



## CSIS COMMISSION ON SMART POWER

A smarter, more secure America.

### **Science and Technology: Making Smart Power Smarter** **By Gerald Epstein**

#### **Analytic Overview**

American excellence in science and technology underlies this nation's economic performance, quality of life, and national security, contributing both to its ability to project hard power and to articulate and enhance soft power. According to a National Academy of Sciences report, "the growth of economies throughout the world has been driven largely by the pursuit of scientific understanding, the application of engineering solutions, and continued technological innovation."<sup>1</sup> Continued advances in science and technology have played a major role in boosting American productivity, generating new, high-wage, high-value-added industries, and maintaining America's standard of living in a globalized world where even technically skilled labor, as well as many resources, are far cheaper overseas than here.

If the American economy has drawn heavily on science and technology, the U.S. national security sector depends even more heavily on it. Particularly since the crash development of nuclear weapons, radar, and a host of other advanced technologies during the Second World War, the U.S. national security community has emphasized technological supremacy. During the Cold War, military investments in science and technology drove innovation in aerospace, electronics, communications, and other sectors as the United States sought to redress Soviet quantitative superiority with American qualitative superiority.

Yet the global technological environment has been transformed in the last few decades. In many technological areas critical to national security, cutting edge technologies are pioneered by the commercial sector, with the U.S. national security community representing a rather minor customer. And this commercial technology base is a global one. Half of all U.S. patents issued in 2006 were of foreign origin,<sup>2</sup> as were over 70% of the papers published in the American Physical Society's world-leading journals.<sup>3</sup> Brains are distributed uniformly around the planet – one per person – and the most successful nations will be the ones that attract the largest share of the brightest minds.

Even though US law prohibits foreign students from entering the United States if they are thought to have any intention of remaining here, our economy depends on many of them doing just that. Fortunately, they have been: more than half of the current U.S. PhD engineering workforce is foreign-born, and three-quarters of the foreign doctoral science and engineering

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<sup>1</sup> Committee on Prospering in the Global Economy of the 21<sup>st</sup> Century, *Rising Above the Gathering Storm* (Washington, DC: National Academy Press, 2005), pre-publication version, p. 2-1.

<sup>2</sup> U.S. Patent and Trademark Office, "Patents By Country, State, and Year - Utility Patents: December 2006," [http://www.uspto.gov/go/taf/cst\\_utl.htm](http://www.uspto.gov/go/taf/cst_utl.htm)

<sup>3</sup> American Physical Society, "Physical Review, Physical Review Letters, and ST-AB Published Articles; Geographic Distribution of Corresponding Authors," available from the American Physical Society



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graduates from US institutions intend to stay.<sup>4</sup> But the United States cannot assume that this inflow will continue indefinitely, particularly as opportunities expand in these individuals' home countries and in other countries seeking to recruit them. The United States cannot afford to be seen as an unwelcoming place for foreign nationals to live, study, and work. Yet as the rest of the world deepens its investment in both financial and human capital in science and engineering, U.S. students are not interested in science and engineering in sufficient numbers to meet U.S. demand, and United States funding for research in mathematics, engineering, and most physical sciences has declined or remained flat, in real terms, for several decades.<sup>5</sup>

Taken together, the commercialization and globalization of advanced science and technology have profound implications for national defense. In 1960, the U.S. national security community conducted approximately  $\frac{1}{4}$  of the world's research and development. Today, the fraction is well below  $\frac{1}{20}$ .<sup>6</sup>

Along with the technological landscape, the nature of the security threat facing the United States has fundamentally changed. Rather than facing a technologically sophisticated peer competitor, the United States must now deal with a diversity of threats, including non-state terrorists that have demonstrated their ability to kill thousands and are seeking the ability to do far worse. These enemies seek to attack the United States asymmetrically, exploiting weaknesses – such as our own dependence on highly leveraged technological systems, or our vulnerable civil infrastructures -- that our advantages in military power and technological sophistication cannot redress.

Complicating the dependence of national security on science and technology is that the latter thrives in an environment of open participation and open communication – a point recognized by current Presidential policy, which asserts, according to the CSIS Commission on Scientific Communication and National Security, that “openness in research is so important to our own security – and to other key national objectives--that it warrants the risk that our adversaries may benefit from scientific openness as well.”<sup>7</sup> In a security environment where technological proliferation can pose serious risk, this principle can be difficult to sustain, but it is important to do so. Although the United States still retains sufficient control over some technological applications that it can unilaterally impede their dissemination, it does not have a monopoly position that would allow it to do so in general – and it shouldn't try. Only by remaining actively engaged in the global technological community can the United States assess and access

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<sup>4</sup> National Science Board, *Science and Engineering Indicators 2006*, Chapter 2 highlights and Chapter 3 highlights, respectively: <http://www.nsf.gov/statistics/seind06/c2/c2h.htm> and ... /c3/c3h.htm

<sup>5</sup> *Rising Above the Gathering Storm*, op. cit., p. 1-8

<sup>6</sup> This fraction corresponds roughly to the year 2000; will firm up these numbers.

