

The e-REAL's Time Traveling Immersive Experience Towards a Net-Zero Greenhouse Gas Emissions Economy

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Abstract—The European Union aims to be climate-neutral by 2050—an economy with net-zero greenhouse gas emissions. RSE carries out research in the field of electrical energy with special focus on national strategic projects supported through the Fund for Research into Electrical Systems. The activity covers the entire supply system with an application-oriented, experimental, and system-based approach. The e-REAL's time travelling immersive experience is based on RSE's know-how and allows interactive and immersive experiences that are a powerful way to cascading relevant communication and fostering people's awareness about the European Union targets.

Keywords—immersive experience, interactive visualization, communication of science

1 Time traveling towards a climate-neutral society

The European Union aims to be climate-neutral by 2050—an economy with net-zero greenhouse gas emissions. This objective is at the heart of the European Green Deal and in line with the EU's commitment to global climate action under the Paris Agreement. The transition to a climate-neutral society is both an urgent challenge and an opportunity to build a better future for all. All parts of society and economic sectors will play a role—from the power sector to industry, mobility, buildings, agriculture, and forestry.

The European Union is leading the way by investing in technological solutions, aligning actions in key areas such as industrial policy, finance, and research, while ensuring social fairness for a just transition. Italy, as a leading European country, has been working towards ensuring the widest possible use of instruments that, together, serve to enhance energy security, environmental protection, and the affordability of energy, thus contributing to European objectives relating to energy and the environment. To reach these results, the Italian company RSE—a publicly controlled entity headquartered in Milan—co-designed with the Instructional Design Team from

Logosnet and the e-REAL Multimedia Graphic and Software Engineering Teams an immersive and interactive experience based on a time travel “machine”—created by an e-REAL portable lab—towards a climate-neutral society, in order to foster different communication campaigns.

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2 Communication of science and immersive experiences within e-REAL

Communication of science is a process based on distilling technical information about science-related topics into understandable messages and stories for public consumption. It is a field concerned with bridging the gap between scientists and a general audience thanks to a multi-faceted form of communication that spans scientific fields such as the hard sciences, physical sciences, technology, health, environmental science, and more.

The e-REAL science communication professionals leverage their understanding of complex scientific topics, along with strategic communication and storytelling principles, to craft compelling and informative content about science and related disciplines. This combination of industry knowledge and practical communication skills advances the public's understanding of quite complex topics and issues.

To enhance the communication of science, Logosnet developed e-REAL[®], which is both a phygital technology for immersive and interactive experiences and a cloud-based platform for interactive communication [1, 2]. Since 2011, Logosnet has developed a number of projects in advanced simulation, virtual reality, online and lifelong learning, and interactive communications. e-REAL develops 3D scenarios, interacting with visitors in a natural way, with no need of helmets, glasses, or any kind of visors. Thanks to proximity sensors, visitors interact with virtual elements of the scenario with just a flick of the hands or by gesture shaping. Eye-catching interactive infographics disclose new ways to cascading science and technology related information to the general public.

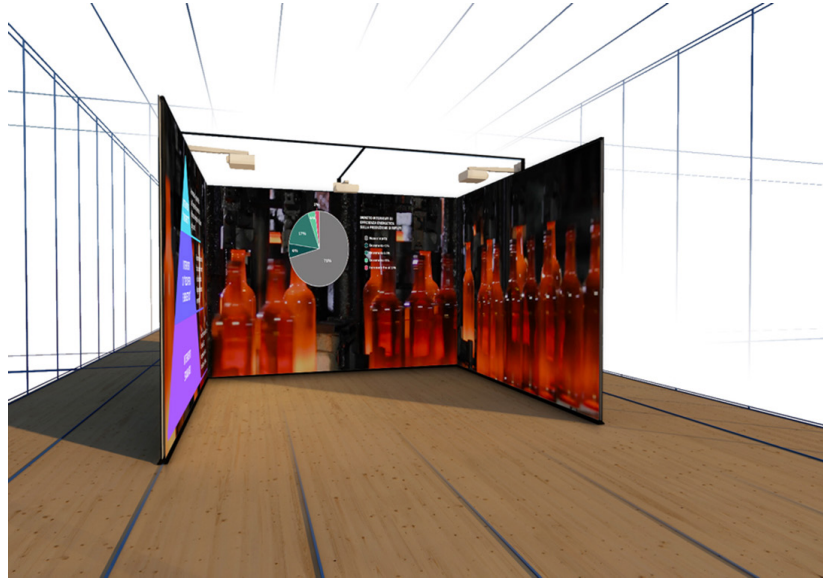


Fig. 1. Rendering of the e-REAL portable pop-up for the RSE immersive and interactive experience regarding time travelling toward a climate-neutral society: infographics are interactive and responsive by gesture shaping



