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Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5: Condensed Version

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By Members of the 2005 "Rising Above the Gathering Storm" Committee; Prepared for the Presidents of the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine

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THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

RISING ABOVE THE GATHERING STORM, REVISITED

Rapidly Approaching Category 5

By Members of the 2005
"Rising Above the Gathering Storm" Committee

Prepared for the Presidents of the
National Academy of Sciences,
National Academy of Engineering,
and Institute of Medicine

NATIONAL ACADEMY OF SCIENCES,
NATIONAL ACADEMY OF ENGINEERING, *AND*
INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

2005 "Rising Above the Gathering Storm" Committee Members Participating in "The Gathering Storm, Revisited "[1]

NORMAN R. AUGUSTINE [NAE/NAS] (Chair) is the retired chairman and CEO of the Lockheed Martin Corporation and a former Undersecretary of the Army. He is a recipient of the National Medal of Technology.

CRAIG BARRETT [NAE] is retired chairman and CEO of Intel Corporation.

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P. ROY VAGELOS [NAS/IOM] is the retired chairman and CEO of Merck & Co., Inc.

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RICHARD N. ZARE [NAS] is the Marguerite Blake Wilbur Professor of Natural Science at Stanford University. He was chair of the National Science Board from 1996 to 1998.

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[1]Additional members of the 2005 Committee:

STEVEN CHU [NAS], a Nobel Laureate in physics, is currently serving as U.S. Secretary of Energy.

ROBERT GATES, former president of Texas A&M University, is currently serving as U.S. Secretary of Defense.

JOSHUA LEDERBERG [NAS], recipient of the Nobel Prize in physiology/medicine, passed away on February 2, 2008.

FOR MORE INFORMATION

More information, including the full body of the report and the original *Gathering Storm* report, is available at the National Academies Web site, www.nationalacademies.org.

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THE GATHERING STORM, REVISITED
Rapidly Approaching Category 5

"It is amazing the insights one can get sitting in an airport waiting for a flight. Last week I found myself at Heathrow Airport in London sitting with two businessmen. The stories they told were remarkable.

"One businessman was on his way home from China. He had just spent a week working out the details to build a major manufacturing facility at a booming Chinese industrial park. The development authority promised expedited zoning procedures to facilitate rapid construction. Another government entity offered to line up job fairs to recruit workers. The mayor said they will provide free transportation services from downtown to the factory for employees for two years. The local university promised an intern program for engineering students. And on it went.

"The other businessman relayed the challenges he faced with his factory in America. He wanted to double the size of the factory, but was informed he needed a new environmental impact study before he could approach zoning authorities. He sought a meeting with federal officials who were managing "stimulus" funds that he hoped would help finance the expansion. But he was informed he could not meet with the assistant secretary because it would possibly suggest a 'conflict of interest'."

JOHN HAMRE, *Former Deputy Secretary of Defense*

Bipartisan requests from the United States House of Representatives and the United States Senate in 2005 prompted the National Academies to conduct a study of America's competitiveness in the newly evolved global marketplace. A National Academy of Sciences, National Academy of Engineering, and Institute of Medicine committee composed of 20 individuals of highly diverse professional backgrounds, supported by the staff of the Academies and many others subsequently conducted a review of America's competitive position and released a document that has become popularly referred to as the "*Gathering Storm*" report after the first line in its title.

The Academies' original review culminated in four overarching recommendations, underpinned by 20 specific implementing actions. Generally strong bipartisan support was granted these findings on Capitol Hill and in the White House and a number of the recommendations were eventually implemented. The preponderance of the enabling financial resources was provided in the one-time American Recovery and Reinvestment Act ("Stimulus Legislation"). The three-year Authorizing Legislation, known as the America COMPETES Act, that approved many of the *Gathering Storm* recommendations, expired in September 2010. It was then renewed in a modified form in December 2010, by a vote of 228 to 130 in the House of Representatives and by unanimous consent in the Senate. While this was an extremely important action, the effort to "jump start" America's competitiveness finds itself standing at a precipice with regard to continued funding at an adequate level. For example, all funding for the Advanced Research Projects – Energy (ARPA-E) program is scheduled to expire a few months into the current year.

