

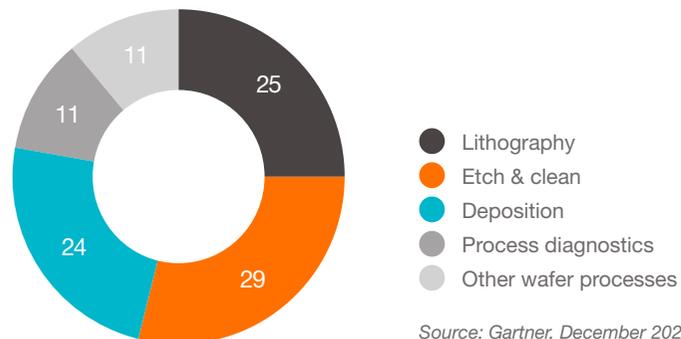
ASMI AT A GLANCE

ASM International N.V. (ASMI) is a leading supplier of semiconductor wafer processing equipment and process solutions. Our customers include all of the top semiconductor device manufacturers in the world. Semiconductor chips sit at the heart of almost every electronic device we use today, and ASMI equipment is a key technology used to manufacture many of these chips.

WHAT WE DO

ASMI supplies wafer processing equipment to the leading semiconductor manufacturers. The total market for wafer fab equipment (WFE) amounted to US\$63 billion in 2020 (Gartner, December 2020). Within wafer processing equipment, the major segments include lithography, etch & clean, deposition, and process diagnostics. Our focus is on deposition equipment, which comprises about a quarter of WFE. We are a key player in the deposition equipment segments for atomic layer deposition (ALD) and epitaxy, and a focused niche player for PECVD and vertical furnaces.

WAFER FAB EQUIPMENT in %



At ASMI we design, manufacture, sell and service our deposition tools to supply our customers with advanced technologies for the production of semiconductor devices, or integrated circuits (ICs). Semiconductor ICs, or chips, are a key technology enabling the advanced electronic products used by consumers and businesses everywhere. Our tools are used by semiconductor manufacturers in their wafer fabrication plants, or fabs. Furthermore, we provide maintenance service, spare parts, and process support to our customers globally at their fabs, which typically operate on a 24-hour basis.

LOGIC, FOUNDRY AND MEMORY MARKETS

The semiconductor market can be split into three primary segments: logic, foundry and memory. ASMI supplies equipment to the leading semiconductor manufacturers in all of these segments:

- › The logic market is made up of manufacturers that create chips, such as microprocessors, that are used to process data and are used in smartphones, laptops and computers;
- › The foundry market consists of businesses that operate semiconductor fabrication plants to manufacture the designs of other so-called fabless semiconductor companies; and
- › The memory market covers manufacturers that make chips that store information either temporarily, such as Dynamic Random Access Memory (DRAM), or permanently, such as NAND non-volatile memory.

There are other smaller, yet still important market segments for which ASMI supplies equipment, such as analog and power. Analog and power semiconductors are devices used in a wide range of electronic systems for mobile products, automobiles, telecommunications, and other applications. Wafer manufacturing is another relatively small segment that we participate in, for the processing of bare silicon wafers before they are delivered to semiconductor fabs.

Our customers' goal is to build faster, cheaper, and increasingly more powerful semiconductors for each new technology node. We work closely with our customers to make this a reality, forging mutually beneficial partnerships to help develop their technology roadmap. Through our intensive R&D programs and customer co-development, we continuously improve and extend the capability of our products and processes to meet these advanced technology roadmaps, increase productivity and lower operating costs per wafer. The result is value creation for our customers. While doing so, we work on the edge of what is technologically possible. This creates a very attractive professional and learning environment for our employees and generates long-term value for all of our stakeholders. We serve society by helping our customers to produce the chips needed for advanced electronics that deliver a world of improvements and opportunities. The world around us shows an increasing need for the use of more applications and lower energy usage. For example, increasingly complex processor chips are used for artificial intelligence applications and advanced chips used in 5G mobile phones require lower power usage, for which our high-k ALD process is beneficial.

