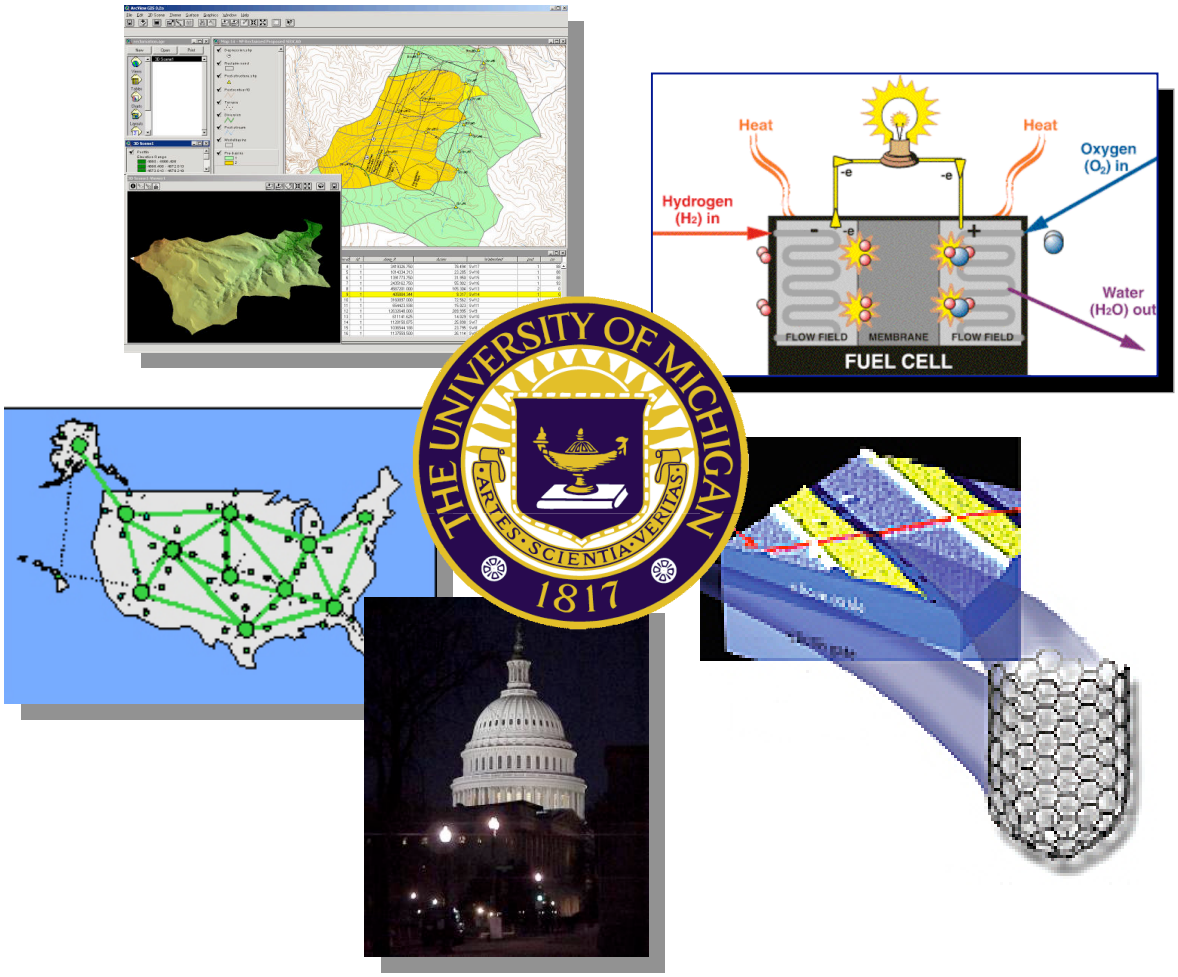


Annual Report on Research and Scholarship

FY2003

Fawwaz T. Ulaby
Vice President for Research
January 15, 2004

Annual Report on Research and Scholarship
FY2003
Office of the Vice President for Research

Contents

I. Research Funding Profile 2

II. How does the University nurture and develop major new research thrusts? 5

1. FACULTY DRIVEN INITIATIVE
Spatial Analysis and Geographic Information Systems 6

2. EMERGING CRITICAL RESEARCH FRONTIER
Nanoscience and Engineering 8

3. PARTNERING WITH INDUSTRY
Hydrogen Research Initiative 10

4. CONNECTING RESEARCH TO POLICY
Science, Technology and Public Policy Program 12

5. PLANNING FOR THE FUTURE
National Ecological Observatory Network 15

III. Conclusion 17

IV. Appendix
Table 1: Volume of Research Expenditures by Sponsor 19
Table 2: Volume of Research Expenditures by School, College and other Units 21

