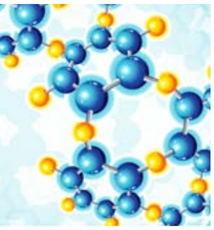
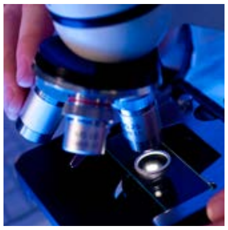
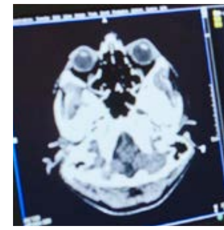



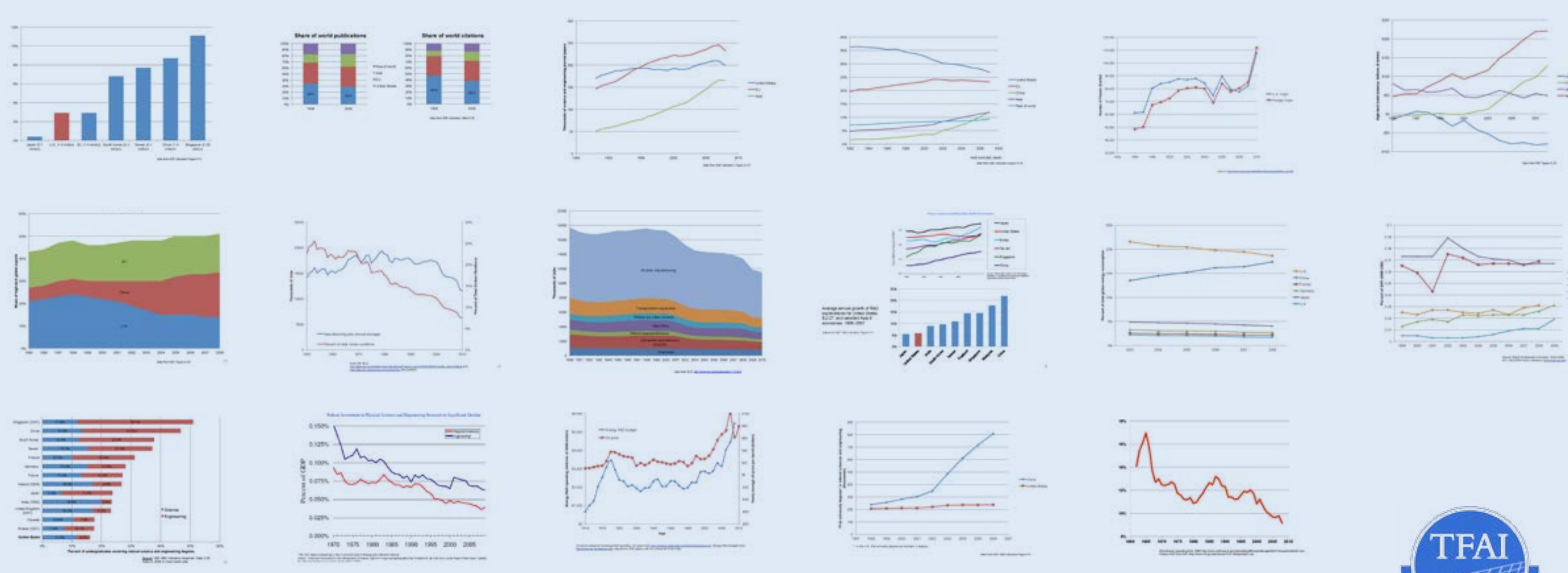


AMERICAN EXCEPTIONALISM, AMERICAN DECLINE?

Research, the Knowledge Economy, and the 21st Century Challenge

December 2012



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AMERICAN EXCEPTIONALISM, AMERICAN DECLINE?

Research, the Knowledge Economy, and the 21st Century Challenge

Benchmarks Of Our Innovation Future III
December 2012

The Task Force on American Innovation is a coalition of businesses, scientific and university organizations that came together in 2004 out of concern that insufficient investment by the federal government in research in the physical sciences and engineering was threatening the nation's global economic leadership and national security in an increasingly competitive world.

http://www.futureofinnovation.org

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Executive Summary

Despite a strong history of being the world leader in research and discovery, the United States has failed to sufficiently heed indications that our advantage is diminishing and that we may soon be overtaken by other nations in these areas, which are critical to economic growth and job creation.

American Exceptionalism, American Decline? updates the Task Force on American Innovation's 2005 report *The Knowledge Economy: Is the United States Losing Its Competitive Edge?*[1] Based on a number of key benchmarks, that report found: "The United States still leads the world in research and discovery, but our advantage is rapidly eroding, and our global competitors may soon overtake us." A November, 2006 update of the report, entitled *Measuring the Moment: Innovation, National Security, and Economic Competitiveness*, expanded the benchmarks and found a continuation of these trends.[2]

In the six years since the first report, there have been few signs that the U.S. is taking the steps necessary to reverse the tide. Even the reauthorization of the America COMPETES Act, despite its lofty vision, has not been met with a commensurate financial commitment from Congress. Although the American Recovery and Reinvestment Act provided a temporary boost in federal investments in scientific research, that boost has expired. Some of this reflects the difficult economic and fiscal environment that has challenged our nation's policymakers.

There are strong indications that the health of the U.S. innovation system is faltering. First, the stagnation of the American K-12 education system and the inadequate numbers of U.S. students entering the STEM (science, technology, engineering, and mathematics) disciplines are threatening the nation's ability to recruit, train, and retain the scientists and engineers required to create new products and systems. On this subject, key findings of this report include:

- *In 2009, the U.S. ranked 27th among developed nations in the proportion of college students receiving undergraduate degrees in science or engineering.*
- *China now produces nearly an equal number of natural science and engineering doctoral degrees compared to the U.S., having increased from approximately 5,000 in 1997 to over 20,000 in 2006.*
- *In 2007, China became second only to the U.S. in the estimated number of people engaged in scientific and engineering R&D.*

Second, the U.S. is not sending a clear signal that the country is supporting its science and engineering innovators. Years of boom-and-bust cycles of federal funding for scientific research have disrupted the ability of researchers to obtain funding for projects, scared away private sector investments, and sent a chilling signal to young people considering careers in STEM fields. In this tenuous economy, students need greater assurance that jobs will be available when they complete their degrees. Similarly, researchers must know that the infrastructure and federal funding to support their current and future research will

1 http://www.futureofinnovation.org/PDF/Benchmarks.pdf
2 http://www.futureofinnovation.org/PDF/BII-FINAL-HighRes-11-14-06_nocover.pdf

be preserved and strengthened. To maintain its global competitiveness and world leadership, the U.S. must and can both achieve fiscal discipline and build a better America through scientific research and education. Relevant findings of this report include:

- *Since the 1960s, when the U.S. devoted 17 percent of the federal budget to R&D for agencies like NASA and DARPA, outlays have fallen to around nine percent of the discretionary budget.*
- *The U.S. share of worldwide scientific publications and citations has declined. Europe has surpassed the U.S. in science and engineering publications, and Asia is rapidly catching up.*
- *Utility patents (issued for the invention of a new and useful process, machine, manufacture, or composition of matter, or a new and useful improvement) of foreign origin have surpassed patents of U.S. origin. Researchers have found strong correlations between public R&D investment and the number of new patents across a variety of energy technologies, including wind, fuel cells, nuclear fission and fusion, and photovoltaics.*

Finally, the stability of our investments in basic scientific and engineering research strongly influences vital sectors of the U.S. economy, including energy and manufacturing. Federal investments in research precipitate additional private sector research investments, as demonstrated by the pharmaceutical industry, which significantly expanded its own R&D on the heels of increased federal investments in biomedical research.

This report cites trends in international energy investments which demonstrate that the U.S. is ceding ground in energy innovation. Key findings include:

- *The energy industry spends 0.3 percent of domestic sales revenue on R&D, compared with nearly 26 percent by the communications sector and 21 percent by the semiconductor industry.*
- *More than six million American manufacturing jobs have been lost since January 2000, exceeding the losses of any other economic sector. Some manufacturers have outsourced their R&D operations to foreign partners or subsidiaries.*
- *The U.S. is losing its share of high-tech global exports and remains a net importer of high-technology products, while Asian countries remain powerful high-tech exporters.*
- *In 2008, U.S. publicly-funded energy R&D spending was less than half what it had been three decades before in real purchasing power.*
- *By 2013, one-third of the energy workforce in the U.S. will be eligible for retirement.*

Introduction

Since the end of the Second World War, the United States has been the world's scientific and technological leader. The strength of our distinctive partnership among the federal government, universities, and the private sector has allowed us to outpace the world in discovery and innovation, attract the most talented people, and spark sustained growth in an economy increasingly dependent upon the generation of new knowledge and ideas. Yet the 21st century has seen the advent of a new world that puts our leadership at risk: a "flatter" world where nations like China and India have emerged as economic powers, and where the U.S. faces new fiscal and national security challenges both at home and abroad.

In 2005, the Task Force on American Innovation issued *The Knowledge Economy: Is the United States Losing Its Competitive Edge?*, a report that assembled a set of benchmarks to assess the international standing of the United States in science and technology.[1] The report found: "The United States still leads the world in research and discovery, but our advantage is rapidly eroding, and our global competitors may soon overtake us." A November, 2006 update of the report, entitled *Measuring the Moment: Innovation, National Security, and Economic Competitiveness*, expanded the benchmarks and found a continuation of these trends.[2]

> The United States still leads the world in research and discovery, but our advantage is rapidly eroding, and our global competitors may soon overtake us.

In the six years since the first report was released, there have been few signs that the U.S. is taking the necessary actions to reverse the tide. Even the reauthorization of the America COMPETES Act, despite its lofty vision, has not been met with a commensurate financial commitment from Congress. Some of this reflects the difficult fiscal and economic environment that has challenged our nation's policymakers. In recent years, the federal budget deficit and national debt have expanded at an alarming rate. The American Recovery and Reinvestment Act provided a temporary boost to federal investments in scientific research, but that boost has now expired.

Meanwhile, once-developing nations and emerging economic giants such as China and India continue to ramp up investments in research and development (R&D). Their actions reflect an acknowledgment that science and technology once helped make the U.S. the most powerful nation on earth, and similar power could belong to the nation that most successfully harnesses its intellectual resources and cultivates innovation within its borders.

Many factors have contributed to the U.S. remaining an exceptional nation. Our freedoms and our spirit of innovation, combined with our unique government-university-industry partnerships, have historically created a strong infrastructure and an ecosystem that has fostered entrepreneurism and sustained creativity. All of these ingredients are required for success, and must be maintained. However, as we strive

1 *http://www.futureofinnovation.org/PDF/Benchmarks.pdf*
2 *http://www.futureofinnovation.org/PDF/BII-FINAL-HighRes-11-14-06_nocover.pdf*

…science and technology once helped make the U.S. the most powerful nation on earth, and similar power could belong to the nation that most successfully harnesses its intellectual resources and cultivates innovation within its borders.

to strengthen our workforce and sustain our ability to create and deploy new technologies, we face new and historic challenges.

There are strong signs that the U.S. innovation system is in need of repair. First, the continuing stagnation of the American K-12 education system and the inadequate support for STEM (science, technology, engineering, and mathematics) disciplines threaten the nation's ability to recruit, train, and retain the scientists and engineers required to create new products and systems. In January 2010, the latest National Assessment of Educational Progress showed that fewer than half of American students were proficient in science. [3] Other indicators in this report add further weight to the seriousness of this problem. Our educational system is not keeping pace with the needs of the 21st century.

Boom-and-bust cycles of federal funding for scientific research send mixed signals to researchers, private industry, and young people considering careers in STEM fields.

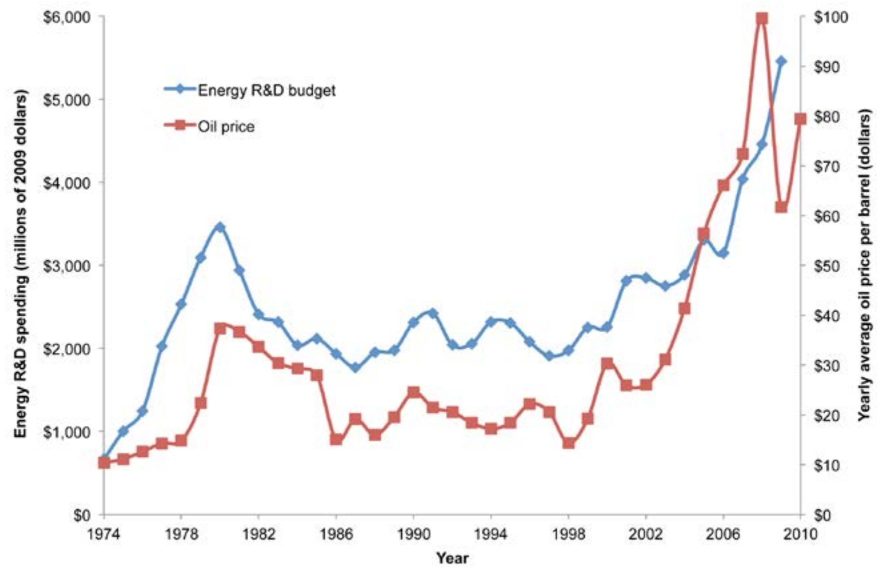
Second, the U.S. is not sending a clear investment or policy signal that there is strong support for innovation. Boom-and-bust cycles of federal funding for scientific research send mixed signals to researchers, private industry, and young people considering careers in STEM fields. In this tenuous economy, more assurances must be provided to students that jobs will be available when they complete their degrees. Similarly, researchers must know that the infrastructure and federal funding to support their current and future research will be preserved and strengthened.

Energy and Manufacturing Innovation

In today's "flat" world, the stability of our investments in basic scientific and engineering research strongly influences vital sectors of the U.S. economy. We must strike the right balance between fiscal discipline and building a better America through scientific research and education. Energy is one example. The need for alternative energy sources has been well-known for decades. Despite this reality, since the 1973 oil embargo crisis, federal funding of energy R&D has fluctuated with oil prices, usually going up only after a crisis has begun, before plummeting at the first signs of recovery (Chart 1-1). This, too, sends an uncertain signal to our energy producers and—more importantly—to energy innovators. And it aids the other nations that supply us with the energy we need. Reaction to crisis, rather than any deliberate plan for the future, has guided our policy.

3 *http://nationsreportcard.gov/science_2009/summary.asp*. Students in grades 4, 8, and 12 were tested.