The original *Gathering Storm* report focused on the ability of all Americans to compete for quality jobs in the evolving global economy. The possession of such jobs is of course the very foundation of a high quality life for the nation's citizenry. The *Gathering Storm* report presented a daunting outlook for America if it were to continue on the perilous path it had been following in recent decades with regard to sustained competitiveness.

Five years after the release of the *Gathering Storm* report, a second report, *Rising Above the Gathering Storm, Revisited,* was prepared to assess changes in America's competitive posture. The committee confirmed once again that the 20 actions previously endorsed should be fully implemented.[2] This document is a condensed version of that report.

The committee is, of course, acutely aware of the extreme fiscal challenges facing the nation—however, it believes that in reducing outlays priorities must be assigned which distinguish between investments for the future and near-term consumption. Just as the solution to the problems of an aircraft that is too heavy to fly is not to remove an engine—the solution to the current economic burden is not to eliminate the engine that propels the economy.

[2] The status of Congressional implementation of the committee's 20 recommended actions is tabulated in *Gathering Storm, Revisited*.

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Robert Solow received a Nobel Prize in economics in part for his work that indicated that well over half of the growth in United States output per hour during the first half of the twentieth century could be attributed to advancements in knowledge, particularly technology.[3] This period was, of course, before the technology explosion that has been witnessed in recent decades. The *Gathering Storm* committee concluded that a primary driver of the future economy and concomitant creation of jobs in the 21st century will be innovation, largely derived from advances in science and engineering. While only 4 percent of the nation's work force is composed of scientists and engineers, this group disproportionately creates jobs for the other 96 percent.[4]

When scientists discovered how to decipher the human genome it opened entire new opportunities in many fields from medicine to archeology. Similarly, when scientists and engineers discovered how to increase the capacity of integrated circuits by a factor of one million as they have in the past 40 years, it enabled entrepreneurs to replace tape recorders with iPods, paper maps with GPS, pay phones with cell phones, two-dimensional X-rays with three-dimensional CT scans, paperbacks with electronic books, slide rules with computers, and much, much more.[5] Further, the pace of creation of new knowledge is seen by almost all measures to be accelerating.[6]

Importantly, *leverage* is at work here. It is not simply the scientist, engineer, and entrepreneur who benefit from progress in the research laboratory or engineering design center; it is also the factory worker with a job building the items that have been designed, the advertiser who promotes them, the truck driver who delivers them, the salesperson who sells them, and the maintenance person who repairs them—not to mention the benefits realized by the ultimate user. Further, each job directly created in this chain of manufacturing activity generates, on average, another 2.5 jobs in such unrelated endeavors as operating restaurants, grocery stores, barber shops, filling stations, and banks.[7]

IT products such as those cited above were built upon the work of a few individuals who decades ago investigated something very basic called solid-state physics. None of these individuals could possibly have foreseen CT scans, GPS, or iPods and devices that store 160,000 books in one's pocket, yet that is what their work made possible.[8] Similarly, we cannot foresee what products today's basic research will lead to tomorrow. But what we can foresee clearly is that failure to invest in the future now is *highly likely* to result in extended unemployment and a reduced standard of living for most Americans.

The *Gathering Storm* report assessed America's position with respect to each of the principal ingredients of innovation and competitiveness—Knowledge Capital, Human Capital and the existence of a creative "Ecosystem." Numerous significant findings resulted—for example, with regard to Knowledge Capital it was noted that federal government funding of R&D as a fraction of GDP had *declined* by 60 percent in 40 years.[9] With regard to Human Capital, it was observed that over two-thirds of the engineers who receive PhD's from United States universities were not United States citizens.[10] And with regard to the Creative Ecosystem it was found that United States firms spend over twice as much on litigation as on research.[11] However, the most pervasive concern was considered to be the state of the nation's K-12 education,

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[3] R.M. Solow, "Technical Change and the Aggregate Production Function." Review of Economics and Statistics, 39: 312-320, 1957.

[4] National Science Board, Science and Engineering Indicators 2010. Arlington, VA: National Science Foundation (NSB 10-01), Figure 3-3.

