Position paper on "XR chips & components pilot-line"

Editors: Dr. Uwe Vogel, Dr. Leif Oppermann[1], Dr. Tanguy Coenen[2].

Authored by the members of the Virtual Worlds Partnership

This document synthesises the outcome of a series of workshops organised by the Virtual Worlds Association in March 2026, under the umbrella of the Virtual Worlds Partnership[3], to identify the main research and innovation priorities where research, innovation, standardisation and skills development are needed to ensure the EU organisations being active in hardware components relevant for extended-reality (XR) devices fully benefit from the strategic potential of virtual worlds.

The Virtual Worlds Association is grateful to its member organisations for their participation and support in the creation of this document: Fraunhofer, imec, CEA-Leti, DFKI, Infineon, VoxelSensors.

The Virtual Worlds Association warmly extends its gratitude to the following organisations and individuals for their valuable contributions during these workshops (in alphabetical order): Axelera, BTH, CSEM, EssilorLuxottica, FORTH, Joya Team, INESC TEC, Konica Minolta Sensing, LusoVu, Microoled, Oliver Achten (individual), Phenix Consulting, Racyics, Varjo.

The Virtual Worlds Association warmly thanks the European Commission – DG CONNECT, Communications Networks, Content and Technology – Unit G.2 for their support in the orchestration of the effort.

The Virtual Worlds Association is deeply grateful to Dr. Uwe Vogel from Fraunhofer, Dr. Tanguy Coenen from imec, and its Vice-President Dr. Leif Oppermann from Fraunhofer for their leadership and substantial contributions to the writing and development of this Position Paper.

Final version - created 18 May 2026

---

[1] Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e.V.

[2] Interuniversitair Micro-Electronica Centrum (IMEC)

[3] European Commission launches European Partnership for Virtual Worlds, 2025 (https://digital-strategy.ec.europa.eu/en/news/european-commission-launches-european-partnership-virtual-worlds)

1 Context

Virtual Worlds (VWs) are **interactive environments** grounded in 3D and eXtended Reality (**XR**) technologies with varying degrees of persistence. They facilitate **collaboration** via **human-machine interaction** with complex systems of systems and the **real-time blending of physical and digital worlds** across a range of applications and devices, including head-mounted/-worn displays, tablets, smartphones and watches, as well as smaller ubiquitous and embedded computing devices. In this context, XR is adopted as a neutral umbrella term for a range of experiences that extend, augment, or merge physical and digital realities, such as Virtual Reality (VR), Augmented Virtuality (AV), Augmented Reality (AR), and Mixed Reality (MR).

It is noteworthy that the meaning of MR shifted from the classic Reality-Virtuality Continuum to a broader understanding as the blending of the real and the digital, as we now use it for VWs. Concurrently, over the past decade, the terminology in this domain has been increasingly influenced by the marketing strategies of companies such as Microsoft and Meta. This dynamic may have contributed to the growing adoption of XR as a more neutral umbrella term, while more strongly branded concepts are used more selectively. Virtual Worlds represent a transformative convergence of physical and digital realities, creating environments in which users can interact, work, learn, and play in unprecedented ways, spanning both visually immersive interfaces and more distributed, context-aware, and ubiquitous computing paradigms.

This "XR chips & components pilot-line" position paper identifies the required foundational concepts and technological advancements in hardware components driving Virtual Worlds, highlighting their potential to evolve various sectors, including industry, entertainment, education, and commerce. The transformative potential of VW hinges critically upon significant advancements in Human Machine Interfaces (HMI) to create seamless and effective User Experiences (UX) across the continuously expanding range of professional and consumer XR applications.

While conventional direct-view displays, such as found in smartphones or tablets, continue to play an important role, our focus here is more on near-to-eye 'virtual-view' displays, such as in head-mounted displays (HMDs), with future possibilities extending to 'on-eye' devices or even direct neural interfaces. This focus is further motivated by the highly consolidated and globally competitive market for conventional displays, in contrast to microdisplay technologies, which remain a comparatively open and rapidly evolving domain within XR. HMDs (incl. advanced headsets and smart glasses) are essential to offering truly immersive modalities and are repeatedly identified as critical enablers across all use cases. Improving their performance, comfort, and sustainability is a central research and innovation priority to support the transition to VW. Also, multi-sensory applications are in scope. Defining the next generations of these physical interfaces for Virtual, Augmented, and Mixed Realities demands a holistic, transdisciplinary approach, encompassing technological innovation, user-centricity, ethical considerations, and sustainability.

