

March 2022. Technological Snapshot

# Photonics

## in Catalonia

## Photonics in Catalonia

### ACCIÓ

Government of Catalonia (Generalitat de Catalunya)



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The brands and logos used in this report are for information purposes only. The brands and logos mentioned belong to their respective owners. None of them is owned by ACCIÓ. This report offers a partial overview of the companies, organizations and entities that form part of the photonics ecosystem. Some companies, organizations and entities may not have been included in the study.

### Execution

ACCIÓ's Strategy and Competitive Intelligence Unit

### Collaboration

IDOM

Barcelona, March 2022

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Photonics in Catalonia

# 1. Definition of Photonics

**Photonics** is the branch of physics that studies the use of photons, which are fundamental elements of light. It analyses how they are generated, transmitted and manipulated, as well as how they interact with matter.



In today's world, this discipline produces various technologies that are applied in almost every field of activity and have a positive impact on everyday life, from smartphones to cutting-edge technologies used in science, medicine, culture and education.

The development of photonic technology such as fibre optics has made the evolution of telecommunications possible, especially high-speed Internet.



Photonics is the scientific basis upon which the following technologies are being developed, among others:

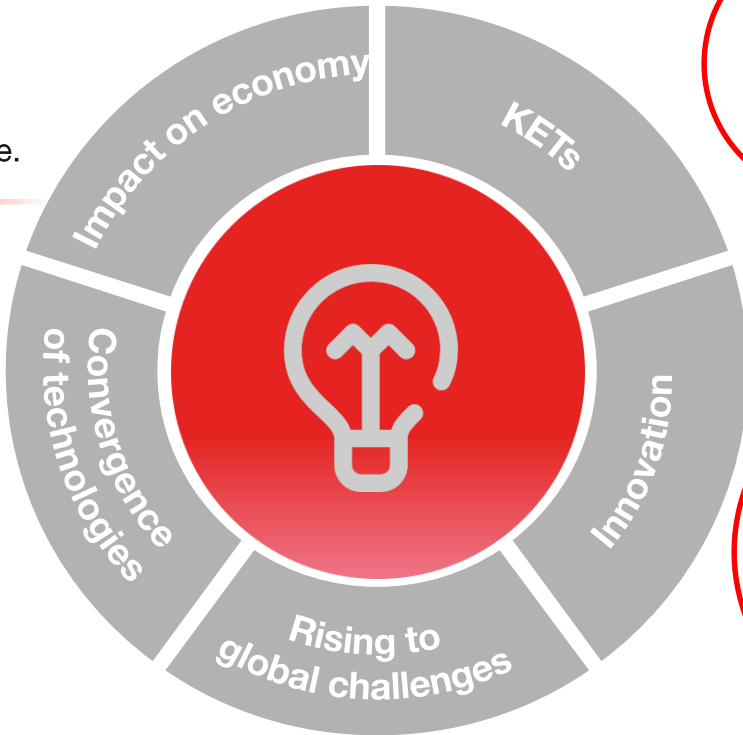


	SENSORS AND IMAGING	COMMUNICATIONS AND NETWORKS	LASER SYSTEMS	SMART LIGHTING SYSTEMS	SCREENS AND DISPLAYS	PHOTOVOLTAIC SYSTEMS	QUANTUM TECHNOLOGIES
FUNCTIONS	Measuring, controlling, and acquiring information	Transmitting data	Manufacturing processes and medical treatments	Supplying light	Delivering information	Collecting and supplying energy	A new paradigm for how devices work
EXAMPLES	LiDAR (Light Detection and Ranging) and digital cameras	Fibre optics and Internet	High-precision lasers for industry and medicine	LED, OLED and MicroLED	OLED	Advanced solar panels	Photonic encryption for cybersecurity

Photonics has an impact on a multitude of sectors, including optical data and image communications, lighting, screens, nanotechnology, security, biology and medicine.

Photonics converges with a number of technologies, such as artificial intelligence and 3D printing, by exploiting its exceptional innovative potential.

Photonics is essential to tackle and provide solutions for global challenges such as climate change, increased raw material costs, demographic growth, population ageing, health and the digital society.



As a key enabling technology, photonics plays an important role in fomenting innovation in a growing number of fields through actions such as improving productivity and equipping final products with new functionalities.

The impact of photonics in the 21st century will be of the same magnitude as that of electricity in the 20th century. When traditional technologies reach their limits in terms of speed, capacity, energy consumption and precision, photonics, as a deep tech, will offer new and unique solutions. Photonics has a great growth potential and possible impact on other industries.

