Optics & Photonics

Industry Report

2022

FALL UPDATE

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 weather and climate monitoring to the fabrication of new automobiles, and from advanced agriculture to vision correction.

The monetary value of all the finished goods and services produced worldwide in 2021 (global GDP) amounted to about $96 trillion US dollars.[1] The value of light-enabled products and services is estimated to be between $7 trillion and $10 trillion annually, which means the science and application of light—called photonics—represents roughly 11% of the world's economy.[2]

Accelerating photonics innovation will continue to drive economic growth and increase its share of the global GDP.

Underpinning all of the light-enabled products and services are fundamental (or core) photonics components, which range from raw materials to image sensors, and from light-emitting diodes (LEDs) to lasers.

This Industry Report provides an in-depth assessment of the global manufacturing infrastructure that produces these basic photonics components. The report offers a unique perspective on the 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.

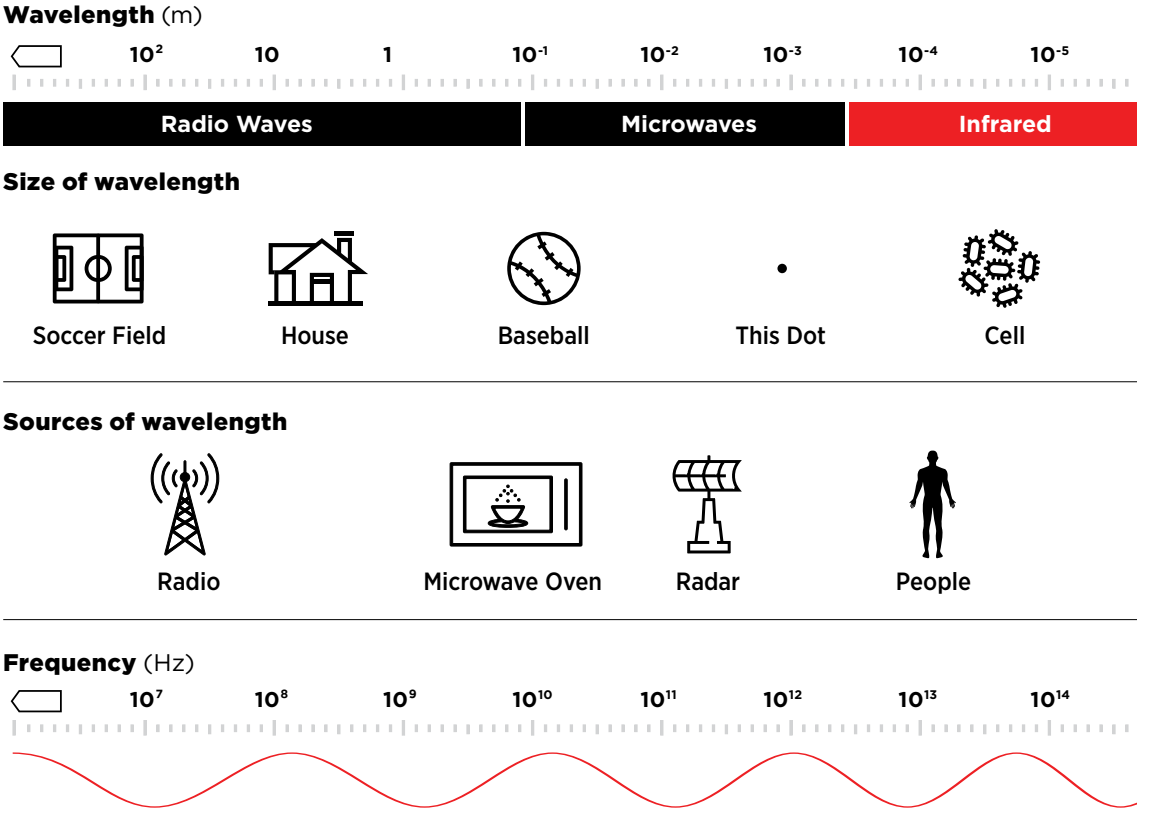
While it is too early to assess the full economic impact of the pandemic, the repercussions for the photonics industry appear to be moderate compared to many other industry segments. Despite a short-term impact on photonics, we believe that optics and photonics will recover and continue to drive economic growth throughout the world.

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 can be used to explore the universe, cure diseases, and even solve crimes. Photonics is so ubiquitous in our daily lives that the 21st century has been called the "Age of the Photon."

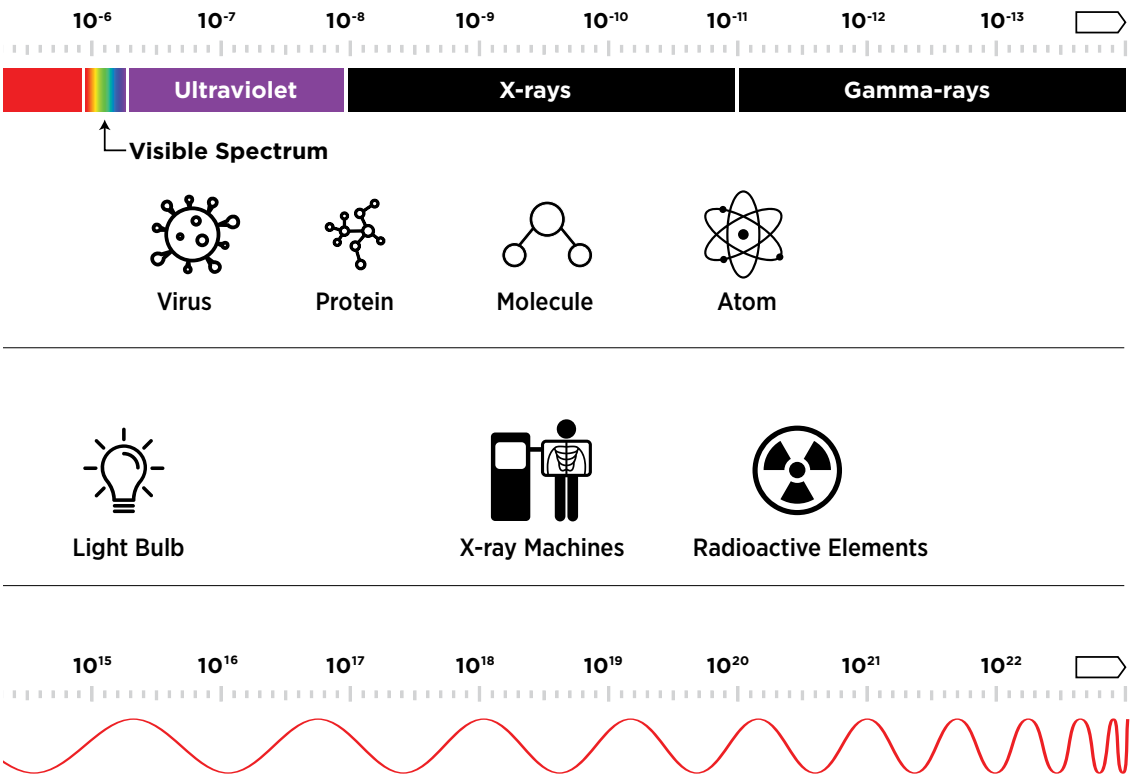
Scientists have been studying light for hundreds of years, but it was only in the 17th century that Sir Isaac Newton showed that white light is made of different colors of light. The colors of the rainbow are only a small part of the entire wavelength range of light, called the electromagnetic spectrum.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

Electromagnetic Spectrum



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.

Even if we cannot see the entire electromagnetic spectrum, visible and invisible light waves are a part of our everyday life. Photonics is everywhere: in consumer electronics (barcode scanners, DVD players, TV remote controls), telecommunications (fiber optics, lasers, switches), health (eye surgery, medical instruments), manufacturing (laser cutting and machining), defense and security (infrared cameras, remote sensing), and entertainment (holography, cinema projection), to name a few examples.



Key Findings

- **Global annual revenues from production of optics and photonics core components amounted to $302 billion in 2020.**

- **Production of optics and photonics core components is a global enterprise spanning more than 50 countries.**

- **4,842 manufacturing companies produced core components in 2020:**
  - 71% of them are small- to medium-size enterprises (SMEs).
  - 73% of all core optics and photonics components revenues are generated by only 2% of the companies.

