

Chapter 4: Lithography

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CHAPTER

04

STAGE 4 OF 15

Lithography

ASML, a Dutch firm, is the only maker of extreme ultraviolet scanners, the machines that print the finest layers of a chip. It sold 48 of them in 2025.

IN PLAIN TERMS

Lithography prints the pattern of a circuit onto the wafer. A machine holds a stencil of one layer of the circuit up to a light source and projects the image, four times smaller, onto the silicon. The shorter the wavelength of the light, the finer the lines a machine can print. A machine can still print lines narrower than its light's wavelength. Immersion scanners shine the light through a layer of water between lens and wafer, which lets them print smaller features with the same light ⁶. ASML rates its NXT:2150i immersion scanner at features of 38 nanometers or less with 193-nanometer argon fluoride laser light ¹³. Air soaks up extreme ultraviolet light, the shortest in use, so machines that print with it work in a vacuum. Only ASML, a Dutch company, makes them. Export controls are government rules on who a company may sell to. Every advanced chip passes through ASML's machines, so export controls on ASML affect all advanced chipmaking.

⁶ Lenses & mirrors - Lithography principles. ASML · Accessed 9 September 2026 www.asml.com/en/technology/lithography-principles/lenses-and-mirrors

¹³ TWINSCAN NXT:2150i. ASML · Accessed 18 October 2026 www.asml.com/en/products/duv-lithography-systems/twinscan-nxt-2150i

IN SHORT

ASML also holds above 80 percent of the market for deep ultraviolet (DUV) lithography, the kind that uses longer-wavelength light ². ASML says the production capacity of Zeiss, its sole supplier of optics, limits how many lithography systems it can build ¹.

Export controls bar extreme ultraviolet (EUV) scanners from Chinese chip foundries ⁸. In December 2025 Reuters reported a Chinese prototype that had made EUV light but had printed no chip ⁴⁵. In July 2026 Reuters reported, citing one unnamed source, that a Shanghai firm with two state shareholders has started producing immersion DUV tools, which shine their light through water ⁴⁴.

2 Explainer: The \$400 million ASML 'printers' key for the AI chip boom. Reuters · 28 July 2026 [B] www.reuters.com/world/asia-pacific/250-million-asml-printer-behind-nvidias-chips-2026-07-28/

1 ASML HOLDING NV, Form 6-K report of foreign private issuer for the period ended 2025-12-31 (6-K). U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 25 February 2026 [A] www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualxreportx.htm

8 Breakthroughs or Boasts? Assessing Recent Chinese Lithography Advancements. Center for Strategic and International Studies · 24 September 2025 [A] www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography

45 How China built its 'Manhattan Project' to rival the West in AI chips. Reuters · 17 December 2025 [B] www.reuters.com/world/china/how-china-built-its-manhattan-project-rival-west-ai-chips-2025-12-17/

44 China starts production of home-grown immersion DUV chipmaking tools, source says. Reuters · 28 July 2026 [B] www.reuters.com/world/china/china-starts-production-home-grown-immersion-duv-chipmaking-tools-source-2026-07-28/

CHOKEPOINT CARD			EXTREME CONCENTRATION	VERY HARD TO SUBSTITUTE
CONCENTRATION			SUBSTITUTABILITY	PRICE OR MARKET SIZE
Extreme			Very hard ASML is the only maker of EUV scanners, and Zeiss is its sole supplier of their mirrors ¹ .	About \$200M for a standard EUV scanner, an estimated \$350-400M for the newer High-NA version and roughly \$60M for a tool in the DUV segment, according to Reuters in July 2026 ²
WHO LEADS			NL ASML 100% of EUV (extreme ultraviolet) systems sold in 2025 ³ JP Nikon 22 new chip lithography systems in the year to March 2026 ⁴ JP Canon 234 chip lithography systems in 2025, 188 of them i-line and 46 KrF ⁵	
WHERE IT IS MADE			NL Netherlands ASML, the Dutch maker of every EUV scanner DE Germany Zeiss SMT optics, Oberkochen, and Trumpf carbon dioxide drive lasers, Ditzingen US United States ASML light-source research and manufacturing, San Diego JP Japan Nikon and Canon lithography scanners and steppers	
WHY SUBSTITUTION IS SLOW			A newcomer would first have to make mirrors a meter wide, polished smooth to within tens of picometers, a picometer being a trillionth of a meter ⁶ . It would also need a light source that hits tin droplets with a laser 50,000 times a second ⁷ .	
WHERE CHINA STANDS			WHERE THE US STANDS	
In September 2025 CSIS judged that EUV remained firmly out of reach for China despite massive state investment ⁸ . SMEE, the older Chinese supplier, had its largest share in i-line tools, the coarsest kind, and even there held 4 percent of the world market as of 2025 ⁸ .			No American firm makes scanners, CSET found in 2021 ⁹ . But a US rule published in October 2023 covers certain immersion scanners bound for advanced chipmaking if they hold any American-made parts ¹⁰ . The US entity list also requires a license to supply the firms it names ¹¹ .	