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## 2. World Photonics Market

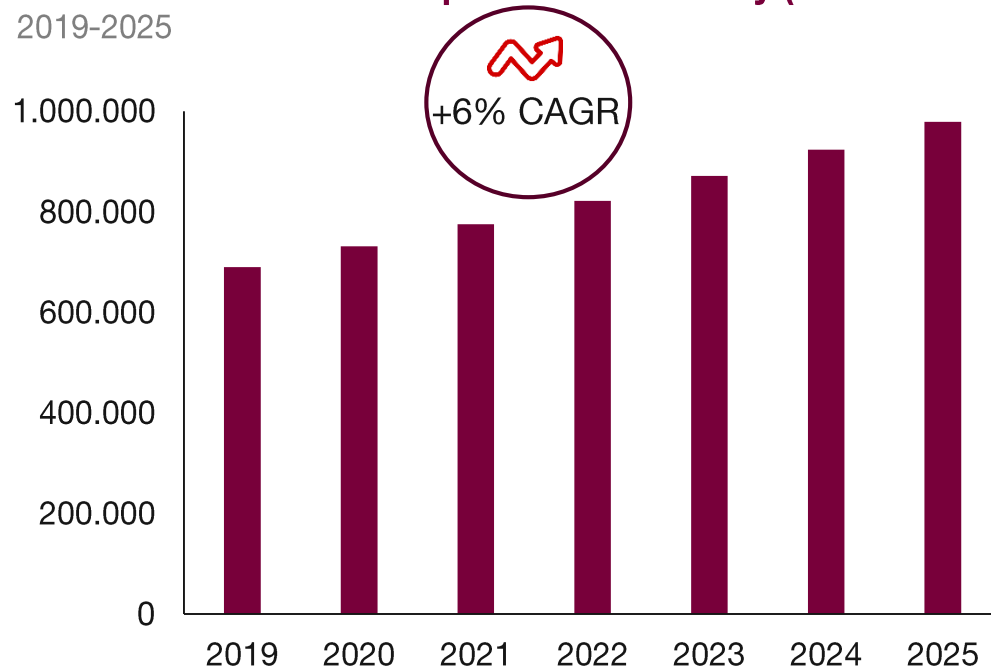




The photonics industry is growing more quickly than traditional industries and even more than high-tech industries such as microelectronics. The world photonics market amounted to **€690 billion in 2019** and is estimated to surpass **€900 billion by 2025**.

### Growth forecast for the photonics industry (millions of euros)

2019-2025

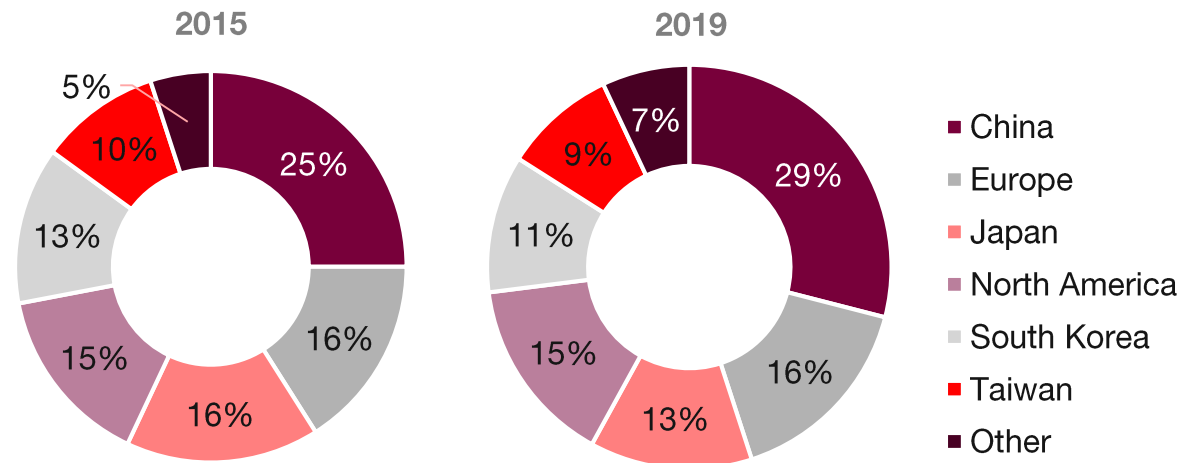


The world photonics industry showed cumulative growth of 7% between 2015 and 2019. It is estimated that the photonics industry will grow at a rate of 6% annually between 2020 and 2025.

**Only 20% of the potential and benefits of light technologies has been harnessed thus far**

Revenues in the **European photonics industry** in 2019 amounted to €103 billion, representing a **16% share of the global market** and supplying more than 390,000 jobs.