- **Core components production employs more than 1.2 million people worldwide.**

- **The global share of the photonics components market is shifting as dominance of Asia, and specifically China, increases.**

- **China now employs the largest number of people in the photonics components industry.**

- **The components industry has shown solid growth above global GDP since 2012.[1]**

- **Global annual revenues for photonics-enabled products exceeded $2.1 trillion in 2021.**

- **Production of photonics-enabled products generates more than five million jobs worldwide.**

> *"In a diverse and ever-changing industry, the comprehensive industry data published by SPIE is a valuable resource for our company."*
>
> **—Jay Kumler**, President
> JENOPTIK Optical Systems LLC

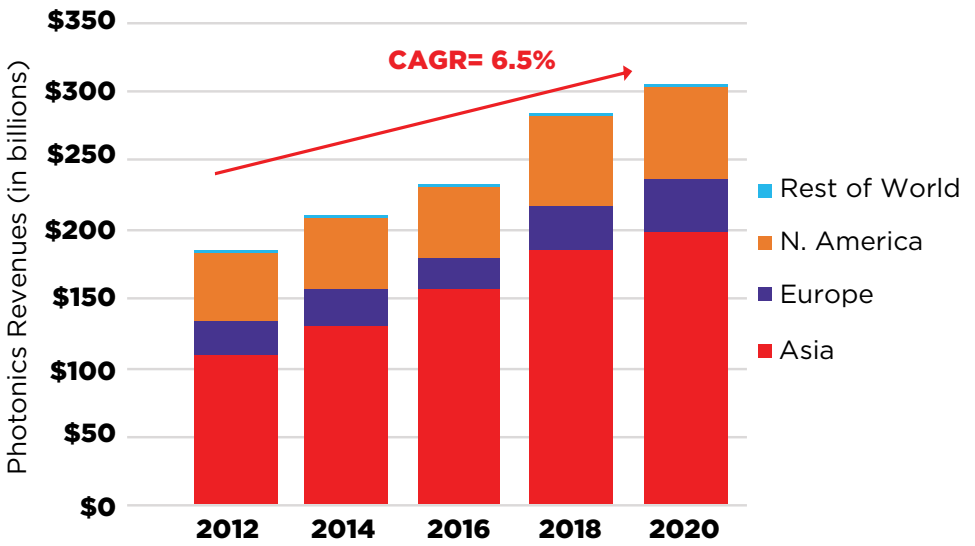
Global photonics components production

Industry Trends: Companies, Revenues, and Jobs

	2012	2014	2016	2018	2020	8-year CAGR
Companies in market	**2,714**	**3,193**	**3,768**	**4,298**	**4,842**	**+7.50%**
Photonics revenues	**$182 B**	**$206 B**	**$230 B**	**$282 B**	**$302 B**	**+6.55%**
Photonics jobs	**729K**	**910K**	**997K**	**1,144K**	**1,269K**	**+7.18%**

The photonics components production industry has shown steady growth since 2012, the first SPIE study year. With a compound annual revenues growth rate of more than 6.5% between 2012 and 2020, the industry has also grown in terms of the number of producers and has added more jobs every year. Most of the growth during this period has occurred in Asia.

Revenue Growth by Region



The Photonics Marketplace

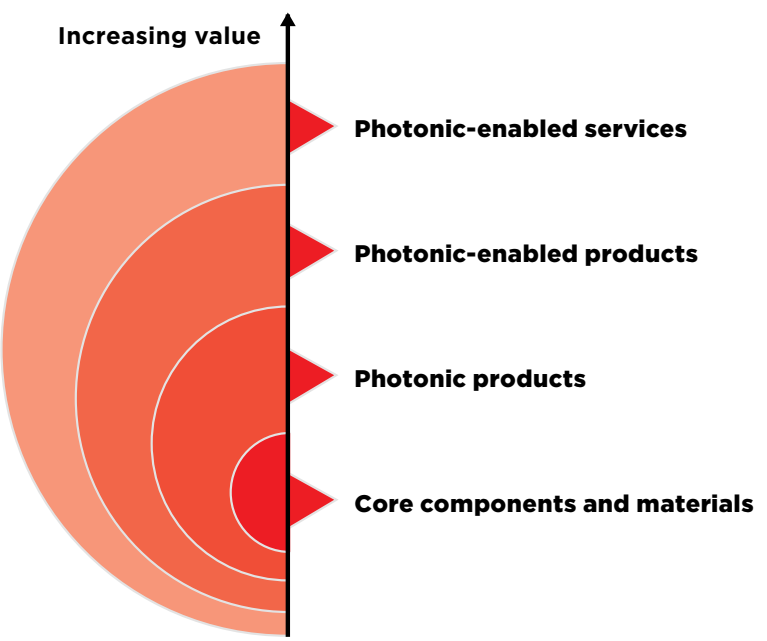
Photonics is not a market or an industry but a collection of technologies based on light that creates or enables many end-use applications and markets. However, it is often convenient to talk about the collection of entities that develop, manufacture, and distribute optics and photonics components, systems,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

The range and diversity of photonics applications make it difficult to characterize this industry and to assess its economic impact. 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

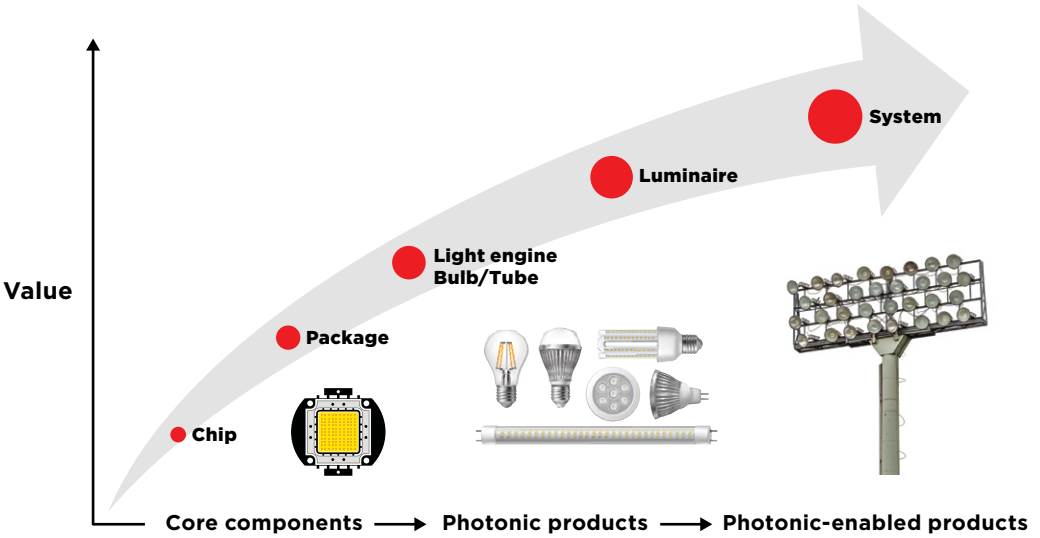
Any assessment of the photonics business must take into account the photonics value chain. That is, the process of taking raw materials and adding value to them through various processes to create a finished product.

Photonics Value Chain



Photonics Value Chain Example

LED Lighting



The photonics value chain starts with raw materials like glass and semiconductor substrates, and progresses through optical components and subsystems to photonics-enabled products such as lighting systems, data centers, and smart phones. The global photonics-enabled marketplace is based on these “end-use” products.

Photonics technologies also underpin a large range of enabled services based on the Internet, which relies on optical fiber to transport its data. These services include cloud computing, streaming 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, other industry sectors may benefit and grow from related opportunities like software development.

The complexity of the categories increases with the higher value. For 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 a display. The internal chips are made using lasers. Yet smartphone manufacturers would not identity themselves as photonics companies.

Governments do a poor job of tracking photonics technology revenues.

- Economic tracking codes in the USA (NAICS) and in Europe (NACE) do not have a category for photonics.[3]
- 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.

For this reason, SPIE makes its industry assessments as transparent as possible. We have also worked 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 globally consistent picture of our industry.

> *"Accurately sizing the photonics industry is vital for positioning and leveraging support for our industry with end users, governments and support agencies. SPIE provides a benchmark for quantifying the global photonics industry with a robust, consistent methodology. The result is trusted figures enabling national initiatives, such as 'UK Photonics: the Hidden Economic Engine', to put the local economic impact of photonics in a global context."*
>
> **—Dr John Lincoln**, Chief Executive,
> The UK Photonics Leadership Group

The SPIE global industry profile

An apparently simple method of assessing the size of an industry (in terms of revenues) is to sum the value of 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 an approximate estimate.

