

## **Projects of the National Academies on Women in Science and Engineering**

### Remarks for the conference on Gendered Innovations in Science and Engineering

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#### Relevant Background of the Author:

National Associate of the National Academies; NRC Board on Policy and Global Affairs, 2001-present; National Panel of Presidents and Chancellors on Models for Flexible Tenure-track Faculty Career Pathways, American Council on Education (ACE), 2004-2005; California Council on Science and Technology, 2003 – present ; American Council on Education's Commission on Women in Higher Education, 2005 – 2008; Chair-Elect, Commission on Human Resources and Social Change, National Association of State Universities and Land-Grant Colleges (NASULGC), 2005 – 2007; invited speaker, California Governor's Conference on Women and Families, 2004 .

### **Remarks**

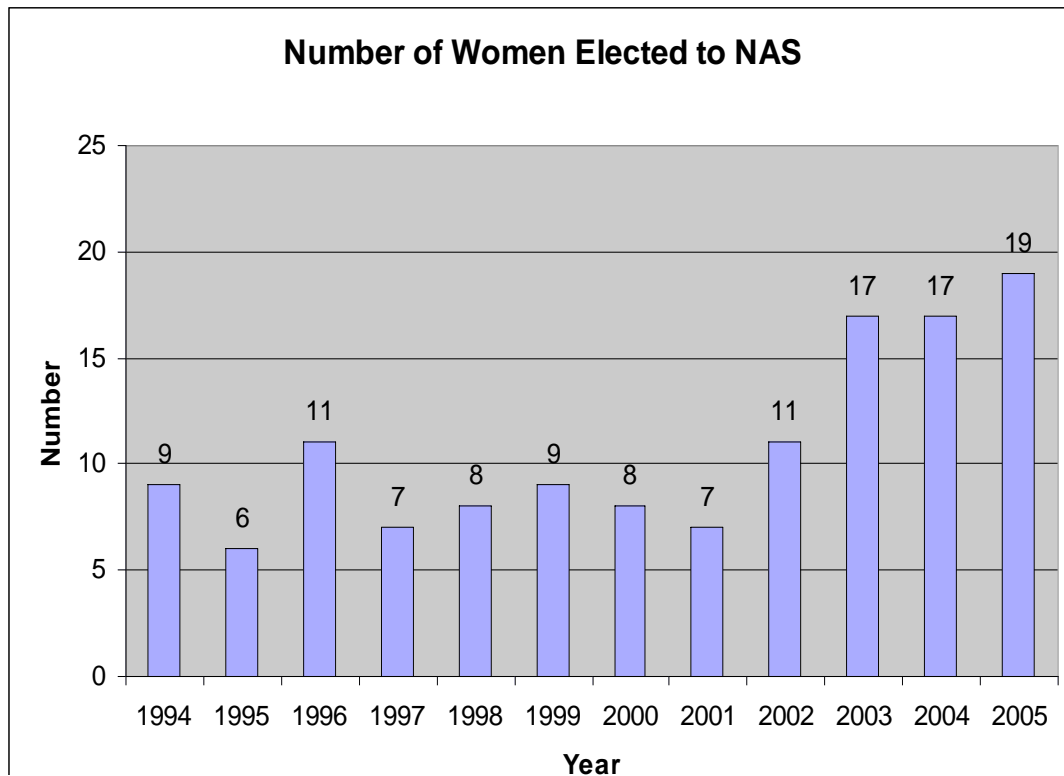
The National Research Council (NRC) is the operating arm of the National Academy of Science, the National Academy of Engineering, and the Institute of Medicine. As a member of the NRC's Committee on Policy and Global Affairs (PGA, the overseer of many of the NRC's policy boards and commissions), I was recently asked to chair a review of the activities and plans of CWSE, the Committee on Women in Science and Engineering. Also recently, another of the PGA's boards called COSEPUP (Committee on Science, Engineering, and Public Policy) asked me and several other women scientists to speak on the subject of women's participation in academic science and engineering, and to consider what COSEPUP could do that would be of value to institutions and individuals concerned about the dearth of women in STEM (Science, Technology, Math, and Engineering) fields.