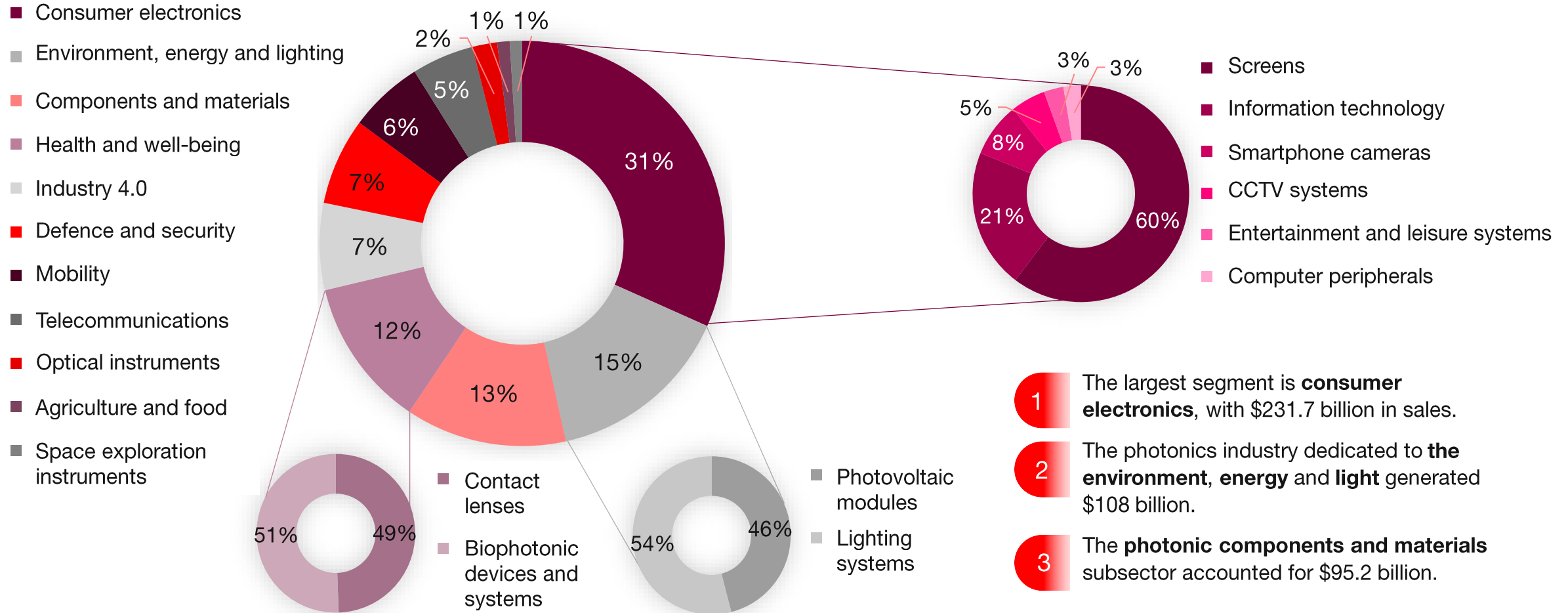
Evolution of global photonics market share (%)



For four years, Europe’s photonics industry maintained its share of sales in the global market thanks to research, innovation and the dynamic nature of its ecosystem. Meanwhile, China increased its market share for the 2015-2019 period to the detriment of Japan, South Korea and Taiwan. North America also maintained its market share.