Chart 1-1: Federal investments in energy R&D track oil prices



Oil prices compared to energy R&D spending. Oil prices from http://research.stlouisfed.org/fred2/data/oilprice.txt. Energy R&D budgets from http://www.iea.org/stats/rd.asp, adjusted to 2009 dollars with the Consumer Price Index.

Reaction to crisis, rather than any deliberate plan for the future, has guided our policy.

Our policies should not be tied to trends in oil prices, but rather should address the looming issue of our nation's economic dependence on, and vulnerability to, oil. Although new hydraulic fracturing, or fracking, techniques—developed based on past federal research investments—are opening up previously unreachable domestic gas and oil reserves, worldwide demand for oil continues to grow leaving the U.S. at the mercy of global oil prices and global energy markets.

While some choices about energy technologies are policy-dependent, many basic research questions underlying the future use of these technologies remain unanswered. [4] A bevy of reports from organizations within and outside the government have recently highlighted these issues, underscoring an urgency to focus more attention—and investment—on the basic research underlying energy technologies.[5] This energy vulnerability places U.S. economic and national security in precarious positions, in both the immediate and the long term. The most recent Index of U.S. Energy Security Risk report from the U.S. Chamber of Commerce indexed our energy security risk at 98 out of 100, a 6.5-point increase from 2009 and the fourth-highest score since 1970.[6]

4 *http://www.sc.doe.gov/bes/reports/files/NSSSEF_rpt.pdf*

5 *http://www.energy.gov/news/9829.htm*; *http://www.americanenergyinnovation.org/*; *http://www.aps.org/policy/reports/upload/rags-revisited.PDF*; *http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-energy-tech-report.pdf*; *http://thebreakthrough.org/blog/Post-Partisan%20Power.pdf*

6 *http://www.energyxxi.org/images/Energy_Index_2011_FINAL.pdf*

Not only is manufacturing capacity being exported at an alarming rate, but the R&D that supports it is leaving as well.

Finally, this report highlights the strong links between innovation and manufacturing. As with energy, the manufacturing sector is closely tied to the knowledge economy, a highly skilled workforce, and investments in basic research. Improving our supply chains, retraining our workforce, and investing in high-technology manufacturing can enhance our nation's economy and regrow our once-dominant manufacturing base. The U.S. retains considerable capability for producing and commercializing technological innovations and, indeed, remains the world's largest manufacturing economy.[7] However, we are quickly losing the capacity to "capture" innovations that are produced here at home, as the manufacture of commodities moves abroad, eroding a competitive edge enjoyed by this country for decades. Not only is manufacturing capacity being exported at an alarming rate, but the R&D that supports it is leaving as well.[8]

This report serves to update the earlier benchmarks reports from 2005 and 2006, and highlights the energy and manufacturing sectors because these sectors arguably hold the highest potential for reinvigorating the U.S. economy by cultivating new products and industries that create jobs in this country. This report will also show that our economy and our national security are becoming increasingly interlinked, and thus dependent upon, the outcomes of basic research.

Sustained investments in scientific research, particularly in the physical sciences, will provide certainty to students, researchers, and private industry, and will also indicate to the global workforce that the U.S. is and will remain the perennial nation for innovation. A deliberate investment strategy will help us meet and overcome current and future challenges in energy, manufacturing, and other emerging technology industries, allowing us to maintain and build upon our dominant economic position and enhancing our national security.

Sustained investments in scientific research, particularly in the physical sciences, will provide certainty to students, researchers, and private industry, and will also indicate to the global workforce that the U.S. is and will remain the perennial nation for innovation.

The choice is clear: renew the powerful government-university-industry partnerships that have made America so exceptional, or fail to act and risk further stagnation and decline. America's workers—and the world—are watching.

7 *http://www.milkeninstitute.org/pdf/JFAFullReport.pdf*

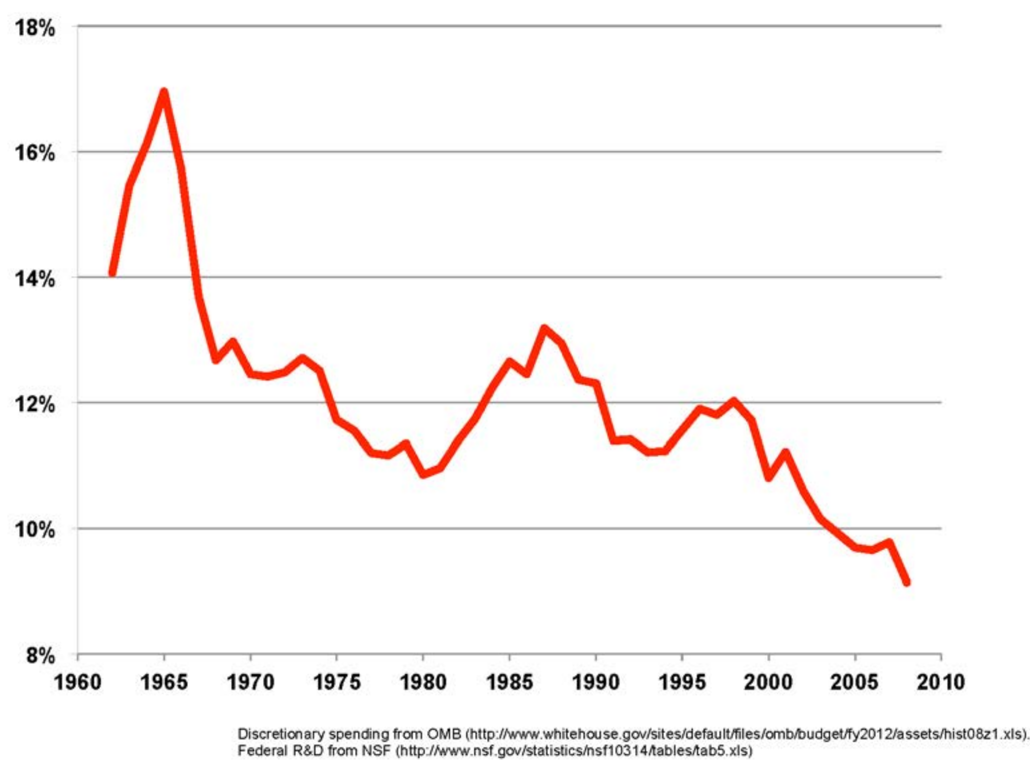
8 *http://www.compete.org/images/uploads/File/PDF%20Files/2010_Global_Manufacturing_Competitiveness_Index_FINAL.pdf*

Benchmarks of the Knowledge Economy

Research Investment Benchmarks

The federal government is investing less in R&D, both as a percentage of total discretionary spending and as a percentage of U.S. GDP.

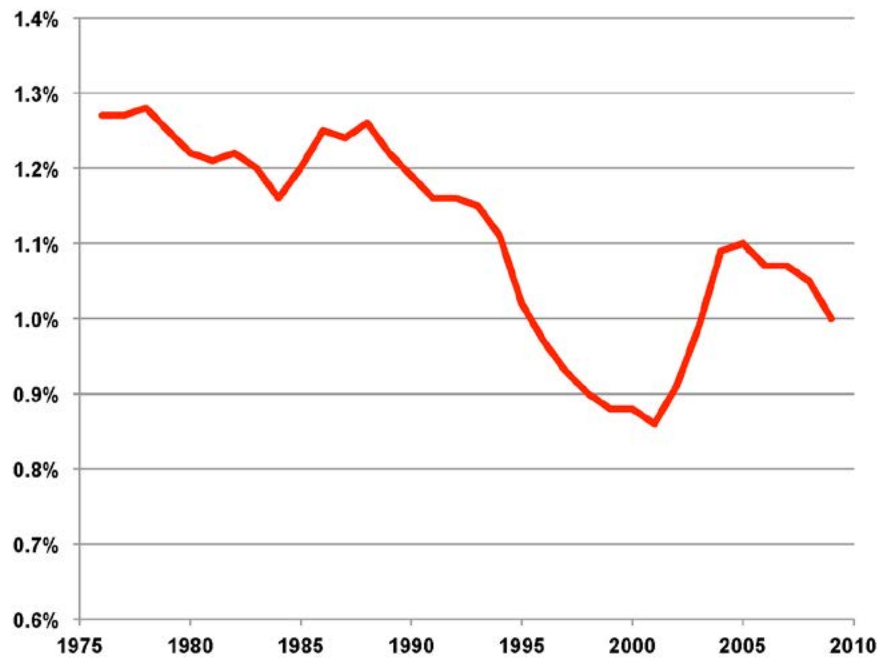
Chart 2-1: Total federal R&D outlays as a percentage of total discretionary spending: FY 1962-2008



The U.S. spent up to 17 percent of the national budget on R&D during the space race of the 1960s; in recent years, outlays have fallen to around nine percent of the federal discretionary budget (Chart 2-1).[9]

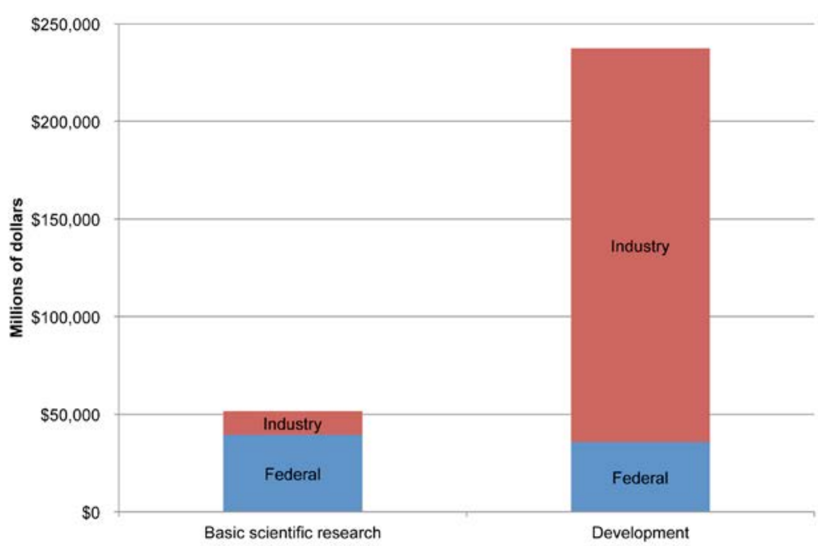
9 *http://www.scienceprogress.org/wp-content/uploads/2011/02/SciProgResearchandDevelopment-101.pdf*

Chart 2-2: Total federal R&D as a percentage of U.S. GDP: FY1976–2009



Data from AAAS: http://www.aaas.org/spp/rd/tbrdgdp09.pdf

Chart 2-3: The federal government is a critical source of investments in basic scientific research



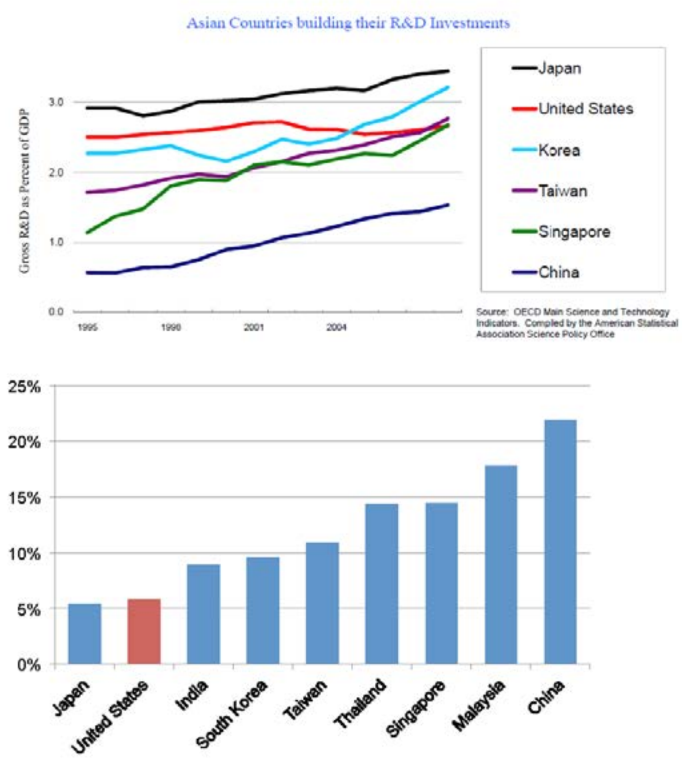
Data from NSF, for 2008

Because returns on research investments accrue over the long term, and not necessarily to those who fund or perform the research, the federal government is the critical source of investments in basic scientific research.

Federal investments are crucial to the private sector's ability to develop new products.

Today, private industry invests nearly three times what the federal government spends on R&D, accounting for nearly two-thirds of total U.S. R&D investment.[10] Yet, as shown in the charts above, it is the federal government that invests more in basic scientific research, while almost all industry funding is for development (Chart 2-3). The federal government thus plays a crucial role in the innovation system by funding scientific research, while industry invests in taking breakthroughs from that research to market. Federal investments are crucial to the private sector's ability to develop new products.

Chart 2-4: Asian countries are building their R&D investments.

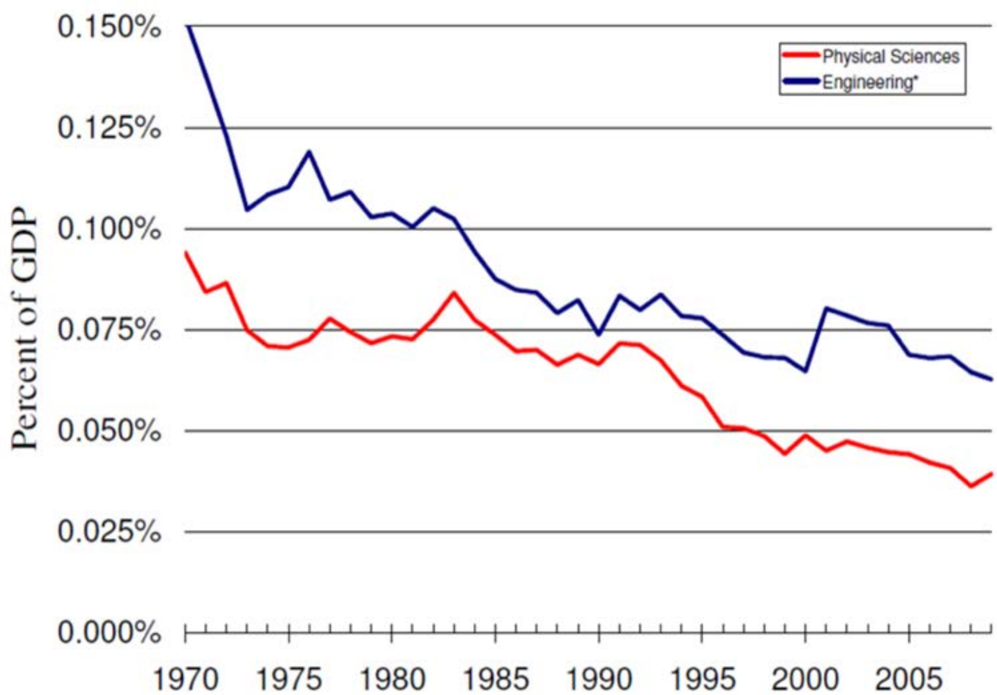


Average annual growth of R&D expenditures for United States, EU-27, and selected Asia-8 economies: 1996–2007

Data from NSF S&E Indicators Figure 0-4

10 *http://www.scienceprogress.org/wp-content/uploads/2011/02/SciProgResearchandDevelopment-101.pdf*

Chart 2-5: Federal investment in physical sciences and engineering research, as a percentage of GDP, is in significant decline



*The 2001 jump in engineering is due to reclassification of funding and is therefore artificial. Source: AAAS. Updated by the American Statistical Association Science Policy Office.