My participation in these projects gave me the opportunity to examine what the NRC is doing on issues related to women in science, and to offer, with others, some recommendations for future work. Our conference organizer Londa Schiebinger has asked me to share this with you today.

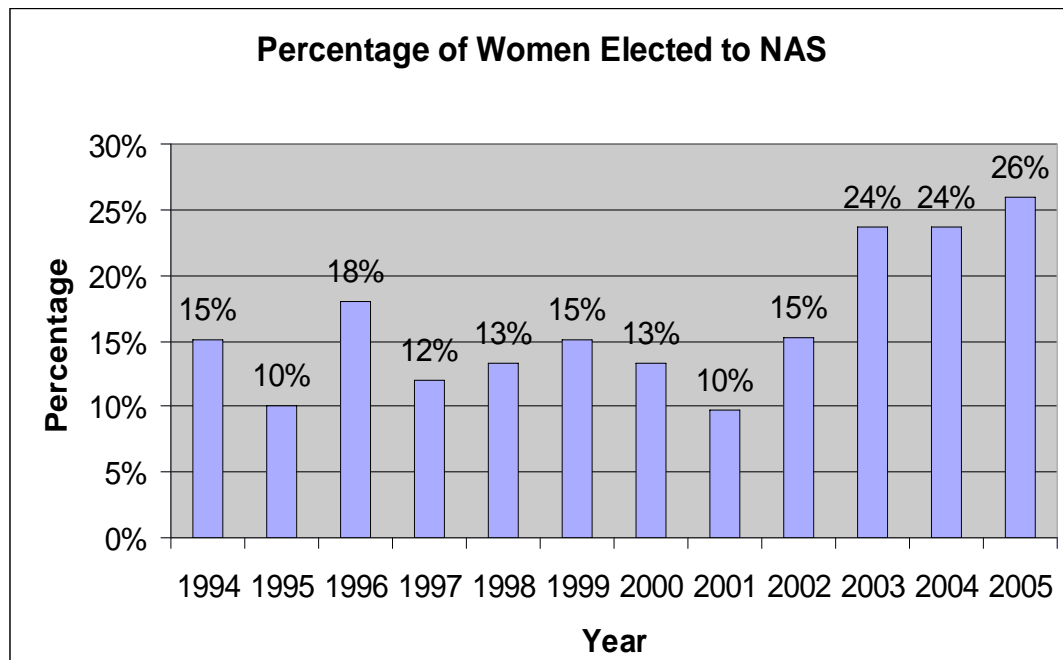
## 1. Is the National Academy (still) gender imbalanced?

The short answer is yes, but there is momentum in the Academy to address this imbalance. The proportion of women is increasing with time, especially recently, as a result of internal discussions and focus on this issue by Academy members.

The current membership of the National Academy of Science (NAS) is 1899. About ten percent, or 189, are women. Graph 1 shows how the number of women has increased with time since 1994. It is encouraging that the percentage of women elected in the three most recent elections (2003 - 2005) was more than 20% per year (Graph 2). Sixty members were elected each year from 1994 to 2000, and 72 members were elected each year thereafter.



Graph 1



Graph 2

Of course, a significant factor in achieving parity in the ranks of the NAS is achieving parity in the ranks of academic faculty, especially faculty in research institutions where women represent just 28% of the total faculty. This number is even lower in the most prestigious universities. It is to the dearth of women in STEM careers in academe (and to some extent also in industry) that two policy committees of the NRC, CWSE and COSEPUP, are addressing considerable energies. I now turn to a discussion of what these committees are doing about the issue. Hopefully some of this new work will be useful for studies of gendered innovation in S&E. And if it doesn't, well then these NRC committees may welcome your input since these newly proposed projects are still in the formative stages.

## **2. CWSE**

The Committee on Women in Science and Engineering (CWSE) was established in 1991 as a standing committee of the National Research Council. Its mandate is to coordinate, monitor, and advocate action to increase the participation of women in science and engineering.