**Breakdown of the global market by application segment (%)**

2019

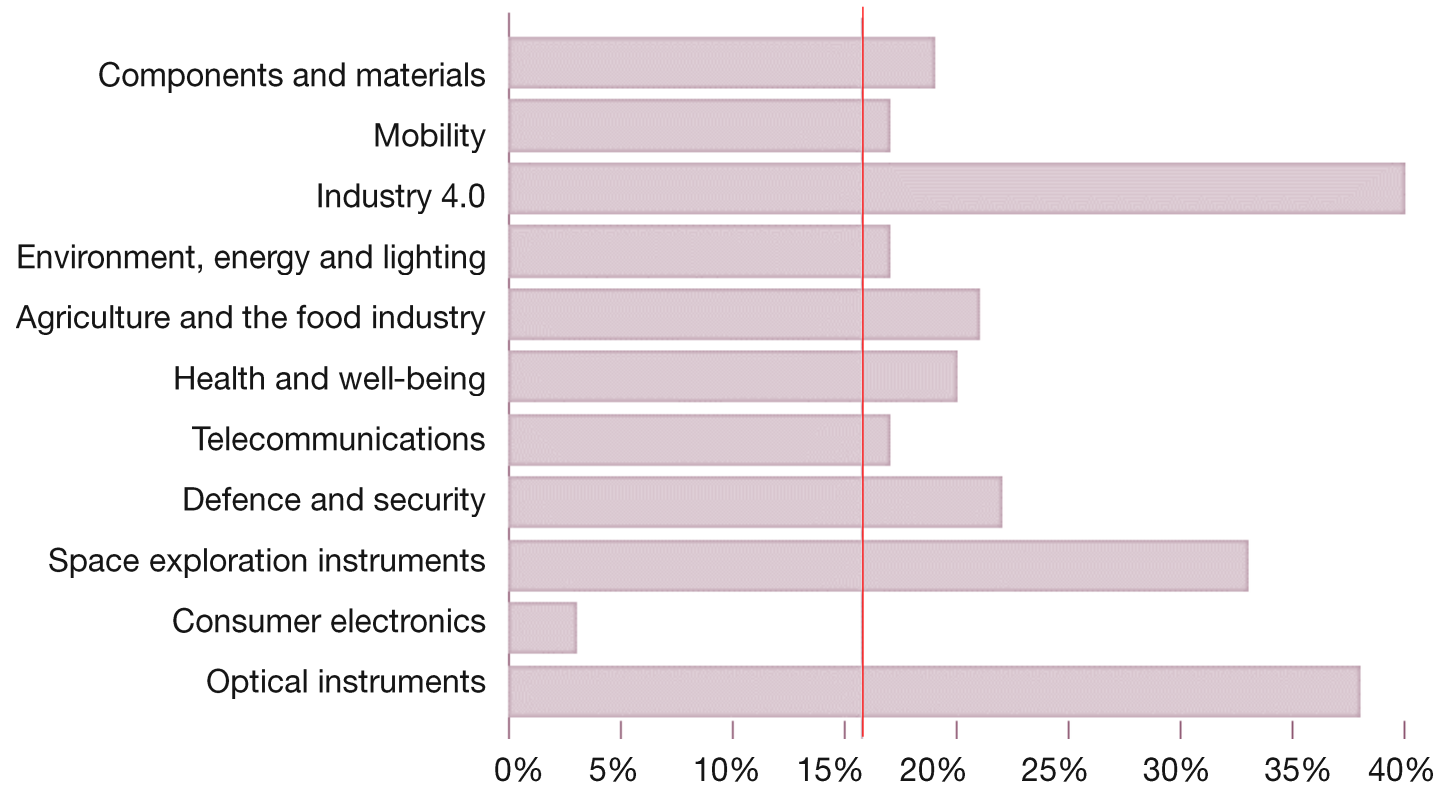


- 1 The largest segment is **consumer electronics**, with \$231.7 billion in sales.
- 2 The photonics industry dedicated to **the environment, energy and light** generated \$108 billion.
- 3 The **photonic components and materials** subsector accounted for \$95.2 billion.

Sources: Prepared by the authors, based on data from Photonics 21 and TEMATYS

**Market share by segment in the European photonics industry, 2019 (%)\***

2015-2019



The red line indicates the average market share for European photonics (16%)

The most important segments in Europe are Industry 4.0, optical instruments and space exploration instruments.

Although Europe trails behind in the two largest photonics markets (consumer electronics and photovoltaic energy), it maintains its global photonics market share thanks to the dynamism of other segments.