This “product-focused” approach is not practical in industries that are more diverse, such as the photonics industry, where there are multiple photonics companies making 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 industry to characterize the global production of photonics components. Our knowledge base includes the most current and comprehensive database of photonics organizations in the world.

Now in its fifth iteration, our 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, and an understanding of some of the structural factors like the role of large companies versus small.

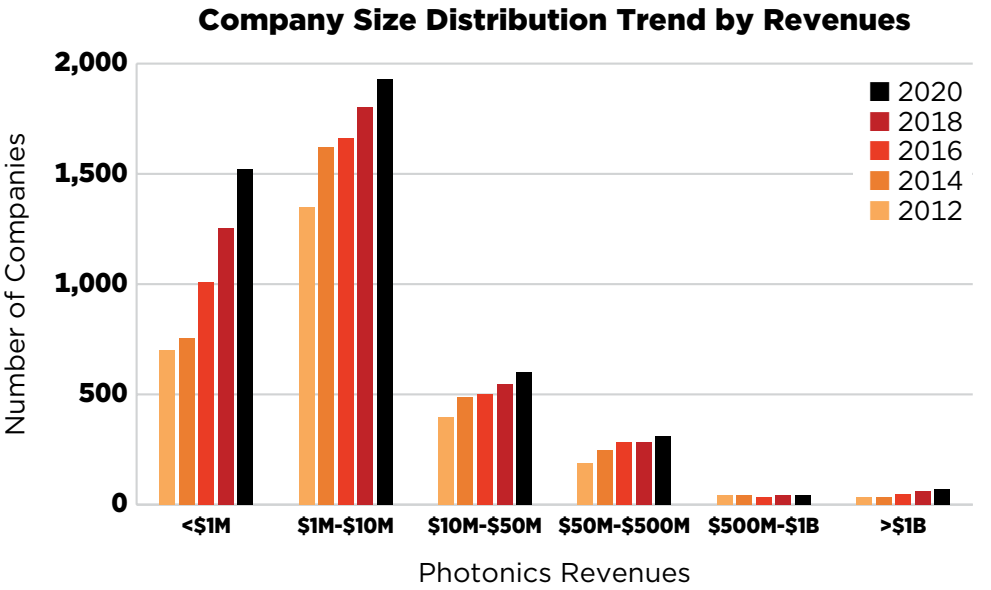
Photonics Components Production

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, SPIE has focused its recent industry analysis efforts on the core photonics components business. Our goal is to profile the core components industry in terms of its revenues, geographical diversity, employment, and structure.

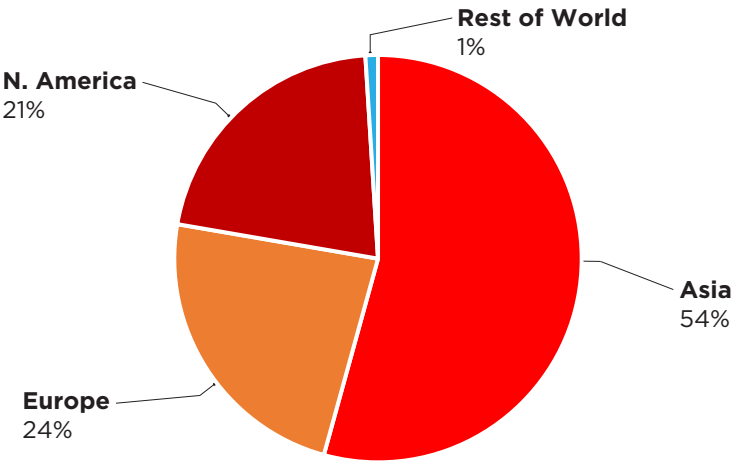
Producers profile

The majority of photonics components manufacturers are small- and medium-size entities (SMEs). In fact, about 71% are companies with revenues of less than $10 million. The percentage of SMEs has grown over the years as new companies entered the market.



In 2020—based on our selection methodology—there were about 4,840 companies making photonics components. Firms based in Asia accounted for 54% of these, followed by Europe (24%) and North America (21%).

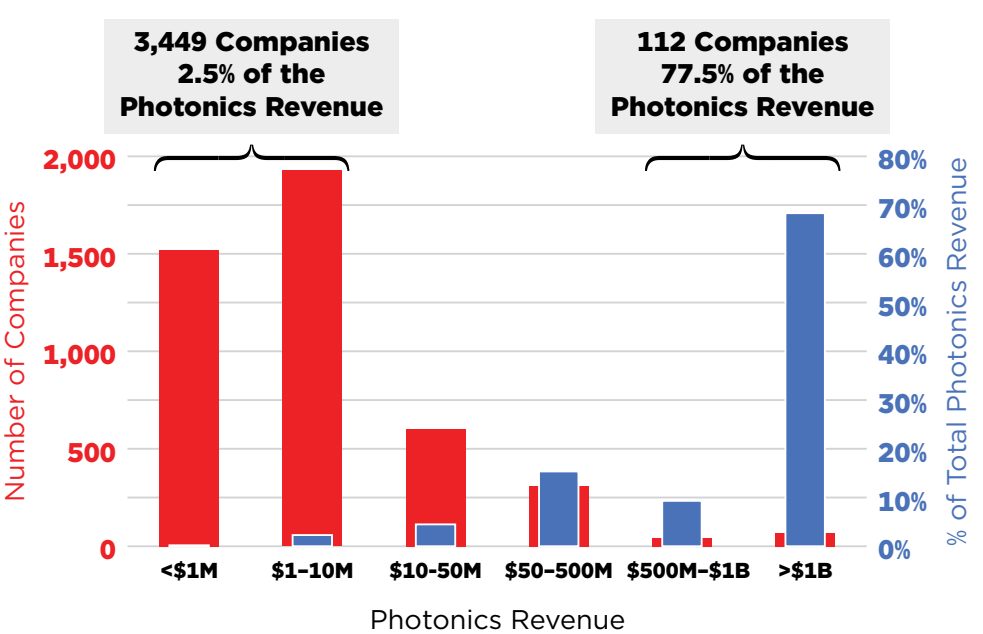
Regional Distribution of Components Producers (2020)



Although the majority of companies are SMEs, larger entities generate most of the revenues. In fact, only 2% of all companies, including such household names as Corning, Nikon, and Carl Zeiss, generated almost three quarters of total revenues in 2020.

Small companies generate less than 3% of global revenues, but they play a vital role in filling the technology innovation pipeline.

Manufacturers Grouped by 2020 Revenue

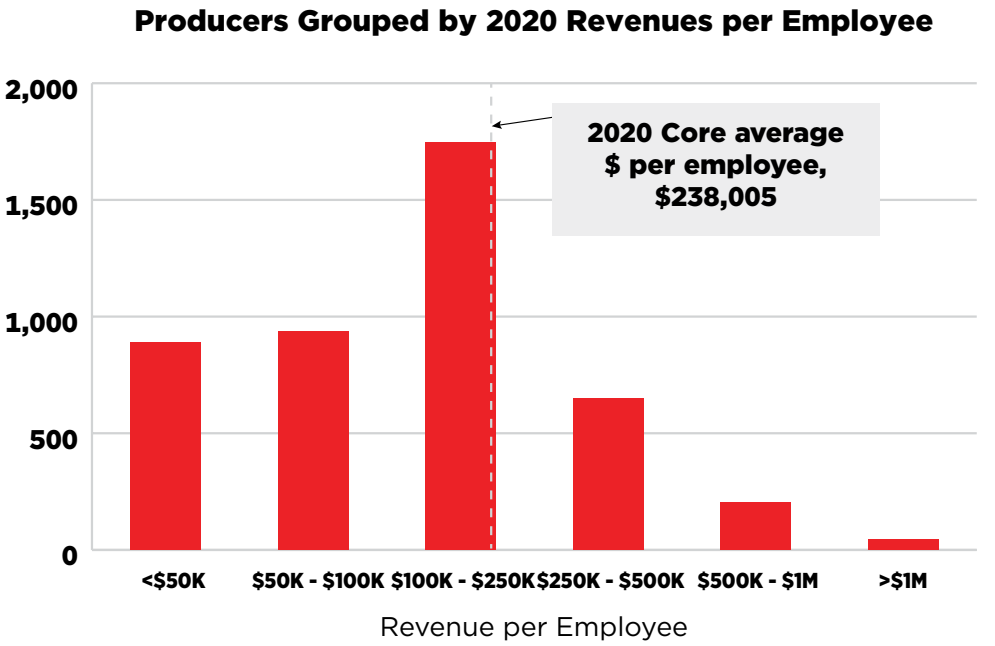


Revenue per employee

Revenue per employee is a measure of how efficiently a given company is able to utilize its employees. In general, relatively high revenue per employee is a positive sign that suggests the company is operating efficiently.