1 ASML HOLDING NV, Form 6-K report of foreign private issuer for the period ended 2025-12-31 (6-K). U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 25 February 2026 [A] www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualxreportx.htm

2 Explainer: The \$400 million ASML 'printers' key for the AI chip boom. Reuters · 28 July 2026 [B] www.reuters.com/world/asia-pacific/250-million-asml-printer-behind-nvidias-chips-2026-07-28/

3 Strategic report: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 16 [A] ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16

4 Financial Results: The Year Ended March 31, 2026. Nikon · 8 May 2026 · p. 8 [A] www.nikon.com/content/dam/web-assets/nikoncom/company/local/global/en/ir/ir_library/result/pdf/2026/26_all_e.pdf#page=8

5 Canon Inc. FY 2025 Results. Canon · 29 January 2026 · p. 22 [A] global.canon/en/ir/conference/pdf/conf2025e.pdf#page=22

6 Lenses & mirrors - Lithography principles. ASML · Accessed 9 September 2026 [A] www.asml.com/en/technology/lithography-principles/lenses-and-mirrors

7 All about light and lasers in lithography. ASML · Accessed 9 September 2026 [A] www.asml.com/en/technology/lithography-principles/light-and-lasers

8 Breakthroughs or Boasts? Assessing Recent Chinese Lithography Advancements. Center for Strategic and International Studies · 24 September 2025 [A] www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography

ASML sold 327 lithography systems in 2025, 48 of them extreme ultraviolet (EUV)

¹². Nobody else makes EUV systems ³.

How it works

The stencil is called a photomask, and the machine a scanner (see Photomasks and pellicles).

The wafer is coated with photoresist, a film that changes wherever light touches it. The mask holds one layer of the circuit as a pattern of clear and dark areas, drawn at four times its size on the chip. The machine shines light through the mask, shrinks the image four times with a lens, and lands it on the film.

A wash then removes the film where the light hit, or, with some films, where it did not, leaving the pattern standing on the wafer ¹⁴. The film then serves as a stencil for the next step, which either etches the pattern into the layer beneath or fires ions into the open areas to change how the silicon conducts ¹⁴. Then the film is stripped and the next mask goes in. Chips are made up of dozens of layers, ASML says ¹⁴. Photronics, a US mask maker, says masks are typically sold in sets, with each layer's pattern on a different mask ¹⁵.

The image from one mask covers a patch of up to 26 by 33 mm ¹⁶. The wafer moves under the lens one patch at a time, close to a hundred patches per wafer. ASML's own wafers-per-hour rating for an EUV scanner assumes 96 of them ¹⁶. Before the wafer is exposed, the machine measures alignment marks printed in earlier layers so the new layer lines up with them ¹⁶. ASML rates the NXE:3400B's

8 Breakthroughs or Boasts? Assessing Recent Chinese Lithography Advancements. Center for Strategic and International Studies · 24 September 2025 [\[A\]](https://www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography) www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography

9 The Semiconductor Supply Chain - Issue Brief. Center for Security and Emerging Technology (CSET) · 21 January 2021 · p. 4 [\[A\]](https://cset.georgetown.edu/wp-content/uploads/The-Semiconductor-Supply-Chain-Issue-Brief-1.pdf#page=4) cset.georgetown.edu/wp-content/uploads/The-Semiconductor-Supply-Chain-Issue-Brief-1.pdf#page=4

10 Export Controls on Semiconductor Manufacturing Items. Federal Register (Commerce Department; Industry and Security Bureau) · 25 October 2023 [\[A\]](https://www.federalregister.gov/documents/2023/10/25/2023-23049/export-controls-on-semiconductor-manufacturing-items) www.federalregister.gov/documents/2023/10/25/2023-23049/export-controls-on-semiconductor-manufacturing-items

11 Expansion of End-User Controls To Cover Affiliates of Certain Listed Entities. Federal Register (Commerce Department; Industry and Security Bureau) · 30 September 2025 [\[A\]](https://www.federalregister.gov/documents/2025/09/30/2025-19001/expansion-of-end-user-controls-to-cover-affiliates-of-certain-listed-entities) www.federalregister.gov/documents/2025/09/30/2025-19001/expansion-of-end-user-controls-to-cover-affiliates-of-certain-listed-entities

12 Financial performance: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 5 [\[A\]](https://ourbrand.asml.com/m/419103cb23dfeaa4/original/asml-2025-annual-report-financial-performance-section.pdf#page=5) ourbrand.asml.com/m/419103cb23dfeaa4/original/asml-2025-annual-report-financial-performance-section.pdf#page=5

3 Strategic report: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 16 [\[A\]](https://ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16) ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16

