Best Sci-Tech Book—*Library Journal*

THE HYPE ABOUT HYDROGEN

Fact and Fiction in the Race to Save the Climate

Joseph J. Romm

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Foreword

Just as day follows night, human attention is drawn to energy, probably the most important bounty of creation and enabler of the evolution of Earth's biosphere. Energy drives the tides, provides fresh water, conditions the air and climate, and nourishes the biosphere, which in turn nourishes humanity. We earthlings enjoy the fruits of diverse forms of energy in countless ways, especially now that advancing technology allows us to readily manipulate it.

The energy-based industrial and scientific revolution, which continues today, has given us massively magnified powers over the "forces of nature." Disease has been reduced; food and shelter have become more readily available; transportation and communication have leaped forward. Over time, this progress has accelerated the growth of population and the consumption of food, timber, minerals, and aquatic life. Billions of people are now able to live lives of material splendor. With a flick of the switch, we can illuminate where and when we wish, heat and cool our structures, move about (physically and figuratively) with unbelievable speed and freedom, dispose of our wastes, treat our sick, and explore the universe.

At the same time, this extraction and use of energy are at the heart of a host of problems, such as air pollution and its adverse effects on health and infrastructure, degradation of water quality, despoliation of the land from mining and waste disposal, and alteration of Earth's entire climate. The chances of continuing our economic progress hang on the achievement of unprecedented advances in science and technology, as well as a revolution in the way we measure progress.

Evidence of the challenge abounds. Despite concerted, sustained,

and fruitful efforts, human population still expands at 70 million people per year, and debilitating sprawl is everywhere. Earth's climate is suddenly showing deeply disturbing changes for the worse. Petroleum production is peaking now, and the production peak for natural gas will follow within several decades, threatening the end of our long joyride with "cheap energy." A comic strip character once observed, "From here on down, it's going to be uphill all the way." I get that feeling when I think of the human bolide spinning its way into the twenty-first century.

How shall we make our future secure? Unlike the case in Disney's world, wishing will *not* make it so. And that brings us to the subject of this book. Sadly, the general public and most politicians lack sufficient knowledge to judge whether a technical proposal to set us on a better course to the future is plausible or whether it is hype—and this is certainly true when it comes to hydrogen. But imagination tempered with sound arithmetic and sustained support of research and development can result in nearly miraculous outcomes.

This is an important and opportune book. Joe Romm deftly applies his keenly developed technical knowledge, political experience, and analytical mind to a frank and sensible appraisal of the chances to transform our energy system over the next half-century or so into one that will employ hydrogen as a key energy carrier. Properly devised, this may allow major advances in the provision of energy services and improved protection of health and environment. The path *is* possible, but it will require a major, broad-based, and sustained research and development investment in both the public and private sectors.

Dr. Romm puts the already worn cliché "hydrogen economy" into a refreshing framework. For example, to point out one misconception he clarifies, hydrogen is not an energy *source* except in the futuristic realm of nuclear fusion, but it is a potent *carrier* of energy, albeit with the enormous disadvantage of having low energy density and not being readily storable.

Romm also reminds us that many decades will be required for the transition to an energy system with no net CO_2 emission. If we

hope to be using hydrogen in a major way by 2050, we need to start now to devise ways to produce, convert, and carry it. Meanwhile, there are alternatives that can be employed more quickly, including major increases in efficiency of energy use in all sectors.

Given our current choices and policies, I am drawn to the observation that "mankind would rather commit suicide than learn arithmetic." We must gain enough wisdom to be able to be "emotionally moved by statistics." In the early days of complex research on controlled thermonuclear fusion, the effort was dubbed "Project Sherwood," alluding to the work of Robin Hood to rob the rich (deuterium in water) in order to pay the poor (low-cost energy). It also was interpreted as "Sherwood is (sure would be) nice if it would work!" It is a lot easier for the public to be persuaded by soothsayers that the fabled "hydrogen economy" is nearly here than for the science and technology community to make that possible!

The time is at hand to come to grips with the real challenge—and opportunity—before us of committing our creativeness and financial resources to the long and arduous task of safely navigating our way through the next hundred years. Romm's book transports the reader a hopeful (but nearly tearful) distance in coming to terms with energy realities and challenges for the twenty-first century.

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Introduction

Imagine a world in which you can drive your car to work each day without consuming any oil or producing any pollution. When you park your car at work or at home, you hook it up to the power grid, generating pollution-free electricity for your community. And, as part of the deal, you get money back from your utility.

You are living in the hydrogen economy, a high-tech Eden. Is it too good to be true? Will it happen in your lifetime?

The environmental paradise of a hydrogen economy rests on two pillars: a pollution-free source for the hydrogen itself and a device for converting it into useful energy without generating pollution. Let's start with the fuel cell—a small, modular electrochemical device, similar to a battery, but which can be continuously fueled. For most purposes, think of a fuel cell as a black box that takes in hydrogen and oxygen and puts out water plus electricity and heat, but no pollution whatsoever.

The first commercial stationary fuel cell was introduced in the early 1990s by United Technologies Corporation. Since fuel cells have no moving parts, they hold the promise of high reliability, and since power outages had caused countless business disruptions in the late 1990s, the product seemed like a sure winner.

These fuel cells were first used to provide guaranteed ultra-reliable