2024

OPTICS & PHOTONICS

Global Industry Report

SPIE.

Introduction

Light is everywhere, playing a vital role in our daily lives. Energy comes to Earth in the form of sunlight. Light enables plants to synthesize foods. Light is the basis of the technology that enables computers and smartphones to connect over the internet. Light can also be a tool: focused light can cut metals or be used in medicine to perform surgery.

Light-based technology also fuels the world's economic growth engine. Its applications affect almost every facet of modern life, from renewable energy and climate monitoring to video streaming, and from gene therapy to artificial intelligence (AI).

The total monetary value of all light-enabled products and related services (such as cloud computing, streaming, and e-commerce) comprise over 15 percent (~$16 trillion USD) of worldwide economic output, measured as global gross domestic product or GDP[1,2,3]. According to the International Monetary Fund (IMF) the value of all the finished goods and services produced worldwide (global GDP) is $106 trillion (USD) in 2023.[4]

Accelerating innovation coupled with an incredibly diverse range of light-enabled applications and markets has enabled growth of photonics technology revenues to consistently outpace gains in global GDP. Photonics enabled technologies and services will continue to increase their share of the global economy.

Underpinning all the light-enabled products and services are core photonics components, ranging from raw materials used for lenses and displays to image sensors, and from light-emitting diodes (LEDs) to lasers. This SPIE global industry report, now in its tenth year, provides an in-depth assessment of the global manufacturing base that produces these core components.

At the report's inception in 2012, blue and green laser diodes were just becoming a commercial reality, compact lidar systems were emerging for self-driving vehicles and for monitoring wind turbines, and the iPhone 5 was introduced. The years since have brought significant advances on multiple fronts including quantum technologies, renewable energy, and AI platforms. The National Ignition Facility (NIF) made history by successfully producing a nuclear fusion reaction, and the iPhone 15 appeared in 2023.

With 10 years of accumulated data, this report delivers a unique perspective on the thriving global ecosystem of core photonics components manufacturing, the companies involved, where they are based, their revenues, and the number of jobs created globally by optics and photonics components production. This report also highlights key industry trends.

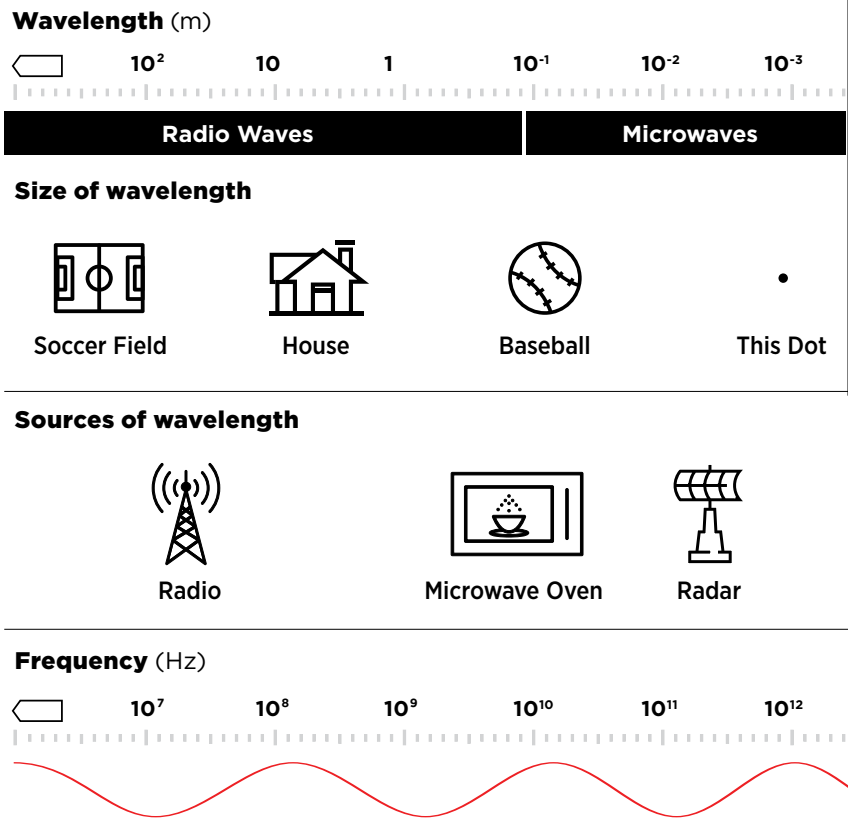
Photonics in our world

Photonics is the science and application of light; it is the technology of generating, controlling, and detecting light. The characteristics of the waves of light or individual photons that make up light enable exploration of the universe, curing diseases, and even solving crimes. Photonics is so ubiquitous in our daily lives that the 21st century has been called the "Age of the Photon."

Scientists have been studying light for hundreds of years, but it was only in the 17th century that Sir Isaac Newton showed that white light is comprised of different colors. The colors of the rainbow are only a small part of the entire wavelength range of light, called the electromagnetic spectrum. Photonics covers the full electromagnetic spectrum, from gamma rays to radio, including X-rays, ultraviolet (UV), and infrared (IR) light.

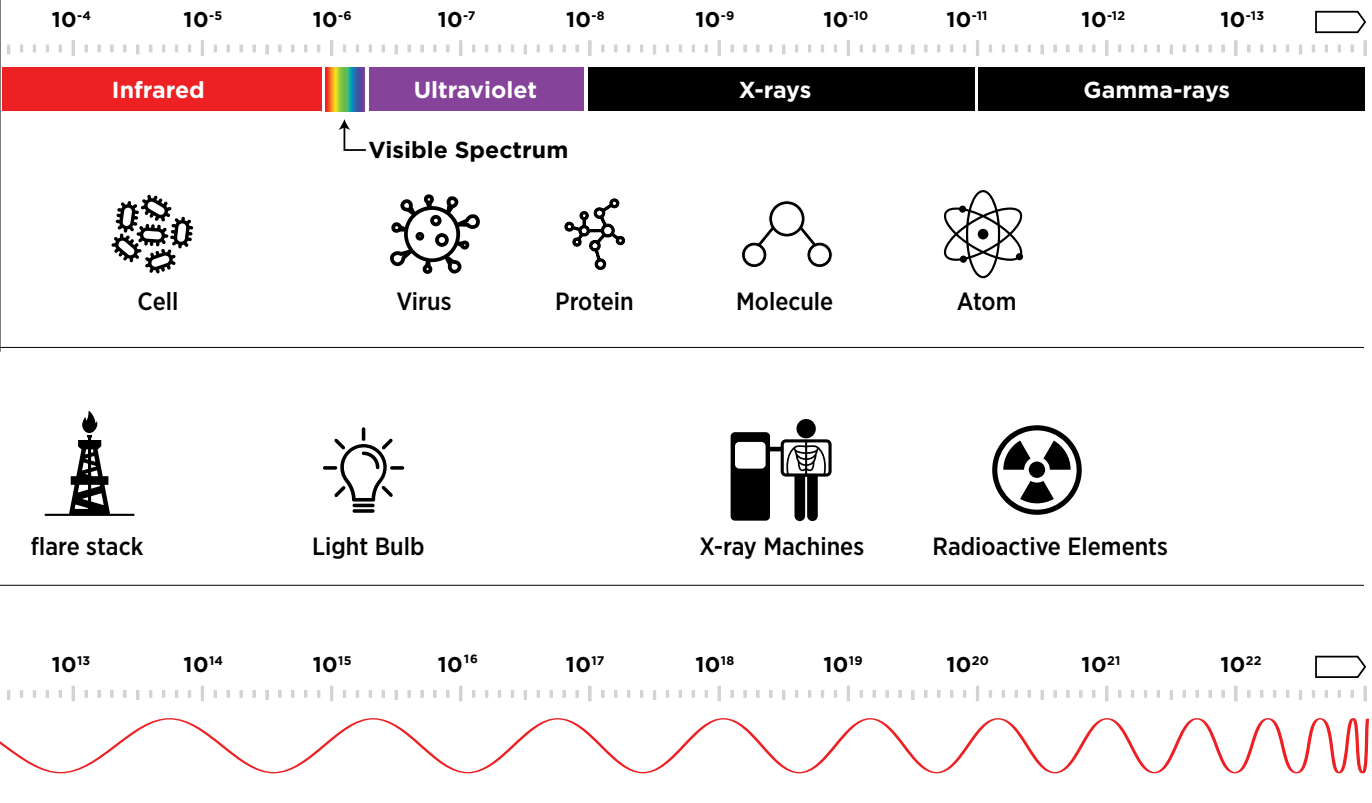
At the beginning of the 20th century, Max Planck, and later Albert Einstein, proposed that light was a wave as well as a particle, a very controversial theory at the time. How can light be two completely different things at the same time? Experimentation later confirmed this duality in the nature of light. The word "photonics" appeared around 1960, which is when Theodore Maiman first demonstrated the laser.

Electromagnetic Spectrum



Both Plank (1918) and Einstein (1922) were awarded Nobel Prizes in Physics for the discovery of energy quanta and contributions to theoretical physics respectively. Many other Nobel Prizes have been awarded for work arising from or contributing to photonics, most recently for work related to the generation of attosecond pulses of light (an attosecond is one quintillionth of a second) that enable scientists to study the motions of subatomic particles.[5]

Photonics is everywhere: in consumer electronics (smart phones, AR/VR headsets, smart doorbells), telecommunications (fiber optics, lasers, Li-Fi), health (eye surgery, medical imaging, wearables), manufacturing (3D printing, laser cutting, robotics and vision), defense and security (directed energy, night vision, satellites, autonomous systems), and sustainability (climate monitoring, solar photovoltaics, lidar for wind turbines, LED lighting) to name a few examples.



Summary of key findings

- Global annual revenues from production of optics and photonics core components reached $368 billion in 2022. Up 26 percent from 2020 and well above global GDP growth of 18 percent over those two years.
- Production of optics and photonics core components is a global enterprise spanning at least 52 countries.
- 4,706 manufacturing companies produced core photonics components in 2022:
  - » 84 percent are small- to medium-size enterprises (SMEs).
  - » 85 percent of all core optics and photonics components revenues are generated by only ~5 percent of the companies.
- Core components production employs more than 1.25 million people worldwide.
- The global share of the photonics components business has shifted during the past 10 years, with increased dominance of companies headquartered in China, Korea, and Taiwan.
- Japan-headquartered companies in 2022 generated the most revenue and employed the largest number of people in the photonics components manufacturing industry.
- Since 2012 the photonics components industry has grown at a rate of more than twice (2x) global GDP over the same period.
- Global annual revenues for photonics-enabled products is projected to exceed $2.39 trillion in 2023.
- Production of photonics-enabled products generates more than five million jobs worldwide.