14 6 crucial steps in semiconductor manufacturing. ASML · 4 October 2023 [\[A\]](https://www.asml.com/en/news/stories/2021/semiconductor-manufacturing-process-steps) www.asml.com/en/news/stories/2021/semiconductor-manufacturing-process-steps

15 PHOTRONICS INC, Form 10-K annual report for the period ended 2025-10-31 (10-K). U.S. Securities and Exchange Commission (filing by PHOTRONICS INC) · 17 December 2025 [\[A\]](https://www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm) www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm

16 TWINSCAN NXE:3400B: EUV lithography systems. ASML · Accessed 27 September 2026 [\[A\]](https://www.asml.com/en/products/euv-lithography-systems/twinscan-nxe3400b) www.asml.com/en/products/euv-lithography-systems/twinscan-nxe3400b

matched-machine overlay, a measure of that alignment, at 2 nm¹⁶. That model first shipped in 2017¹⁷.

Finer lines need shorter light. Glass and air both absorb the shortest light in use, at 13.5 nm¹⁸. So an EUV scanner works in a vacuum and uses mirrors instead of lenses, and its masks are mirrors too¹⁸. Deep ultraviolet (DUV) machines use light with a wavelength more than fourteen times longer⁷. ASML calls its immersion DUV scanners the workhorses of the industry, used in high-volume manufacturing of the most advanced logic and memory chips¹⁹.

When one exposure cannot draw a pattern finely enough, chipmakers use multipatterning. In the litho-etch kind, the pattern is split between two or more masks printed in turn²⁰. Each added mask brings more process steps, more cost and a risk that the parts of the pattern misalign²¹. Self-aligned double and quadruple patterning (SADP and SAQP) print the lines with one exposure and then multiply them with deposition and etch steps²⁰. In SAQP each printed line ends up as four²⁰. Because one exposure places all those lines, they cannot misalign with each other, though a later exposure still prints blocks that break them where the circuit needs gaps²⁰. ASML says one EUV exposure per layer cuts masks and process steps and lowers cost³.

Variants and trade-offs

Deep ultraviolet

Deep ultraviolet (DUV) light comes from gas lasers called excimer lasers: 248 nanometers from krypton fluoride (KrF), 193 from argon fluoride (ArF), shone through air or water⁷. Cymer, an independently run ASML business in San Diego,

¹⁶ TWINSKAN NXE:3400B: EUV lithography systems. ASML · Accessed 27 September 2026 [\[A\]](https://www.asml.com/en/products/euv-lithography-systems/twinscan-nxe3400b) www.asml.com/en/products/euv-lithography-systems/twinscan-nxe3400b

¹⁷ Stronger than expected demand drives ASML Q1 sales. U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 19 April 2017 [\[A\]](https://www.sec.gov/Archives/edgar/data/937966/000093796617000010/pressreleasequarterlyresul.htm) www.sec.gov/Archives/edgar/data/937966/000093796617000010/pressreleasequarterlyresul.htm

¹⁸ ASML EUV lithography systems. ASML · Accessed 9 September 2026 [\[A\]](https://www.asml.com/en/products/euv-lithography-systems) www.asml.com/en/products/euv-lithography-systems

⁷ All about light and lasers in lithography. ASML · Accessed 9 September 2026 [\[A\]](https://www.asml.com/en/technology/lithography-principles/light-and-lasers) www.asml.com/en/technology/lithography-principles/light-and-lasers

¹⁹ See ASML's DUV lithography systems. ASML · Accessed 9 September 2026 [\[A\]](https://www.asml.com/en/products/duv-lithography-systems) www.asml.com/en/products/duv-lithography-systems

²⁰ EUV lithography: weighing the options. imec · 6 June 2019 [\[A\]](https://www.imec-int.com/en/imec-magazine/imec-magazine-june-2019/euv-lithography-weighing-the-options-for-future-logic-and-memory-applications) www.imec-int.com/en/imec-magazine/imec-magazine-june-2019/euv-lithography-weighing-the-options-for-future-logic-and-memory-applications

²¹ Applied Materials' Innovative Pattern-Shaping Technology Reduces the Cost, Complexity and Environmental Impact of Advanced Chip Manufacturing. Applied Materials · 28 February 2023 [\[A\]](https://ir.appliedmaterials.com/news-releases/news-release-details/applied-materials-innovative-pattern-shaping-technology-reduces) ir.appliedmaterials.com/news-releases/news-release-details/applied-materials-innovative-pattern-shaping-technology-reduces

³ Strategic report: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 16 [\[A\]](https://ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16) ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16

makes these excimer lasers, which generate the light that scanners use to print patterns on wafers ²². Gigaphoton, a Komatsu company in Japan, also makes excimer lasers for lithography tools ²³. Most of the machines sold are still DUV tools. Of the systems ASML sold in 2025, 131 were ArF immersion, 78 KrF and 16 ArF dry, all deep ultraviolet, and another 54 were older i-line tools ²⁴. The i-line tools use 365 nm light from a mercury lamp, and ASML says they print features as small as 220 nm ⁷.