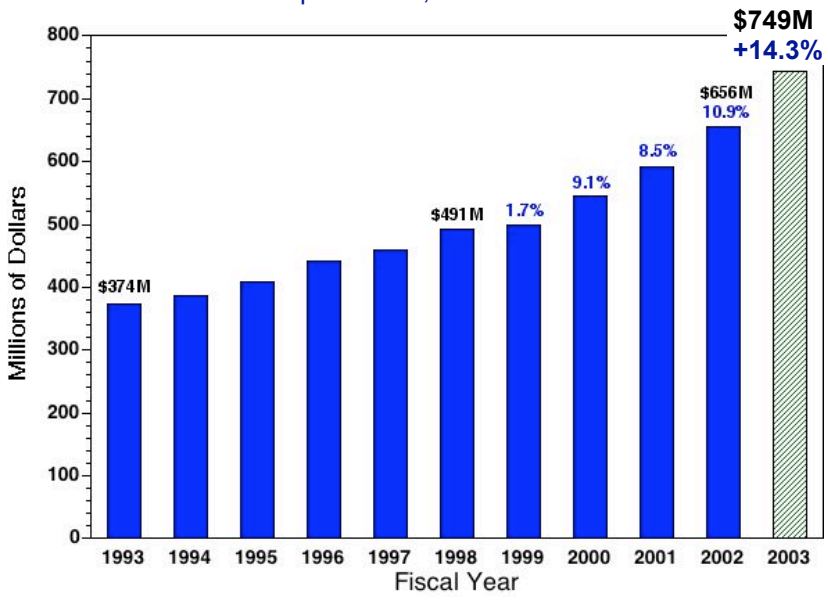
Annual Report on Research and Scholarship
FY2003
Office of the Vice President for Research

During a period when so much attention has focused on tightening budgets, the University of Michigan research portfolio continues to grow at a strong pace. In this year's research report, we will outline the successes of our faculty to obtain external funding through competitively awarded grants and contracts. Additionally, we will describe and give examples of the many ways that the Office of the Vice President for Research and other central administration offices collaborate with the schools and colleges to help support the development of new areas of research strength so that Michigan remains highly competitive in a broad mix of disciplines.

Research Funding Profile

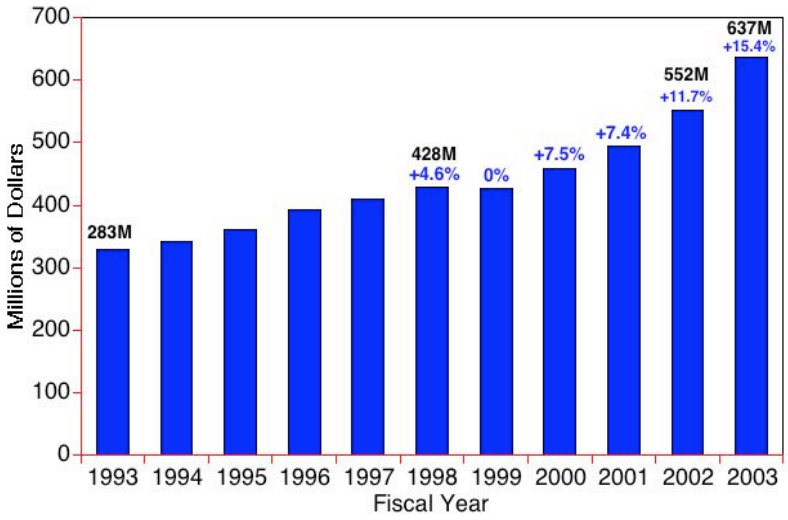
The success of our faculty to sustain Michigan's vital research program must be applauded. Overall, research expenditures for FY2003 rose to nearly $750 million, an increase of 14.3% compared to the previous year. (Figure 1) This percent increase is the largest single-year jump since 1987.

Figure 1: Total UM Research Expenditures, FY1993-2003



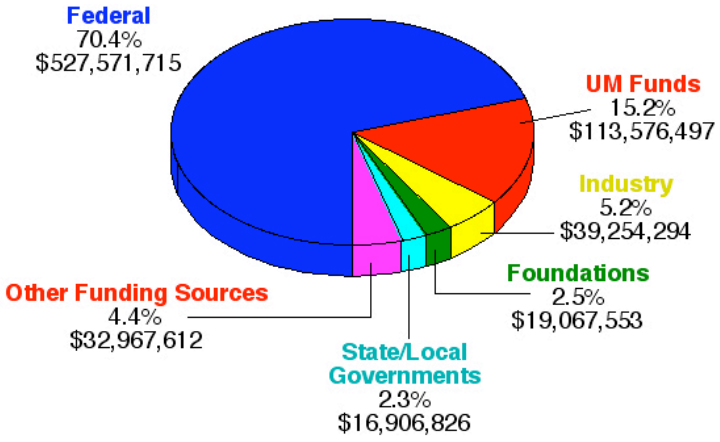
Expenditures from external sources rose at a slightly higher rate, rising 15.3% from FY02 to FY03 (Figure 2).

Figure 2: UM Research Expenditures from External Sources, FY1993-2003



The portion of research expenditures that comes to the University from the federal government through grants and contracts continues to grow slowly (Figure 3). In FY03, research spending from federal sources comprised 70.4% of total spending, compared to 69.5% last year.

Figure 3: UM Total Research Expenditures by Source of Funding, FY2003



In looking at research expenditures from external sources by school and college, the medical school spent nearly $265 million in FY03, increasing by $27 million over the previous year (Figure 4).