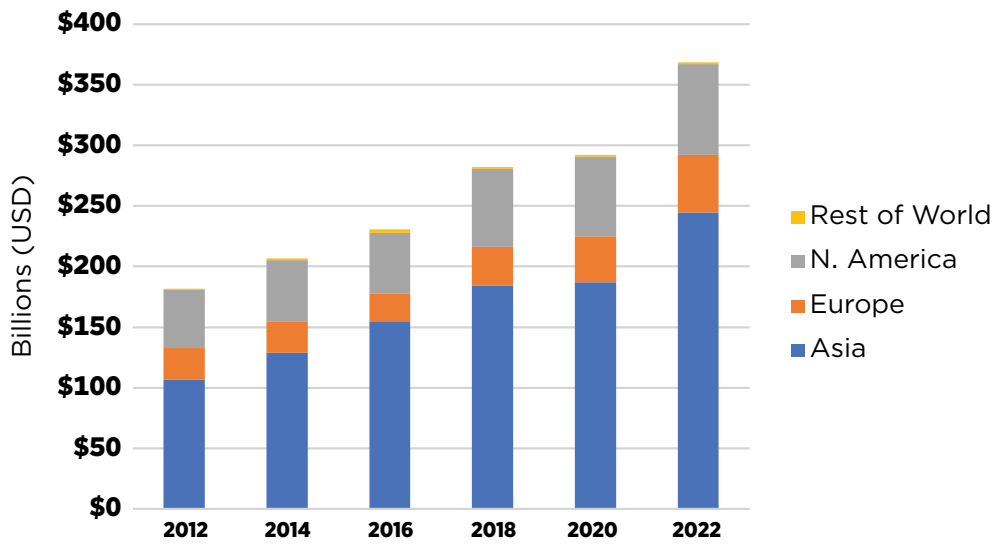
Global photonics components production

Industry Trends: Companies, Revenues, and Jobs

	2012	2014	2016	2018	2020	2022	10-year CAGR
Photonics revenue ($B)	**$182B**	**$206B**	**$230B**	**$282B**	**$292B**	**$368B**	**+7.31%**
Photonics jobs (K)	**729K**	**910K**	**997K**	**1,144K**	**1,158K**	**1,235K**	**+5.41%**
Companies	**2,714**	**3,193**	**3,768**	**4,298**	**4,843**	**4,706**	**+5.66%**

Industry performance has been impressive over the past decade. Components revenues have grown at a rate of more than twice that of global GDP, with a compound annual growth rate (CAGR) exceeding 7.3 percent. Employment has also increased steadily since 2012, the first SPIE study year. While most of the revenue gain occurred in Asia-headquartered firms, in particular China, Korea, and Japan, other key regions also saw moderate growth over the period. The impact of the global pandemic is evident in the growth slowdown for 2020.

Revenue Growth Trend by HQ Region



The photonics marketplace

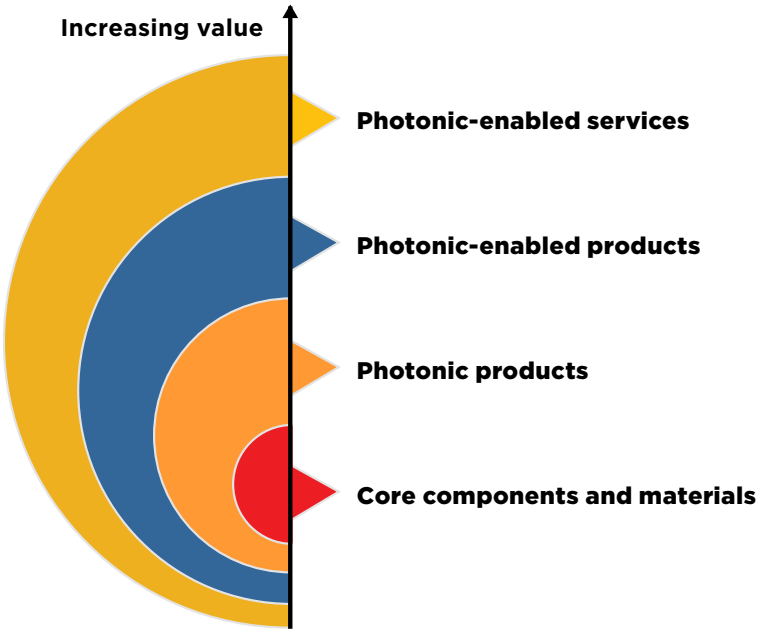
Photonics is not a market or an industry, but a collection of technologies based on light that creates or enables many end-use applications and markets. It is often convenient, however, to describe the collection of entities that develop, manufacture, and distribute optics and photonics components, systems, and light-enabled products as the "photonics industry."

The industry is global with many large companies, though most are relatively small. Photonics is a powerful driver of the global economic growth engine, and it is gaining significance in the world's economy.

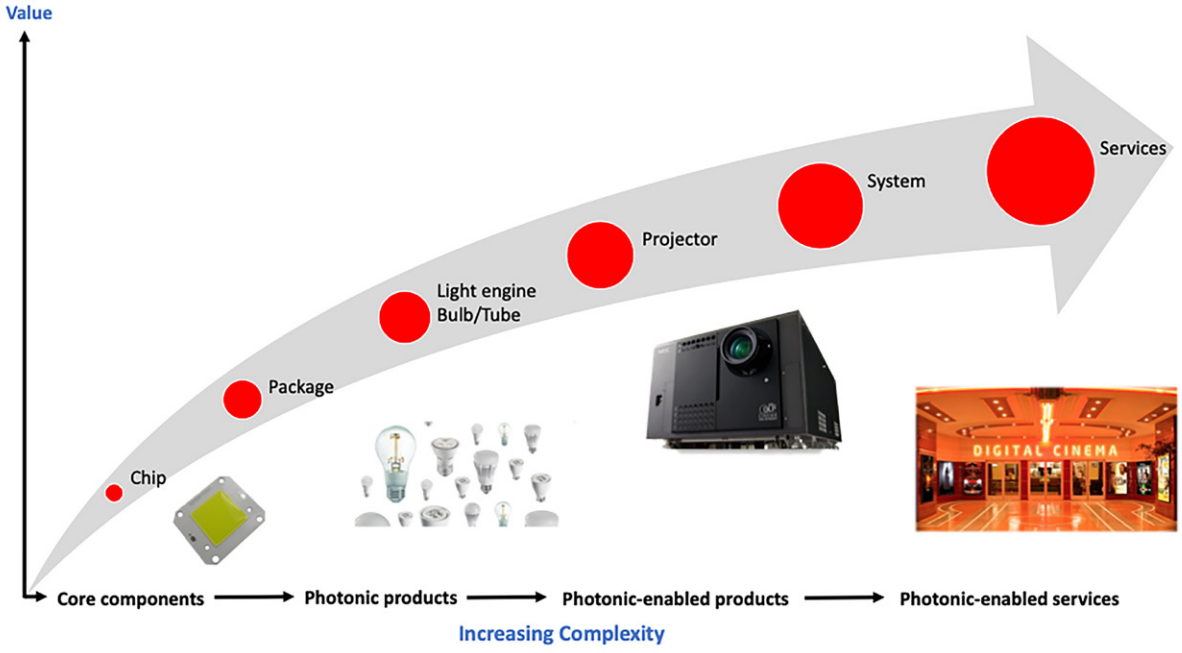
The photonics value chain

Any assessment of the photonics industry must consider the photonics value chain. That is, the practice of taking raw materials and adding value to them through various processes to create a finished product.

Photonics Value Chain



Photonics Value Chain Example



The photonics value chain starts with raw materials like glass and semiconductor substrates and progresses through optical components and subsystems to photonics products and photonics-enabled products such as smart phones, autonomous vehicles, lighting systems, quantum computers, and AR/VR vision systems.

The global photonics-enabled marketplace is based on these end-use products, which themselves also support photonics-enabled services, which are typically based on the internet. The internet relies on light to transport its data, either over optical fiber or free space. The enabled services include, for instance, cloud computing, streaming audio and video, and e-commerce.

Each level of the value chain has higher value than the previous one, so the total revenues associated with the enabled services, for instance, are much larger than those derived from the core components.

Along this value chain, adjacent industry sectors such as software development, auto manufacturing, healthcare, consumer products, entertainment, and even space may benefit and grow from related opportunities.

The complexity of the categories increases with the higher value. Among the enabled products, lighting systems serve a different set of end-users with unique market dynamics and regulatory environment than, for instance, medical imaging scanners, or data centers. As a result, each photonics-enabled market sector moves independently, which means that measuring the size and impact of each one can be a significant undertaking.

SPIE is uniquely positioned to understand and evaluate these markets with our deep understanding of the industry, world-class database, and global footprint.

Measuring the photonics marketplace

There is no clear or widely accepted definition of the photonics market or industry, even though thousands of entities use optics and photonics technology every day.

Many of the largest users of light-based technology do not think of themselves as photonics companies.

» Smartphones use LEDs, lasers, cameras, and displays. The internal chips are made using lasers. Yet smartphone manufacturers would not identify themselves as photonics companies.

Governments do a poor job of tracking photonics-based technology revenues.

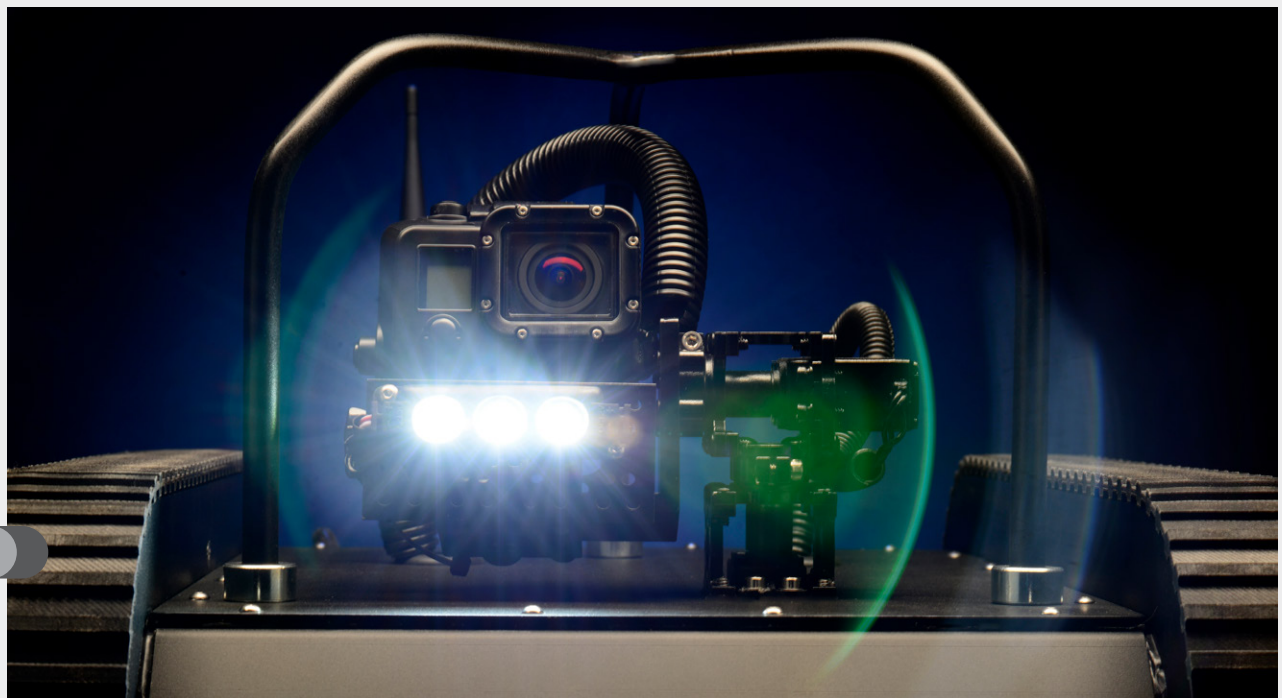
» Economic tracking codes in the USA (NAICS) and in Europe (NACE) do not have a category for photonics.[6]

» In a sampling by SPIE, 2,750 photonics companies used 259 different NAICS codes.