[5] In 1971, the Intel 4004 Processor had 2300 transistors. See: *http://download.intel.com/pressroom/kits/events/moores_law_40th/MLTimeline.pdf*. In 2009, Intel released the Xeon® 'Nehalem-EX' Processor with 2.3 billion transistors. See: *http://www.intel.com/pressroom/archive/releases/2009/20090526comp.htm*.

[6] Beyond Discovery: The Path from Discovery to Human Benefit is a series of articles that explore the origins of various technological and medical advances (*www.beyonddiscovery.org/*).

[7] J. Bivens, Updated Employment Multipliers for the U.S. Economy (2003), Economic Policy Institute Working Paper, August 2003. Available at: *http://www.epi.org/page/-/old/workingpapers/epi_wp_268.pdf*.

[8] For a 64 gigabyte iPod, holding books with an average file size of 400 kilobytes.

[9] Federal R&D was 1.92 percent of GDP in 1964 and 0.76 percent of GDP in 2004. See: *http://www.nsf.gov/statistics/nsf10314/pdf/tab13.pdf*.

[10] National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates. See *http://www.nsf.gov/statistics/nsf09311/pdf/tab3.pdf*.

[11] NSB, 2010, Appendix Tables 4-8 and 4-9; Towers Perrin, 2009 Update on U.S. Tort Cost Trends, Table 5.

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which on average is a laggard among industrial economies while costing more per student than any other OECD country.[12]

So where *does* America stand relative to its position of 5 years ago when the *Gathering Storm* report was prepared? The unanimous view of the committee members participating in the preparation of this report is that our nation's outlook has not improved but rather has *worsened*.

Although progress has been made in certain areas such as launching the ARPA-E, the growth of our national debt from $8 trillion to $13 trillion during the past five years has diminished our latitude to confront challenges.[13] Nonetheless, other nations facing corresponding challenges are continuing to invest in competitiveness: Russia is building an entire new high-tech city; the world's largest private solar R&D facility has just been established in China (by a U.S. firm), Saudi Arabia has established one of the highest-endowed technological universities in the world, and that only begins the list.[14]

Further, in spite of sometimes heroic efforts and occasional very bright spots, our public school system—or more accurately 14,000 systems—has shown little sign of improvement, particularly in mathematics and science.[15] To do this we must upgrade the teacher corps, especially in math and science.

In addition, a recent National Academies report points out that "America faces a demographic challenge with regards to its S&E workforce." Minorities constitute almost 30 percent of the total U.S. population, yet comprise just 9.1 percent of Americans working in science and engineering occupations.[16] A disproportionately small percentage of underrepresented minority students earn science or engineering bachelor's degrees, yet this is the fastest growing segment of our population. Unless this percentage increases substantially, the number of U.S. engineers will decline in the coming years. Addressing this issue requires that we improve public K-12 STEM education and inspire these communities about science and engineering.

Finally, many other nations have been markedly progressing, thereby affecting America's relative ability to compete effectively for new factories, research laboratories, administrative centers—and *jobs*. While this progress by other nations is to be both encouraged and welcomed, so too is the notion that Americans wish to continue to be among those peoples who prosper.

The only promising avenue for achieving this latter outcome, in the view of the *Gathering Storm* committee and many others, is through *innovation*. Fortunately, this nation has in the past demonstrated considerable prowess in this regard. Unfortunately, it has increasingly placed shackles on that prowess such that, if not relieved, America's ability to provide financially and personally rewarding jobs for its own citizens can be expected to decay at an accelerating pace. The recommendations made 5 years ago, the highest priorities of which were strengthening the public school system and investing in basic scientific research, appear to be as appropriate today as then.

In summary, the Gathering Storm *committee's considered judgment is that in spite of the efforts of both those in government and the private sector, the outlook for America to compete for quality jobs has still further deteriorated over the past 5 years.*

The Gathering Storm *appears to be a Category 5.*

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[12] NSB, 2010, Appendix Tables 1-9, 1-10, and 1-11; and Organization for Economic Cooperation and Development, Education at a Glance 2009: OECD Indicators; Table B-1. See: *http://www.oecd.org/document/24/0,3343,en_2649_39263238_43586328_1_1_1_37455,00.html*.