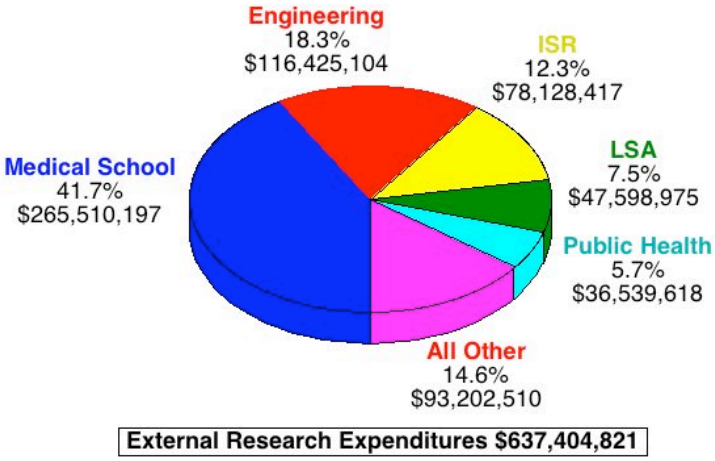
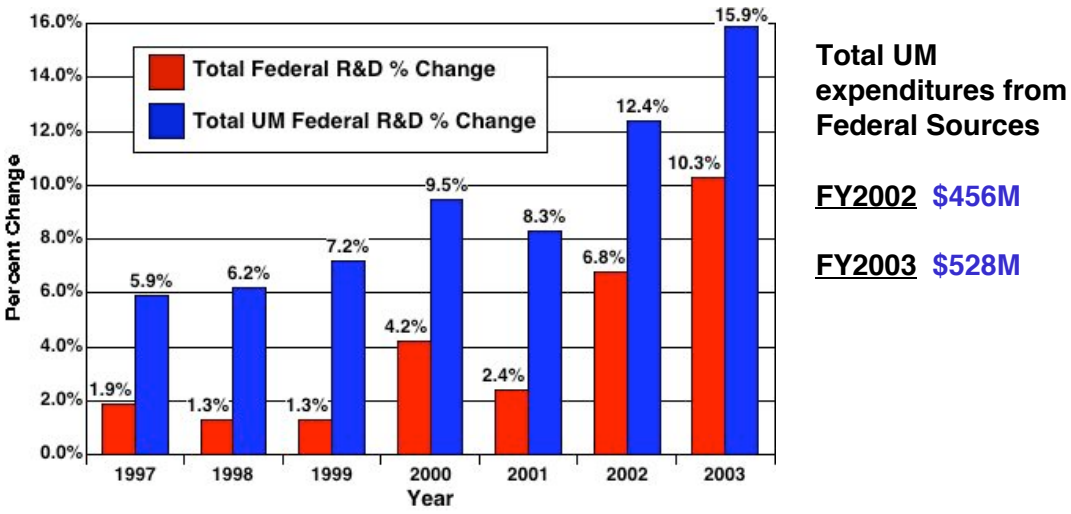


Figure 4: UM External Research Expenditures by School/College, FY2003

UM spending growth from federal sources rose faster than the overall growth in federal R&D, suggesting that UM research remains highly competitive nationally (Figure 5).

Figure 5: UM Federal Research Expenditures vs. Total Federal R&D, FY1997-2003



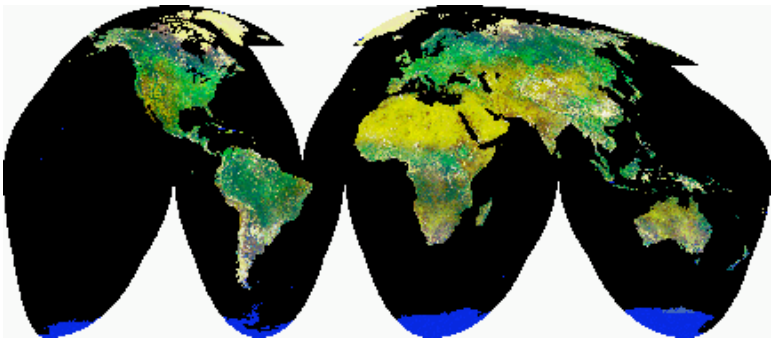
The great depth and diversity of research conducted at the University of Michigan is a source of tremendous pride both within and outside the institution. The contributions of this scholarship and research to a large extent define Michigan as the national and international leader that it has become.

How does the University nurture and develop major new research thrusts?

While the majority of research on campus is initiated by individual faculty who have the infrastructure and collaborators needed to be successful, some areas where Michigan that might be strong have lagged because they are missing a few key ingredients. In a few cases, the University undertakes a major initiative to develop an area, as we have in the life sciences over the last several years. But in many situations, initiatives are launched on a much different scale. Often, these are partnerships between the central administration and schools and colleges, or even simply with an informal grouping of faculty. Although relatively inexpensive, such small-scale initiatives are nonetheless vital to maintaining the institution's leadership in all areas of research and scholarship. In this section of the report we will describe five recent examples of efforts to develop new research strengths and describe how OVPR and other central offices collaborated in such efforts.