As a result, although market estimates and economic impact assessments are an essential tool for understanding and promoting the photonics business, the conclusions of such estimates can vary widely and comparing them almost impossible.

SPIE makes its industry assessments as transparent as possible. We also work with multiple other entities worldwide to assist them in making their own national assessments that are consistent in methodology. A major benefit of this approach is that these studies use a common taxonomy and the outcomes can be directly compared, resulting in a more consistent worldwide picture of our industry.

Details of the methodology used to compile the information in this booklet can be found online at www.spie.org/market-intelligence.



The SPIE global industry profile

An apparently simple method of assessing the size of an industry (in terms of revenues) is to sum up the value of all its products produced. In the auto industry, for instance, one could add up the value of all the cars produced. While this does not account for service and other related revenue-producing activities, it may at least provide a basic estimate.

This product-focused approach is not practical in industries that are more diverse, such as photonics, where multiple photonics companies make multiple different components that feed multiple end-use markets.

At SPIE, by focusing on the core components and the companies that produce them, we have been able to leverage our comprehensive understanding of the photonics business to characterize the global production of photonics components. These core components underpin all photonics products and services. Our knowledge base includes the most up-to-date, comprehensive database of global photonics organizations, enabling a consistent, global assessment of the status and trends in the photonics industry.

Our sixth biennial assessment of the photonics components business has enabled SPIE to demonstrate the size and breadth of components production worldwide, the number of jobs created, trends over time and how the photonics industry compares to the global economy, and an understanding of some of the structural factors such as the role of large companies versus small.

Photonics components production

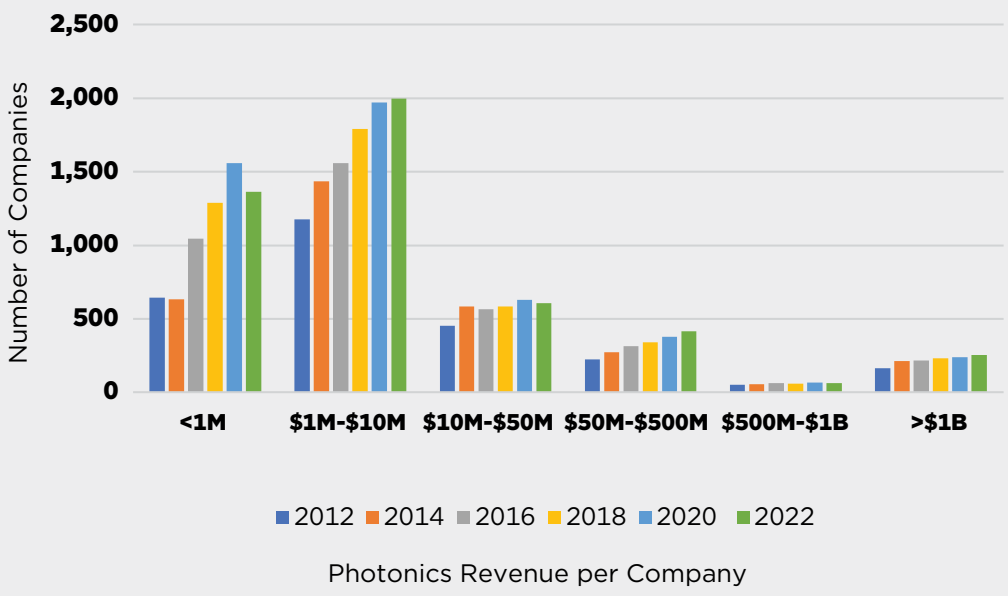
Common to all of the photonics-enabled products and end-use markets are the basic raw materials and core optical components that are the building blocks of photonics systems. These core components represent the lowest value, yet essential, photonics parts in the value chain and include LED and laser chips, optical glass, detectors and image sensors, lenses, prisms, optical filters, gratings, and optical fibers.

The same component can often serve more than one end-use or enabled market. For this reason, our analysis of the core photonics components business is made without regard to the end-use application of a given component. Our goal is to build a profile of the entire core components industry in terms of its revenues, geographical diversity, employment, and structure. The end-use or enabled applications underpinned by these core components are addressed later, starting on page 21.

Producers profile

Most photonics components manufacturers are small- and medium-size entities, meaning their annual revenues are less than $50 million.[6] In fact, about 84 percent of companies are SMEs — a percentage that has grown over the years as new companies have entered the market.

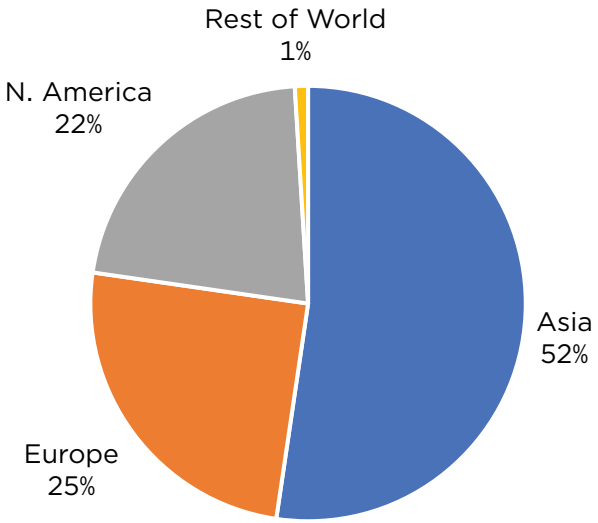
Company Size Distribution Trend by Revenues (USD)



Photonics Revenue per Company

In 2022 — based on our selection methodology — some 4,706 companies were making photonics components. Firms headquartered in Asia accounted for 52 percent of these, followed by Europe (25 percent) and North America (22 percent).

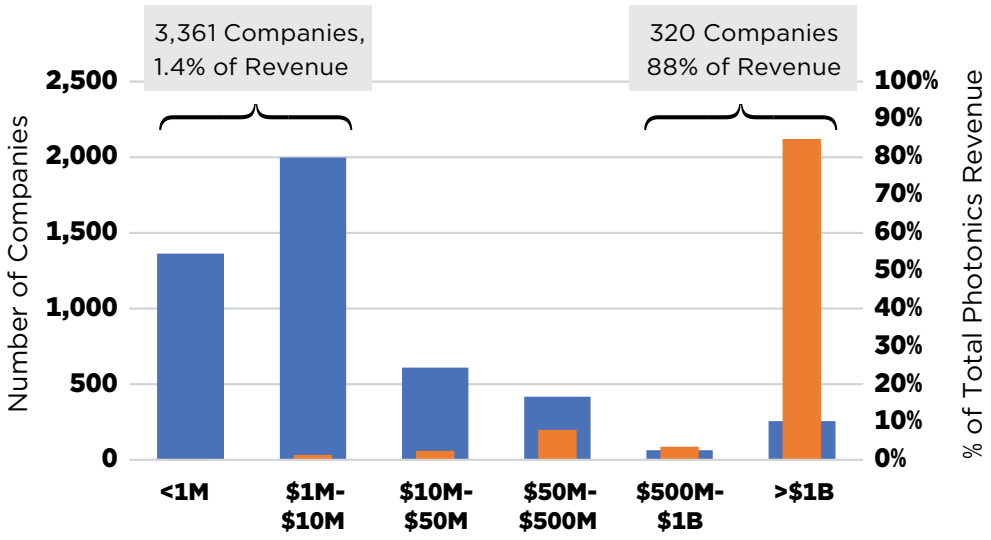
Global Distribution by Company HQ of Components Producers (2022)



Although most of the companies are SMEs, the larger entities generate the majority of the photonics revenues. In fact, only ~5 percent of all companies, including such household names as Samsung, Corning, Nikon, and Carl Zeiss, generated more than 85 percent of global photonics revenues in 2022.

While the smaller companies produce only ~3 percent of global revenues, they play a vital role in feeding the technology innovation pipeline so their impact on the industry should not be underestimated.