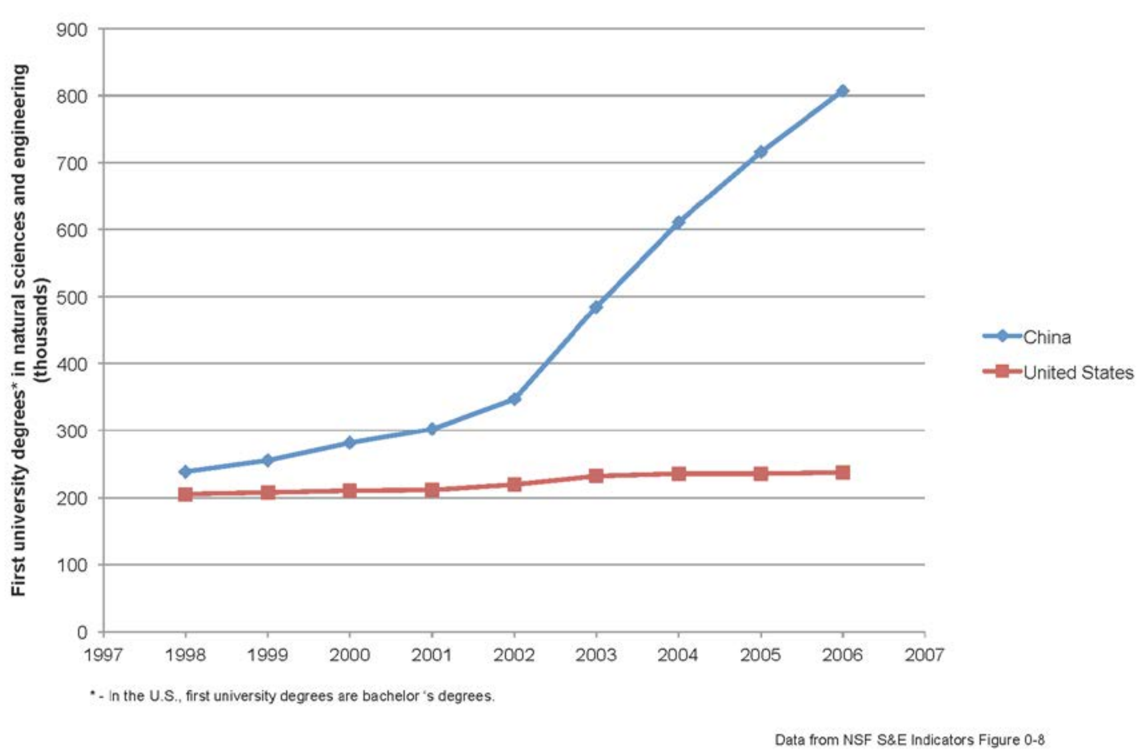
ENERGY FACT: In 2008, U.S. publicly-funded energy R&D spending was less than half what it had been three decades before in real purchasing power.[11]

11 *http://www.greentechhistory.com/wp-content/uploads/2009/07/federal-investment-in-energy-rd-2008.pdf*; D. Kammen and G. Nemet, Reversing the Incredible Shrinking Energy R&D Budget, Issues in Science and Technology, Fall 2005.

Education Benchmarks

The number of Chinese students earning science and engineering undergraduate degrees is growing dramatically, while the number of U.S. students doing so is barely rising (Chart 2-6).

Chart 2-6: Chinese and U.S. students earning bachelor's degrees in science and engineering

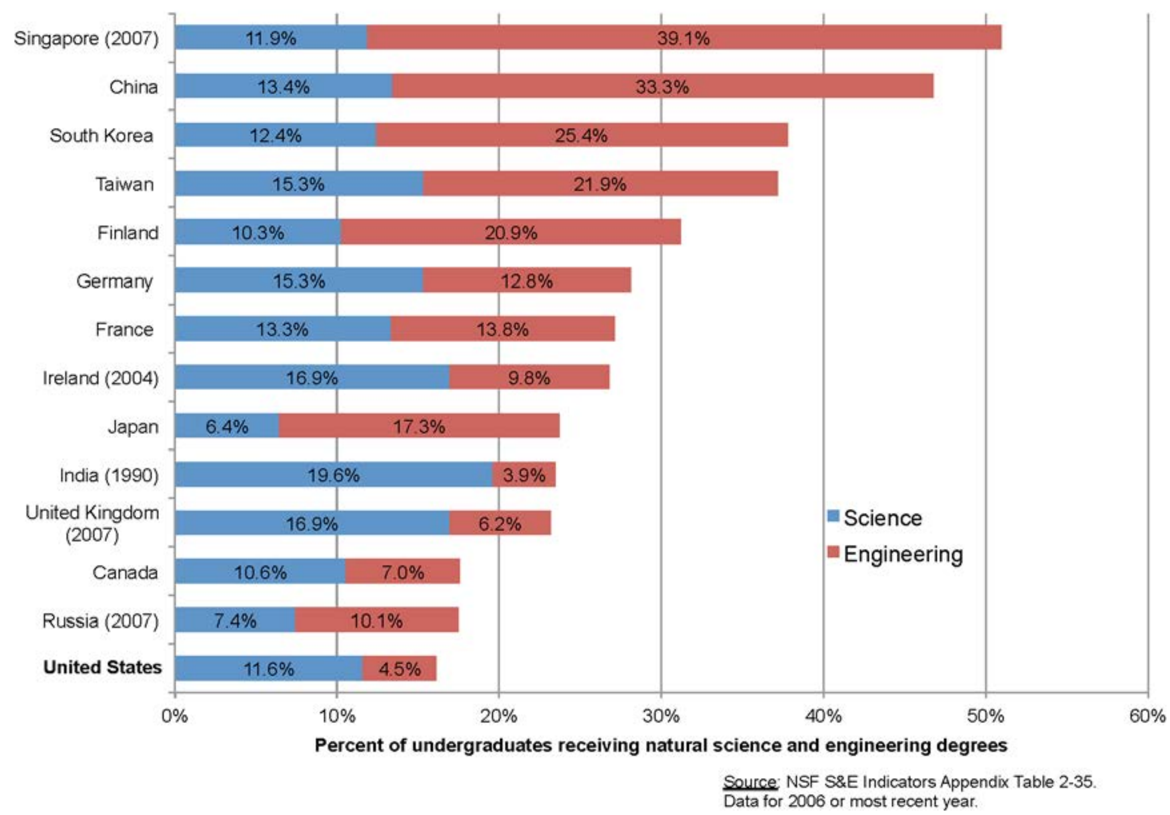


Between 1998 and 2006, the number of undergraduate science and engineering degrees awarded in China more than tripled. At the same time, U.S. degrees increased by only 15 percent. In 2006, natural sciences and engineering degrees earned by Japanese and South Korean students were approximately the same as the number earned by U.S. students, even though the U.S. population is nearly twice as large.[12]

The United States lags behind other nations in its percentage of undergraduate degrees awarded in science and engineering fields (Chart 2-7).

12 *http://www.nsf.gov/statistics/seind10/pdf/overview.pdf*

Chart 2-7: Percentage of undergraduates receiving undergraduate degrees in the natural sciences and engineering in selected nations



The World Economic Forum, in 2010, ranked the U.S. 52nd out of 133 nations in quality of math and science education.[13]

According to the OECD, the U.S. recently ranked 27th among developed nations in the proportion of college students receiving undergraduate degrees in science or engineering.[14]

U.S. students earned 11 percent of the world's four million science and engineering undergraduate degrees awarded in 2006, compared to 21 percent by Chinese students. About 15 percent of U.S. bachelor's degrees are in science and engineering, compared to 53 percent in China. About 5 percent of U.S. bachelor's degrees are in engineering, compared to 20 percent in Asia and 33 percent in China.[15]

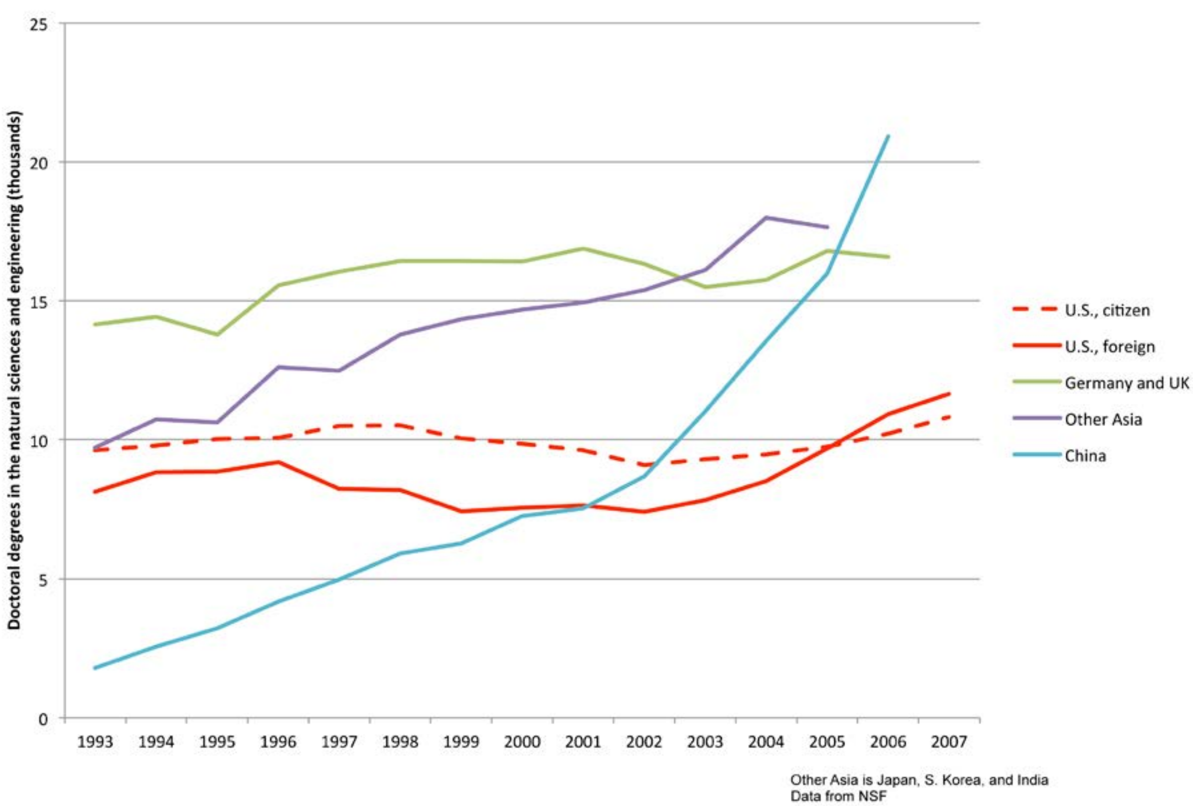
13 *http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf*

14 Organization for Economic Cooperation and Development, Education at a Glance 2009: OECD Indicators; Table A-3.5. as cited by RAGS Revisited.

15 *http://leadenergy.org/wp-content/uploads/2010/12/SAISReview-AmericanPower-NorrisShenai-Nov2010.pdf* and NSF Indicators 2010.

The U.S. trails Asia and Europe in numbers of science and engineering doctoral degrees awarded.

Chart 2-8: Doctoral degrees in natural sciences and engineering for selected nations

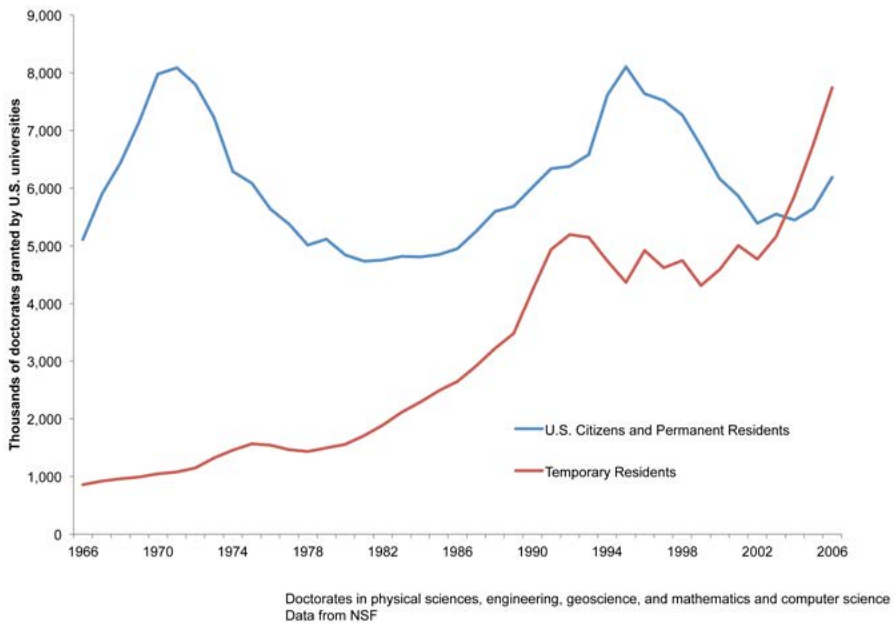


China now produces nearly as many natural science and engineering doctoral degrees as the U.S., having increased from approximately 5,000 in 1997 to over 20,000 in 2006.[16] During this same time period, the number of U.S. doctorates in these fields increased by about 3,000 (Chart 2-8).[17]

16 *http://leadenergy.org/wp-content/uploads/2010/12/SAISReview-AmericanPower-NorrisShenai-Nov2010.pdf*, summarizing NSF Indicators.