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

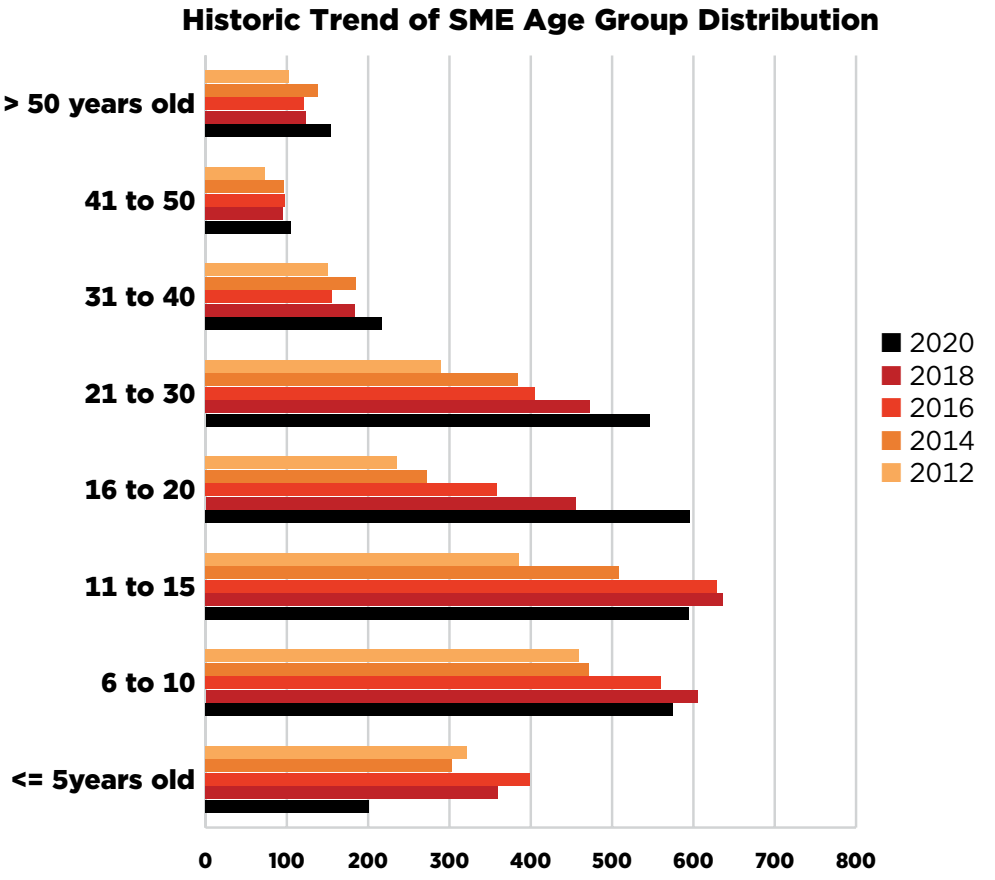
In the photonics components industry, the global average revenue per employee for 2020 was about $238,000. There are significant regional variations in this metric.



Age of companies in photonics

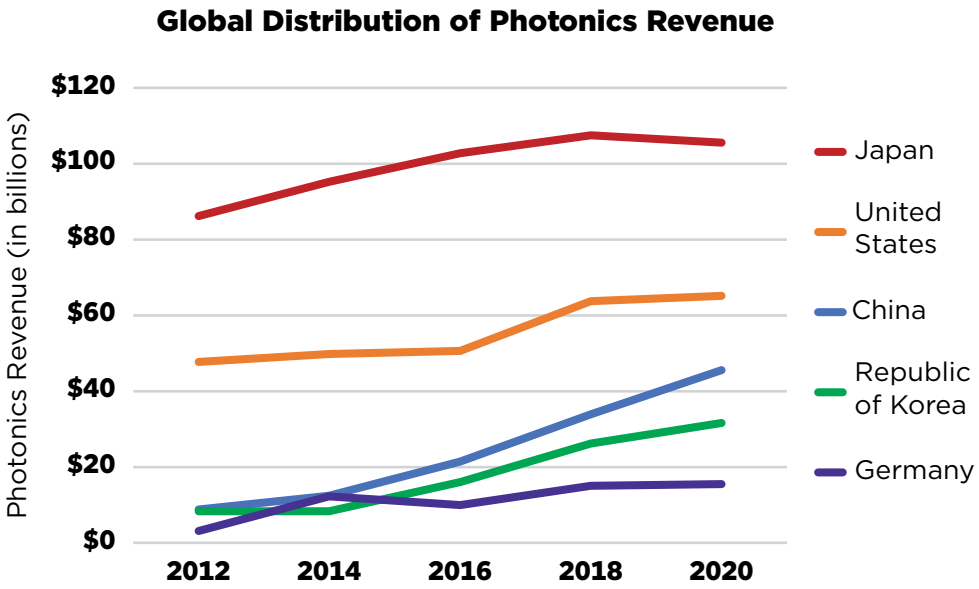
Entrepreneurial organizations are an important source of innovation and, ideally, many are destined for growth. Within the photonics components business, SMEs account for a significant majority of the total company count. Age data is available for 2,988 of the SMEs in our 2020 components companies database.

A comparison of the SMEs' ages over the five iterations of our study shows a relatively constant entry of new companies into the industry.



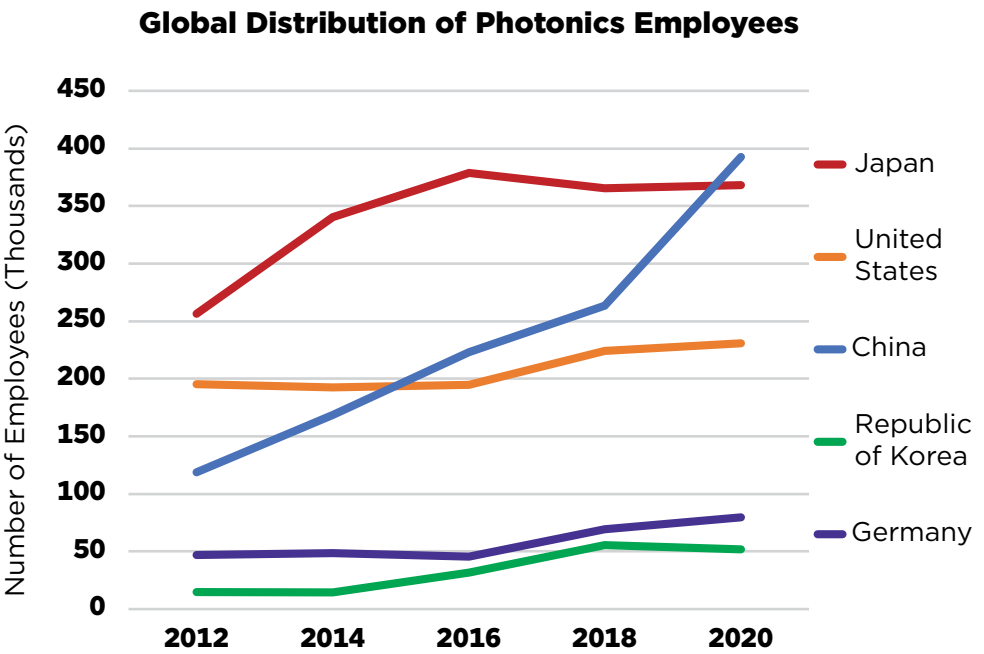
Global distribution of photonics revenue

SPIE follows a methodology of rolling up a company's global revenues up to the country where its headquarters is located. Japan is still on top, but photonics revenue growth year-over-year has flattened. China has seen significant growth over the last decade, with a compound annual growth rate of almost 23% for the 2012–2020 period.