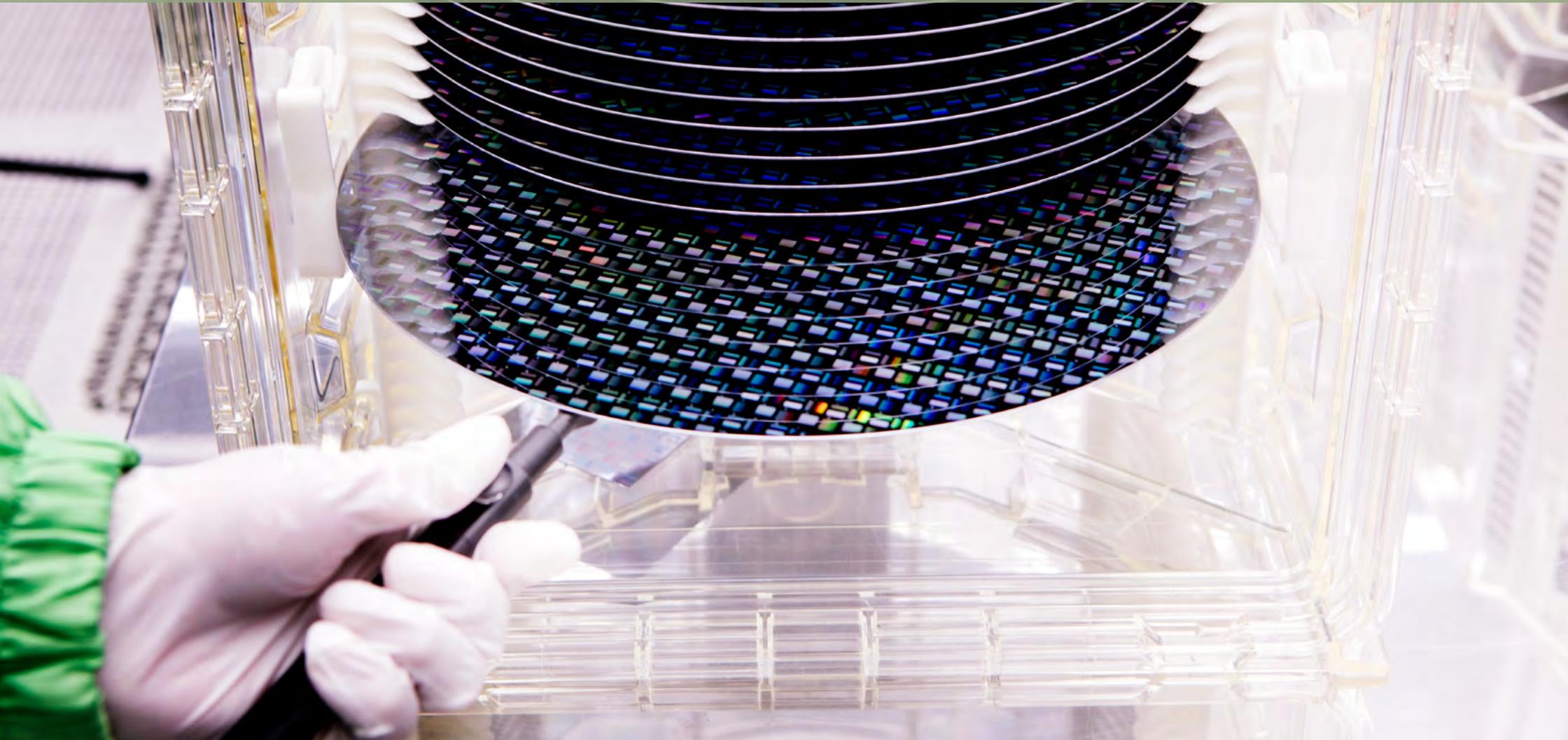
BASICS OF SEMICONDUCTOR MANUFACTURING

The process of making semiconductor chips at our customers' fabs is both highly complex and very costly. Semiconductor fabs house a large set of wafer-processing equipment which perform a series of process steps on round silicon wafers, which are typically 300mm in diameter. The equipment is operated in cleanrooms, which filter the air to avoid contamination from small particles that could negatively affect the circuitry on the chips.

