Order Code 97-746

Foreign Science and Engineering Presence in U.S. Institutions and the Labor Force

Updated January 3, 2006

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Summary

The increased presence of foreign students in graduate science and engineering programs and in the scientific workforce has been and continues to be of concern to some in the scientific community. Enrollment of U.S. citizens in graduate science and engineering programs has not kept pace with that of foreign students in those programs. In addition to the number of foreign students in graduate science and engineering programs, a significant number of university faculty in the scientific disciplines are foreign, and foreign doctorates are employed in large numbers by industry.

Few will dispute that U.S. universities and industry have chosen foreign talent to fill many positions. Foreign scientists and engineers serve the needs of industry at the doctorate level and also have been found to serve in major roles at the masters level. Not surprisingly, there are charges that U.S. workers are adversely affected by the entry of foreign scientists and engineers, who reportedly accept lower wages than U.S. citizens would accept in order to enter or remain in the United States. These arguments occur in the context of a job market in which there is a reported imbalance between supply and demand for scientists and engineers in certain fields. The National Science Foundation (NSF) reports that between 1998 and 2008, employment in science and engineering fields will increase at more than four times the rate for all other occupations. In addition, approximately 80% of the increase in science and engineering will be in computer-related positions.

NSF data reveal that in 2003, the foreign student population earned approximately 31.6% of the doctorate degrees in the sciences and approximately 60.3% of the doctorate degrees in engineering. In 2003, foreign students on temporary resident visas earned 27.4% of the doctorates in the sciences, and 55.3% of the doctorates in engineering. The participation rates in 2002 were 25.9% and 52.2%, respectively. In 2003, permanent resident status students earned 4.2% of the doctorates in the sciences and 5% of the doctorates in engineering, a decrease from the 2002 levels of 4.6% and 5.3%, respectively. Trend data for science and engineering degrees for the years 1994-2003 reveal that of the non-U.S. citizen population, temporary resident status students consistently have earned the majority of the doctorate degrees.

Many in the scientific community maintain that in order to compete with countries that are rapidly expanding their scientific and technological capabilities, the country needs to bring to the United States those whose skills will benefit society and will enable us to compete in the new-technology based global economy. However, the academic community is concerned that the more stringent visa requirements for foreign students may have a continued impact on enrollments in colleges and universities. There are those who believe that the underlying problems of foreign students in graduate science and engineering programs is not necessarily that there are too many foreign-born students, but that there are not enough U.S. students. This report will be updated periodically.

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The increased presence of foreign students in graduate science and engineering programs and in the scientific workforce has been and continues to be of concern to some in the scientific community.[1] Enrollment of U.S. citizens in graduate science and engineering programs has not kept pace with that of foreign students in those programs. In addition to the number of foreign students in graduate science and engineering programs, a significant number of university faculty in the scientific disciplines are foreign, and foreign doctorates are employed in large numbers by industry.

Those in the scientific community, arguing for ceilings on admissions for immigrants, maintain that foreign students use U.S. graduate education programs as steppingstones to immigration through sponsorships for permanent residence.[2] Approximately 56% of foreign doctorate degree earners on temporary visas remain in the United States, with many eventually becoming citizens.[3] Data on adjustments from temporary visas to permanent status increased by 68% from 347,416 in 2003 to 583,921 in 2004.[4] (A significant part of this increase resulted from the reduction in backlogs at the U.S. Citizenship and Immigration Services).[5] It is estimated that

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[1]This report excludes the discussion of foreign students entering the medical profession. For a general discussion of foreign students in the United States in all disciplines, see for example, CRS Report RL31146, *Foreign Students in the United States: Policies and Legislation*, by Ruth Ellen Wasem.

[2]An employer may sponsor a foreign scientist or engineer for permanent residence, if they meet terms established by the Immigration and Nationality Act.

[3]Foreign students planning to remain in the United States following graduation vary by field and discipline as well as by country. For all science and engineering fields, the stay rate is 56%; for physical sciences, 64%; life sciences, 63%; mathematics, 57%; computer sciences, 63%; and agricultural sciences, 38%. Stay rates are not static, and various estimates appear in the literature. Differences are observed over a period of time in the main country of origin for foreign scientists and engineers. (It is estimated that Chinese and Indian students who choose to remain in the United States following their studies range from 66% to 92% and 77% to 88% respectively). The stay rates of foreign students have an impact on both the U.S. economy and the supply of scientific personnel in the United States and on the economies of the home countries of the foreign students. National Science Foundation, *Science and Engineering Indicators 2004, Volume I*, NSB04-01, Arlington, VA, January 15, 2004, pp. 3-38 - 3-39.

[4] Department of Homeland Security, Office of Immigration Statistics Management Directorate, *U.S. Legal Permanent Residents: 2004*, Nancy F. Rytina, June 2005, p. 3.

[5] At the end of 2003, there was a reported backlog of 1.2 million "adjustment of status

(continued...)

by 2010, more than 50% of all employment-based preference workers would adjust their temporary status to permanent status.

Few will dispute that U.S. universities and industry have chosen foreign talent to fill many positions.[6] Foreign scientists and engineers serve the needs of industry at the doctorate level and also have been found to serve in major roles at the masters level.[7] Not surprisingly, there are charges that U.S. workers are adversely affected by the entry of foreign scientists and engineers, who reportedly accept lower wages than U.S. citizens would accept in order to enter or remain in the United States.[8] These arguments occur in the context of a debate on projections and potential imbalances in certain scientific and technical disciplines.[9] The U.S. Bureau of Labor Statistics reports that between the years 2000 and 2010, employment in science and engineering fields will increase at a faster rate than all other occupations. The growth rate will result, primarily, from growth in mathematics and computer-related occupations.[10]

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[5] (...continued)
cases" — temporary visa holders seeking permanent residency.

[6] It is estimated that in colleges and universities, foreign-born doctorate degree holders account for approximately 33% of the full-time faculty in computer sciences, 26% in engineering, 33% in mathematics, and 22% in the physical sciences. At the postdoctoral level, the participation of foreign doctorate holders is 56% in engineering, 50% in mathematics, and 42% in physical sciences. These foreign-born graduate students, post-doctoral researchers, research assistants, and professors reportedly increase the research and educational capacity and breadth of the institutions. (Data for computer sciences are not available). National Science Foundation, *Science and Engineering Indicators 2004*, Volume 2, NSB-04-01A, Arlington, VA, January 2004, Appendix Table 5-25. Note: Data show that since 1990, approximately 50% of the U.S. Nobel laureates in the scientific and technical disciplines were foreign-born.

[7] See for example The National Academies, Committee on Science, Engineering, and Public Policy, *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States*, Washington, DC, May 2005, pp.17-65, and Washington Fax, "Foreign Postdocs, Other Foreign Scientists Vital to NIH Intramural Research Workforce," October 20, 2004, [http://www.washingtonfax.com/pl/2004/20041020.html].

[8] Center for Immigration Studies, Davis, Donald R. and David E. Weinstein, United States Technological Superiority and the Losses From Migration, February 2005, 7 pp., Matloff, Norm, H-1B Bill Introduced in Congress, April 20, 2004, [http://heather.cs.ucdavis.edu], and Dougherty, Jon, Foreigners Displacing U.S. Hi-Tech Workers, WorldNetDaily.com, September 6, 2003, [http://www.rense.com/general41/usthi.htm].

