Foreword

Hydrogen has been the most prevalent element in the universe since its early beginnings thirteen billion years ago, and there is a compelling logic that makes us all believe that surely this gas can provide an almost limitless source of energy for the world.

Although abundant on Earth, not least as water in the oceans and the atmosphere, the chemical activity and physical properties of hydrogen make its isolation an energy-intensive process and its subsequent storage and transport a challenge.

In an ideal world, hydrogen would be made available through the splitting of water into its constituent elements, drawing on renewable or long-term energy sources. Following recombination with oxygen in the air to liberate this energy — typically elsewhere — water would be returned to the atmosphere as part of the natural water cycle. Such a process would be both sustainable and carbon neutral.

In reality, nearly all the hydrogen currently manufactured in the world is through the reforming of hydrocarbons, a process that has low energy-conversion efficiency and contributes to the 8.8 billion tonnes of carbon being emitted annually as a result of fuel usage. The small proportion of hydrogen produced by electrolysis uses electricity that includes the burning of fossil fuels, although renewable sources such as hydroelectric power, wind, photovoltaics and geothermal energy are being employed increasingly.

There is the prospect of wind farms, wave and tidal power facilities being linked to hydrogen generation, as well as nuclear plants, which nevertheless pose other challenges related to security and radioactive waste disposal. In one form or other and with the right leadership and entrepreneurship, these could meet, potentially, all our heating, power and transportation needs.

The world is now at a pivotal point in planning its energy provision for the future, as the effects of climate change have to be addressed and, in the much longer term, fossil fuels will become scarcer. We cannot rely on the latter solving the former! There are schools of thought that picture a Hydrogen Economy based on combustion and fuel cells supported by electrolysis and solar pyrolysis of water, while others see a domination of electricity as the principal energy vector of the future. A further component is the role of

biofuels, but current rates of energy conversion to liquid fuel (less than 1% of sunlight received) pale against photovoltaic direct power generation of 20%.

This then is the context of the present book that explores the scientific, economic, fiscal, social and regulatory framework of a world economy supported by hydrogen. It is a fascinating journey that will inspire all of us who are looking for a clean, sustainable future.

Richard Pike
Chief Executive, Royal Society of Chemistry