



ADVANCING SCIENCE, SERVING SOCIETY

A large, light-colored circular graphic containing a map of the Midwestern United States. The map shows the outlines of Minnesota (MN), Wisconsin (WI), Illinois (IL), Indiana (IN), Michigan (MI), and Ohio (OH). The text of the title is overlaid on this map.

The Future of Federal Research & Development in the Midwest: Trends and Indicators

**Developing a Regional View
of the Midwest Economy**
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The Future of Federal R&D in the Midwest: Trends and Indicators

Highlights

- The seven states of the Midwest play a significant role in the U.S. R&D enterprise. One-fifth of the nation's R&D is performed in this region, primarily by industrial firms. The federal government plays a strong role in this R&D enterprise, and spends billions of dollars a year in the Midwest on research and development projects that underpin the Midwest's strengths in high-technology sectors. This region received \$8.1 billion in federal R&D funds in fiscal year (FY) 2005, 7.3 percent of the national total.
- The Midwest's strength comes from the diversity of the R&D performed in each of the states. Ohio has a strong network of federal and industrial labs performing R&D for the Department of Defense (DOD) and other federal agencies; Illinois has the Argonne National Laboratory and the Fermi National Accelerator Laboratory and four major research universities; Michigan has the fifth-ranked research university in the nation and a large private-sector R&D presence; Indiana performs automobile-related R&D and defense development; Minnesota maintains a varied portfolio of R&D on health, defense, and agriculture; Wisconsin has the tenth-ranked research university in the nation; and Iowa has a diverse and well-balanced set of R&D performers, including a national lab, research universities, federal labs, and industrial firms.
- Midwestern universities are major contributors to the U.S. R&D enterprise. They receive nearly 16 percent of all federal R&D support to universities, including 20 percent of the National Science Foundation's (NSF) university support. Two universities (Michigan and Wisconsin) are ranked among the top ten university recipients of federal R&D funds, and 11 are in the top 50.
- The Department of Health and Human Services (HHS) is the largest sponsor of R&D in the Midwest, with \$3.3 billion in FY 2005. Most of this support (\$2.6 billion) flowed to universities. Nearly all of HHS' support comes from its National Institutes of Health (NIH) for biomedical research.
- The Department of Defense is the second-largest federal supporter of R&D in the Midwest, providing \$2.3 billion in FY 2005, half of which went to Ohio.
- The National Science Foundation (NSF) is the second-largest supporter of R&D in Midwestern universities, obligating \$666 million in FY 2005.
- The Midwest is home to three federally funded research and development centers (FFRDCs), which performed \$679 million in federal R&D in FY 2005, mostly for the Department of Energy (DOE). Argonne National Laboratory and Fermi National Accelerator Laboratory, both in Illinois, performed \$333 million and \$319 million in R&D, respectively, and Ames Laboratory in Iowa performed \$27 million in FY 2005. DOE is the third-largest federal sponsor of R&D in the Midwest with a total of \$855 million.

Table 1. Federal R&D to the Midwest by Performer, Fiscal Year 2005
(obligations in millions of dollars)

	Federal Labs	Industry	Univs./ Colleges	FFRDCs*	Nonprofits	State/ Local	TOTAL
Illinois (19)	155	243	961	643	81	6	2,087
Indiana (30)	83	117	354	0	3	1	558
Iowa (31)	70	89	283	27	7	4	480
Michigan (23)	114	204	736	0	50	4	1,109
Minnesota (26)	55	209	312	0	186	2	763
Ohio (14)	602	813	734	0	242	5	2,396
Wisconsin (27)	62	84	533	0	25	1	706
Total Midwest	1,141	1,759	3,912	670	594	22	8,098
U.S. Total	24,220	45,408	24,874	9,803	5,744	687	110,736
Midwest % of U.S.	4.7%	3.9%	15.7%	6.8%	10.3%	3.1%	7.3%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

Numbers in parentheses refer to ranking among 50 states and DC in federal R&D received.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Table 2. Federal R&D to the Midwest by Agency, Fiscal Year 2005
(obligations in millions of dollars)

	HHS	DOD	DOE	NSF	USDA	NASA	other	TOTAL
Illinois (19)	733	330	684	196	64	21	60	2,087
Indiana (30)	217	192	21	87	19	15	6	558
Iowa (31)	202	93	39	35	94	10	6	480
Michigan (23)	542	311	35	128	31	23	38	1,109
Minnesota (26)	436	180	13	52	38	8	35	763
Ohio (14)	758	1,154	36	74	29	151	194	2,396
Wisconsin (27)	376	68	28	119	68	25	22	706
Total Midwest	3,264	2,329	855	691	343	255	362	8,098
U.S. Total	28,889	53,814	8,594	4,082	2,315	8,821	4,221	110,736
Midwest % of U.S.	11.3%	4.3%	10.0%	16.9%	14.8%	2.9%	8.6%	7.3%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

Numbers in parentheses refer to ranking among 50 states and DC in federal R&D received.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Overview

The seven states of the Midwest—Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin—have been through dramatic economic transitions over the past few decades. Long associated with smokestack industries, the Midwest now boasts a highly diversified economy including many high-technology industries in telecommunications, biotechnology and health care, and alternative energy. Even the automobile industry, the leading industry in the region, relies heavily on cutting-edge technologies in the design and manufacture of its products.