FACULTY DRIVEN INITIATIVE
Spatial Analysis and Geographic Information Systems

In the last half of the 1990s, some faculty on campus recognized that many areas of research could benefit from the application of new computer tools known broadly as spatial analysis and geographic information systems (SA-GIS). A relatively small subset of campus researchers had been using these tools for their research, but knew there was untapped potential at Michigan. OVPR began holding strategy meetings with this small faculty group in order to develop a proposal for enhancing campus capabilities. By the spring of 2000, it became apparent that without some increase in resources, education, and facilitation, the University would not be able to achieve its full potential in this developing area. So through discussions with faculty and Research Associate Deans representing the schools and colleges, a specific proposal was forged with the goal of stimulating growth in SA-GIS. This plan addressed both the infrastructure available for training faculty in the latest analytical tools as well as assistance with proposal development for new projects. Additionally, it was determined that some specific pilot projects might benefit from seed funding using institutional funds.



Oct. 1999: OVPR learns of federal interest in biological complexity and spatial analysis
Sept. 2000: NSF Announces Biocomplexity Initiative; $35M/year awarded by all NSF Directorates in five topical areas
Oct. 2000: Faculty workshops at OVPR; Teams formed to address campus expertise in use of modern Geographic Information Systems (GIS) software tools
Nov.-Dec. 2000: OVPR joins with Rackham to develop a Spatial Analysis/GIS Competition

SA-GIS Investment (FY2001 & 2002)

OVPR	$400,000
Provost	$200,000
Rackham	$135,000
Schools/Colleges	$377,000
Total	$1,112,000

With the participation of the Provost and several Deans, a fund of $1.1 million was established and awarded competitively over a two-year period. Funding went to projects from LSA, School of Social Work, UM-Dearborn, Taubman College of Architecture and Urban Planning, the International Center and the School of Natural Resources and Environment. OVPR also hired an expert Research Scientist to support these efforts and lend technical as well as administrative support to the initiative. To date, the results have been impressive, and we are seeing continuing ramifications.

SA/GIS Projects Selected for Funding

"Spatial Analysis and the Archeology of Early Civilizations in the Old World" Susan Alcock, Classical Studies, LSA.

"Developing a Basic GIS Capacity and GIS Research Course Within the School of Social Work (SW-GIS)" - Larry Gant, School of Social Work

"Program in Spatial Analysis and Geographic Information Systems" Kent Murray, UM-Dearborn

"Initiating Research in Spatial Analysis of Society-Environment Interactions in South-Eastern Michigan" - Daniel Brown, SNRE

"Educational Program for Spatial Analysis/GIS – Spatial Analysis/GIS Capacity Building at the University of Michigan" - John Nystuen, Taubman College of Architecture and Urban Planning

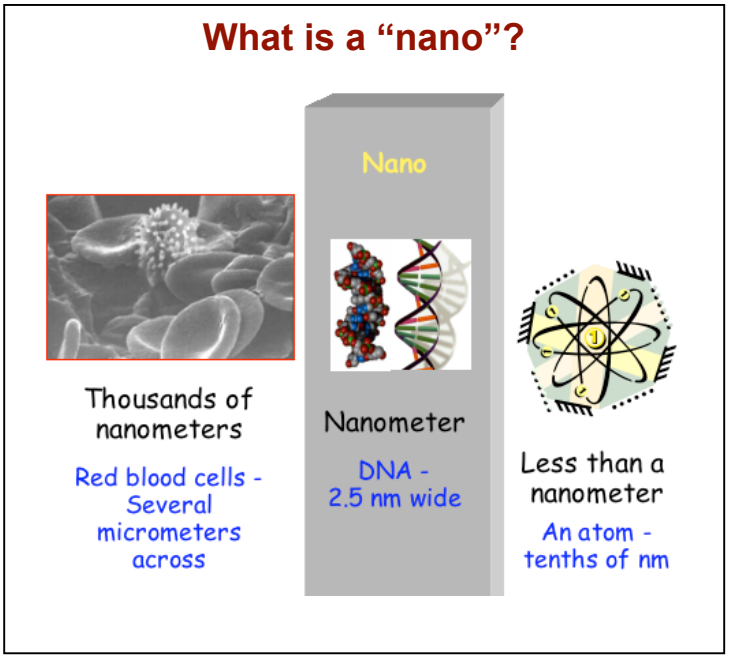
"A Spatial Data Analysis Server for International Research and Instructional – Developing an Infrastructure for Spatial Analysis and Geographic Information Science" - Steven Whiting, International Center

Since the start of this development effort, several projects have been funded by external sponsors, with the value of these new awards totaling about $5.6 million. In addition, a Certificate Program was established through the Rackham Graduate School to provide an interdisciplinary training program for graduate students across the campus. Lastly, the Center for Statistical Consultation and Research (CSCAR) was given the resources and responsibility to provide ongoing computing support to the research community interested in adopting SA-GIS techniques.