17 *http://www.nsf.gov/statistics/seind10/c2/fig02-27.xls*

Chart 2-9: At U.S. universities, foreign students earning doctorates in physical sciences and engineering outnumber U.S. students



Since 2000, the number of foreign students studying physical sciences and engineering in U.S. graduate schools has exceeded the number of U.S. students (Chart 2-9).

A 2008 study by the Commission on Professionals in Science and Technology found that the two largest suppliers of students who receive doctorates in the U.S. are not U.S. universities; they are Tsinghua University and Peking University in China.[18]

Foreign students disproportionately come to the U.S. to earn degrees in science and engineering fields. Between 2004 and 2009, the proportion of U.S. science and engineering doctorates awarded to foreign students ranged between 35 percent and 39 percent; during the same period, the proportion of U.S. non-science and engineering doctorates awarded to foreign students ranged from 16 percent to 17 percent.[19]

ENERGY FACT: Between 1993 and 2007, the number of U.S. doctorates awarded in fields important to energy innovation rose only modestly. For example, doctorates in engineering increased by 38 percent, and the number awarded in physical sciences increased by 15 percent. At the same time, the number of U.S. doctorates awarded in medical sciences increased by over 500 percent. [20] The pattern of federal investment is at least part of the explanation; it has been shown to be correlated, for example, with student enrollment in nuclear engineering programs.[21]

18 *http://www.sciencemag.org/content/321/5886/185.full*

19 *http://www.nsf.gov/statistics/infbrief/nsf11305/* Table 2.

20 *http://www.nsf.gov/statistics/seind10/c2/fig02-14.xls*

21 *http://www.esi.nagoya-u.ac.jp/h/isets07/Contents/Proceedings/FinalManuscript/Session08/1173Ahn.pdf* Figure 11 and *http://www.unene.ca/newg/Canada6_29_06-gutteridge.ppt* Slide 4.

Workforce Benchmarks

Other nations are adding researchers more quickly than the United States.

Chart 2-10: Average annual growth in number of researchers in selected regions and countries: 1995-2007

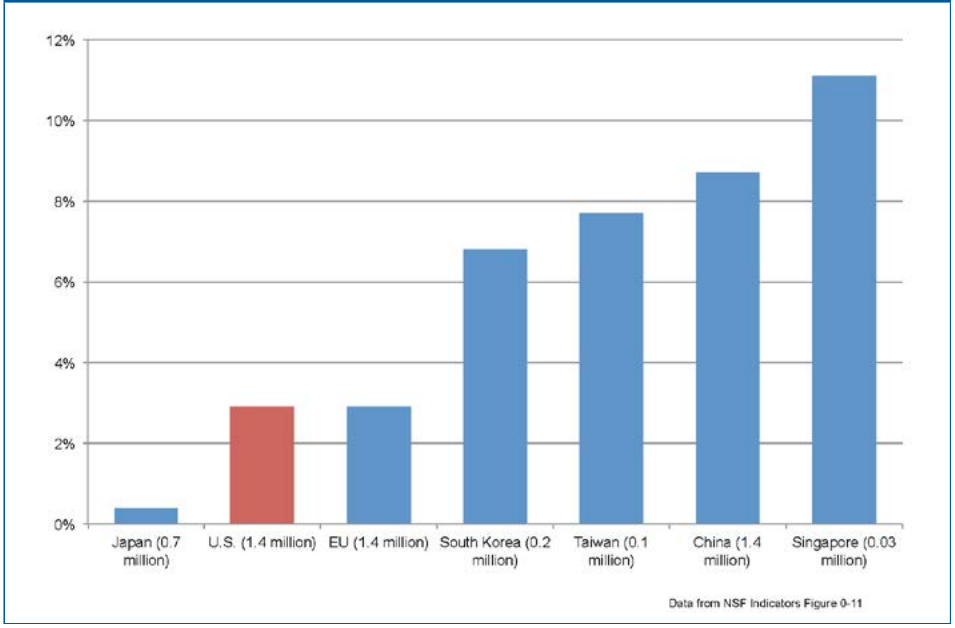
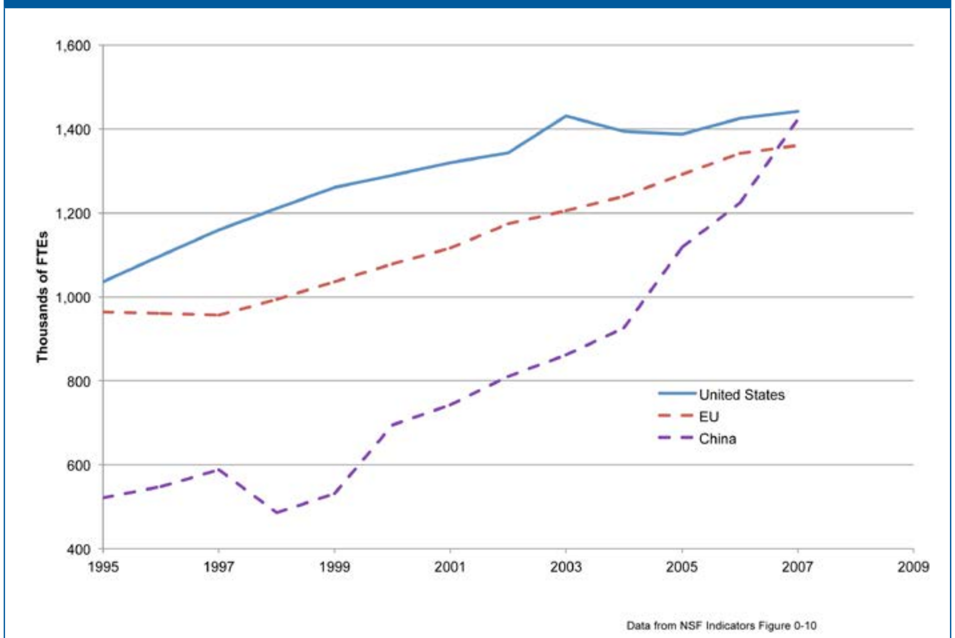


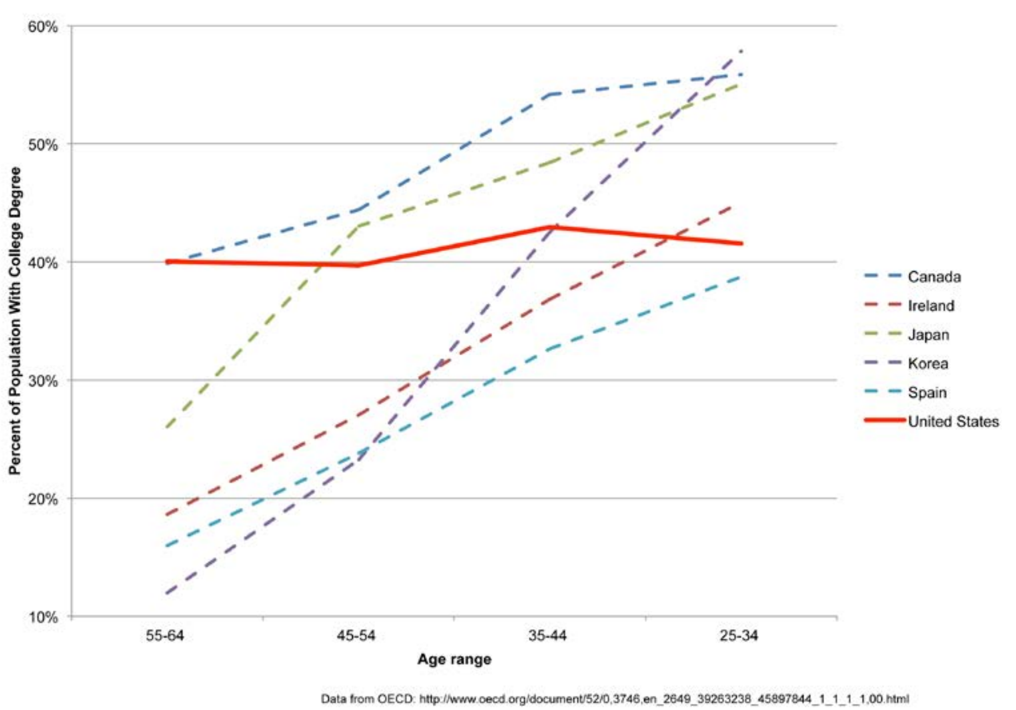
Chart 2-11: Number of researchers in the U.S., China, and the EU



Between 1995 and 2006, the U.S. experienced approximately 3 percent annual growth of researchers, while China averaged nearly 9 percent annual growth (Chart 2-10). China's total number of researchers nearly tripled, from just over half a million to more than 1.4 million, making China's numbers nearly equivalent to those of the U.S (Chart 2-11).[22]

In 2007, China became second only to the U.S. in the estimated number of people engaged in scientific and engineering R&D.[23]

Chart 2-12: In other nations, a higher proportion of younger people have college degrees. In the U.S., this figure is stagnant



In 2003, one quarter of college-educated U.S. workers in science and engineering occupations were foreign born. Forty percent of doctorate holders in science and engineering occupations were foreign born. About half of all foreign-born scientists and engineers were from Asia, and more than a third of U.S. resident doctorate holders came from China (22 percent) and India (14 percent) combined.[24]

22 *http://leadenergy.org/wp-content/uploads/2010/12/SAISReview-AmericanPower-NorrisShenai-Nov2010.pdf* and NSF Indicators.
23 NSF Indicators as cited by RAGS update.
24 *http://leadenergy.org/wp-content/uploads/2010/12/SAISReview-AmericanPower-NorrisShenai-Nov2010.pdf* and NSF Indicators.

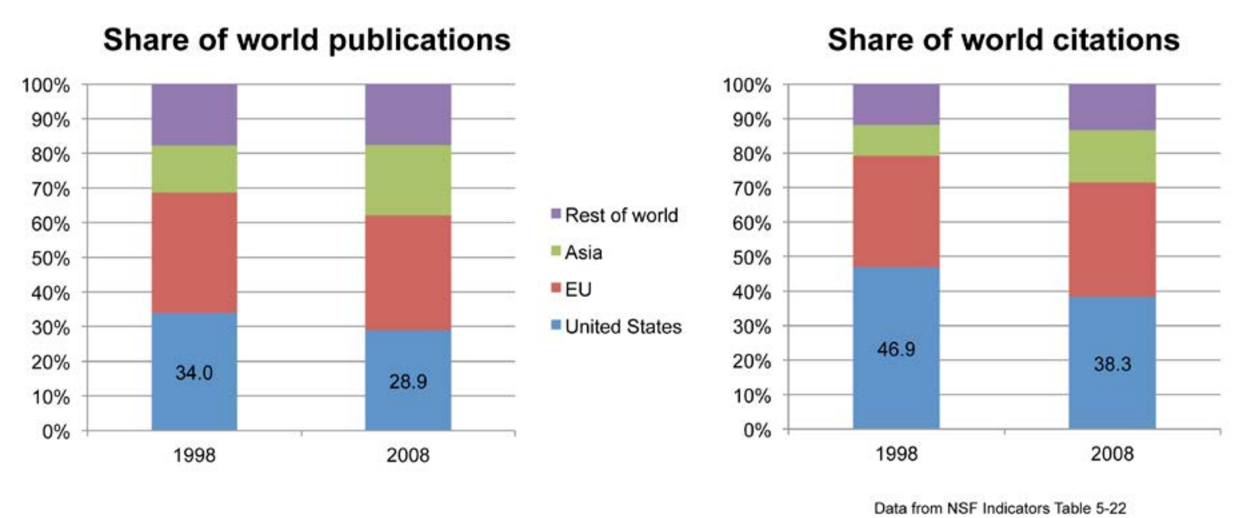
U.S. employers are having trouble finding enough qualified engineers to fill available positions, especially in the defense industry, which must rely upon domestic scientific and engineering talent.

Globally, employers ranked engineers as the fourth most difficult job to fill. In China, engineers ranked ninth most difficult, but in the U.S., they ranked third most difficult.[25]

ENERGY FACT: In 2013, due to retirements, and for other reasons, the electric utility sector will need to refill or replace more than one third of its workforce.[26]

Knowledge Creation Benchmarks

Chart 2-13: The U.S. share of worldwide scientific publications and citations has declined

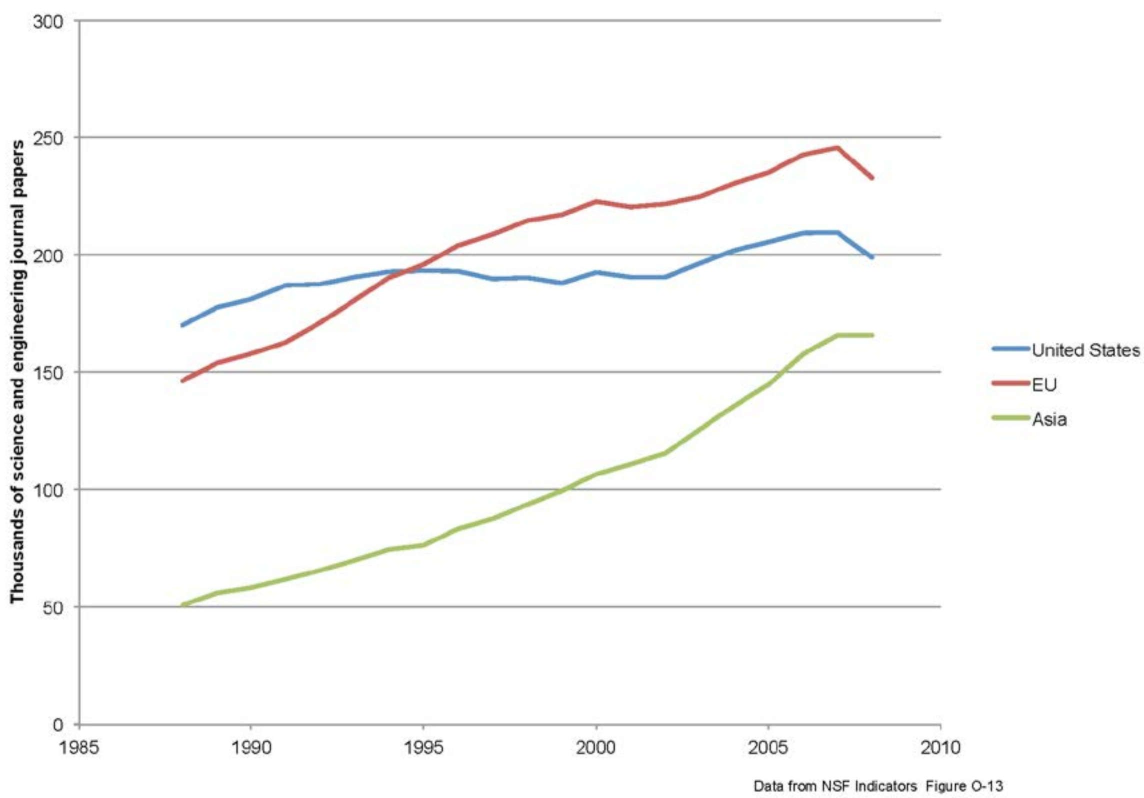


Europe has surpassed the U.S. in science and engineering publications, a key metric of scientific productivity, and Asia is rapidly catching up (Chart 2-13).