Reuters gives one price for the whole DUV segment, with tools costing roughly \$60 million each ². In 2025, those 131 ArF immersion tools made up 42 percent of ASML's system sales and the 78 KrF tools only 4 percent ²⁴. In DUV, ASML competes with Nikon and Canon, and it still holds above 80 percent of that market ². Without EUV, chipmakers build their finest layers on immersion DUV scanners, in several passes per layer ³. From 1 September 2023, Dutch export licensing covered the most advanced of these scanners, ASML's NXT:2000i and later models ²⁵.

Extreme ultraviolet

The 13.5 nm light comes from molten tin droplets shot from a generator ⁷. A laser hits each droplet twice, first with a low-intensity pulse that flattens it and then with a more powerful one that vaporizes it into plasma ⁷. The process repeats 50,000 times a second ⁷. Mirrors made by Zeiss, a German optics company, carry the light to the wafer ⁶. The largest are a meter across and smooth to within tens of picometers, a picometer being a thousandth of a nanometer ⁶.

Brighter light means more wafers an hour, and ASML demonstrated the first 1,000-watt EUV source in April 2025 ²⁶. Its TWINSCAN NXE:3800E ships at its full 220 wafers an hour, 37 percent more than the NXE:3600D ²⁷.

22 Explore ASML San Diego. ASML · Accessed 9 September 2026 [\[A\]](https://www.asml.com/en/company/about-asml/locations/san-diego) www.asml.com/en/company/about-asml/locations/san-diego

23 Gigaphoton, company profile. Gigaphoton · Accessed 9 September 2026 [\[A\]](https://www.gigaphoton.com/company) www.gigaphoton.com/company

24 ASML 2025 fourth-quarter and full-year results (investor presentation). ASML · 28 January 2026 · p. 9 [\[A\]](https://ourbrand.asml.com/m/3136300aa4999bc1/original/2026_01_28_Presentation-Investor-Relations-Q4-2025.pdf#page=9) ourbrand.asml.com/m/3136300aa4999bc1/original/2026_01_28_Presentation-Investor-Relations-Q4-2025.pdf#page=9

7 All about light and lasers in lithography. ASML · Accessed 9 September 2026 [\[A\]](https://www.asml.com/en/technology/lithography-principles/light-and-lasers) www.asml.com/en/technology/lithography-principles/light-and-lasers

2 Explainer: The \$400 million ASML 'printers' key for the AI chip boom. Reuters · 28 July 2026 [\[B\]](https://www.reuters.com/world/asia-pacific/250-million-asml-printer-behind-nvidias-chips-2026-07-28/) www.reuters.com/world/asia-pacific/250-million-asml-printer-behind-nvidias-chips-2026-07-28/

3 Strategic report: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 16 [\[A\]](https://ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16) ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16

25 Statement regarding export control regulations Dutch government. ASML · 30 June 2023 [\[A\]](https://www.asml.com/en/news/press-releases/2023/statement-regarding-export-control-regulations-dutch-government) www.asml.com/en/news/press-releases/2023/statement-regarding-export-control-regulations-dutch-government

6 Lenses & mirrors - Lithography principles. ASML · Accessed 9 September 2026 [\[A\]](https://www.asml.com/en/technology/lithography-principles/lenses-and-mirrors) www.asml.com/en/technology/lithography-principles/lenses-and-mirrors

26 Strategic report: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 30 [\[A\]](https://ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=30) ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=30

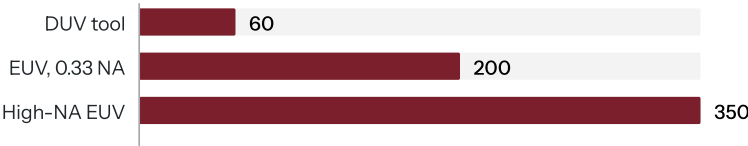
27 Strategic report: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 17 [\[A\]](https://ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=17) ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=17

High-NA EUV

High-NA scanners raise the numerical aperture (NA), a measure of how well the optics collect and focus light, from 0.33 to 0.55 ²⁸. That cuts the smallest printable feature from 13 nm to 8 nm ²⁸. Their optics shrink the mask image four times in one direction and eight in the other, halving the patch of wafer one exposure covers and doubling the exposures per wafer ²⁸. The second-generation TWINSCAN EXE:5200B runs at 175 wafers an hour, 60 percent above the EXE:5000 ³.

Reuters puts a standard EUV tool at around \$200 million and a High-NA machine at an estimated \$350 to \$400 million ².

