EAC
INTERNATIONAL CONSULTING

EXECUTIVE REPORT

"Political Steering Processes in China in Core Segments of the Photonics Industry"

2024

Commissioned by the European Technology Platform Photonics21

PHOTONICS21

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List of Abbreviations

Abbreviations	Full name
14th FYP	14th Five-Year Plan and Beyond
3C	Computer, Communications, Consumer electronic
AI	Artificial Intelligence
Bln	Billion
CAGR	Compound Annual Growth Rate
CAS	Chinese Academy of Science
Etc.	Et cetera
EU	European Union
EUR	Euros
HUD	Head-up Displays
IC	Integrated Circuit
ICF	National Integrated Circuit Industry Investment Fund
ICT	Information and Communication Technologies
IoT	Internet of Things
L1-L3	Level 1 - Level 3
LED	Light-emitting Diode
IT	Information Technology
LiDAR	Light Detection and Ranging
MEE	Ministry of Environment
MIC 2025	Made in China 2025
MIIT	Ministry of Industry and Information Technology
Mln	Million
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOHRSS	Ministry of Human Resources and Social Security
MOST	Ministry of Science and Technology
NDRC	National Development and Reform Commission
NHC	National Health Commission
NSFC	The National Natural Science Foundation of China
R&D	Research and Development
S&T	Science and Technology
SPIE	The International Society for Optics and Photonics
Tln	Trillion
US	United States

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A. Executive Summary

- **China's spectacular economic growth has remade the geopolitical landscape, which is playing a crucial role in influencing China's economic growth and shaping China's future roadmap.**

  China's long-term economic growth will downshift with GDP growth falling from ~7% (2015-2019), estimated 5% in 2023 to ~4% (2024F-2028F).

  After a period of rapid growth, China has placed more emphasis on high-quality development, increasing self-reliance in high-tech industries, and becoming a manufacturing power.

  The geopolitics accelerate the technology race, and meanwhile stimulate industry upgrading in China, such as the US "*CHIPS and Science Act*".

- **China has no dedicated "*China Chip Act*", but has a national fund for the development of integrated chips called "*National Integrated Circuit Industry Investment Fund (ICF)*".**

  Phase I (2014-2019): 138.7 bln RMB (~18.0 bln EUR*), mainly for industrial layout.

  Phase II (2019-2024): 204.15 bln RMB (~26.5 bln EUR), focus more on manufacturing equipment and materials.

  Phase III (2024-2029): 300 bln RMB (~39 bln EUR) is being planned to support high-end chip manufacturing.

  The Photonics part of IC investment, especially integrated photonics, is still an emerging topic in China and is currently not the focus of the ICF.

- **Currently, China's photonic industry is characterized as "*strong in applications, weak in technologies, huge in markets, and low in profits*". But China is leading in displays and photovoltaics and catching up quickly in lasers, lighting, ICT, photonic sensors, etc.**
- **Central government still plays an important role but more in steering role in the future development direction of basic photonics research, while policies, strategies and funds are more deployed at regional level as China's industry reached already market commercialization.**

  Policy shifts from the national level to the regional level for better commercialization and industrialization.

  There are 8 major photonics industrial clusters distributed in 8 cities, and most of the clusters have their own regional strategies and development focus for the photonics industry.

  The initial establishment of clusters is more of a spontaneous formation driven by market demand.

- **Compared to EAC's investigation in 2015,[1] China's funds for photonics are currently more raised by local governments and regional clusters with a capital scale much larger than national funds.**

  It's estimated that the total funds raised from regional governments, investment institutions, and enterprises will be approximately 5 bln EUR in the next few years, and public funds account for 20%~30%.

[1] Political Steering Processes in Asia Aimed at the Photonics Industry 2015 available under: Photonics_Asia_Study_Executive_Report.pdf (photonikforschung.de).

Local funds are more initiated for industrial integration and industrialization, while national funds are invested more in cutting-edge basic research topics, there are two major national funds allocated to photonics-related subjects, including but not limited to 120 mln EUR in 2022.

Referring to the 2015 report, the national "*863, 973 and NTS programs*" allocated 140 mln EUR for photonics research in 2014, which was estimated to increase to 1 bln EUR in 2020.

- **China adopts the "*top-down and bottom-up*" science & technology approach with an integrated development system of industry, academia, and research.**
- **In the future, China will strengthen the development of optical chips including integrated optical circuits, laser chips, etc., meanwhile accelerating the upgrade of devices.**

* Exchange rate: 1 EUR = 7.7 RMB

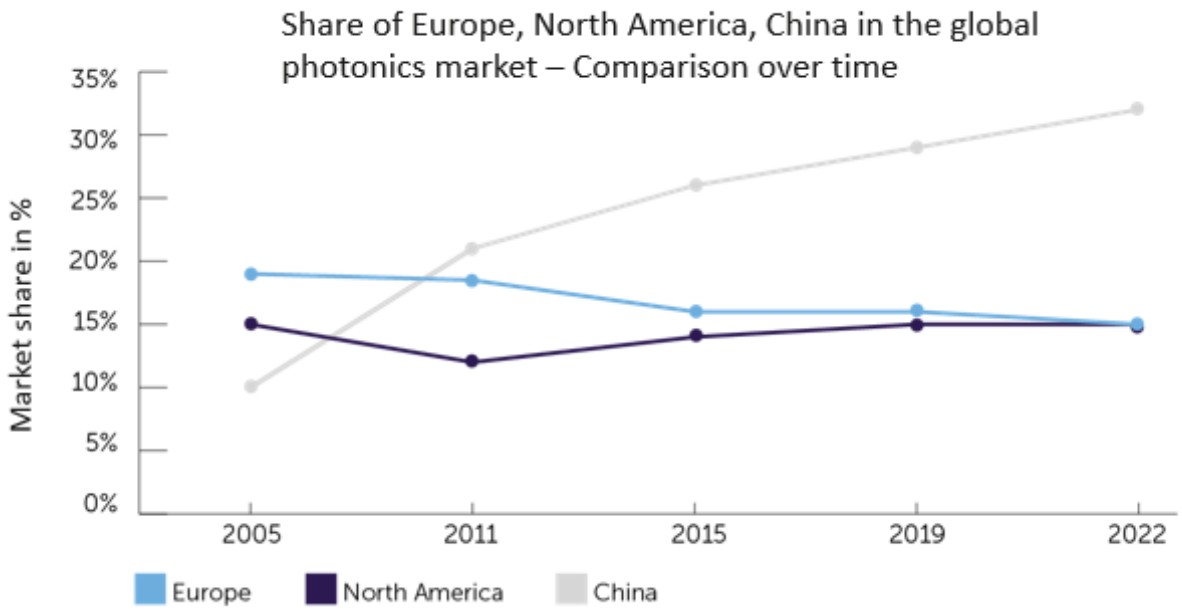
B. Preliminary Remarks by Photonics21

Similar to Europe, China understands photonics as a wide range of technologies and applications that involve generating, manipulating, and detecting photons, which are particles of light. Photonics technology powers the world's economic growth engine, as it plays a critical role in various industries, including telecommunications, IT, lighting, healthcare, manufacturing, etc. While definitions and corresponding market sizes vary significantly, common denominators are huge volumes, attractive future growths, and China as the gravity center.

According to the statistical analysis published by the European Technology Platform Photonics21 and carried out by the French market research institute Tematys, the global market for photonic components and systems accounted for $865 bln (~795 mn EUR) in 2022. The market grew at a CAGR (Compound Annual Growth Rate) of 6.8% between 2019 and 2022 exceeding global GDP growth. This growth is expected to continue, leading to a global photonics market of $1.2 tln by 2027. The fastest-growing photonics segments worldwide are photonics for environment, energy and lighting, photonics for industry 4.0, and photonics for agriculture and food. Photonics for Agriculture and Food is a strongly growing emerging market, which – at a small level with a segment share of only 1% – demonstrates a high CAGR of 11.8%.[2] With the rapid growth of the photonic industry, the number of producers is growing, and more jobs are added each year.[3]

As highlighted in the new Photonics21 Market Research Study, China has rapidly gained market share in photonics over the last decades, the share of photonics "*Made in China*" in the global market increased from about 10% in 2005, over 26% in 2015, to 32% in 2022, recognising its pivotal role in strengthening its economic prowess in emerging digital markets and enhancing its defence, security and space capabilities.

Figure 1 Global Photonics Industry: Breakdown by Geographical Areas (2005-2022)



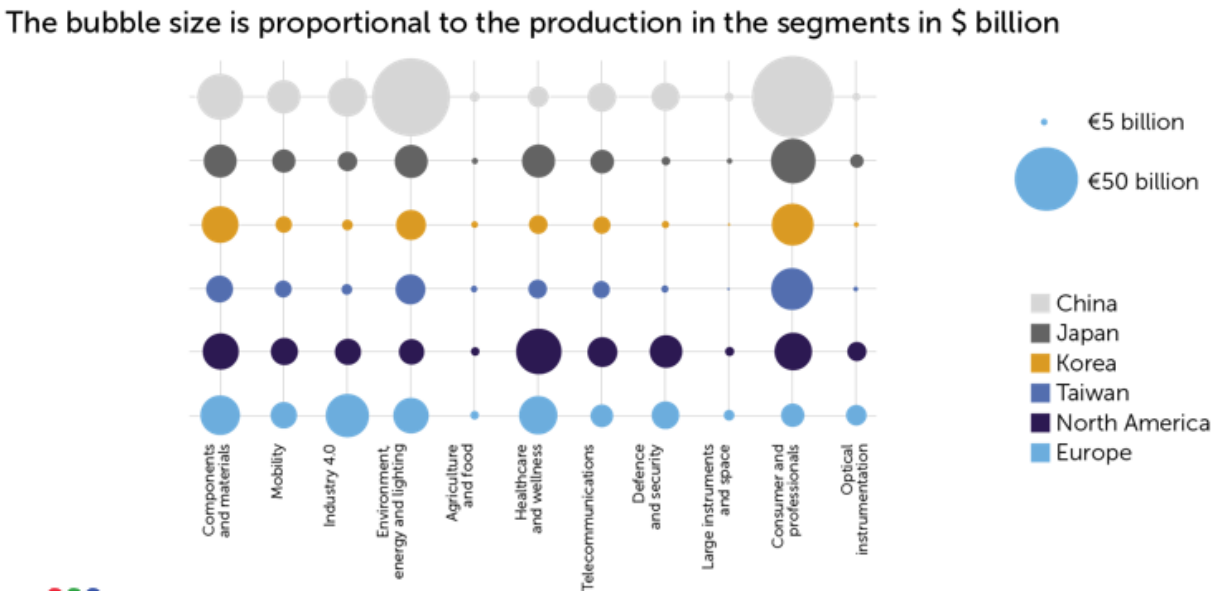
Source: Photonics21 Market Research Study 2024.

[2] Photonics21 Market Research Study 2024 available under: Market_Research_Study_Photonics_2024.pdf (photonics21.org).
[3] Photonics21 Market Research Study 2024, SPIE Optics & Photonics Industry Report 2022.