Fig. 2. Immersive and interactive e-REAL infographics, distributed on 3 walls

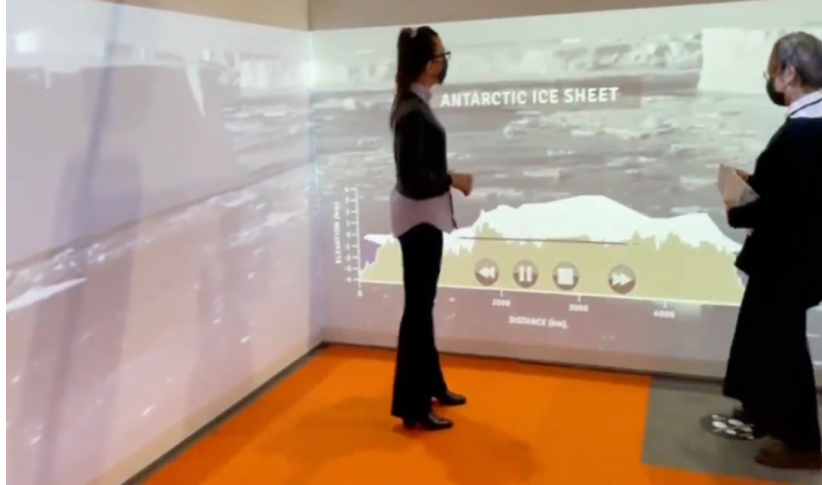


Fig. 3. Another e-REAL infographic, immersive, and interactive

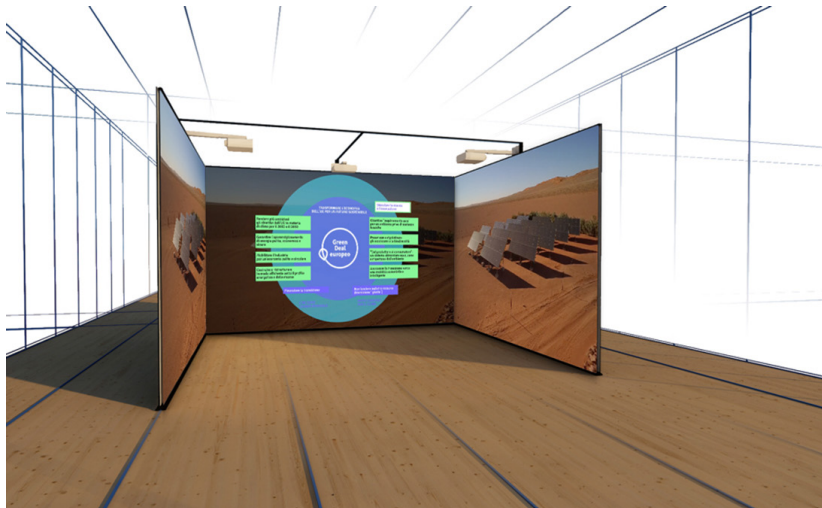


Fig. 4. Rendering of an interactive infographic with immersive videos on the side walls

