May 3, 2021

The Honorable Charles E. Schumer
Majority Leader
U.S. Senate
322 Hart Senate Office Building
Washington, D.C. 20510

The Honorable Todd C. Young
Committee on Commerce, Science,
 and Transportation
U.S. Senate
185 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Senator Schumer and Senator Young:

On behalf of the undersigned organizations and universities, thank you for your commitment to solidifying the United States' leadership in scientific and technological innovation through the Endless Frontier Act. Collectively, our institutions play a vital role in advancing technology at every stage, from research and development to production and adoption. We are in complete agreement with you that the United States must increase its investment in the technologies of the future in order to ensure its role as the global leader of the 21st century. We are at the threshold of a Fourth Industrial Revolution in which the physical, digital and biological worlds will merge, impacting all disciplines, economies and industries.[1] We firmly believe immersive technologies will be at the forefront of this transformation.

The Endless Frontier Act (EFA) is a visionary bill that rightly identifies as priorities key technology focus areas like artificial intelligence, robotics, and advanced communications, among others. Yet these technologies should not be thought of as separate and independent. The technologies of the Fourth Industrial Revolution are interconnected – and the U.S. approach to research and development should reflect and foster that symbiosis. Our focus must be on the future technology ecosystem as a whole.

Immersive technologies (virtual reality [VR]; augmented reality [AR]; and mixed reality [MR] – collectively known as "XR") are a key part of this ecosystem, and are closely tied to the development of many of the technology focus areas highlighted in the EFA. Immersive technologies will play a preeminent role in achieving our national goals related to economic competitiveness, domestic manufacturing, national security, healthcare, agriculture, transportation, education, and workforce development. They will stimulate and support advanced development in other critical technology fields as well. What's more, the time is ripe

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[1] Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, first introduced the phrase "Fourth Industrial Revolution" in a 2015 article published by *Foreign Affairs*. Previous industrial revolutions liberated humankind from animal power, made mass production possible and brought digital capabilities to billions of people. This Fourth Industrial Revolution is, however, fundamentally different. It is characterized by a range of new technologies that are fusing the physical, digital and biological worlds, impacting all disciplines, economies and industries, and even challenging ideas about what it means to be human. (see https://www.weforum.org/pages/the-fourth-industrial-revolution-by-klaus-schwab).

as U.S. rivals are already investing heavily in XR. Some, like China, have even developed national strategies to support its growth and adoption. As a transformative technology in its own right and natural member of the cohort of technologies highlighted in the bill, immersive technology should be included in the Endless Frontier Act.

To better understand the symbiosis between immersive technologies and other technologies highlighted in the EFA, we can look to the powerful relationship between VR and artificial intelligence (AI) as an example. Recently, major advances have been made to bring VR and AI together to create a single form of technology that offers seemingly endless possibilities. Through AI, researchers improve simulations by endowing artificial agents with complex rules that emulate human behavior. Likewise, immersive technologies are helping to advance AI. Looking to the evolution of human cognition, researchers posit that immersion of advanced AI agents in virtual worlds - exposing them to essential, real-world conditions and large numbers of human users with whom they must interact - is the special ingredient needed to bring AI to the next level. Indeed, scientists assert that VR may in fact trigger an evolutionary leap in AI.[2]

The synergistic effect of immersive technologies is not limited to its relationship with AI. XR is a key part of the new-generation information and communications technologies ecosystem and will play an important role in driving the transformation and upgrade of core components, extensive smart devices, network transmission devices, cloud computing devices, telecommunications services, and software. The development of XR itself is also inextricably bound to near-eye display, rendering processing, spatial computing, perception and interaction, and network transmission. Even 5G will be impacted. The ultra-high bandwidth, ultra-low latency, and ultra-high mobility of 5G enable the advanced the immersive experience. As XR becomes a key area of 5G commercial use, 5G technology will improve to meet its requirements.

U.S. allies and adversaries alike have recognized the outsized potential of immersive technology. In particular, China has taken impressive steps towards controlling XR's future. XR is featured prominently in the Made in China 2025 strategy, and the Ministry of Industry and Information Technology, the National Development and Reform Commission, the Ministry of Science and Technology, the Ministry of Culture, and the Ministry of Commerce have all developed detailed strategies concerning XR. In addition, Chinese provincial and municipal local governments are proactively building industrial parks and labs to promote the development of local VR industries.[3] These developments further demonstrate the importance of U.S. investment in XR. Technology reflects the culture and values of the people who create it, and U.S. leadership in this area will ensure immersive technology is used to advance an open and flourishing society. Although the EFA requires the list of 10 key technology focus areas to be reviewed and refreshed every three years, the time is now to include immersive technologies. Whoever dominates this grand fourth computing platform will enjoy irrefutable technology primacy because it will unleash the prosperity of thousands more companies in its ecosystem, along with

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[2] "Artificial Intelligence and Virtual Worlds – Toward Human-Level AI Agents," Vladimir M. Petrović, Institute of Electrical and Electronics Engineers (IEEE), 2018. Available at
https://www.goldmansachs.com/insights/pages/virtual-and-augmented-reality.html
[3] "Virtual Reality/Augmented Reality White Paper," China Academy of Information and Communications Technology (CAICT), 2017. Available at: https://www-file.huawei.com/-/media/corporate/pdf/ilab/vr-ar-en.pdf

countless new ideas that were not possible before its arrival. Because of the magnitude and ubiquity of immersive technologies' coming impact, as well as its synergistic effect on the development of the adjacent technologies named in the EFA, we urge you amend the bill to read as follows:

"(2) KEY TECHNOLOGY FOCUS AREAS.—

"(A) INITIAL LIST.—The initial key technology focus areas are—

 (vi) advanced communications **and immersive** technologies

For an extended discussion of the points raised above, please find attached a white paper published by the XR Association titled, "The Integrated Technology Landscape of the Future and Synergistic Effect of Immersive Technologies."

Our organizations and universities look forward to working with Congress to secure America's role as the leader in shaping the future technology landscape, and to ensure critical technologies like XR are developed and adopted in line with American values for the betterment of society. Thank you for considering our views and recommendations on this important issue.

Sincerely,

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Sen. Susan Collins	Sen. Gary Peters
Sen. Chris Coons	Sen. Rob Portman
Sen. Steve Daines	Sen. Mitt Romney
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