From a market perspective, **Smart Eyewear** and **AR glasses** are expected to grow most, by 45% CAGR 2024-2030 (coming from 0.6 Mu/year in 2023 and 1.6 Mu/year in 2024)[4]. More than 10 million units annually are expected to be sold before 2030. In contrast, VR is supposed to meet a glass ceiling around 10 Mu/year before 2030. Smart glasses in particular, together with their immanent hardware components such as chips, sensors and photonics are currently the focus of **massive investment from non-European technology leaders, mainly in the US (e.g. Meta, Apple, Google, Amazon) and Asia (e.g. Samsung, Xreal, RayNeo, Oppo),** who are exporting and spreading their products and standards, while protecting their supply chains. Consequently, because most research and development occurs outside the EU, Europe faces **strategic dependencies on critical components** such as processors, displays, optics, connectivity, power management, sensors, and actuators – all to be optimized for wearables, i.e. enabling devices with very low size, weight, power consumption, at reasonable cost. Eyewear in general is not just about vision correction, but also about

[4] AR/VR 2025 From Optics and Displays to Advanced Sensing and Processing, Yole Group

fashion, visual assets, and personal statement. The global eyewear and eyecare market is worth $120B (price to consumer) according to EssilorLuxottica and Euromonitor. EU-players such as EssilorLuxottica or ZEISS are highly relevant in that segment. Starting from their market potential there can be a chance for even gaining a strong foothold in consumer applications – as soon as the VW hardware component and service ecosystem will be established to a wide extent in the EU as well.

AI will play an important role in adoption, because in combination with the smart eyewear hardware and its capabilities it provides services enabling even 'superpowers' to the users, in addition to more traditional uses such as sensor data analysis. Currently, much of AI processing is performed via cloud computing infrastructures, often located outside of the EU. Strengthening technological sovereignty in this area will require greater adoption of Edge-AI, enabling more localized processing and reducing the need to transfer user data to the cloud for better privacy preservation. This is particularly important as many of these devices rely on continuous data connections to non-EU servers and may involve extensive tracking of user behaviour. Such characteristics can limit their suitability in sensitive or regulated environments (e.g. industrial, medical, or security contexts) and may also hinder broader consumer adoption, for example in cases where gaze tracking enables the inference of user states or emotions, or where the storage of users' media and profile data outside their control is perceived as intrusive. Moreover, the transfer and aggregation of such data on external platforms raises concerns related to data sovereignty, privacy, and alignment with European values and regulatory frameworks.

Therefore, **European technological sovereignty must be secured in this domain**. Strengthening European research and industrial capacity whilst **securing the supply chain for critical VW components** should become strategic priorities. To **safeguard operational autonomy**, Europe requires **sovereign capabilities to design, standardise, manufacture, operate, and control its own Virtual World hardware technology stack**. As critical cross-domain enablers, VW technologies are vital for many professional and consumer domains with already strong R&D and manufacturing strengths, e.g. medical, automotive, industrial, defense.

2 Technology Domains

As part of EU Chips Act Pillar 1 „Chips for Europe" initiative, five „pilot-lines" have been previously established: They act as platforms for European research and development with an industrial perspective to bridge the gap from lab to fab, and mainly cover process development, test and experimentation, as well as small-scale production. They are operated by leading EU RTO's in the field, i.e., IMEC (NanoIC), CEA-LETI (FAMES), Fraunhofer (APECS), Tampere University (WBG), ICFO (PIXEurope). Since those pilot-lines mainly cover enabling technologies in their specific areas (e.g. "NanoIC: sub-2nm system-on-chips"), they are key to contribute to future "XR chips & components" as well, and therefore will be strategic partners of the envisioned "XR chips & components pilot-line". In the following, the focus is placed on chips and components, and does not cover plant or equipment manufacturers, even where these represent key European strengths (e.g., ASML, ASM International, BE Semiconductor Industries, Hesse Mechatronics). Still, while focusing on new XR hardware components, we keep in mind XR platform and S/W architectures for the entire XR hardware stack.

There are a set of general application- and EU value-driven conditions that XR-specific chips and components have to enable: a) Wearable, compact form-factor, b) untethered connectivity, c) low-energy consumption for long recharge cycles and battery life, d) User-centric, multimodal immersive, i.e. sensors/actuators related to human senses, e) ubiquitous and sustainable experiences, recyclability, f) Embodied AI, and g) privacy-aware sensing, data processing and connectivity.