[9] Monastersky, Richard, "Is There a Science Crisis? Maybe Not," *The Chronicle of Higher Education*, v. 50, July 9, 2004, p. A10, and Jackson, Shirley Ann, *Envisioning a 21st Century Science and Engineering Workforce for the United States*, Report to the Government-University-Industry Research Roundtable, Washington, DC, 2003, 18 pp.

[10] Hecker, Daniel E., "Occupational Employment Projections to 2012," *Monthly Labor Review*, February 2004, pp. 80-105.

Much attention in the scientific community has focused on the H-1B temporary admissions program.[11] A report of the National Science Foundation (NSF) during the late 1980s claiming a nationwide shortage of scientists and engineers may have contributed to the decision by Congress to expand the skilled-labor preference system contained in the Immigration Act of 1990.[12] The 1990 legislation more than doubled employment-based immigration, including scientists and engineers entering under the H-1B visa category. The act raised the numerical limits or ceilings on permanent, employment-based admissions, from 54,000 to 140,000 annually.[13] In addition, the legislation ascribed high priority to the entry of selected skilled and professional workers, and simplified admissions procedures for foreign nationals seeking to temporarily work, study, or conduct business in the United States.

On October 17, 2000, the American Competitiveness in the Twenty-First Century Act of 2000 was signed into law (P.L. 106-313), significantly changing the H-1B program and the employment-based immigration program. The legislation raised the annual number of H-1B visas to 195,000 for FY2001, FY2002, and FY2003, and returned to 65,000 in FY2004. It excluded from the new ceiling all H-1B nonimmigrants who are employed by institutions of higher education and nonprofit or governmental research organizations. The law authorized additional H-1B visas for FY1999 to offset the visas inadvertently approved for the year that exceeded the cap.[14] In addition, the law increased the fees employers paid for each

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[11]The H-1B visa category was established by the Immigration Act of 1990. The Immigration Act and the American Competitiveness and Workforce Improvement Act of 1998 regulate H-1B policy and guide H-1B procedures. The H-1B temporary visa category allows the foreign professional to work in the United States in specialty occupations for a period up to six years (generally in three-year increments). Typically the specialty occupation includes positions such as scientists, engineers, teachers, computer programmers, medical doctors, and physical therapists. The application for H-1B status must be filed by an employer; an individual cannot obtain an H-1B visa on his or her own. Employers of H-1B workers are required to meet certain labor conditions, including paying comparable wages. The requirements are designed to ensure that U.S. workers are not negatively impacted by nonimmigrant workers. For discussion of the H-1B visa see Usdansky, Margaret L. and Thomas J. Espenshade, *The H-1B Visa Debate in Historical Perspective: The Evolution of U.S. Policy Toward Foreign-Born Workers*, Working Paper No. 11, The Center for Comparative Immigration Studies, University of California-San Diego, May 10, 2000, 11pp.

[12]The shortage of technical workers that was projected and used to justify the significant increase in employment-based immigration authorized by the 1990 Immigration Act never materialized. The projections were determined to be erroneous because of flawed data and faulty methodology. Mervis, Jeffrey, "Congress Presses Probe Into NSF Prediction of Scientist Shortage," *The Scientist*, v. 5, October 28, 1991, pp. 1, 6-7.

[13]Immigration to the United States occurs in three ways: (1) legal, including family- and employment-based immigration; (2) humanitarian, which includes refugees and/or asylum seekers; and (3) illegal.

[14] The then Immigration and Naturalization Service acknowledged that in the fall of 1999, problems with the computerized tracking system lead to the approval of between 21,888 and 23,385 more H-1B visas allowable for FY1999. See for example General Accounting Office, *H-1B Foreign Workers: Better Controls Needed to Help Employers and Protect Workers*, GAO/HEHS-00-157, Washington, DC, September 2000, pp. 28-29.

petition for nonimmigrant status — from $500 to $1,000 per petition.[15] A portion of the fees are made available to the NSF for the development of private-public partnerships in K-12 education, the expansion of computer science, engineering, and mathematics scholarships, and the establishment of demonstration programs or projects that provide technical skills training for U.S. workers, both employed and unemployed.[16]

Signed into law on December 8, 2004, P. L. 108-447, The Consolidated Appropriations Act, 2005, reauthorized H-1B funding.[17] The fee employers pay for each petition was raised from $1,000 to $1,500 per petition. For employers with less than 25 full-time equivalent employees, the fee was set at $750 per petition. Also, the legislation created an additional 20,000 H-1B visas for FY2005, for those who had earned a masters degree or higher from a U.S. institution of higher education.[18]

The scientific community has been divided over proposals to impose stricter immigration limits on people with scientific and technical skills. Attempts to settle upon the balance between the needs for a highly skilled scientific and technical workforce, and the need to protect and ensure job opportunities, salaries, and working conditions of U.S. scientific personnel, will continue to be debated.[19] This paper addresses these issues.

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[15] The law expanded the list of employers who are exempt from paying the fee. For expanded discussion of the H-1B specialty worker see General Accounting Office, *Grants from H-1B Visa Fees Meet Specific Workforce Needs, But At Varying Skill Levels*, GAO-02-881, Washington, DC, September 2002, 78 pp.

[16] In addition, the Department of Labor received fees for job training, scholarships, and grants. The fees had sunset on October 1, 2003.

[17] Title IV, Subtitle B: H-1B Visa Reform.

[18] The first 20,000 H-1B beneficiaries with an earned master's degree or higher from a U. S. institution are exempt from the annual congressional mandated H-1B visa cap of 65,000. In addition, the legislation modified the formula for allocating fees from the H-1B Nonimmigrant Petitioner Account. See U.S. Department of Homeland Security, U.S. Citizenship and Immigration Services, Press Release, "USCIS to Implement H-1B Visa Reform Act of 2004," December 9, 2004, 2pp. Citizenship and Immigration Services began taking applications for the 20,000 H-1B visa workers with advanced degrees on May 12, two months behind schedule. The USCIS stated that the delay in implementation of the expanded H-1B visa program resulted from a need for clarification and interpretation of the law. NOTE: The USCIS exceeded the 65,000 cap on H-1B visas by approving 10,000 more petitions for visas than were authorized by Congress.

[19] See for example Bollag, Burton, "Wanted: Foreign Students," *The Chronicle of Higher Education*, October 8, 2004, v. 51, p. A37, Washington Fax, "Higher-Ed, Science and Engineering Groups Unite to Press Administration on Visa 'Quagmire'", May 13, 2004, [http://www.washintonfax.com/pl/2004/20040513a.html], Arnone, Michael, "Security at Home Creates Insecurity Abroad," *The Chronicle of Higher Education*, March 12, 2004, vol. 50, p. A21, Dougherty, Jon, "Foreigners Displacing US Hi-Tech Workers," WorldNetDaily.com, September 6 2003, [http://www.rense.com/general141/usthi.htm], and AScribe, The Public Interest Newswire, "U.S. Innovation Hurt by Restrictions on Foreign Grad Students, Consumer Union Study Shows, December 7, 2004, [http://www.ascribe.org/cgi-bin/behold.pl?ascribed=20041207.091922&time].

