OECD
Global Forum
on Technology

Technology deep dives
Immersive technologies

Key messages

- **Transforming reality:** Immersive technologies enable digital experiences that are more interactive, engaging and realistic, with a greater degree of sensory immersion and spatial interaction, than other online experiences.
- **A range of applications:** While entertainment applications are the most advanced, immersive technologies have important use-cases in health, industry, education and training.
- **Responsible, values-based and rights-oriented technology:** Immersive technologies are associated with potential risks for privacy, security and online safety, including for children.
- **Contributing to sustainable development:** Immersive technologies can be leveraged to help global sustainability goals but like other digital technologies, they could have environmental impact throughout their life cycle, including through increased energy use and e-waste.
- **Technology divides:** Immersive technologies could let more people access experiences that are otherwise expensive, dangerous or out of reach. However, immersive technologies also rely on enablers that are not evenly distributed, especially connectivity and computational power. A small number of players currently account for most virtual reality hardware sales.

Understanding immersive technologies

Immersive technologies aim to create digital experiences that are more interactive, engaging and realistic, with a greater degree of sensory immersion and spatial interaction, compared with other online experiences. A hallmark of some immersive technologies is that they integrate with and blur the boundaries between digital and physical experiences.

Immersive technologies differ in the use cases and the experiences they offer. Virtual reality (VR) describes computer-generated simulations of three-dimensional environments where users with connected devices like headsets, goggles, or gloves can interact with the environment and with one another. Other immersive technologies, like mixed or augmented reality, allow users to see and hear the physical world with a digital layer, and often integrate digital objects seamlessly into real-world contexts. For example, in medical training, mixed reality can simulate surgical procedures by overlaying virtual anatomy over a physical training mannequin.

Advancements in computing capabilities, artificial intelligence-enabled computer vision and photogrammetric techniques widen the applications of immersive technologies, including their potential economic and social effects. These advancements correlate with significant increases in venture capital investments in virtual and augmented reality start-ups, which passed USD 12 billion in 2021, a more than fivefold increase since 2016 (Figure 1).

Emerging benefits and applications of immersive technologies

By simulating reality, augmenting perceptions of physical reality, and providing a greater degree of sensory immersion and spatial interaction, immersive experiences offer advantages over both traditional online experiences and physical experiences.

Immersive technologies can provide more realistic training and education experiences than traditional two-dimensional online training, and can substitute for physical experiences that are otherwise costly, dangerous, impossible or impractical. For example, virtual reality provides a safer, controlled, cheaper, repeatable, and reproducible environment, which has been found to be effective for mental health treatments that reduce anxiety and treat phobias.

Immersive technologies can also enable new forms of social interaction. Social virtual reality platforms where users can connect and share virtual activities and experiences, such as concerts and movies, already exist. In workplace settings, immersive technologies can facilitate more realistic and engaging virtual meetings and conferencing.

In industrial contexts, immersive technologies can support dynamic virtual versions of physical places or objects, known as "digital twins". These digital twins can model complex systems, to enable dynamic, real-time design and collaboration. For example, they can enable distributed workforces to co-design complex equipment and experiment with potential product changes before execution.

Potential policy implications

While immersive technologies are rapidly maturing, their potential policy implications are slowly coming into focus. These and other issues will be discussed in the forthcoming OECD Digital Economy Outlook 2024. These include, in particular, concerns around privacy and online safety – especially of vulnerable groups such as children – which may also impact the trust needed for broader uptake. Unlike other digital experiences, some immersive technologies enable, and can sometimes rely on, the collection of data that is largely non-voluntary and difficult for users to control, like pupil dilation. One estimate from the Stanford Virtual Human Interaction Lab found that 20 minutes in a VR simulation result in almost 2 million unique recordings of body language. Research further highlights that users can be uniquely identified with almost 95% accuracy with just 100 seconds of VR data. Meanwhile, the sensory, realistic and immersive nature of these technologies heightens the effect of exposure to inappropriate content, notably for children.

Some predict that immersive technologies will soon dominate most online experiences. However, there are currently few players in some immersive markets. For example, 90% of VR headsets available today are sold by just two companies. To encourage competition and avoid lock-in, it could become increasingly important to enable firms and consumers to easily switch between different immersive technology providers and environments. Common standards for applications in immersive environments, from digital twins to 3D assets, might encourage interoperability and help in this regard.