<sup>7</sup> CSIS Commission on Scientific Communication and National Security, *Security Controls on Scientific Information and the Conduct of Scientific Research*, June 2005, p. 2, available online at [http://www.csis.org/media/csis/pubs/0506\\_cscans.pdf](http://www.csis.org/media/csis/pubs/0506_cscans.pdf). This quote describes the approach taken by National Security Decision Directive 189, “National Policy On The Transfer Of Scientific, Technical And Engineering Information” (September 21, 1985), which is still in force.



promising new technologies and avoid technological surprise. “In a world of globalized science and technology,” stated the CSIS Commission on Scientific Communication and National Security, “security comes from windows, not walls.”<sup>8</sup>

Fortunately, because of its open and international nature, science and technology are excellent arenas in which to engage the rest of the world productively and proactively. In addition to fostering mutual exchanges of students and researchers and serving as a source of national power and prestige, technical activities offer the United States the opportunity to show leadership in addressing thorny problems in global environment, food supply and safety, public health, water, energy, and other areas where the United States can do well by doing good.

As the Hart-Rudman Commission concluded, “Second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous than a failure to manage properly science, technology, and education for the common good over the next quarter century.”<sup>9</sup> And when the source of both technological threats and technological solutions is global, this is not a job that can be done at home.

## Recommendations

- 1.) *Boost federal research investments to restore the erosion in long-term fundamental research funding, especially in the physical sciences and engineering; increase support for math and science education and teacher training; and increase support for undergraduate and graduate scholarships and fellowships for US technical students.*

These are among the key recommendations of the landmark National Academies study *Rising Above the Gathering Storm*. They also support findings of the Hart-Rudman Commission. They are necessary to build a strong scientific and technological base from which the United States can lead by action and example.

- 2.) *Improve visa processing for international students and scholars by eliminating security reviews based on fields of study or technical expertise, unless that training is uniquely available in the United States. Implement new skills-based preferential immigration options.*

Current screening procedures that single out students and scholars seeking to study technical disciplines that the United States in no way monopolizes serve only to discourage them from coming, while conferring no security benefit.

Unless such visitors seek to study fields that are uniquely available in the United States, no security objective is served by encouraging them to make their

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<sup>8</sup>CSIS Commission on Scientific Communication and National Security, *Security Controls on the Access of Foreign Scientists and Engineers to the United States*, October 2005, p. 15. at [http://www.csis.org/media/csis/pubs/051005\\_whitepaper.pdf](http://www.csis.org/media/csis/pubs/051005_whitepaper.pdf).

<sup>9</sup> The United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change*, February 15, 2001, p. 30



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contributions outside the United States and denying ourselves a vital mode of engagement.

- 3.) *Fund a global research and technology demonstration initiative for global problems by matching funds donated by other countries for multilateral research and technology demonstration in areas such as public health, energy, and environment. Collaborative research would be done both in the US and abroad.*

Two-way technical engagement is as much the objective as is the development of science and technology, but that science and technology must be first rate.

“Potemkin Science” that has no real merit and is done solely in an attempt to curry political favor wastes money and does not foster true engagement.

Demonstration is as important as research, since research alone will not lead to implementation.

### **Message and Marketing**

The pitch is three-fold:

- 1) A strong domestic science and technology base is needed to support economic competitiveness, national security, and international engagement.
- 2) The scientific and technological enterprise is fully global, and no country can maintain a strong domestic S&T base without being globally engaged.
- 3) As the CSIS Commission on Scientific Communication and National Security put it, “In a world of globalized science and technology, security comes from windows, not walls.”

The challenges to implementation will be considerable. These will cost a lot of money at a time when money will be very tight. Much of recommendations 1 and 2 are already incorporated in President Bush’s American Competitiveness Initiative (elements of which have wide bipartisan support) and his immigration bill (which is more controversial). It will ease entry of foreign students and researchers to the United States, an outcome that is politically sensitive but should not be. Science and technology are pursued in “above ground” institutions that check references, resumes, and reputations; that require applicants’ true identities, and that can flag applicants who are here illegally. So long as these people seek work in the areas they have trained for years to learn, they will not disappear into the underground economy.

The one difficult message will be reconciling the fact that science and technology can be used for harm with the recommendation for greater openness and engagement (that would further disseminate that science and technology). The resolution is that science and technology sufficient to do harm is not necessarily very sophisticated, and typically has necessary and widespread legitimate use – meaning that there is nothing to be gained, and a lot to be lost, by pretending it can be bottled up. However, this is not universal; there are areas where controls might be appropriate, and those bear more detailed analysis.