Photonic Components



Fibre Optics

Photonics for Industry



Automotive

Lighting

Ophthalmology



Health

Telecommunications

Instruments



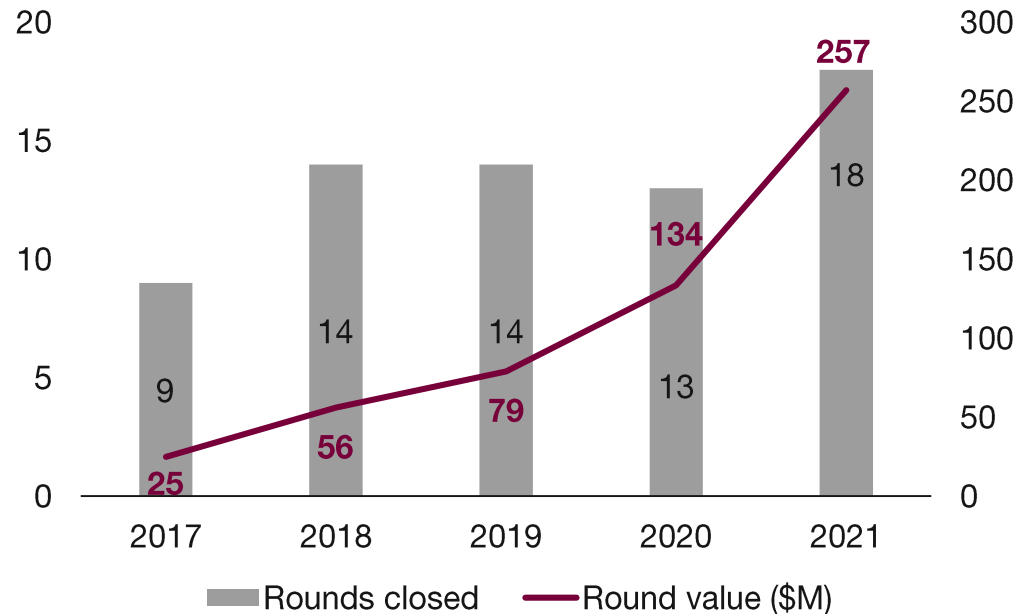
Defence and Security



In the last five years, there have been **68 rounds of investment\*** in photonics startups around the world, with a total value of **\$551M**. In 2021, these numbers reached record figures, with 18 rounds valued at **\$257M**.

## Investment rounds in photonics

2017-2021



## Main countries

2017-2021



**\$188.9M**  
21 rounds



**\$95.2M**  
4 rounds



**\$93.4M**  
13 rounds

## Main startups

2017-2021 (round value)



**RIGHTMATTER**  
**\$80.0M**



**isorg**  
**\$47.2M**



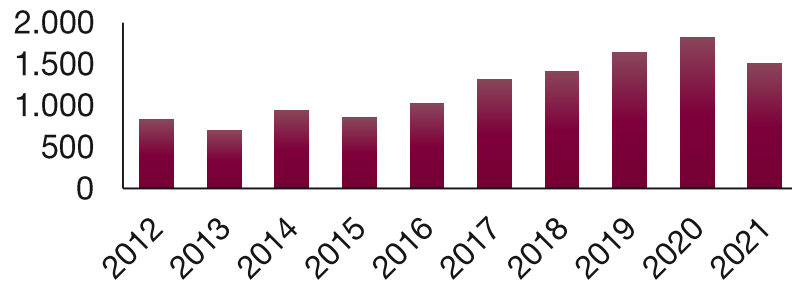
**indigo**  
**\$44.7M**

\*These include pre-seed, seed and Series A, B and C investment rounds.

Over the past 10 years, **12,000 patents** in photonics have been registered worldwide, concentrated mainly in **China** and the **United States**. **Optical elements** and **semiconductors** are the main photonics areas for patents.

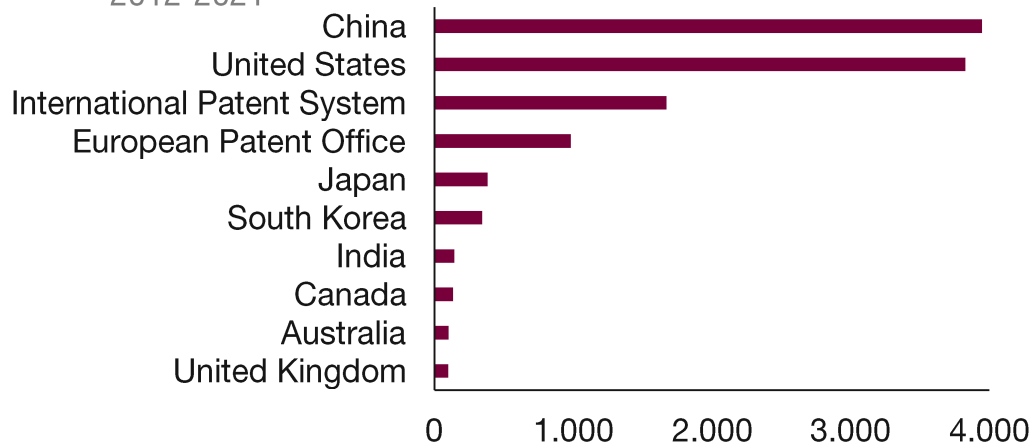
**Evolution of global patents in photonics**