Photonics growth in China is mainly driven by new applications such as artificial intelligence, the Internet of Things, 5G, big data, etc. Today, China's position in the world's photonics industry chain is the largest production market, the second largest consumer market, the third largest revenue market, and the fastest growing market.

China is a world leader in photovoltaics and is penetrating sectors traditionally dominated by Europe, such as laser manufacturing, sensing, optical components and systems, showcasing its determination to expand its influence across diverse segments of the industry. [4]

Figure 2 Market Shares of Photonic Segments in Leading Geographical Areas



Source: Photonics21 Market Research Study 2024.

Given the successful enhancement of China in the field of photonics, especially in terms of application markets, EAC conducted a comprehensive study to help the EU better understand how China's photonics industry developed and how the Chinese political system steers and provides funds for this industry.

[4] Photonics21 Market Research Study 2024 available under: Market_Research_Study_Photonics_2024.pdf (photonics21.org).

C. China Insights: Economic Powerhouse in Global Context

1. Economic Development Post-COVID: Return to Normal?

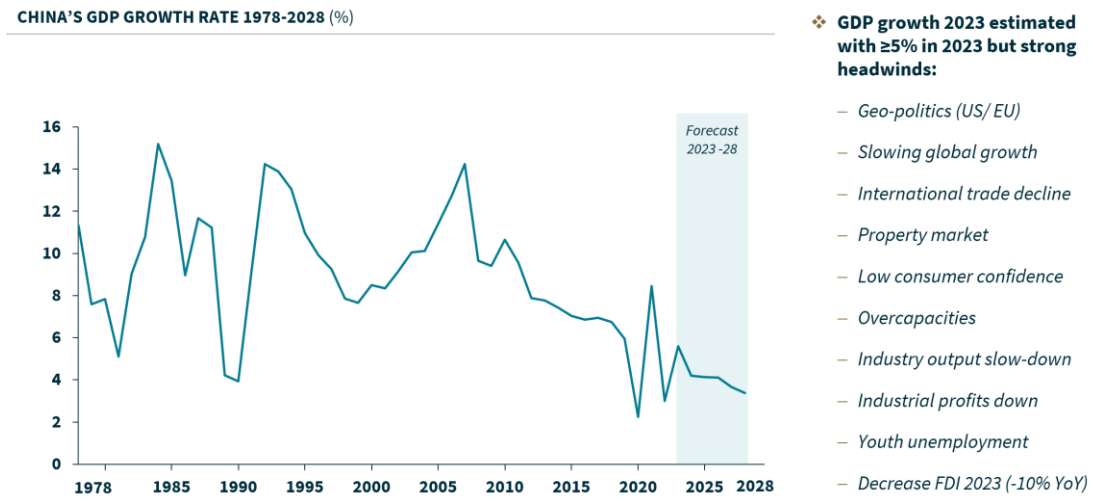
As one of the first countries to be affected by the COVID-19 pandemic, China has implemented strict measures to control the virus's spread. However, China's previous lockdown policy and supply chain tensions caused by COVID-19 have led some companies to consider reducing dependence on China. What is China experiencing now?

Economic Growth Slow Down in the Long Run: Although China's economy shows strong rebounding after relaxing its zero-COVID policy at the end of 2022 and with GDP growth in 2023 estimated at ~5% but still facing strong headwinds such as geopolitics, overcapacities, youth unemployment, etc. In the long-term perspective, China's economic growth will downshift with an expected GDP growth of ~4% past 2023 until 2028.

Promoting International and Domestic Dual Circulation: China will maintain international openness while paying attention to its own economic security. China's role in global trade remained significant, and it continued to strengthen economic ties with various countries via initiatives like the "*Belt and Road Initiative"*. In the meanwhile, Chinese government aimed to boost domestic consumption as a driver of economic growth, partly to reduce reliance on exports. Policies promoting urbanization and increased income levels play an important role in this strategy.

Promote Digitalization and Innovation: The pandemic accelerated trends toward digitalization and e-commerce in China. And China continued to invest heavily in cutting-edge technologies like artificial intelligence, 5G, and renewable energy.

Figure 3 China Long-Term GDP and Industrial Production Forecast



Source: World bank, Statista, EAC research.

It's important to note that the post-COVID economic landscape is highly dynamic and subject to a wide range of factors. The extent to which China returns to "*normal*" depends on various variables, including the global economic recovery, domestic policies, and international relations.

2. Geopolitical Landscape & Impact on China's Future Roadmap

The geopolitical landscape plays a crucial role in shaping China's future roadmap, as China is a major global player with far-reaching ambitions. While 'decoupling is here to stay' as an irreversible trend, it remains critical to understand its intensity and speed. Several key factors in the geopolitical landscape have a significant impact on China's strategic decisions and future trajectory:

US-China Relations: The relationship between China and the US is a linchpin of global geopolitics. An adversarial relationship can lead China to strengthen alliances with other nations and develop its own strategic alliances to counterbalance the United States. The US Semiconductor Ban on China would further undermine China's ability to import and manufacture the semiconductors that run the world, accelerate the technology race, and meanwhile stimulate industry upgrading in China.

Economic Interdependence: China's economic interdependence with other nations shapes its future roadmap. Trade disputes, sanctions, or market access barriers can prompt China to seek alternative strategies, e.g., diversifying trade partners and boosting domestic consumption.

Belt and Road Initiative (BRI): The geopolitical situation along the BRI route significantly impacts China's ability to execute this ambitious project. Political instability or conflicts in partner countries can disrupt China's investment plans and influence the strategic direction of the BRI.

Regional Dynamics: China's relationships with its neighbors, including Japan, South Korea, India, and countries in Southeast Asia, are crucial. Disputes over territory, resources, and historical issues can have significant geopolitical implications and shape China's foreign policy.

Energy Security: China's growing critical resources and energy needs drive its global engagement, especially with resource-rich nations. It seeks to secure these resources through trade deals and investments, which can be influenced by geopolitical developments.

Technological Competition: The race for technological dominance, especially in areas like 5G, artificial intelligence, and cybersecurity, has significant geopolitical implications. China's advancement in these fields can impact its global standing and influence. Geopolitical tensions can lead to restrictions on technology exports & imports, impacting China's innovation and trade.

Climate Change and Environmental Concerns: China's role as the world's largest emitter of greenhouse gases and its commitment to carbon neutrality by 2060 make it a key player in global climate negotiations. Its engagement in international climate agreements and cooperation with other nations on environmental issues are shaped by the global geopolitical context.

The geopolitical situation exerts a profound influence on China's future roadmap. It influences China's foreign policy decisions, economic strategies, etc. China must navigate this complex landscape to pursue its objectives including the "Two Centenary Goals" (building a moderately prosperous society by 2021 and a fully modern socialist country by 2049) and China's broader aspirations on the global stage.

All in all, China's future roadmap is a dynamic process influenced by these geopolitical factors and its leadership's goals. Geopolitical stability and cooperation with other global powers will be essential for China's continued economic growth and influence.

D. Outline of Key Industrial Development Plans

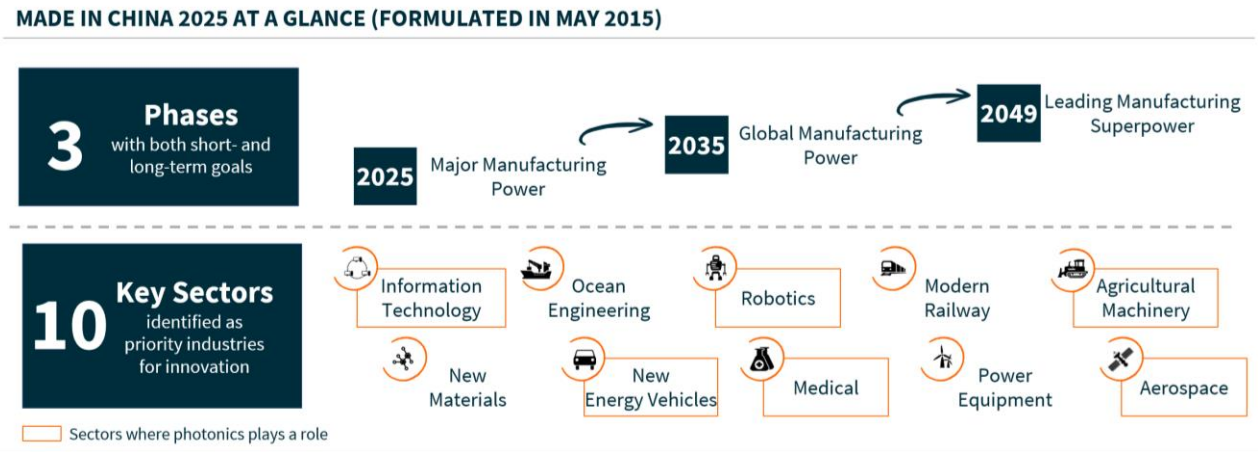
1. Made in China 2025 (MIC 2025)

"*Made in China 2025*" – which targets technology leadership of China in key industries and self-sufficiency of up to 70% of core basic components and materials by 2025 – has opened a "*new chapter*" in the transformation and upgrading of the manufacturing industry. 3 phases with both short- and long-term goals which are to become a manufacturing superpower by 2049.

Innovative research on advanced manufacturing, intelligent manufacturing & equipment is encouraged as a national policy to promote China as a manufacturing power. Photonics technologies, e.g., laser-based manufacturing, are crucial in precision cutting, welding, and enable advanced manufacturing processes.

Though not directly mentioned, photonics is also essential to "*MIC 2025*" initiative as it underpins various advanced manufacturing processes, communication systems, sensors, and innovations that are essential for China's high-tech manufacturing transformation and economic growth. The initiative recognizes the importance of developing indigenous photonics capabilities to reduce reliance on foreign technology and strengthen China's position in global markets.

Figure 4 Made in China 2025 at a Glance (Total Plan Till 2049)



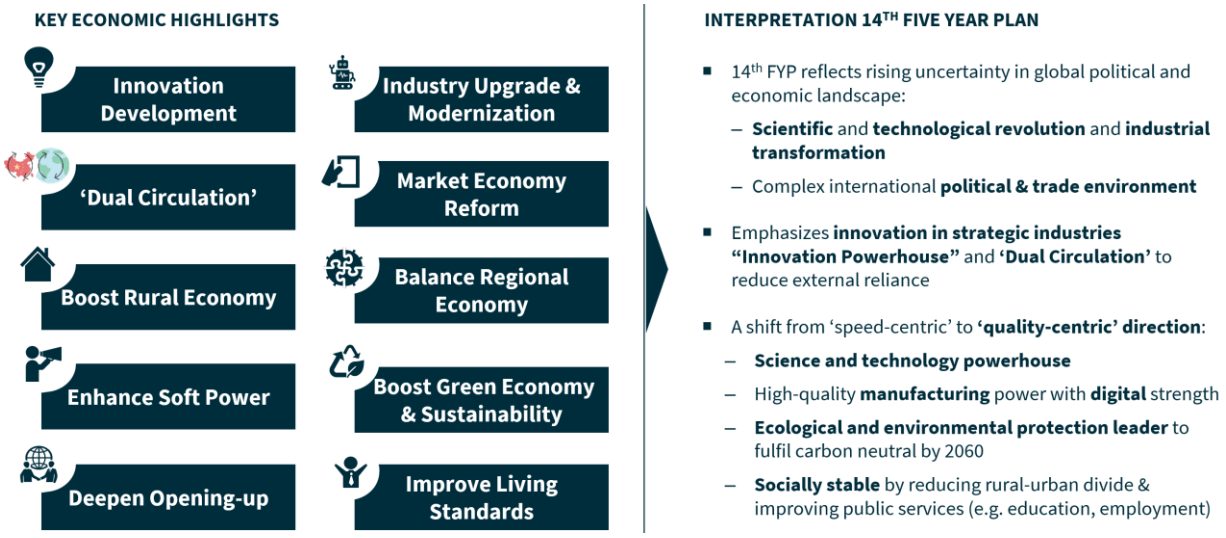
Source: State Council Information Office, EAC research.