Foreign Students in U.S. Institutions

The number of non-U.S. citizens enrolling in U.S. colleges and universities has slowed following the September 11th terrorist attacks.[20] The slowing of enrollments has been attributed to, among other things, the tightening of U.S. visa policies and increased global competition for graduates in the scientific and technical disciplines from countries such as China, India, and Canada.[21] A 2004 report of the Institute of International Education reveals that for the academic year 2003-2004, the number of foreign-born students (in all disciplines) decreased by 2.4% from the previous academic year to 572,509.[22] The report noted that

> An increase of 2.5% in the total number of international students enrolled at the graduate level partially offset a 5% decline in the number of international undergraduate students in 2003/04. These international student enrollment changes were experienced differently by different types of institutions and in different levels and fields of study.[23]

There are noticeable differences by world region of origin in the flow of foreign students to the United States. India's students were 13.9% of the population for academic year 2003-2004. The other countries of origin of foreign students falling within the top ten were China (10.8%), Republic of Korea (9.2%), Japan (7.1%), Canada (4.7%), Taiwan (4.6%), Mexico (2.3%), Turkey (2.0%), Thailand (1.6%), and Indonesia (1.6%). The top ten fields of study for all foreign students were: business and management (19%), engineering (16.6%), mathematics and computer sciences (11.8%), general studies (10.5%), social sciences (9.5%), physical and life sciences (7.8%), fine and applied arts (5.6%), undeclared (5.1%), health professions (4.5%), and humanities (2.9%).[24]

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[20] Bhattacharjee, Yudhijit, "Drop in Foreign Application Slows," *Science*, v. 307, March 18, 2005, p. 1706, and *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States*, pp. 17-34.

[21] See for example Mooney, Paul and Shailaja Neelakantan, "No Longer Dreaming of America," *The Chronicle of Higher Education*, October 8, 2004, v. 51, p. A41, Birchard, Karen, "Canada Seeks More Foreign Students," *The Chronicle of Higher Education*, April 29, 2005, v. 51, p. A39, and Altbach, Philip G., "Higher Education Crosses Borders - Can the United States Remain the Top Destination for Foreign Students?," *Change*, March/April 2004. pp. 19-24.

[22] Institute of International Education, *Open Doors 2004: International Students in the U.S.*, Institute of International Education Online, [http://opendoors.iienetwork.org/]. NOTE: The report analyzes only foreign students on temporary visas and may include holders of F (students) visas, H (temporary worker/trainee) visas, J (temporary educational exchange-visitor) visas, and M (vocational training) visas.

[23] Ibid.

[24] Ibid.

Participation Rates in Science and Engineering

NSF data reveal that in 2003, the foreign student population earned approximately 31.6% of the doctorate degrees in the sciences and approximately 60.3% of the doctorate degrees in engineering.[25] In 2003, foreign students on temporary resident[26] visas earned 27.4% of the doctorates in the sciences, and 55.3% of the doctorates in engineering.[27] (See Figure 1). The participation rates in 2002 were 25.9% and 52.2%, respectively. In 2003, permanent resident[28] status students earned 4.2% of the doctorates in the sciences and 5% of the doctorates in engineering, a decrease from the 2002 levels of 4.6% and 5.3%, respectively. Trend data for science and engineering degrees for the years 1994-2003 reveal that of the non-U.S. citizen population, temporary resident status students consistently have earned the majority of the doctorate degrees. (See Tables 1 and 2).

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[25] National Science Foundation, *Science and Engineering Doctorate Awards:2003*, Detailed Statistical Tables, NSF05-300, Arlington, VA, December 2004, Table 3.

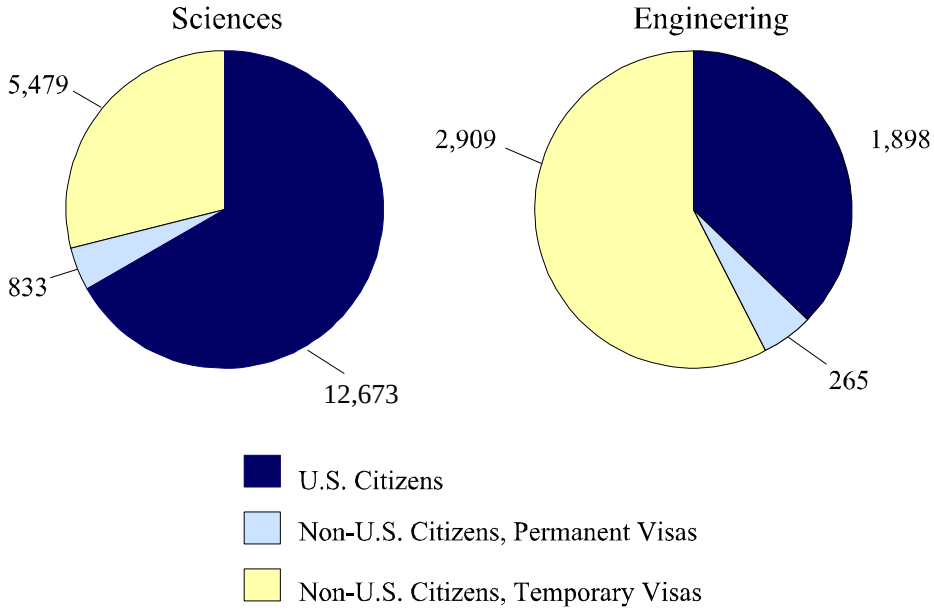
[26] A temporary resident is a person who is not a citizen or national of the United States and who is in this country on a temporary basis and can not remain indefinitely. The terms nonresident alien or nonimmigrant are used interchangeably.

[27] *Science and Engineering Doctorate Awards:2003*, pp. 3, 13-25.

[28] A permanent resident ("green card holder") is a person who is not a citizen of the United States but who has been lawfully accorded the privilege of residing permanently in the United States. The terms resident alien or immigrant apply.

Disaggregated data for the subfields of science provide a detailed picture of degree recipients by U.S. citizenship and non-U.S. citizenship status. In 2003, foreign students (temporary and permanent resident status) were awarded 41.4% of the doctorates in the physical sciences, an increase from the 39.7% awarded in 2002. In mathematics, 48.9% of the doctorates were awarded to foreign students in 2003, a decrease from the 51.3% awarded in 2002. For the computer sciences, 50.2% were awarded to foreign students, almost level to the 51.2% awarded in 2002. The earth, atmospheric, and ocean sciences and the agricultural and biological sciences awarded 34% and 31.6% of the degrees respectively to foreign-born students in 2003,

Figure 1. Doctorate Degrees: U.S. and Non-U.S. Citizens, 2003



Note: An additional 1,008 degrees in the sciences and 193 degrees in engineering were awarded to individuals of unknown citizenship.

Source: Science and Engineering Doctorate Awards: 2003, Table 3.

compared to the 2002 levels of 36.4% and 31%. In the social sciences and psychology, 22.4% of the doctorates were awarded to foreign students in 2003, an increase from 20.2% in 2002.[29]

[29] *Science and Engineering Doctorate Awards: 2003*, Table 3.

Table 1. Science Doctorates: Non-U.S. Citizens — Temporary and Permanent Residents as a Percentage of Total Awards, 1994-2003

	Total Sciences	Temporary Residents	As % of Total Awards	Permanent Residents	As % of Total Awards
1994	20,383	4,881	23.9	2,184	10.7
1995	20,527	4,480	21.8	2,553	12.4
1996	20,931	5,101	24.4	2,216	10.6
1997	21,117	4,954	23.5	1,688	8.0
1998	21,354	5,194	24.3	1,540	7.2
1999	20,602	5,046	24.5	1,250	6.1
2000	20,645	5,208	25.2	1,059	5.1
2001	20,038	5,172	25.8	979	4.9
2002	19,500	5,041	25.9	895	4.6
2003	19,993	5,479	27.4	833	4.2

Source: U.S. National Science Foundation, *Science and Engineering Doctorate Awards: 2003*, Detailed Statistical Tables, NSF05-300, Arlington, VA, December 2004, Table 3.