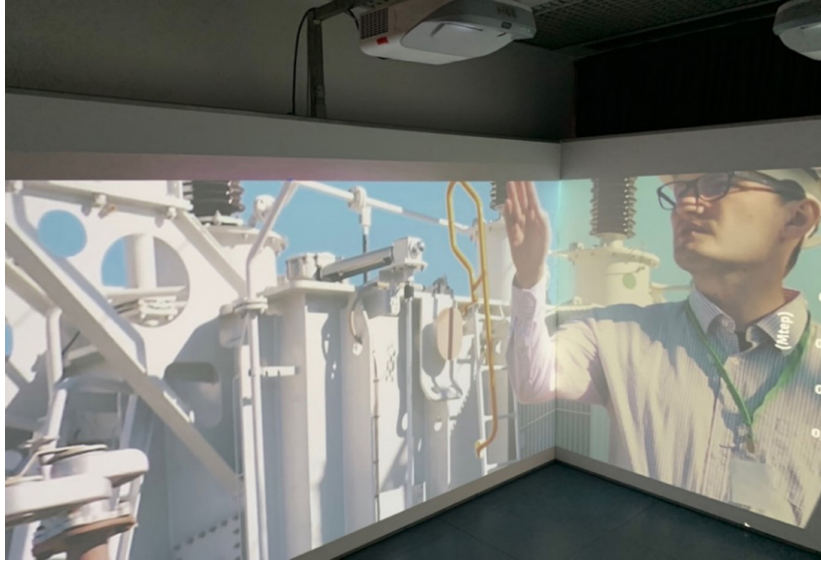


Fig. 5. Immersive video with content displayed on the three e-REAL walls



Fig. 6. Interactive e-REAL puzzle about the carbon footprint

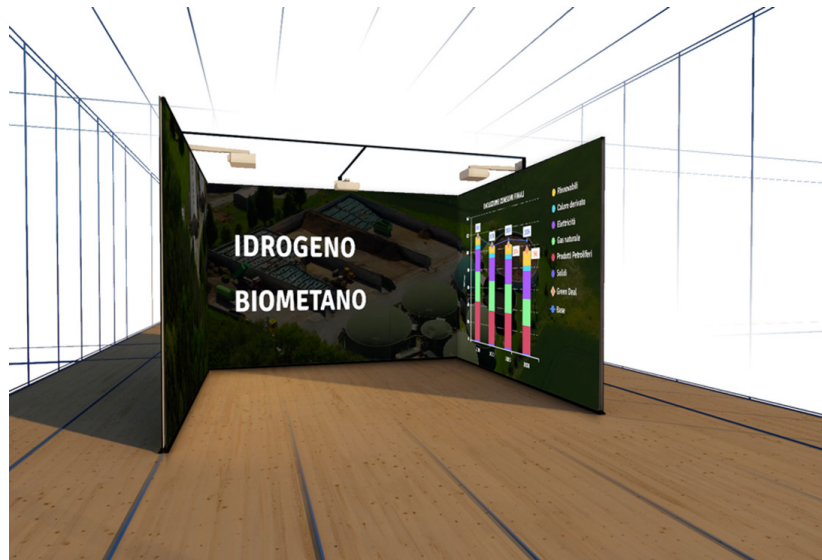


Fig. 7. Rendering of an e-REAL immersive video with an infographic on a side wall

Developing a communication based on the time travelling metaphor, the audience is engaged with an immersive and interactive experience in the years 2020, 2030, and 2050, and along 3 axes: Energy consumption trends, European Union and Italian public policies, and available technologies to reduce the carbon footprint. The audience may take the decision to travel from 2020 till 2050 or to explore only one or two time's periods. Another choice to take by the audience, within each time's period, is about the focus: energy consumption and/or public policies and/or technologies and production processes.

The setting of the portable e-REAL pop-up is designed around 3 key words: visualization, interaction, immersion. It is a fully immersive and multitasking environment, designed to help untangle complexity: the visualization of information enables the audience to gain insight and understanding quickly and efficiently. Examples of such visual formats include sketches, diagrams, images, objects, interactive visualizations, information visualization applications, and imaginary visualizations such as in stories. Visualizations within e-REAL show relationships between topics, activate involvement, generate questions that learners didn't think of before and facilitate memory retention. So visualizations act like concept maps to help organize and represent knowledge in an effective way [3–9].

From a visual storytelling perspective, the main scenarios related to this time travelling adventure are the following:

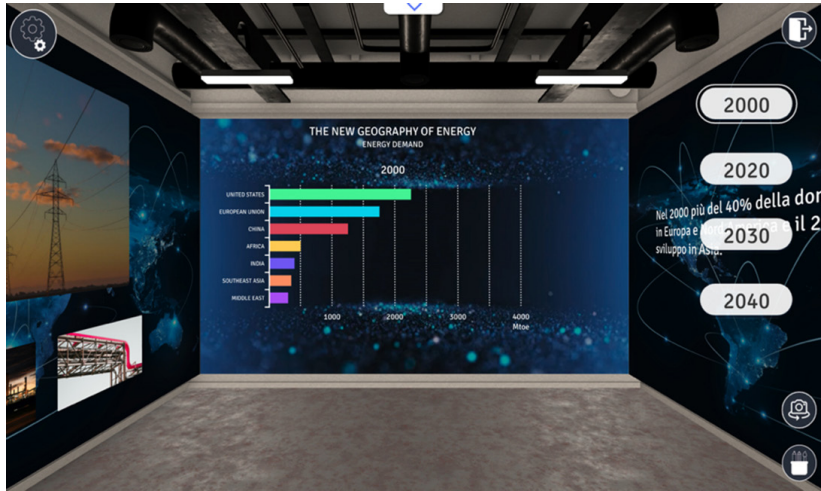


Fig. 8. Energy consumption trends in 2000: e-REAL interactive infographics



Fig. 9. Energy consumption trends in 2030: e-REAL interactive infographics

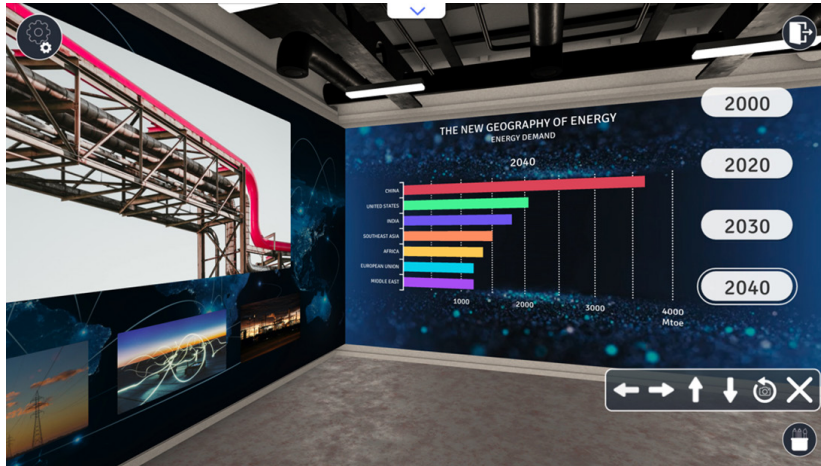


Fig. 10. Energy consumption trends in 2040: e-REAL interactive infographics

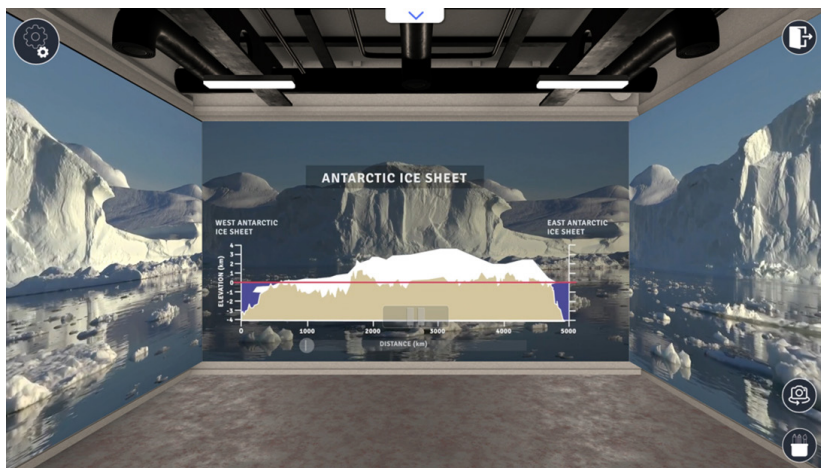


Fig. 11. Consequences of climate change: e-REAL interactive infographics

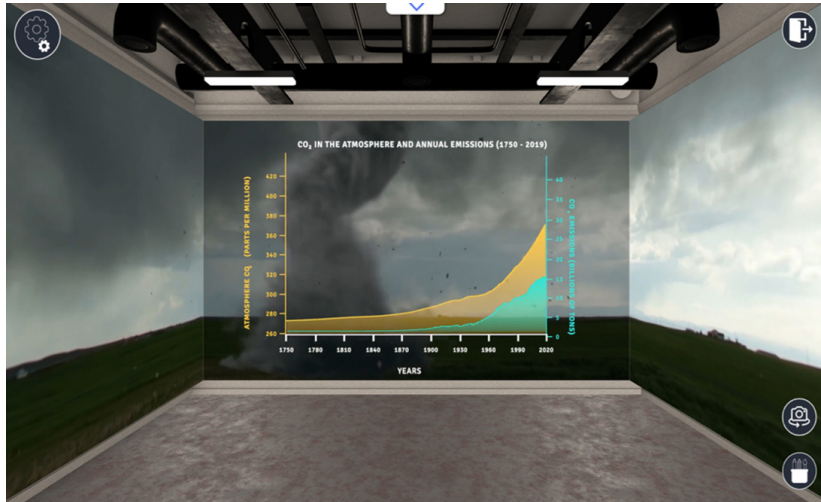


Fig. 12. CO₂ trends: e-REAL interactive infographics

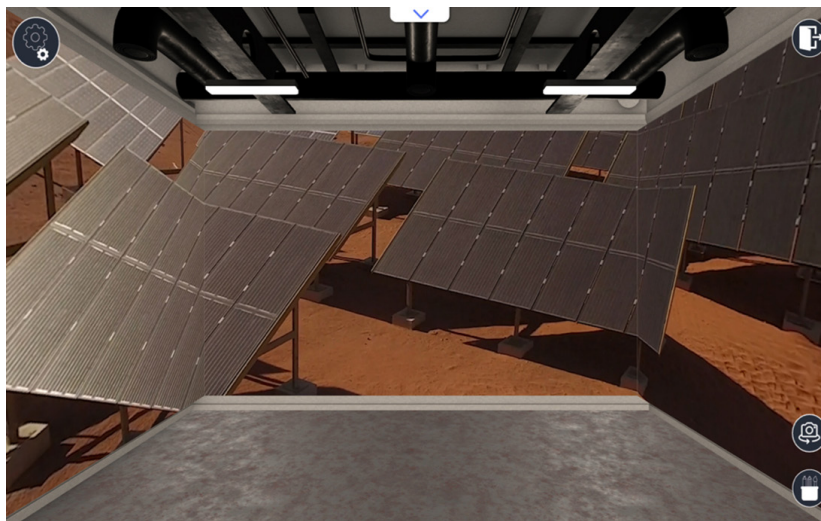


Fig. 13. Available technologies: e-REAL immersive video



Fig. 14. European Union and Italian policies: e-REAL interactive infographics



Fig. 15. 4.0 digital revolution and 5.0 society trends: e-REAL immersive video



Fig. 16. e-REAL interactive infographics about the main trends regarding renewable energies, energetic efficiency, emissions

All the scenarios are designed according to the visual thinking paradigm that, according to Rudolph Arnheim, implies that all thinking—not just thinking related to art—is basically perceptual in nature and that the dichotomy between seeing and thinking, or perceiving and reasoning is misleading [10]. Furthermore, all the scenarios are compliant with the guidelines shared by the experts from the multimedia graphics and computer vision fields that are interdisciplinary areas that deal with digital images or videos, audio clips, photographs, 3D models, volumetric data. Last but not least, all the scenarios are designed to provide an advanced simulation experience that is a highly realistic imitation of a real-world object, process or system. This type of experience encourages audience to cross conceptual and theoretical boundaries with the help of simulation or game based tools. It is one of the most promising methods for STEM education and communication of science and technology.

The e-REAL setting offers a unique user experience, a combination of visual communication and direct interaction with the content—by gesture shaping or spoken commands—immersing the audience in an entirely interactive ecosystem. Visual storytelling techniques are part of the simulation scene, to represent a realistic context where learners are proactively involved to analyze scenarios and events, to face technical issues, to solve problems. Effective visualization is the key to help untangle complexity: the visualization of information enables learners to gain insight and understanding quickly and efficiently. The most effective learning occurs when being immersed in a context: realistic experience is lived and perceived as a focal point and as a crossroad [11].