2. 14th Five-Year Plan and Beyond (14th FYP)

14th Five-Year Plan is a strategic economic and social development initiative in China that covers the period from 2021 to 2025, and is aligned with China's longer-term vision, including the "*Made in China 2025*" initiative, which focuses on transforming China into a high-tech manufacturing powerhouse.

The plan emphasizes the need for China to strengthen its innovation capacity, and photonics, which encompasses lasers, optical systems, sensors, and optical communications, play a crucial role in driving innovation in various industries.

Figure 5 "14th Five-Year Plan" at a Glance



Source: State Council Information Office, EAC research.

3. China National Semiconductor Plan

The world is facing a serious shortage of chips, and countries are beginning to attach importance to strengthening their domestic chip manufacturing capabilities. Both the US and the EU have introduced their own "*Chips Act*" respectively with subsidies of 52 bln USD and 43 bln EUR, respectively for industry development.

China also has corresponding support but with slightly different approaches. China does not have a dedicated "*Chips Act*" but set up a large national fund to strongly support the traditional integrated circuit industry, which is, as mentioned by industry experts, quite rare in terms of funding scale in China. As early as September 2014, the "*National Integrated Circuit Industry Investment Fund*" (ICF) was established, with an investment scale of 138.7 bln RMB (~18.0 bln EUR) for Phase I. Phase I also drove private industry funds, such as venture capital, private equity, etc. to reach 514.5 bln RMB (~66.9 bln EUR). In October 2019, Phase II was launched, with a registered capital of 204.15 bln RMB (~26.5 bln EUR). If calculated based on the leverage ratio of 1:5 driven by Phase I investment, it is expected to drive over a trillion RMB (~130 bln EUR) of private funds. Phase I (2014-2019) was mainly focused on chip design, while Phase II (2019-2024) mainly focused on upstream fields, such as chip equipment and materials, committed to promoting the development and upgrading of the industry chain for semiconductors.

Sources suggest that Phase III (2024-2029) is currently being planned, with a national investment of ~300 bln RMB (~39.0 bln EUR). The ICF is more focused on technology shortcomings, in which traditional electronic IC accounts for the largest proportion of the funds. For "*Integrated Photonics*", it's a kind of new technology, and the funds for it are limited right now. However, as the country attaches greater importance to the photonics industry and the fact that China is more likely to overtake in photonics chips, it is likely expected that the funds in Phase III will be allocated more to "*integrated photonics*" related companies.

4. National Science and Technology Plan

Before 2015, China had successively established several scientific research plans such as the "*Spark Plan*", the "*National Natural Science Foundation*", the "*863 Plan*", the "*Torch Plan*", the "*973*

Plan", etc. to cultivate scientific and technological talents. However, this original S&T system was too complex and caused various disadvantages, such as fragmented planning and duplicated applications. Therefore, in early 2015, the Ministry of Science and Technology (MOST) and the Ministry of Finance (MOF) jointly formulated "*Plan on Deepening the Management Reform of Central Financial and Science & Technology Plans (Special Projects, Funds, etc.)*", which integrated science & technology plans managed by various ministries into five science & technology plans (elaborated in Chapter F), effective since 2017.

5. Impact on the Photonics Industry

Both "*MIC 2025*" and "*14th FYP*" emphasize high-quality development and technological innovation to transform China into a manufacturing powerhouse. Although the photonics field is less mentioned in the overarching strategy, the development priorities and the emerging downstream applications that are highlighted in the policies are directly or indirectly promoting the development of the photonics industry. For example, photonics can be applied and help promote innovation in the key sectors identified as priority industries in MIC 2025, e.g., information technology, robotics, medical, and aerospace. In addition, "*ultra-high-speed and large capacity optical transmission technology*" is mentioned, requiring breakthrough for information communication devices. Photonics technologies such as lasers and machine vision are crucial to help the development of high-end CNC machines and robotics, which are highlighted as areas that need breakthroughs in MIC 2025.

In the "*14th FYP*", photonics-related technologies such as quantum information, micro-nano electronics, and integrated circuits are mentioned in chapter 4 - "*Strengthen National Strategic Scientific and Technological Strength*", which needs to integrate and optimize the allocation of scientific and technological resources, and to strengthen the R&D and innovation. Based on the "*14th FYP*", we can find that the strategic focus of the photonics industry at the current stage is still strengthening R&D and technological strength. For more than half a century, the semiconductor industry has been developing rapidly following the trajectory of Moore's law. As the component size of the IC gets closer and closer to physical limits, further reduction of the feature size has become particularly difficult and no longer adequately meets the current needs. Therefore, the semiconductor industry has entered the post-Moore era and is in urgent need of new methods to replace traditional methods, and "*Integrated Photonic Circuits*" are one of them. At present, the development of optical chips is still in its early stages globally, and most developed countries are still at the same starting line, so China may have a greater possibility to overtake in the field of optical chips. However, there are still many difficulties to overcome in the scale production of integrated photonics, and traditional IC are still the mainstream. Some local governments already offer funds for the development of optical chips, for example, the Wuxi government provided 1 bln RMB (~130 mln EUR) funds to Wuxi Photonic Chip Research Institute, Shanghai Jiao Tong University to realize the pilot production of optical chips.

E. Photonics Industry China: Key Pillar to Achieve Technological Advancement

1. Market Dynamics and Industry Landscape

As the cornerstone of future industries such as 5G, AI, IoT, biotechnology, aerospace, intelligent manufacturing, life science, etc., the photonics industry is the "*core key*" of the modern industrial system. China has been actively promoting advances in photonics as part of its broader efforts to become a global leader in advanced technologies.

Up to now, China has been the world's largest production market, production in China accounted for more than 197 bln EUR in 2019 and is expected to reach 315 bln EUR in 2025, with a CAGR 2019-2025 of approximately 8%.

China is actively developing the photonics industry and conducting comprehensive industrial layout planning from many perspectives:

Investment & funding: China established the "*Key National R&D Programs*" for "*Photonics Information Technology*" initiated by the Ministry of Science and Technology. Another key national funding is from the National Natural Science Foundation of China for the most basic scientific research, and there are two departments supporting photonic-related topics: Information Optics & Optoelectronic Devices; Laser Technology and technical Optics. Besides national funding, there are many local funding provided by provinces to encourage the development of the local photonics industry.

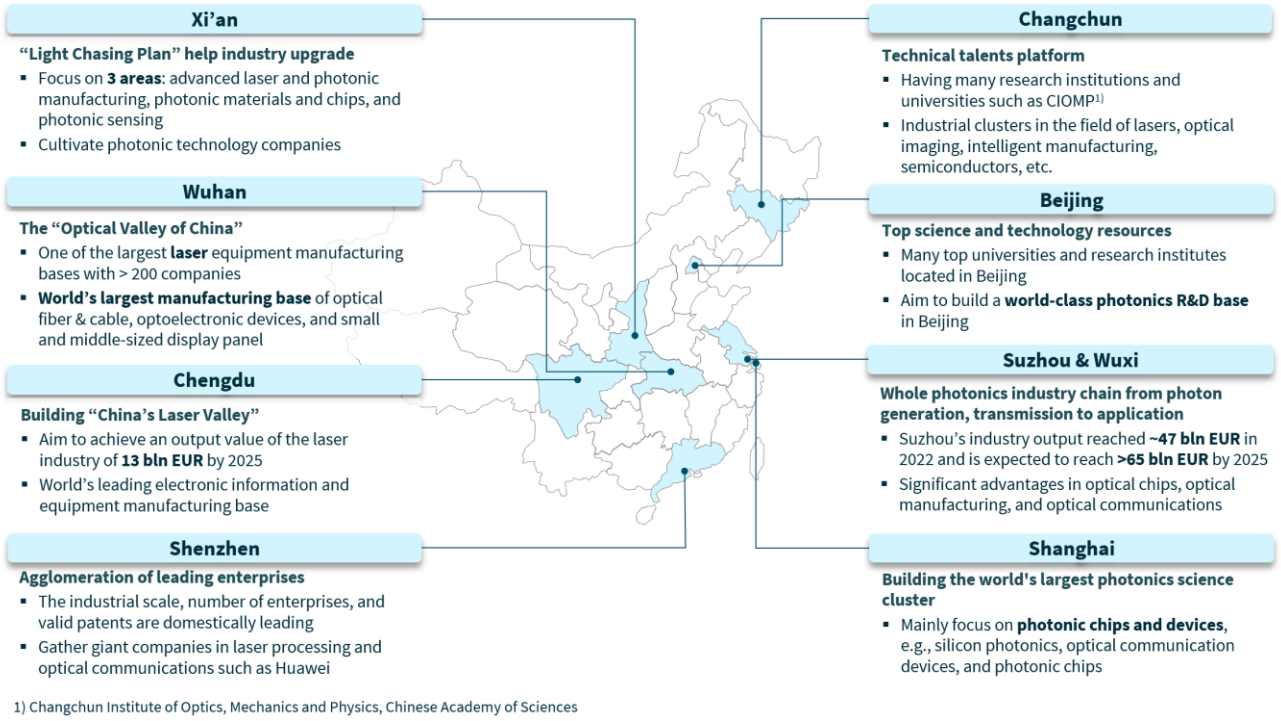
Research & innovation: China's research institutions (e.g., Chinese Academy of Sciences) and universities have been actively engaged in photonics research, leading to advancements in areas such as quantum photonics, integrated photonics, and laser technology. Promote the development of the photonics industry through industry-university-research cooperation.

Startups & entrepreneurship: China has seen the emergence of photonics startups and entrepreneurial ventures, particularly in areas like laser technology, optical communications, and photonic-integrated chips. For example, in 2016, CASSTAR which is an early-stage investment institution focusing on "*core technology*" established China's first optoelectronic chip fund - "*Shaanxi Pioneer Optoelectronics Integrated Venture Capital Fund".* The fund has a total scale of 1 bln RMB (130 mln EUR) and mainly focuses on the layout and investment of consumer photonics, photonic integrated chips, and optoelectronic application industries. Now CASSTAR has invested in more than 80 photonic technology start-ups in 7 years. There are many investment institutions focused on photonics technologies such as Hubble, China Fortune-Tech, Matrix, NLVC, and so on.