25 *http://files.shareholder.com/downloads/MAN/1262980731x0x469531/7f71c882-c104-449b-9642-af56b66c1e6d/2011_Talent_Shortage_Survey_US.pdf*

26 *http://bipartisanpolicy.org/sites/default/files/Final%20report.pdf*

Chart 2-14: Science and engineering journal publications in the U.S., EU, and Asia

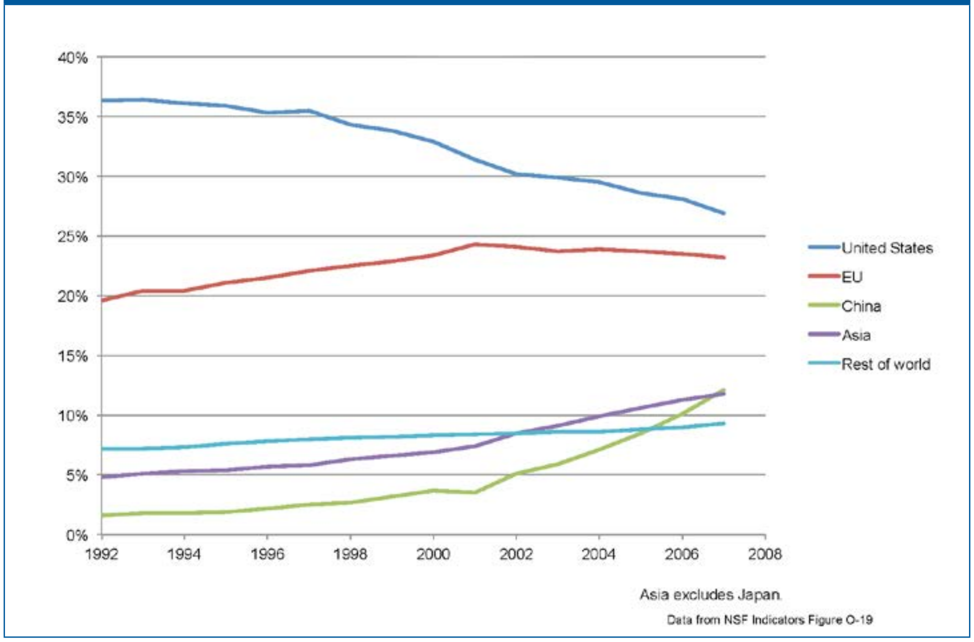


In less than 15 years, China has moved from 14th place to second place in published research articles (behind the United States).[27]

Scientific publications from Asian countries (China, India, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Taiwan, and Thailand) are less likely to cite U.S. work, and more likely to cite scientific work done in other regions (Chart 2-15).

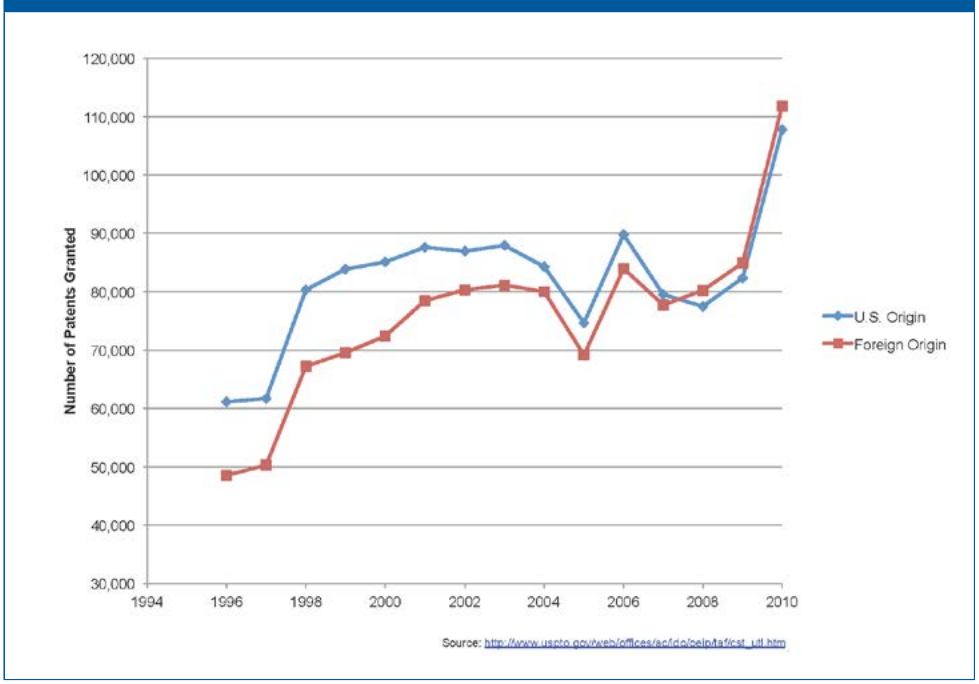
27 *http://www.washingtonpost.com/wp-dyn/content/article/2010/06/27/AR2010062703639.html*

Chart 2-15: Citations in science and engineering articles, by cited region/ country: 1992-2007



Utility patents are issued for the invention of a new and useful process, machine, manufacture, or composition of matter, or a new and useful improvement. For the last three years, utility patents of foreign origin have surpassed patents of U.S. origin.

Chart 2-16: Utility patents granted by the U.S. Patent and Trademark Office



For the most recent three years for which data are available, the number of U.S. utility patents of foreign origin have surpassed those of U.S. origin (Chart 2-16). In 2009, only four of the top ten companies in terms of U.S. patents awarded were U.S.-headquartered.[28]

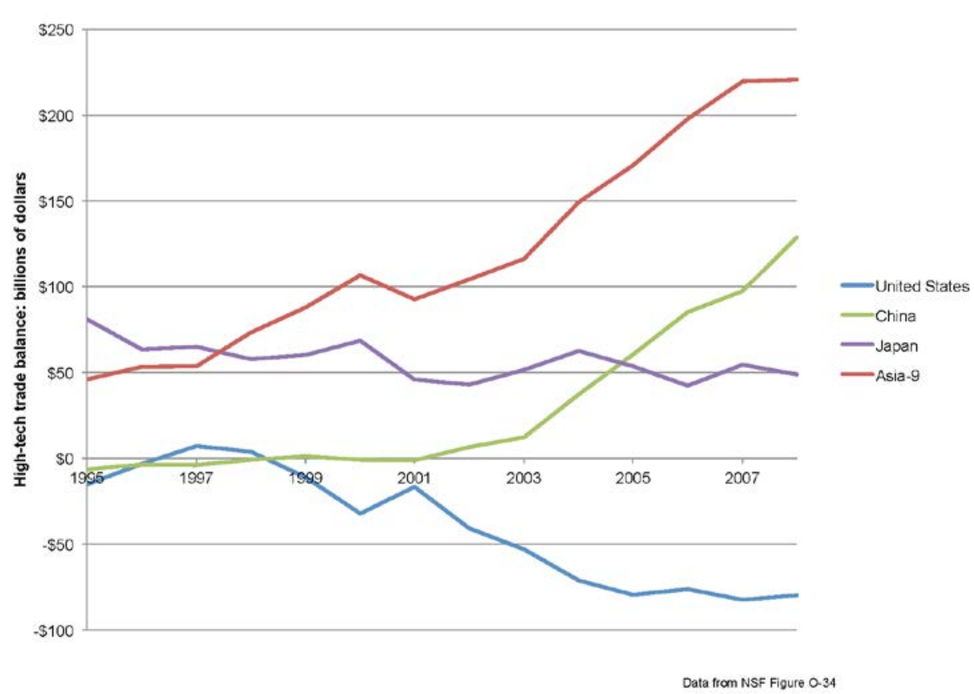
China has been increasingly successful at obtaining patents; its success rate has increased from 18.5 percent for patent applications filed between 1976 and 1985 to 62.1 percent for patents filed between 1996 and 2002. At the same time, China is filing ever more patent applications: 93,485 in 2005, 122,518 in 2006, and 153,060 in 2007, for a two-year increase of more than 60 percent.[29]

ENERGY FACT: Researchers have found strong correlations between public R&D investment and the number of new patents across a variety of energy technologies, including: wind, fuel cells, nuclear fission and fusion, and photovoltaics.[30]

Manufacturing and High-Tech Economy Benchmarks

The U.S. is increasingly a net importer of high-technology products, while Asian countries remain powerful high-tech exporters (Chart 2-17).

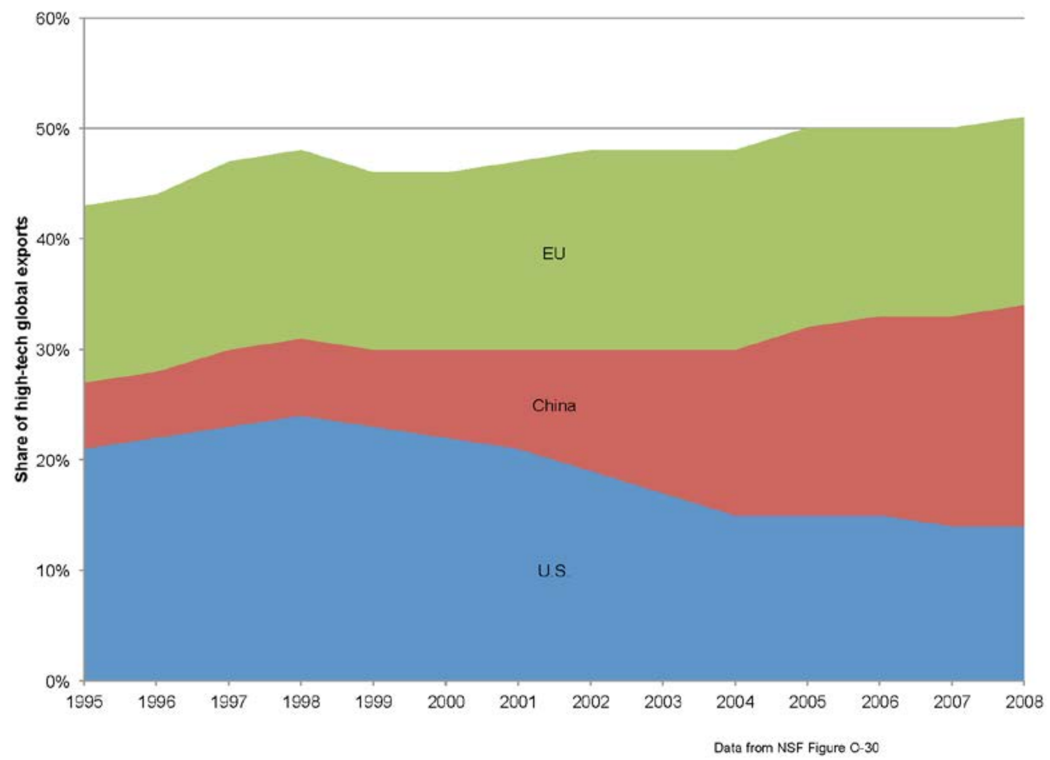
Chart 2-17: The high-tech trade balance for selected nations



28 *https://www.uschamber.com/sites/default/files/testimony/100119_americacompetes.pdf*
29 *http://www.rdmag.com/uploadedFiles/RD/Featured_Articles/2009/12/China_GFF_2010.pdf*
30 *http://thebreakthrough.org/blog/Nemet%20and%20Kammen%20Energy%20R%26D.pdf*; *http://rael.berkeley.edu/sites/default/files/old-site-files/2005/Kammen-Nemet-ShrinkingRD-2005.pdf*

The U.S. is losing its share of high-tech global exports.

Chart 2-18: EU, China, and U.S. share of high-tech global exports: 1995-2008



The U.S. is projected to fall from fourth to fifth in manufacturing competitiveness by 2015.

