—ABSTRACT—

FUEL CELLS, HYDROGEN, AND NUCLEAR POWER

Charles W. Forsberg
Oak Ridge National Laboratory*
P.O. Box 2008
Oak Ridge, Tennessee 37831-6179
Tel: (865) 574-6783
Fax: (865) 574-9512
Email: forsbergcw@ornl.gov

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3 Park Ave, New York, NY 10016-5991

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The implications of fuel cells and nuclear-generated hydrogen are examined for different sets of assumptions. Historically, the market for nuclear energy has been the base-load production of electricity. Nuclear power has high capital costs but low operating costs. Therefore, economics depend upon operating the nuclear plant at full capacity (i.e., base-load operations) while using lower-capital-cost power plants with higher operating costs for intermediate and peak loads.

If low-cost fuel cells and methods to produce hydrogen using nuclear energy are successfully developed, radical changes would likely occur in the electrical system, the transportation system, and the role of nuclear energy. If fuel cell costs are reduced to several hundred dollars per kilowatt capacity, hydrogen becomes the preferred fuel for peak and intermediate-load electricity production. Furthermore, if fuel-cell costs meet the goals of automobile manufacturers (<$100/kW), then hydrogen becomes the primary transportation fuel as well. Because hydrogen can be stored in large caverns and pipelines (via packing by pressure variation), hydrogen plants can be designed and operated as base-load units. Such operation increases the potential market for nuclear power to significantly more than half the total energy demand and increases its economic competitiveness relative to other energy sources.

In such a future, nuclear energy may also become an enabling technology for larger-scale use of renewables. The economic viability of renewables strongly depends upon the existence of reliable, inexpensive backup power to meet power demands with variable energy production from wind and sunlight. Fuel cells, hydrogen from nuclear power, and large-scale hydrogen storage technologies may create a viable method for production of inexpensive backup power.