



# Future of photonics in the EU Chips Act

European Commission - DG CNECT.A3 Microelectronics and Photonics Industry  
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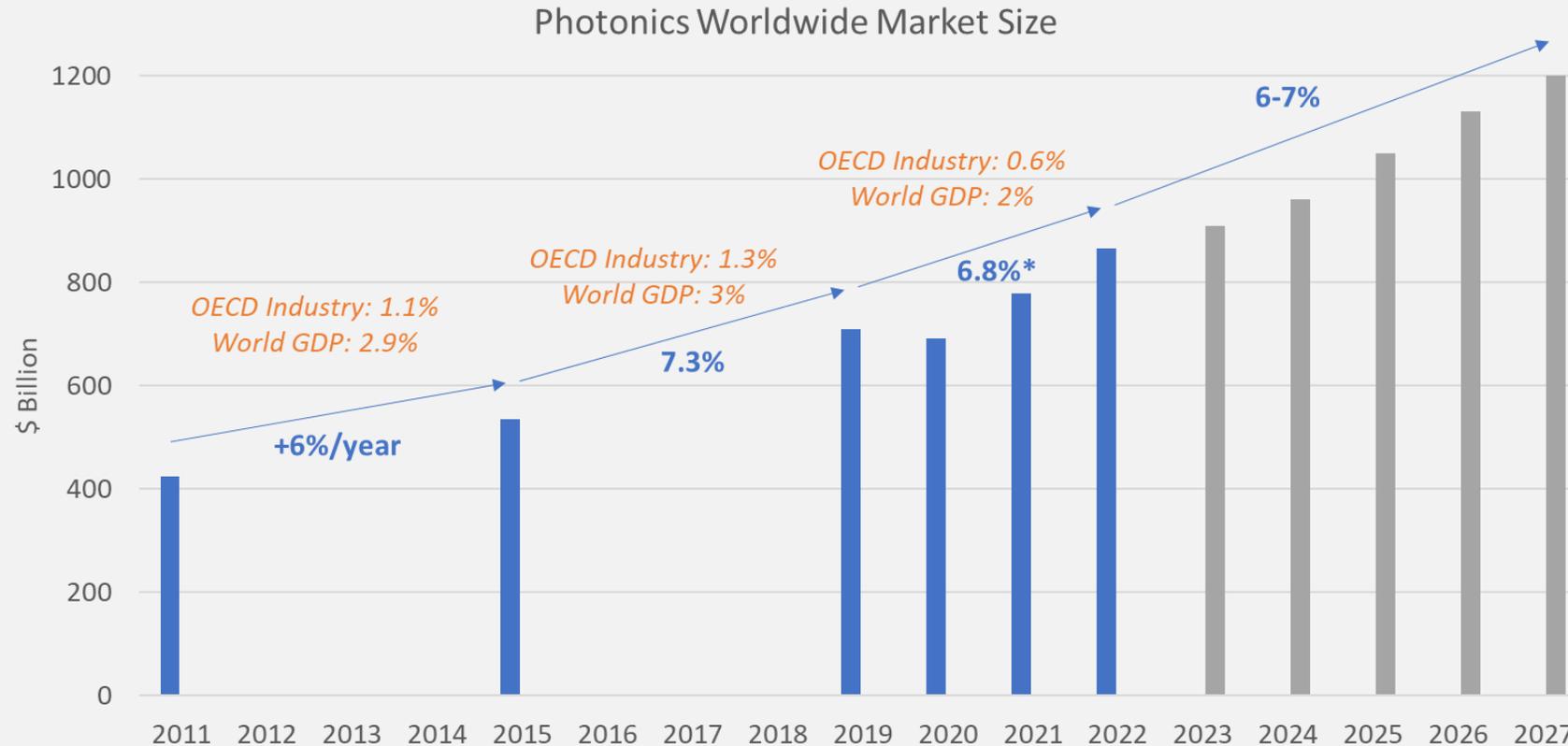
*Photonics Partnership Annual Meeting 2024*  
*14 May 2024*

# Outline

1. Relevance of the Photonics Partnership
2. EU support in Horizon Europe
3. The EU Chips Act
4. Integrated Photonics in Horizon Europe
5. Towards Integrated Photonics in the Chips JU
6. Outlook

# The Photonics Partnership is important

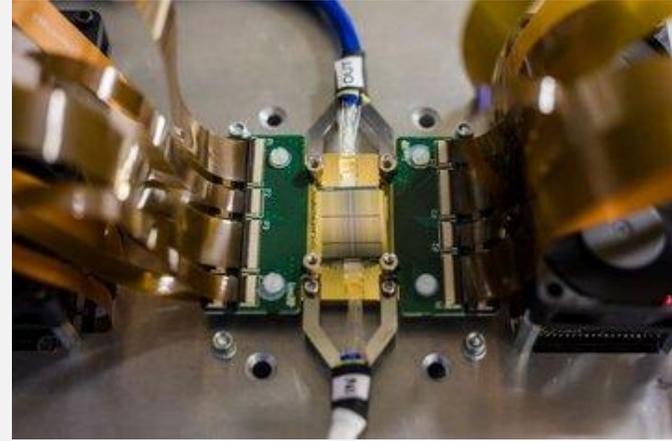
- Global photonics market is growing by 6-7% per year