During recent years manufacturing technologies for microelectronics, microsystems, photonics and optics have started to converge, i.e. innovations in those areas benefit from each other. Although the most advanced silicon semiconductor process nodes fabrication (<10nm) as well as integrated circuitry (IC) design is located in Asia (TW, KR, JP) and US, a lot of the basic capabilities have been created in the EU, either on component design, process technology, or manufacturing equipment. These process and manufacturing technologies have been identified as 'enabling technologies' for chips and components, which constitute a higher level of system complexity and form key building blocks of XR devices.

Looking at the basic functions of those components, **seven major categories** have been identified: Chips for local **processing/computing**, **displays** and **optics** components for visualisation, chips for internal and external signal and data **connectivity**, **power** supply and management, as well as **sensors** and **actuators** for interacting with human senses beyond visualisation. They will be discussed in the following alongside **enabling technologies**.

2.1 Processing/computing

For a high degree of visual fidelity and contextual support, XR devices require immense signal and data processing at the edge, i.e. with sparse or even no cloud/internet connectivity. Computing-intense examples are graphics, AI, local multi-modal sensor signal and acquisition and processing, or very high-resolution imaging for large field-of-view visualisation. Example components are CPU, GPU, NPU, memory, typically designed and manufactured as System-on-chip (SoC) or System-in-package (SiP). Manufacturers are typically large enterprises (either integrated device manufacturers/IDM, who also do own chip design, e.g. Infineon, Bosch, ST Microelectronics, NXP, or silicon foundries, e.g. GlobalFoundries, XFAB, ESMC or Intel, while design is also performed by start-ups, small-medium enterprises (e.g. Racyics, Axelera, SiPearl, Openchip) or RTO/academia (e.g. IMEC, CEA-LETI, Fraunhofer, SINTEF, TU München, CSEM) as well.

2.2 Displays

Visualisation is the major channel to support human immersion into virtual worlds, providing the highest bandwidth and information capacity of all human senses, in both spatial and time domains. While the far majority of displays in daily life are seen by the users in direct view (e.g. smartphones or monitors), XR devices can often provide virtual images via optical magnification from a tiny micro-display. Those can be either emissive (i.e. no external light source necessary, e.g. OLED, microLED), or light-modulating (e.g. MEMS SLM, LCOS, laser beam scanning). The global ecosystem in microdisplay design, manufacturing and R&D has been limited in the past and was mostly covered by SME and RTO. More recently (since the advent of consumer XR and AI), major consumer electronics companies have acquired SMEs to gain access to that technology (e.g. Samsung, Apple). China was supposed to become the major production hub for emissive microdisplays, about 10 fabrication lines have been constructed since about 2020. However, due to the geopolitical changes, EU customers increasingly demand sovereign supply chains, avoiding Asian and US supply or ownership. That provides a significant opportunity for EU in this field, since the supply chain can fully be covered within EU already. There is globally leading R&D (e.g. Fraunhofer), few established SME (e.g. Microoled, Holoeye), as well as promising start-ups (e.g. PolarLight, Qubedot). CMOS backplane wafers can be and partly are already provided by EU silicon foundries and IDM, since microdisplays typically do not require the most advanced process nodes. Frontplane integration is available in EU, while packaging/assembly had often been outsourced to Asia for cost reasons, though this is expected to return home in future.

2.3 Optics

Companies active in optics are often prone to smart eyewear and/or XR visualisation devices, e.g. Essilor Luxottica (Ray-Ban link to Meta) or ZEISS (via their Tooz subsidiary). For consumer applications there are a number of motivations to develop XR capabilities into smart eyewear: a) The devices provide 'super-power', b) become recognized (by others) as fashion gadget, c) significantly improve impaired natural vision, or d) get to a form-factor making smart eyewear indistinguishable from regular (non-smart) eyewear. About 20% of those requiring vision correction wear contact lenses. Ultimately, smart contact lenses could combine the above, but would require strongest R&D efforts, with unclear outcomes about feasibility and user acceptance. It is thus recommended to not focus on contact lenses at the moment and stay with the bigger form factors of smart eyewear and head mounted displays.