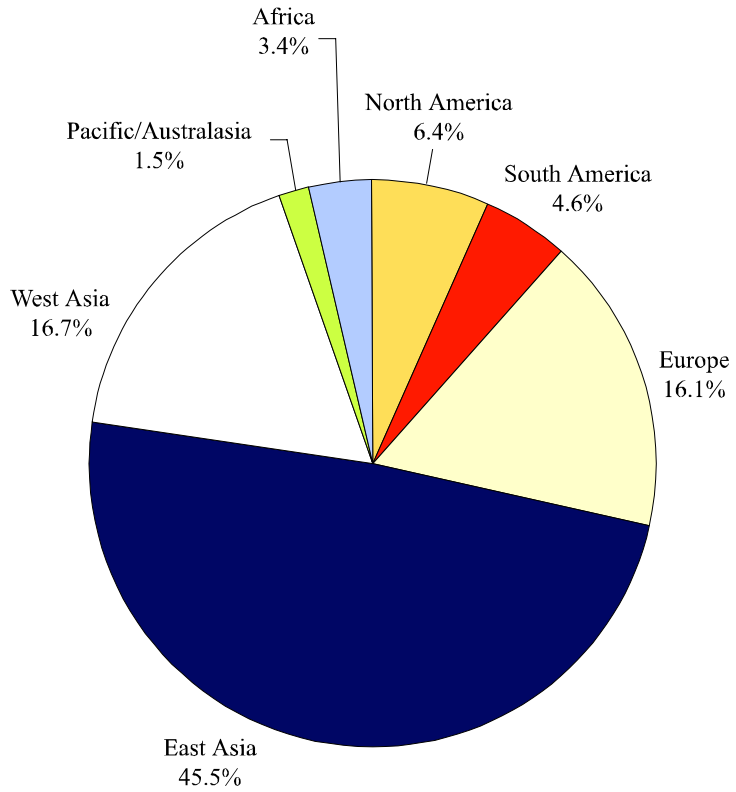
Table 2. Engineering Doctorates: Non-U.S. Citizens- -Temporary and Permanent Residents as a Percentage of Total Awards, 1994-2003

	Total Engineering	Temporary Residents	As % of Total Awards	Permanent Residents	As % of Total Awards
1994	5,821	2,653	45.6	838	14.4
1995	6,008	2,527	42.1	956	15.9
1996	6,309	2,734	43.3	793	12.6
1997	6,115	2,555	41.8	593	9.7
1998	5,924	2,582	43.6	479	8.1
1999	5,330	2,192	41.1	403	7.6
2000	5,321	2,452	46.1	350	6.6
2001	5,502	2,787	50.7	299	5.4
2002	5,071	2,647	52.2	271	5.3
2003	5,265	2,909	55.3	265	5.0

Source: U.S. National Science Foundation, *Science and Engineering Doctorate Awards: 2003*, Detailed Statistical Tables, NSF053-300, Arlington, VA, December 2004, Table 3.

The NSF provides specific data on the country of origin of foreign-born science and engineering doctorate awards. Data for 2003 reveal that of the earned doctorate degree holders, 26.4% were from China, 10.1% were from Taiwan, 3.4% from Canada, 3.6% from Africa, 1.2% from the United Kingdom, 2.1% from Japan, and 4% from Turkey.[30] See Figure 2 for additional disaggregated data on doctorate degrees awarded to non-U.S. citizens by country of origin.

Figure 2. Non-U.S. Citizens Awarded Doctorates in Science and Engineering by Country or Citizenship, 2003



Note: A total of 80 degrees were awarded to non-U.S. citizens from countries unknown.

Source: Science and Engineering Doctorate Awards: 2003, Table 11.

Support of Foreign Students in Graduate School

Certain restrictions have been placed on foreign students with temporary resident student status who are enrolled in graduate programs in U.S. institutions. Foreign graduate students are required to be full-time students, and are prohibited, due to visa restrictions, from seeking employment.[31] While they are prohibited also

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[30] *Science and Engineering Doctorate Awards: 2003*, Table 11.

[31] Restrictions are primarily because of their temporary status and related visa restrictions (continued...)

from obtaining most fellowships, traineeships or federally guaranteed loans, they are able to be employed as research assistants or teaching assistants on federally funded research projects.[32]

Foreign and U.S. science and engineering graduate students receive financial support from many resources — personal, university (primarily through teaching assistantships, research assistantships/traineeships, fellowships/dissertation grants)[33], foreign government, employer, and other.[34] Many foreign students receive support from their home country, though it is generally limited to the first year of study. For the continuing years, the university usually provides support mostly in the form of research assistantships or teaching assistantships. While temporary resident foreign students are ineligible for direct federal aid, the university support provided to them through research assistantships and teaching assistantships often result from federally funded research grants awarded to their home institution.[35]

The 2004 report, *Doctorate Recipients from United States Universities: Summary Report 2003*, revealed that institutions of higher education provided a significant amount of support, primarily through teaching assistantships, research assistantships/traineeships, and fellowships/dissertation grants, to foreign students on temporary and permanent resident visas.[36] In all fields, a greater percentage of non-U.S. citizen doctoral recipients receive financial assistance from universities than do U.S. citizen doctoral recipients.[37] (See Table 3 for primary sources of financial support). A disaggregation of the data by race/ethnicity reveal that 46% of black doctoral students relieved on their own resources to finance their graduate

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[31] (...continued)
imposed by the Immigration and Nationality Act.

[32] Limited funds are available, however, to foreign students (J-visas for cultural exchange) within the Fulbright program.

[33] A survey report notes that the federal government and other governments can be the source of these particular funding mechanisms. Approximately 66% of the 2003 doctorate recipients received funding from these sources. Hoffer, T.B., L. Selfa, V. Welch, Jr., K. Williams, M. Hess, J. Friedman, S.C. Reyes, K. Webber, and I. Guzman-Barron, *Doctorate Recipients from United States Universities, Summary Report 2003,* 2004, Chicago, National Opinion Research Center, 183 pp.

[34] A significant number of doctoral students receive support from more than one source or one mechanism. Multiple sources of support may occur in the same academic year.

[35] The NSF reports that "Total Federal support of graduate students is underestimated since reporting on Federal sources includes only direct Federal support to a students and support to research assistants financed through the direct costs of Federal research grants. This omits students supported by departments through the indirect costs portion of research grants; such support would appear as institutional (non-Federal) support, since the university has discretion over how to use these funds." *Science and Engineering Indicators 2000,* Volume I, NSB00-1, Arlington, VA, January 13, 2000, pp. 6-29.

[36] *Doctorate Recipients from United States Universities: Summary Report 2003,* pp. 24-25.

[37] Primary mechanisms of support differ broadly by discipline and field of study. Admittedly, various graduate programs have different financial aid policies and mechanisms, with science and engineering programs offering more fellowships and traineeships than other disciplines.

studies, followed by Native Americans at 45.8%, whites, at 35.2%, Hispanics, at 33.3%, and Asians, at 19.6%.[38]

Table 3. Primary Sources of Financial Support for Doctorate Recipients, 2003

Primary Source of Support		Total	U.S. Citizen	Permanent Visa	Temporary Visa
All Fields	N	35,484	24,299	1,500	9,574
Teaching Assistantships	%	17.3	16.7	19.8	18.2
Research Assistantships/Traineeships	%	27.0	19.5	32.9	45.1
Fellowships/Dissertation Grants	%	21.9	23.3	20.8	18.7
Own Resources	%	27.8	35.5	21.7	9.2
Foreign Government	%	2.3	0.1	1.9	7.9
Employer	%	3.6	4.7	2.9	0.7
Other	%	0.2	0.2	0.1	0.1

Source: Doctorate Recipients from United States Universities: Summary Report 2003, p. 62.
NOTE: Includes only doctorate recipients who reported primary source of support.