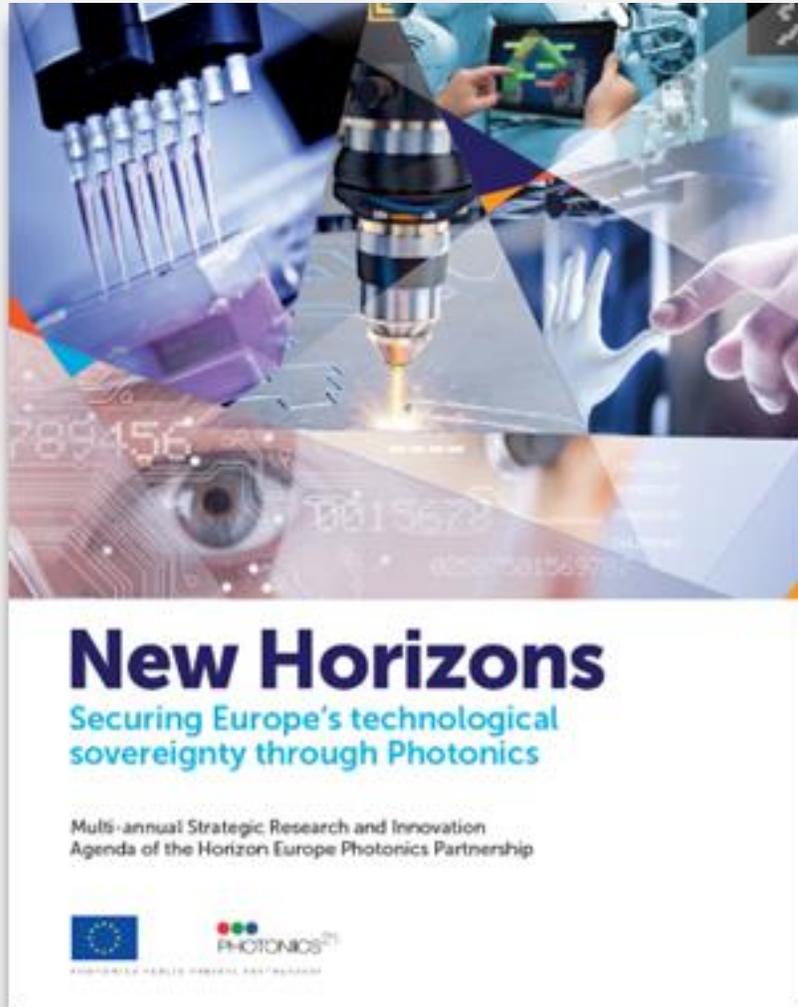
- EU ranks #2 with about 15% market share (2022)
- Significant R&I efforts are necessary to stay competitive

# The Photonics Partnership helps to strengthen EU's R&I leadership

- In Horizon Europe (2021-2027) the partnership focuses on supporting **core technologies**.
- Joint calls in EU deep-tech policy areas
  - Quantum (Quantum Flagship)
  - Virtual Worlds (VR/AR Industrial Coalition)
  - Advanced Manufacturing (Made in Europe)
- The **Chips JU** increasingly addresses **Integrated Photonics**.
- From 2021 to 2023 a total of **42 projects** have been funded with an EC contribution of **Euro 204 million**.
- In 2024 topics with EC support of Euro 39 million are programmed.
- For the entire HE cycle a budget of Euro 340 million is foreseen.