What one lithography system costs. The DUV bar is one figure for the whole segment, and the High-NA bar shows the low end of an estimated \$350-400M range \$M



Source: Reuters explainer on ASML's lithography machines, first published 28 January 2026 and updated 28 July 2026

Intel and TSMC have chosen differently on High-NA:

- **Intel Foundry** says it uses High-NA in volume production for select layers of some Intel 18A products ²⁹. It installed the first EXE:5200B ³⁰. By September 2026 it had run more than one million wafers on High-NA tools, a count that includes tool testing and research as well as volume production ²⁹.
- **TSMC** waited, and in September 2026 said it will use High-NA in high-volume manufacturing from 2030 ³¹.

28 5 things you should know about High NA in EUV. ASML · 25 January 2024 ^[A] www.asml.com/en/company/stories/2024/5-things-high-na-euv

3 Strategic report: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 16 ^[A] ourbrand.asml.com/m/8ab959d4926657b/original/asml-2025-annual-report-strategic-report-section.pdf#page=16

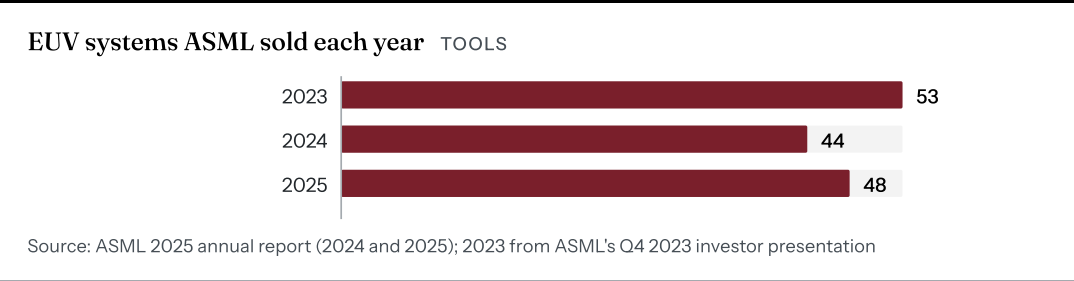
2 Explainer: The \$400 million ASML 'printers' key for the AI chip boom. Reuters · 28 July 2026 ^[B] www.reuters.com/world/asia-pacific/250-million-asml-printer-behind-nvidias-chips-2026-07-28/

29 Intel Foundry and ASML Accelerate Industry Readiness for High-NA EUV. Intel · 7 September 2026 ^[A] www.intel.com/content/www/us/en/newsroom/news/intel-foundry/intel-foundry-asml-accelerate-industry-readiness-for-high-na-euv.html

30 High NA EUV reaches new readiness milestone with first high-volume Logic product. ASML · 15 July 2026 ^[A] www.asml.com/en/news/press-releases/2026/high-na-euv-reaches-new-readiness-milestone

31 ASML and TSMC Announce Initiative to Pioneer Industry Transition to Large-Format Photomasks for High NA EUV. TSMC · 8 September 2026 ^[A] pr.tsmc.com/english/news/3338

ASML sold four High-NA (EXE) systems in 2025, against two in 2024 ³². In its 2025 annual report, filed in February 2026, ASML said it expected High-NA to start supporting high-volume manufacturing in 2027 ¹. On 8 September 2026 ASML and TSMC announced a move from 6-inch photomasks to 12-inch ones, to remove stitching constraints ³¹. Stitching constraints are the design limits that come from printing a large chip in two halves. They aim for a pilot line for the new masks by 2031 and for High-NA systems that use them to enter production by 2033 ³¹.



Who makes it

ASML's net sales were EUR 32.7 billion in 2025, at a 52.8 percent gross margin ¹². In October 2026 it expected 2026 net sales of EUR 44 to 45 billion, at a gross margin of around 56 percent ³³. Its 2025 annual report lists 5,100 suppliers ¹. Three of them and ASML's own San Diego site make the main parts of the EUV machine:

- **Zeiss SMT**, Oberkochen, makes the illumination system and the six-mirror projection optics ³⁴.
- **Trumpf**, Ditzingen, makes the carbon dioxide drive laser, which amplifies a few watts to 40 kilowatts ³⁵.
- **ASML San Diego**, which includes the light-source maker Cymer that ASML bought in 2013, designs the source where the laser turns tin into plasma, and builds the droplet generator ²².

32 Financial performance: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 7 [\[A\]](#)
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1 ASML HOLDING NV, Form 6-K report of foreign private issuer for the period ended 2025-12-31 (6-K). U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 25 February 2026 [\[A\]](#)
www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualxreportx.htm

31 ASML and TSMC Announce Initiative to Pioneer Industry Transition to Large-Format Photomasks for High NA EUV. TSMC · 8 September 2026 [\[A\]](#) pr.tsmc.com/english/news/3338

12 Financial performance: From ASML's Annual Report 2025. ASML · 24 February 2026 · p. 5 [\[A\]](#)
ourbrand.asml.com/m/419103cb23dfeaa4/original/asml-2025-annual-report-financial-performance-section.pdf#page=5