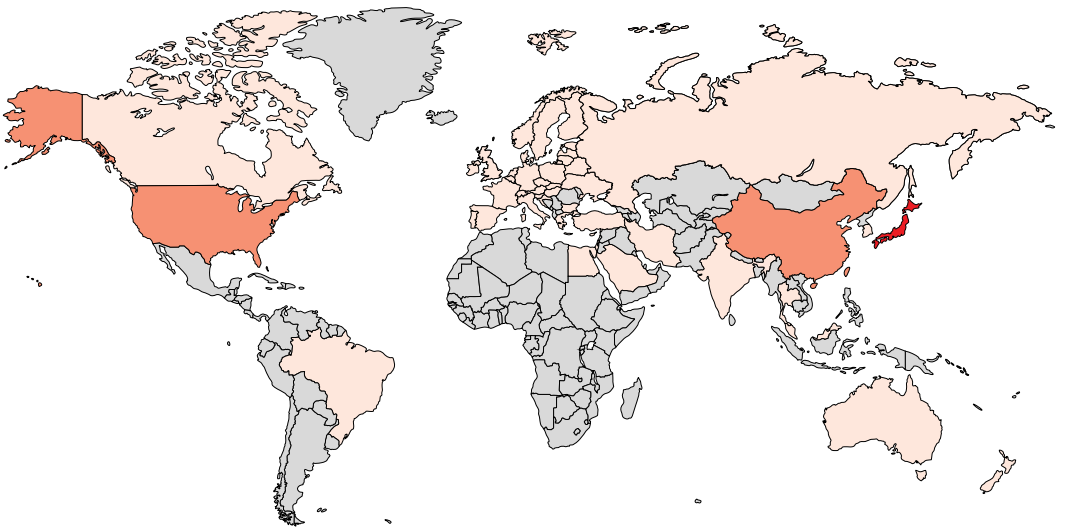


Global distribution of photonics employees

Japan has been trending flat over the past four years for the number of employees employed in the photonics industry. China now employs the largest number of people in the photonics industry, with almost four times its 2012 employees.



The geography of photonics components production

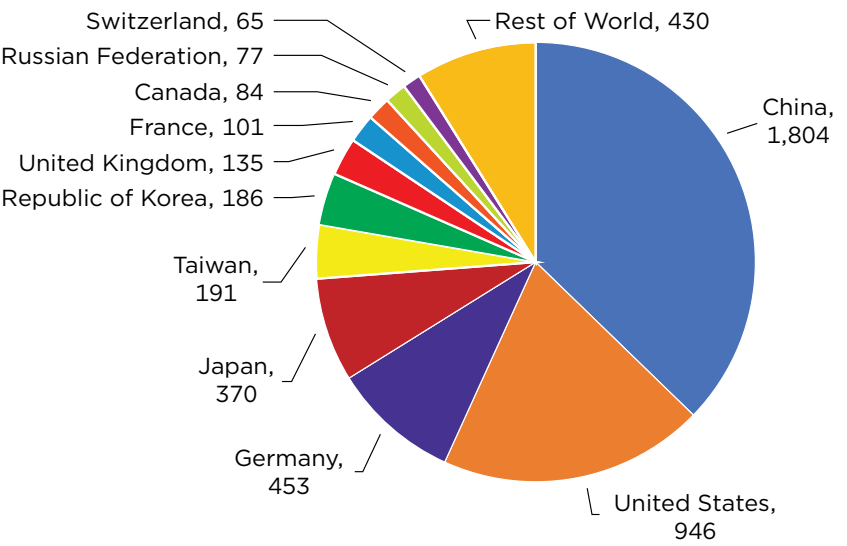


» 4,842 companies across 50 countries made photonics components in 2020.

The number of companies and countries involved in photonics components production is growing. In 2020 SPIE tracked 4,842 companies in 50 countries making and selling core photonics components, up 78% since 2012.

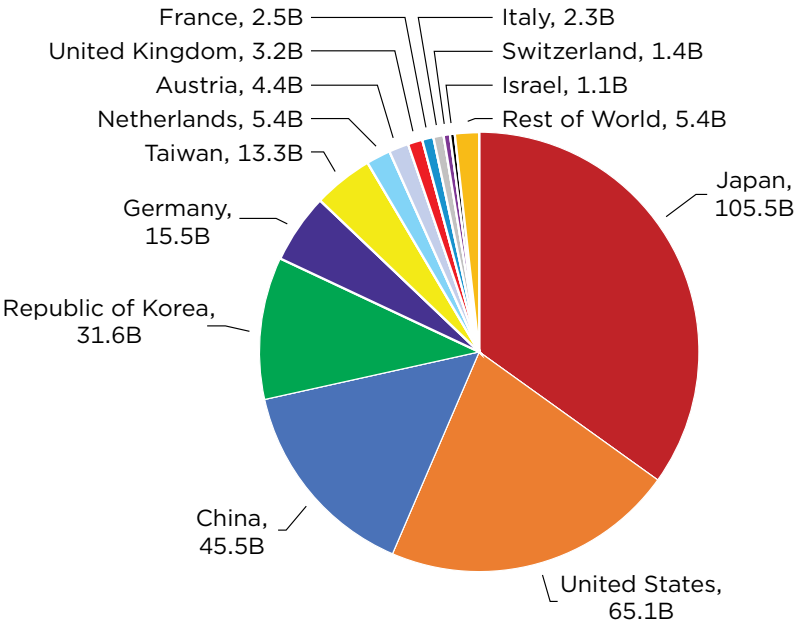
The top countries for 2020 in terms of number of companies include China, USA, Germany, and Japan, with USA and China accounting for more than half of all firms producing photonics components.

Company Count by Country



In terms of revenue generation for 2020, however, the top countries include Japan, USA, China, and South Korea. The predominance of large photonics components manufacturers headquartered in Japan—such as Panasonic, Sony, and Sharp—means that Japan's share of total photonics components revenues is very high. Together, United States and Japan account for more than 55% of the total global components revenues.

Photonics Revenue by Country



Photonics Components Outlook

The industry has grown to the point that combined demand for lasers and all other photonics components in 2020 underwrote more than 1.2 million jobs worldwide, with 4,842 companies creating a market exceeding $300B in revenue. As employment has grown, so too has the number of countries hosting components manufacturers, making it a truly global industry.

The global nature of photonics industry 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 put to test during the global pandemic, but our data shows that the industry weathered the perturbations associated with lockdowns, supply chain, and shipping issues well—it experienced continued growth in 2020, albeit at a reduced level from prior periods.

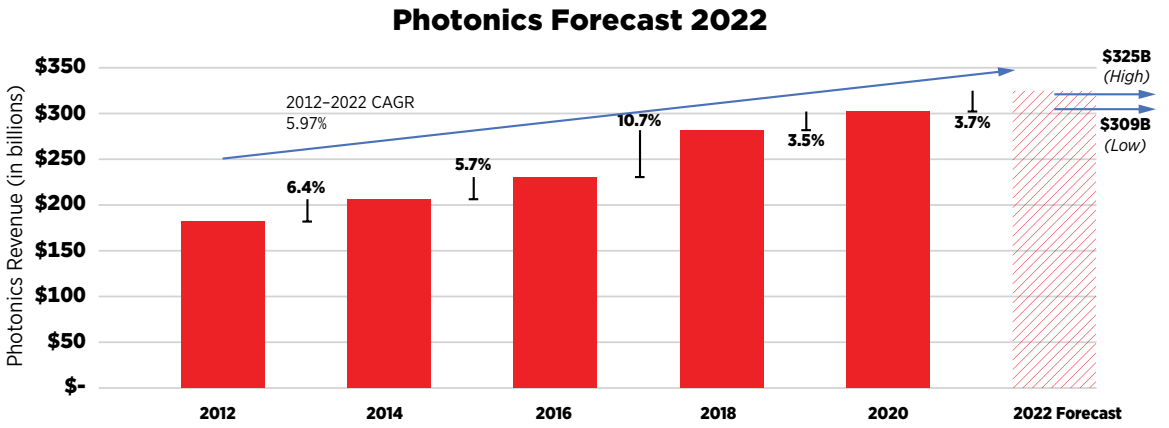
SPIE data shows 2020 revenues increased 4% over 2018 to $300B. While this growth was slower than the 10 year CAGR of 6.5%, the use of photonics technologies to address the pandemic, as well as increased demand in many markets enabled by photonics, resulted in continued growth.