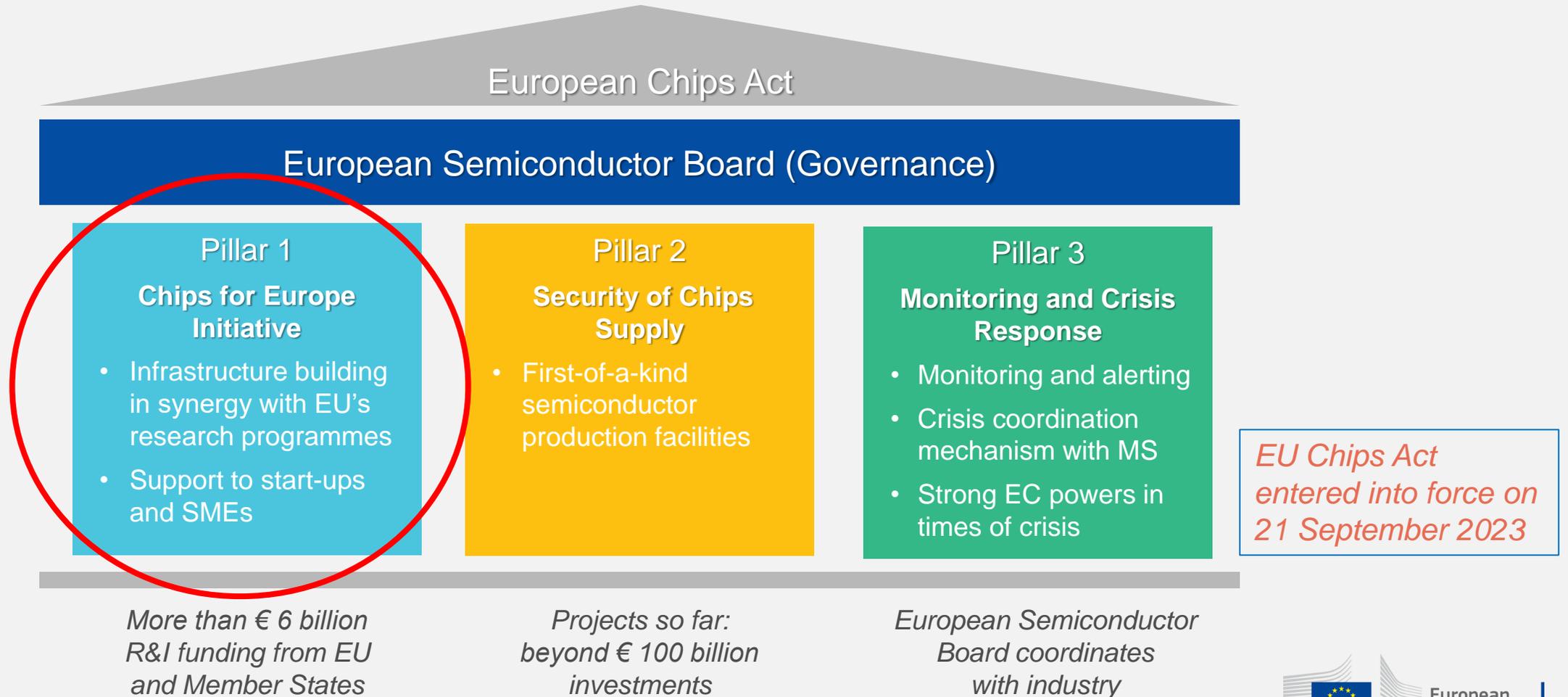


# The Photonics Strategic Research and Innovation Agenda - Basis for Cooperation



- Involvement of more than 1000 stakeholders is much appreciated.
- Roadmap links photonics core technologies with application areas
- Discussion of R&I priorities in seven working groups provides valuable input for the EU.

# The EU Chips Act provides a framework to strengthen **integrated photonics** activities



# Towards more integrated photonics in the Chips JU

## Rationale:

- EU Chips Act encompasses electronic and photonic chips.
- R&I project results in the Horizon part have reached technological maturity to be industrially relevant.
- Separation from micro/nano-electronic integration is artificial.
- Joint R&I is essential for co-integration of photonics and electronics.
- Mass-production challenges on wafer-scale are better addressed in the JU.

## Objective:

Transfer integrated photonics R&I activities to the Joint Undertaking to exploit synergies of integrated photonics with electronic components and systems.

# Research pilot line projects under the Photonics partnership - scaling up PIC production in Europe – Horizon2020



SiN PIC technology for health applications; visible wavelength domain: 400-700nm

2016-20

Total cost  
**€ 10 229 106**



Open-access photonic integrated circuit assembly and packaging pilot line

2017-20

Total cost  
**€ 15 690 921**



Impulse - JePPIX Manufacturing pilot line for InP PICs from first prototypes to commercialisation

2016-22

Total cost  
**€ 17 281 093**

# Ongoing Photonics Partnership PIC research projects in Horizon Europe



RIA – Research & Innovation action

## PhotonicLEAP

PhotonicLEAP will develop a disruptive wafer-level PIC module integration, packaging and test technology which can be scaled from ...



Lithium Niobate PICs for Europe

RIA – Research & Innovation action

## ELENA

ELENA will develop the first European lithium niobate on insulator (LNOI) PIC platform, accessible to all interested entities in ...



RIA – Research & Innovation action

## PICaboo

Cloud applications, 5G and IoT are pushing modern networks over the edge to satisfy the stringent high capacity and low latency ...



HORIZON-AG - HORIZON Action Grant Budget-Based

## VISSION

VISSION will tap into the potential of silicon nitride – an ideal platform for photonic integrated circuits owing to low ...