Education & workforce development: China has been investing in education and workforce development in the photonics field to cultivate a skilled talent pool, through academic programs, scholarships and research funding, industry-academia collaboration, research and innovation center, and other key aspects to approach talent cultivation in photonics principles and technologies.

Manufacturing & production: There are many industrial layouts of photonics in China, mainly distributed in eight important cities which are Beijing, Shanghai, Wuhan, Xi'an, Suzhou, Changchun, Shenzhen, and Chengdu. 80% of the industries are concentrated in East China, Central China, and South China. The Greater Shanghai Area (Yangtze River Delta) features the largest industry cluster, led by Suzhou and Shanghai. The initial establishment of clusters is more of a spontaneous formation driven by the market.

Figure 6 China Photonic Industry Cluster



Source: photonicsX, EAC research.

Policy & regulation: China's national development plans such as "*Made in China 2025*", and "*14th Five-Year-Plan*" point in the direction of high-quality development and high-end manufacturing, including photonics as a key technology area for development. At present, China has no formal national-level policies or strategies dedicated to the photonics industry, it's more driven by local government policies or specific industry-related policies issued by the Ministry of Industry and Information Technology (MIIT), for example:

1. "***China Optoelectronic Device Industry Technology Development Roadmap (2023-2027)***" issued by MIIT was released in August 2023). The roadmap includes optical communication devices, optical fiber and cable, special optical fibers, optical sensors, optical lighting devices, and optical display devices and will guide the high-quality development of China's optoelectronics industry. As pointed out in the roadmap, optical chip, as the "heart" of optical communication devices, has an extremely high technical burden which may lead to potential "bottleneck" in the future if no breakthrough is done now, so it also becomes the direction of key research in optical devices in China. Currently, China's optical chip products still lag far behind international benchmarking enterprises.

The future research direction is still the development of high-end optical chips, e.g., 25Gb/s and above optical chips, and potential mass production.

2. "***China Optics Valley 2035 Innovation-Driven Development Strategic Action Outline***" issued by the Wuhan government in 2018. It aims to build a "*World Optics Valley*" in Wuhan by 2035, focusing on optical communications, new optical storage, aerospace information, artificial intelligence, and precision medicine.
3. Shanghai issued "***Several Action Plans to Create a Future Industrial Innovation Highland, Develop and Expand Future Industrial Clusters***" in October 2022. Aim to build a quantum technology industry cluster around quantum computing, quantum communications, and quantum measurement, and to achieve breakthroughs in R&D and applications of silicon photonics, optical communication devices, photonic chips, and other devices.
4. In 2020, the Chengdu government released the "***Chengdu City Implementation Plan to Promote the Accelerated Development of the Laser Industry***", which aims to create a domestic advanced laser product innovation demonstration area, well-known as "China Laser Valley".
5. Wuxi High-tech Zone announced the launch of the construction of Taihu Bay Silicon Photonics Industry Innovation Center in March 2023, jointly established by the Wuxi Government, leading enterprises in Wuxi High-tech Zone, universities and institutions, and industry funds. The high-tech released the "***Xinguang 18***" policies to support the construction of Taihu Bay Silicon Photonics Industry Innovation Center from R&D, manufacturing, talents introduction, ecosystem, service platforms, etc. Focus on optical chips, optical sensing, optical computing, optical communication, optical display, optical processing, and optical detection.
6. "***Suzhou High-tech Zone 'Photon Loan' Implementation Plan***" issued by the Suzhou Government in July 2023, provides loans to photonics industry enterprises for capital turnover in production and operation.
7. Suzhou also released "***Several Policies of Suzhou High-tech Zone on Supporting the Construction of Photonics Industry Innovation Clusters (Trial)***" in 2022.
   - **Major targets**: Focus on 6 directions in the fields of energy photons, information photons, life and environmental photons: optical manufacturing, optical communication, optical display, optical medical treatment, optical sensing, and optical defense. Aiming to achieve a revenue scale of 50 bln RMB (~6.6 bln EUR) in the photonics industry by 2025; to form a 100-billion-level (~13.1 bln EUR) photonics industry innovation cluster with international competitiveness and covering the entire industry chain by 2030.
   - A series of supporting policies have been released to support the construction and development of the Suzhou photonics industry cluster from innovative research and development, production and manufacturing, talent introduction and training, enterprise support, ecological buildup, service platforms, etc., and each initiative is given fund support. Details as shown in Figure 6.

Figure 7 Case Study: Policy Interpretation on "Several Policies" of Suzhou High-tech Zone

5 POLICIES	A SERIES OF INITIATIVES AND FUNDS			
1. Build a high-innovation platform for the photonics industry	Up to 200 mln RMB (~26 mln EUR) will be provided in phases to **new national key laboratories** Up to 20 mln RMB (~2.6 mln EUR) to new **provincial key laboratories**	Newly built high-level scientific facilities for photonics and high-level major scientific and technological innovation platforms will be supported on a "**one case, one discussion**" basis	Grant up to ~6.5 mln EUR and ~1.3 mln EUR to the newly built **National Technology Innovation Center**, and **National Enterprise Technology Center**, respectively	Grant up to ~2.6 mln EUR to encourage **leading photonics enterprises** to build advanced technology **research institutes**
2. Accelerate the construction of the original innovation center for photonic technology	Support various entities with each max. ~0.7 mln EUR of R&D funding to promote cutting-edge scientific research in photonics, focusing on **energy photons, information photons, life, and environmental photons**	Provide max. ~0.4 mln EUR of R&D funds to entities that undertake major "*national key R&D programs*" in photonics, focusing on solving **technical problems** in **core light sources, optical sensors, optical chips, optical communications**, etc.	Layout **S&T innovation projects** that can **fill domestic gaps** and support the **leapfrog development** of the photonics industry. Establish the "*list mechanism to select the best candidates*" with each ~0.3 mln EUR funds support	Support enterprises to overcome bottlenecks in the engineering stages such as **technology maturation, pilot and mass production** in key industrial fields. A single project will be funded up to ~0.7 mln EUR based on 50% of the research investment
3. Enhancing industry integration and application demonstration of the photonics industry	Accelerate the construction of a **photonics industry innovation consortium** led by leading enterprises, supported by universities, and coordinated by various innovation entities, with support up to 0.3 mln EUR	Promote the application of innovative products e.g., the first (set/batch/version) of **key equipment, key materials, and the software** for photonics. Up to ~1.3 mln EUR given for 10% to 30% of the sales price of the unit (set)	Encourage terminal manufacturers and system solution integrators in the photonics field to try out **integrated circuit** products. Max. reward is ~0.1 mln EUR	Support the development of key **technology standards** for the photonics industry, incl. design, manufacturing, testing, product, etc. Rewards of up to ~0.1 mln EUR to those who lead the standards formulation
4. Vigorously promote high-quality cluster development in the photonics industry	Accelerate the implementation of projects introduced. Subsidize up to ~6.5 mln EUR and ~1.3 mln EUR respectively for the **introduction** of major **innovation teams** and leading **entrepreneurship talents**	Support the cultivation of key enterprises in the photonics field. Up to ~1.3 mln EUR awarded for enterprises to implement mergers and reorganization projects that strengthen industrial chains	Up to ~3.9 mln EUR reward to "***World's Top 500***" companies for the first time, max. ~1.3 mln EUR to "***China's Top 500***" companies, and max. ~0.8 mln EUR to **listed companies**	Encourage companies to conduct **intelligent and digital transformation**. Rewards of up to ~0.3 mln EUR given to global "***lighthouse factories***"
5. Optimize the innovation and entrepreneurship ecosystem of the photonics industry	Establish ~1.3 bln EUR **photonic investment fund** led by leading enterprises, participated by private capital, and guided by government funds, and establish a **fund support system** covering the **entire life cycle** of angel incubation, VC, growth acceleration, and mergers and acquisitions.	Support the construction of a **public service platform**, and prioritize services e.g., **compound semiconductors, silicon photonics integration, and MOEMS micro-optical electromechanical services**. Up to ~0.4 mln EUR funds to the service platform	Enhance the ability of **S&T services**, cultivate and develop S&T intermediary service platforms and institutions such as **design, IT services, technology evaluation, and testing certification**. Provide support of up to ~0.4 mln EUR based on service results	Accelerate the gathering of **talents**. For newly introduced high-skilled leading talents, up to 0.2 mln EUR of salary and a settlement subsidy will be provided

Source: Several Policies of Suzhou High-tech Zone on Supporting the Construction of Photonics Industry Innovation Clusters (Trial).

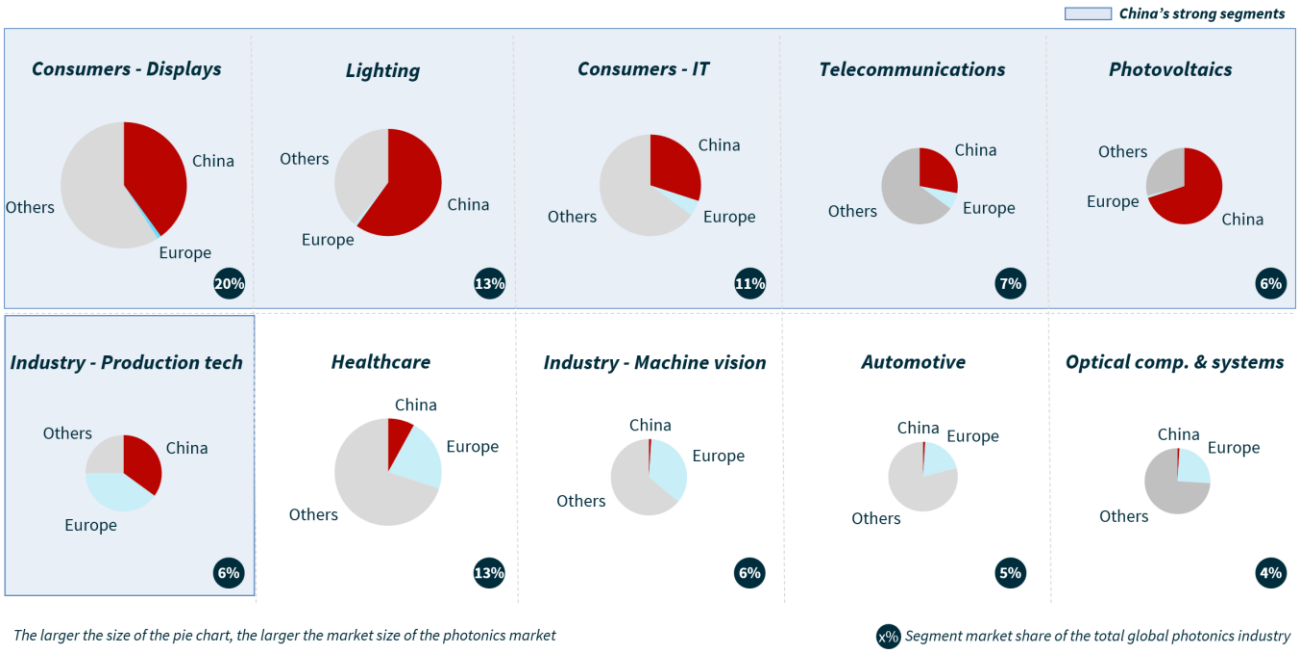
2. Key Application Industries Driving the Future Growth

China's photonics are more market-oriented and are widely used in industrial and consumer industries. China's rapid development and huge application market of photonics such as communications, network, display & imaging, and as well as a complete industrial chain and rich technology accumulation in manufacturing, drive the rapid growth of China's photonic market.