Many individual steps are performed using various types of wafer processing equipment to create a semiconductor chip, including photolithographic patterning, depositing thin-film layers, etching

to remove material and thermal treatments. Our systems are designed for deposition processes when thin films, or layers, of various materials are grown or deposited onto the wafer. Many different thin-film layers are deposited to complete the full sequence of process steps necessary to manufacture a chip. After testing the individual circuits to ensure correct performance, the chips on the wafer are separated and then packaged in a protective housing before ultimately becoming part of a set of semiconductor chips on circuit boards within an electronic product.

ASMI is a key player in the ALD and epitaxy segments, and a niche player in vertical furnace and PECVD. The characteristics of those activities are described in the following pages.



ALD

ASMI has a leading position in ALD, which is our largest product line and continued to account for more than half of our equipment revenue in 2020. ALD is the most advanced deposition method available in the market and makes it possible to create ultra-thin films of exceptional material quality, uniformity and conformality.

ALD is expected to be the fastest growing deposition market segment for at least the coming 3-5 years. As the industry moves to smaller geometries, more complex device structures, and new materials, the need for more precise and conformal film deposition will further increase, which is expected to drive the growth of the ALD market.

We are the leader in the logic/foundry segment of the ALD market and serve nearly the whole addressable market. In 2020, the transition to the most advanced 10nm node in logic and 5nm node in foundry has once more confirmed this position. At each new advanced technology node, a substantially higher number of process steps use ALD, both for new applications and replacing conventional deposition methods.

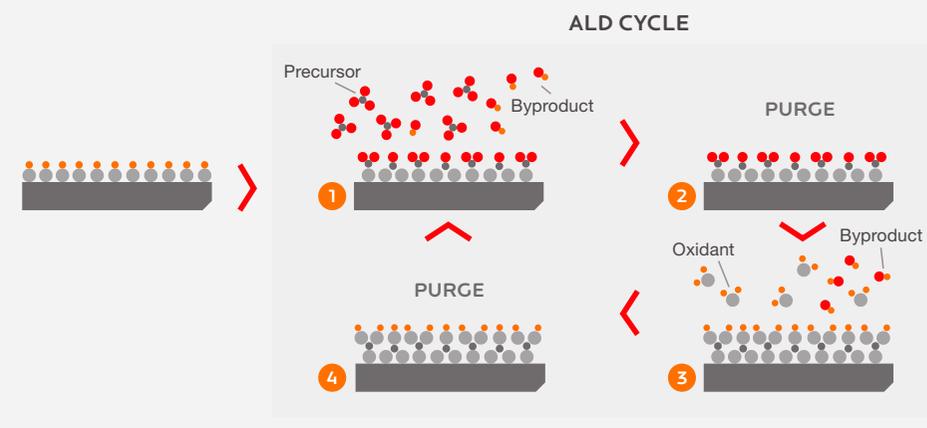
Because we entered the ALD memory market at a later stage, the part of the addressable market we are serving is smaller. Despite this, we have leading positions in selected parts of this market. In DRAM, ALD requirements have been expanding from multi-patterning to new non-patterning applications. For example, technology challenges require ALD high-k layers for the control transistors in the most advanced DRAMs. In 3D-NAND, the device complexity is increasing as the industry moves to higher stacks, such as the transition from 96 layer to 128 layers. This in turn will gradually increase the need for ALD. We are strongly focused on expanding our position by broadening our addressable market in ALD, including parts of the market that we previously did not address.

Atomic Layer Deposition

ASMI first started developing ALD in 1999 through the acquisitions of Microchemistry, and later Genitech (ASM Korea). Around 2007 we had our first breakthrough in mainstream semiconductor applications when a leading player in the logic segment introduced ALD into high-volume manufacturing for high-k metal gate technology. Since then, the use of ALD has steadily increased to a multitude of different applications across the logic, foundry and memory segments. Over time, we have substantially expanded our position and we now supply our ALD solutions to all of the top 10 capital spenders in the semiconductor industry.

In recent years we have introduced two new ALD products, the Synergis thermal ALD tool and the XP8 QCM tool for plasma enhanced ALD applications. Both products offer a wide range of processes with high productivity.