RIA – Research & Innovation action

## INSPIRE

INSPIRE aims to revolutionize photonic integrated circuit technology by combining two technologies, InP photonics and SiN ...



HORIZON-AG - HORIZON Action Grant Budget-Based

## PHOENIX

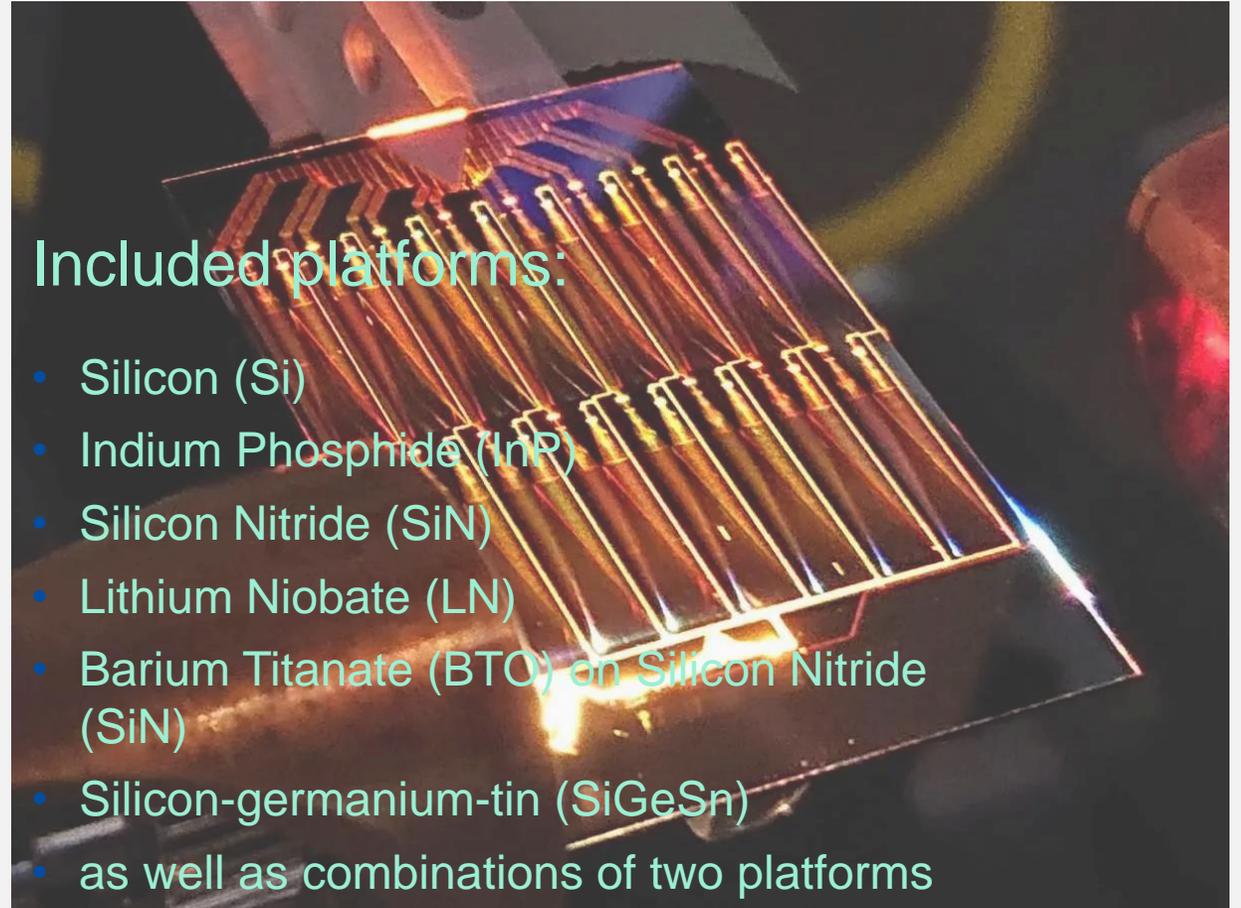
The EU-funded PHOENIX project is seeking to create the next generation of PICs by working with new material platforms, such as ...

& more



# Photonics Partnership triggered a variety of PIC activities in Horizon 2020 and Horizon Europe

- Building & supporting the PIC community in Europe for 20 years
- 35 PIC projects have been/are currently funded (last 5 years)
- **Total budget: about € 190 million**



# Integrated Photonics Project under the Chips JU



Access to low-loss SiN and SOI based photonics platforms with InP and LN heterogenous integration capabilities