In the physical sciences, which include mathematics and computer sciences, universities provided the primary support for 78.9% of temporary resident students, 76.1% for permanent residents, and 63.5% for U.S. citizens.[39] In engineering, 76.4% of temporary resident students received primary financial support from universities, as did 70.5% of permanent resident students, and 48.9% of U.S. citizen doctoral students. Even in those disciplines where foreign students do not participate with any degree of frequency (i.e., education and the social sciences), larger percentages of foreign doctoral students on temporary and permanent resident visas obtained their primary financial assistance from universities than did comparable U.S. students. In the field of education, 30.5% of temporary resident doctoral students received their primary financial support from universities; for permanent resident students, 24.8%, and for U.S. citizens, 14.5%. In the social sciences, universities provided financial support to 47.5% of temporary resident doctoral students, 41.5% for permanent residents, and 35.7% for U.S. citizens.

Perceived Benefits and Problems

There are divergent views in the scientific and academic community about the effects of a significant foreign presence in graduate science and engineering programs. Some argue that U.S. universities benefit from a large foreign citizen

[38] *Doctorate Recipients from United States Universities: Summary Report 2003*, p. 62.

[39] University support includes teaching assistantships, research assistantships, and research traineeships.

enrollment by helping to meet the needs of the university and, for those students who remain in the United States, the Nation's economy.[40]

> Foreign students generate three distinct types of measurable costs and benefits. First, 13 percent of foreign students remain in the United States, permanently increasing the number of skilled workers in the labor force. Second, foreign students, while enrolled in schools, are an important part of the workforce at those institutions, particularly at large research universities. They help teach large undergraduate classes, provide research assistance to the faculty, and make up an important fraction of the bench workers in scientific labs. Finally, many foreign students pay tuition, and those revenues may be an important source of income for educational institutions.[41]

The increased participation of foreign students in graduate programs has generated critical responses by many in the minority community. Blacks, Hispanics, and Native Americans, historically underrepresented in the science and engineering fields, contend that disparity exists in the university science community with respect to foreign students.[42] It is charged that there is not equal access for U.S. minorities to graduate education, receipt of scholarships, promotion to higher ranks, receipt of research funds, access to outstanding research collaborators, and coauthorship of papers and other outlets for scientific publications. Frank L. Morris, professor, University of Texas, charges that colleges and universities employ exclusionary mechanisms. Rather than supporting minority graduate students, institutions provide the majority of their resources to departments that have admitted foreign students. In testimony before the Subcommittee on Immigration and Claims, Morris states that:

> The generous immigration policy coupled with the much better and disproportionate and much better subsidy out of U.S. taxpayer funds of foreign doctoral student over all American minority students and especially much better than the support given to African American doctoral students. . . . This has created a situation that place the economic well being of the African American community in jeopardy because we have received inadequate doctoral training to prepare for or compete in an increasing information and higher order scientifically technologically driven current and future U. S. economy.[43]

Another criticism noted by some is that foreign student teaching assistants do not communicate well with American students. Language as a barrier has been a

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[40] The Institute of International Education reports that foreign students contribute approximately $12.9 billion annually to the U.S. economy in money from tuition, living expenses and related costs. The Department of Commerce estimates that U.S. higher education is the nation's fifth largest service sector export. See *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States,* pp. 13-59.

[41] Borjas, George, Center for Immigration Studies, *An Evaluation of the Foreign Student Program,* June 2002, [http://www.cis.org/articles/2002/back602.htm], pp.6-7 .

[42] See for example House Subcommittee on Immigration and Claims, *Impact of Immigration on Recent Immigrants and Black and Hispanic Citizens,* 106th Cong., 1st Sess., March 11, 1999, p. 22, prepared statement of Julian R. Betts, Associate Professor, Department of Economics, University of California, San Diego.

[43] Ibid., Testimony of Frank L. Morris, Sr., p. 33.

perennial problem for some foreign students.[44] There are charges that the "accented English" of the foreign teaching assistants affects the learning process.[45] A large number of graduate schools require foreign teaching assistants to demonstrate their proficiency in English, but problems remain.[46] Several states have passed legislation setting English-language standards for foreign students serving as teaching assistants.[47]

Some academics and scientists do not view scientific migration as a problem, but as a net gain. These proponents believe that the international flow of knowledge and personnel has enabled the U.S. economy to remain at the cutting-edge of science and technology. A 2005 report of the National Academies states that:

> The participation of international graduate students and postdoctoral scholars is an important part of the research enterprise of the United States. In some fields they make up more than half the populations of graduate students and postdoctoral scholars. If their presence were substantially diminished, important research and teaching activities in academe, industry, and federal laboratories would be curtailed, particularly if universities did not give more attention to recruiting and retaining domestic students.[48]

Foreign Scientists and Engineers in the U.S. Labor Force

During the 1980s, the number of immigrant scientists and engineering entering the United States remained somewhat stable (12,000), registering only slight annual increases. In 1992, there was a marked increase in the admissions of scientists and engineering, fueled primarily by the changes in the Immigration Act of 1990 that allowed significant increases in employment-based quotas of H-1B visas. By 1993, the number of scientists and engineers on permanent visas increased to 23,534.[49] The numbers were increased further as a result of the Chinese Students Protection Act of

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[44] In addition to the Korean, Japanese, Vietnamese, Chinese, Arabic and Spanish speaking students, there are the other languages such as Malay, Thai, Indonesian, Tongan, Ibo, Tagalog, Hungarian, Haitian, Creole, and Farsi.

[45] Gravois, John, "Teach Impediment - When the Student Can't Understand the Instructor, Who is to Blame?," *The Chronicle of Higher Education*, v. 51, April 8, 2005, p. A10, and Bollag, Burton, "New Test of English as a Foreign Language Puts an Emphasis on Speaking,"*The Chronicle of Higher Education*, v. 52, October 7, 2005, p. A49.

[46] Sarkisian, Ellen, *Teaching American Students, A Guide for International Faculty and Teaching Assistants in Colleges and Universities*, Cambridge, Massachusetts, 1997, 109 pp.

[47] Gravois, John, "Teach Impediment - When the Student Can't Understand the Instructor, Who is to Blame?," p. A10.

[48] *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States*, p. 65.

[49] National Science Foundation, *Major Declines in Admissions of Immigrant Scientists and Engineers in Fiscal Year 1994*, NSF97-311, Arlington, VA, June 18, 1997, p. 1.

1992.[50] *Science & Engineering Indicators 2004* reports that the proportion of foreign born scientists and engineers in the U.S. labor force reached a record in 2000, revealing high levels of entry by holders of permanent and temporary visas during the 1990s.[51] The issuance of permanent visas in the past few years has been impacted by administrative changes at the Bureau of Citizenship and Immigration Services, changes in immigration legislation, and any impact of September 11th. The NSF reports declines in high-skilled related visas issued from 2001 to 2003. These declines are attributed to a decrease in the number of students and workers applying for visas and the percentage of visa applications rejected by the State Department.