Manufacturers Grouped by 2022 Revenue



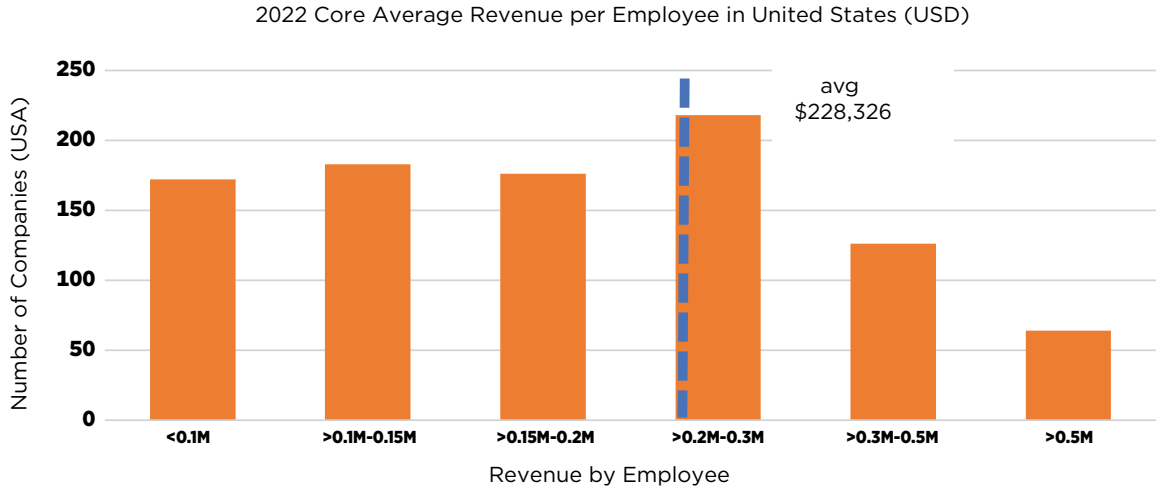
Revenue per employee

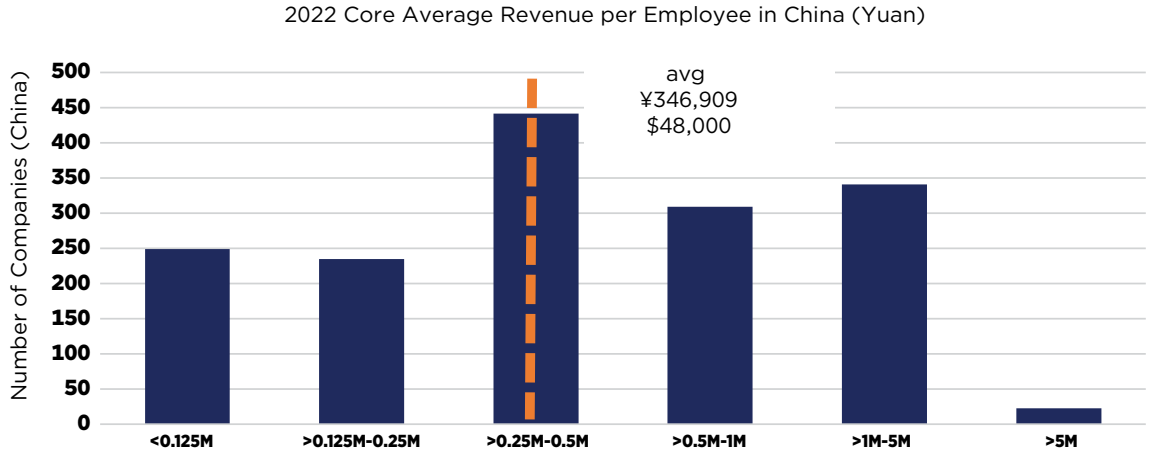
Revenue-per-employee is a financial metric measuring roughly how much revenue one employee generates for a company. It is a measure of how efficiently a given company utilizes its employees and a metric generally compared to a company's industry peers. A higher revenue-per-employee ratio is a positive sign suggesting the company operates more efficiently than others.

For established companies, revenue-per-employee ranges from about $100,000 to more than $1 million (USD). Examples of photonics companies with revenue-per-employee at the high end of this range include Dow Chemical (US), Heraeus (Germany), and Dasan Network (Japan).

In the photonics components industry, the global average revenue-per-employee for 2022 was ~$219,000, up from ~$185,000 in 2020. There are significant regional variations in this performance indicator due to differences in corporate practice and product mix. In the US for instance, the average revenue-per-employee was ~$228,326 in 2022, while in China it was ~$48,000 (CNY 346,909). Outsourcing of manufacturing or distribution may explain these variations, as can the differences in production of a commodity product versus a high-value custom item. Regional salary variations may also be a factor.[7]

Revenue-per-Employee: Local Currency Comparison US vs China





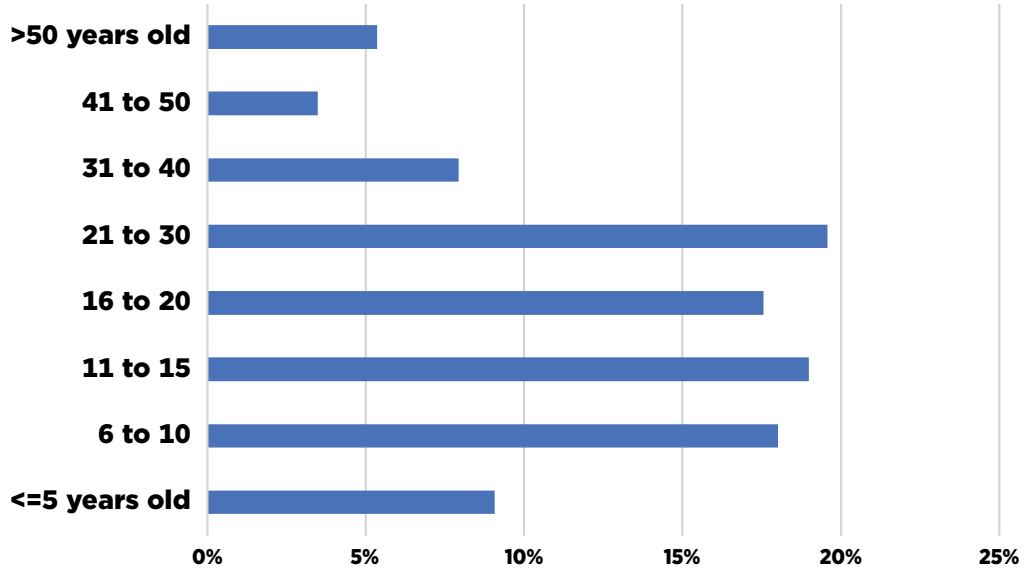
Age of companies in photonics

Entrepreneurial organizations are an important source of innovation and next-generation technologies. Ideally, many are destined for growth either organically or via mergers and acquisitions. Within the photonics components business, SMEs (companies with revenues of less than $50 million) account for a significant majority (84 percent) of the total company count. Age data are available for 3,839 of the SMEs in our 2022 components companies database, and the distribution is shown below.

Over our study's six iterations, we have seen a fairly constant entry of new companies into the photonics business. In their early years, the youngest companies often may not get counted: they are not visible because of their small size, or they may be operating in stealth mode. This means the youngest startup companies will likely not appear in our database until after they begin significant sales activity and become visible in the industry, by which time they may be a few years old.

The age categories shown below are not static. As companies age, they will move up this chart into a new bucket. A five-year-old company in 2012 will now be 15 years old and has moved two levels up on this chart. Not all companies will progress in this way. Some will fail, some will be acquired, and in others the founders may retire and close the company.

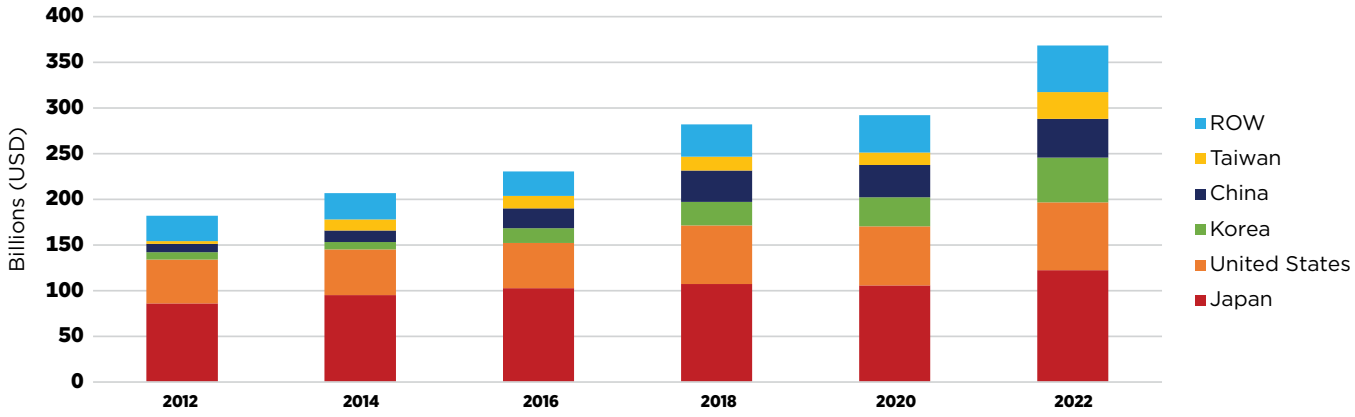
Age Distribution of SMEs in 2022



Global distribution of photonics revenue

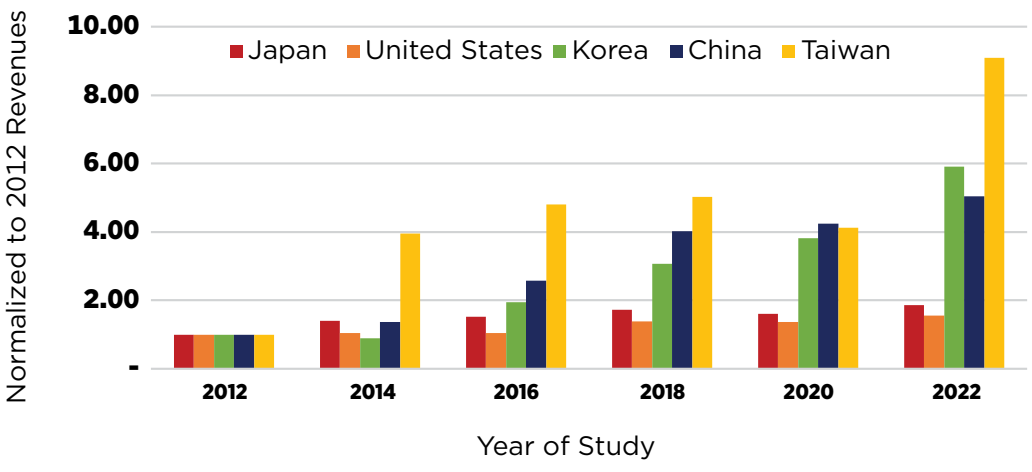
SPIE follows a methodology of assigning a company's global revenues to the country in which its headquarters is located. Total revenues (reported in USD) from companies headquartered in Japan have been considerably higher than other regions over the past decade. They have also been relatively flat until 2022 when they jumped 15 percent from 2020. Revenues in Korea and Taiwan also flourished in 2022. Conversely, growth of revenues from China moderated somewhat.

Global Photonics Revenue Trend by Company HQ Country (USD)



Though shown above in USD, the data originates in the local currency of the company headquarters. Changes in relative currency values (exchange rates) over time can mask local-currency-based revenue trends. Hence, local currency growth rates (below, normalized to 2012) provide a more nuanced picture of the growth trends by country. Revenues in USD of companies headquartered in the US, for instance, have remained relatively flat over the decade, while companies with headquarters in Taiwan exhibited ~120 percent revenue growth (in TWD) between 2020 and 2022.