2023-26

Total cost € 42 million

**Under KDT/Chips JU Programme**

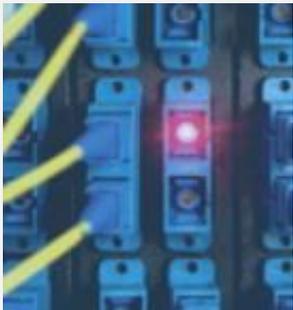


# Roadmaps and White Papers for Integrated Photonics

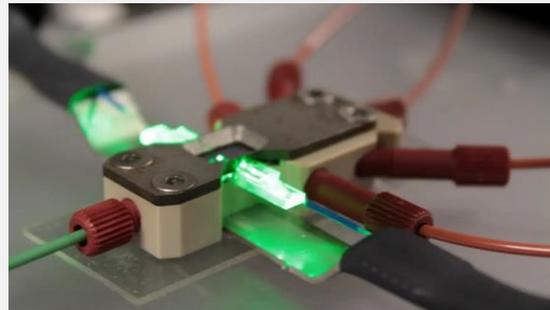
1. The **Photonics21** Strategic Research and Innovation agenda presents R&I challenges on Integrated Photonics in chapter *Core Photonics*.
2. The **SRIA of the Chips JU** mentions photonics on many occasions, yet there is no coherent description of the challenges.
3. **Photonics21** and **EPOSS** co-drafted and published a **White Paper on Integrated Photonics addressing industry trends**
  - a) *heterogeneous photonics integration*
  - b) *manufacturing at increasingly larger diameter wafers*
  - c) *co-integration of photonic and electronic IC*
  - d) *reducing power consumption.*

# Integrate Photonics Drives Future Markets

- ❑ Photonic integrated circuits drive digital markets in the multi-billion Euro range
- ❑ Trends are amongst other
  - The introduction of optical IO in data centres and edge computing
  - Integration of imaging in automotive (LiDAR etc.)
  - Advanced sensing and advanced displays in Virtual Worlds
- ❑ Application areas in Automotive, Datacom & Telecom, Augmented and Virtual Reality, Health, Agro and Food, Quantum, Defence and Security, Safety



Valeo - LIDAR



Lionix Int. – Lab on Chip



OQmented GmbH

# Integrated Photonics in the Chips JU

- ❖ For Photonics21 to consider participating in the Chips JU governance; start with Observer status
- ❖ Represent integrated photonics in the discussion of JU Focus Topics.
- ❖ Contribute to pilot line on integrated photonics in JU workprogramme
- ❖ Revise the SRIA of the Chips Joint Undertaking (JU) to create a coherent description of photonic technologies and its links to electronics
- ❖ Reflect on scope of photonics in JU including photonic systems
- ❖ EC will assess role of photonics in the JU for the next MFF

Thank you.

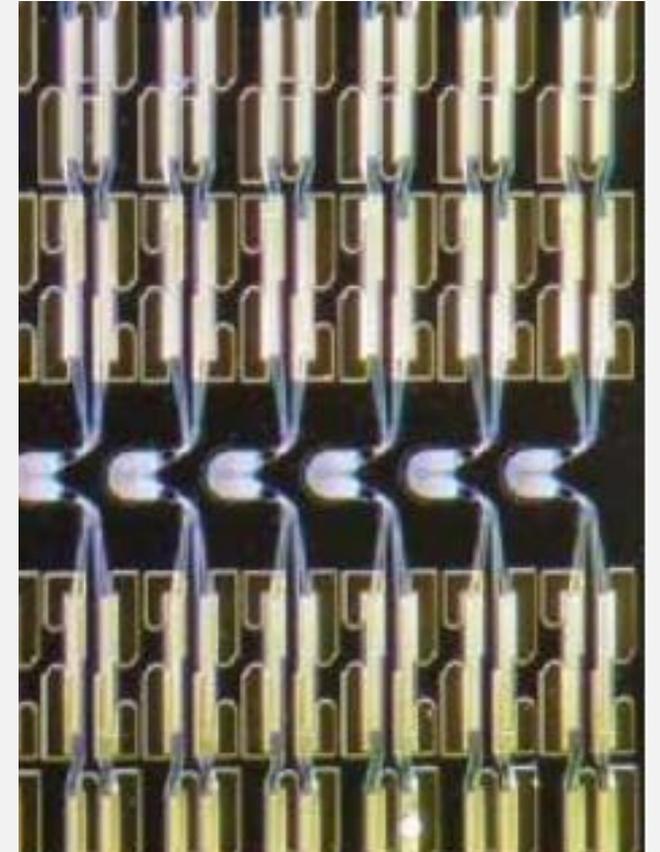
# Horizon Europe 2025-2027 – Orientations

**Sensing and Imaging** for mobility, health, manufacturing, safety and security/defense

**Photonics integration** – photonics and optoelectronics integration up to Photonic Integrated Circuits

Photonic building blocks supporting **hardware for extended reality platforms**

Photonic building blocks for **communication networks and data centers**



# Photonics topics considered for Horizon Europe WP 2025

## Main expected outcomes

- Reinforce leadership of European research and industry in sensor technologies such as LIDAR, 3D imaging techniques and multispectral/hyperspectral sensors including algorithms driving medical, industrial, agricultural, safety, security and env. applications
- Provide the light-based access technologies to interact with virtual worlds starting from professional environments
- Equip Europe's manufacturing industry with the best and most versatile production tools using lasers and cutting-edge sensing technology