The richness of the mental model relates to the completeness of multiple channels of sensory information, meaning the more those senses work in alignment, the better. The richness also depends on having a cognitively demanding environment and a strong and interesting narrative. Cognitively demanding environments in which players must focus on what's going on in the game will occupy mental resources. The richness of the mental model is good for immersion, because if brain power is allocated to understanding or navigating the world, it's not free to notice all of its problems or shortcomings that would otherwise remind them that they're playing a game. Finally, good stories—with interesting narratives, credible because intrinsically congruent as much as possible— attract attention to the game and make the world seem more believable. They also tie up those mental resources.

Turning to game traits related to consistency, believable scenarios and behaviors in the game world means that virtual characters, objects, and other creatures in the game world behave in the way in which the audience expects. Usually game developers strive for congruence among all the elements. The audience is challenged both cognitively and behaviorally in a fully immersive and multitasking learning environment, within interactive scenarios that usually also present a wealth of information. The many levels of the situation are made available simultaneously, by overlaying multisource—words, numbers, images, etc.—within an environment designed by AR techniques based on the overlaying of multiple information. e-REAL submerges the audience in an immersive reality where the challenge at hand is created by sophisticated, interactive computer animation. Importantly, the system includes live and real time interaction on a peer-to-peer basis. Thus, it adds a very important social component and leaves the audience with a memorable experience.

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