33 ASML reports €11.7 billion total net sales and €5.0 billion net income in Q3 2026. U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 14 October 2026 [\[A\]](#)
www.sec.gov/Archives/edgar/data/937966/000162828026065813/pressreleasefinancialresul.htm

34 EUV lithography and technology. Carl Zeiss · Accessed 9 September 2026 [\[A\]](#) www.zeiss.com/semiconductor-manufacturing-technology/inspiring-technology/euv-lithography.html

35 Good things come in ever-smaller packages. TRUMPF · Accessed 9 September 2026 [\[A\]](#) www.trumpf.com/en_US/products/lasers/euv-drive-laser/

22 Explore ASML San Diego. ASML · Accessed 9 September 2026 [\[A\]](#) www.asml.com/en/company/about-asml/locations/san-diego

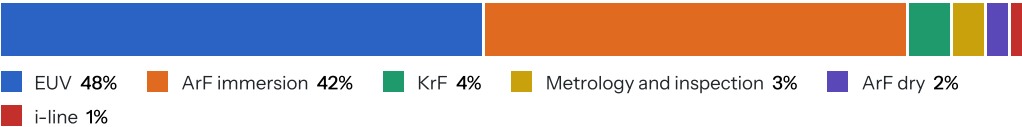
- VDL ETG builds the frames that suspend and position the mirrors ³⁶.

ASML says the production capacity of Zeiss, its sole supplier of optics, limits how many lithography systems it can build ¹.

In Japan, Nikon and Canon also make lithography tools. Nikon sold 22 new chip lithography systems in the year to March 2026, in a market it sizes at 570 units for 2025 ⁴. Its Precision Equipment business made an operating loss in the year to March 2026 ³⁷. Canon sold 234 chip lithography systems in 2025, 188 of them i-line and 46 KrF ⁵. Its range runs from KrF scanners to i-line steppers, including some built for advanced packaging ³⁸. Canon also makes a nanoimprint system, the FPA-1200NZ2C, which stamps the pattern instead of projecting it, down to a 14 nm linewidth ³⁹. Canon delivered one in 2024 to the Texas Institute for Electronics, to be used for research and prototypes ³⁹.

In January 2021 CSET, a research center at Georgetown University, found that the United States lacked firms in a few key parts of the chip supply chain, above all lithography tools ⁹.

ASML net system sales by technology, 2025 %



Source: ASML Q4 2025 investor presentation

36 VDL ETG builds complex frames for Zeiss. VDL Groep · 22 March 2019 ^[A]
web.archive.org/web/20240726075938/https://www.vdlgroep.com/en/news/vdl-etg-builds-complex-frames-for-zeiss

1 ASML HOLDING NV, Form 6-K report of foreign private issuer for the period ended 2025-12-31 (6-K). U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 25 February 2026 ^[A]
www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualreportx.htm

4 Financial Results: The Year Ended March 31, 2026. Nikon · 8 May 2026 · p. 8 ^[A] www.nikon.com/content/dam/web-assets/nikoncom/company/local/global/en/ir/ir_library/result/pdf/2026/26_all_e.pdf#page=8

37 Financial Results: The Year Ended March 31, 2026. Nikon · 8 May 2026 · p. 6 ^[A] www.nikon.com/content/dam/web-assets/nikoncom/company/local/global/en/ir/ir_library/result/pdf/2026/26_all_e.pdf#page=6

5 Canon Inc. FY 2025 Results. Canon · 29 January 2026 · p. 22 ^[A] global.canon/en/ir/conference/pdf/conf2025e.pdf#page=22

38 Semiconductor Lithography Equipment. Canon · Accessed 18 October 2026 ^[A] global.canon/en/product/indtech/semicon/

39 Canon delivers FPA -1200NZ2C nanoimprint lithography system for semiconductor manufacturing to the Texas Institute for Electronics. Canon · 26 September 2024 ^[A] global.canon/en/news/2024/20240926.html

9 The Semiconductor Supply Chain - Issue Brief. Center for Security and Emerging Technology (CSET) · 21 January 2021 · p. 4 ^[A] cset.georgetown.edu/wp-content/uploads/The-Semiconductor-Supply-Chain-Issue-Brief-1.pdf#page=4

Controls and China's answer

Export controls bar EUV from Chinese foundries ⁸. In September 2025 CSIS judged that EUV remained "firmly out of reach" for China despite massive state investment ⁸. For DUV scanners and other tools, the restrictions came in this order:

- **Dutch national licensing** of advanced DUV took effect on 1 September 2023 ⁴⁰.
- **A US rule** published on 25 October 2023 put certain immersion scanners bound for advanced chipmaking under US export rules if they held any American content at all ¹⁰. The rule did not apply if the country the scanners were first exported from already controlled them ¹⁰.
- **A partial license revocation** by the Dutch government, disclosed by ASML on 1 January 2024, stopped shipments of NXT:2050i and NXT:2100i immersion scanners to a few Chinese customers ⁴¹.
- **The Netherlands widened its licensing** from 7 September 2024 ⁴⁰. On 15 January 2025 it announced that from 1 April 2025 the license requirement would also cover a very limited number of further goods, among them specific measuring and inspection equipment ⁴².