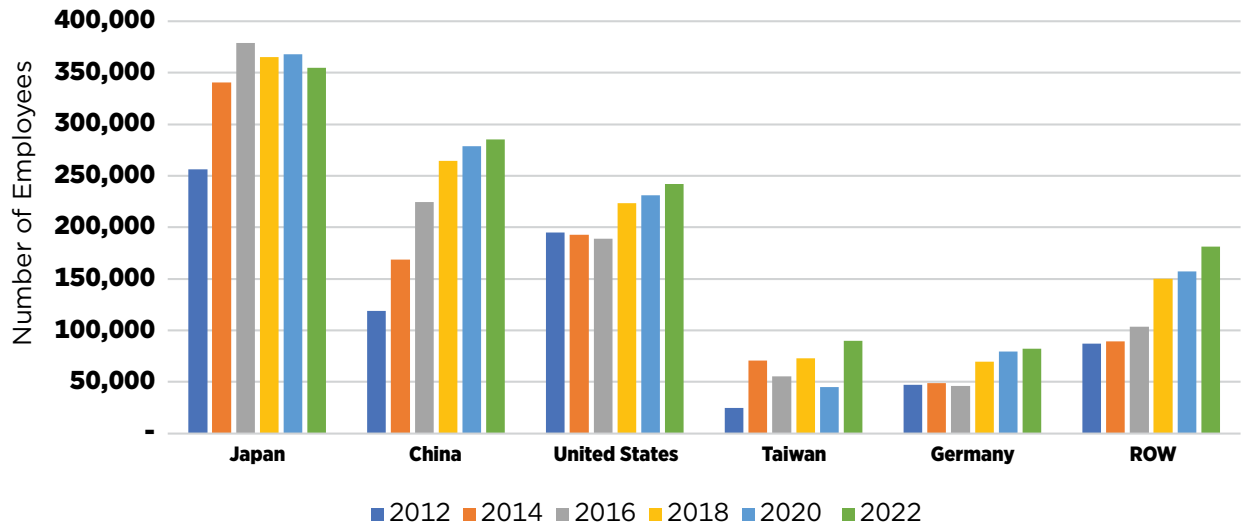
Normalized Revenue Trend in Local Currencies for Top Five Countries



Global distribution of photonics employees

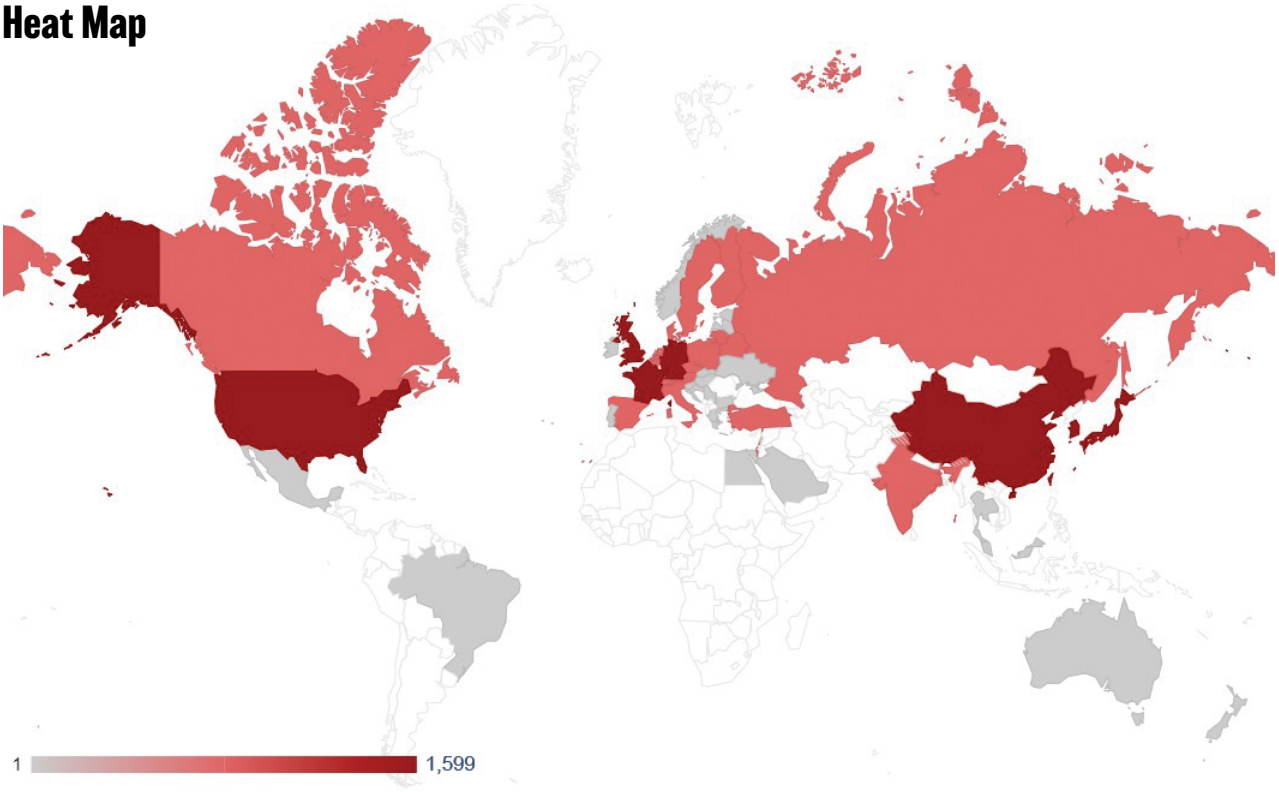
Regional employment growth in the recent past has been mixed. Jobs at Japan-headquartered companies have trended somewhat flat over the past six years, but in other regions the employment trend has been mostly upwards. For companies based in Taiwan, job growth was noticeably higher in 2022 over 2020, which is consistent with its local-currency revenue growth for the same period. Chinese-based companies have experienced steady job growth over the last decade.

Global Distribution of Photonics Employees by HQ Country



Geography of photonics components production

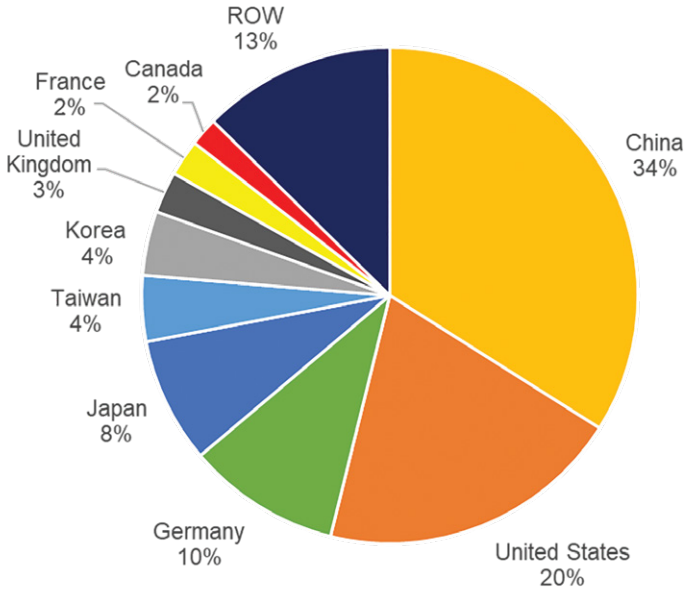
Heat Map



An increasing number of countries are recognizing the importance of photonics to their economic future and investing accordingly. In 2022, SPIE identified 4,706 companies headquartered in 52 countries making and selling core photonics components, representing an increase of 74 percent compared to the number of firms identified in 2012.

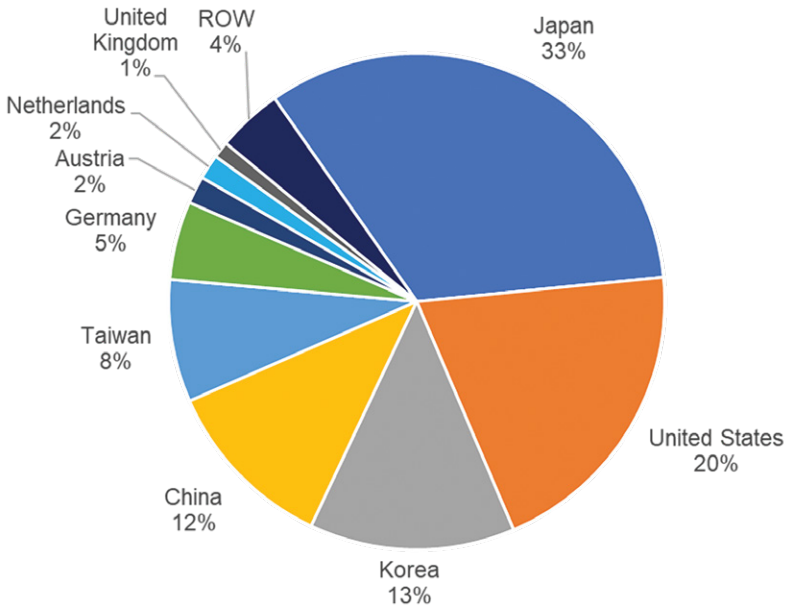
The map highlights the countries with the largest number of companies in 2022. China hosts almost 1,600 company headquarters, with the US hosting 935. Despite the two countries together accounting for more than half of all firms producing photonics components, the distribution of worldwide revenue production is quite different.

Company Count by Country



The top five revenue-producing countries for 2022 were Japan, US, South Korea, China, and Taiwan. The predominance of large photonics components manufacturers headquartered in Japan — such as Keyence, Nikon, Olympus, Panasonic, Sony, and Sharp — means that Japan's share of total photonics components revenues is very high. Together, companies headquartered in the US and Japan account for more than half of the total global components revenues.