Ensuring benefits can be realised depends on the diffusion and uptake of immersive technologies. As with other emerging digital technologies, immersive technologies rely on key enablers like connectivity and computational power that are not evenly distributed. As with other technologies, we are on the cusp of understanding the net impact of immersive technologies on sustainability and climate change. For example, while digital twins show promise in reducing industrial energy use and greenhouse gas emissions, immersive technologies have other environmental impacts throughout their life cycle, including e-waste and energy use.

Source: (OECD, forthcoming) OECD Digital Economy Outlook 2024

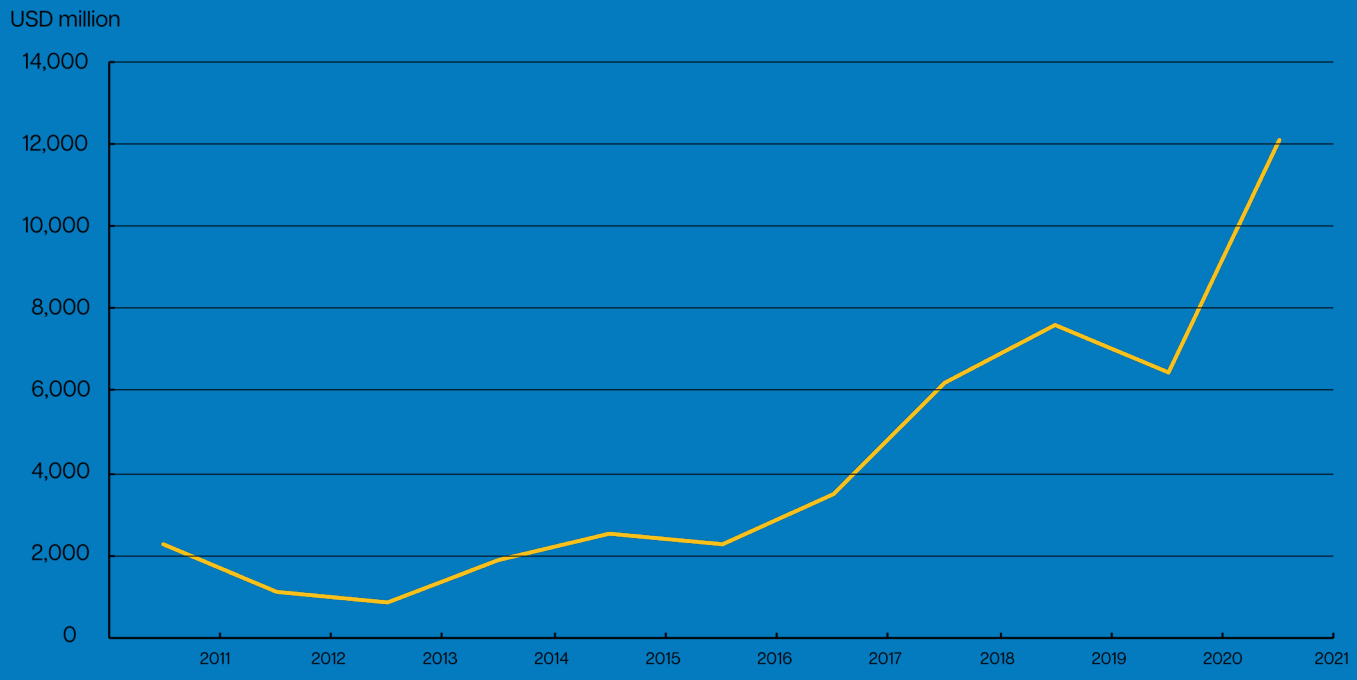
Questions for discussion

- Which technical developments might unlock broad uptake and further development of immersive technologies?
- Which immersive technologies applications show most promise for societies and economies? What are key risks to prepare for?
- How can policy help to realise the benefits and mitigate the risks of immersive technologies?

The Global Forum on Technology inaugural event will take place on 6 June 2023 under the theme "Shaping our future at the tech frontier".

Learn more at **http://oe.cd/gftech**

Figure 1. Worldwide venture capital investment in virtual reality (VR) and augmented reality (AR) start-ups, 1996- 2021



Source: OECD calculations based on Preqin (2023), https://pro.preqin.com