⁸ Breakthroughs or Boasts? Assessing Recent Chinese Lithography Advancements. Center for Strategic and International Studies · 24 September 2025 [\[A\] www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography](https://www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography)

⁴⁰ The Netherlands expands export control measure for advanced semiconductor manufacturing equipment. Government of the Netherlands · 6 September 2024 [\[A\] www.government.nl/latest/news/2024/09/06/the-netherlands-expands-export-control-measure-advanced-semiconductor-manufacturing-equipment](https://www.government.nl/latest/news/2024/09/06/the-netherlands-expands-export-control-measure-advanced-semiconductor-manufacturing-equipment)

¹⁰ Export Controls on Semiconductor Manufacturing Items. Federal Register (Commerce Department; Industry and Security Bureau) · 25 October 2023 [\[A\] www.federalregister.gov/documents/2023/10/25/2023-23049/export-controls-on-semiconductor-manufacturing-items](https://www.federalregister.gov/documents/2023/10/25/2023-23049/export-controls-on-semiconductor-manufacturing-items)

⁴¹ Statement regarding partial revocation export license. ASML · 1 January 2024 [\[A\] www.asml.com/en/news/press-releases/2023/statement-regarding-partial-revocation-export-license](https://www.asml.com/en/news/press-releases/2023/statement-regarding-partial-revocation-export-license)

⁴² Klever: export controls on advanced semiconductor manufacturing equipment to be tightened. Government of the Netherlands · 15 January 2025 [\[A\] www.government.nl/latest/news/2025/01/15/klever-export-controls-on-advanced-semiconductor-manufacturing-equipment-to-be-tightened](https://www.government.nl/latest/news/2025/01/15/klever-export-controls-on-advanced-semiconductor-manufacturing-equipment-to-be-tightened)

- **The BIS Affiliates Rule**, issued by the US Bureau of Industry and Security, extended entity-list controls to affiliates owned 50 percent or more by listed entities from 29 September 2025 ¹¹. BIS then suspended it until 9 November 2026 ⁴³. Exporting goods covered by US export rules to a firm on the entity list needs a US license ¹¹.
- **The EU** added certain Dutch controls to the EU Control List in November 2025 ¹. ASML says this changed nothing for its immersion tools, because they already needed a Dutch license ¹.

China's share of ASML's net system sales fell from 41 percent in 2024 to 33 percent in 2025 ²⁴.

On DUV, Reuters reported in July 2026, citing one unnamed source, that Shanghai Aishengna Electronic Technology Group has started producing home-grown immersion DUV tools ⁴⁴. The firm was registered in August 2023 with 7 billion yuan of capital and two state shareholders, Shanghai Electric Holding and a Shanghai International Trust subsidiary ⁴⁴. It has no website and has taken in teams from SMEE, China's older scanner maker, and the startup Yuliangsheng ⁴⁴. SMEE is strongest in i-line, the coarsest kind of lithography tool, and even there holds only four percent of the world market ⁸.

On EUV there is less evidence. Reuters reported in December 2025 that a Shenzhen team of former ASML engineers had built a prototype that made extreme ultraviolet light but had printed no chip ⁴⁵. To print a chip, a machine also needs mirrors that carry that light to the wafer, and ASML's sole supplier of those mirrors is Zeiss ¹.

¹¹ Expansion of End-User Controls To Cover Affiliates of Certain Listed Entities. Federal Register (Commerce Department; Industry and Security Bureau) · 30 September 2025 [\[A\]](https://www.federalregister.gov/documents/2025/09/30/2025-19001/expansion-of-end-user-controls-to-cover-affiliates-of-certain-listed-entities) www.federalregister.gov/documents/2025/09/30/2025-19001/expansion-of-end-user-controls-to-cover-affiliates-of-certain-listed-entities

⁴³ One Year Suspension of Expansion of End-User Controls for Affiliates of Certain Listed Entities. Federal Register (Commerce Department; Industry and Security Bureau) · 12 November 2025 [\[A\]](https://www.federalregister.gov/documents/2025/11/12/2025-19846/one-year-suspension-of-expansion-of-end-user-controls-for-affiliates-of-certain-listed-entities) www.federalregister.gov/documents/2025/11/12/2025-19846/one-year-suspension-of-expansion-of-end-user-controls-for-affiliates-of-certain-listed-entities

¹ ASML HOLDING NV, Form 6-K report of foreign private issuer for the period ended 2025-12-31 (6-K). U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 25 February 2026 [\[A\]](https://www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualxreportx.htm) www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualxreportx.htm