2012-2021



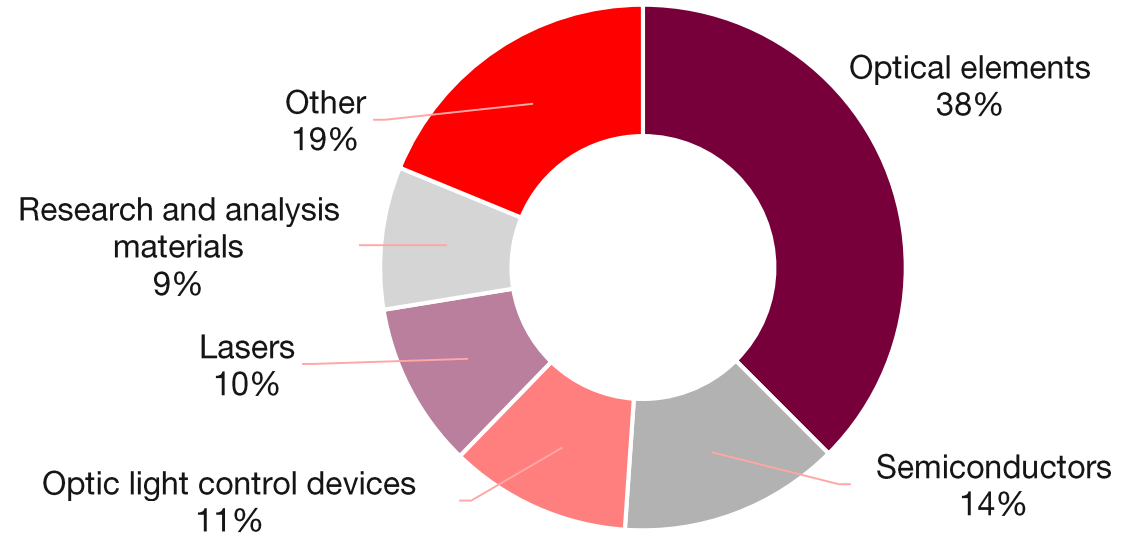
**Patents in photonics by geographical area**

2012-2021



**Distribution by technological area**

2012-2021



**Main patent applicants**

2012-2021



Source: Prepared by the authors, based on data from the World Intellectual Property Organization



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## 3. Photonic Applications



# Future Applications by Demand Sector (I)

MANUFACTURING  
INDUSTRY



Micro- and nanomanufacturing

CONSTRUCTION  
INDUSTRY



Lasers for topographic scanning and measuring distances and alignment

LOGISTICS AND  
AUTOMOTIVE  
INDUSTRY



Energy-efficient lighting for vehicles and LED traffic signals



Traffic monitoring cameras

TEXTILE  
INDUSTRY

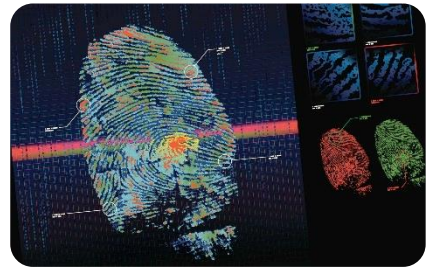


Laser cutting and metrology

SECURITY  
INDUSTRY



Unpiloted aerial and ground surveillance units



Forensic analyses with lasers, DNA scanning and retinal scanning

AERONAUTICS  
AND AEROSPACE  
INDUSTRY



LiDAR systems




Holographic vision screens and laser altimeters

Sources: Prepared by the authors, based on data from different sources

## Future Applications by Demand Sector (II)

ELECTRONICS AND OPTICS INDUSTRY




Use of lasers to manufacture electric devices

AGRICULTURAL AND FOOD INDUSTRY

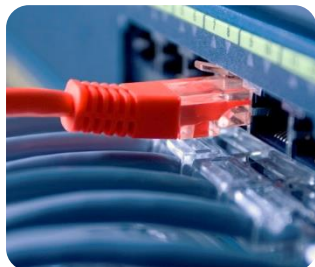



Satellites and drones for large-scale planting and irrigation



Optical scanners for quality control and food safety

TELECOMMUNICATIONS (ICTs)

Optical equipment for data processing and storage

ELECTRICAL ENERGY INDUSTRY





Solar panels for energy supply

CIRCULAR ECONOMY




Resource exploitation using optical sensors

BIOMEDICAL INDUSTRY




Robotic and laser surgery, and optical biosensors to detect pathogens



Disinfection equipment

CHEMICAL AND PHARMACEUTICAL INDUSTRY




NIR spectroscopy for analysing chemical components

Photonics directly impacts the fulfilment of **8 Sustainable Development Goals**



**3. Good Health and Well-Being**

Photonics provides techniques that can be applied to biomedicine, such as the use of lasers in surgery, photodynamic therapies, glucose monitors, as well as rapid diagnostic techniques that facilitate and streamline medical care.



**6. Clean Water and Sanitation**

Light technologies offer opportunities to face challenges associated with water management and sustainability. Through the release of biophotons, the quality of drinking water can be controlled, water can be disinfected and hydraulic infrastructure can be managed.



**7. Affordable and Clean Energy**

Photonic science offers opportunities to develop clean, renewable alternative energy sources. For example, it is used in photovoltaic panels and ultraviolet optical absorption spectrometers to control air quality.



**8. Decent Work and Economic Growth**

Photonics is a cross-cutting science with multiple areas of application. Its market also anticipates huge growth in sectors and production activities that create considerable added value for technological innovation and modernity.