China's share of high-tech manufacturing industries has more than quadrupled, rising from 3 percent in 1997 to 14 percent in 2007, surpassing the Asia-9 (India, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam) in 2006 and Japan in 2007.[31] China has now replaced the U.S. as the world's number one high-technology exporter (Chart 2-18).[32]

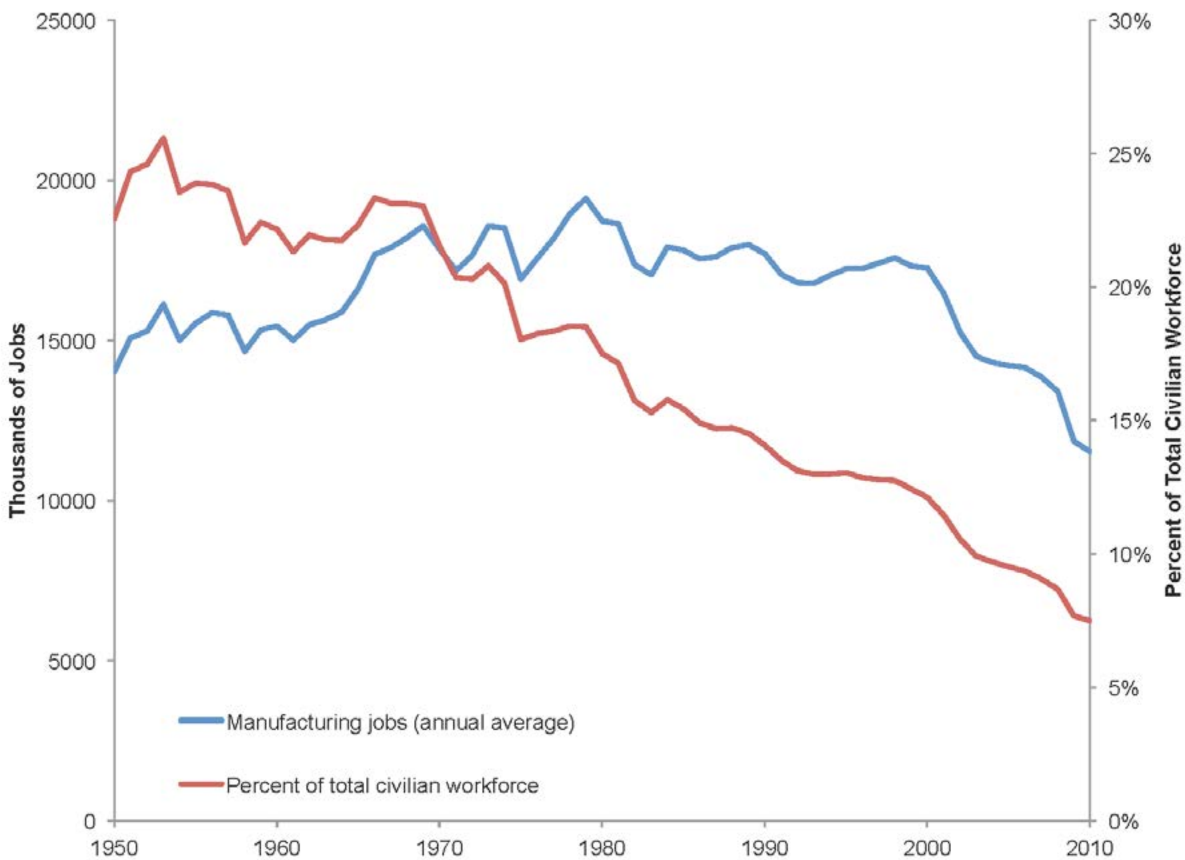
According to a recent report issued by the Council on Competitiveness, the U.S. is projected to fall from fourth to fifth in manufacturing competitiveness by 2015: "Much of this projected decline has been attributed to the hollowing out of manufacturing by the outsourcing of not only millions of U.S. manufacturing jobs, but also, increasingly, the export of R&D and customer support to foreign partners and subsidiaries."[33]

31 *http://www.nsf.gov/statistics/seind10/pdf/c06.pdf*
32 *http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-09-025/EN/KS-SF-09-025-EN.PDF*
33 *http://www.compete.org/images/uploads/File/PDF%20Files/2010_Global_Manufacturing_Competitiveness_Index _FINAL.pdf*

ENERGY FACT: Since 1995, the U.S. market share of photovoltaics world shipments has decreased from 45 percent to less than 10 percent. At the same time, the overall market has grown by nearly one hundred times.[34]

The decline of U.S. manufacturing jobs continues to accelerate, even in high-tech sectors.

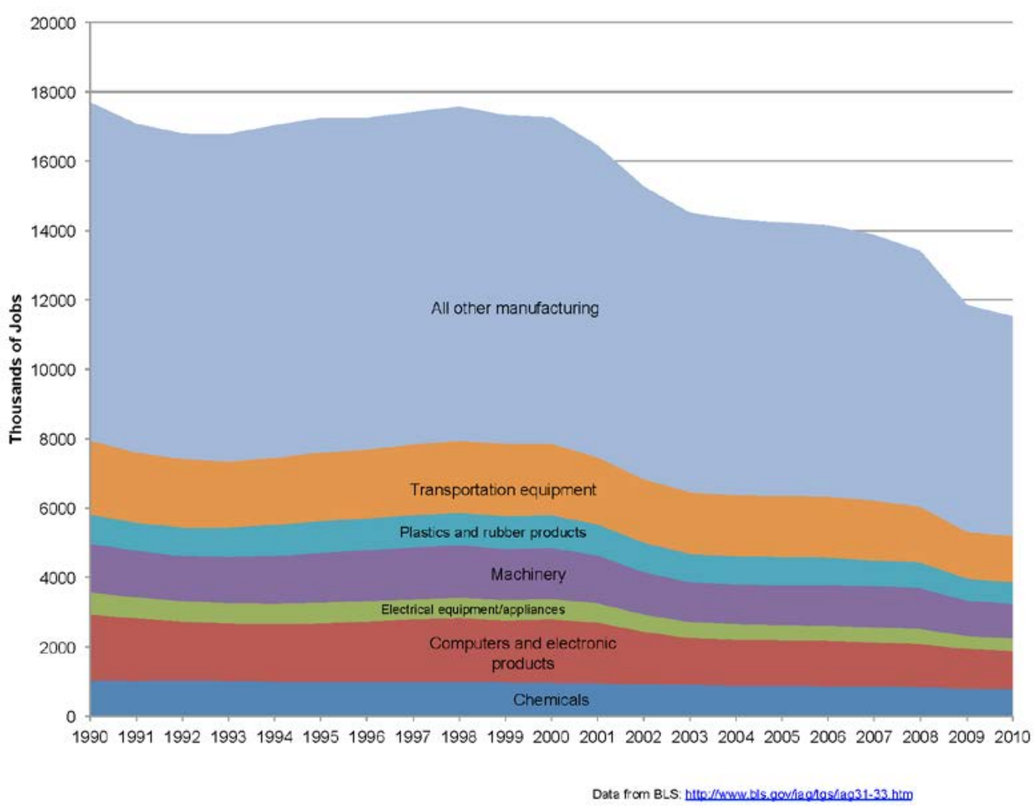
Chart 2-19: Manufacturing jobs–total jobs and as a percentage of the civilian workforce: 1950-2010



Data from Bureau of Labor Statistics
http://data.bls.gov/pdq/SurveyOutputServlet?series_id=CES3000000001&data_tool=XGtable and
http://data.bls.gov/cgi-bin/surveymost?bls LNS11000000

34 *http://science.house.gov/sites/republicans.science.house.gov/files/documents/hearings/012710_Majumdar.pdf*

Chart 2-20: U.S. manufacturing jobs by sector: 1990-2010



Although the U.S. remains the world's manufacturing leader, producing more than 18 percent of the world's manufactured goods, since December 2007, nearly two million manufacturing jobs have been lost.[35] For now, China is second in manufacturing globally, at 17.6 percent.[36]

If the recent past is any indication, this decline could continue; from January 2000 to January 2010, manufacturing jobs fell by 6.17 million, or 34 percent (Chart 2-20). Output fell at the same time: between 2000 and 2009, 15 of the 19 U.S. manufacturing sectors reduced their change in real value-added (a measure of productivity).[37] Some manufacturers have outsourced their R&D operations to foreign partners or subsidiaries.[38] As measured by the Global Manufacturing Competitiveness Index, the U.S. is projected to fall from fourth to fifth in manufacturing competitiveness over the next five years, behind China, India, South Korea, and Brazil.[39] Manufacturing employment in the U.S. computer industry is now lower than when the first personal computer was built in 1975.[40] Reflective of this decline, ninety percent of all electronics R&D now takes place in Asia.[41]

35 *http://www.milkeninstitute.org/pdf/JFAFullReport.pdf*

36 *http://www.nam.org/Statistics-And-Data/Facts-About-Manufacturing/Landing.aspx*

37 *http://www.itif.org/files/2011-national-manufacturing-strategy.pdf*

38 *http://www.milkeninstitute.org/pdf/JFAFullReport.pdf*; *http://www.nist.gov/director/planning/upload/manufacturing_strategy_paper.pdf*

39 *http://www.compete.org/images/uploads/File/PDF%20Files/2010_Global_Manufacturing_Competitiveness_Index_FINAL.pdf*

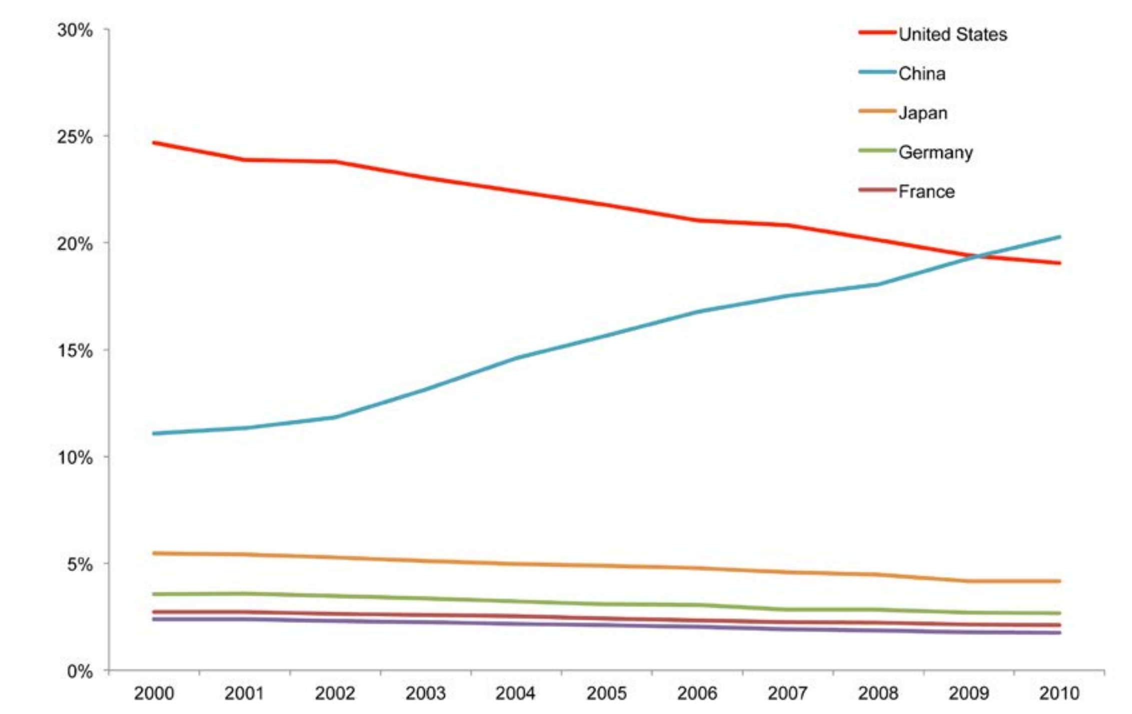
40 *http://www.buec.udel.edu/sullivad/Handouts%20Directory/GB%20Readings/How%20to%20Make%20an%20American%20Job%20Before%20It_Andy%20Grove.docx*

41 *http://www.itif.org/files/2011-national-manufacturing-strategy.pdf*

Energy R&D and Our Economic and National Security

Although the global economic recession significantly chilled private investment in energy technology R&D in 2009 and 2010, the U.S. has historically maintained a low and inconsistent commitment to federal research support for energy technology development. In the decades ahead, energy will represent the single largest technological challenge for the United States, a challenge tied closely to our national security and global strategic interests. The U.S. has a growing appetite for energy, and it will be an increasingly scarce resource as major developing economies compete for it. Yet statistics show that the U.S. is falling behind in the global race for new energy technologies. In 2008, the U.S. consumed 15 percent more energy than Japan, while Japan invested a mere four percent less in its energy R&D in absolute terms, and more than twice as much as a percentage of GDP, compared to the U.S.

Chart 3-1: Percentage of global energy consumption by nation: 2003-2010

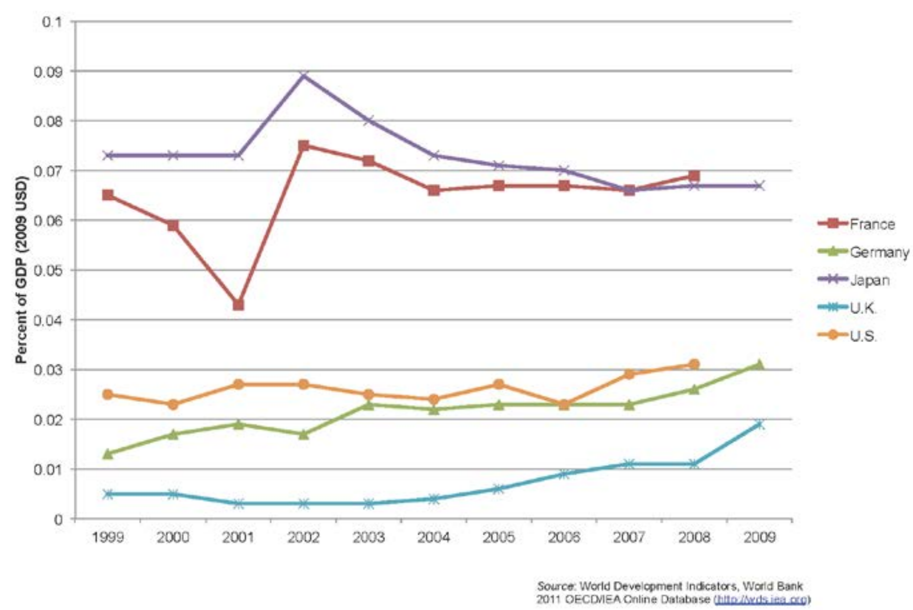


Source: BP Statistical Review of World Energy (2011)

As of 2008, the United States and China accounted for a combined 36 percent of the total global energy consumption. Other major consumers of energy include France, Germany, Japan, and the United Kingdom. As of early 2010, China had surpassed the U.S. as the largest consumer of energy in the world.

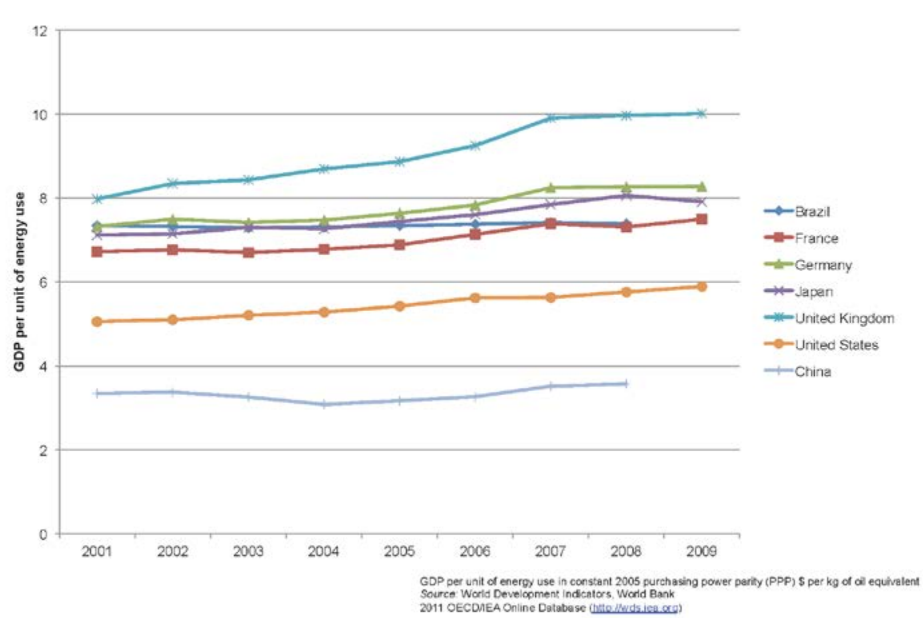
The U.S. lags well behind France and Japan in energy R&D spending as a percentage of GDP.