## First tentative list of topics under consideration:

- Active sensor technologies and multimodal sensor integration for multiple application domains (**Photonics Partnership**)
- Photonics for projection, sensing and perception in **Virtual Worlds** (joint effort Photonics and Virtual Worlds Partnerships)
- Laser-based manufacturing (**joint effort** Photonics and Made in Europe Partnerships)



# Proposed Photonics Partnership call topics 2025-27

<u>Topic</u>	<u>Type</u>	<u>TRL</u>	<u>Budget in M€</u>	<u>Year</u>	<u>Partner/Notes</u>	<u>Link to WGs</u>
<b>Development of active sensor technologies and multimodal sensor integration for multiple application domains</b>	IA	TRL > 5	15-20	2025		3, 4, 5, 6, 7
Ultra-high efficiency photonics	IA	TRL > 5	15-20	2026		1, 3, 4, 5, 6, 7
Extended functionality in integrated photonics	RIA	TRL 1-5	15-20	2027		1, 2, 3, 4, 7
Education and training	CSA		1.5	2025		7
Photonics21 Secretariat	CSA		3.0	2026		
Joint application call (tbd)	tba	tba	10-15	2025	tba	tba
Joint application call (tbd)	tba	tba	10-15	2026	tba	tba
Joint application call (tbd)	tba	tba	10-15	2027	tba	tba
<b>Sustainable, environmentally friendly manufacturing of photonic components and systems</b>	IA	TRL > 5	tba	tba	Chips JU	1, 2, 3, 4, 7
<b>Pilot lines and competence centres for advanced integrated photonics and PIC technologies, including electronic-optical systems</b>	IA	TRL > 5	tba	tba	Chips JU	1, 2, 3, 4, 7
<b>Co-design and manufacture of photonic components and systems with microelectronics and complementary technologies</b>	RIA	TRL 1-5	tba	tba	Chips JU	1, 2, 3, 4, 7

# Roadmaps and White Papers for Integrated Photonics

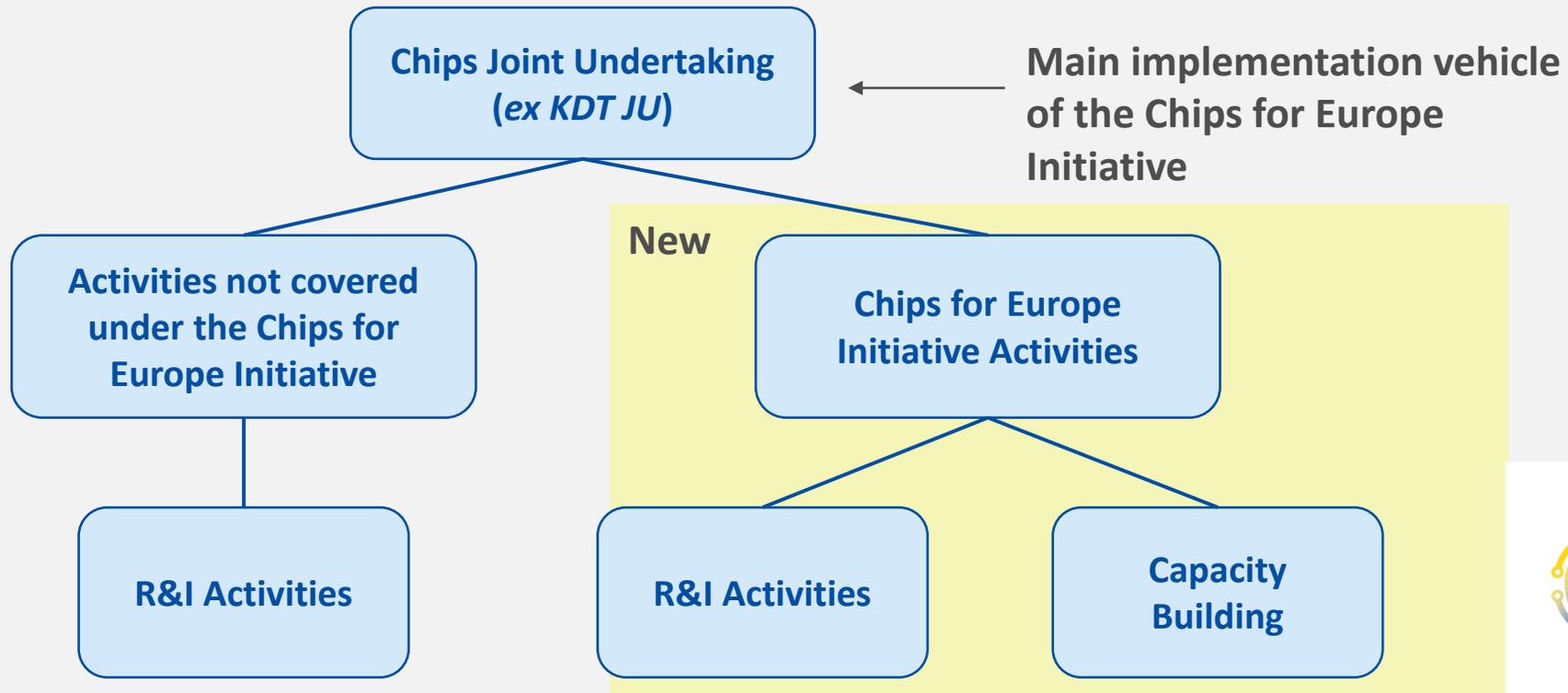
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  - d) *reducing power consumption.*
4. The **Integrated Photonics System Roadmap – International (IPSR-I)** identifies key technology gaps to boost industries including RF photonics (wireless communication), 3D imaging, datacom and sensing. (PhotonDelta and MIT 2024).