Before moving into consumer markets, professional and prosumer markets are addressed regularly. That's already ongoing for XR devices, and EU has a significant stake in those, e.g. Engo Eyewear, Varjo, Vrgineers, Lightspace, Everysight, Thales. However, there are many more XR optics component suppliers, e.g. Schott, Optinvent, Creal, Trilite, Vitrealab, Lusovu, Joya Team, Lumus.

2.4 Connectivity

Current XR devices heavily depend on extensive data transfer between the device at the edge and the cloud, e.g. by continuously collecting data, sending those into the cloud for AI analysis, and receiving cloud-processed responses. Such high-bandwidth wireless data traffic causes high power drain from a very limited battery volume/capacity, i.e. devices would have to be recharged after a few hours only. Another aspect is privacy-aware sensing & connectivity. Therefore, XR connectivity aims for limited data transfer, seeing offline as a valid state in networking, and putting emphasis on local vs. cloud computing, while still enabling controlled access to external data.

This field is addressed by EU IDMs, e.g. Infineon, Bosch, ST Microelectronics, NXP, telecom companies, e.g. Nokia, Ericsson, Orange, start-ups and SME, e.g. Deveritec, Last Mile Semiconductor, as well as RTO, e.g. BTH, CETIC, UCLM, TUD, CSEM, FORTH.

2.5 Power

In wearable devices battery capacity is very limited, i.e. ultra-low power consumption of their chips and components is most critical, and regularly performance has to be traded for battery life. Beside that, power management (i.e. enabling power consumption to those components only where currently needed), high-capacity batteries and energy harvesting are necessary.

EU entities in this field are Infineon, Bosch, ST Microelectronics, OnSemi (e.g. power management IC), Dolphin, Varta, Iten, and RTO, e.g. CEA, CSEM, Fraunhofer, FORTH.

2.6 Sensors

Sensors are key to making XR devices user-centric, i.e. they detect human motion or emotion (e.g. head and body movement, eye-tracking), and enable virtual user-interaction based on the real environment. While they often mimic human senses (e.g. hearing->microphone, vision->camera), in XR they are also used to expand and augment those senses, e.g. night or infrared vision, 3D mapping, segmentation, etc..

There is significant ecosystem in EU sensors, IDMs (e.g. STM, Infineon, Bosch, amsOsram, OnSemi, Sensirion), system integrators (e.g. Exosens, Thales), SME (e.g. Voxelsensors, Quantune, Heimann Sensors, Xenomatix, Prophesee, Tobii, Emberion, Akmira, QDI Systems), and RTO (e.g. CSEM, DLR, ETHZ, SINTEF, Fraunhofer, IMEC).

2.7 Actuators

Actuators provide feedback to the human senses well beyond vision, e.g. auditory, tactile, haptics, smell, taste, and are thus immanent to enable user-centric, multi-modal immersion in XR. Often actuation is combined with sensing in terms of transducers, e.g. based on ultrasound, radar, lidar or bi-directional micro-displays. MEMS technologies play a vital role in actuators, e.g. for micro-speaker, ultrasound-transducer or micro-scanning mirrors used in laser beam scanning.

A future level of XR could be reached by enabling nerve and brain interfaces. Though mostly developed for medical application so far, e.g. restoring impaired human senses (e.g. hearing by cochlear implants) or suppressing pain, they could potentially open new ways of immersion.

Accordingly, the EU ecosystem is in MEMS-fabricating IDMs, e.g. Bosch, Infineon, STM, amsOsram, and foundries (e.g., Silex), while also RTO (e.g., Fraunhofer, CSEM) and SME are active (e.g. Quantune, Senseglove, Mimetik).

2.8 Enabling technologies

Chips and components of the previous categories are widely fabricated by technologies of microelectronics, microsystems, photonics and optics, also making use of innovative advanced materials (IAM, e.g., metasurfaces, holographic resins, liquid materials, high refractive index). They are designed based on capabilities in information and communication technologies (ICT), e.g. integrated circuits (IC) and components ("chips"), require packaging and assembly to enable systems, as well as characterization. Advancing these enabling technologies will benefit XR device and system integration significantly, e.g. by advanced ultra-low power edge AI microprocessors that could be achieved by heterogeneously integrating chips of different technological origin into a highly miniaturized single module by chiplets, or new materials for high-density low-power memories or photonics.