Compared with developed countries, China generally shows a structure of "***strong in applications, weak in technologies, big in markets, and low in profits***". The core basic capabilities of China's photonic industry are still weak, and many important optical materials such as high-end optical glass, and optical plastic must be imported abroad, which need R&D on advanced optical materials to increase self-reliance. But China is leading in display and photovoltaics and catching up quickly in lasers, lighting, ICT, photonics sensors, etc. In addition, China is a big country in materials, except for some high-end materials that still need to be imported, the current domestic optical materials self-sufficiency rate and production capacity are relatively high.

According to domestic policies and national funding directions, optical communications, optical manufacturing (laser processing), optical storage, and various technologies from photon generation, transmission to application are the key development areas in China. China is actively promoting the application of photonics/optoelectronics in communication (5G/6G), big data computing, medical health, photonic chips, display, defense, et cetera. Based on the segments identified in the Market Data and Industry Report 2020 published by Photonics21 and carried out by Tematys, the evolution and growth of the segments are presented in the figure below (see Figure 8).

Figure 8 Photonics Segment Overview – China vs. Europe.



Source: Market Data and Industry Report 2020, Photonics21, Tematys, EAC Research.

Displays: From 2017 to 2022, the market size of China's display industry increased from 36 bln EUR to 93 bln EUR, with a CAGR of 20.8%, and it is expected to reach 112 bln EUR in 2023. China's proportion of display panel industry scale is around 40%, ranking first in the world.

In the future, the applications of displays will be more diversified, except traditional applications such as TV and mobile phones, new applications such as vehicles, virtual reality (VR), metaverse, intelligent navigation equipment, smart homes, education, and medical are expected to grow rapidly. In addition, certain breakthroughs have been made in the R&D of lasers, holograms, and MicroLEDs, and display technology will become more diversified.

Lighting: China is the world's largest LED lighting market. Based on the China Lighting Electrical Appliances Association, China's LED lighting market size increased from 70 bln EUR in 2017 to 89 bln EUR in 2022, with a CAGR of 5%. The growth rate is estimated to slow, with a CAGR of 2% between 2022 and 2026, reaching 97 bln EUR in 2026. In the future, China will continue to promote LED lighting in new applications such as smart cities, smart homes, agriculture, health & medical, cultural tourism, water treatment, automobiles, and other fields.

Information and Communication Technologies (ICT): In 2022, China's optical communication market reached 151 bln EUR, accounting for 35%-40% of the global market, driven by supportive national policies and the huge domestic demand of optical communication devices for telecommunication, network, 5G, data center and other fields. From 2023 to 2028, China's optical communication devices market will grow at a CAGR of approximately 12%, reaching 33 bln EUR by 2028. Among them, the optical module market will grow at a CAGR of approximately 15% and will reach 24 bln EUR by 2028.

Although Chinese optical communication equipment manufacturers occupy the first position in global market share, there is still a large technical gap compared with the world-leading level. Core high-end optical communication devices, chips, and supporting integrated circuit (IC) chips are still heavily dependent on imports, which is a bottleneck for China's ICT industry. Therefore, the importance of industrial strategy and the urgency of breakthroughs in core technology development are self-evident.

Photovoltaics currently serve as one of the main pillars of the Chinese photonic local market, from which governmental support and company innovation efforts can be observed. In photovoltaics, the Chinese share in the global market is about 70%.

Production Technology has high strategic importance for the Chinese government considering the MIC 2025 and China's 14th FYP's emphasis on advanced manufacturing, to achieve the industrial ambition as a "*world-leading manufacturing powerhouse*". Industrial laser is one of the key photonics levers to support industrial ambitions and receives the biggest support from the Chinese government with various policies. The Chinese laser equipment market size was nearly 10.7 bln EUR in 2021 and is expected to expand to 24.4 bln EUR by 2026, of which the industrial market size accounts for an estimated 60% of the total market. The laser equipment's downstream applications are widely distributed including automobiles, 3C, lithium batteries, photovoltaics, aerospace, and other fields.

Healthcare/Medical Technology in the Chinese market is currently dominated by foreign players, especially the high-end market that needs high levels of research and innovation. An industry executive estimates the import ratio at around 65% for medical devices. However, as the increased aging population demanding healthcare services and higher expectations from the young generation on medical diagnosis and treatments, coupled with the Chinese government's policy push to promote localization and upstream capacity building to reduce its

reliance on imported technology and devices, China's medical devices have huge market growth potential, and the market size will further grow from 1.1 bln EUR in 2019 to 1.9 bln EUR in 2024.

Machine Vision's development history in China is short but is developing rapidly, with the help of a favorable macro environment and policy environment. The market size of China's machine vision was recorded at 3.0 bln EUR in 2021 and is expected to grow at a CARG 2022-2026 of 8.3%. The continuing market growth is partially attributable to the fact that machine vision solutions are particularly suited to many industries that are performing well even in today's weak economic situation. These include electronics, semiconductors, food & beverage packaging, pharmaceuticals, logistics, and robotics. Industrial lenses and industrial cameras are core components for machine vision, which account for 80% of total product costs. As for industrial lenses and industrial cameras/sensors, the high-end market is still dominated by German and Japanese brands, but Chinese players have made breakthroughs in key technologies through years of R&D efforts, squeezing the market share of foreign manufacturers through cost-effective advantages.

Automotive: The development of autonomous driving and the rise of new power in automaking drive the demand growth for vehicle lenses and other automotive driving sensors. It is estimated the market size for L1-L3 pre-installed autonomous driving components will increase from 4.0 bln EUR in 2021 to 12.1 bln EUR in 2025 with a CAGR of 30%. Meanwhile, the demand for vehicle optical components and sensors, including the application of light detection and ranging ("*LiDAR*"), smart headlamps, head-up displays (HUD), and other relevant products, has also significantly increased starting from the year 2020 in the Chinese market. The market of optical products is also dominated by foreign brands while domestic manufacturers are emerging, for example, Sunny Optical is the domestic-leading player for cameras & lenses.

Optical components and systems: according to the China Optics and Optoelectronics Industry Association, China's optical materials and components industry (including some optical instruments) achieved revenue of nearly 21.5 bln EUR. Currently, many important optical materials mainly rely on imports, such as optical plastic. And, with the rapid growth market and the continuous improvement of manufacturing capabilities, the manufacturing and detection technology problems of ultra-precision optical components have gradually become a bottleneck restricting the development of China's optical components. The high-precision detection equipment is almost all imported, so China has an urgent need to reduce dependence through independent research and development or technology introduction.

F. Political Steering Process Photonics Industry

1. Overview of Political Steering Process & Key Stakeholders

To foster research and innovation and to upgrade the competitiveness of the local industries, research programs, e.g., 863, 973, etc. were initiated and established. Till the end of 2014, there were 100+ science and technology plan projects in China, managed by 40+ national agencies. Complex systems have caused various drawbacks such as fragmented planning and repeated application.

In early 2015, the Ministry of Science and Technology (MOST) and the Ministry of Finance (MOF) jointly formulated "***Plan on Deepening the Management Reform of Central Financial and Science & Technology Plans (Special Projects, Funds, etc.)***", which integrated science & technology plans managed by various ministries into five science & technology plans (**Fehler! Verweisquelle konnte nicht gefunden werden.**). The new system came into effect in 2017.

Figure 9 China's National Science & Technology Plans

Bodies	Focus Area	Recipient	Objective and Measure
National Natural Science Foundation	▪ Basic research and scientific frontier exploration	▪ Universities and research institutes ▪ Individuals	▪ Enhance original innovation ability and support professional personnel and team development ▪ Via national natural science foundation
National Science and Technology Major Projects	▪ Major national strategic products and industrial targets	▪ Enterprises (majority) ▪ Universities and research institutes	▪ Solve bottleneck problems ▪ Via small number of dedicated projects highlighting major strategic products and industrial targets
Key National R&D Programs	▪ "Cross-cutting" Mega-R&D trends with impacts on several industries	▪ Universities and research institutes	▪ Increase overall capability of independent innovation and major breakthroughs in science and technology ▪ Consolidate current programs into one key national R&D program
Special Fund for Technological Innovation	▪ R&D of enterprises	▪ Enterprises	▪ Promote scientific and technological transformation (to commercialization) ▪ Using funds for SME managed by NDRC, MOF[1)] and other 2 ministries, angel investors, venture capital, and hedge fund
Special Projects for Developing Base and Talents	▪ Base development and talents training	▪ New Base (consist of current national key labs & similar bodies)	▪ Support innovative talents and teams in the new base ▪ Merge current laboratories and research centers according to their functions

1) National Development and Reform Commission and the Ministry of Finance

Source: MOST, EAC research and analysis.