# Technologies for Integrated Photonics Pilot Line

- ❑ R&I Activities should cover all relevant materials platform:
  - Si-based (silicon on Insulator, SiN)
  - III-V-based (InP, GaAs, etc. )
  - hybrids
  
- ❑ All relevant production steps should be included:
  - design
  - manufacturing (frontend and backend)
  - test
  - opto-electronic interconnection, packaging, co-packaging with electronic ICs.

# Chips JU Activities

## Chips for Europe Initiative





## Proposed roadmap for 2025–2030

	2025–2027	2028–2030
<b>Photonics Research (R)</b> Challenges, TRL up to 5	<ul style="list-style-type: none"> <li>• Semiconductor devices, integrated photonics and PICs for extended wavelength ranges, power efficiency, modulation speed, extreme environments</li> <li>• Co-design and manufacture with microelectronics and complementary technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Hetero-epitaxy and integration approaches for all wavelengths, UV to mid-IR</li> <li>• Approaches to photonic VLSI</li> <li>• Photonic neural networks with high energy efficiency</li> <li>• Optical fibres with very low loss and high stability, operating across wide wavelength ranges; special fibres and fibre devices</li> <li>• Neuromorphic, adaptive and programmable photonics</li> </ul>
<b>Photonics Innovation (I)</b> Challenges, TRL starting from 5	<ul style="list-style-type: none"> <li>• Production tools and techniques; Pilot lines for advanced integrated photonics and PIC technologies, electronic-optical systems</li> <li>• Development of active sensor technologies for multiple application domains</li> </ul>	<ul style="list-style-type: none"> <li>• Scale up for multi-technology pilot lines</li> <li>• Production tool development and deployment in industrial trials throughout product value chain</li> <li>• Pilot production for 'quantum-compatible' photonics</li> </ul>
<b>Joint actions required with other Horizon Europe Missions or partnerships</b>	<ul style="list-style-type: none"> <li>• Development of joint programmes with Quantum Flagship and KDT/Chips JU, addressing R&amp;I challenges in quantum PICs and multi-technology integration</li> <li>• First pilot lines for key semiconductor and quantum technologies</li> <li>• Education and training actions</li> </ul>	<ul style="list-style-type: none"> <li>• Evolution of pilot lines to full value chain of photonic devices, circuits and systems, including semiconductor devices and PICs, assembly and packaging</li> <li>• Tackling the challenges of manufacturing at scale with multiple technologies including electronics and optics</li> <li>• Wider education and training actions</li> </ul>

