UNEP

THE HYDROGEN ECONOMY

A non-technical review

UNITED NATIONS ENVIRONMENT PROGRAMME

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Introduction

There is a growing belief among policy-makers, environmental organisations, energy analysts and industry leaders that hydrogen is the fuel of the future that will revolutionise the way we produce and use energy. In the long term, our reliance on finite fossil energy is clearly unsustainable, both environmentally and economically. Soaring prices of oil in recent years have drawn attention to the energy-security risks of relying on oil and gas, and have led to a growing perception that the world is starting to run out of cheap fuel, hastening the need to move to more secure and cleaner energy technologies. Hydrogen is widely held to be the most promising of a number of such technologies that could be deployed on a large scale in the foreseeable future. Replacing fossil fuels with hydrogen in final energy uses could bring major environmental benefits – as long as technical, environmental and cost challenges in the way hydrogen is produced, transported, stored and used are overcome.

UNEP is following developments in hydrogen-energy technology with great interest, as it holds out the prospect of providing the basis of a sustainable energy future – one in which the environmental effects of energy production and use are greatly reduced or eliminated. Indeed, the hydrogen economy will most likely never become a reality unless it brings major environmental benefits. But there are widespread misunderstandings about the role hydrogen could play in the global energy system, how quickly it could be introduced commercially on a large scale and its impact on the environment. UNEP believes that it is important to keep countries, especially those in the developing world, informed about the true potential, costs and benefits of hydrogen, and to counter popular misconceptions.

In keeping with its mission to encourage and facilitate the adoption of environmentally-friendly technologies, UNEP has decided to prepare this informative document on the hydrogen economy. It sets out in non-technical language the main issues surrounding the transition to a global energy system based on hydrogen. It provides a sober assessment of the current state of technology development, the technical and cost challenges that will need to be overcome, and the prospects for commercial deployment. It also considers what the emergence of hydrogen as a viable energy technology would mean for policy-making – particularly in developing economies.

The first part of this report briefly describes how the hydrogen economy would work and what it might mean for the environment. The following section reviews the cost and technical challenges that will need to be overcome for hydrogen to become commercially viable on a large scale. The next section discusses the potential barriers to development of a hydrogen system and the need for

government support, and describes long-term projections of hydrogen use. The report then considers the relevance of hydrogen for developing economies and what it could mean for national policy-making, and the role of international and non-governmental organisations. A concluding section summarises the key messages contained in this report.

Annex A describes the activities of key players in hydrogen energy research and development. Annex B provides references to selected publications on hydrogen and the addresses of relevant websites for readers looking to find out more about hydrogen developments and programmes.

The Hydrogen Economy and Sustainable Development

Interest in hydrogen as a way of delivering energy services has been growing in recent years in response to heightening concerns about the environmental impact of energy use and worries about the security of fossil-fuel supplies. Hydrogen, as an energy carrier, can in principle replace all forms of final energy in use today and provide energy services to all sectors of the economy. The fundamental attraction of hydrogen is its potential environmental advantages over fossil fuels. At the point of use, hydrogen can be burned in such a way as to produce no harmful emissions. If hydrogen is produced without emitting any carbon dioxide or other climate-destabilising greenhouse gases, it could form the basis of a truly sustainable energy system – the hydrogen economy.

What is Hydrogen?

Hydrogen is the simplest, lightest and most abundant element in the universe,