ALD is a leading edge technology capable of depositing ultra-thin films of exceptional flatness, material quality and uniformity. ALD allows us to deposit thin films atom-by-atom, meaning we can deliver atomic-scale thickness control, high-quality deposition film properties, and large area uniformity, even on complicated features on the wafer, such as fins and deep trenches. Such precision enables us to use materials that previously could not be considered, and develop 3D structures that are vital to the future of electronics. The ALD process is a saturated surface-controlled layer-by-layer process where layers are formed during reaction cycles by alternately pulsing precursors and reactants, and purging with inert gas in between each pulse. Deposition thickness is precisely controlled by varying the number of cycles.



EPITAXY

We have a solid position in the market for epitaxy or Epi. Epitaxy is a process for depositing highly controlled silicon-based crystalline films. It is one of the fastest growing parts of the deposition market, with the number of Epi steps increasing as logic/foundry customers move to smaller nodes.

From a solid position in the niche market for power devices, we have successfully broadened our position in recent years in advanced-node CMOS applications, which represents the larger part of the Epi market. Our Intrepid ES 300mm epitaxy tool, for advanced-node CMOS logic and memory applications, offers an innovative closed-loop reactor temperature control system enabling precise process control, high productivity, and low cost per wafer.

Intrepid ES was selected by a leading foundry customer for an Epi layer at the 7nm node, and its use has expanded for multiple layers at the 5nm node. For improved epitaxy film performance, we introduced the Previuum process module, which is integrated together with Intrepid Epi process modules for pre-epi wafer surface cleaning. The surface clean process creates a pristine silicon surface for defect-free Epi films, critical for achieving the most advanced node transistor performance requirements.

Epitaxy, alongside ALD, is an important growth engine in our portfolio.

PECVD AND VERTICAL FURNACES

We hold niche positions in the PECVD and vertical furnace market segments. The relatively large size of these markets makes this part of the market attractive to ASMI. Vertical furnaces utilize a batch configuration, meaning a large number of wafers are processed simultaneously for productivity and cost savings. Our furnace tools are designed with dual batch reactors for even more productivity.

In PECVD, our key position is on low-k for advanced logic interconnects. Our PECVD processes are offered on our high-productivity XP8 platform and include a broad range of dielectric films for various low temperature deposition applications such as interconnect layers, passivation layers, and etch stop layers.

We invest selectively in the PECVD and vertical furnace markets. Combined with healthy development in the market segments that we address, we have seen solid revenue increases in recent years.

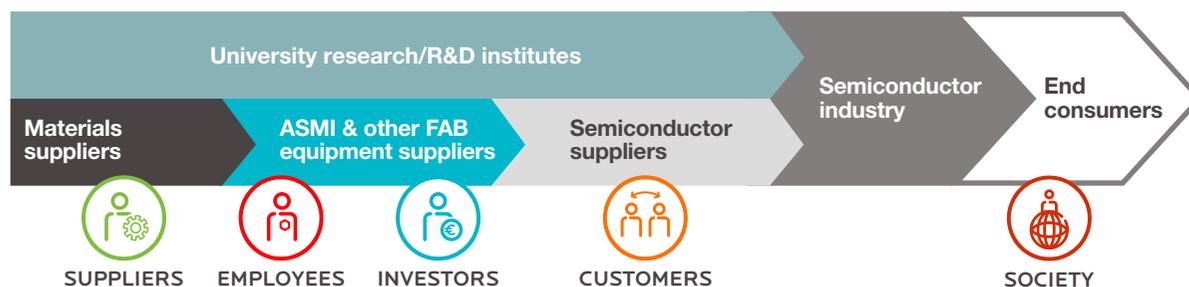
THE WORLD AROUND US

The world around us is digitalizing quickly, with our way of living and working becoming more and more dependent on technology. As society becomes increasingly automated and connected, we rely on a broad range of electronic devices to control our homes, offices, vehicles, and communications. Advanced semiconductors play a key role in creating this more digitized world. As a result, new end market products and applications are developing, including:

- › Mobile and cloud computing, and big data analysis;
- › Artificial intelligence;
- › Autonomous vehicles;
- › Internet of Things for smart connected devices; and
- › Ultrafast wideband communication networks (5G).