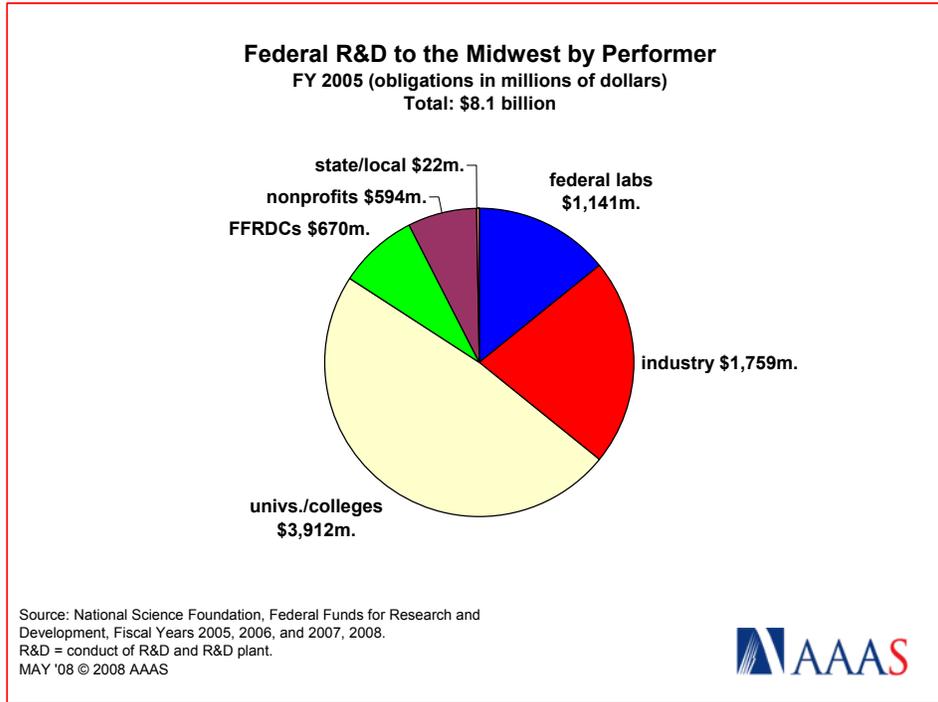


Chart 1.

Research and development is an integral part of the Midwest's regional economy. In 2004, the latest year for which comprehensive figures on industrial as well as federal R&D expenditures are available, \$53 billion was spent on R&D in these seven states, accounting for 18 percent of the national effort. This is roughly proportional to the Midwest's one-fifth share of the U.S. population.

Private industrial firms dominate R&D in the Midwest. Of the \$53 billion in R&D performed in the Midwest in 2004, \$43 billion was funded by industry. The Midwest is home to a number of companies with strong R&D investments, such as GM, Ford, Chrysler, 3M, and Motorola, all of which have large R&D laboratories in the region. 24 percent of the nation's industry-funded R&D, now approaching \$180 billion a year, is performed in the Midwest.

The Midwest has traditionally relied on industrial R&D for the strength of its R&D enterprise, but the federal role is also crucial in sustaining the knowledge and science bases that are the foundation of future discoveries and industries. In FY 2005, the latest year for which statistics on federal government obligations are available, the federal government obligated \$8.1 billion in funds for R&D to the Midwest (see Table 1). Of this amount, the largest share (\$3.9 billion) went to the region's universities, followed by industrial firms (\$1.8 billion), government labs (\$1.1 billion), and three federally funded research and development centers (FFRDCs) in Illinois and Iowa (\$670 million; see Chart 1).

Although the flow of federal R&D funds to the region is significant, it is less than what one might expect based on the region's population and economic strength. For the past few decades, federal R&D to the

Midwest has remained fairly steady at about 8 percent of total federal R&D (see Chart 3), although in recent years this share has dipped toward 7 percent. This is less than the Midwest's 17 percent share of the U.S. population and is far less than the Midwest's 24 percent share of industry-funded R&D.