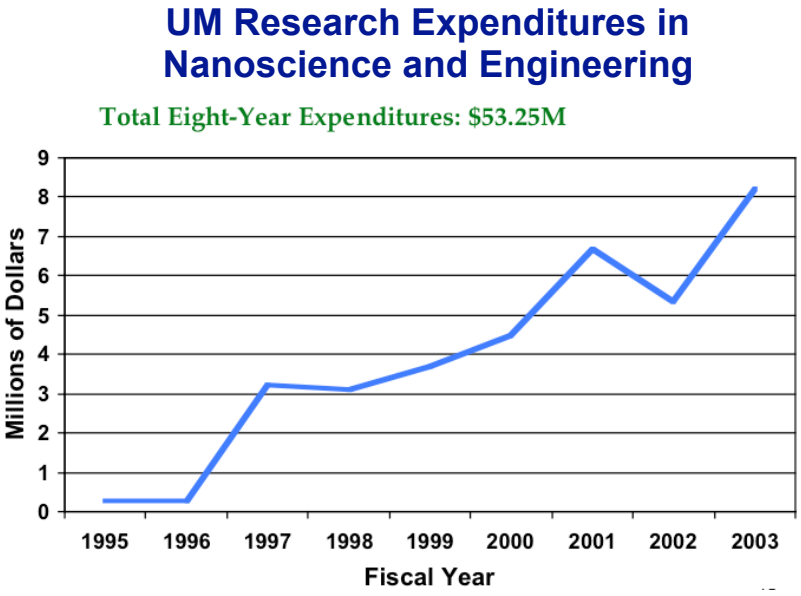
But beyond the funded projects and GIS software labs, a major benefit of the development effort over the past several years is the development of a number of collaborations and potential collaborations. As new funding opportunities present themselves, or as researchers in one field recognize the value of GIS and spatial analysis to a project, people now have other experts to turn to for help with proposal writing and to carry out new projects.

EMERGING CRITICAL RESEARCH FRONTIER
Nanoscience and Engineering

Since the mid 1990s, several research groups at the University of Michigan have become involved in an up-and-coming field that is broadly described as nanoscience and engineering. About a year ago, OVPR conducted an analysis of UM resources and strengths in nanoscience and found much promising research on campus, but little national recognition for UM activity in this field.



In addition, it has become clear that nanotechnology is fast becoming an area of special emphasis across all federal agencies, with interest going all the way to the White House. In fact, on December 3, 2003, President George W. Bush signed the 21st Century Nanotechnology Research and Development Act, which authorizes funding of $3.7 billion for nanotechnology research and development over four years, starting in FY 2005. This legislation puts into law programs and activities supported by the National Nanotechnology Initiative, one of the President's highest multi-agency R&D priorities.



The OVPR analysis concluded that the UM has the potential to be much more prominent in this area, but not without some assistance from the central administration.

To this end, OVPR formulated a preliminary proposal for coordinating the enhancement of UM nanoscience and engineering activity. This proposal was shared with the Executive Officers, a number of deans, and a core group of faculty researchers. In addition, OVPR organized a two-day symposium in October 2003 that included presentations by nearly 20 respected scientists in nanoscience and technology and a poster session where UM faculty and students presented research. The visiting scientists also met with several Executive Officers and faculty to discuss the appropriate niche that the UM might pursue through a nanotechnology and engineering initiative.

Currently, a faculty group is meeting to develop a specific proposal for this initiative and expects to report its recommendations by the end of the Winter 2004 semester. In all, OVPR expects that the investment needed to launch this initiative will be quite modest, perhaps $3 million to $5 million over the next several years. Yet the return on this investment should be quite significant in the form of much greater national recognition for UM accomplishment and expertise in nanoscience and engineering as well as new support from federal funding agencies.

PARTNERING WITH INDUSTRY
Hydrogen Research Initiative

Interest in hydrogen as an energy source has been around for a long time, but many practical barriers have prevented it from becoming a mainstream fuel. For instance, fuel cells are a desirable source of energy for automobiles because of their high efficiency and cleanliness, but producing the necessary hydrogen in real time is still difficult.

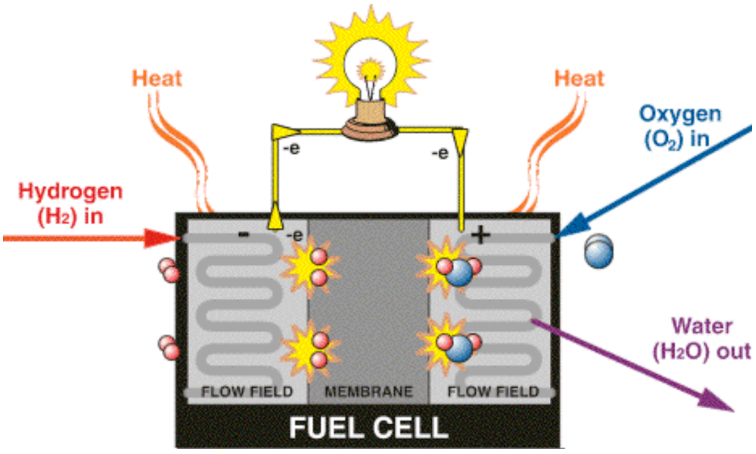
On a national level, interest in hydrogen is evidenced by the announcement of the Freedom Car Initiative by President George W. Bush in his 2003 State of the Union address. That initiative stems in part from a February, 2002 National Hydrogen Energy Vision document issued by the U.S. Department of Energy, which notes that "the transition to a so-called 'hydrogen economy' has already begun, [however] the 'technology readiness' of hydrogen energy systems needs to be accelerated." Likewise, the Big 3 auto companies are all conducting R&D on hydrogen-based fuel cells for use in vehicles.