[13] See Table 7.1, Federal Debt at the End of the Year: 1940:2015 at: *http://www.whitehouse.gov/omb/budget/Historicals/* (accessed August 23, 2010).

[14] Smart Russia, Newsweek, May 14, 2010 (*http://www.newsweek.com/2010/05/14/smart-russia.html*); Applied Materials Opens Solar Technology Center in Xian, China, TechOn, October 27, 2009 (*http://techon.nikkeibp.co.jp/english/NEWS_EN/20091027/176977/*); L. Gold, Skorton and Rhodes attend groundbreaking for Saudi Arabian university, a potential Cornell partner, Cornell Chronicle, October 25, 2007 (*http://www.news.cornell.edu/stories/Oct07/saudiarabia.html*); and E. Prentice, MIT Endowment Has 3.2 Percent Yield, Even As U.S. Markets Slide, The Tech, October 7, 2008 (*http://tech.mit.edu/V128/N45/endowment.html*).

[15] National Center for Education Statistics, Numbers and Types of Public Elementary and Secondary Local Education Agencies, From the Common Core of Data: School Year 2007–08. See: *http://nces.ed.gov/pubs2010/2010306.pdf* (accessed August 23, 2010).

[16] National Academy of Sciences, National Academy of Engineering, Institute of Medicine. 2011. Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads. Washington, DC: National Academies Press.

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TABLE 1 U.S. Rankings in Various International Competitiveness Indicators

Current innovation-based competitiveness[a]	**6th**	(in the world)
Percentage of young adults who have graduated from high school[b]	**11th**	(in the OECD)*
Science literacy among top students[c]	**15th**	(of 65 countries/regions tested)
College completion rate[b]	**16th**	(in the OECD)*
High school completion rate[b]	**20th**	(in the OECD)*
Density of broadband Internet penetration[d]	**22nd**	(in the world)
Science proficiency of 15-year-olds[c]	**23rd**	(of 65 countries/regions tested)
Proportion of college students receiving S&E degree[b]	**27th**	(in the OECD)*
Mathematics literacy among top students[c]	**28th**	(of 65 countries/regions tested)
Mathematics proficiency of 15-year-olds[c]	**31st**	(of 65 countries/regions tested)
Improvement in innovation-based competitiveness in the past decade[a]	**40th**	(in the world)
Quality of mathematics and science education[e]	**48th**	(in the world)
Density of mobile telephony subscriptions[d]	**72nd**	(in the world)

*The Organization of Economic Cooperation, and Development (OECD) currently has 34 members.

[a] Information Technology and Innovation Foundation, *The Atlantic Century: Benchmarking EU & U.S. Innovation and Competitiveness*, February 2009. See: *http://www.itif.org/files/2009-atlantic-century.pdf*.

[b] OECD, 2009. Rankings include OECD members and partners, and college graduation ranking is based on Tertiary-A institutions. See: Tables A1.2.a, A2.1, A3.1, and A.3.5 at *http://www.oecd.org/document/24/0,3343,en_2649_39263238_43586328_1_1_1_1,00.html*.

[c] National Center for Education Statistics, PISA 2009 Data Tables, Figures and Exhibits, Tables S1, S3, M1, and M3. See *http://nces.ed.gov/pubs2011/2011004_1.pdf*.

[d] S. Dutta and I. Mia, *Global Information Technology Report 2009–2010*: *ICT for Sustainability*, World Economic Forum, 2010.

[e] World Economic Forum, *The Global Information Technology Report 2009-2010*, Available at: *http://www.weforum.org/node/48197*.