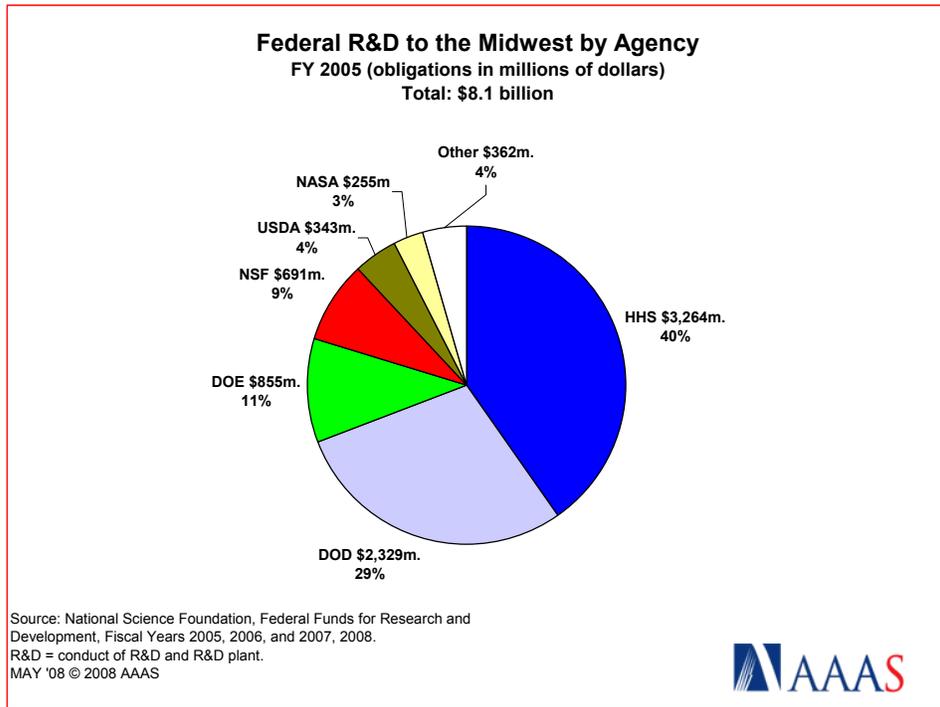


Chart 2.

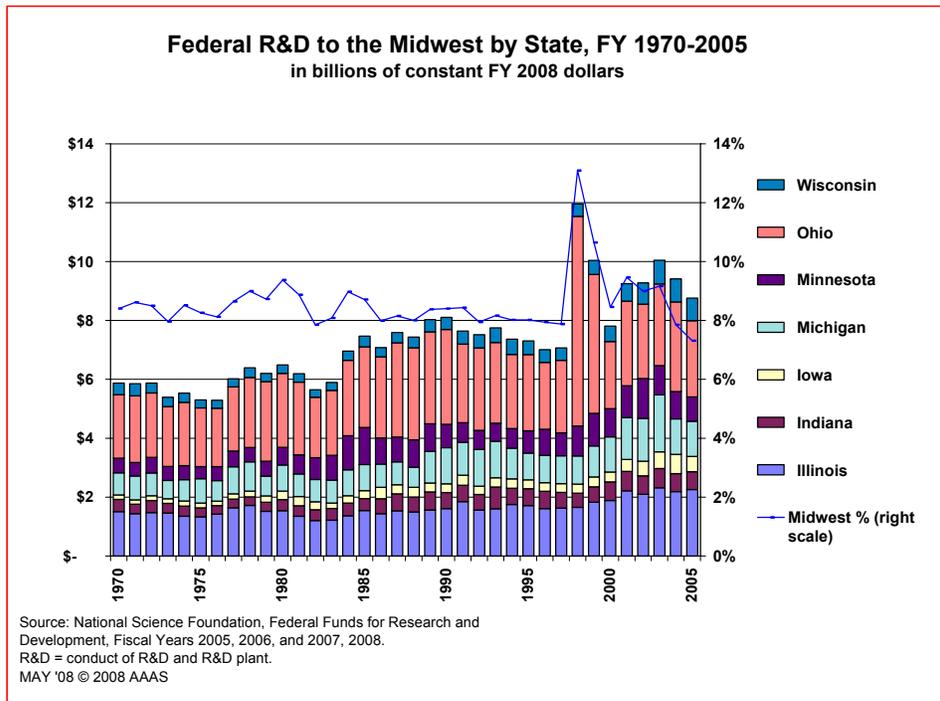


Chart 3.