Foreign scientists and engineers on temporary work visas have generated considerable discussion.[52] As previously stated, recent legislation has increased the annual quota for the H-1B program in which foreign-born workers can obtain visas to work in an occupation for up to six years.[53] The H-1B program, generally, is thought of as an entry for technology workers, but it is used also to hire other skilled workers.[54] *Science & Engineering Indicators 2002* states that "An H-1B visa is sometimes used to fill a position not considered temporary, for a company may view an H-1B visa as the only way to employ workers waiting long periods for a permanent visa."[55] Data on selected occupations for which companies have been given permission to hire H-1B visa workers are contained in Table 4.

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[50] As an outgrowth of the 1989 Tiananmen Square uprising, Chinese students residing temporarily in the United States were allowed to adjust to permanent resident status in 1993.

[51] Data were from the 2000 Census. *Science Indicators 2004*, p. 3-4.

[52] See Thibodeau, Patrick, "H-1B Fraud Investigations Are Expected to Increase," *Computerworld*, March 21, 2005, Vaughan, Jessica, Center for Immigration Studies, *Shortcuts to Immigration, The Temporary Visa Program is Broken*, January 2003, [http://www.cis.org/articles/2003/back103.htm], and General Accounting Office, *H-1B Foreign Workers: Better Tracking Needed to Help Determine H-1B Program's Effects on U.S. Workforce*, GAO03-883, Washington, DC, September 2003, 47 pp,

[53] See *supra* note 11.

[54] Data from the Office of Immigration Statistics reveal that the industry employing the largest number of H-1B workers in FY2003 was computer systems design and related services. There was a 12% increase from FY2002 to FY2003 in the employment of H-1B workers in computer related positions. Department of Homeland Security, Office of Immigration Statistics, "Characteristics of Speciality Occupation Workers (H-1B): Fiscal Year 2003," November 2004, p. 20.

[55] National Science Foundation, *Science and Engineering Indicators 2002*, Volume I, NSB02-1, Arlington, VA, January 15, 2002, p. 3-32.

Table 4. H-1B Petitions Approved by Select Occupation Group, Fiscal Year 2003

Occupation	Total	Percent
Computer-related Occupations	83,114	38.5
Engineering, Architecture, and Surveying)	26,843	12.4
Medicine and Health	15,623	7.2
Miscellaneous Professional, Technical, and Managerial	4,876	2.3
Life Sciences and Social Sciences	13,820	6.4
Mathematics and Physical Sciences	5,679	2.6
Education	23,980	11.1
Other	43,405	20.1
Total	217,340	100.00

Source: *Department of Homeland Security, Office of Immigration Statistics, Characteristics of Speciality Occupation Workers (H-1B): Fiscal Year 2003,* November 2004, 23 pp. NOTE: "During fiscal year 2003, USCIS approved 217,340 H-1B petitions submitted by employers on behalf of alien workers. The number of approved petitions exceeds the number of individual H-1B workers because sometimes more than one U.S. employer submits a petition on behalf of individual H-1B workers (multiple petitions). The number of approved petitions for initial employment exceeds the cap because of employer-based cap exemptions and multiple petitions for individuals. For example, approved petitions for initial employment are exempt from the cap because the sponsors are institutions of higher education or nonprofit organizations affiliated with institutions of higher education." p.4.

Some argue that the influx of immigrant scientists and engineers has resulted in depressed job opportunities, lowered wages, and declining working conditions for U.S. scientific personnel. While many businesses, especially high-tech companies, have recently downsized, the federal government issued thousands of H-1B visas to foreign workers. There are those in the scientific and technical community who contend that an over-reliance on H-1B visa workers to fill high-tech positions has weakened opportunities for the U.S. workforce.[56] Many U.S. workers argue that a number of the available positions are being filled by "less-expensive foreign labor."[57] Those critical of the influx of immigrant scientists have advocated placing restrictions on the hiring of foreign skilled employees in addition to enforcing the existing laws designed to protect workers. Those in support of the H-1B program maintain that there is no "clear evidence" that foreign workers displace U.S. workers in comparable positions and that it is necessary to hire foreign workers to fill needed positions, even during periods of slow economic growth.[58] A September 2003 report

[56] See for example Schwartz, Ephraim, "H-1B: Patriotic or Treasonous?," *InfoWorld*, v. 27, May 6, 2005, [http://www.infoworld.com/article/05/05/06/19NNh1b_1.html].

[57] Johnson, Carrie, "Hiring of Foreign Workers Frustrates Native Job-Seekers," *Washington Post*, February 27, 2002, p. E01.

[58] See for example Clark, John, Nadine Jeserich, and Graham Toft, Hudson Institute, *Can Foreign Talent Fill Gaps in the U.S. Labor Force? The Contributions of Recent Literature*, September 2004, 33 pp., Baker, Chris, "Visa Restrictions Will Harm U.S. Technology, Gates Says; Microsoft Chief Calls For End to Caps On Workers," *The Washington Times*, April 29, 2005, p. C13, and Frauenheim, Ed, "Brain Drain in Tech's Future?,"CNET Nets.com., August 6, 2004, [http://global.factiva.com/en/arch/print-results.asp].

of the General Accounting Office, *H-1B Foreign Workers, Better Tracking Needed to Help Determine H-1B Program's Effe*cts *on U. S. Workforce,* states that:

> While a number of employers acknowledged that some H-1B workers might accept lower salaries than U.S. workers, the extent to which wage is a factor in employment decisions is unknown. Labor's Wage and Hour Division (WHD), which is responsible for ensuring that H-1B workers are receiving legally required wages, has continued to find instances of program abuse. The extent to which violations of the H-1B program take place is unknown and may be due in part to WHD's limited investigative authority.[59]

The maturing of the computer industry has wrought its own set of problems relative to employment of foreign scientists and engineers[60]. There are some who contend that the salary of the foreign-born computer professionals working in the United States is lower than that of their U.S. counterparts who are the same age and educational level.[61] Others charge that the hiring of H-1B workers "undermines the status and bargaining position of U.S. workers."[62] The Department of Labor has sought to enforce the existing policies on temporary employment of nonimmigrant foreign workers under H-1B visas, and to penalize those employers who are found to be in violation.[63]

Many in the scientific community maintain that in order to compete with countries that are rapidly expanding their scientific and technological capabilities, the United States needs to bring in those whose skills will benefit society and will enable us to compete in the new-technology-based global economy. Individuals supporting this position do believe that the conditions under which foreign talent enters U.S. colleges and universities and the labor force should be monitored more carefully. And there are those who contend that the underlying concerns of foreign students in graduate science and engineering programs is not necessarily that there are too many foreign-born students, but that there are not enough U.S. students entering the scientific and technical disciplines.

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[59] General Accounting Office, *H-1B Foreign Workers, Better Tracking Needed to Help Determine H-1B Program's Effects on U.S. Workforce,* GAO03-883, Washington, DC, September 2003, p. 26.

[60] See for example Thibodeau, Patrick, Sidebar: Foreign Students Fill Computer Science Graduate Programs," *Computerworld*, February 28, 2005, Matloff, Norman, "On the Need for Reform of the H-1B Non-Immigrant Work Visa in Computer-Related Occupations," December 12, 2003, 99 pp., and Zavodny, Madeline, "The H-1B Program and Its Effects on Information Technology Workers", *Economic Review*, Third Quarter 2003, pp.1-11.

[61] *H-1B Workers Face Ugly Backlash*, p. 2,

[62] Federation for American Immigration Reform, *Deleting American Workers - Abuse of the Temporary Foreign Worker System in the High Tech Industry*, August 2003, 17 pp.

[63] Approximately 25% of current H-1B visa holders change from foreign student status. Lowell, B. Lindsay, *H-1B Temporary Workers: Estimating the Population*, p. 15.