U.S. Department of Energy
Energy Efficiency and Renewable Energy

FreedomCAR and Fuel Initiative

H_2

On campus, the College of Engineering has been developing a research plan in this area, which it calls the Hydrogen Energy University Research Initiative (HEURI). This plan calls for the creation of university-based research centers of excellence each supported by a consortium of 3-5 university partners. The UM would plan to lead one of these consortia, should they be established by the federal government, since we have a number of faculty conducting research on fuel cells and other aspects of hydrogen economy.



Last fall, OVPR got involved in this issue when it helped arrange a meeting to discuss how the federal government might be encouraged to fund more university-based research on this topic. Participants in this meeting included representatives of the auto industry, DTE Energy, and the State of Michigan's NextEnergy initiative.

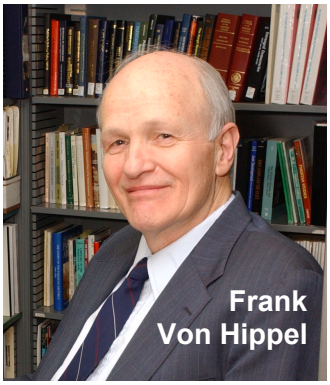
The meeting participants concluded that the University could contribute to the emergence of the hydrogen economy by sponsoring the development of a "roadmap" for university research. To that end, OVPR has assembled a UM-led team of energy experts to prepare a research roadmap for low-cost, clean hydrogen as a viable energy source. This group began meeting in December, 2003 to define the goals and objectives of the hydrogen initiative, determine the possible approaches that might be pursued to secure the generation of hydrogen energy cleanly and at competitive cost, generate a budget plan and a possible funding approach (Federal, State, other) for the roadmap, provide a timeline with specific denotable stages of technology development, and propose an operational structure for the consortium.

What makes this initiative different is that the University is participating largely as a "citizen" making a contribution to the country. While it is true that our faculty may receive research funding from some kind of federal or state initiative that might materialize, our current contribution stems more from the desire to help create a coherent plan that will help the country reduce its dependence on hydrocarbon-based energy sources and make the transition to other renewable energy systems, most notably hydrogen.

CONNECTING RESEARCH TO POLICY
Science, Technology and Public Policy Program

Over the past several years there have been several discussions about the creation of an academic program in science, technology, and public policy (STPP) at the University, similar to those at other peer institutions (e.g., Harvard, UC-Berkeley, MIT, Princeton, and Carnegie Mellon). Members of the University's faculty have long been involved in STPP activities at the state, federal, and international level, and several existing academic programs have both instructional and research programs that would relate well to an integrated STPP effort. Furthermore, over the years there have been efforts by individual faculty members to develop interdisciplinary courses on STPP topics (e.g., energy, global climate change, disarmament), including most recently the STPP course developed by Professor Homer Neal in the Physics Department for undergraduate and graduate students from both the sciences and public policy areas.







To focus these discussions, the Provost and Vice President for Research launched several activities during the 2002-2003 academic year:

- Under the banner of the Jerome B. Wiesner Lecture Series, the University invited to campus a number of national leaders in science and technology policy, including John Holdren (Harvard), Neal Lane (Rice, former White House Science Advisor), Jack Gibbons (Council on Economic Competitiveness, former White House Science Advisor), Lewis Branscomb (Harvard, former chair of the National Science Board), Congressman Vern Ehlers, and Frank von Hippel

(Princeton) for formal lectures on particular science policy topics and to meet with University faculty and administrators to discuss the possibility of a Michigan STPP program in this area.

- A group of deans and executive officers was invited to meet with the Wiesner Lecturers and to monitor ongoing efforts to develop recommendations concerning a UM STPP program.
- A working STPP Task Team of faculty members and chaired by former President James Duderstadt was assembled to address the following questions.
    1. Should the University of Michigan have a formal academic program in Science Public Policy? If so, why? If not, why not?
    2. If the answer to the preceding question is in the affirmative, please develop strategies that respond to the following ancillary questions.
        a. What should Michigan's area of focus be in this arena, in contrast with the science public policy programs at other institutions (MIT, Princeton, Cornell, RPI, Virginia Tech, Carnegie Mellon, George Washington, etc.)?
        b. Should Michigan's program lead to a formal degree, a Rackham certificate, or other? Which students would such a program be aimed at and how could these students use this program to advance their educational and career goals?
        c. Which units or departments at Michigan should be involved in such a program? How should the program be administered; what level of resources would be needed to implement it, etc.?

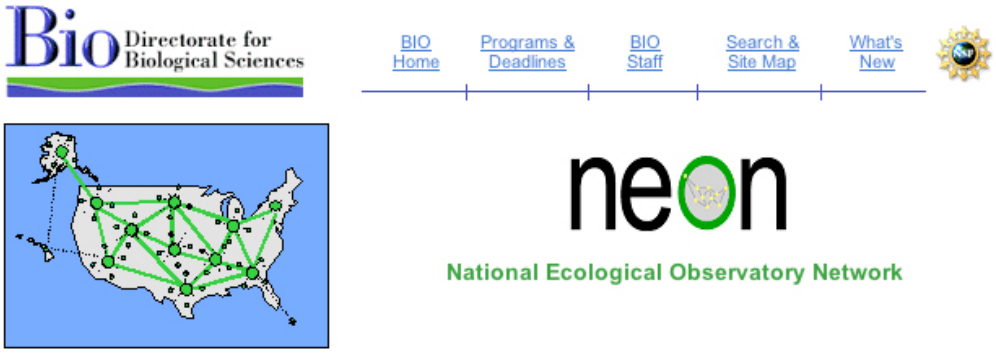
In the spring of 2003, the Task Team submitted a report which recommended that the University begin a phased approach to launching instructional and research activities in two key areas: (1) the application of scientific and technological knowledge to improve decision-making across a broad array of public sector domains ("science for policy") and; (2) the shaping of government policies to ensure continuing progress in science and technology ("policy for science"). More specifically, the faculty committee proposed that the University develop instructional programs to provide disciplinary scientists (including those in traditional scientific and engineering disciplines as well as more cross-cutting fields such as medicine or public health) with a better understanding of the policy context into which science and technology often fit, and to provide social scientists (including those in traditional disciplines as well as those in professional