Midwestern universities are strong competitors for federal funds and use these federal dollars to educate students, perform cutting-edge research, and catalyze local economic development. In federal support for university R&D, Midwestern universities capture 16 percent of total federal support for university R&D (see Table 1). Midwestern firms receive only 4 percent of total federal support for R&D, chiefly because the largest defense contractors, who receive over half of all federal support for industrial R&D, are located outside the region in the South and the West. Similarly, government labs in the region receive only 5 percent of total federal support for government labs. The three Midwest FFRDCs (government-owned labs operated under contract by non-government institutions) account for 7 percent of total federal spending on FFRDCs.

In real terms (after adjusting for inflation; see Chart 3), federal R&D to the Midwest mostly increased from the mid-1970s until FY 2003 because of the growth rate in total federal R&D spending, but declined in 2004 and 2005. A closer look at the chart shows that Ohio accounts for much of the fluctuation over the years. Ohio receives nearly half of its R&D funds from the Department of Defense, and is therefore sensitive to trends in defense spending, which can fluctuate dramatically because of specific weapons projects entering or leaving the development phase. The other six states have held fairly steady and have even increased slightly over the past several decades, mirroring trends in overall nondefense R&D spending by the federal government. But these states' federal R&D support also dropped in 2004 and 2005. As a result, the Midwest's share of federal R&D has been falling in recent years below 8 percent of the national total to a new low of 7.3 percent in 2005.

As Table 1 shows, Ohio receives the most in federal R&D funds among the seven states, with a \$2.4 billion inflow to the state economy in FY 2005, placing it 14th among the states, followed by Illinois (19th) with \$2.1 billion. These two states, ranked 7th and 5th respectively in population, account for the majority of federal R&D funds to the Midwest. Iowa received the least of the seven states, \$480 million in FY 2005.

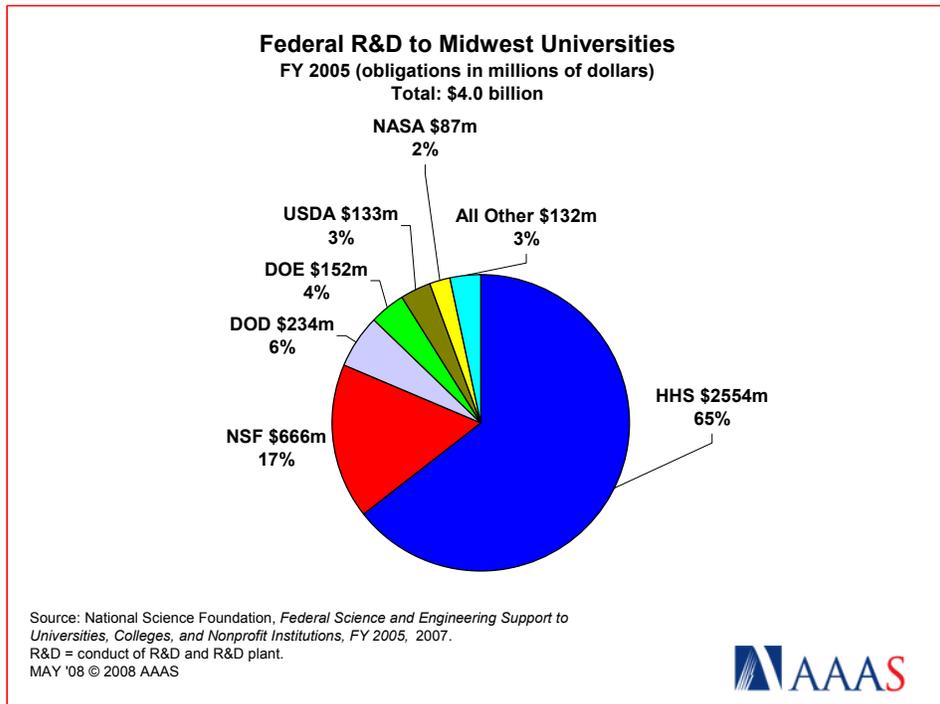


Chart 4.

The Department of Health and Human Services (HHS) is the largest federal sponsor of R&D in the Midwest (see Table 2 and Chart 2) with \$3.3 billion, almost entirely from the National Institutes of Health (NIH). Nationally, HHS is ranked 2nd behind the Department of Defense (DOD). DOD sent \$2.3 billion in R&D funds to the Midwest, followed by the Department of Energy (DOE) with \$855 million and the

National Science Foundation (NSF) with \$691 million. The U.S. Department of Agriculture (USDA) and the National Aeronautics and Space Administration (NASA) round out the top six federal sponsors of R&D in the Midwest with \$343 million and \$255 million, respectively.