The accomplishments of CWSE are many:

- a. CWSE has produced publications that address workforce and related issues. These are listed in Appendix 1, some with brief summaries. You'll find this a rich source of data, stories, and other information. From Scarcity to Visibility describes gender differences in the careers of doctoral scientists and engineers and is an excellent resource for social scientists.
- b. CWSE has provided important support to the academies as they seek to address gender inequities in their membership. It is on hand to give advice to other policy groups of the NRC.
- c. CWSE, with its emphasis on data collection, has proven to be a helpful conduit to Congress and has been mandated by Congress to participate in or lead selected studies.
- d. The goal of providing objective data at a national level on inequalities in pay and working conditions (e.g. laboratory space) similar to the well-known MIT study is commendable. CWSE's website links to over 600 Web sites of Organizations Encouraging Women in Science and Engineering. This is the most comprehensive set of links on this topic currently available on the Web.
- e. The CWSE website is a helpful resource to researchers and policy makers, as well as those simply wishing to become more informed about issues and university responses to equity issues. For more information about CWSE and its resources, see <http://www7.nationalacademies.org/cwse/index.html>
- f. CWSE has two useful current studies:
  - i. One project assesses gender differences in the careers of science, engineering, and mathematics faculty, focusing on four-year institutions of higher education that award Bachelor's and graduate degrees. The study will examine issues such as faculty hiring, promotion, tenure, and allocation of institutional resources including laboratory space.
  - ii. CWSE is preparing a guide on best practices in recruiting, retaining, and advancing women scientists and engineers in academia. The project provides guidelines and practices which institutions and individuals can use to increase the participation of women in science and

engineering, by stressing successful efforts at top research universities in the United States.

The review I chaired and the discussion surrounding it emphasized that this is the right time for CWSE to expand its portfolio of activities. There is nationwide momentum and CWSE has already established itself as a leader. Our review recommended that CWSE develop further studies to include:

- a. Understanding the causes of the substantial differences in the representation of women in the physical sciences and engineering versus the biological sciences and medicine.
- b. Understanding the implications of the July 2004 GAO report on Gender Issues (more about this later) and perhaps hosting a conference on this subject.
- c. Understanding the underlying causes of inequity. For example, the differential impacts of child rearing, the impact of extramural funding agencies, and the impact of the tenure system all deserve more careful study to point the way towards creative solutions to contemporary problems.
- d. Developing a handbook on best practices perhaps based on the experience of institutions that are most effective in advancing women scientists and engineers would be a valuable contribution. For example, a manual might provide guidelines on the successful implementation of mentoring systems, and on how to protect young women faculty from being over used in minor administrative assignments.
- e. Articulating how CWSE might provide a unique contribution in the national effort to address pipeline, recruitment, and retention goals. To this end the NRC might request that staff (or a task force) be deployed to compile a list of current efforts being undertaken elsewhere in the NRC (e.g. COSEPUP), by federal agencies (NSF, NIH, etc.), industry, scientific and educational societies (e.g. ACE, NASULGC, AACU) and individual universities (e.g. NSF's ADVANCE program.).

- f. Expanding its web portal to include a list of policy and issues papers and references to best practices conducted around the country (e.g., in NSF's ADVANCE program).

### **3. COSEPUP**

The Committee on Science, Engineering, and Public Policy (COSEPUP) is a joint unit of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine. Most of its members are current or former members of the Councils of the three institutions.

COSEPUP mainly conducts studies on cross-cutting issues in science and technology policy. COSEPUP was chartered by the Academies to address "the concerns and requests of the President's Science Advisor, the Director of the National Science Foundation, the Chair of the National Science Board, and heads of other federal research and development departments and agencies, and the Chairs of key science and technology-related committees of the Congress." Its recent studies range from a workshop on OMB's program rating assessment tool to a discussion of setting priorities for NSF large research facilities to a monograph on human reproductive cloning.

COSEPUP recently invited several women scientists (three of them chancellors of UC campuses, including myself) to speak on the subject of women faculty in science and engineering. A few things I would share with you from this stimulating panel discussion, which was moderated by Nancy Hopkins (MIT):

Anneila Sargent (Caltech) offered that what is not working for women is often not working for men either. She emphasized that Guide books are not enough; what is critical is mass – hiring more women means getting commitment not just from the university chancellor or president, but from the departments.