Since enabling technologies often require large infrastructures, e.g. cleanrooms, they are mostly operated by large enterprises and RTOs. Beside Integrated Device Manufacturers (IDM), who operate cleanrooms as part of their chips and components product development and fabrication (e.g. ST Microelectronics, Infineon, Bosch, NXP), the foundry model has been established successfully (e.g. XFAB, GlobalFoundries, ESMC, SIlex), while their products are typically wafers based on their customers design, employing such enabling technologies.

3 Research and Innovation Priorities

EU stakeholder input has been gathered at VWA workshops to identify major gaps and prioritize relevant actions. In XR chips and components enabling technologies by far the widest gaps have been seen in "deep-submicron CMOS process nodes" and "design capabilities". These are followed by "photonics/optics" and "test/characterization". This correlates conspicuously with the result in XR chips and components themselves, where those for "processing/computing" have received highest priority, followed by "sensors", and further on "optics" and "displays".

3.1 Edge-AI processing for wearable XR: Sovereign EU access to leading-edge microelectronics

The most prominent gap and lack of sovereign EU supply in XR chips and components is in highly energy-efficient EdgeAI-capable processing, exhibiting ultra-low power consumption for wearable devices and applications. This requires combined efforts in EU-based access to advanced deep-submicron CMOS process technology and their design enablement, as well as the design capabilities for processors, memories, AI accelerators and connectivity.

Research and Innovation Priorities:

- Develop CMOS process technologies early accessible by EU foundries and IDM as well as IC design houses in the range 5..20nm.
- Research new processor and memory architectures enabling edge-AI inference capable performance at average power consumption <20mW.
- Develop chiplets and monolithic IC combining processing with sensing and actuating, as well as photonic and optic components, to achieve high-performance, ultra-low latency, very low power consumption, at lowest form-factor, and reduced production cost.
- Set and maintain power efficient and small-footprint wired and wireless connectivity interface standards

3.2 Multi-domain sensing for user-interaction

Advanced sensing is a cornerstone for enabling truly user-centric and context-aware XR experiences in Virtual Worlds. Beyond visualisation and computing, the quality, naturalness, and trustworthiness of interaction increasingly depend on the device's ability to perceive both the user and their surrounding environment across multiple sensory domains, while remaining unobtrusive, energy-efficient, and privacy-aware. Future XR systems must therefore integrate a heterogeneous set of sensors that operate across spatial, physiological, and environmental modalities, enabling real-time understanding of user intent, state, and context. In wearable XR devices, sensing and rendering must be tightly coupled with local processing at the edge to minimise latency, power consumption, and dependency on cloud infrastructures, and allow for local data abstraction/realisation and high-level concept manipulation. This is particularly critical for continuous interaction loops such as head and body tracking, eye and gaze monitoring, gesture recognition, and environmental mapping, but also for emerging modalities such as vital signs, affective states, or multispectral perception that extend human senses. Achieving this at scale requires coordinated innovation in sensor hardware, system integration, data fusion, and interface standardisation, alongside strong safeguards for data privacy and user autonomy aligned with European values.

Research and Innovation Priorities:

- Unobtrusive low-power and ultra-compact sensing and rendering of a) 3D environment and b) user body movement (head, gaze, gait,...)
- Multi-domain (e.g., bio/vital signs, visual, audio, smell, taste, vestibular,...) and multi-spectral sensing (e.g., visible, infrared, UV, X-ray,...); set standards in multi-domain sensor interfaces
- Concern user sensor data privacy and data security and protection, i.e. edge data processing and analysis at no or sparse cloud connection

3.3 Design

Design plays a pivotal role in translating technological capabilities into scalable, interoperable, and sovereign XR hardware ecosystems. As XR devices integrate an increasing number of heterogeneous chips, sensors, optics, and actuators within extremely constrained form factors, design choices become decisive for performance, energy efficiency, manufacturability, sustainability, and user trust. Beyond individual components, XR design must therefore be approached at system level, considering co-design across hardware, software, and data flows. In the context of Virtual Worlds, design is also a strategic lever for reducing non-European dependencies and strengthening supply-chain resilience. This includes architectural decisions that enable modularity, chiplet-based integration, and standardized interfaces, as well as design methodologies that support interoperability between components from different vendors. At the same time, design must explicitly embed European values, including privacy-by-design, long-term sustainability, and lifecycle awareness, from material selection to recyclability and end-of-life considerations. To keep pace with the rapid evolution of XR technologies and use cases, future design practices must be supported by open reference architectures, digital twins, and shared design frameworks spanning the XR value chain. Such approaches are essential to lower entry barriers for SMEs, accelerate innovation cycles, and ensure that European XR hardware platforms remain adaptable, secure, and globally competitive.