Chart 3-2: Energy R&D as a percentage of GDP for selected nations



The U.S. does not consume energy as efficiently as other countries.

Chart 3-3: Energy efficiencies (GDP per unit of energy use) for different nations

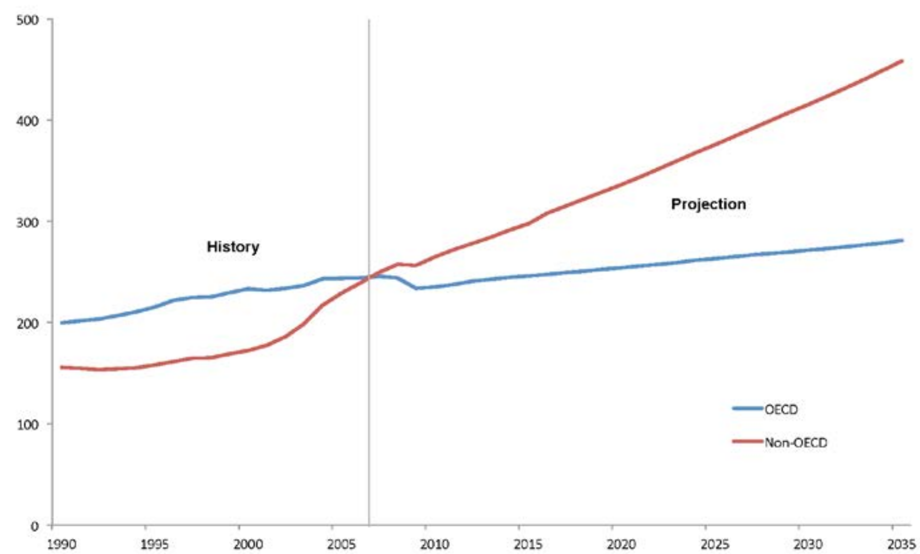


Over the last decade, concern over the future of U.S. economic competitiveness has centered on the energy sector, due to both the explosive economic growth and corresponding demand for energy in major developing economies and the U.S.'s continuing vulnerability to fluctuations in global energy markets.

Although the U.S. currently has the world's largest economy, with a GDP of more than $14.8 trillion in 2010, our GDP per unit of energy use (a measure of efficiency) lags behind that of many other developed nations (Chart 3-3). While we use the most energy to support our economy, we are not using it in the most efficient way to maximize its economic output.

Panics over the cost of energy have driven new investments in energy R&D, but these have often been short-lived, leaving investments in basic energy research among the lowest priorities for federal research dollars.

Chart 3-4: Past and projected energy consumption of OECD and non-OECD nations



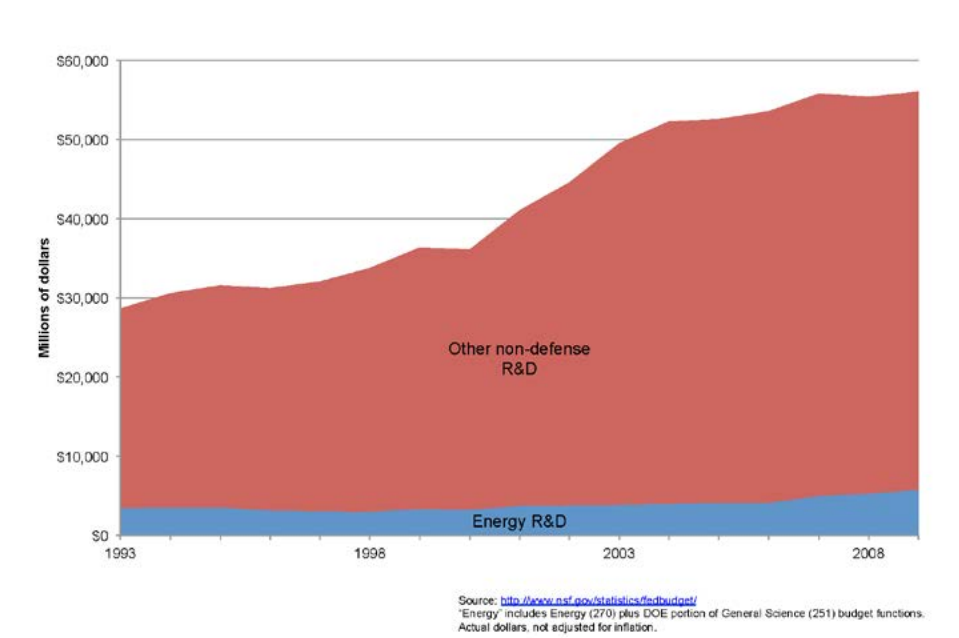
EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. Projections: EIA, World Energy Projection System Plus (2010).

The Energy Information Administration projects that global energy use will increase by 53 percent by 2035, in large part due to demand in places like India and China. Currently, the combined energy use of developing nations is only slightly more than the energy consumed by the developed world, but by 2035, the developing world's energy use is expected to double (Chart 3-4).[42]

42 *http://money.cnn.com/2011/09/19/markets/global_energy_use/*

U.S. public and private investments in energy R&D are low.

Chart 3-5: Federal investment in energy R&D and other non-defense R&D



Currently, the energy industry as a whole spends just 0.3 percent of its domestic sales on R&D, compared with 18 percent by the pharmaceutical sector and 16 percent by the semiconductor industry.[43]

Government investment in energy R&D, meanwhile, has been essentially flat in actual dollars since 2003, and declined in real terms (Chart 3-5).[44] From 1980 until 2009, while R&D expenditures grew substantially for defense, and steadily for health, energy R&D remained essentially flat, with a slight increase over 2009-2010, mostly due to the passage of The American Recovery and Reinvestment Act.[45]

Given the alarming U.S. standing in energy innovation and the long-term energy security challenges this presents, there is a critical need for strategic long-term investments in fundamental energy research.

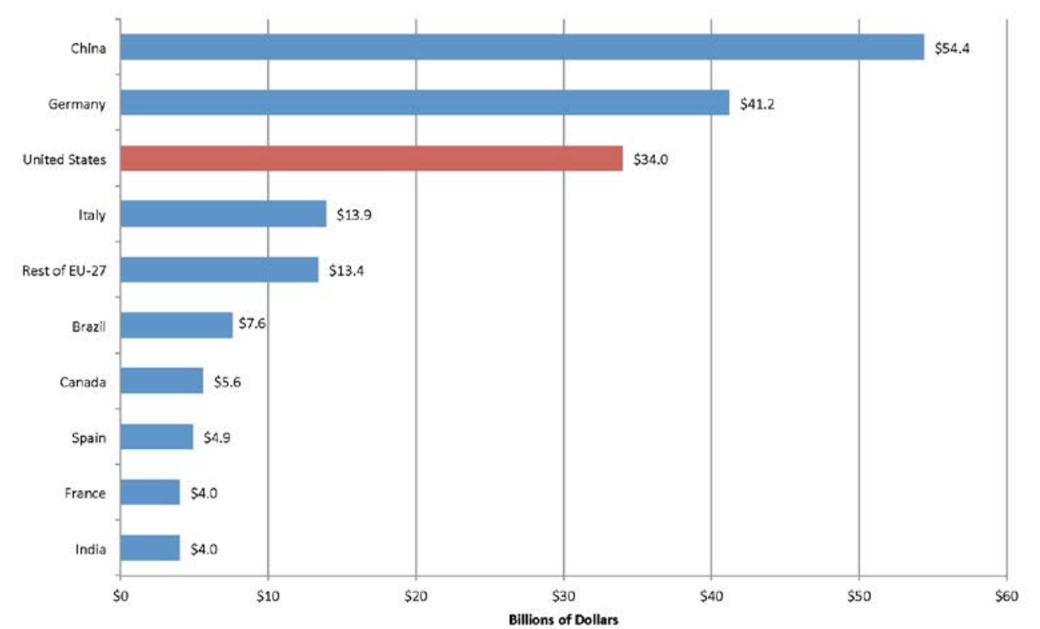
43 Battelle, "2011 Global R&D Funding Forecast," R&D Magazine, December 2010, *http://www.areadevelopment.com/article_pdf/id4963_BattelleRD.pdf; Charles Weiss and William Bonvillian, "Structuring an energy technology revolution," 2009, p. 129.*

44 *http://articles.latimes.com/2010/sep/13/business/la-fi-economy-rd-20100913*

45 *http://www.politico.com/static/PPM170_101012_postpartisan.html*

China and Germany lead the U.S. in clean energy technology investment

Chart 3-6: Top ten nations in terms of clean energy investment (2010)



Source: http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Report/G-20Report-LOWRes-FINAL.pdf

As the American Energy Innovation Council recently noted, "The country sends $1 billion overseas *every day* to purchase oil, but publicly funded research in advanced vehicles and alternative fuels totals just $680 million annually—about 16 hours' worth of oil imports."[46]

Currently, the U.S. not only lags behind China in the energy technology race but is in danger of falling behind nations like South Korea, Germany, and Japan.[47]

The Chinese government has made clean energy technology one of its top national R&D priorities.[48] For example, in 2010, China's National Energy Bureau announced the licensing of sixteen national clean energy R&D facilities to develop wind, nuclear, and other technologies.[49]

46 *http://www.americanenergyinnovation.org/full-report-download/AEIC_Brochure_Final.pdf*
47 *http://leadenergy.org/2010/12/china-builds-on-lead-in-4th-quarter/*
48 *http://leadenergy.org/wp-content/uploads/2010/12/SAISReview-AmericanPower-NorrisShenai-Nov2010.pdf*
49 *http://english.peopledaily.com.cn/90001/90778/90860/6862287.html*

The U.S. Needs to Invest More in Energy Technology Research

The R&D tax credit expired in 2009 and was temporarily extended at the end of 2010. Since its creation, the R&D tax credit has been extended 13 times but has never been made permanent.

Overall, U.S. industry's average R&D investment is 2.6 percent of sales. Innovating industries invest much more heavily in research:

- Biotech invests 39 percent annually;
- Pharmaceuticals invests 18 percent;
- Semiconductors invests 16 percent;
- The electronics industry invests 8 percent; and
- The auto industry invests 3.3 percent.[50]

It is more likely that government investment in scientific research will stimulate, rather than stifle, energy industry investment in R&D.

As stated above, the private energy sector invested on-average only 0.3 percent of annual revenue in new energy technology R&D from 1988-2003.

Clearly, U.S. investments in energy R&D, both public and private, remain low by global standards. It has been suggested by some that government investment in energy R&D squeezes out private investment, and therefore the government should not invest in basic energy research.[51] Yet other sectors, such as the biotech and pharmaceutical industries, have invested heavily in R&D despite significant U.S. government investments in scientific research in these areas. Based on this evidence, it is more likely that government investment in scientific research will stimulate, rather than stifle, energy industry investment in R&D.[52]

Importance of DOE Office of Science Energy Research: The DOE Office of Science, the largest funder of physical science research in the U.S., oversees 10 national laboratories housing 14,500 PhDs, and supports researchers and students at over 300 colleges and universities nationwide. Funding basic scientific research allows scientists and engineers to conduct broad investigation that can, over time, unearth new products and enhancements in productivity and efficiency that will help the U.S. economy continue to grow.

50 Charles Weiss and William Bonvillian. *"Structuring an energy technology revolution."* 2009. p. 129

51 *http://www.heritage.org/Research/Reports/2011/04/Department-of-Energy-Spending-Cuts-A-Guide-to-Trimming-President-Obamas-2012-Budget-Request*

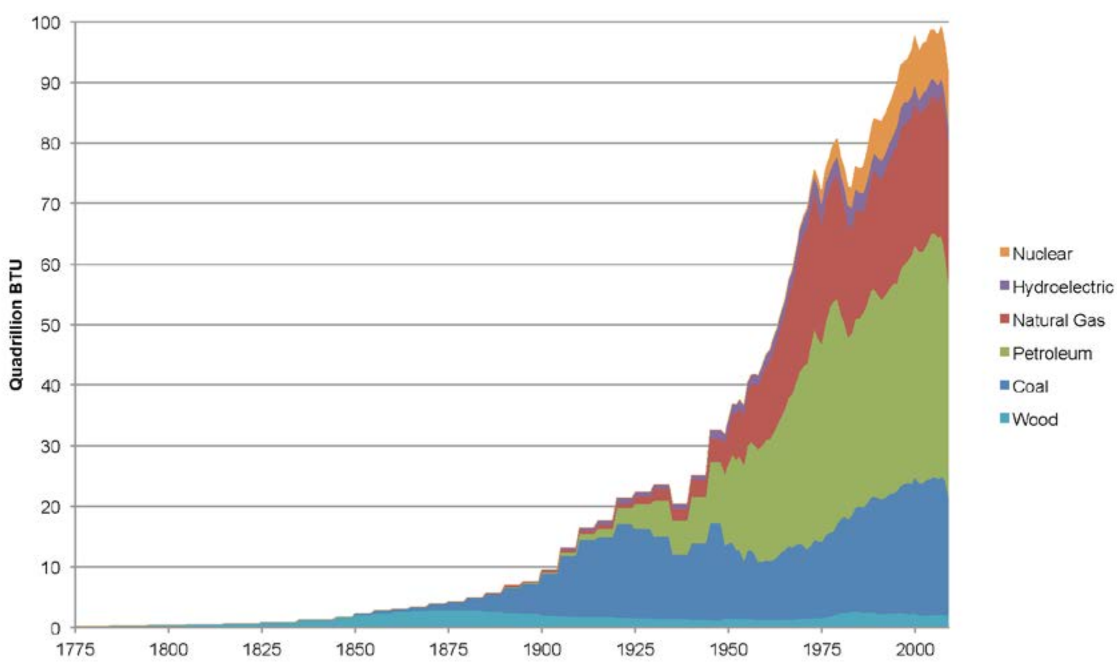
52 Paul A. David, Bronwyn H. Hall, and Andrew A. Toole, "Is Public R&D a Complement or Substitute for Private R&D? A Review of Economic Evidence," Research Policy, vol. 29, no. 4-5 (April 2000), pp. 497-529. Cited in Federal Support for Research and Development, Congressional Budget Office Report, 2007, p. 19

The U.S. Lags Behind Other Nations in Key Areas of Energy Technology Development

In fiscal year 2010, the U.S. spent about $5 billion on energy technology research, a paltry amount compared to the global leaders in energy technology investment. Over the next decade, China will spend an estimated $750 billion on energy technology research. South Korea has pledged to spend $46 billion over the next five years on energy technology development.[53]

Two-thirds of China's energy comes from coal, but renewable energy is on track to become 8 percent of China's portfolio by 2020.[54] In the U.S, renewable energy technologies provide 8 percent of the energy consumed and 11 percent of electricity generated.