schools such as public policy, law, and business) to better understand the relevance of science and technology to their work.

The Provost and Vice President for Research accepted the report and last fall launched a second faculty committee, also chaired by former President Duderstadt, which will propose a structure for the first phase of the UM STPP program. This implementation committee is expected to issue its recommendations by the end of the Winter 2004 semester.

PLANNING FOR THE FUTURE
National Ecological Observatory Network (NEON)

The National Ecological Observation Network, when completed, will be a continent-wide research network of geographically distributed observatories, linked through state-of-the-art communications. The network will consist of an array of local and distributed remote sensors that will enable collection of the data needed to forecast long-term trends in the behavior of regional and national ecological systems. Data flowing from NEON sites will permit scientists to address a wide range of large-scale ecological issues, including: pollutant dispersion and tracking, the spread of invasive species, short-term and long-term climate and hydrological change, weather forecasting, fire danger prediction, and landscape management.



NEON represents the first major federal investment in instrumented infrastructure for ecological research. A corps of distinguished UM researchers seek to take a leadership role in NEON and approached OVPR for assistance. They would like to establish one of the first NEON observatories at the University of Michigan Biological Station (UMBS) in Pellston. The UMBS is a well-established and substantial research facility that includes 10,000 acres of diverse natural habitat available for monitoring and experimentation. UMBS is at the center of a boundary between temperate deciduous and boreal forests. Because many species reach their southern or northern limit in the vicinity of UMBS, it is an ideal site for detection of changes in biological systems due to climate change. In addition, the UM natural history museums, among the 3 largest university collections in the country, contain specimens collected over time, from early settlement to the present date. These can be linked to long-term climatic records to identify long-term patterns. The establishment of a NEON observatory at the UMBS

will greatly strengthen research activities at the facility and will provide additional support for our museum collections.

OVPR has been able to assist this NEON effort by facilitating meetings between UM faculty from multiple schools and colleges, and to arrange partnerships with Michigan State University, the University of Wisconsin, and Notre Dame University. The National Science Foundation has asked Congress to appropriate funds for the NEON program starting in FY05. When that happens, the Michigan team will be ready to submit an exceptionally strong proposal in the hopes of winning one of the earliest awards granted by the agency.

CONCLUSION

The financial profile for research and scholarship at the University of Michigan is continuing the very strong trend of the past decade. OVPR attributes this to faculty excellence and the strength of the research proposals they submit. Our institution has done exceptionally well in winning new awards and keeping ahead of the relatively high growth rate seen in some federal agencies, especially the National Institutes of Health. Whether the federal government can sustain such growth in research support remains to be seen.

As part two of this report demonstrates, Central Administration plays many roles in fostering research and scholarship. The strategies employed depend on the needs of a particular situation and an evaluation of how our faculty strengths match with opportunities on the horizon. It is important to note, as well, that nurturing new areas of strength is not always a matter of spending more money. Often the identification of faculty leadership, promoting greater collaboration on campus, or working to remove organizational barriers may be key to our success. OVPR is dedicated to employing diverse strategies that meet the needs of each situation as it arises.

In summary, we are pleased to report that the University of Michigan continues to be a national source of new knowledge and discovery!