Universities and Colleges

Federal support for R&D is especially important to the region’s network of large research universities, many of which were founded as land-grant institutions nearly 150 years ago. Together, the Midwest’s universities received nearly \$4 billion in R&D funds from the federal government in FY 2005 (see Table 3), and received even more in federal funds when training grants, student aid, and other funds are counted. Nearly two thirds of the federal funds for university R&D came from the Department of Health and Human Services (HHS), home of the National Institutes of Health (NIH; see Chart 4). NIH funds nearly two thirds of total federal support for university research, and that is true for the Midwest as well. In FY 2005, HHS sponsored \$2.6 billion in R&D in Midwestern universities, nearly four times as much as the next-largest sponsor, the National Science Foundation with \$666 million. Other important sponsors are the Department of Defense (DOD, \$234 million), the National Aeronautics and Space Administration (NASA, \$87 million), the Department of Energy (DOE, \$152 million), and the U.S. Department of Agriculture (USDA, \$133 million).

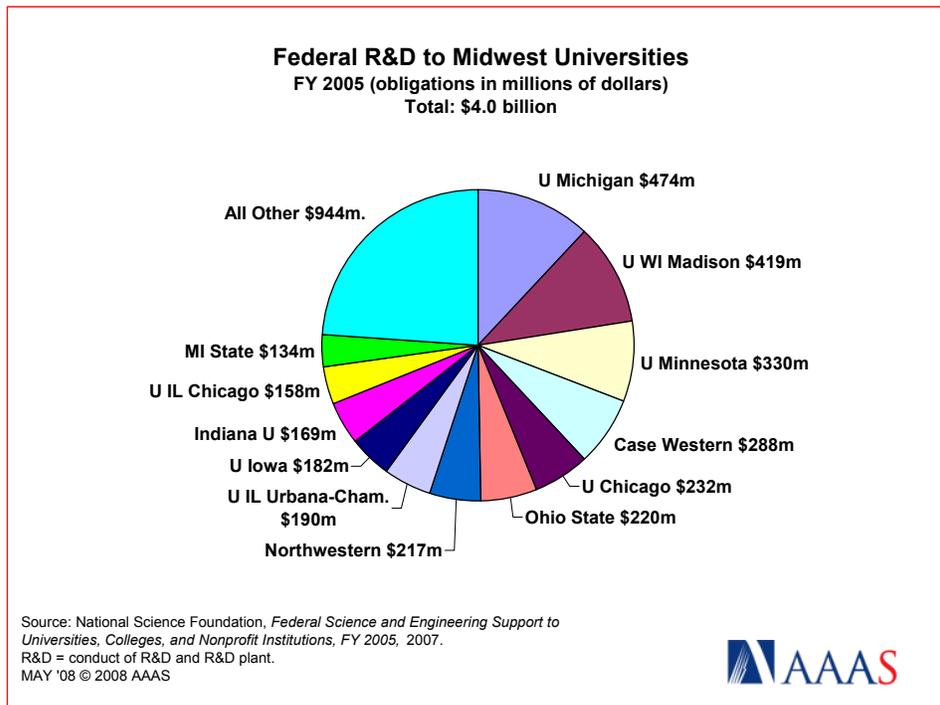


Chart 5.

The strength of the region’s universities at winning federal research grants can be seen in Table 3 and Chart 5. Both the University of Michigan and the University of Wisconsin-Madison rank among the top ten recipients of federal R&D funds, and the breadth of the region’s excellence can be seen by the presence of 11 institutions, at least one from each of the seven states, among the top 50 recipients. 14 universities in the region receive more than \$100 million annually from the federal government for R&D.

Nationwide, the federal government funds 63 percent of the R&D conducted at universities. Most of the larger Midwest universities receive at least 50 percent of their total R&D budgets from the federal government, dwarfing other sources such as institutional, state, and local government funds. The University of Michigan, for example, reports that 71 percent of its R&D performance in 2006 was funded by the federal government; Case Western reports that 83 percent of its R&D was funded by federal

**Table 3. Federal R&D to Midwest Universities,
Fiscal Year 2005**
(obligations in millions of dollars)

	HHS	NSF	DOD	DOE	USDA	NASA	other	TOTAL
U Michigan (5)	350	62	25	14	1	11	10	474
U WI Madison (10)*	239	110	15	26	16	9	4	419
U Minnesota (18)	221	46	19	7	13	6	17	330
Case Western (22)	271	9	3	1	0	4	0	288
U Chicago (30)	169	45	2	4	1	2	8	232
Ohio State (32)	117	36	14	9	16	6	23	220
Northwestern (34)	158	27	15	8	0	3	6	217
U. IL Urbana-Cham.(38)*	56	87	23	7	15	2	1	190
U Iowa (41)	160	9	7	1	0	4	2	182
Indiana U (46)*	133	31	0	4	0	0	1	169
U. IL Chicago (49)*	130	13	7	5	1	1	3	158
MI State (55)	40	46	4	11	23	4	7	134
Purdue U (64)	40	37	12	7	12	8	6	121
U Cincinnati (72)	100	5	4	1	0	0	1	111
Wayne State (81)	75	5	10	1	0	1	0	93
Iowa State (85)	20	23	6	3	25	4	4	86
Medical C. WI (86)	83	0	0	0	0	0	1	85
All Other	193	73	69	43	9	22	40	449
Total Midwest	2,554	666	234	152	133	87	132	3,958
U.S. Total	16,005	3,328	2,504	940	727	1,091	838	25,433
Midwest % of U.S.	16.0%	20.0%	9.4%	16.1%	18.3%	8.0%	15.8%	15.6%