Chart 3-7: History of energy consumption in the U.S.



Source: http://www.eia.gov/todayinenergy/detail.cfm?id=10

53 *http://thebreakthrough.org/blog/Rising_Tigers.pdf*

54 *http://www.nytimes.com/2010/01/31/business/energy-environment/31renew.html?pagewanted=1*

Conclusion

These benchmarks paint a picture of the United States as a nation whose global scientific leadership is in question, even as our overall public spending, debt, and deficit have grown. Certainly our nation is facing profound challenges, but we can learn from the past, when our strength relied in part upon strong investments in scientific research. Moving forward, we can maximize the efficiency of that investment by providing sustained funding for scientific research, rather than funding that fluctuates based on perceived short-term crisis. Such decisions will capitalize on our strength—that is, our unique government-university-industry partnerships, which have allowed us to lead the world in discovery and innovation.

Our nation is facing profound challenges, but we can learn from the past, when our strength relied in part upon strong investments in scientific research.

Energy is a particularly compelling example of a long-term strategic national challenge. Our response to this challenge will have repercussions for the entire workforce and the economy overall. Lagging behind foreign nations in both our energy efficiency and the development of new energy technologies will place the U.S. at a significant disadvantage in the energy technology markets of the future, weakening both our economic and our national security.

Our international competitors are following our historic example for success—increasing, not cutting, their investments in scientific research and STEM education—and the effects are clear.

In the current environment, our leaders need to take bold action to ensure sustained investments in research in the physical sciences. The U.S. must overcome not just the past decade's inertia but also the current emphasis on short-term cuts that do not discriminate sufficiently between spending and investment. Our international competitors are following our historic example for success—increasing, not cutting, their investments in scientific research and STEM education—and the effects are clear in the figures presented in this report. Their educational systems, contributions to knowledge, and economic power are on the rise, as ours stagnate and decline.

Innovation was a great source of American strength through the latter half of the 20th century, and our spirit of innovation is an integral part of our national character. The federal government has always been, and must continue to be, an indispensible partner in the enterprise of scientific research because of the benefits it provides for our national and economic security. Nurturing this important partnership can help renew American exceptionalism and reestablish the U.S. as the unquestioned global leader in innovation.

References Cited

"2010 Global R&D Funding Forecast." *R&D Magazine*. December 2009. 2pp. <http://www.rdmag.com/uploadedFiles/RD/Featured_Articles/2009/12/China_GFF_2010.pdf>.

Ahn, J. "Current Status of Nuclear-Energy Development and the Role of University Research and Education in the U.S." 2007. 7pp. <http://www.esi.nagoya-u.ac.jp/h/isets07/Contents/Proceedings/FinalManuscript/Session08/1173Ahn.pdf>.

Allen, S., Quigley, J., and Deborah Wince-Smith. "2010 Global Manufacturing Competitiveness Index." June 2010. 56pp. <http://www.compete.org/images/uploads/File/PDF%20Files/2010_Global_Manufacturing_Competitiveness_Index_FINAL.pdf>.

American Energy Innovation Council. "Catalyzing American Ingenuity: The Role of Government in Energy Innovation." 2011. 40pp. <http://americanenergyinnovation.org/wp-content/uploads/2012/04/AEIC_Catalyzing_Ingenuity_2011.pdf>.

Bradsher, K. "China Leading Global Race to Make Clean Energy." *The New York Times*. 30 January 2010. <http://www.nytimes.com/2010/01/31/business/energy-environment/31renew.html?_r=2&pagewanted=1>.

Battelle. "2011 Global R&D Funding Forecast." R&D Magazine. December 2010. <http://www.areadevelopment.com/article_pdf/id4963_BattelleRD.pdf>.

Breakthrough Institute and Information Technology and Innovation Foundation. "Rising Tigers, Sleeping Giant." November 2009. 129pp. <http://thebreakthrough.org/blog/Rising_Tigers.pdf>.

David, P., Hall, B., and Andrew Toole. "Is Public R&D a Complement or Substitute for Private R&D? A Review of Economic Evidence." *Research Policy*, Vol. 29, no. 4-5. April 2000. 33pp.

DeVol, R. and Wong, P. "Jobs for America: Investments and policies for economic growth and competitiveness." January 2010. 67pp. <http://www.milkeninstitute.org/pdf/JFAFullReport.pdf>.

Donohue, T. "Statement of the U.S. Chamber of Commerce: The Reauthorization of the America Competes Act." 20 January 2010. <https://www.uschamber.com/sites/default/files/testimony/100119_americacompetes.pdf>.

Ezell, S., and Atkinson, R. "The Case for a National Manufacturing Strategy." April 2011. <http://www.itif.org/files/2011-national-manufacturing-strategy.pdf>.

"First national energy R&D centers established." *People's Daily*. 7 January 2010. <http://english.peopledaily.com.cn/90001/90778/90860/6862287.html>.

Grove, A. "How America Can Create Jobs." *Bloomberg Businessweek Magazine.* 1 July 2010. <http://www.businessweek.com/magazine/content/10_28/b4186048358596.htm>.

Gutteridge, J. "U.S. Nuclear Engineering Infrastructure Programs and Workforce Demographics." 29 June 2006. Slide 4. <www.unene.ca/newg/Canada6_29_06-gutteridge.ppt>.

Hargreaves, S. “Global energy use to jump 53%.” 20 September 2011. <http://money.cnn.com/2011/09/19/markets/global_energy_use/>.

Hayward, S., Muro, M., Nordhaus, T., and Michael Shellenberger. “Post-Partisan Power.” October 2010. 35pp. <http://thebreakthrough.org/blog/Post-Partisan%20Power.pdf>.

Kammen, D., and Nemet, G. “Reversing the Incredible Shrinking Energy R&D Budget.” 2005. 5pp. <http://rael.berkeley.edu/sites/default/files/old-site-files/2005/Kammen-Nemet-ShrinkingRD-2005.pdf>.

Lee, D. “US hard-pressed to stem domestic R&D losses.” *Los Angeles Times*. 13 September 2010. <http://articles.latimes.com/2010/sep/13/business/la-fi-economy-rd-20100913>.

Goldfarb, D. “China Builds Cleantech Lead in 4th Quarter.” 1 December 2010. <http://leadenergy.org/2010/12/china-builds-on-lead-in-4th-quarter/>.

Loris, N. “Department of Energy Spending Cuts: A Guide to Trimming President Obama’s 2012 Budget Request.” 18 April 2011. <http://www.heritage.org/research/reports/2011/04/department-of-energy-spending-cuts-a-guide-to-trimming-president-obamas-2012-budget-request?query=Department+of+Energy+Spending+Cuts:+A+Guide+to+Trimming+President+Obama%92s+2012+Budget+Request>.

Manpower Group. “Talent Shortage Survey Results.” 2011. 37pp. <http://files.shareholder.com/downloads/MAN/1262980731x0x469531/7f71c882-c104-449b-9642-af56b66c1e6d/2011_Talent_ Shortage_Survey_US.pdf>.

Meri, T. “China Passes the E.U. in High-tech exports.” 2009. 8pp. <http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-09-025/EN/KS-SF-09-025-EN.PDF>.

Mervis, J. “Top Ph.D. Feeder Schools Are Now Chinese.” *Science*, Vol. 185. 11 July 2008. <http://www.sciencemag.org/content/321/5886/185.full>.

National Association of Manufacturing Website. “Facts About Manufacturing in the United States.” 2012. <http://www.nam.org/Statistics-And-Data/Facts-About-Manufacturing/Landing.aspx>.

National Center for Education Statistics. “The Nation’s Report Card.” 2009. <http://nationsreportcard.gov/science_2009/summary.asp>.

National Commission on Energy Policy’s Task Force on America’s Future Energy Jobs. “Executive Summary and Policy Recommendations.” 30pp. <http://bipartisanpolicy.org/sites/default/files/Final%20report.pdf>.

National Science Foundation. “Science and Engineering Indicators 2010.” 2010. 21pp. <http://www.nsf.gov/statistics/seind10/pdf/overview.pdf>.

Nemet, G., and Kammen, D. “U.S. energy research and development: Declining investment, increasing need, and the feasibility of expansion.” *Energy Policy*, Vol. 35. 7 February 2006. 10pp. <http://thebreakthrough.org/blog/Nemet%20and%20Kammen%20Energy%20R%26D.pdf>.

Norris, T. “American Power in the Age of Innovation.” 6 December 2010. <http://leadenergy.org/2010/12/american-power-in-the-age-of-innovation/>.

Norris, T., and Shenai, N. “Dynamic Balances: American Power in the Age of Innovation.” *SAIS Review* no. 2. Baltimore, MD: Johns Hopkins University Press, 2010. <http://leadenergy.org/wp-content/uploads/2010/12/SAISReview-AmericanPower-NorrisShenai-Nov2010.pdf>.

Organization for Economic Cooperation and Develoment. “Education at a Glance 2009: OECD Indicators.” 2009. Table A-3.5. <http://www.oecd.org/document/24/0,3746,en_2649_39263238_43586328_1_1_1_1,00.html>.

Pomfret, J. “China pushing the envelope on science, and sometimes ethics.” *Washington Post*. 28 June 2010. <http://www.washingtonpost.com/wp-dyn/content/article/2010/06/27/AR2010062703639.html>.

President’s Council of Advisors on Science and Technology. “Report to the President on Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy.” November 2010. 41pp. <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-energy-tech-report.pdf>.

“Rising Above the Gathering Storm” Committee. “The Gathering Storm Revisited: Rapidly Approaching Category 5”. National Academies Press. 2010. 102pp.

Science Progress. “U.S. Scientific Research and Development 101.” 16 February 2011. 7pp. <http://www.scienceprogress.org/wp-content/uploads/2011/02/SciProgResearchandDevelopment-101.pdf>.

“Statement of Arun Majumdar before the Committee on Science and Technology.” 27 January 2010. <http://science.house.gov/sites/republicans.science.house.gov/files/documents/hearings/012710_Majumdar.pdf>.

The Task Force on the Future of American Innovation. “The Knowledge Economy: Is the United States Losing Its Competitive Edge?” 16 February 2005. <http://www.futureofinnovation.org/PDF/Benchmarks.pdf>.

The Task Force on the Future of American Innovation. “Measuring the Moment: Innovation, National Security, and Economic Competitiveness.” November 2006. <http://www.futureofinnovation.org/PDF/BII-FINAL-HighRes-11-14-06_nocover.pdf>.

Tassey, G. “Rationales and mechanisms for revitalizing US manufacturing R&D strategies.” 29 January 2010. 51pp. <http://www.nist.gov/director/planning/upload/manufacturing_strategy_paper.pdf>.

U.S. Chamber of Commerce. “Index of U.S. Energy Security Risk.” 2011. 83pp. <http://www.energyxxi.org/themes/energyxxi/pdfs/Energy_Index_2011_FINAL.pdf>.

U.S. Department of Energy. “New Science for a Secure and Sustainable Energy Future.” December 2008. <http://science.energy.gov/~/media/bes/pdf/reports/files/nsssef_rpt.pdf>.

Weiss, Charles, and William Bonvillian. *Structuring an Energy Technology Revolution*. Cambridge, MA: MIT, 2009. Print.

World Economic Forum. “The Global Competitiveness Report 2010-2011.” 2010. 516pp. <http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf>.

TFAI

TASK FORCE ON AMERICAN INNOVATION

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AAAS ADVANCING SCIENCE, SERVING SOCIETY
AAS
ACS Chemistry for Life®
American Institute for Medical and Biological Engineering
AIP American Institute of Physics
AMS American Mathematical Society
APS physics
American Society for Engineering Education ASEE
ASME SETTING THE STANDARD
ASA AMERICAN STATISTICAL ASSOCIATION
APPLIED MATERIALS
acm Association for Computing Machinery
AAU Association of American Universities 1900
Association of Public and Land-Grant Universities
Association of University Research Parks Creating Communities of Innovation
Autodesk
Battelle The Business of Innovation
BR Business Roundtable
C-PET Center for Policy on Emerging Technologies
CRA Computing Research Association
CompTIA
CGS Council of Graduate Schools
Compete. Council on Competitiveness
CRAY
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THE GEOLOGICAL SOCIETY OF AMERICA®
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IRI Industrial Research Institute
infineon
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Innovation Advocates, LLC
intel
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LUNA INNOVATIONS
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Manufacturers
ncms National Center for Manufacturing Sciences
national center for women & INFORMATION TECHNOLOGY
NUFO NATIONAL USER FACILITY ORGANIZATION
NORTHROP GRUMMAN
P&G
QUALCOMM
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semi
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SRC Semiconductor Research Corpor
SILICON VALLEY LEADERSHIP GROUP
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TECHNOLOGY CEO COUNCIL
TIA
Texas Instruments

About the Task Force on American Innovation

Who: Formed in 2004, the Task Force is an alliance of America's most innovative companies, leading research universities, and largest scientific societies.

Why: Our mission is to support scientific research in the physical sciences and engineering. Federal research investment has fallen to historic lows as a share of our gross domestic product, raising concerns that we're not investing an adequate share of today's resources to support the innovations of tomorrow.

Innovation is central to American jobs, competitiveness and prosperity. In today's world, many nations compete very well on the basis of cost or quality. It is the ability to innovate—to create new high-value, high-margin goods and services—that sets a country, a state, or a locality apart. Investment in scientific research is a critical component of America's innovation system.

How: The Task Force is based in Washington, D.C. and works with the Administration and Congress to support the National Science Foundation, the Department of Energy's Office of Science, the Commerce Department's National Institute of Standards and Technology, the Defense Department, and the National Aeronautics and Space Administration. The budgets of these agencies support critical research at universities and laboratories across the country, build the skills of our scientific workforce and supply essential infrastructure used by firms and institutions to make new breakthroughs.

Although companies conduct the vast majority of American research, most of their investment is dedicated to applied research and development that builds on the insights of federally supported basic research that uncovers new fundamental knowledge. Financial markets and shareholders limit the amount of high-risk and longer-term scientific research conducted by companies.

Only the federal government has the resources and risk horizon to fulfill this national mission. Even though research in the physical sciences and engineering accounts for only a tiny fraction of the federal budget, it is responsible for some of the last century's biggest breakthroughs, and in many ways will determine whether America enjoys a prosperous 21st century.