Revenues are projected to be up in 2021 as employees returned to work, shipments stabilized, and supply-chain managers overcame their various shortages.

Forecast

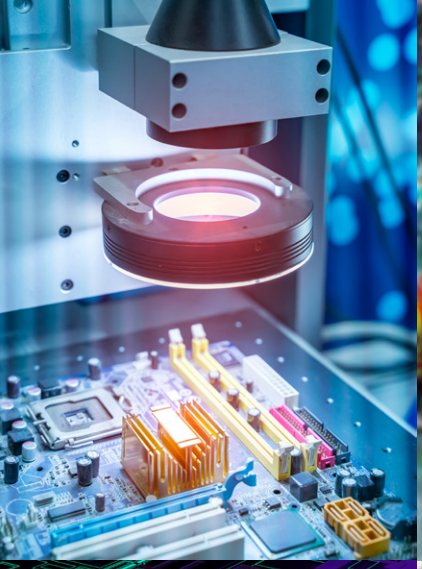
Looking ahead, SPIE currently forecasts global photonics component revenues for 2022 will end up reaching between $309 and $325 billion.

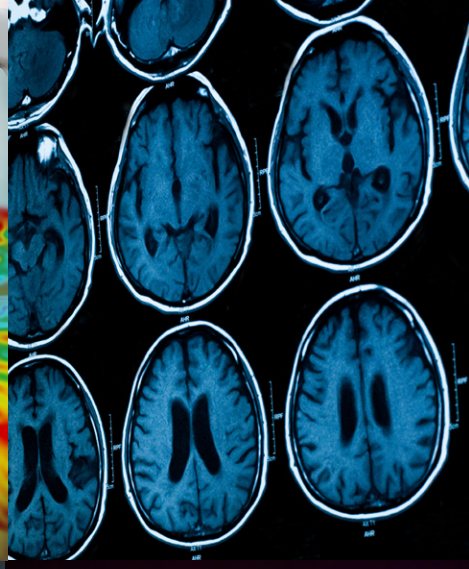
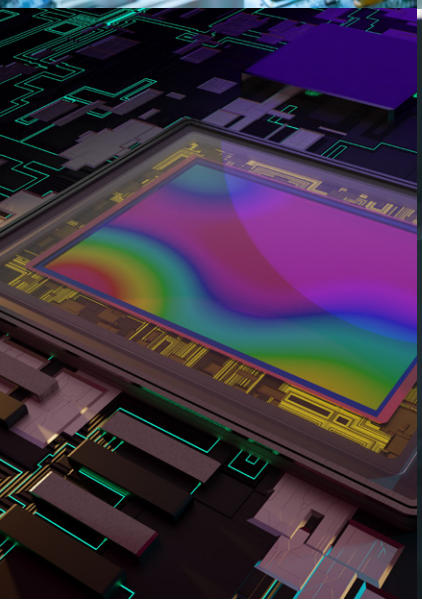
The forecast was developed in April of 2022 and incorporates many factors across the global industry including pandemic-driven demand for test and measurement systems, inflation, supply-chain challenges, the worldwide chip shortage, the conflict in Ukraine, and interest-rate and federal reserve policy changes to curb inflation. Depending on the applications served, some companies were forecast to have significant growth while others were expected to have declining revenues as they battled their various business challenges.



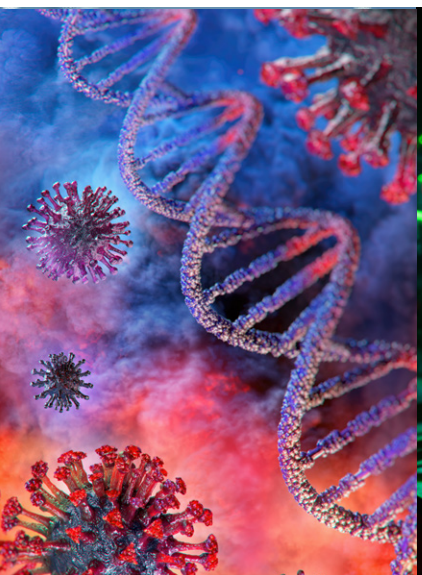
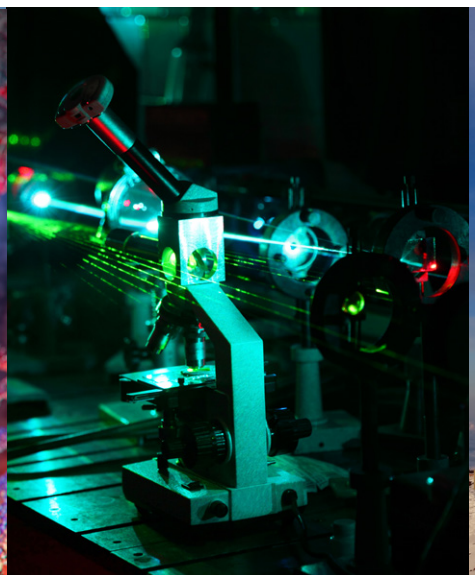
Forecasts for 2022 revenues are extrapolated from a review of industry analysts' predictions for 198 public companies in the SPIE database representing ~59% of total photonics component revenues for 2020.

In summary, the photonics industry has experienced a decade of consistent growth even under the duress of a global pandemic. There are certainly many challenges ahead that can adversely affect the global economy, however the global nature and diversity of the end-use applications enabled by photonics results in an extremely resilient industry.



Enabled Markets: Total global revenues exceed $2.1 trillion


The Photonics-Enabled Marketplace

The photonics components manufacturing industry underpins ten major "photonics-enabled" or end-use market segments. Each segment encompasses products based on photonics technologies that address different markets.

These major market segments range from the consumer products segment (smartphones and TVs, for instance) to the advanced manufacturing segment (such as 3D printing) and to healthcare and life sciences (like DNA sequencing and medical imaging).

Each of these major market segments is significant in its own right and comprises many smaller sectors. Each market moves independently of the others, but all are dependent on photonics.

Many of the enabled market segments are large enough to justify their own studies focused only on that segment. This makes sense because the factors affecting each of these markets are very different so the trends differ, as do the end-user characteristics.

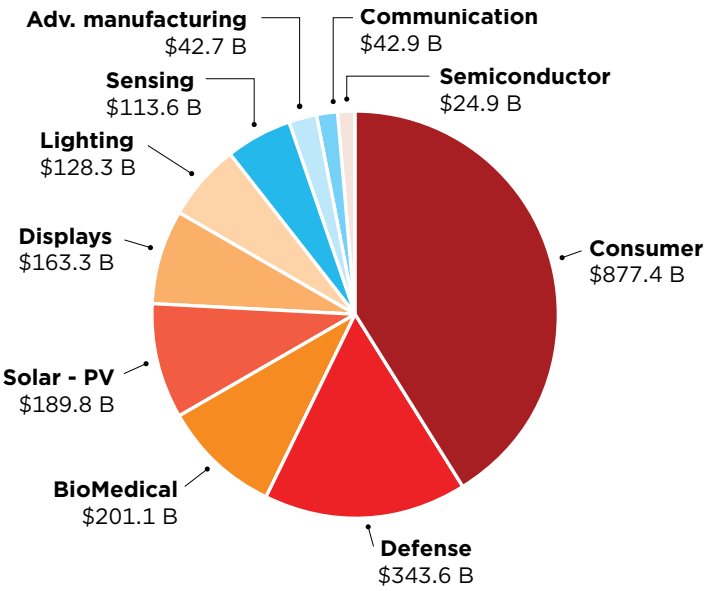
Nonetheless, it is useful to understand the full impact of a technology area like photonics by looking across all its markets. Hence, many governments track the overall photonics marketplace to gain insight into the impact of photonics on their country's economic well-being.[4]

> *"Data is important. Collecting it and analyzing it can be hard work. As a regional industry group, we are able to quantify data from our membership, but when we need to show where we are positioned in the global economy, SPIE's market research is without parallel. We share it with our regional and federal political delegations, with the DoD, and with other stakeholders to validate the importance of our industry."*
>
> —**Tom Battley,** Executive Director,
> New York Photonics Industry Association