This connected and automated world is leading to a growing demand for massive amounts of data, requiring ever-greater computer processing power and storage, capable of analyzing and acting on the data quickly and effectively. Making this possible requires a constant increase in processing power of semiconductor chips. And it is our technology that is playing a vital part in making it all possible.

OUR POSITION IN THE INDUSTRY



In 2020, the semiconductor industry was driven by a US\$2.1 trillion global electronics industry (VLSI Research, December 2020) that required approximately US\$381 billion of semiconductors ICs, which was up about 7% compared to 2019. The increased need for semiconductors was driven by growing demand for data processing in the work-from-home economy, and by higher prices in memory devices, as the supply and demand of the memory market began to achieve a balance. In turn, the semiconductor industry supported the approximately US\$90 billion semiconductor capital equipment industry, which supplies the required production systems and services. Wafer fab equipment spending was up about 18% in 2020, reaching US\$62.7 billion (VLSI Research, December 2020), due to increased spending for advanced logic and foundry, as leading customers stepped up their spending on the most advanced nodes. China, in particular, showed solid spending growth in 2020.

The constant drive for smaller, more powerful and more energy-efficient devices puts further pressure on our industry at each new technology node. Moving to new nodes is increasingly difficult, with challenges in new materials, new device architectures, and complex process steps, which are driving more ALD and epitaxy process steps.

Consequently, we see that each new technology node requires increasing process equipment investments. Because the semiconductor production market is so capital intensive, only a limited number of companies are able to participate, meaning that our customer base has become smaller over time. It is only more recently that we have seen some new customers from China enter the semiconductor space, albeit not yet in the most advanced nodes. Our customers are increasingly dependent on the R&D investments and performance of their equipment suppliers. Accordingly, we maintain a close, mutually beneficial business relationship with our customers, which includes a cooperative development environment, linking technology roadmaps and equipment performance requirements.

While the market has evolved to a smaller number of large semiconductor manufacturers, it is still highly global with major fabs, which we support throughout the US, Asia and Europe. Notably, the China region has become a significant growth area for new fab investments, for both domestic Chinese companies and also foreign companies building fabs there for the local market. To better serve the growing China market, we continue to increase our investment in people and support infrastructure in China. In 2020, our equipment revenue in China increased significantly, more than doubling from 2019.

The world is more focused than ever on Environmental, Social and Corporate Governance (ESG) and the way companies conduct business. Expectations across our landscape of stakeholders are increasing. From our customers and shareholders, to our employees, our ESG conduct is increasingly important. These topics have our full attention and we are engaged with external stakeholders so that we have understood and incorporated them appropriately into what we do.