Percent of Photonics Revenues by HQ Country

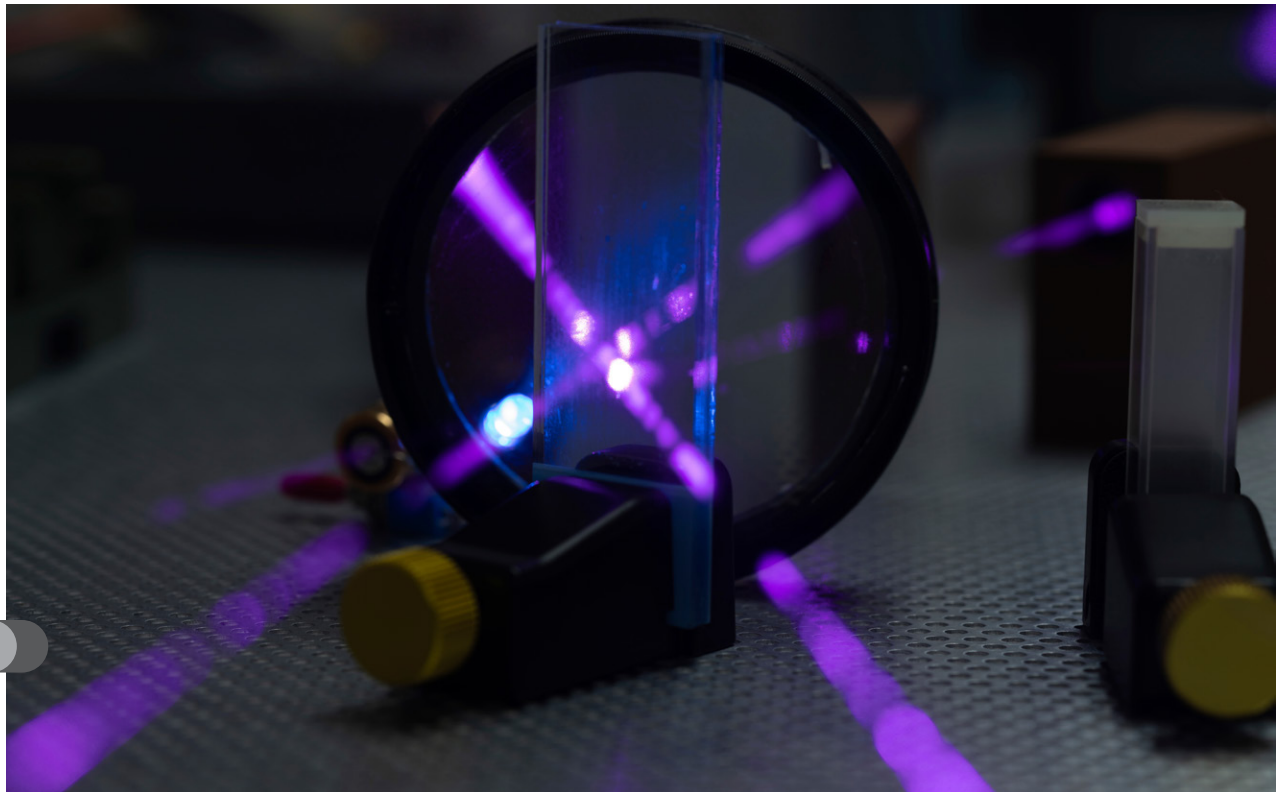


Photonics components outlook

The industry has grown to the point that combined demand for lasers and all other photonics components in 2022 underwrote more than 1.2 million jobs worldwide, with 4,706 companies creating a market exceeding $368 billion in revenue. As employment has grown, so has the number of countries hosting components manufacturers, making it a truly global industry.

The global nature of photonics and the diversity of end-use applications tends to buffer the industry from local economic cycles and leads to more consistent growth over time. The robust nature of the photonics industry was tested during the global pandemic, but our data show that photonics successfully weathered the disruptions associated with lockdowns, supply chain, and shipping issues. While global GDP dipped ~3 percent in 2020,[4] the global photonics industry continued to show modest expansion followed by robust growth through 2022.

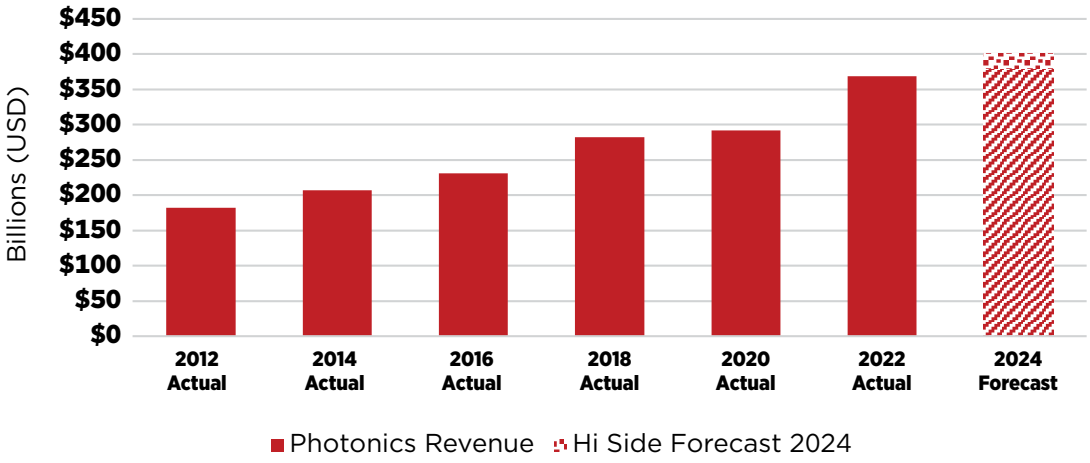
Revenues in 2022 increased 25 percent compared to 2020, with a 10-year CAGR of 7.3 percent. While use of many photonics technologies to help address the pandemic was a key growth contributor, increased demand in other markets enabled by photonics, such as renewable energy, defense, and displays, combined with emerging technologies like artificial intelligence computing platforms and quantum served to maintain a healthy photonics ecosystem.



Forecast

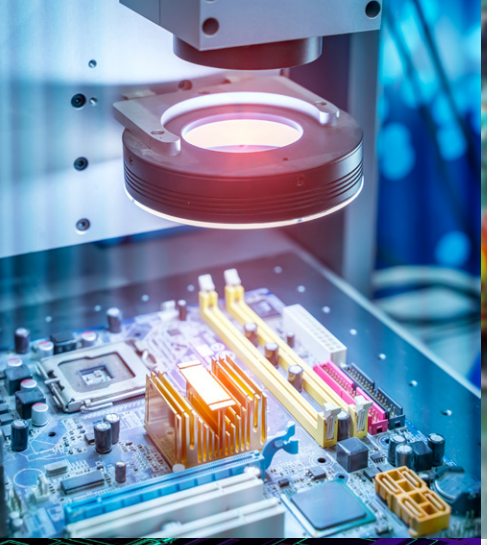
Looking ahead, SPIE projects that global photonics will continue to expand, with modest growth of almost 3 percent in 2024 over 2022. Core components revenues are projected to reach $379 billion, representing a 12-year CAGR of 7 percent for the industry. Though shown here in USD, the data originates in local currencies. Relative currency values change over time and can mask local-currency-based revenue trends. Hence the 2024 forecast ranges from a low of $360 billion to a more optimistic high of $401 billion. SPIE looks forward to providing additional data and commentary during presentations at upcoming conferences.

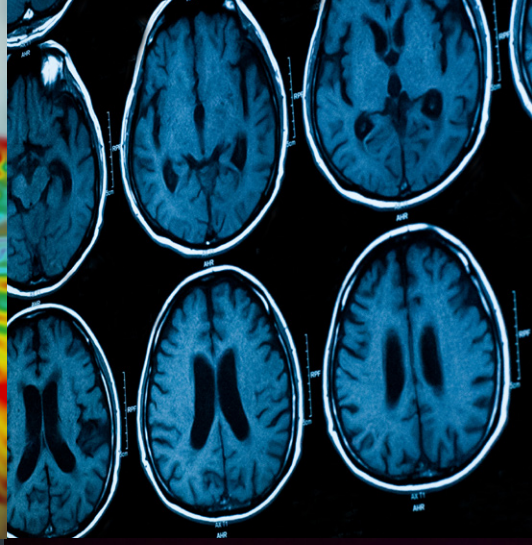
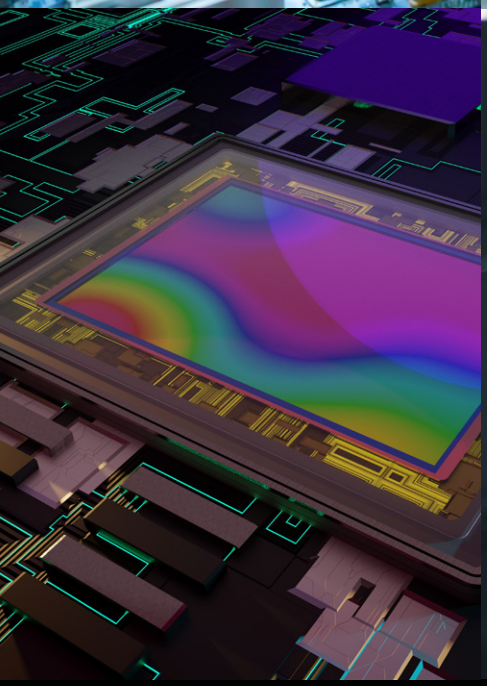
Forecast of Core Photonics Components Revenues for 2024



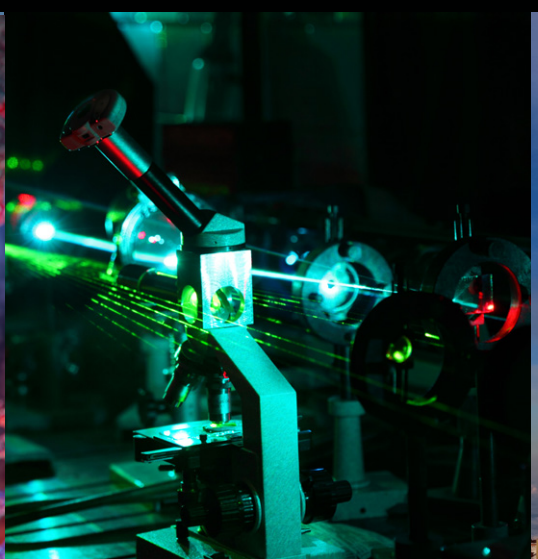
The forecast was developed late in 2023 and is derived from integration of multiple industry analysts' projections for 371 public companies representing about 80 percent of total photonics revenues. Depending on the applications served, some companies will exhibit significant growth while others will see declining revenues as they address various business challenges.

In summary, the world's photonics industry has experienced a decade of consistent growth even under the duress of chip shortages, regional conflicts, rising costs, and a global pandemic. There are certainly challenges ahead that will adversely affect the many local economic environments, however the global nature and increasing diversity of the end-use applications enabled by light has produced an industry with remarkable resilience and a bright future.



Enabled Markets: Total global revenues exceed $2.3 trillion


The photonics-enabled marketplace

The photonics components manufacturing industry underpins 10 major photonics-enabled market segments. Each segment encompasses products based on photonics technologies such as lenses and cameras, lasers, sensors, imaging systems, and displays. Each market segment moves independently of the others, but all are dependent on photonics.

