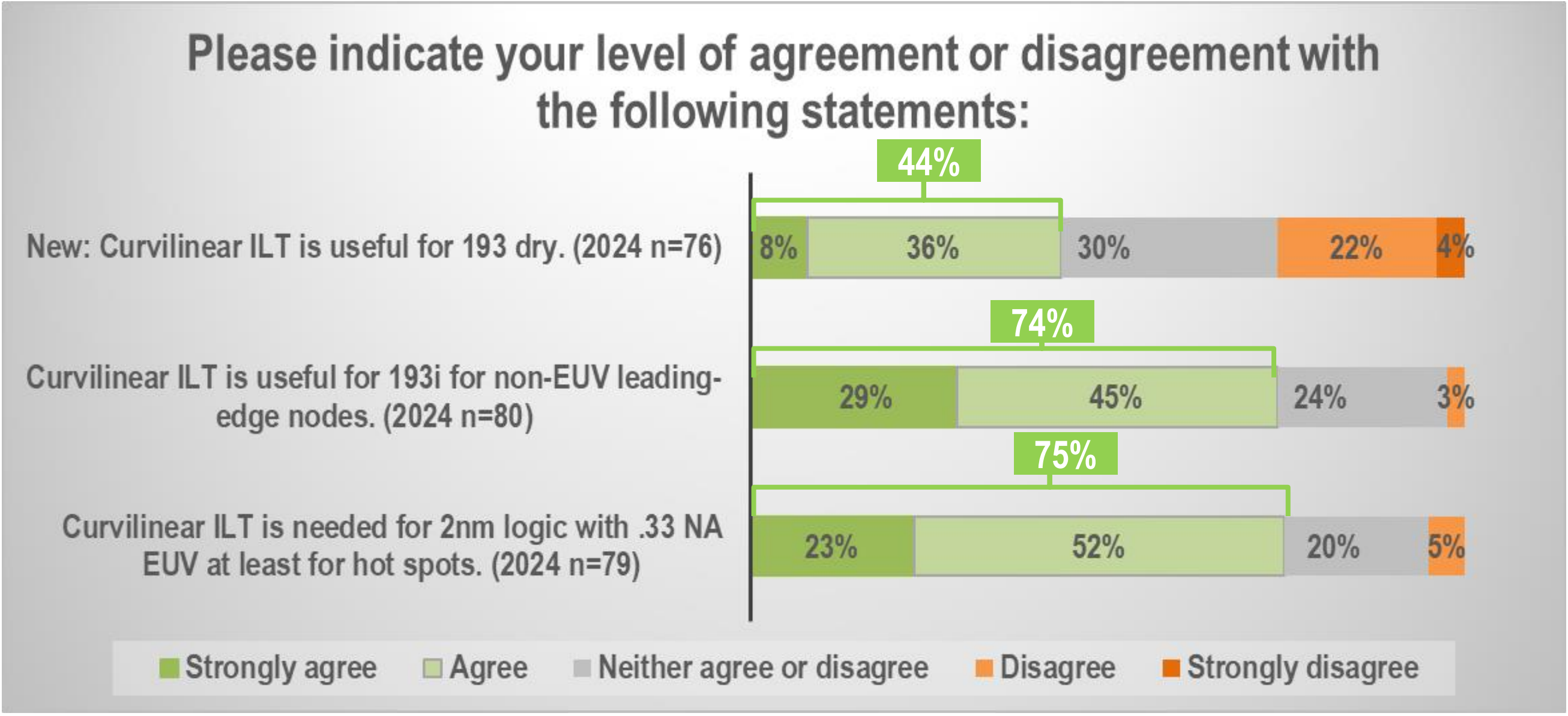


Note: Repeat question since 2017 but only showing most recent 3 years in this chart

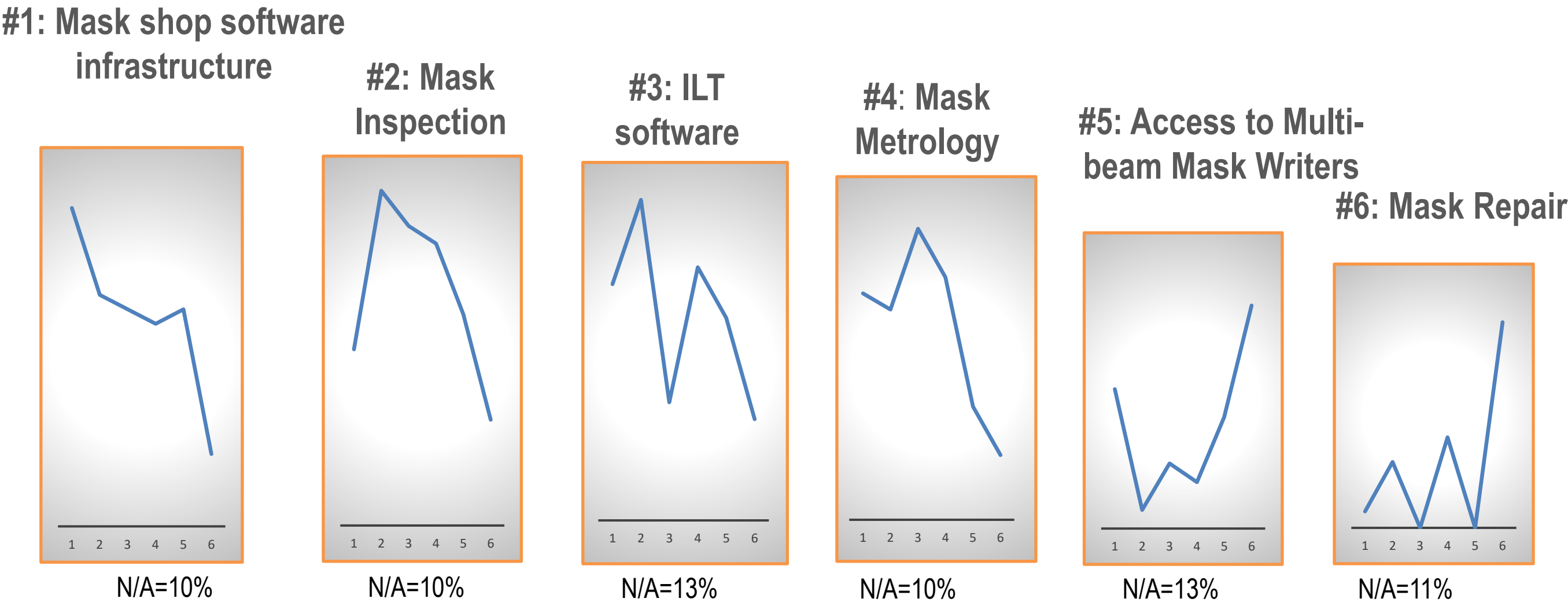
New Question: 44% Agree Curvilinear ILT Useful for 193 Dry

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





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



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.”

19

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

13th 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.**