Source: National Science Foundation, *Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2005, 2007.*

Figures may differ from other tables because of differing survey methods.

Figures in parentheses denote national rank among universities and colleges in federal R&D funds received.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

* - Central office funds counted separately.

sources. Many of the larger public Midwestern universities report federal funding ratios between 50 and 60 percent. Whether public or private, the federal government is the primary supporter of research at these universities and makes possible not only the bulk of the research done on campus but also faculty support, research training for graduates and undergraduates, and funding for graduate education. Industrial contributions to university research have been growing in recent years, but they still account for less than 10 percent of total university R&D, though with some exceptions in the Midwest such as Ohio State (ranked #2 in the nation among universities receiving industry R&D support with \$107 million in 2006) and Purdue (ranked #6 with \$46 million). Despite significant increases over the past decade and a variety of innovative partnership strategies to better link university and industrial research, industrial funding of university R&D is likely to remain a small part of the overall funding picture for universities. Continued federal support for R&D is thus vital to the continued strength of research capabilities at these universities.

State and local governments fund between 10 to 20 percent of the R&D conducted at the major universities, and their indirect support for facilities, operating funds, and other costs associated with running the university is important. In an era when state education budgets are increasingly constrained by other state needs, it seems unlikely that this source could expand significantly. Similarly, institutional funds fund a significant part of the research conducted on campuses, but public resistance to tuition increases, especially at the public universities, will make expanding this revenue source difficult.

Government Laboratories

Government laboratories are also major recipients of federal support in the Midwest. Table 1 shows that federal labs received \$1.1 billion in federal R&D funds in FY 2005, of which a majority went to labs in Ohio operated by DOD, NASA, and the Environmental Protection Agency (EPA).

The Department of Agriculture has a large network of government labs in the region, with at least one facility in each of the seven Midwest states. These labs, funded through the Agricultural Research Service (ARS) or the Forest Service, are often located on the campuses of the network of land-grant universities in the region, although they operate independently. One large lab in the region is the National Center for Agriculture Utilization Research in Peoria, Illinois. Its 10 research units comprise a diverse portfolio of agricultural research issues. Together with other ARS units in Urbana, the Illinois USDA labs received over \$48 million in R&D funds in FY 2005. Other significant labs in the region are the ARS labs in Ames, Iowa, including the National Animal Disease Center and the National Soil Tilth Laboratory, with \$69 million in FY 2005, and several research units in Madison, Wisconsin, receiving \$51 million in FY 2005. The Forest Service maintains labs in Michigan, Minnesota, Michigan, and Wisconsin to perform forestry research.

Federally Funded Research and Development Centers (FFRDCs)

The Midwest is home to three federally funded research and development centers (FFRDCs), which received \$679 million in FY 2005 (see Table 5). FFRDCs are government-owned facilities that are operated and managed by either universities, industrial firms, or nonprofit organizations to conduct research for the federal government. There are a total of 38 FFRDCs. The largest in the region is Argonne National Laboratory in Argonne, Illinois, which conducts R&D primarily for the Department of Energy but is expanding its work for the relatively new Department of Homeland Security (DHS). Argonne, operated by UChicago Argonne LLC, a partnership led by the University of Chicago, received \$333 million for R&D in FY 2005, including funds for R&D facilities, and employs 2,800 people. Its research falls into five broad categories: basic science, scientific facilities, energy resources, environmental management, and national security. Fermi National Accelerator Laboratory, in Batavia, specializes in particle physics research. Because of its unique facilities, much of the field of high-energy physics conducts its experiments here. FermiLab is operated by a consortium of research universities, and received \$319 million in R&D funding in FY 2005, almost entirely from DOE's High Energy Physics program.

