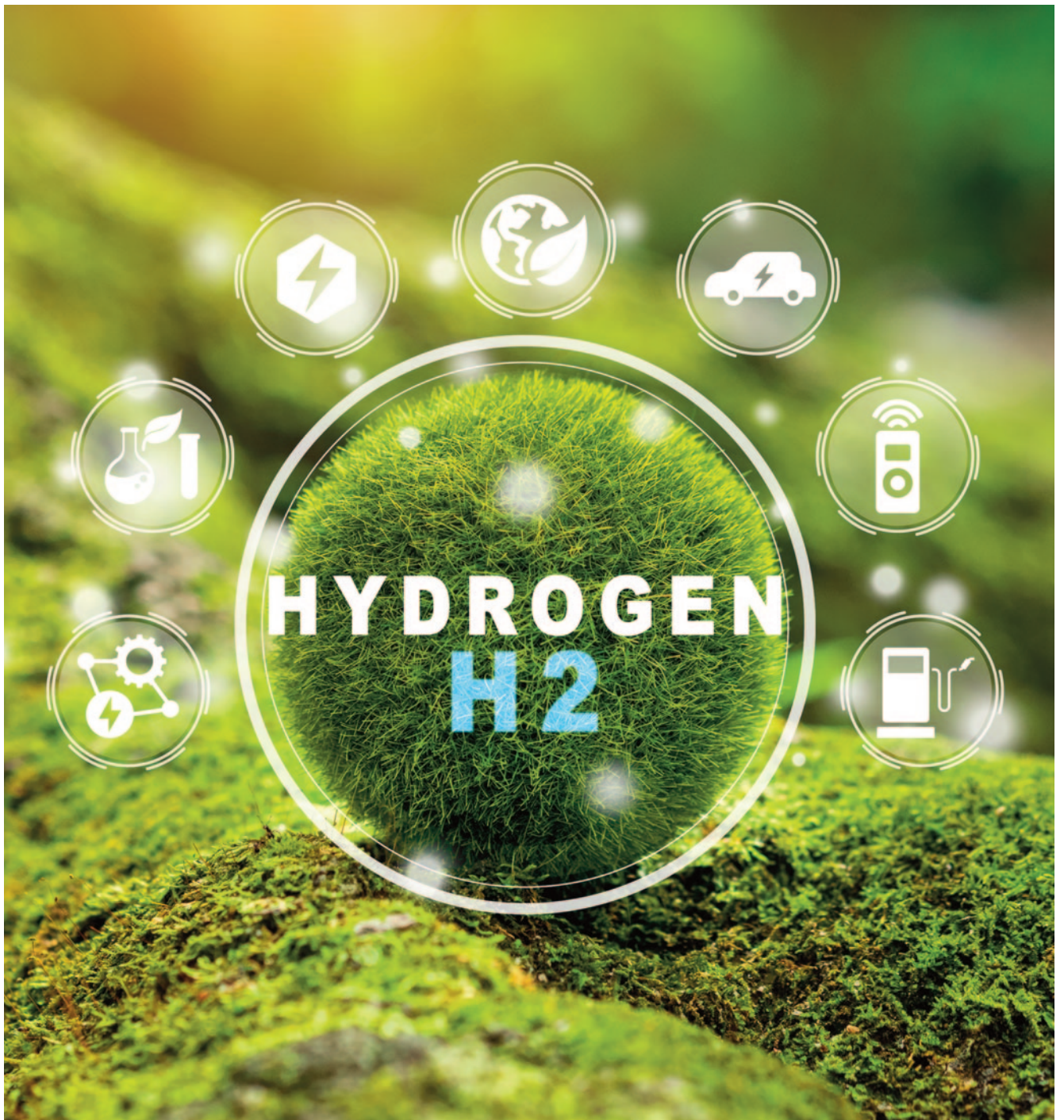


Introduction

“Energy is essential for development, and sustainable energy is essential for sustainable development”
Tim Wirth¹



In recent decades, the world's population has grown dramatically. By mid-November 2022, the world's population had reached eight billion, more than three times the number of people in the middle of the 20th century, and a quarter of this increase has taken place in the last 25 years (in the last decade alone this increase was 11.3%)². This demographic growth has been accompanied by a growth in economic development which has been spurred by increased industrialization. Both elements have significantly intensified the demand for energy. Specifically, in the last 25 years, total consumption³ of primary energy⁴ grew by 57.8% (in the last decade, the increase amounted to 14.4%, with around 80%⁵ of total global demand being met by fossil fuels: coal, oil and natural gas).

