



## Stock story: ASML

The Netherlands company, with its lithography, is behind the world's best microchips.

**Lithography is the process by which powerful, fast and cheap microchips are made. Advances in how lithography systems imprint electronic circuitry patterns on silicon wafers govern enhancements in microchips and memory.**

In more detail, a lithography system is essentially a manufacturing machine whereby light is projected through a blueprint of the pattern to be printed. The system's optics shrink and focus the pattern onto a photosensitive silicon wafer (whereby a wafer is covered with chemicals that react with light). A series of other non-lithography steps are also carried out. To make a microchip, the process is repeated layer upon layer to create the components of the chip including the transistors, which are miniaturised semiconductor devices. The most advanced chips have up to 150 layers. So advanced is lithography, the latest chips are printed at a scale of nanometres, where a nanometre is one billionth of a metre. The A16 processor in the iPhone 14 will contain about 16 billion transistors.

Lithography is so key to making the best microchips, the US stops the company that makes the most advanced of these manufacturing systems from selling its product to China.

That company is ASML. The Netherlands-based group sold 309 lithography systems on the way to earning revenue of 18.6 billion euros in fiscal 2021. The most advanced ASML lithography system today costs about 160 million euros.

ASML, which formed as a venture between Philips and ASMI of the Netherlands in 1984 and listed in 1995, extended its industry leadership in lithography with its development of 'extreme ultraviolet' lithography, which is an advance on its 'deep ultraviolet' lithography system. This system is regarded as the best system for reliably printing transistors on wafers at high volume using a light wavelength of just 13.5 nanometres.

ASML's customers are microchip manufacturers such as TSMC of Taiwan, Intel, Micron, Samsung and SK Hynix of Korea. All semiconductor producers rely on ASML's equipment to produce the most advanced chips. From an investor's point of view, ASML's technology leadership is its core competitive advantage

that has given it an 83% stranglehold on one of the world's most crucial industrial systems. Nikon of Japan is ASML's nearest, even a distant, competitor.

Couldn't Nikon or another company invent a lithography system that betters that of ASML? Such questions have always existed but competitors have only fallen further behind over time. ASML's advantage is not in any singular aspect of the lithography system but across the many complex technologies, including the light source, optics, wafer stage, software, and process control, that need to come together in perfect unison. All of this would take incredible effort to replicate.

ASML has also set up a sophisticated production network underwritten by exclusive agreements whereby it outsources the making of components to about 4,000 companies around the globe. Many of the parts are complex. The mirrors in ASML's lithography machines, for instance, are the smoothest structures produced on earth. In fact, they are so flat, if someone expanded a mirror to the size of Victoria, the highest mountain would be 1 millimetre tall.

No rival, even if possessing a better design for a lithography system, could quickly or easily build a similar global manufacturing network. The biggest semiconductor manufacturers in the world have a vested interest in ASML's commercial success.

At the very least, it seems ASML is poised to hold onto its market dominance for the foreseeable future; in recent years, the company has widened its lead over competitors as it achieved double-digit sales growth. The stock is found in the Magellan global portfolio because ASML has the potential to generate excess returns on capital for the foreseeable future.

Even the best-placed companies, however, face challenges. Among threats to ASML, the shrinking of transistors could reach its physical limits in terms of tininess and finesse. If so, it would buy time for rivals to one day catch up to ASML's lithography standards. But somehow microchip-related technology keeps advancing. Another threat is the Chinese government. Beijing understands the strategic worth of microchips and is investing billions of dollars to catch up with the West and is willing to ignore patents to do so. ASML warned in February that an affiliate of a Chinese company it had accused of stealing its trade secrets is marketing products that could infringe on its

intellectual property rights. Hence Washington is keen to keep ASML's lithography systems out of China.

ASML, however, has a record of delivering ever-improving lithography machines on time to its customers. If the company keeps doing that, investors will be looked after too.

*Sources: ASML Annual Report 2021, company filings, Bloomberg and Dunn & Bradstreet.*

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