TABLE 2 A Tale of Two Countries, A and B: Why 77 Percent of Companies Say They Will Expand in Country B

Consideration	Established Country A*	Representative Rapidly Developing Country B
Corporate Tax Rate	Second highest in the world	Multi-year tax holiday for newly established facilities
Assembly Labor Cost	Approximately $20.00 per hour	Approximately $1.50 per hour
Fringe Benefits	35% of wage	Zero — paid by government
Relative Number of Engineers for Fixed Cost	One	Eight
Average Global Standing of High School Graduates	Bottom 25%	Top 10%
Annual Domestic Market Growth Rate	3%	10%
Ratio of Corporate Litigation Cost to Research Investments	Double	Near zero
Government Regulation	Extensive	Minimal
Tax on Repatriated Foreign Earnings	Yes	No
Export Controls	Nineteen categories containing hundreds of items	Few
Sanctity of Contracts	High	Less certain
Predictability of Controls on Business	Moderate to high	Low to moderate

*Country A is the United States.

Items highlighted in red are less favorable for innovation, and those highlighted in green are more favorable.

BOX 1 OVERVIEW OF RECOMMENDATIONS

The Gathering Storm committee offered four overarching recommendations. These are highly interdependent. For example, to produce more researchers but not increase research spending would be highly counterproductive. In order of assigned importance, the four recommendations can be summarized as follows:

I. Move the United States K-12 education system in science and mathematics to a leading position by global standards.

II. Double the real federal investment in basic research in mathematics, the physical sciences, and engineering over the next 7 years (while, at a minimum, maintaining the recently doubled real spending levels in the biosciences).

III. Encourage more United States citizens to pursue careers in mathematics, science, and engineering.

IV. Rebuild the competitive ecosystem by introducing reforms in the nation's tax, patent, immigration, and litigation policies.

IMPLEMENTING ACTIONS

In support of the above general recommendations, the National Academies offered 20 specific implementing actions:

10,000 Teachers Educating 10 Million Minds

(focuses on K-12 education, the committee's unanimous highest priority).

- Provide 10,000 new mathematics and science teachers each year by funding competitively awarded 4-year scholarships for U.S. citizens at U.S. institutions that offer special programs leading to core degrees in mathematics, science, or engineering accompanied by a teaching certificate. On graduation, participants would be required to teach in a public school for 5 years and, one hopes, beyond that time by choice.
- Strengthen the skills of 250,000 current teachers by such actions as subsidizing the achievement of master's degrees (in science, mathematics, or engineering) and participation in workshops, and create a world-class mathematics and science curriculum available for voluntary adoption by local school districts throughout the nation.
- Increase the number of teachers qualified to teach Advanced Placement courses and the number of students enrolled in those courses

[17] For a complete presentation of the recommendations, see National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2007), *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future,* Washington, DC: National Academies Press.

by offering financial bonuses both to high-performing teachers and to students who excel.

Sowing the Seeds

(focuses on funding for research).

• Increase federal basic-research funding in the physical sciences, mathematics, and engineering by a real 10 percent each year over the next 7 years.

• Provide research grants each year to 200 early-career researchers, payable over 5 years.

• Provide an incremental $500 million per year for at least 5 years to modernize the nation's aging research facilities, with the expenditures overseen by a National Coordination Office for Research Infrastructure to be in the White House Office of Science and Technology Policy.

• Allocate 8 percent of government research funds to pursuits specifically chosen at the discretion of local researchers and their managers, with emphasis on projects potentially offering a high payoff even though accompanied by substantial risk.

• Establish an ARPA-E in the Department of Energy patterned after the highly successful DARPA in the Department of Defense but focused on major breakthroughs in energy security.

• Institute a Presidential Innovation Award to stimulate advances serving the national interest.

Best and Brightest

(focuses on higher education).

• Provide 25,000 competitively awarded undergraduate scholarships each year of up to $20,000 per year for 4 years in the physical and life sciences, mathematics, and engineering for U.S. citizens attending U.S. institutions.

• Provide 5,000 competitively awarded portable graduate fellowships each year of up to $20,000 per year in fields of national need.

• Grant tax credits to employers that support continuing education for practicing scientists and engineers.

• Continue to improve visa processing for international students.

• Offer a one-year visa extension to PhD recipients in science, technology, engineering, mathematics, or other fields of national need; grant automatic work permits to those meeting security requirements and obtaining employment; provide a preferential system for acquiring citizenship for those who complete their degrees; and repeal the mandatory "go-away" provision now in U.S. immigration law.