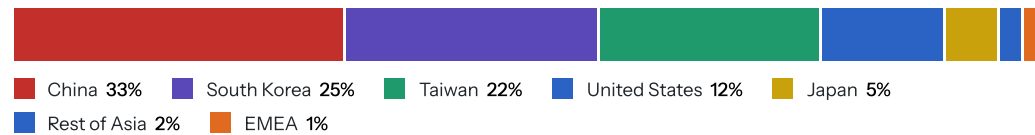
²⁴ ASML 2025 fourth-quarter and full-year results (investor presentation). ASML · 28 January 2026 · p. 9 [\[A\]](https://ourbrand.asml.com/m/3136300aa4999bcb1/original/2026_01_28_Presentation-Investor-Relations-Q4-2025.pdf#page=9) ourbrand.asml.com/m/3136300aa4999bcb1/original/2026_01_28_Presentation-Investor-Relations-Q4-2025.pdf#page=9

⁴⁴ China starts production of home-grown immersion DUV chipmaking tools, source says. Reuters · 28 July 2026 [\[B\]](https://www.reuters.com/world/china/china-starts-production-home-grown-immersion-duv-chipmaking-tools-source-2026-07-28/) www.reuters.com/world/china/china-starts-production-home-grown-immersion-duv-chipmaking-tools-source-2026-07-28/

⁸ Breakthroughs or Boasts? Assessing Recent Chinese Lithography Advancements. Center for Strategic and International Studies · 24 September 2025 [\[A\]](https://www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography) www.csis.org/blogs/strategic-technologies-blog/breakthroughs-or-boasts-assessing-recent-chinese-lithography

⁴⁵ How China built its 'Manhattan Project' to rival the West in AI chips. Reuters · 17 December 2025 [\[B\]](https://www.reuters.com/world/china/how-china-built-its-manhattan-project-rival-west-ai-chips-2025-12-17/) www.reuters.com/world/china/how-china-built-its-manhattan-project-rival-west-ai-chips-2025-12-17/

ASML net system sales by the region tools shipped to, 2025 %



Source: ASML Q4 2025 investor presentation

The chokepoint

If ASML stopped shipping, no fab anywhere could add EUV scanners. Tools already in fabs would keep printing for as long as they were serviced. In its 2025 annual report ASML said about 95 percent of the systems it had sold in the previous 30 years were still in use ¹. It guarantees service and spare parts for each platform until at least a committed date, subject to export controls ¹. ASML itself could not quickly rebuild its production, because Zeiss makes its optics and Trumpf its drive laser.

In July 2026 ASML put its 2026 capacity at around 65 standard (low-NA) EUV scanners and said it plans to add 30 percent for 2027 ⁴⁶.

For AI accelerators, EUV is the point of control, because it prints the finest layers, the ones that set how densely transistors and wires pack ¹⁸. TSMC expects the number of layers needing High-NA to rise, driven mainly by the more complex transistors that AI chips need ³¹.

FOUR THINGS TO REMEMBER

- Lithography prints each layer of a chip's circuit onto the wafer.
- Extreme-ultraviolet (EUV) light prints the finest layers in fewer steps than deep ultraviolet, but air and glass absorb it, so EUV machines work in a vacuum and use mirrors.
- ASML of the Netherlands is the only maker of EUV machines, and Zeiss alone supplies their mirrors.
- Export controls block EUV sales to Chinese chipmakers, and a Chinese prototype reported in December 2025 had printed no chip.

¹ ASML HOLDING NV, Form 6-K report of foreign private issuer for the period ended 2025-12-31 (6-K). U.S. Securities and Exchange Commission (filing by ASML HOLDING NV) · 25 February 2026 [\[A\]](https://www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualxreportx.htm) www.sec.gov/Archives/edgar/data/937966/000162828026011377/asml-2025xannualxreportx.htm

⁴⁶ Press Release Financial Results Q2 2026. ASML · 15 July 2026 [\[A\]](https://ourbrand.asml.com/asset/c8dbf3fc-4c5e-4406-83f6-27694b138245/Press-Release-Financial-Results-Q2-2026.pdf) ourbrand.asml.com/asset/c8dbf3fc-4c5e-4406-83f6-27694b138245/Press-Release-Financial-Results-Q2-2026.pdf

¹⁸ ASML EUV lithography systems. ASML · Accessed 9 September 2026 [\[A\]](https://www.asml.com/en/products/euv-lithography-systems) www.asml.com/en/products/euv-lithography-systems

³¹ ASML and TSMC Announce Initiative to Pioneer Industry Transition to Large-Format Photomasks for High NA EUV. TSMC · 8 September 2026 [\[A\]](https://pr.tsmc.com/english/news/3338) pr.tsmc.com/english/news/3338

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A company filings, governments, standards bodies, universities and research institutions; **B** SemiAnalysis, Reuters, the Financial Times and Nikkei Asia.

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