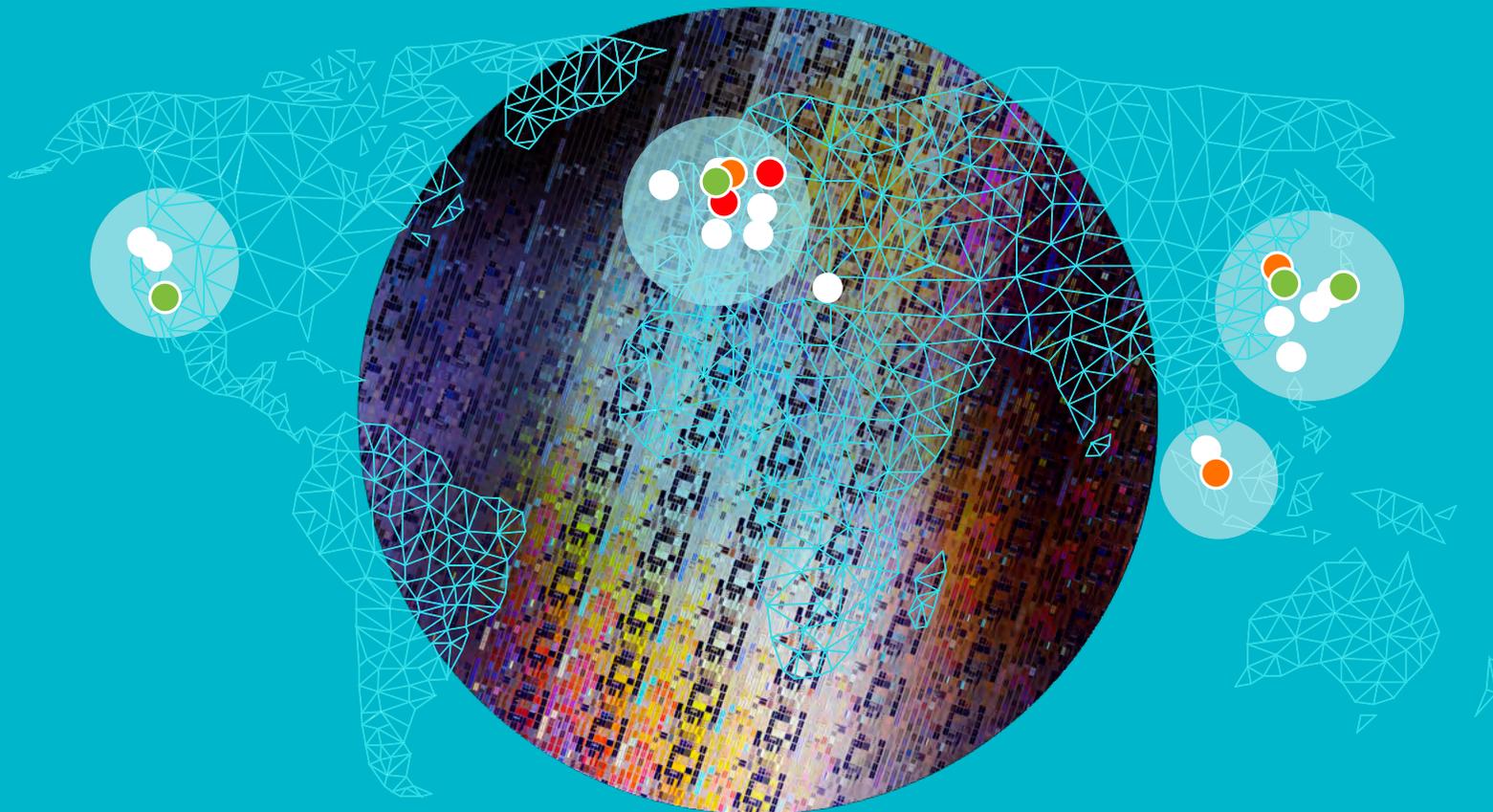
OUR PURPOSE

It is our purpose to lead innovation for the semiconductor industry:

- › Our deposition technology helps our customers address their device and process development challenges and as such is a key enabler of innovations in semiconductor technology;
- › By partnering with our customers to develop new materials, processes, and technologies that support their roadmaps, we enable innovations in semiconductor technology which in turn help create new improved semiconductor devices;
- › By serving the leading chipmakers, we maintain an understanding of the important requirements of the next generation of device roadmaps, enabling us to develop value-added solutions to the industry's critical issues, creating an attractive professional and learning environment for our employees;
- › Our key contribution to society at large is that our technology helps keep the industry roadmap moving forward, driving innovation in the broader electronics markets; and
- › We strive to achieve this in a responsible way, aligned with the priorities of our stakeholders.

This value creation benefits not only our customers and employees, but also businesses and consumers that benefit from the resulting new products and available technologies used throughout society. And our value-added innovations create attractive possibilities for our suppliers and attractive returns for our shareholders.

THE WORLD IN WHICH WE OPERATE



RESEARCH FACILITIES

- **Belgium** - Leuven
- **Finland** - Helsinki

BUSINESS UNIT AND PRODUCT RESEARCH AND DEVELOPMENT FACILITIES

- **Japan** - Tokyo
- **The Netherlands** - Almere
- **South Korea** - Dongtan
- **US** - Phoenix

MANUFACTURING FACILITIES

- **The Netherlands** - Almere
- **Singapore** - Singapore
- **South Korea** - Dongtan

CORPORATE, SALES AND SERVICE OFFICES

- **China**
- **France**
- **Germany**
- **Ireland**
- **Israel**
- **Japan**
- **Malaysia**
- **The Netherlands**
- **Singapore**
- **Taiwan**
- **US**

For a complete overview of all our locations, please visit our corporate website: www.asm.com.