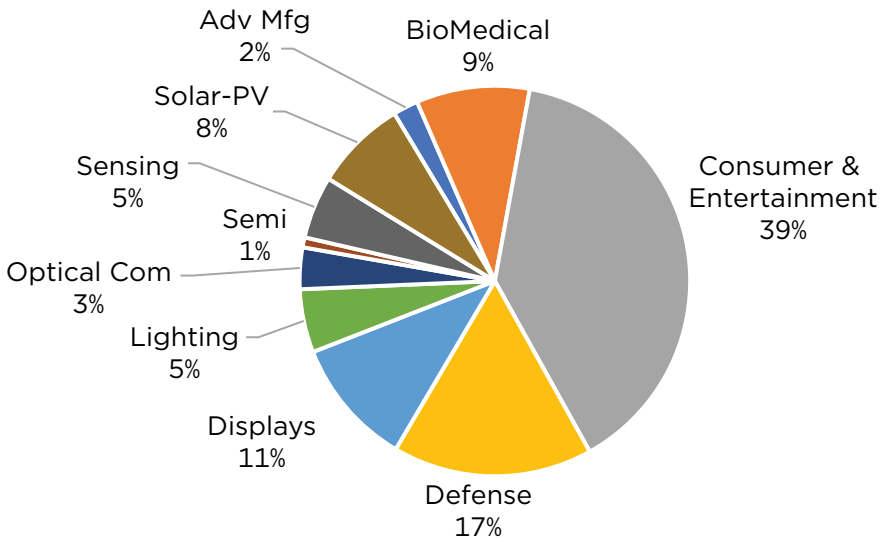
These major market segments range from the consumer products segment (smartphones, TVs, and AR/VR headsets, for instance) to the advanced manufacturing segment (such as 3D printing and lasers systems for cutting and marking) and to healthcare and life sciences (like spectroscopy analysis, DNA sequencing, and medical imaging).

Many of the photonics-enabled market segments are large enough to justify their own studies. The factors affecting each of these markets are very different, so the trends differ, as do the end-user characteristics.

Nonetheless, it is useful to understand the full impact of a technology area like photonics by looking across all end-use markets. Hence, to gain insight into the impact of photonics on their country's economic well-being, many governments track the overall photonics marketplace.[8]

Enabled markets economic impact

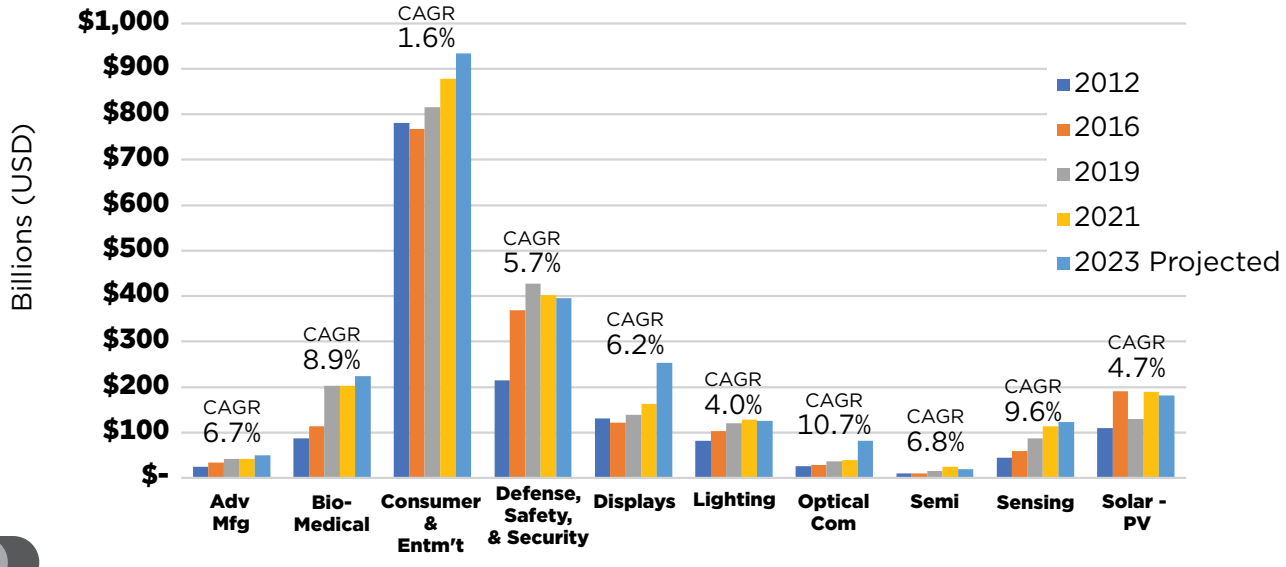
When SPIE completed its first in-depth assessment of the entire photonics-enabled marketplace in 2012, the total revenues of the photonics-enabled markets was $1.5 trillion.



Enabled Markets Economic Impact 2023

The most recent estimate values the 2023 photonics-enabled marketplace at $2.39 trillion — an increase of 40 percent over the 10-year period, and a compound annual growth rate of 4.3 percent. Total worldwide employment was more than five million.

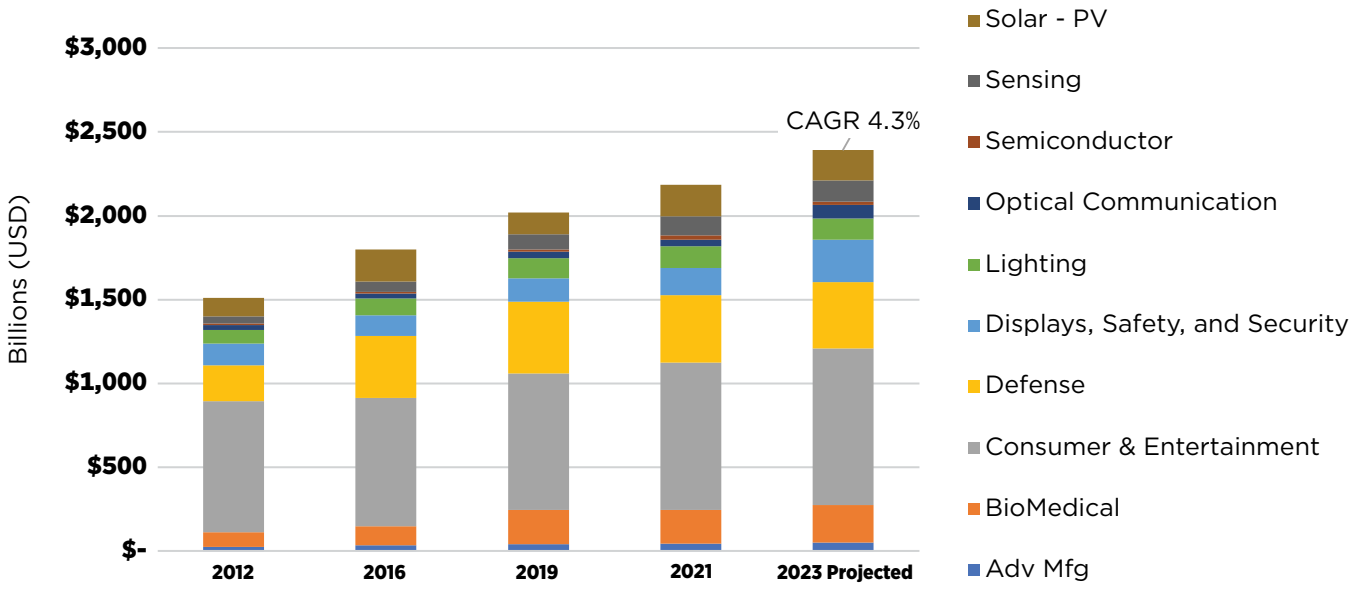
Enabled Markets Revenue Trend by Segment (USD)



Enabled markets segment trends

The 10 major photonics-enabled market segments exhibit different growth rates over time as market conditions change. Fluctuations in total segment revenues from year to year are a function of demand for the end-use products, and of their pricing. It is important to note that for commodity products like solar panels or consumer products, price erosion can undermine revenue growth even as unit product sales increase.

Enabled Markets Segment Trends



The top four growth segments based on growth rates between 2021 and 2023 were:

- Optical communications (+43 percent): Widespread global adoption of cloud-based services is driving an expansion of telecom infrastructure in developing economies resulting in significant growth of the optical communications and networking markets.
- Displays (+25 percent): Demand for displays in the automotive and healthcare industries, more widespread use of LED-based video walls, and interactive displays are driving market growth, which is also boosted by price erosion and adoption of newer technologies across a range of existing applications.
- Advanced manufacturing (+8 percent): Manufacturing has regained momentum lost during the Covid-19 pandemic. Increased implementation of AI with machine vision is boosting the use of vision-guided robotics across a range of production processes.
- Biomedical (+5 percent): In-vitro diagnostic (IVD) testing and endoscopy benefitted from a growing emphasis by healthcare providers on early diagnosis and treatment of diseases, driving an upswing in diagnostic and surgical procedures.

A bright future

The broad range of photonics-related activities offered by SPIE, including Photonics West — the world's largest annual photonics technologies event — provides us with unmatched insight into the technology trends and pace of global photonics innovation across almost all the end-use markets.

As such, we anticipate that photonics technology will advance at a rate and in ways that will continue to outpace the effects of price erosion in commodity areas while new technologies are adopted in others. Examples include:

Displays

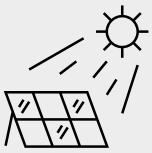
Novel display technologies including immersive and foldable/rollable devices are gradually moving into the mainstream. Wearable displays are an emerging reality. Projection technology is evolving to include 3D image projection, including holograms and window signage applications. All these advances are creating new opportunities for displays.

Artificial, virtual, and mixed reality (AR, VR, MR)

The combination of AR, VR, MR with AI platforms can aid in visualizing things and understanding them effectively. These systems rely on small displays, cameras, and optical sensors. As immersive online experiences improve, their adoption for training and education, gaming, industry, and medicine will gain momentum.

Medical

The pandemic in 2020 gave a major boost to photonics-based diagnostic and therapeutic medical devices as well as remote (internet-enabled) healthcare. Wearable devices for the healthcare sector continue to make rapid strides, enabling real-time monitoring of physiological parameters (such as blood oxygen) for wellness and disease control.

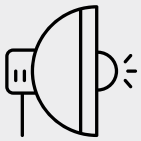


Solar and photovoltaic technologies (PV)

Global investment in clean energy, such as solar and PV, is expected to reach $1.7 trillion in 2023, according to the International Energy Agency,[9] compared to roughly $300 billion a decade ago. Prices of solar, wind, and batteries have plummeted over the past 15 years, and for much of the world, solar power is now the cheapest form of electricity.

Defense and security

The need to achieve precise targeting with reduced collateral damage are factors speeding adoption of directed energy weapons development and deployment. Implementation of AI image management such as recognition and fusion is leading to increasingly sophisticated infrared and hyperspectral surveillance systems.

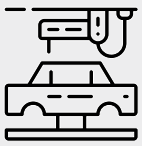


Lighting

The high efficiency of LED lighting combined with strong governmental incentives to adopt low-energy alternatives to conventional lighting has propelled significant growth of this market segment, even as prices have eroded. Higher value-add options such as Li-Fi and occupancy sensors are further boosting demand. Applications such as sterilization, photonics in precision farming, and water purification also benefit from lower-cost smart sources.

Autonomous systems

Drones, self-driving autos, and industrial robotics systems utilize a wide range of photonic sensors and vision systems. Many increasingly benefit from stereoscopic cameras, thermal imaging, lasers for 3D mapping, and embedded artificial intelligence.