Table 4. Federal R&D to Midwest Nonprofit Institutions, Fiscal Year 2005
(obligations in millions of dollars)

	HHS	DOD	DOE	NASA	other	TOTAL
Mayo Foundation (5)	172	14	0	0	0	186
Battelle Memorial (7)	32	66	6	7	20	131
IIT Research Institute (9)	4	114	0	0	0	118
Children's Hospital (Cincinnati, OH; 16)	81	0	0	0	0	82
National Marrow Donor Program (41)	1	38	0	0	0	39
American C. of Radiology (42)	38	0	0	0	0	38
Henry Ford Health System (61)	21	1	0	0	0	23
Children's Research Institute (Columbus; 68)	21	0	0	0	0	21
Evanston Northwestern Healthcare (75)	18	0	0	0	0	18
Minneapolis Medical Res. Foundation (96)	13	0	0	0	0	13
OH Aerospace Institute (100)	0	1	0	11	0	12
All Other	80	26	21	1	17	145
Total Midwest	482	260	27	20	38	826
U.S. Total	3,964	1,397	105	282	636	6,382
Midwest % of U.S.	12.2%	18.6%	25.4%	7.0%	6.0%	12.9%

Source: National Science Foundation, *Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2005, 2007.*

Figures may differ from other tables because of differing survey methods.

Figures in parentheses denote national rank among independent nonprofit institutions in federal R&D funds received.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Table 5. Federal R&D to Midwest FFRDCs* by Agency, Fiscal Year 2005
(obligations in millions of dollars)

	DOE	DHS	HHS	DOD	other	TOTAL
Argonne National Lab	295	13	12	4	9	333
Fermi Nat'l Accel. Lab	319	0	0	0	0	319
Ames Laboratory	27	0	0	0	0	27
Total Midwest FFRDCs	641	13	12	5	9	679
U.S. Total	5,727	415	446	1,308	1,954	9,850
Midwest % of U.S.	11.2%	3.1%	2.6%	0.3%	0.5%	6.9%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007, 2008.*

Totals are slightly higher than in other tables because of the inclusion of all R&D funding agencies.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

The other FFRDC in the region is Ames Laboratory in Ames, Iowa, operated by Iowa State University, which received \$27 million from DOE in FY 2005 to perform energy-related research. It employs approximately 400 people.

Nonprofit Institutions

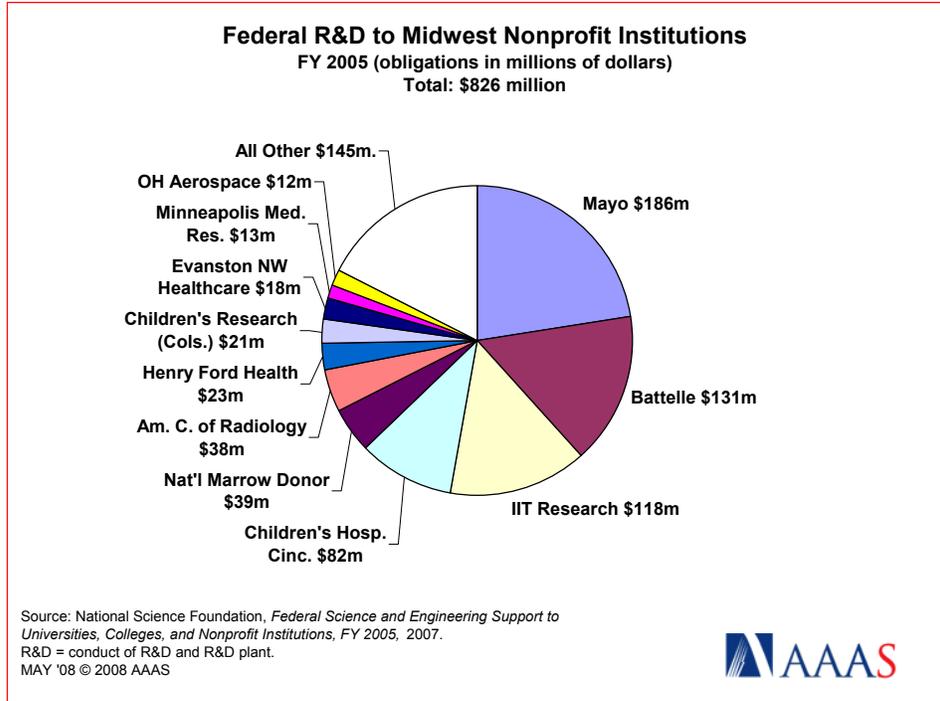


Chart 6.