Policy Implications

The debate on the presence of foreign students in graduate science and engineering programs and the workforce has intensified as a result of the terrorist attacks of September 11, 2001. It has been reported that foreign students in the United States are encountering "a progressively more inhospitable environment."[64] Concerns have been expressed about certain foreign students receiving education and training in sensitive areas.[65] There has been increased discussion about the access of foreign scientists and engineers to research and development (R&D) related to chemical and biological weapons. Also, there is discussion of the added scrutiny of foreign students from countries that sponsor terrorism.[66] The academic community is concerned that the more stringent requirements of foreign students may have a continued impact on enrollments in colleges and universities.[67] Others contend that a possible reduction in the immigration of foreign scientists may affect negatively on the competitiveness of U.S. industry and compromise commitments made in long-standing international cooperative agreements.[68]

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[64] House Committee on the Judiciary, Subcommittee on Immigration, Border Security, and Claims, *Sources and Methods of Foreign Nationals Engaged in Economic and Military Espionage*, 109th, 1st Sess., September 15, 2005, Written testimony of William A. Wulf, President, National Academy of Engineering, p. 12, and Foroohar, Rana, "America Closes Its Doors," [http://msnbc.msn.com/id/6038977/site/newsweek/print/1/displaymode/1098].

[65] See The White House, Office of the Press Secretary, "Homeland Security Presidential Directive 2, Combating Terrorism Through Immigration Policies," October 29, 2001, [http://www.whitehouse.gov/news/releases/2001/10/20011030-2.html], p. 2, Burd, Stephen, "Bush May Bar Foreign Students From Sensitive Courses," *The Chronicle of Higher Education*, April 26, 2002, v. p. A26, Massachusetts Institute of Technology, *In The Public Interest*, Report of the Ad Hoc Faculty Committee on Access to and Disclosure of Scientific Information, June 12, 2002, pp. 11-15, and Stone, Richard, "U.S. Visa Crackdown Disrupts Meetings," *Science*, v. 297, August 23, 2002, p. 1259.
NOTE: The Bureau of Consular Affairs, Department of State, issues visas to foreign students and maintains a "technology alert list" that includes 16 sensitive areas of study. The list was produced in an effort to help the United States prevent the illegal transfer of controlled technology, and includes chemical and biotechnology engineering, missile technology, nuclear technology, robotics, and advanced computer technology.

[66] The State Department publishes a list annually of state sponsors of terrorism. Currently, the countries include Cuba, Iran, Libya, North Korea, Sudan, and Syria. CRS Report RL32251, *Cuba and the State Sponsors of Terrorism List*, by Mark P. Sullivan.

[67] See for example Black, Harvey, "Foreign Student Scrutiny," *The Scientist*, October 21, 2002,[wysiwyg://7/http://www.biomedcentral.com/news/20021021/06/index.html], Margulies, Jonathan, "Delays in Visa Approvals Cause Headaches for Colleges," *The Chronicle of Higher Education*, v. 49, September 20, 2002, p. A24, Washington Fax, "Visa Delays Discourage International Scholars and Researchers, NAFSA Survey Finds, November 19, 2002, [http://www.washingtonfax.com/pl/2002/20021119.html], and Rooney, Megan, "More Effort Urged on Foreign Students," *The Chronicle of Higher Education*, v. 49, January 31, 2003, p. A42.

[68] "Current Visa Restrictions Interfere with U.S. Science and Engineering contributions to Important National Needs," Statement from Bruce Alberts, President National Academy of Sciences, Wm. A. Wulf, President, National Academy of Engineering, and Harvey Fineberg,

(continued...)

The issue of tracking foreign students attending U.S. institutions has generated particular debate in the academic and scientific community following the September 11th terrorist attacks.[69] Prior to September 11th, the Illegal Immigration Reform and Immigrant Responsibility Act (P.L. 104-208) authorized the Student and Exchange Visa Program/Coordinated Interagency Partnership Regulating International Students (SEVP/CIPRIS).[70] This electronic information reporting system for tracking foreign students and researchers was to replace the existing paper-based format. The legislation required colleges and universities to monitor and compile data on foreign students attending their respective institutions in such areas as date of enrollment/reporting, field of study, credits earned, and source of financial support for the student.[71] The information was to be provided to the INS by the colleges and universities. However, the system was never fully implemented, primarily because institutions described it as being too costly, an "unnecessary burden on colleges and universities," and "an unreasonable barrier to foreign students."[72]

The USA Patriot Act (P.L. 107-56) and the Enhanced Border Security and Visa Entry Reform Act (P.L. 107-173) revised and enhanced the process for collecting and monitoring data on foreign students and researchers in U.S. institutions.[73] In response to the legislation, the INS developed the Student and Exchange Visitor Information System (SEVIS). SEVIS, a web-based system, was designed to maintain current information on foreign students and exchange visitors in order to ensure that they arrive in the United States, register at the institution or predetermined exchange

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[68] (...continued)
President, Institute of Medicine, December 13, 2002, [http://www4.nationalacademies.org]. See also, Southwick, Ron, "Agriculture Department Draws Fire for Decision to Stop Hiring Foreign Scientists," *The Chronicle of Higher Education*, v. 48, May 13, 2002.

[69] Homeland Security Presidential Directive 2, "Combating Terrorism Through Immigration Policies," and American Association for the Advancement of Science, Science & Technology in Congress, "Tracking Foreign Students," November 2001, pp. 1, 4, 6,

[70] The Illegal Immigration Reform and Responsibility Act was signed into law on October 1, 1996.

[71] Colleges and universities were required to collect the information, but were not required to automatically report it to the INS.

[72] Marlene M., Executive Director and CEO, Association of International Educators, "Thinking Clearly About Foreign Students and Terrorism," September 20, 2001, [http://www.nafsa.org/content/PublicPolicy/NAFSAontheIssues/CIPRISoped.htm], Peterson, Jonathan, and Trounson, Rebecca, "Foreign Students Being Checked, INS Asked to Create Computerized System", *Pittsburgh Post-Gazette*, September 29, 2001, p. A-5, Sheridan, Mary Beth, "Visa Tracking System Limited by Lack of Personnel," *Washington Post*, February 25, 2002, p. A03, Zernike, Kate and Drew, Christopher, "A Nation Challenged: Student Visas; Efforts to Track Foreign Students are Said to Lag, *New York Times*, January 28, 2002, p. 1A, "U.S. Urged to Give More Details on Database for Tracking Foreign Students," *The Chronicle of Higher Education*, February 8, 2002, p. A22, and Hebel, Sara, "Senators Say They Expect Foreign Students, Colleges to Help Pay for New Monitoring System," *The Chronicle of Higher Education*, October 15, 2001.

[73] The USA Patriot Act was signed into law on October 26, 2001. The Enhanced Border Security and Visa Reform Act was signed into law on May 14, 2002.

program, and properly maintain their visa status during their stay.[74] Congress directed the INS to have the tracking system in operation by January 30, 2003. The deadline for implementation of SEVIS was extended to February 15, 2003.[75] However, SEVIS experienced considerable problems and created excessive delays in processing visa applications.[76] The more rigorous screening of visa applicants was one factor contributing to the delays.[77] The current problems with SEVIS are reported to be primarily those relating to technical matters and personnel costs.