### New Horizons

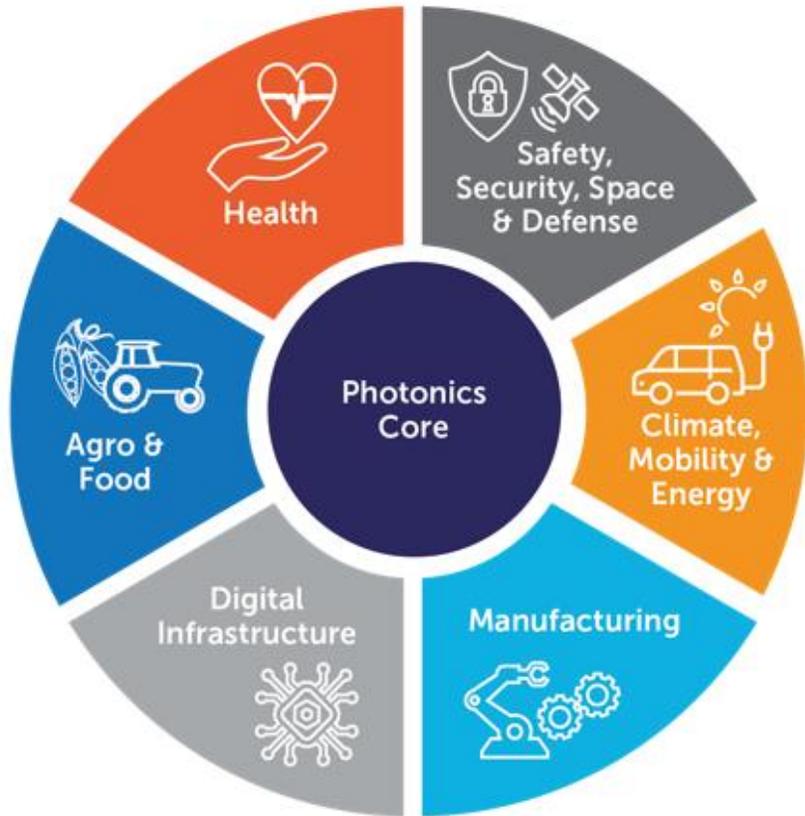
Securing Europe's technological sovereignty through Photonics

Multi-annual Strategic Research and Innovation Agenda of the Horizon Europe Photonics Partnership

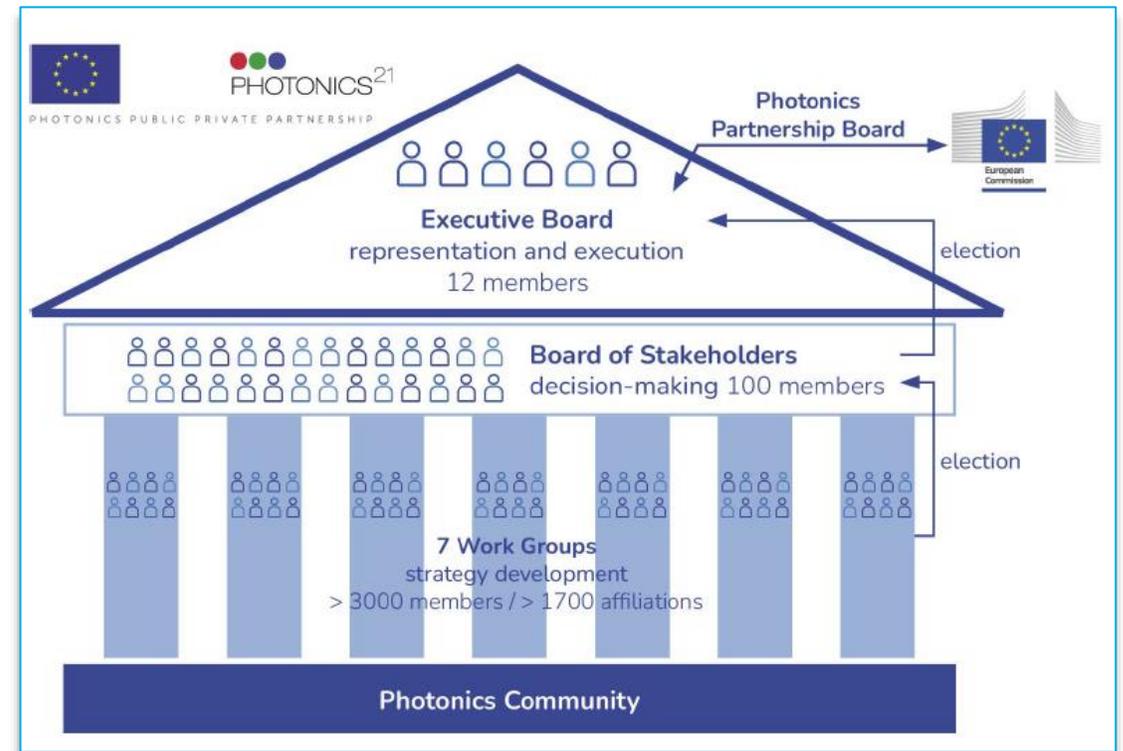


# R&I challenges: Core Photonics work group

# Photonics21: European Photonics Stakeholder Organisation



- ✓ Since 2014 – Public Private Partnership with EU in Framework Programmes; budget in HE: ~Euro 450 million
- ✓ 7 Photonics21 **working groups** develop R&I priorities
- ✓ More than 3000 members (SMEs, LEs, RTOs, universities)



# Single point of access to use Photonics Partnership pilot line services in Horizon Europe



**"Test-before-invest"** – provide support to end-users along the full TRL and MRL value chain

Design, prototyping, experimentation, engineering and pilot manufacturing with further guidance to manufacturing in Europe

Free-space optics, optical fibres, MOEMs and flexible organic photonics, to photonic integrated circuits and laser sources