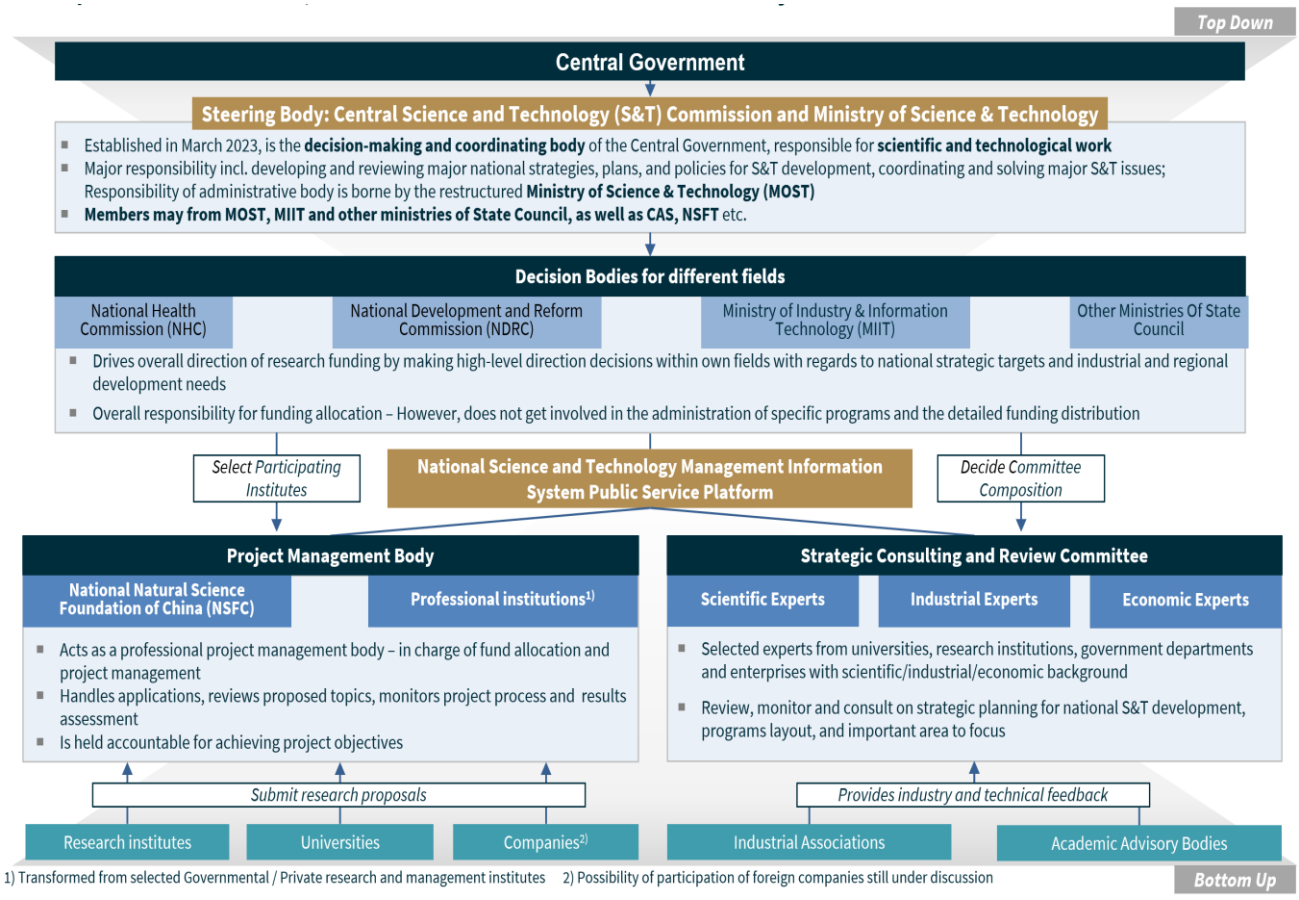
After the reformation, the Science and Technology (S&T) system is more concise, with clearer functions and authority allocation. But the need for overall allocation of funds and collaboration among different ministries in major research projects keep growing, to better fulfill the need, the 14th National People's Congress in 2023 passed the "*Plan for Institutional Reform of State Council*". The **Central Science and Technology Commission** was established to strengthen the centralized and unified leadership of the central government on S&T work, coordinate the construction of a national innovation system and reform of S&T system. Members of the committee may come from the Ministry of Science & Technology (MOST), MIIT, and other ministries of the State Council, as well as Chinese Academy of Science (CAS), National Natural Science Foundation of China (NSFC), etc. while the responsibility of daily work and administrative body is borne by MOST.

The management responsibilities of S&T work in various industries have been transferred from MOST to the corresponding ministries, including the Ministry of Agriculture (MOA), Ministry of Environment (MEE), Ministry of Human Resources and Social Security (MOHRSS), National Development and Reform Commission (NDRC), National Health Commission (NHC), and MIIT. High-tech industry-related S&T work incl. photonic now belongs to MIIT, which strengthened the comprehensive integration of S&T innovation into economic and social development. Through reform, the interaction between government and enterprises in S&T innovation is strengthened and industrialization

transformation of S&T achievements is promoted, meanwhile, a technology innovation system centered on enterprises is to be promoted, which is deeply integrated with industry, academia, and research, and guided by market demand.

The reform is expected to be finalized by the end of 2023, afterwards, MOST will focus more on S&T strategy & direction design and macro coordination on major special projects, national laboratories, and other S&T work related to overall and long-term development. Various ministries will define the R&D focus and the overall fund allocation of related industries. Universities, research institutes, and enterprises can apply for funds & projects in corresponding areas to professional institutions, e.g., NFSC, which are major management bodies for funds and projects, while the **government will act more as supervisors and no longer be involved directly in management**. Reform has achieved the separation of "*referees*" and "*athletes*", ensuring fairness and impartiality in the use of funds.

Figure 10 Governmental Research Steering System



Source: State Council, MOST, EAC research and analysis.

Currently, the central government acts more in the steering role and design & control the future development direction of photonics research while the funds and subsidies to support photonics industries are more from the regional level.

2. Government Funding Programs and Sector Focus

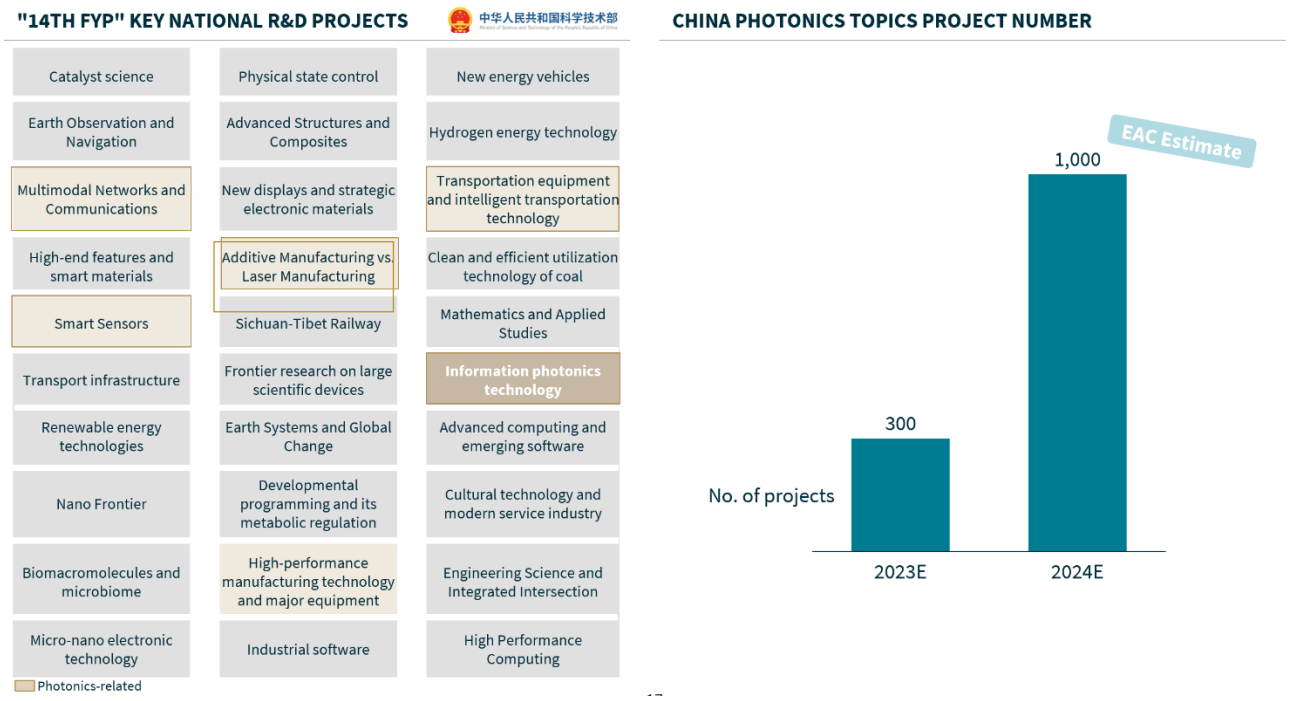
There are two key national-level research funding for China's photonic-related industry. One is the Key National R&D Programs initiated by the MOST, and another is from the National Natural Science Foundation of China.

The Key National R&D Programs focus on key research tasks that are urgently needed by national strategies, have clear application orientation, and are clear to end users. In 2021, "*Information Photonics Technology*" was listed as one of the 30 key projects of the "*14th Five-Year Plan*" National Key R&D Plan.

The funds of Key National R&D Programs allocated to "*Photonics Information Technology*" in 2023 are estimated at 55 mln EUR, including 29 mln EUR of state appropriation, and an estimated 26 mln EUR of supporting funds from local governments or institutions. There are 27 projects in 2023 that mainly cover three technical directions: optical communication devices and integration (e.g., core chips), optical computing and storage, and optical display and interaction.

Although the funding for "*Photonic Information Technology*" has been reduced somewhat, other key National R&D Projects also include photon-related technologies, such as smart sensors, high-performance equipment, intelligent transportation, etc. It is difficult to estimate the overall fund amount, but according to experts interviewed, the funds' allocation to photon-related projects has increased twofold. Taking the number of projects as an example, there are about 300 photon-related projects nationwide in 2023 and about 1,000 projects in 2024.

Figure 11 Photonics-related Fund from Key National R&D Programs

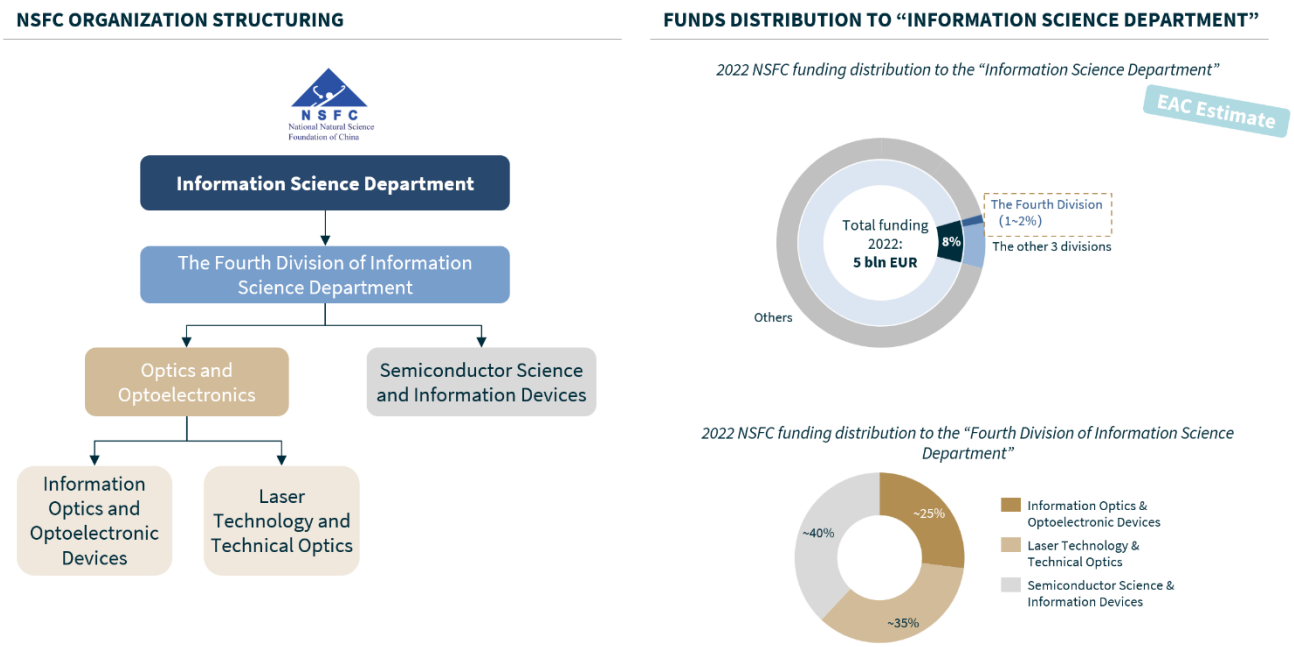


Source: Ministry of Science and Technology, EAC analysis, EAC interview.