• Offer preferential visas to applicants who have special skills in mathematics, science, engineering, and selected languages.

• Modify the "deemed export" law to give faculty greater flexibility in teaching technology classes and industry less-outdated criteria for determining the appropriateness of certain exports.

Incentives for Innovation

(focuses on the innovation environment).

• To permit accelerated handling of patent matters, adopt a "first-to-file" patent system and increase employment of the U.S. Patent and Trademark Office.

• Expand and make permanent the R&D tax credit. It has been extended 11 times since it was first enacted in 1981 but never made permanent.

• Restructure the corporate income-tax laws to help make firms that create jobs in the United States more competitive.

• Increase broadband Internet access throughout the nation.

BOX 2 A FEW FACTOIDS[18]

In October 2010, China announced that it had built the world's fastest supercomputer.[19]

Federal funding of research in the physical sciences as a fraction of GDP fell by 55 percent between 1970 and 2007. The decline in engineering funding was 54 percent.[20]

India is projected to add 7 million to 8 million new mobile subscribers a month in the coming years, while total U.S. mobile subscriber growth is about 1 million per month.[21]

The U.S. is now a net importer of high technology goods, with its trade deficit reaching $80 billion in 2008.[22]

In the 2009 Program for International Student Assessment (PISA) evaluation of the Organization for Economic Cooperation and Development (OECD), U.S. 15-year-olds ranked 23rd in science and 31st in math among the 65 countries and economies tested.[23]

Thirty years ago, 10 percent of California's general fund went to higher education and three percent to prisons. Today, nearly 11 percent goes to prisons and 8 percent to higher education.

China is now second in the world in its publication of biomedical research articles, having recently surpassed Japan, the United Kingdom, Germany, Italy, France, Canada, and Spain.

In 2008, for the first time, more U.S. patents were awarded to non-U.S. companies than were awarded to U.S. companies.

Hon Hai Precision Industry Co. (computer manufacturing) employs more people than the worldwide employment of Apple, Dell, Microsoft, Intel, and Sony combined.

United States consumers spend significantly more on potato chips than the government devotes to energy R&D.

Manufacturing employment in the U.S. computer industry is now lower than when the first personal computer was built in 1975.

China has now replaced the United States as the world's number one high-technology exporter.

Eight of the 10 global companies with the largest R&D budgets have established R&D facilities in China, India, or both.

China has a $196 billion positive trade balance. The United States' balance is negative $379 billion.

Forty-nine percent of United States adults do not know how long it takes for the Earth to revolve around the Sun.

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[18] Factoid references not provided here are available in the full report, available at: *http://www.nap.edu/catalog.php?record_id=12999.*

[19] China: Our supercomputer is faster than yours! MSNBC, October 28, 2010 (*http://www.msnbc.msn.com/id/39889753/ns/technology_and_science-tech_and_gadgets/*).

[20] American Association for the Advancement of Science, Historical Table: Federal Support of Research by Discipline (*http://www.aaas.org/spp/rd/disc07tb.pdf*); NSB, 2010, Appendix Table 4-1.

[21] S. Singh, 3G, MNP to define 2011 telecom story, *Times of India*, December 23, 2010 (*http://timesofindia.indiatimes.com/business/india-business/3G-MNP-to-define-2011-telecom-story/articleshow/7148490.cms*).

[22] NSB, 2010.

[23] Organization for Economic Cooperation and Development, PISA 2009 Results (*http://www.oecd.org/dataoecd/54/12/46643496.pdf*).

The United States graduates more visual arts and performing arts majors than engineers.

To put things in perspective, the total federal investment in research in mathematics, the physical sciences and engineering each year is equal to the amount by which the nation's healthcare costs *increase* in just 9 weeks.

China's Tsinghua and Peking Universities are the two largest suppliers of students who receive PhD's—in the United States.

A Japanese company produces over 75 percent of the world's nickel-metal hydride batteries used in vehicles.

The increase in cost of higher education in America has substantially surpassed the growth in family income in recent decades. United States current and former students have amassed $633 billion in student loan debt.