Alice Huang (Caltech) stressed the importance of hiring staff at universities to manage programs, assist with evaluation and status of programs, promote new policies, obtain funds, in short, help the faculty and administrators with

implementation and sustainability of new programs. Alice noted that getting women as chairs of departments and deans may be even more important than getting a women president because they have more impact on faculty hiring. She noted the importance of developing a culture that doesn't diminish women's accomplishments, and paying attention to spousal hiring and day care.

Marye Anne Fox (chancellor, UCSD) talked about the July 2004 GAO report on Title IX, which isn't just about athletics. The Government Accountability Office said, with respect to women's participation in the sciences, that federal agencies need to do more to ensure that their grantees comply with Title IX. "The report documented salary and resource allocation inequity, sometimes hostile institutional culture, inequitable expectations, accumulated disadvantage, barriers to re-entry, a lack of faculty mentoring, and a dearth of family-friendly policies."

Denise Denton (chancellor, UCSC) showed an example from the University of Washington, where she was Dean of Engineering, of how a college can hire many more women engineers while simultaneously increasing quality.

I presented a web-based sample of Agency, Association, Consortium, Academy, and University websites focused on diversity initiatives and best practices in recruitment and retention of women and minorities (see Appendix 2 of this paper). I said that some entity should provide a web-portal where all of these sites are listed, as a community resource for policy, illustrative programs, and best practices.

Charlotte Kuh of the NRC said that the new NRC rankings will list the proportion of women on every department's faculty!

As a result of this discussion, at which CWSE chair Lilian Wu also presented CWSE's plans, COSEPUP has submitted a proposal, the statement of work for which is: "To guide faculty, department chairs and deans, academic leaders, funding organizations, and government officials on how to maximize the potential of women science and engineering researchers, an *ad hoc* COSEPUP committee will integrate the wealth of data available on gender issues across all fields of science and engineering. The committee will focus on academe, but will examine other research sectors to determine effective practices and develop findings and recommendations for recruiting,

hiring, promotion, and retention of women science and engineering researchers. Throughout the report, profiles of effective practices, scenarios, and summary boxes will be used to reinforce the key concepts.”

This study is extremely promising as an eventual resource for social scientists as well as university and industry leaders committed to effecting institutional change.

In its proposal COSEPUP, like many other groups, notes that leaks in the pipeline are at all stages, with women leaving academe at higher rates than men. The number of women obtaining undergraduate degrees, graduate degrees, and postdoctoral positions in STEM careers has increased tremendously in the last few decades (see Figure 1), but the proportion of women with faculty appointments in these areas, especially at the most prestigious research universities, is disproportionately low. Cited is an outstanding example of multiple leaks along the mathematics pipeline: about ½ of undergraduate mathematics degrees are awarded to women, but women comprise only 8.3% of the faculty ranks in mathematics. The COSEPUP proposal notes that “In S&E departments at top 50 universities the proportion of full professorships held by women ranges from 3 – 15%.”