The National Natural Science Foundation of China (NSFC) focuses more on basic scientific research and exploration projects. "*Optics & Optoelectronics*", which belongs to the "*Information Science*" Department is the key subject to receive photonics-related funding, and it consists of two parts: Information Optics & Optoelectronic Devices; Laser Technology & Technical Optics. In 2022,

the total funding allocated to the "*Optics & Optoelectronics*" subject is estimated at approximately 49 mln EUR, an increase of 2% year-on-year, with around 700 projects. The funding fees received by "*Optics & Optoelectronics*" from NSFC are generally not high, accounting for less than 1% of all funds.

Figure 12 Photonics-related Fund from NSFC



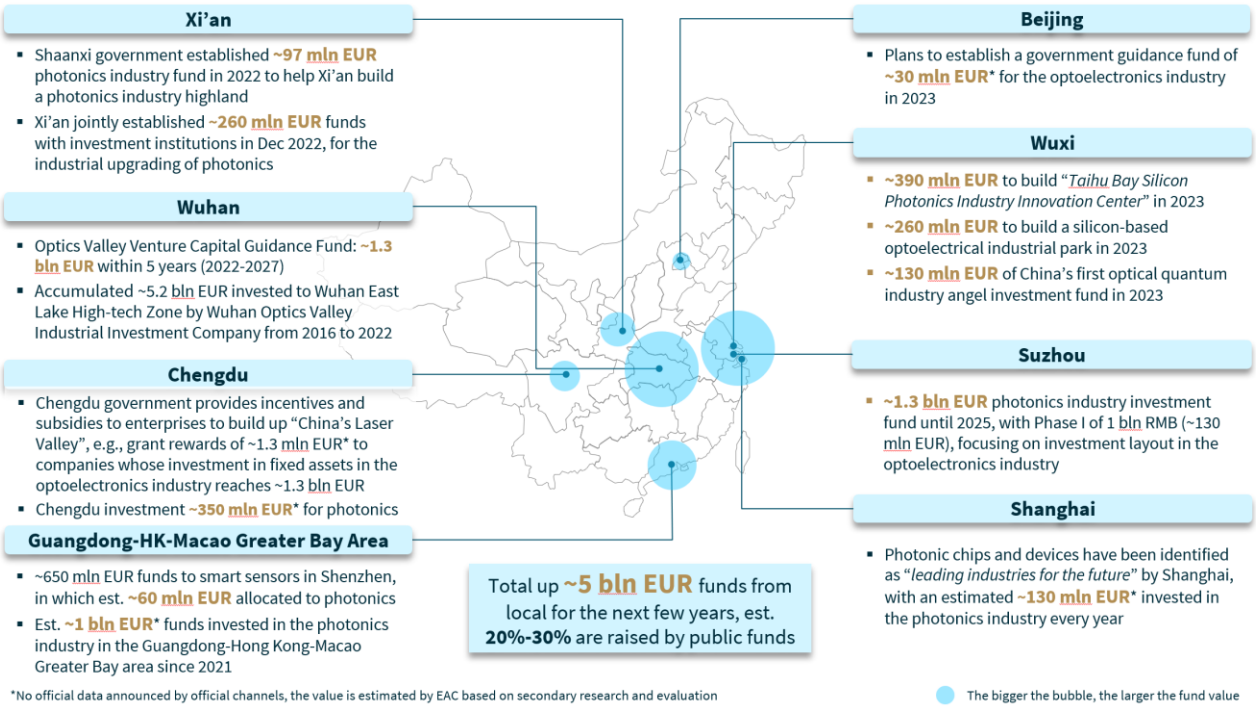
Source: National Natural Science Foundation of China, EAC analysis.

Compared with the previous EAC investigation in 2015, the photonics state funds for 2022 are lower than the ~140 mln EUR of photonics research funding allocated by the "*863, 973 and NTS programs*" in 2014. EAC regards there are two main reasons: 1. After the scientific research system reform in 2017, the classification of subjects and projects has changed, resulting in many photonics-related research topics being involved in other non-photonics-dedicated projects, such as "*Smart Sensors*" of "*National R&D Projects*" also could involve photonics topics, so funding data is hard to estimate. 2. With the development of the market and the formation of industrial clusters over the years, Photonics funds have been increasingly dominated by the local government and local capital.

3. Regional Funding for the Photonics Industry

China's photonics industry is more driven by regional strategies and initiatives to achieve commercialization and industrialization of the photonics industry. Besides national funding, there are many local funds provided by provincial and municipal governments, or investment companies to encourage the development of the local photonics industry. Based on the local government website announcements and news information, EAC roughly estimates that a total of **~5 bln EUR** of regional funds will be invested in the photonics industry in the next few years, mainly concentrated in East China (Suzhou, Wuxi, Shanghai), and Wuhan. In most cases, public funds account for 20%-30%, and the remaining 70%-80% is mainly composed of funds from investment institutions and enterprises.

Figure 13 Regional Funding Distribution of China's Photonics Industry



Source: government official website, EAC research and analysis.

1. In 2022, the Suzhou municipal government and investment institutions announced the joint establishment of a 10 bln RMB **(~1.3 bln EUR)** photonics industry investment fund, targeting research and production, to help build the "*Suzhou Taihu Photonics Center*" and create a scientific and technological innovation highland for China's photonics industry. (Details in Figure 6)
2. Wuxi municipal government plans to build "*Taihu Optics Valley*" through a large number of funds from different channels, a total of approximately **0.8 bln EUR**:
   - Jointly established a fund of 3 bln RMB **(~390 mln EUR)** with several investment institutions and leading enterprises to support the construction of the "*Taihu Bay Silicon Photonics Industry Innovation Center*" in Wuxi City. Phase I has ~39 mln EUR, which will be used to upgrade the production technology and the production line equipment for silicon photonics products. Phase II will focus on the silicon photonics mass production line.

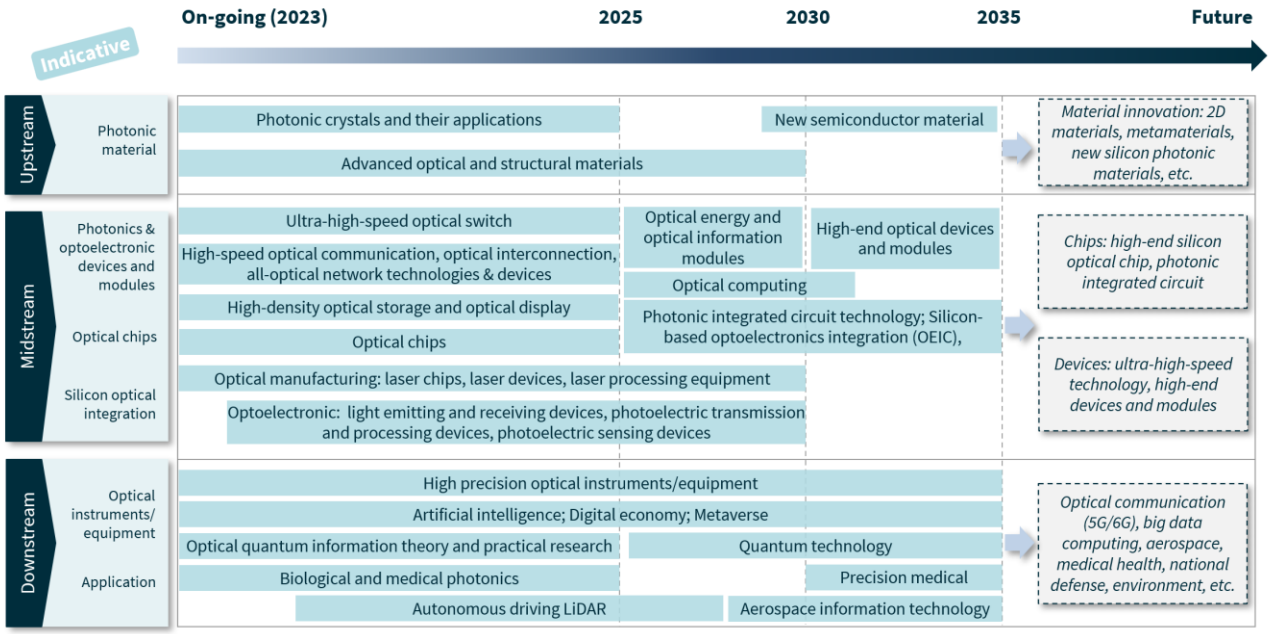
- The high-tech zone will also invest 2 bln RMB **(~260 mln EUR)** to build a 105-acre silicon-based optoelectrical industrial park. Construction is planned to start in 2023 and be completed by 2025.
- Additionally, in 2023, the Wuxi government and other investment institutions jointly established China's first optical quantum industry angel investment fund of 1 bln RMB **(~130 mln EUR)** in Wuxi City, to promote the commercialization of photonics chips and the quantum computing industry.

3. Wuhan, the "*Optical Valley of China*", is the largest and most mature photonics industry base in China. It mainly supports high-tech enterprises through the establishment of investment companies or venture capital funds:
   - In March 2022, "*Wuhan East Lake High-tech Zone*", which is the main production base for the photonics industry, released the latest policy for "*Guangu (or Optical Valley) Venture Capital Guidance Fund*", which will expand the total scale of Optics Valley Venture Capital Guidance Fund to 10 bln RMB **(~1.3 bln EUR)** within 5 years, and the first phase of the fund in 2022 was 2 bln RMB **(~260 mln EUR)**. The fund is mainly used to support technology start-ups.
   - Supporting by Wuhan Optics Valley Industrial Investment Company, a state-owned investment company established in 2016 that mainly invests in optoelectronic information projects, as of 2022, the cumulative investment scale of Optics Valley Industrial Investment in Wuhan East Lake High-tech Zone is nearly 40 bln RMB **(~5.2 bln EUR)**.
4. The Shaanxi government established a 750 mln RMB **(~97 mln EUR)** photonics industry fund in 2022 to help Xi'an build a photonics industry center.
5. The Chengdu government supports the development of the local laser industry cluster through active policy incentives and subsidy measures for enterprises, for example, grant awards of 10 mln RMB **(~1.3 mln EUR)** to those whose investment in fixed assets in the optoelectronics industry reaches 10 bln RMB (~1.3 bln EUR) in Chengdu.

