

*The next generation of sensors and imagers enabled by 2D materials digital integration*

**Project ambition:**

Next-2Digits has set challenging objectives aiming to transform the next generation of devices based on 2D materials. In order to accomplish these objectives, it will advance the current state-of-the-art value chain of technologies, including a **Si photonics platform** fostering the direct integration of 2D materials, **wafer scale integration of 2D materials, 2D material-based PICs and OEICs**, and **2DM enabled applications**.

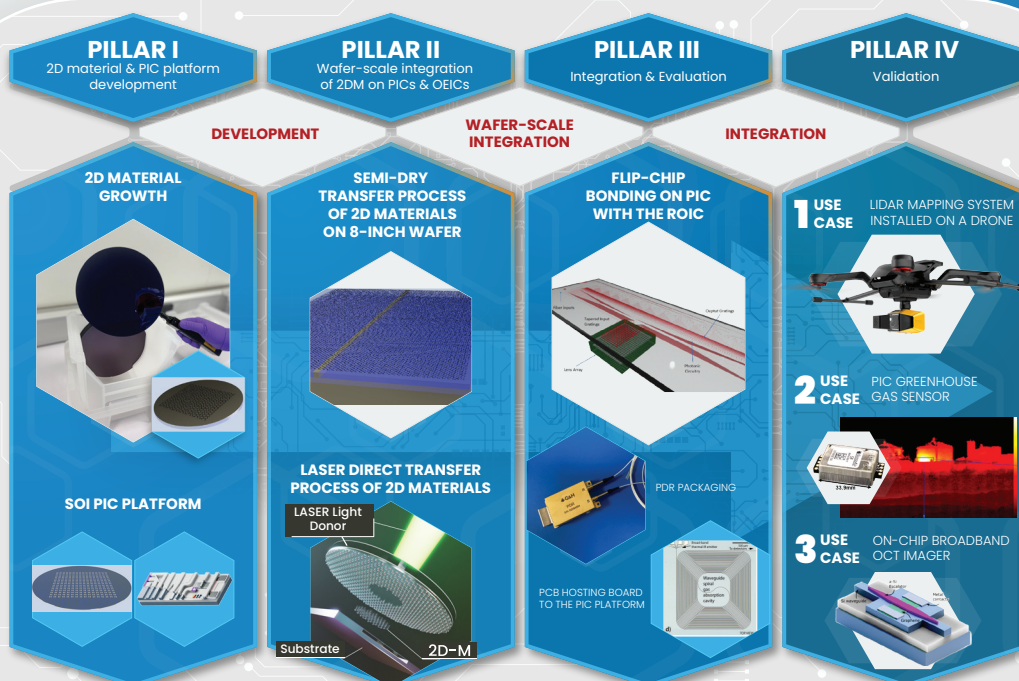
**Project description:**

The field of Photonic Integrated Circuits (PICs) and Optoelectronic Integrated Circuits (OEICs) faces several challenges in the integration of **photodetectors** (PDs) and **modulators** (MDs): different mechanisms and device architectures, incompatible form-factors, and reliance on materials with heterogeneous properties are the most prominent.

The introduction of **Graphene** and other two-dimensional materials (2DM) has proven to overcome these challenges, offering miniature footprint and ultrawide bandwidth. However, issues related to impurities, defects, and integration complexities still hinder their widespread use.

The Next-2Digits project aims to address these challenges by directly integrating Graphene into PICs using **semi-dry transfer** and **Laser Digital Transfer** technologies. This approach ensures defect-free interfaces, high carrier mobilities, and large bandwidths, paving the way for the next generation of integrated PDs and MDs.

The project focuses on **four pillars**:



**PROJECT FACTS**

START DATE  
**01/10/2023**

END DATE  
**31/12/2026**

DURATION IN MONTHS  
**39**

PROJECT BUDGET  
**€ 5,134,570.50**

GRANT AGREEMENT  
**101120651**

CALL  
**HORIZON-CL4-2022-DIGITAL-EMERGING-02-17**

TOPIC  
**HORIZON-CL4-2022-DIGITAL-EMERGING-02-17**  
- New generation of advanced electronic and photonic 2D materials-based devices, systems and sensors (RIA)

**HE RESEARCH AND INNOVATION ACTION (RIA)**

KEYWORDS  
*Electrical and electronic engineering / 2D materials / PICs / Graphene / Digital Processing / Additive Manufacturing / LiDARs / Gas Sensors / Polarization Diverse Receiver*

The overarching goal is to establish wafer-scale heterogeneous integration technologies for 2D materials in the next generation of PICs and OEICs, validated through practical use cases at TRL5. Next-2Digits envisions to develop the first hybrid Graphene-based photodetectors (PDs) and modulators (MDs) which will be integrated into three device demonstrators:

1. A **miniaturized LiDAR** with an integrated graphene photodetector will be validated at TRL5 in an **Unmanned Aerial Vehicle** (UAV) to fulfil the requirements of long flight times and minimal energy consumption in advanced geo-mapping.
2. A **PIC greenhouse gas sensor** with sensitivity below 50ppm and miniaturized footprint offering multi-sensing capability. The PIC-based sensor device will be validated at TRL5 in two types **of biogas plants**.
3. An **on-chip polarization diversity receiver** (PDR) offering extended bandwidth and high resolution will be used for **biomedical optical coherence tomography** (OCT) imaging in a cardiovascular application and compared against currently available receivers.

### Expected impact:

The Next-2Digits project aims to achieve significant outcomes in advancing the **integration of 2D materials** (2DM) technology and **fostering competitive value chains** in Europe.

Recognizing the unique properties of graphene and 2D materials, the project focuses on overcoming challenges in wafer-scale integration and scalable production. By reducing production costs, power consumption, and footprint, Next-2Digits seeks to establish integrated fabrication processes accessible to the European industry. The expected outcomes include:

- The integration of 2D materials in standard fabrication processes
- The development of new 2DM-based components with enhanced performance and reduced costs
- The deployment of these devices in specific use cases to validate their improved performances.

The project aligns with the European Union's recognition of graphene as a Future Emerging Technology, with the potential for significant impact and the creation of competitive value chains.

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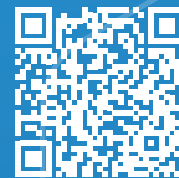
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**GRAPHENE**  
FLAGSHIP

NEXT-2DIGITS COLLABORATES WITH THE GRAPHENEEU PROJECT "EUROPE IN THE LEAD COORDINATION AND SUPPORT ACTION", UNDER THE SCOPE OF THE GRAPHENE FLAGSHIP INITIATIVE.



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101120651.