In 2008, 770,000 people worked in the United States correction sector, a number which is projected to grow. During the same year there were 880,000 workers in the entire United States automobile manufacturing sector.

Between 1996 and 1999, 157 new drugs were approved in the United States. In a corresponding period 10 years later the number dropped to 74.

American youths between the ages of 8 and 18 average 7.5 hours a day in front of video games, television, and computers—often multi-tasking.

View of the Large Hadron Collider tunnel sector 3-4, under the Franco-Swiss border. Source: © Copyright CERN. See http://cdsweb.cern.ch/record/1211045/.

BOX 2 *(continued)* A FEW FACTOIDS

In 2007, China became second only to the United States in the estimated number of people engaged in scientific and engineering research and development.

In January 2010, China's BGI made the biggest purchase of genome sequencing equipment ever.

Almost one-third of U.S. manufacturing companies responding to a recent survey say they are suffering from some level of skills shortages.

According to the ACT* College Readiness report, 78 percent of high school graduates did not meet the readiness benchmark levels for one or more entry-level college courses in mathematics, science, reading, and English.

All the National Academies *Gathering Storm* committee's recommendations could have been fully implemented with the sum America spends on cigarettes—with over $60 billion left over each year.

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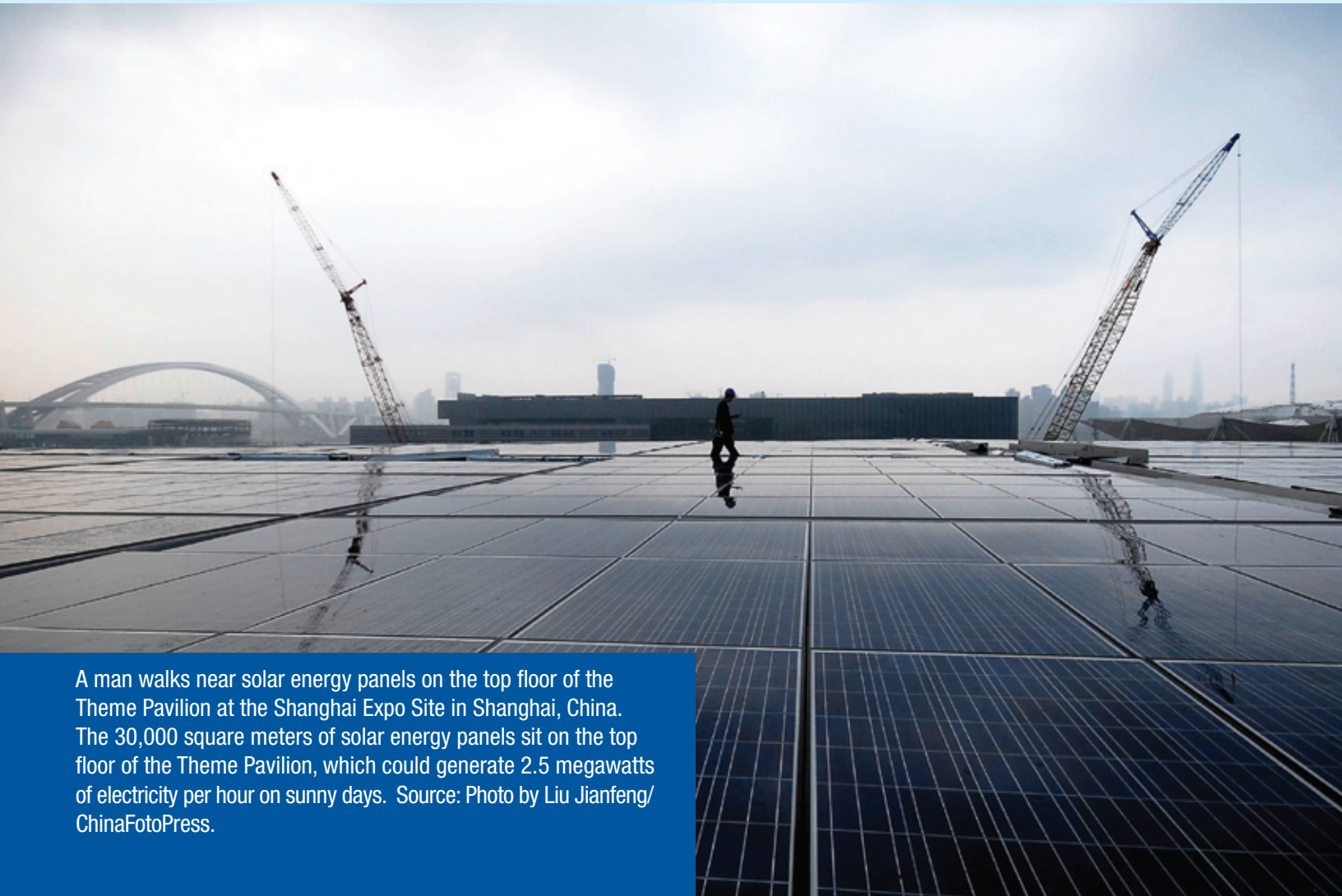
*ACT, Inc. is a non-profit organization best known for its standardized test used in college admissions.