On February 15, 2005, the State Department announced that progress had been made in reducing the clearance time for the Visas Mantis process.[78] Currently, the process averages 15 days. In addition to reducing the clearance process, the State Department revised the clearance procedures by reducing the restrictions placed on students and scholars and extending the validity of the clearances (lengthening the time for each clearance). The Government Accountability Office (GAO) released a report detailing the efforts and the improvements that have been made in the visa processing. The February 2005 report, *Border Security: Streamlined Visas Mantis Program Has Lowered Burden on Foreign Science Students and Scholars, but*

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[74] NOTE: For expanded discussion of SEVIS see CRS Report RL32188, *Monitoring Foreign Students in the United States: The Student and Exchange Visitor Information System (SEVIS)*, by Alison Siskin.

[75] The deadline for implementation of SEVIS was extended to February 15, 2003. August 1, 2003 is the date by which all institutions must enter data into SEVIS for those students who were enrolled prior to January 30, 2003. NOTE: In addition to SEVIS, the Department of State requires institutions to submit, electronically, basic biographic information about their foreign students. The information becomes part of the Department of State's new Interim Student and Exchange Authentication System (IDEAS), a temporary Web-based international student information collection system required by the Enhanced Border Security Act of 2001. IDEAS is separate from SEVIS and directs that institutions submit the necessary information to both systems. IDEAS went into effect on September 11, 2002 and will remain operational until SEVIS achieves total implementation.

[76] Murphy, Caryle and Nurith C. Aizenman, "Foreign Students Navigate Labyrinth of New Laws," *Washington Post*, June 9, 2003, p. B01, Greene, Marcia Slacum, "Computer Problems Slow Tracking of Foreign Students," *Washington Post*, March 26, 2003, p. A06, and Arnone Michael, "Colleges Expect the Worse in Preparing for New System to Track Foreign Students," *The Chronicle of Higher Education*, v.49, September 6, 2002, p. A33. NOTE: Less than 2% of all visas issued are student visas.

[77] For a discussion of the screening process and review procedures for visa issuance, see, for example, John Marburger, Director, Office of Science and Technology Policy, Speech before the American Association for the Advancement of Science, Science and Technology Policy Colloquium, April 10, 2003, Washington, DC. p. 5.

[78] Upon application for a visa, a consular officer will determine if the applicant needs a Security Advisory Opinion (SAO) from the State Department. SAOs are required for, among other things, applicants that have contact with or may engage in illegal transfer of sensitive technology. An SAO related to sensitive technology concerns is referred to as Visas Mantis and is the most common type of SAO used for science applicants. Visa applicants from China account for approximately 50% of all Visas Mantis security reviews. Approximately 2-3% of all nonimmigrant visa applications need an SAO determination.

Further Refinements Needed[79], detailed the efforts that have been made in strengthening the visa processing. It addresses other issues that science and engineering students and scholars encounter when traveling to the United States. Additional reports of the GAO assessed agencies' progress in implementing recommended changes in visa operations. A September 13, 2005 report — *Border Security, Strengthening Visa Process Would Benefit from Improvements in Staffing and Information Sharing*, stated that while steps have been taken to improve the visa application system, additional issues required immediate attention.[80] The recommendations include clarifying visa policies and procedures in order to facilitate their implementation, and ensuring that consular officers have access to the needed tools to improve national security and promote legitimate travel.

On September 13, 2005, the House Subcommittee on National Security, Emerging Threats, and International Relations held a hearing to examine the procedures put in place to correct the gaps and vulnerabilities in the visa process.[81] Attention was directed at the mechanisms that are necessary to strengthen the visa process as an antiterrorism tool while simultaneously facilitating legitimate travel by foreign students, scientists, researchers, and others in the United States.[82] Witnesses testified that consular workloads have increased significantly, yet the visa-processing offices continue to lack strategic direction, adequate resources, and training. In addition, reliable data are not readily available, across and among departments and agencies, to determine security and visa fraud related issues and overall increased visa wait times.[83] Witnesses stated that because visa policies and requirements are ongoing and can change quickly, clear procedures on visa issuance and monitoring operations worldwide are necessary to guarantee that visas are adjudicated in a consistent manner at each visa-issuing post.

In the 109th Congress, legislation has been introduced to reform the visa application process for foreign students – S. 455, the American Competitiveness Through International Openness Act of 2005. The bill calls for, among other things, the development of a mechanism for institutionalized coordination of procedures of the Departments of State, Commerce, Education, and Homeland Security in facilitating entree to the United States for foreign students, scientists, and researchers. Language in the bill states that the mechanism should include a well defined division of responsibility that eliminates duplication and fosters inter-agency cooperation. It

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[79] Government Accountability Office, *Border Security: Streamlined Visas Mantis Program Has Lowered Burden on Foreign Science Students and Scholars, but Further Refinements Needed*, GAO-05-198, Washington, DC, February 2005, 35 pp.

[80] Government Accountability Office, *Border Security: Strengthened Visa Process Would Benefit from Improvements ibn Staffing and Information Sharing*, GAO-05-859, Washington, DC, September 2005, 55 pp.

[81] House Committee on Government Reform, Subcommittee on National Security, Emerging Threats, and International Relations, *Combating Terrorism: Visas Still Vulnerable*, 109th Cong., 1st Sess., September 13, 2005,

[82] All 19 of the terrorists of the September 11th attacks had been issued temporary visas.

[83] The State Department's database did not have any information linking the September 11th attackers with terrorists activities, however, there was information in other agencies' databases.

is anticipated that the 109th Congress will continue to monitor the participation of foreign students in graduate science and engineering programs and the processing of visas for foreign science students and scholars. There may be further debate regarding the increased scrutiny of foreign students from countries that sponsor terrorism. Added attention may be given to the restrictions placed on the participation of foreign students and scientists in certain types of R&D, including the use of research equipment necessary for conducting unclassified, fundamental research.[84] There are questions as to whether or not a continued reduction in the immigration of foreign scientists may impact negatively on the competitiveness of U.S. industry.

In testimony before the House Subcommittee on 21st Century Competitiveness and Select Education, C.D. Mote, Jr., President, University of Maryland, College Park, stated that :

> Other nations are competing effectively for [foreign students and scholars in science and engineering] and will gain technological advances, weakening our economic and technological position and our security. . . . New contenders in the fiercely competitive environment of higher education emerge daily. China has set a goal to greatly increase over the next decade the number of universities, and some will be of world-class stature. Taiwan and Japan also plan to build top universities. Though most of the world's top universities are currently in the U.S., many are determined to change this balance, and they probably will. To remain competitive in the coming decades, we must continue to embrace the most capable students and scholars of other countries. Our security and quality of life depend on it.

Should there be limits placed on the foreign student presence, particularly in tax supported U.S. institutions? Are the more-restrictive visa policies enacted following September 11th dissuading foreign students from studying in the United States? Do immigration ceilings affect the health of the national R&D enterprise? Would a reduction in the immigration of foreign scientists impact negatively on the competitiveness of U.S. industry? Should there be separate immigration ceilings for scientists and engineers? Can U.S. students be encouraged to participate in graduate science and engineering programs in numbers approximating that of foreign students? Should certain foreign students be prohibited from receiving education in certain disciplines? Does higher education have a responsibility to address the concerns about foreign students who return to their home country carrying away vital science and technology? This debate will continue as foreign student enrollments in U.S. graduate science and engineering programs receive added attention.

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[84] House Committee on the Judiciary, Subcommittee on Immigration, Border Security & Claims, *Sources and Methods of Foreign Nationals Engaged in Economic and Military Espionage*, 109th Cong., 1st Sess., September 15, 2005, Testimony of the Honorable Michelle Van Cleave, [http://judiciary.house.gov/media/pdfs/ForeignNational9705.pdf].