G. Outlook: Future Technology Roadmap

From the perspective of China's support for funds, fields with the largest amount of fund support over the years are "*photonics & optoelectronic devices*", "*transmission & switching photonic devices*", and "*lasers*"; Followed by "*biology*", "*medical optics & photonics*", "*infrared and terahertz physics*", "*optical information acquisition*", and "*display and processing*"; Continued growth is in "*spectroscopic informatics*" and "*quantum optics*".

Figure 14 China Photonics Technology Development Roadmap



Source: China Optoelectronic Device Industry Technology Development Roadmap (2023-2027), National Natural Science Foundation of China's "14th FYP" Development Plan, Suzhou "Opinions on Accelerating the Cultivation of Future Industries", 2023 China (Suzhou) World Photonics Industry Development Conference Press Release, EAC expert. interview, EAC research, EAC analysis, etc.

Compared with the promising downstream applications, the upstream – optical materials, midstream – chips, devices, and equipment/systems serve as the foundation of photonic technology, China still needs to increase its efforts in the basic research and industrialization of technological achievements, because the high-end materials, chips, and devices still rely on imports in China. In the future, China will strengthen the development of optical chips including silicon optoelectronic integrated circuits, laser chips, etc., meanwhile accelerating the upgrade of devices. China aims to achieve industrial-scale advantages and an internationally leading technology level in the photonics industry by 2035.

H. Conclusions and Key Lessons Learned

Compared with the results of the "*Executive Report on the Photonics Industry*" conducted by EAC in 2015, China's current photonics industry has undergone great changes, not only in terms of market position and scale but also in the political steering process and funding structure.

Since 2015, the State Council has successively released national strategic plans such as "*Made in China 2025*", and "*National Strategic Emerging Industries Development Plan*", all of which regard optoelectronics technology as an important direction. As a result, China's photonics industry focuses more on "*optoelectronic technology*". After several years of efforts and relying on a strong application market, China is quite strong in the optoelectronic fields such as displays, lighting, ICT, and laser technology.

However, the core basic capabilities of China's photonic industry are still weak, especially in the upstream and midstream of the photonics value chain, such as high-end optoelectronic devices, and chips. In the future, China will strengthen its R&D and investment to overcome its technology bottlenecks and complete its photonics industrial chain. The development of the photonics industry in China is now more market-oriented and some regional clusters such as Wuhan and Suzhou have strategic plans for the photonics industry, they aim to become the world leader not only in output scale but also in technology and innovation by 2035.

After the Science and Technology system reform in 2017, China's research system has a combined structure of both top-down and bottom-up, depending on the level of government understanding and strategic emphasis. The interaction between government and enterprises in S&T innovation is strengthened, and the S&T innovation is deeply integrated with industry, academia, and research, and guided by market demand.

In China, the national government's direct funding is mostly provided to universities and research institutes for research tasks urgently needed by national strategies. The national funds allocated to "*Optics & Optoelectronics*" by NSFC have steadily increased with a CAGR 2018-2022 of 4%. Another national fund, The Key National R&D Programs, has a total of est. 211 mln EUR allocated to "*Information Photonics Technology*" from 2021 to 2023. However, the total value of photonics-related funds under the Key National R&D Programs is expected to increase rapidly, considering implied photonics projects under other programs such as Smart Sensors.

Apart from direct funding and the operation of research programs, various fiscal and non-fiscal instruments are impacting the Chinese photonics industry. China demonstrates a strong usage of additional monetary and non-monetary measures to reach strategic photonics industry goals, e.g., through the setup of industry clusters like the Optical Valley in Wuhan and Photonics Industry Cluster in Suzhou, direct cash grants, venture capitals, or measures such as tax incentives. Moreover, compared with the central government's R&D funding allocation, local governments provide greater support for industries, enterprises, and research to promote the development of photonics industrialization.

In general, China's photonics industry has a huge growth potential, and the layout of all aspects of the industry is gradually being established and improved. The central government steers the general direction of development, while the development of market segments and products is more controlled and funded by local governments or industrial clusters, forming a top-down and bottom-up integrated

development system of industry, academia, and research. Moreover, it is now a time of system reform and industry renewal. Many new systems and policies are being compiled and are expected to be announced this year and next. For example, the "*China's Optoelectronic Device Industry Technology Development Roadmap (2023-2027)*" was released in August 2023 (more details will be revealed at the end of 2023), the "*Plan for Institutional Reform of State Council*" will be finalized in 2023 and "*2021-2035 Science Fund Medium and Long-term Development Plan*" will be announced by MIIT and NFSC, respectively.

In conclusion, the photonics industry is still a new field with huge growth potential in China, driven by enormous application markets. With the rapid development of China's photonics industry and the uncertainty of the international market and geopolitics, some shortcomings and challenges that China needs to face have gradually emerged. For example, except for PV / photonics sensors, etc., Chinese companies generally operate in the mid-to-low-end market, and core components in the mid-and-upstream of the industrial chain still rely on imports, such as optical materials, optical devices & equipment, chips, etc.

China's photonics industry is more market-oriented, the central government remains very important and steers the general direction of development while its development and corresponding policies are more initiated by local governments or regional industry clusters with considerable local funds, which are more jointly established by local governments and investment companies. It's estimated that the total funds raised from regional governments, investment institutions, and enterprises will be approximately 5 bln EUR in the next few years, with public funds accounting for 20%~30% of the ~5 bln EUR funds.

China has no dedicated "*Chip Act*" like the EU or US respectively, but set up a large national fund to strongly support the traditional integrated circuit industry, and will bring a broader market for high-end technology and chip products. To further develop the photonics industry and increase self-sufficiency, optical chips, especially integrated optical circuits, are an important part of China's technological breakthrough in R&D and manufacturing. However, the "*bottleneck problem*" that China urgently needs to solve now is more traditional electronic chips. Therefore, many state support funds such as ICF are mainly invested in the development of electronic chips, while the proportion of optical chips in the fund is very low. The development of optical chips is initiated by regional industrial clusters, such as the Wuxi and Suzhou governments launched considerable funds to develop their local optical chip industry. However, it is foreseeable that with the development of the photonics industry and its important role in China's industry upgrading, China will inevitably attach more and more strategic importance to the photonics industry with more dedicated funds support, but this will take time.

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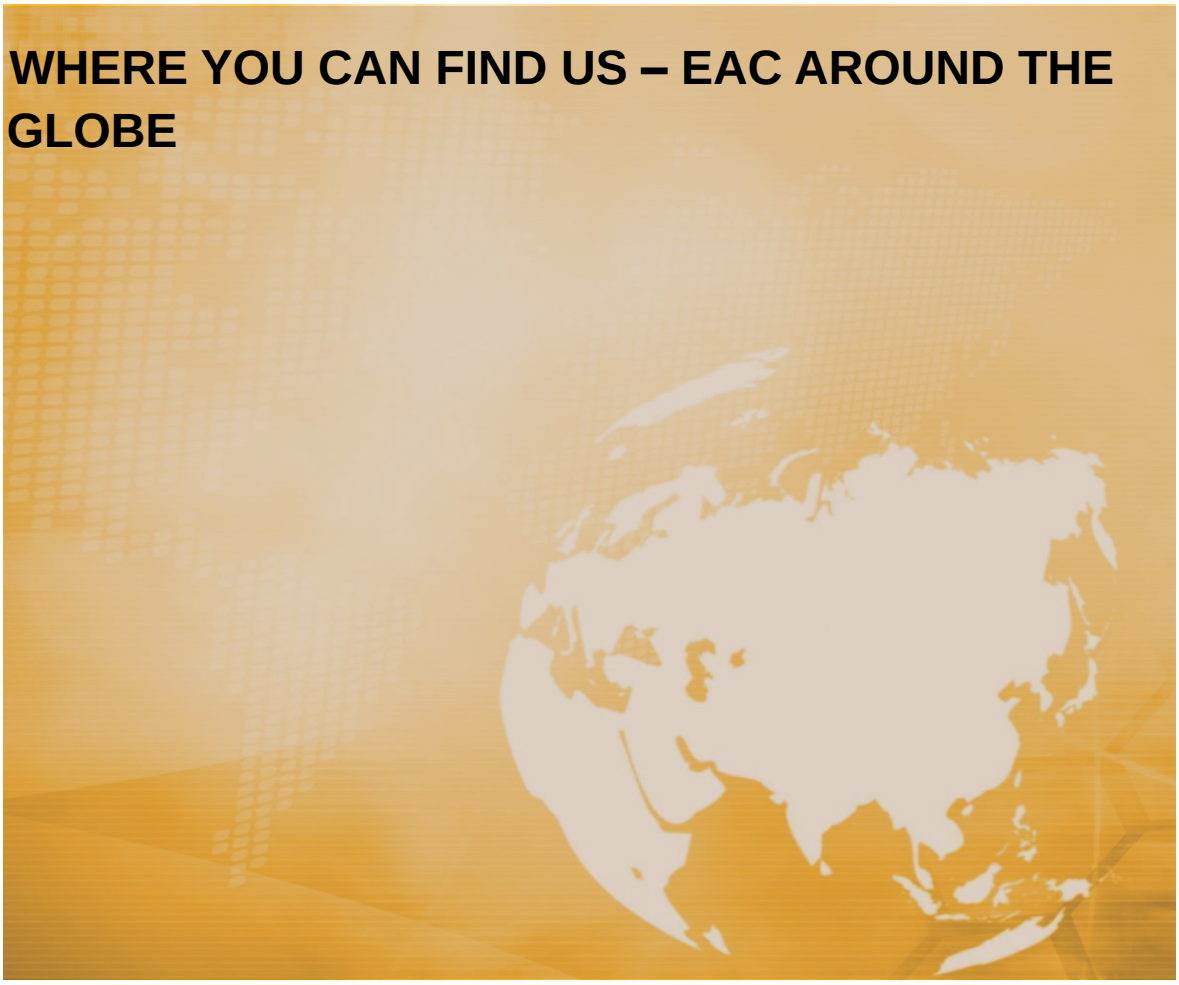

EAC MUNICH

EAC - Euro Asia Consulting PartG
Widenmayerstraße 29
80538 München
Phone +49 89 92 29 93-0
eac-muc@eac-consulting.de

EAC SHANGHAI

EAC - Euro Asia Consulting
Room 1902, Ascendas Plaza, 333 Tian Yao Qiao Road, Xuhui District
200050 Shanghai/ China
Phone +86 21 63 50 81 50
eac-sha@eac-consulting.de

EAC MUMBAI

EAC - Euro Asia Consulting Pvt. Ltd.
704, Leela Business Park,
Andheri Kurla Road, Andheri (East),
Mumbai -400 059/ India
Phone +91 77 18 96 71 26/ 27
eac-mum@eac-consulting.de

EAC Kuala Lumpur

EAC - Euro Asia Consulting
GBC Menara Hap Seng 2
Plaza Hap Seng, No. 1 Jalan P. Ramlee
50250 Kuala Lumpur
Phone: +60 43 9235 1800
eac-sea@eac-consulting.de