**9. Industry, Innovation and Infrastructure**

Development of ICTs and techniques for sustainable, innovative infrastructure using laser systems, topographic scanning and three-dimensional measurement.



**11. Sustainable Cities and Communities**

Light technologies have continued evolving towards the development of more efficient, versatile, economical and environmentally friendly lighting systems.



**12. Responsible Consumption and Production**

Responsible agriculture can use scanning techniques and infra-red images to control food production and quality, along with scanning systems for large-scale planting, irrigation and detection of crop effects.



**13. Climate Action**

Photonics is a technology that plays a key role in achieving climate goals since it offers excellent solutions for sustainable development challenges.

Photonics in Catalonia

## 4. Photonics in Catalonia





By technology\*\*, 42.2% of the companies work in **sensors, scanning systems and image capture** and 28.3% work in **advanced lighting**.

By application sector\*\*, 43.9% are geared towards **Industry 4.0**, while 28.9% work in **lighting**.

\*With respect to the data for mapping carried out in 2018 (job comparisons not available since this figure was not released in 2018).

\*\*Companies can be classified in more than one segment within the photonics value chain.



**Sensors, Scanning Systems and Image Capture**

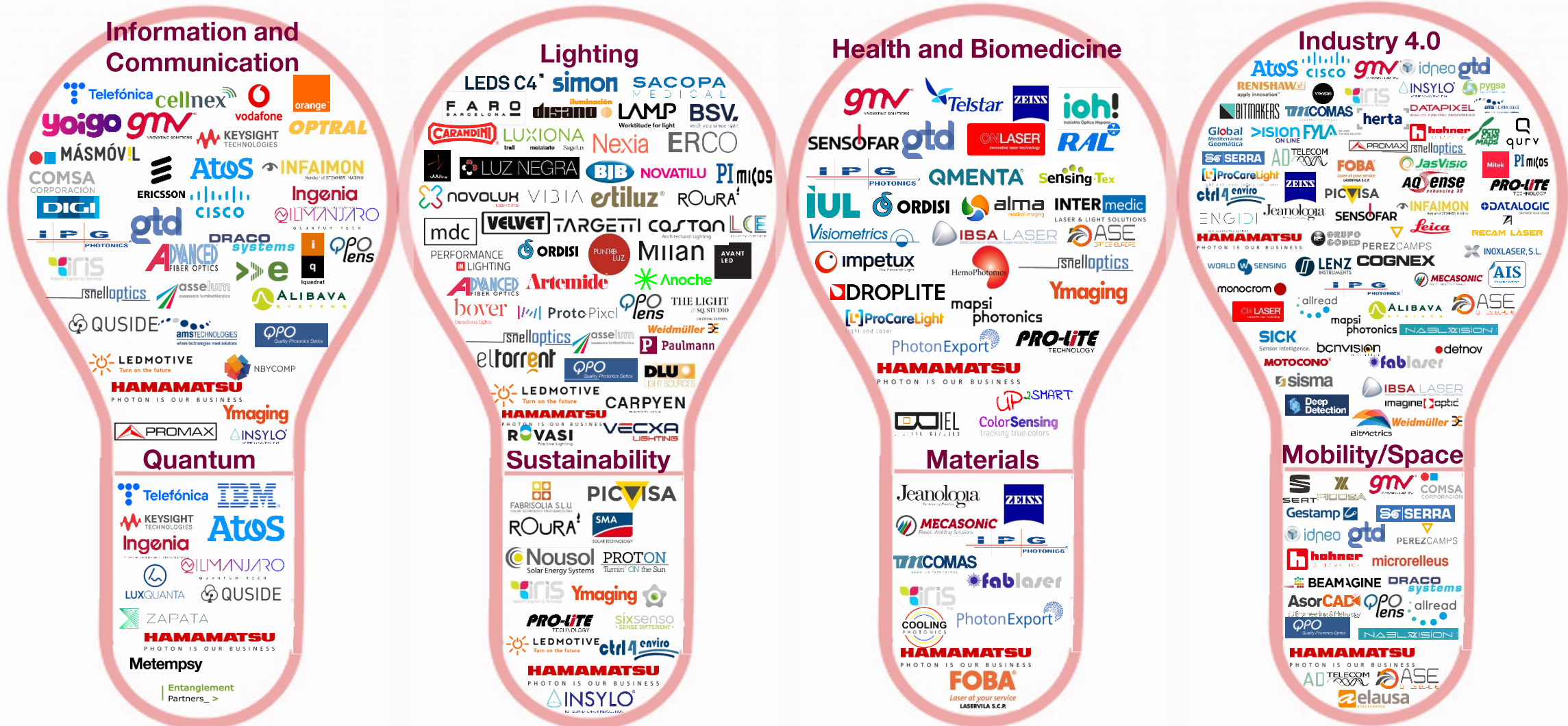
**Communications Systems, Networks and Data Transmission**