Research and Innovation Priorities:

- Design for sovereign ecosystem and supply chain, avoid non-EU dependencies
- Ultra-low power consumption, sustainable and recyclable materials
- Define IP for standard interfaces between components for interoperability and accessibility
- Open-source multi-purpose reference designs, privacy-by-design
- Setup digital twins across XR hardware components

3.4 Optics and Displays

Optics and display technologies form the primary interface between users and Virtual Worlds and are therefore central to immersion, usability, and long-term acceptance of XR devices. Visual performance directly affects user comfort, task efficiency, and social interaction, while constraints on size, weight, energy consumption, and transparency place exceptional demands on component design and integration. Advancements in optics and displays are thus decisive enablers for transitioning XR from specialised professional applications toward scalable consumer and everyday-use devices. Next-generation XR systems require a tight co-evolution of microdisplays, photonics, and optical elements to deliver high resolution, wide field-of-view, large eyebox, and realistic brightness and colour reproduction, while maintaining ultra-low power consumption and lightweight, wearable form factors. At the same time, optics and displays increasingly act as integration platforms for sensing and actuation, supporting eye tracking, environmental perception, and multi-modal interaction directly within the optical path. From a strategic perspective, optics and display technologies represent a significant opportunity for Europe. Unlike advanced logic manufacturing, strong European capabilities already exist across optical materials, photonics, microdisplay R&D, and precision manufacturing. Leveraging and scaling these strengths through closer integration with microelectronics and microsystems technologies is essential to establish sovereign, end-to-end value chains for XR devices. Coordinated research and innovation efforts are therefore required to converge fabrication platforms, improve system-level efficiency, and ensure that European optics and display solutions remain competitive, interoperable, and aligned with European values of sustainability, openness, and user trust.

Research and Innovation Priorities:

- Converge photonics and optics fabrication process technologies with microelectronics and microsystems technologies, extend to 300mm wafer and >300mm panel-level platforms to gain from smaller feature sizes and higher productivity
- Develop lightweight, prescription-compatible, highly efficient optics (>50%), large eyebox and field-of-view (>70°) and ultra-low power photonics (<10mW) components, enabling very high resolution (>10kdpi) for small/inexpensive microdisplays chips sizes, while maintaining high optical transparency >85% for face-to-face social interaction through smart glasses
- Embed visual and non-visual sensing and actuation into optics and display components

Conclusion and Outlook

Virtual Worlds and XR technologies are emerging as critical enablers for Europe's future competitiveness, productivity, and societal resilience across industrial, professional, and consumer domains. As demonstrated throughout this position paper, their success depends fundamentally on access to advanced, energy-efficient, and user-centric XR chips and components tailored to wearable form factors, edge intelligence, and multimodal interaction. While Europe holds strong positions in key enabling technologies, such as photonics, optics, sensors, and microsystems, it continues to face strategic dependencies in advanced processing, design, and large-scale system integration.

To address these gaps, Europe must act decisively. Fragmented technology development and isolated component innovation are no longer sufficient. XR hardware requires coordinated, system-level research and industrialisation spanning processing, sensing, optics, connectivity, power management, and actuation, with privacy, sustainability, and trust embedded by design. Without a concerted effort, Europe risks losing control over critical XR value chains that will underpin future digital economies and platform ecosystems.

The creation of an "XR chips & components pilot-line", building on and complementing existing EU Chips Act pilot-line infrastructures, is therefore a strategic necessity. Such a pilot-line would provide Europe with an integrated environment for design, fabrication, integration, testing, and validation of XR-specific chips and components, accelerating technology transfer from lab to market while reducing industrial risk. It would directly support SMEs, strengthen interoperability and standardisation, and enable sovereign, end-to-end XR hardware value chains rooted in Europe. We consider this best achieved by addressing pilot-line target TRL of 6 to 8.

The window for action is limited. As global investments in XR and AI hardware accelerate, Europe must move now to secure its technological sovereignty and shape XR systems that reflect European values. Establishing an XR chips & components pilot-line should be recognised as a core pillar of Europe's Virtual Worlds strategy and a concrete next step under the EU Chips Act to ensure that Europe is not only a user, but a global architect of future Virtual Worlds.