### PhD Recipients from U.S. Universities by Ethnicity/Gender (U.S Citizens. only) , 1975-2003

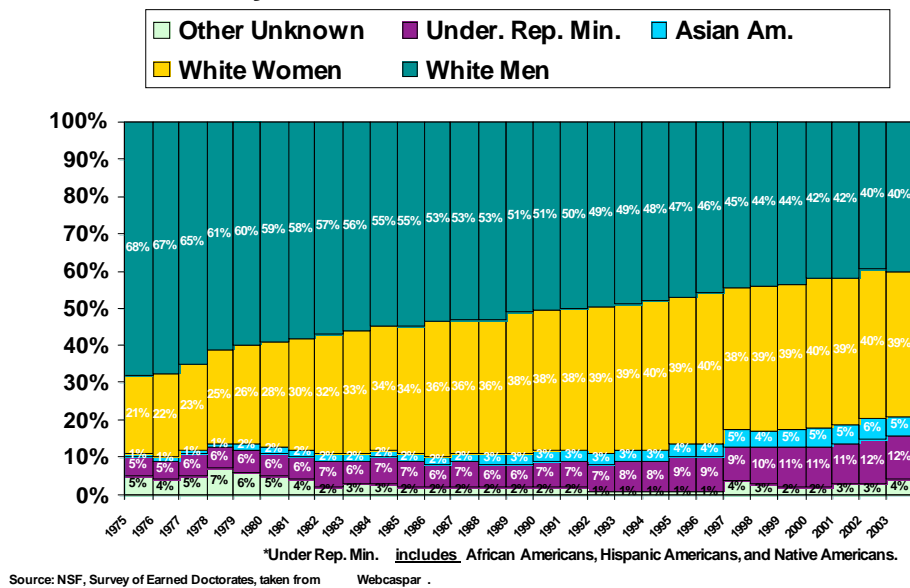


Figure 1



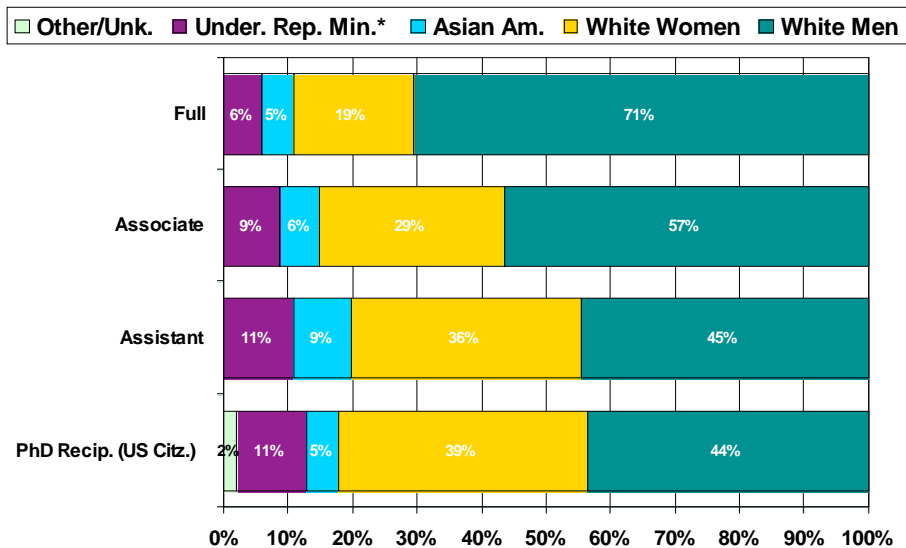
In the CWSE book “From Scarcity to Visibility”, J. Scott Long, a sociologist at Indiana and editor of the volume, includes a study (from 1995) that shows the percentage of PhDs who REMAIN in science and engineering, by gender. This is illustrated in Table 1.

**Table 1: Percent of Doctoral Scientists and Engineers with Full-Time Employment in Science and Engineering: 1995**

Field	Men	Women
All S&E	85.8	73.5
Engineering	90.6	81.3
Mathematics	90.8	79.5
Physical Sciences	87.2	77.4
Life Sciences	85.3	75.9
Social and Behavioral Sciences	79.6	69.4

These data show that women drop out after receiving the PhD at a much higher rate than men. The population effect of this is shown in Figure 2.

**Faculty & PhD Recipient Diversity in the United States, 1999**



\*Under Rep. Min. includes African Americans, Hispanic Americans, and Native Americans.

Sources: NCES, National Study of Post

-Secondary Faculty, 1999 (for faculty) and NSF, Survey of Earned

Doctorates, 1999 (for PhD recipients).

**Figure 2**

As cited in the COSEPUP proposal, “ in 2001, [then] University of California at Santa Cruz Chancellor M.R.C. Greenwood reported that the percentage of women hired UC-wide in S&E often falls short of the postdoctoral pool. In the life sciences in 2000, women comprised 39.3% of the national PhD pool and 36% of postdoctoral scholars, but only 29% of University of California hires. In chemistry, women held 31% of the PhDs, 20% of post-doctoral positions, but only 13% of new hires. In mathematics, the disparity was especially marked, with where women comprise 22.1% of PhDs pool and 13.2% of post-doctoral positions, but only 5.4% of faculty appointments.”

It is these statistics that the National Research Council, through CWSE and COSEPUP among other groups, are committed to address.