**Laser Systems**

**Advanced Lighting**

**Quantum Technologies**

**Energy Systems**





**Technological Centres and Research Institutions**

BCN MEDTECH, CD6 UPC, Centre for Sensors, Instruments and Systems Development, UCEMIC, CPT, CTTC, CVC, eurecat, gtq, i2cat, IBEC, ICFO, ICN2, IFAE, IRTA, IQS, LEITAT, Nb4D, MCS, Tecnologia Aliments CERTA-UAB, CTTC, UPC, Centre Tecnològic de Transferència de Calor, UNIVERSITAT POLITÈCNICA DE CATALUNYA

**Universities and Training Centres**

UPC, UNIVERSITAT DE BARCELONA, UAB, upf, Universitat Pompeu Fabra Barcelona, UNIVERSITAT ROVIRA I VIRGILI, Universitat de Girona, Universitat de Lleida, UNIVERSITAT RAMON LLULL, UOC, Universitat Oberta de Catalunya

**Associations**

secpho, DIH4CAT, MOBILE WORLD CAPITAL BARCELONA, CATALONIA LIVING LAB, SOLARTYS, CARNET, CICAT, Modacc

**Government Institutions and Administration**

Generalitat de Catalunya, ALBA, BSC, Ajuntament de Terrassa

Catalonia boasts dynamic institutions and initiatives, making it a **hub of photonics in Southern Europe**

### Institute of Photonic Sciences in Catalonia (ICFO)

The ICFO has positioned itself as an international reference institution in photonics

### Centre for Sensors, Instruments and Systems Development (CD6)

This technological innovation centre operates in the field of optical engineering and photonics

### SECPHO

Cluster comprised of 180 members focusing on innovation in all economic sectors through deep tech

### Barcelona Medical Photonics Network

This centre promotes research and development in photonics to improve patient health and care quality

### Digital Innovation Hub of Catalonia (DIH4CAT)

Networked community of services, infrastructure and knowledge to promote digital and technological transformation of Catalan industry

### ALBA Synchrotron

This electron accelerator complex produces synchrotron light to visualize the atomic and molecular structure of materials

### QuantumCAT

This hub fosters technology transfer and innovation projects in quantum technologies with an industrial and social impact

### Barcelona Supercomputing Centre (BSC)

This centre will have Southern Europe's first quantum computer and will head up Quantum Spain, the Spanish quantum computing network

### High-Performance Centre for Entrepreneurship in Photonics (CAREF)

This incubator specializing in photonic technologies is backed by Terrassa City Council

### Catalonia Living Lab

The Silicon Nitride Photonic Integration Platform provides a stable and scalable photonics manufacturing platform

Light-based technologies will have **an impact like that of electricity in the 20th century**, but there are still challenges in the **implementation and growth of the photonics industry**

### Opportunities

New fields of application

Digitalization

Integrated photonics

Quantum applications

Research and technology

### Challenges

Talent

Technology transfer


Capital


Development of industrial infrastructure


Convergence with other technologies


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## 5. Success Stories in Catalonia


 **QUSIDE** **Quside** provides quantum technologies that allow for unprecedented computational efficiency


 **LUXQUANTA** **Luxquanta** offers quantum technologies to protect data and telecommunications


 **ProCareLight** **ProCareLight** works on safety using lasers and light-emitting systems


 **Hemophotonics** translates technologies based on light to measure brain haemodynamics


 **Qurv** develops imaging sensor technologies that allow for artificial vision systems


 **Signadyne** works on developing and commercializing high-performance electronics

 **Radiantis** is a manufacturer of conversion systems that fine-tune lasers for optical diagnostics


 **Sixsenso** offers services and products for monitoring water quality


 **BEAMAGINE** **Beamagine** builds LiDAR imaging sensors for autonomous mobility and virtual reality


 **Deep Detection** **Deep Detection** manufactures X-ray cameras for detection on high-speed continuous production lines

 **Meetoptics Labs** is an optical components metasearch platform

 **QILIMANJARO** **Qilimanjaro** develops quantum computing solutions

 **SENSOFAR MEDICAL** **Sensofar** has undertaken a project to tackle severe aortic stenosis

 **Visiometrics** works on designing and manufacturing instruments for ophthalmological diagnostics

 The objective of the **NIR-Q** Project is to implement photonics in textile quality control

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# Interviews

We would like to express our thanks to ICFO, CD6 and SECPHO for their willingness to help and for providing us with data and information that made it possible to create this technological snapshot.



# Thank You!

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