This increase in energy consumption presents a set of challenges that need to be addressed, including global concern about the impact that energy production and consumption can have on climate change. According to the United Nations⁶, fossil fuels, such as coal, oil and gas, are by far the biggest contributors to global warming, generating more than 75% of total global greenhouse gas emissions and nearly 90% of all carbon dioxide emissions. Another important challenge to be addressed is the impact of energy production and consumption on the environment due to air and water pollution processes, land use, the need for large areas for the installation and operation of power plants, or waste management, among other reasons⁷. Renewable energies, which contribute decisively to mitigating this impact on climate, are not exempt from producing potentially adverse environmental impacts (potential extensive use of land, impacts on flora and fauna, etc.).

In addition, they present challenges in terms of the accumulation and storage of the energy produced, due to the variability of generation. Finally, the current energy mix poses a geopolitical challenge for countries dependent on fossil fuel energy that do not have such natural resources, which could jeopardize energy security⁸.

As a result of the aforementioned circumstances, the need to identify additional energy sources to transform the energy mix has grown, with the intended effect being the mitigation of the adverse consequences stemming from the production, transportation and use of energy. In this sense, renewable energies (excluding hydroelectric generation) are the ones that have had the greatest growth in electricity generation. Electricity production through renewable energies has increased more than 18-fold since the beginning of the 21st century, and although not all geographical areas have seen the same growth (see Figure 1), globally, renewable energies accounted for 14% of electricity production in 2022, surpassing nuclear energy, which accounted for 9%. However, coal and gas still remain the largest energy sources, accounting for 35% and 23% of production, respectively⁹.

In this context, hydrogen, a commonly consumed gas in industrial processes, is becoming very important because of its ability to act as a decisive energy carrier (as it can be used to store and transport energy for later release). Recent studies¹⁰ indicate that 60% of emission reductions could come from

renewable generation combined with green hydrogen¹¹. Therefore, there is a consensus on the key role that green hydrogen can play in accompanying this energy transition, enhancing the integration of renewable energies themselves or even acting as a decarbonization solution in some sectors (transport, industrial processes, etc.). The development of green hydrogen is an accelerator for the hydrogen sector in general and is not incompatible with the future incorporation of other types of hydrogen, such as white hydrogen. The creation and expansion of transport infrastructure, market development, industry transformation, and adaptation of consumption patterns around green hydrogen are not only perfectly compatible with white hydrogen, but could also converge synergistically.

This publication aims to provide an understanding of hydrogen by explaining its different types as well as its value chain and key challenges, and by analyzing a case study that illustrates in a practical way how analytical tools can be leveraged to address some of the challenges involved in its adoption process, such as the selection of optimal sites for developing new projects.

¹Timothy Endicott Wirth, a Harvard graduate with a PhD from Stanford, he served in the U.S. House of Representatives and the U.S. Senate. He was Secretary of State for Global Affairs during the Clinton administration. From 1998 to 2013, he was president of the United Nations Foundation, and currently serves on its board of directors.

²Source: United Nations "2022 Revision of World Population Prospects".

³Energy Institute: Statistical review of world energy 2022.

⁴Primary energy: energy from renewable and non-renewable sources that has not undergone any conversion or transformation process (RAE).

⁵Source: U.S. EIA "International Energy Outlook 2021 (IEO2021)".

⁶Source: United Nations. Renewable energies: energies for a more secure future. Retrieved from <https://www.un.org/es/climatechange/raising-ambition/renewable-energy>.

⁷IPCC, "Special Report on global warming of 1.5°C" (2019).

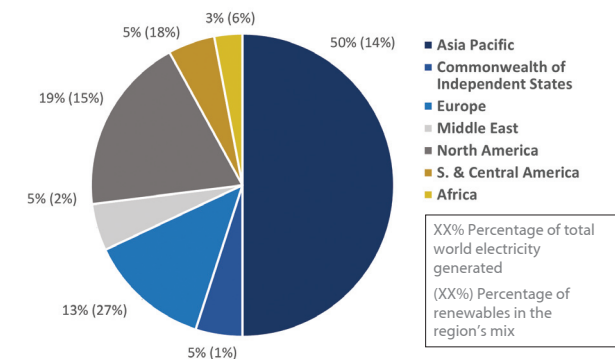
⁸According to the International Energy Agency, energy security is defined as the uninterrupted availability of energy sources at an affordable price.

⁹Energy Institute: "Statistical Review of World Energy".

¹⁰B.E. Lebrouhi: "Global hydrogen development - A technological and geopolitical overview" (2022).

¹¹It is hydrogen generated by electrolysis of water, using electricity from renewable sources.

Figure 1. Total electricity generation by geographic area and percentage of renewable sources in the mix of each region in 2022.



Commonwealth of Independent States (CIS). Member countries are: Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova (participation suspended), Russia, Tajikistan, Turkmenistan and Uzbekistan.
Source: Energy Institute.