It may be noteworthy that Dr. Greenwood is the first women to be the Provost and Senior Vice President for Academic Affairs of the UC; in addition, she chairs the PGA Board. Both the CWSE and COSEPUP committees are chaired by women, Dr. Lilian Wu and Dr. Maxine Singer, respectively. These women and many others are providing leadership in tackling these important issues.

## **Summary**

I have provided an overview of some of the work that the National Academies are doing to promote increased numbers of women in science and engineering careers. It is by no means an exhaustive list, but I hope it illustrates that the Academy takes this issue seriously and is determined to provide both new data for analysis and new insights that may lead to more focused efforts nationwide to effect change in the culture of science.

At the end of my paper (Appendix 1) I list the recent reports and other projects of the NRC related to this issue; I hope this will be a resource for participants in this conference. In Appendix 2 I list some websites, culled from universities and agencies and organizations around the country, dealing with policy and best practices concerning women in science and engineering.

**Acknowledgements and References:** To Richard Bissell, Judy Harrington, and Charlotte Kuh, senior staff of the NRC, for providing NAS data and a preview of the COSEPUP proposal, quoted in this paper, on *Women in Science and Engineering: A Guide to Maximizing Their Potential*; To Michael Clegg, Lilian Wu, and Jong-On Hahm for their work with me on the review of CWSE. Several of the figures shown here were derived from the American Council on Education's Office of Women in Higher Education publication *An Agenda for Excellence: Creating Flexibility in Tenure-Track Faculty Careers* (2005) and the University of California website for work-family policies and programs for faculty, <http://ucfamilyedge.berkeley.edu>. My particular thanks go to Marc Goulden for his leadership in both of the latter efforts.

## **Appendix 1: RELATED Publications of the NRC**



*Committee on Women in Science and Engineering*  
POLICY AND GLOBAL AFFAIRS

The following publications represent the work of the Committee on Women in Science and Education from 2000 to the present. To order any of these publications or other documents from the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, or National Research Council please contact the [National Academy Press](#) at: (800) 624-6242 or (202) 334-3313; or you may visit the Academy bookstore on 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3980. Please note, many of our publications can be read online free of charge.

### **New Release:**

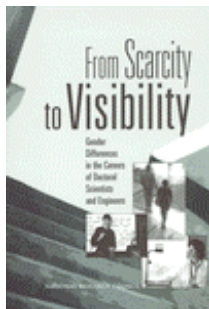


#### **NEW AXXS 2002:**

##### **Achieving XXcellence in Science: The Role of Professional Societies in Advancing Women's Careers in Science and Clinical Research**

CWSE held a one-and-a-half-day workshop, which gathered representatives of clinical societies to discuss ways for the societies to enhance the participation of women scientists in the clinical research workforce. The workshop was a follow-up to AXXS 1999, in which representatives of science societies gathered to identify ways to improve the advancement of women in their respective fields. The workshop proceedings are available online on the NAP Website. [View more information at the National Academy Press](#)

### **Highlighted CWSE Publications:**



##### **From Scarcity to Visibility: Gender Differences in the Career Outcomes of Doctoral Scientists and Engineers**

This report compares the career outcomes of women and men scientists and engineers, matched by the same characteristics, across five broad fields: engineering, life sciences, mathematics, physical sciences, and social and behavioral sciences. The outcomes examined include employment status, salary, rank and tenure status, publications, amount of federal research support, employment sector, and the likelihood of remaining in science or engineering. In addition, regression analyses look at the differential effects of numerous antecedent conditions, including race/ethnicity, level of parents' education, citizenship, type of undergraduate institution, marriage, having children, quality of graduate department, and time to the Ph.D. [View more information at the National Academy Press](#)



### **Female Engineering Faculty in the U.S.: A Data Profile**

This report provides information on the education and employment of approximately 1,300 female engineering faculty members in the United States, based on a survey conducted in 1996. Information is included on race/ethnicity, degrees held, employment history, tenure status, experiences with mentoring, reasons for career decisions, and employment satisfaction. The report is available for downloading. [View More information at the National Academy Press website.](#)



### **NAS Symposium on Women in Science**

On April 25, 1999, the National Academy of Sciences held its first-ever symposium on women in science. Entitled "Who Will Do the Science of the Future? A Symposium on Careers of Women in Science," the event was organized by CWSE and held at the NAS annual meeting. The symposium was well-attended by NAS members and the general public and received considerable attention by the scientific press. The symposium proceedings are available online on the NAP Website. [View More Information at the National Academy Press website.](#)

## **Other Publications Include:**

### **Women Scientists and Engineers Employed in Industry: Why So Few?**

This report addresses issues facing women entering the profession, working as bench scientists and engineers and as managers of a technological work group. (130 pp.). 1994.