A man walks near solar energy panels on the top floor of the Theme Pavilion at the Shanghai Expo Site in Shanghai, China. The 30,000 square meters of solar energy panels sit on the top floor of the Theme Pavilion, which could generate 2.5 megawatts of electricity per hour on sunny days. Source: Photo by Liu Jianfeng/ ChinaFotoPress.

BOX 3 QUOTES

"Science is more essential for our prosperity, our security, our health, our environment, and our quality of life than it has ever been."

PRESIDENT BARACK OBAMA

"If we ensure that America's children succeed in life, they will ensure that America succeeds in the world."

PRESIDENT GEORGE W. BUSH

"Where nations once measured their strength by the size of their armies and arsenals, in the world of the future knowledge will matter most."

PRESIDENT BILL CLINTON

"The history of modernization is in essence a history of scientific and technological progress. Scientific discovery and technological inventions have brought about new civilizations, modern industries, and the rise and fall of nations . . . I firmly believe that science is the ultimate revolution."

WEN JIABAO, Premier, People's Republic of China

"Basic scientific research is scientific capital."

VANNEVAR BUSH

". . . in today's integrated and digitized global market, where knowledge and innovation tools are so widely distributed. . . . : Whatever can be done, will be done. The only question is will it be done *by* you or *to* you."

THOMAS L. FRIEDMAN, Author, "The World Is Flat"

"Such (scientific and engineering) research is what canals and roads once were—a prerequisite for long-term economic vitality."

GEORGE WILL, Pulitzer Prize-Winning Columnist

"(Without a change in U.S. government policy) the next big thing will not be invented here. Jobs will not be created here. And wealth will not accrue here."

PAUL OTELLINI, CEO, Intel Corporation

BOX 3 *(continued)*

QUOTES

"For decades the United States has enjoyed unquestioned leadership in various technologies required for military superiority. This is no longer true."

RICHARD ROCA, Director, Johns Hopkins University Applied Physics Laboratory

"My partners and I found the best fuel cells, the best energy storage, and the best wind technologies were all born outside the United States…we need to restock the cupboard or be left behind."

JOHN DOERR, Partner, Kleiner Perkins

"All of us are going where the high IQ's are."

BILL GATES, Founder, Microsoft Corporation

"We had more sports-exercise majors graduate than electrical engineering graduates last year. If you want to become the massage capital of the world, you're well on your way."

JEFF IMMELT, CEO, General Electric Co.

"At this rate . . . we'll be buying most of our wind generators and photovoltaic panels from China."

ARDEN BEMENT, former director, National Science Foundation

"If the United States doesn't get its act together, DuPont is going to go to the countries that do."

CHAD HOLLIDAY, Retired Chairman and CEO, DuPont Corporation

"We educate the best and the brightest and then we don't give them a green card."

MICHAEL BLOOMBERG, Mayor, New York City

"If we're number one in technology, why do I have to call India for tech support?"

JAY LENO, Entertainer

"Innovation distinguishes between a leader and a follower."

STEVE JOBS, CEO, Apple

"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 . . ."

United States Commission on National Security for the 21st Century, 2001

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