Enabled markets economic impact

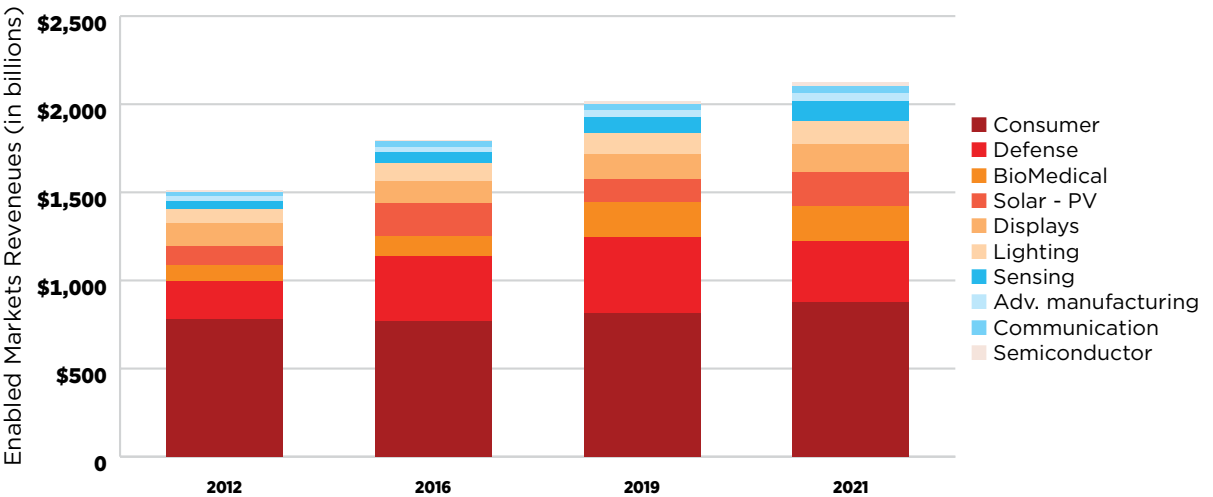
SPIE completed its first in-depth assessment of the entire photonics-enabled marketplace for 2012. The total revenues of the photonics-enabled markets in 2012 was $1.5 trillion.

Enabled Markets Economic Impact 2021
Global Total $2.12 Trillion



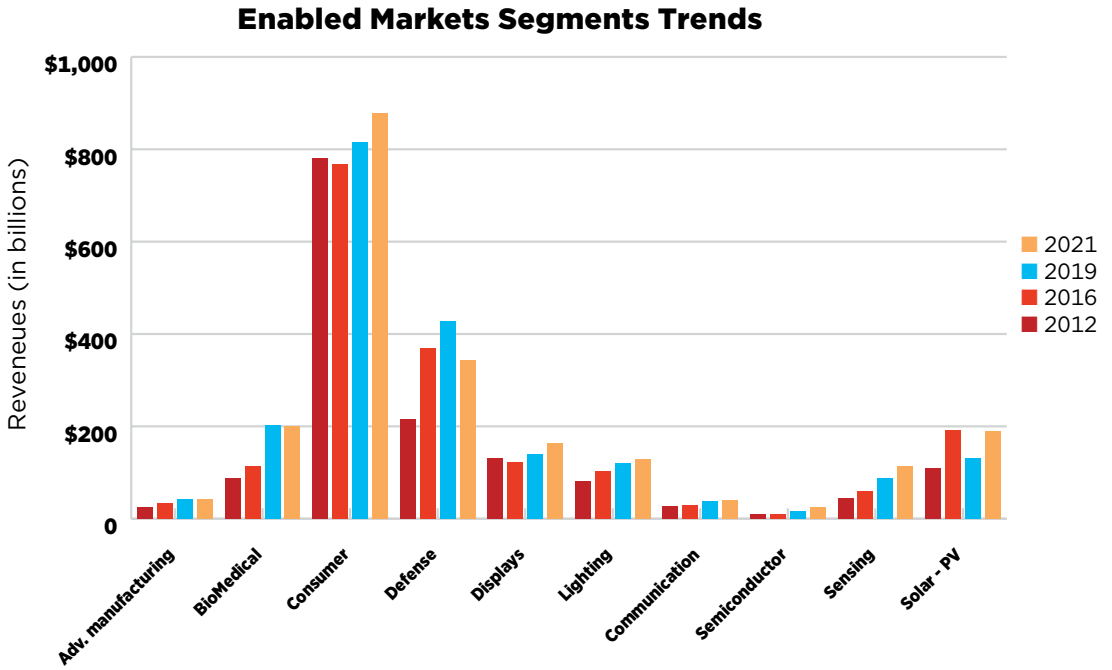
The most recent review valued the 2021 photonics-enabled marketplace at $2.1 trillion—an increase of 40% over the nine-year period, and a compound annual growth rate of 3.9%. Total worldwide employment was more than five million.

Enabled Markets Revenue Trend by Segment



Enabled markets segment trends

The ten 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 in commodity areas like solar panels or consumer products, price erosion can sometimes undermine revenue growth even as unit product sales increase.



The top four growth segments based on compound annual growth rates between 2019 and 2021 were:

- Displays (+8%): Signage, Point-of-Sale (POS), displays for home entertainment and work from home/school from home setups, as well as heads-up displays were winners during the pandemic.
- Sensing, Monitoring, and Control (+14%): Autonomous systems and the Internet-of-things continued to create demand for a wide variety of photonic sensors. This increase is despite significant headwinds in the automotive sensing applications which were growth constrained by a lack of semiconductor chips.
- Solar (+21%): Corporate Clean Energy Goals along with tax incentives at federal and regional levels are driving record numbers of installations with demand outstripping supply in many places, worldwide. Energy independence will continue to drive demand as well.
- Semiconductor Processing (+24%): Internet-of-things, automation, and smart “everything”, all use an increasing number of semiconductor chips. Processing equipment for older and cutting-edge technologies is in high demand. Demand for equipment is expected to continue with legislation such as the US CHIPS and Science Act and the European Chips Act of 2022 designed to improve resilience to supply chain disruptions.

A Bright Future

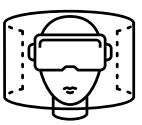
SPIE's broad range of annual photonics-related activities, including Photonics West—the world's largest annual photonics technologies event—provides us with unmatched insight into the technology trends and pace of global photonics innovation across almost all of the end-use markets.

This unique industry insight leads us to expect 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

Higher-resolution displays with continually improving performance are driven by evolving display technologies such as OLEDs, microLEDs, laser-based, and foldable/rollable devices.

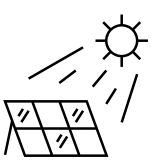


Artificial, Virtual, and Mixed Reality (AR/VR/MR)

AR and VR are establishing themselves in medicine and industry for training, marketing, and e-commerce. Gaming and entertainment are driving consumer adoption.

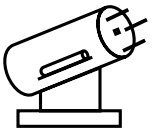
Medical

Cost-effective, photonics-based diagnostic and therapeutic medical devices are achieving higher market penetration. Wearables are rapidly advancing, enabling real-time monitoring of physiological parameters for wellness and disease control.



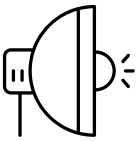
Solar/PV

Diminishing panel cost combined with anticipated more-economic storage options (batteries) is driving large increases in solar deployment across the globe. Next-gen thin-film PV (e.g, perovskite) promises improved performance.



Defense and Security

Infrared systems, hyperspectral imaging, and laser-based countermeasures are all deployed, while laser weapons are emerging as a real near-term possibility.



Lighting

Penetration of LED technology is increasing, driven by declining cost-per-watt of LEDs and higher value-add in smart and human-centric lighting systems. Applications such as sterilization, photonics in precision farming, and water purification are also benefiting from lower-cost smart sources.

Autonomous Systems

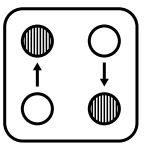
Self-driving cars, drones, and other robotics systems utilize a wide range of photonic sensors and imaging systems, some of which are increasingly benefiting from embedded artificial intelligence.

Advanced Manufacturing

Photonics-based production tools including lasers, optical metrology, and machine vision combined with adoption of rapid prototyping and Industry 4.0 are driving big manufacturing changes in industries like aerospace and automobiles.

Optical Communications and Information

Backhaul needs for 5G implementation will drive developments in communications, while in data centers the photon will increasingly solve the limitations of electronics, which is facing the immutable limits of fundamental physics.



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 30). Plus, SPIE publishes the largest collection of optics and photonics applied research—technical papers, reports, and presentations—more than 560,000—in the SPIE Digital Library.

