Toward a Renewable Hydrogen Economy

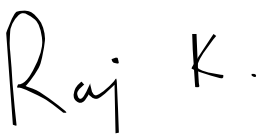
The U.S. Department of Energy projects[1] that the world's total energy consumption will rise by 59% between 1999 and 2020 and that CO_2 emissions during this period will increase by a similar 60%. This growth will mostly occur in the rapidly developing parts of the world. To meet this demand, renewable energy sources (RES) are projected to grow 9.2% on an annually compounded basis relative to the 2.4% projected for electricity from conventional fossil fuel sources.[2] The major RES include photovoltaics, solar thermal, wind, biomass, hydroelectric, ocean, and geothermal. Why this upsurge of interest in RES? Conventional energy systems are the principal source of air pollution and greenhouse gases. They require the dependence of many countries on foreign oil and gas resources—many of them located in politically volatile and unstable regions of the world. On the other hand, the wide dispersal of RES makes them relatively immune to terrorist attacks, unlike nuclear energy systems, for example.

Interest in RES has always been cyclical and it has ebbed and flowed with the price of a barrel of oil. For RES to be at least recognized as potentially major contributors to U.S. and global energy supplies, the realities associated with a dwindling fossil fuel resource base have combined with a grudging realization of the environmental/ecological consequences of an over-reliance on carbon-based fuels. Currently RES account for only ca. 3% of the total energy mix. One problem lies with the intermittent nature of most of RES, especially those based on sun and wind energy. This necessitates the incorporation of a storage component in the overall energy system. Batteries have been used for storage in solar energy conversion systems but they are not viable for large-scale applications. This is where hydrogen and fuel cells come in. We produce hydrogen today by the steam reforming of methane (natural gas). This will undoubtedly continue to be a near-term option for producing hydrogen for our energy needs.

For the long haul, however, efficient and economical production of hydrogen from renewable resources (*e.g.,* water) remains the Holy Grail. Indeed, "disruptive" technologies are needed for achieving this goal. To this end, the U.S. has allocated $1.7 billion for hydrogen R&D and comparable initiatives have begun in other parts of the world as well. Production is not the only showstopper in a hydrogen economy. Efficient and cost-effective ways will have to be found for storing and distributing this fuel. Hydrogen-enabling technologies such as fuel cells must undergo continued development. Finally partnerships have to emerge among companies to prove manufacturing techniques and to demonstrate cost-reduction. We hope to continue to capture, in these magazine pages, some of the excitement and progress in these and related areas in the future.

In the meantime, we hope that you enjoy this special issue of *Interface* on medical applications of electrochemistry. Like R&D on RES, this field has enjoyed a quiet revolution in recent years. While advances in electroanalytical applications in medicine have perhaps been more widely trumpeted, the feature articles in this issue demonstrate that there are other arenas (*e.g.,* biomaterials and drug-delivery) where electrochemistry can play an equally vital role. Two such topics ("Biological Nanostructures, Materials, and Applications" and "Biological Fuel Cells") will be the focus of symposia in the upcoming fall meeting in Orlando. Stay tuned.

1. *http://www.eia.doe.gov/oiaf/ieo.*
2. The Wall Street Journal, *July 19, 2003.*



Krishnan Rajeshwar
Editor

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The Electrochemical Society, Inc.
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Tel 609.737.1902
Fax 609.737.2743
Web: www.electrochem.org

Editor: Krishnan Rajeshwar
e-mail: rajeshwar@uta.edu

Guest Editor: Mordechay Schlesinger
Contributing Editor: Mike Kelly

Managing Editor: Mary E. Yess
e-mail: mary.yess@electrochem.org

Production & Advertising Manager: Ellen S. Popkin
e-mail: interface@electrochem.org

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