### **Science and Engineering Programs: On Target for Women?**

Describes and analyzes a sample of postsecondary programs for recruiting and retaining potential and practicing scientists and engineers. Major chapters focus on undergraduate education, graduate education, and employment in academe, industry, and the federal government. (216 pp.). 1992. Marsha Lakes Matyas and Linda C. Skidmore, eds.

### **Women in Science and Engineering: Increasing Their Numbers in the 1990s**

In addition to providing statistics on the participation of women in the education/employment pipeline, the report summarizes the Committee's deliberations relating to its role in increasing the participation and improving the status of women in science and engineering. The report further offers an ambitious strategic plan of both short-term and long-term activities. (152 pp.). 1991.

### **Additional selected publications of the NRC:**

Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering (COSEPUP, 1997)

Science and Technology in the Academic Enterprise: Status, Trends, and Issues (GUIRR, 1989)

Engineering Employment Characteristics (CETS, 1985)

Personnel Needs and Training for Biomedical and Behavioral Research (IOM, 1977)

AXXS 2002: A Workshop for Clinical Societies to Enhance Women's Contributions to Science and their Profession (CWSE, 2002)

A Guide for Recruiting and Advancing Women in Science and Engineering Careers in Academia (CWSE, 2005) <http://www7.nationalacademies.org/cwse/Guide.html>

Gender Differences in Careers of Science, Engineering, and Mathematics Faculty (CWSE, 2006) [http://www7.nationalacademies.org/cwse/Gender\\_differences.html](http://www7.nationalacademies.org/cwse/Gender_differences.html)

**Appendix 2: Examples of Agency, Association, Consortium, Academy, and University websites focused on diversity initiatives and best practices in recruitment and retention of women and minorities. This list was composed by Drs. France Cordova and Yolanda Moses at UC Riverside.**

BEST (Building Engineering and Science Talent) report on Promoting Diversity in Higher Education  
<http://www.aip.org/fyi/2004/060.html>

The Quiet Crisis: Falling Short in Producing American Scientific and Technical Talent  
[http://www.bestworkforce.org/PDFdocs/Quiet\\_Crisis.pdf](http://www.bestworkforce.org/PDFdocs/Quiet_Crisis.pdf)

University of Washington engineering diversity programs  
<http://www.engr.washington.edu/advance/>

National Academy of Engineering  
<http://www.nae.edu/nae/diversitycom.nsf?OpenDatabase>

AAAS Minority Science Network <http://nextwave.sciencemag.org/miscinet/-Minority>

Faculty for the Future  
<http://www.engr.psu.edu/fff/>

National Science Foundation-ADVANCE Program-increasing the participation and advancement of women in academic science and engineering careers  
[http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=5383](http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383)

National Physical Science Consortium <http://www.npsc.org/>

Bell Labs-Programs to Aid Science and Engineering Students <http://www.bell-labs.com/fellowships/>

Committee on the Status of Women in Computing Research <http://www.cra.org/Activities/craw/>

Women's International Science Collaboration Program <http://www.aaas.org/international/wisc/>

NSF-Alliance for Graduate Education and the Professoriate Program <http://ehrweb.aaas.org/mge/>

University of California's initiative: Faculty Friendly Edge (shows leaks in pipeline for women)  
<http://UCfamilyedge.berkeley.edu>

American Council on Education's "An Agenda for Excellence: Creating Flexibility in Tenure-Track Careers" [http://www.acenet.edu/bookstore/pdf/2005\\_tenure\\_flex\\_summary.pdf](http://www.acenet.edu/bookstore/pdf/2005_tenure_flex_summary.pdf)

