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**PUBLISHER AND
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Kristine Chin
(212) 591-7662
krisc@aiche.org

MANAGING EDITOR

Cynthia F. Mascone
(212) 591-7343
cynfm@aiche.org

SENIOR EDITOR

Rita L. D'Aquino
(212) 591-7317
ritad@aiche.org

**PRODUCTION
COORDINATOR**

Karen Simpson
(212) 591-7337
kares@aiche.org

ART & DESIGN

Jesse Gunzel

ILLUSTRATOR

Craig Carioscia
Colleen Diez

**REGULATORY
EDITOR**

William A. Shirley
(888) 674-2529
envtllaw@charter.net

**PATENT LAW
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M. Henry Heines
(415) 576-0200
mhh@townsend.com
Frank C. Eymard
(504) 585-0449
eymardfc@arlaw.com

**CLASSIFIED
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Denise Deluca-Mallon
(212) 591-7170
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AICHe

**AMERICAN INSTITUTE OF
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**THREE PARK AVENUE
NEW YORK, NY
10016-5991
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Promising Advances in Photovoltaics

In "Demystifying the Hydrogen Myth," Dr. Shinnar makes several important points related to generating electricity and storing hydrogen, but his oversimplification of the R&D needs and the prospects for solar electric (photovoltaics/PV) suggests that he may not be fully conversant with the latest exciting achievements in this field.

The efficiency of solar cells/modules and the cost of producing them has constantly improved as a direct effect of R&D funding from the Energy Efficiency and Renewable Energy Div. of the U.S. Dept. of Energy. The cells' electrical conversion efficiency increased remarkably from ~5% in 1975 to ~20% for terrestrial applications, and to as much as 35% for space applications. During the same time, production costs fell from about \$500/W to ~\$2/W; indeed, PV already is more competitive than diesel fuel in off-grid applications. According to the US industry's roadmap, continuing these learning curves and the concomitant improvements, will bring the cost of grid-connected PV from 18.2¢/kWh in 2004, down to 5.7¢/kWh by 2015, and to 3.8¢/kWh by 2030. It is well accepted that PV can contribute to the U.S. grid by shaving the large demands for power during the peak summer months; this alone can account for up to 10–15% of the total energy consumption in this country.

The DOE and the PV industry forecast a total capacity of 100–180 GW of PV in the U.S., not a negligible contribution to our energy supply. Furthermore, visionary studies by Richard Smalley, Nobel Laureate, Chemistry, 1997; Nate Lewis, CalTech; Martin Hoffert, NYU, and others demonstrate that solar electric is the only type of technology with the capacity to produce the 10–60 TW of new clean energy that will be needed globally by 2050. Establishing advanced electrical grids will foster the growth of photovoltaics and wind systems, and will almost eliminate the need for electrical storage as electricity would flow between day and night hemispheres in a minimum-loss grid comprised of bucky tubes or other advanced materials. Furthermore, new materials and electrochemical systems promise a rapid reduction in storage costs for decentralized systems.

In considering R&D funding for solar electric systems vs. solar thermal ones, I observe that developing solar cells is a much more complex endeavor than improving solar thermal systems. The former effort requires research on basic materials at the molecular level, R&D on the quality and efficiency of film deposition, and of manufacturing operability and reliability, in addition to engineering improvements; in contrast, expanding solar thermal systems poses only engineering challenges. For solar electric systems to reach their full potential, both basic and applied research on new materials and designs is needed.

In 2004, the worldwide production of PV exceeded 1 GW, of which promising new thin-film technologies had a small share of about 7%. The largest contributor to this supply is Japan topping 500 MW, followed by Europe with 300 MW, and the U.S. at 140 MW, with the rest of the world producing 140 MW. The U.S. was the pioneer in PV development, but while the U.S. R&D budget was slashed from \$152 million to \$50 million in 1982, Japan kept increasing their PV R&D funding. Today, we invest about \$70 million/yr on PV R&D, whereas Japan is investing about \$850 million/yr. Unmistakably, others consider photovoltaics to be the only technologies that can provide the terawatts of clean, safe, and sustainable energy needed by the middle of the century. What is not clear yet is who will be the buyer and who will be the seller of the systems. The decision is up to us.

*Vasilis Fthenakis, Ph.D., Fellow of the AICHe
Upton, NY*