Appendix

Table 1: Volume of Research Expenditures by Source

SOURCE	FY 2002	PERCENT OF TOTAL	FY 2003	PERCENT OF TOTAL	PERCENT CHANGE
FEDERAL SOURCES					
Health and Human Services					
Centers for Disease Control	9,502,292	1.4%	**11,682,064**	1.6%	22.9%
Food and Drug Administration	381,738	0.1%	**1,023,926**	0.1%	168.2%
Health Resources & Services Administration	2,076,371	0.3%	**1,650,600**	0.2%	-20.5%
Centers for Medicare & Medicaid Administration	1,942,144	0.3%	**1,671,769**	0.2%	-13.9%
National Institutes of Health	287,161,896	43.8%	**328,852,018**	43.9%	14.5%
Substance Abuse and Mental Health Services	765,612	0.1%	**3,474,385**	0.5%	353.8%
Other HHS	2,054,484	0.3%	**2,388,703**	0.3%	16.3%
Total Health and Human Services	303,884,537	46.4%	350,743,465	46.8%	15.4%
National Science Foundation	50,816,423	7.8%	**58,512,929**	7.8%	15.1%
Department of Defense					
Army	13,973,161	2.1%	**20,184,051**	2.7%	44.4%
Air Force	7,465,775	1.1%	**5,931,298**	0.8%	-20.6%
Navy	8,327,522	1.3%	**9,814,797**	1.3%	17.9%
Other	11,483,983	1.8%	**16,079,385**	2.1%	40.0%
Total Department of Defense	41,250,441	6.3%	52,009,531	6.9%	26.1%
Energy	15,635,837	2.4%	**17,316,810**	2.3%	10.8%
N.A.S.A.	13,957,844	2.1%	**16,253,448**	2.2%	16.4%
Education	9,977,886	1.5%	**8,872,427**	1.2%	-11.1%
Transportation	5,575,669	0.9%	**10,096,267**	1.3%	81.1%
Commerce	4,654,449	0.7%	**4,184,169**	0.6%	-10.1%
Environmental Protection Agency	3,704,035	0.6%	**2,886,711**	0.4%	-22.1%
Justice	1,969,275	0.3%	**1,383,006**	0.2%	-29.8%
Social Security Administration	1,658,362	0.3%	**2,308,029**	0.3%	39.2%
Agriculture	1,021,363	0.2%	**1,029,521**	0.1%	0.8%
Agency for International Development	268,740	0.0%	**843,968**	0.1%	214.0%
Museum and Library Services, Institute of	229,391	0.0%	**156,053**	0.0%	-32.0%
General Services Administration	176,648	0.0%	**41,770**	0.0%	-76.4%

Veterans Affairs	175,672	0.0%	**49,195**	0.0%	-72.0%
National Endowment for the Humanities	147,751	0.0%	**237,531**	0.0%	60.8%
Interior	66,370	0.0%	**136,011**	0.0%	104.9%
Other Federal	218,541	0.0%	510,874	0.1%	133.8%
Total Federal Government	**455,389,234**	69.5%	**527,571,715**	70.4%	15.9%
				0.0%	
OTHER SPONSORS					
Industry	31,415,505	4.8%	39,254,294	5.2%	25.0%
Foundations	21,833,165	3.3%	19,067,553	2.5%	-12.7%
Other (includes voluntary contributions)	21,142,908	3.2%	12,020,771	1.6%	-43.1%
Public Charities	8,313,959	1.3%	9,275,692	1.2%	11.6%
State, Local, and Other Governments	5,424,932	0.8%	16,906,826	2.3%	211.7%
Endowment	4,537,229	0.7%	4,511,897	0.6%	-0.6%
Trade and Professional Associations	3,365,223	0.5%	7,017,520	0.9%	108.5%
International Organizations	64,002	0.0%	142,130	0.0%	122.1%
Total Other Sponsors	**96,096,923**	14.7%	**108,196,683**	14.4%	12.6%
Total Sponsored Research	**551,486,157**	84.1%	**635,768,398**	84.8%	15.3%
UNIVERSITY OF MICHIGAN SOURCES					
University of Michigan Funds	103,915,329	15.9%	113,576,098	15.2%	9.3%
TOTAL RESEARCH EXPENDITURES	**655,401,487**	100.0%	**749,344,497**	100.0%	14.3%

Table 2: Volume of Research Expenditures by School, College and Other Units

UNIT	FY 2001	FY 2002	FY 2003	Avg. % Change
Architecture & Urban Planning, Taubman	527,732	461,698	471,817	-5.2%
Art and Design	303,108	244,030	125,021	-34.1%
Business Administration	9,026,107	8,088,691	6,612,487	-14.3%
Dentistry	9,332,280	10,636,843	13,285,984	19.4%
Education	14,275,130	14,284,016	14,020,236	-.9%
Engineering	112,998,660	128,966,761	137,945,748	10.5%
Graduate School, Rackham	3,766,987	4,145,835	4,049,725	3.9%
Information	3,045,703	3,818,811	3,370,335	6.8%
Kinesiology	1,010,202	1,188,034	1,342,085	15.3%
Law	1,765,146	1,541,007	1,621,946	-3.7%
Literature Science, and the Arts	50,662,256	54,215,482	61,642,886	10.4%
Medical School	216,787,352	238,038,458	284,371,638	14.6%
Music	232,967	271,385	291,049	11.9%
Natural Resources and the Environment	3,062,469	4,292,805	9,683,598	82.9%
Nursing	3,688,322	4,913,534	4,981,069	17.3%
Pharmacy	4,578,792	5,367,032	5,502,315	9.9%
Public Health	32,014,139	33,537,493	38,275,272	9.4%
Public Policy, G Ford	361,510	507,379	1,287,479	97.1%
Social Work	4,585,463	5,170,532	4,213,733	-2.9%
Institute of Social Research	75,089,565	83,951,482	94,500,711	12.2%
OVPR Research Units	29,610,122	36,952,841	43,029,345	20.6%
Other Units	5,154,351	1,641,896	2,152,531	-18.5%
UM Dearborn	2,808,337	2,806,589	2,447,131	-6.4%
UM Flint	1,074,308	1,015,170	1,022,878	-2.4%
University Administration	46,469	2,364,637	1,961,880	2,485.8%
Unassignable Services	5,895,041	6,979,046	11,135,598	39.0%
University Total	**591,702,517**	**655,401,487**	**749,344,497**	**12.5%**