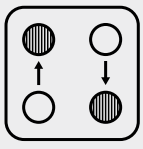


Advanced manufacturing

3D printing technology is transitioning from prototyping to full-scale automated and sometime industry specific production. Metal 3D printing is emerging and can be leveraged to produce complex finished parts and tool components. Photonics-based production tools including lasers, optical metrology, and vision-guided robotics are integral elements of these systems, which continue to drive big manufacturing changes in industries like aerospace and automobiles.

Optical communications and information

Fiber optics carry most of the world's information from place to place. Global adoption of cloud-based computing services is driving an expansion of communications infrastructure. The associated data centers increasingly rely on photonics to reduce power consumption (using photons instead of electrons). Ongoing backhaul needs for 5G deployment are also based on photonics. Some new networks use free-space optical communication within networks of satellites and ground stations to move information without wires or optical fiber.



Quantum technology

Developments in the emerging field of quantum technology will drive major advances in metrology, sensing, communications, and computing, creating a multitude of new opportunities in photonics.

These and many other areas of photonics technologies are covered at multiple SPIE events annually (see page 26-27). Plus, SPIE publishes the largest collection of optics and photonics applied research — more than 560,000 technical papers, reports, and presentations — in the SPIE Digital Library.[10]

Conferences and Exhibitions 2024/25

NORTH AMERICA

2024

SPIE. MEDICAL IMAGING
18–22 February 2024
San Diego, California, USA

SPIE. ADVANCED LITHOGRAPHY+ PATTERNING
25–29 February 2024
San Jose, California, USA
Exhibition: 27–28 February 2024

SPIE. HIGH-POWER LASER ABLATION
26 February–1 March 2024
Santa Fe, New Mexico, USA

SPIE. SMART STRUCTURES+ NONDESTRUCTIVE EVALUATION
25–28 March 2024
Long Beach, California, USA

SPIE. DEFENSE+ COMMERCIAL SENSING
21–25 April 2024
National Harbor, Maryland, USA
Exhibition: 23–25 April 2024

PHOTONICS FOR QUANTUM
SPIE. RIT Rochester Institute of Technology
17–20 June 2024
Waterloo, Ontario, Canada

SPIE. OPTICS+ PHOTONICS
18–22 August 2024
San Diego, California, USA
Exhibition: 20–22 August 2024

SPIE. TRANSLATIONAL BIOPHOTONICS+ADDITIVE MANUFACTURING
16–18 September 2024
Houston, Texas, USA

SPIE. PHOTONICS INDUSTRY SUMMIT
25 September 2024
Washington DC, USA

SPIE. PHOTOMASK TECHNOLOGY + EUV LITHOGRAPHY
29 September–3 October 2024
Monterey, California, USA
Exhibition: 1–2 October 2024

SPIE. LASER DAMAGE
7–10 October 2024
San Ramon, California, USA

2025

SPIE. PHOTONICS WEST
25–30 January 2025
San Francisco, California, USA
PW Exhibition: 28–30 January 2025
BiOS Expo: 25–26 January 2025
Quantum West Expo: 28–29 January 2025

SPIE.AR|VR|MR
27–29 January 2025
San Francisco, California, USA
Exhibition: 28–29 January 2025

SPIE. GLOBAL BUSINESS FORUM
27 January 2025
San Francisco, California, USA

SPIE.OPTIFAB
20–24 October 2025
Rochester, New York, USA
Exhibition: 21–23 October 2025
Biennial event

EUROPE/UNITED KINGDOM

2024

SPIE. OPTICAL SYSTEMS DESIGN

Co-located with
SPIE Photonics Europe

7–11 April 2024
Strasbourg, France
Triennial event

Exhibition: 9–10 April 2024

SPIE. PHOTONICS EUROPE

Co-located with
SPIE Optical Systems Design

7–11 April 2024
Strasbourg, France
Biennial event

Exhibition: 9–10 April 2024

SPIE. SENSORS+ IMAGING

16–19 September 2024
Edinburgh, Scotland

Exhibition: 17–18 September 2024

SPIE. PHOTONEX

Exhibition: 30–31 October 2024
Manchester, United Kingdom

2025

SPIE. OPTICS+ OPTOELECTRONICS

7–11 April 2025
Prague, Czech Republic

Exhibition: 9–10 April 2025

EUROPEAN CONFERENCES ON BIOMEDICAL OPTICS
OPTICA | SPIE.

25–29 June 2025
Munich, Germany
Biennial event

SPIE. DIGITAL OPTICAL TECHNOLOGIES

23–26 June 2025
Munich, Germany

SPIE. OPTICAL METROLOGY

23–26 June 2025
Munich, Germany

ASIA-PACIFIC

2024

OPTICS & PHOTONICS International Congress OPIC 2024

Co-located with SPIE Future Sensing Technologies 2024

22–26 April 2024
Yokohama, Japan

Exhibition: 24–26 April 2024

SPIE. FUTURE SENSING TECHNOLOGIES

Co-located with OPIC24 and OPIE24

22–24 April 2024
Yokohama, Japan

Photomask Japan

16–18 April 2024
Yokohama, Japan

SPIE. ASTRONOMICAL TELESCOPES + INSTRUMENTATION

16–21 June 2024
Yokohama, Japan

Exhibition: 18–20 June 2024

SPIE. COS | PHOTONICS ASIA

October 2024
China

SPIE. ASIA-PACIFIC REMOTE SENSING

2–4 December 2024
Biennial event

References

[1] Global E-Commerce Market Reached US$ 13 Trillion in 2021 (prnewswire.com)

[2] $3 trillion is up for grabs in the cloud | McKinsey

[3] Video Streaming Market Size, Share & Growth Analysis [2030] (fortunebusinessinsights.com)

[4] https://www.statista.com/statistics/268750/global-gross-domestic-product-gdp/

[5] The official website of the Nobel Prize - NobelPrize.org

[6] The NAICS (North American Industry Classification System) is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the US business economy. A similar system exists for the same purpose in Europe called NACE (Nomenclature des Activités Économiques dans la Communauté Européenne).

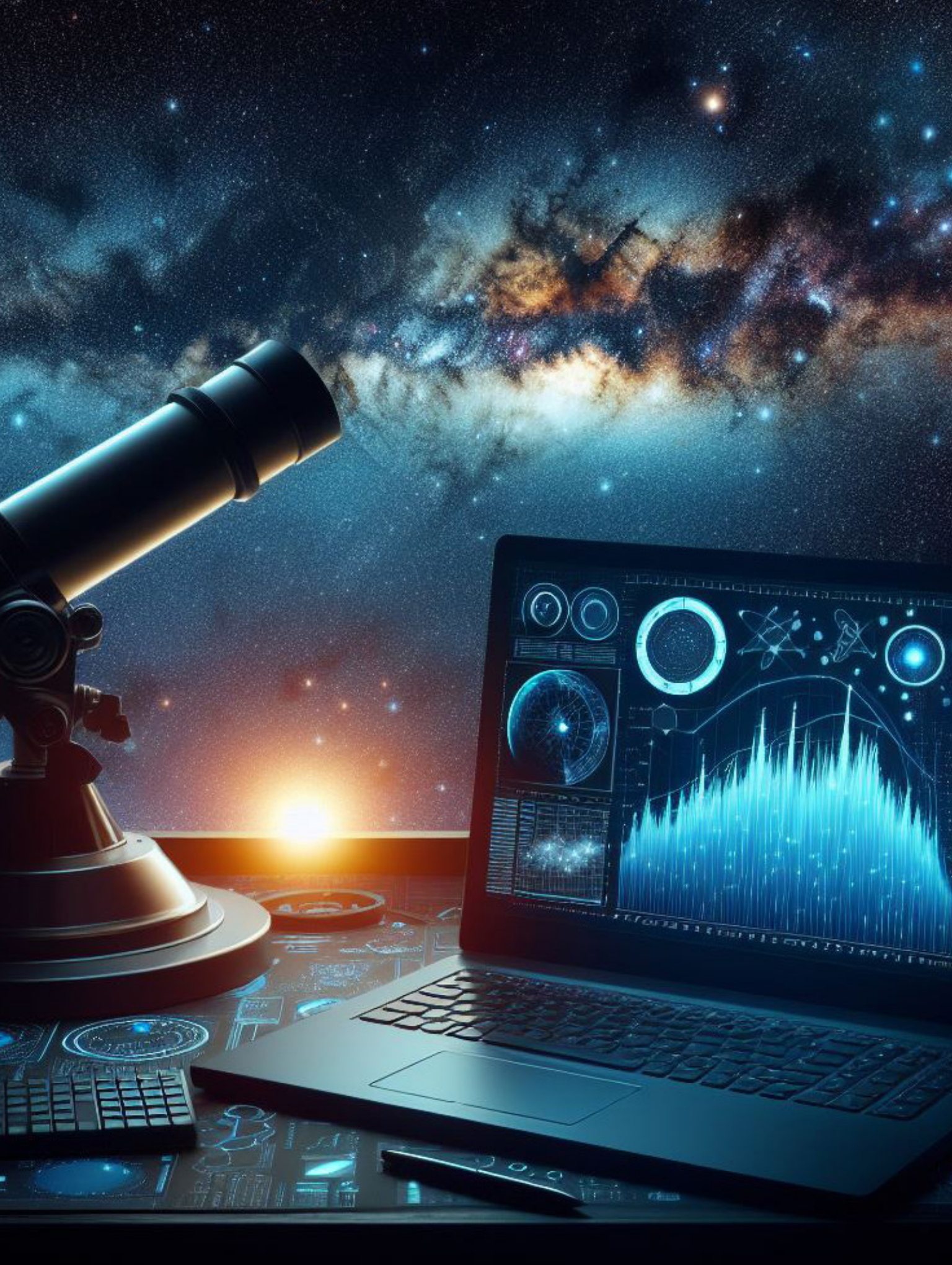
[6] An alternative definition of SMEs can be based on number of employees. Companies with fewer than 250 employees are also considered SMEs. In this case the difference in company count between the two definitions is almost nonexistent.

[7] For more information see SPIE Annual Global Salary Survey (https://spie.org/industry-resources/information/global-salary-report-hub#_=_)

[8] Governments that routinely track photonics include the EU (Photonics21), Japan (OITDA), Korea (KAPID), Taiwan (PIDA), UK, and others.

[9] https://www.iea.org/spotlights/global-investment-in-clean-energy-is-on-course-to-reach-usd-1-7-trillion-in-2023

[10] Search the world's largest collection of optics and photonics applied research. (spiedigitallibrary.org)



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SPIE is the international society for optics and photonics. We bring together engineers, scientists, students, and industry leaders, strengthening the global optics and photonics community through conferences, publications, and professional development. Inspired by the transformative power of photonics to enhance life around the globe, over the past five years SPIE has contributed more than $24 million to the international optics community.

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