SPIE Industry Resources

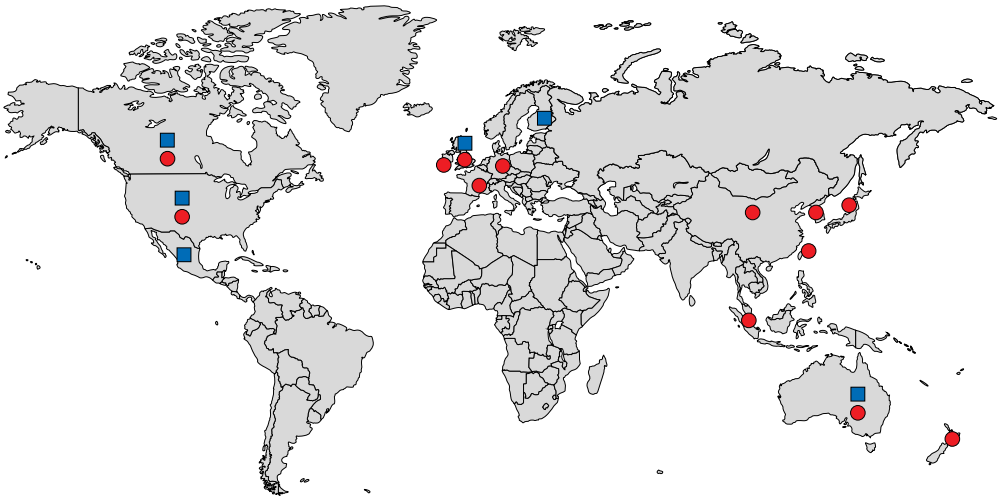
SPIE provides a comprehensive set of business resources for its industry members and partners. Our resources facilitate the growth of organizations working with photonics by fostering entrepreneurship, recognizing innovation, advocating for industry, creating networking opportunities, and connecting sellers with buyers.

These industry resources include:

- **Industry and market data**
  SPIE was the first to establish the size of the core global optics and photonics components business, conduct year-over-year analysis, and size the enabled markets.
- **Advocacy and pro-industry support**
  SPIE works on your behalf, and with your involvement, in areas such as policy development, advocacy, standards setting, education, government funding, and publicity that support the growth and success of our industry.
- **Corporate Membership**
  The SPIE Corporate Membership program provides unmatched value to its 650 current members, including exhibition "priority points" and discounts, global brand exposure, networking opportunities, access to new talent, business information, government policy updates, and more.
- **Marketing opportunities**
  Bring attention to your company and products at SPIE events, exhibitions, and conferences. More than 40,000 researchers, managers, and buyers attend SPIE events every year. Find your target audience with SPIE events, sponsorships, and advertising.
- **Training and education**
  Continuing education is an important investment in your company and your career. SPIE has a variety of options: conferences, workshops, courses at SPIE events, online courses, in-company training, and more. SPIE is your resource for lifelong learning.
- **Award programs**
  From the SPIE Startup Challenge to the PRISM Awards, SPIE is dedicated to supporting and recognizing innovative companies in our industry. Since 1955 SPIE has been honoring individuals in optics and photonics for their scientific, technical, and service achievements.

- **SPIE Digital Library**
  Whether looking for new technical possibilities, collaboration partners, researching the current state-of-the-art technologies (and what competitors are working on), or simply staying up-to-date in the field, having access to the world's largest collection of optical research, innovation, and engineering know-how is critical for business success.
- **Recruitment services**
  SPIE has helped thousands of photonics-focused companies find the right employees and thousands of employees find the right job. The SPIE Career Center, Job Fairs, and Student Program Sponsorships provide opportunities to help you win the war for talent.
- **optics.org**
  optics.org, a subsidiary of SPIE, is the longest-running online resource for OEMs and systems integrators in the core growth market for photonics applications. It has been delivering the latest company, product, and business news, in-depth articles on applications, and market analysis for more than 20 years.
- **Photonics clusters**
  SPIE supports groups of optics-related firms and universities that maintain strong research and workforce ties, create quality jobs, and develop regional economies. Together we work with government and stakeholders to strengthen the industry and grow your business.

SPIE routinely provides support for domestic assessment of photonics industries in many countries. We also regularly present business information and market updates worldwide. This map illustrates the global reach of our industry-support activities.



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Conferences and Exhibitions 2022/23

NORTH AMERICA

SPIE. PHOTONICS WEST
28 January–2 February 2023
San Francisco, California, USA

PW Exhibition
31 January–2 February 2023

BiOS Exhibition
28–29 January 2023

SPIE. AR|VR|MR
29 January–1 February 2023
San Francisco, California, USA

Exhibition
30–31 January 2023

SPIE. MEDICAL IMAGING
19–23 February 2023
San Diego, California, USA

SPIE. SMART STRUCTURES+ NONDESTRUCTIVE EVALUATION
12–16 March 2023
Long Beach, California, USA

SPIE. DEFENSE+ COMMERCIAL SENSING
30 April–4 May 2023
Orlando, Florida, USA

Exhibition
2–4 May 2023

SPIE. ADVANCED LITHOGRAPHY+ PATTERNING
26 February–2 March 2023
San Jose, California, USA

Exhibition
28 February–1 March 2023

PHOTONICS FOR QUANTUM
SPIE. | RIT
6-9 June 2022
Rochester, New York,USA

SPIE. ASTRONOMICAL TELESCOPES + INSTRUMENTATION
17–22 July 2022
Montreal, Canada

Exhibition
19–21 July 2022

Biennial event

SPIE. OPTICS+ PHOTONICS
21–25 August 2022
San Diego, California, USA

Exhibition
23–25 August 2022

SPIE. PHOTONICS INDUSTRY SUMMIT
21 September 2022
Washington DC, USA

SPIE. PHOTOMASK TECHNOLOGY + EUV LITHOGRAPHY
25–29 September 2022
Monterey, California, USA

Exhibition
27–28 September 2022

SPIE. TRANSLATIONAL BIOPHOTONICS
12–14 September 2022
Houston, Texas, USA

SPIE. LASER DAMAGE
18-21 September 2022
Rochester, New York, USA

SPIE.OPTIFAB
October 2023
Rochester, New York, USA

Exhibition
October 2023

Biennial event

EUROPE

SPIE. PHOTONICS EUROPE
3–7 April 2022
Strasbourg, France

Exhibition
5–6 April 2022
Biennial event

SPIE. OPTICAL SYSTEMS DESIGN
September 2024
Triennial event

SPIE. SENSORS+ IMAGING
5–7 September 2022
Berlin, Germany

Exhibition
5–8 September 2022

SPIE. SPACE, SATELLITES+ SUSTAINABILITY (S3)
October 2022
Edinburgh, United Kingdom

SPIE.PHOTONEX
6–8 December 2022
Birmingham, England
Exhibition
7–8 December 2022

SPIE. OPTICS+ OPTOELECTRONICS
24-27 April 2023

Exhibition
April 2023

Biennial event

ASIA-PACIFIC

OPTICS & PHOTONICS International Congress
OPIC 2022
18–22 April 2022
Yokohama, Japan

Photomask Japan 2022
25–27 April 2022
Yokohama, Japan

SPIE. ASIA-PACIFIC REMOTE SENSING
April 2023

Biennial event

SPIE. COS | PHOTONICS ASIA
17-23 October 2022
Beijing, China

SPIE. FUTURE SENSING TECHNOLOGIES
9-11 November 2022
Tokyo, Japan

Methodology and Footnotes

1. www.imf.org/external/datamapper/NGDPD@WEO/WEOWORLD
2. National Academy of Sciences Report: *Optics & Photonics: Essential Technologies for our Nation*.
3. 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).
4. Governments that routinely track photonics include the EU (Photonics21), Japan (OITDA), Korea (KAPID), and Taiwan (PIDA).

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

Notes

SPIE is the international society for optics and photonics

MOVING TECHNOLOGY TO MARKET.

SPIE.

SPIE, the international society for optics and photonics, brings engineers, scientists, students, and business professionals together to advance light-based science and technology. The Society, founded in 1955, connects and engages with our global constituency through industry-leading conferences and exhibitions; publications of conference proceedings, books, and journals in the SPIE Digital Library; and career-building opportunities. Over the past five years, SPIE has contributed more than $22 million to the international optics community through our advocacy and support, including scholarships, educational resources, travel grants, endowed gifts, and public-policy development.

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