The Midwest also has a robust nonprofit sector, which is highly competitive for federal R&D funds (see Table 4 and Chart 6). 3 of the top 10 nonprofit recipients of federal R&D funds are in the Midwest. Midwest nonprofits received \$826 million in federal R&D funds in FY 2005, more than half from HHS for biomedical research. The Mayo Foundation in Minnesota leads the pack with \$186 million, almost entirely from NIH, ranking 5th among the nation's nonprofits. The Battelle Memorial Institute in Columbus, Ohio, received \$131 million in R&D funds in 2005 (7th nationwide), the majority from DOD for various contract R&D projects; similarly, the IIT Research Institute in Chicago ranks 9th among nonprofits in R&D funds received, with nearly all of its \$118 million in 2005 federal R&D coming from DOD. Among other Midwest nonprofits, the bulk of federal R&D funds come from NIH for biomedical research, although the National Marrow Donor Program in Minneapolis receives nearly all of its medical research funds from DOD.

Outlook and Conclusion

Over time, the Midwest's share of total federal support for R&D has been mostly steady at around 8 percent, as shown on Chart 3, except for fluctuations in Ohio's defense R&D. The result is that the flow of R&D funds to the region has mirrored national trends in R&D funding. The Midwest's steady share of total R&D is a result of the diversity of the region's R&D institutions and federal funding sources, detailed earlier in this report, and this consistency suggests that the future of R&D in the Midwest will continue to closely track national trends. But in recent years, the share has trended downward and broke through 8 percent in 2004 down to a new low of 7.3 percent in 2005, just when the overall federal R&D investment grew slower than the rate of inflation in 2005 for the first time in a decade.

As in the nation as a whole, federal support of R&D in the Midwest has helped to build a strong R&D enterprise. Federal support for R&D has been especially important for the region's universities, which are world-class centers of excellence that not only perform research at the frontiers of knowledge but attract faculty and students from all over the world. Federal funds have also helped to sustain the region's privately funded R&D, through the support of graduate education of scientists and engineers at the region's universities who go on to staff industrial R&D labs and also through linkages between federal and private R&D, especially evident in the Midwest in the links between commercial agriculture and federally funded agricultural research.

The continued strength of the region's R&D institutions, however, is in doubt because the national funding outlook for R&D is one of uncertainty mixed with pessimism. Growth in federal support for R&D has failed to keep pace with inflation in recent years, especially on the nondefense side in a time of tight domestic budgets and record budget deficits. Nondefense R&D has a disproportionate impact on the region's universities and FFRDCs.

The Midwest's strength in privately funded R&D may shelter the region's economy somewhat from federal R&D cutbacks, but the region's universities, dependent on the federal government for over half of their research funding, are likely to feel the full impact of any cuts. The region's federal labs and FFRDCs, of course, are dependent on federal funds for all of their research. Thus, recent news that in the proposed federal budget for FY 2009 federal support of basic and applied research would decline for the fifth year in a row in real terms is a worrying trend for the region's R&D institutions. Although there has been a resurgence of interest in recent years among policymakers in reinvigorating federal support of research through policy proposals such as the America COMPETES Act and the American Competitiveness Initiative, they have not yet translated into increased funding for federal R&D.

Illinois

Illinois is home to several leading research universities as well as two federally funded research and development centers (FFRDCs) that perform cutting-edge basic research in physics. Illinois also has a strong industrial R&D sector: in 2004, total R&D in Illinois was \$11.3 billion, of which \$8.3 billion was funded by industry.

There are many high-tech firms in Illinois, including Motorola, headquartered in Schaumburg. Although its R&D operations are increasingly globalized, Motorola has a number of R&D laboratories in the state which focus on automotive and communications technologies.

Illinois boasts a number of leading research universities, with four of them receiving more than \$100 million each in federal R&D obligations in FY 2005: the University of Chicago, \$232 million; Northwestern, \$217 million, the University of Illinois Urbana-Champaign, \$190 million; and the University of Illinois Chicago, \$169 million.

The University of Illinois Urbana-Champaign is unusual among the major research universities in that it receives nearly half its federal R&D support from the National Science Foundation, for a total of \$87 million in FY 2005. NSF is the major sponsor, in collaboration with NASA, DOD's Defense Advanced Research Projects Agency (DARPA), the state government, and corporate partners, of the National Center for Supercomputing Applications (NCSA). NCSA is most famous for inventing Mosaic, the first widely available browser for the World Wide Web and the one credited with popularizing use of the Internet.

Northwestern receives most of its federal R&D support from NIH, for \$158 million in FY 2005 out of a total \$217 million.

Illinois is home to two DOE-funded federally funded research and development centers (FFRDCs), the Argonne National Laboratory in Argonne and the Fermi National Accelerator Laboratory in Batavia. DOE spends 8 percent of its total R&D portfolio in Illinois and is the second-largest federal sponsor of R&D in the state, with a total of \$684 million in FY 2005, \$614 million of which went to the two labs.

FFRDCs are hybrid organizations that are owned by the federal government and perform R&D for the federal government but are operated and managed under contract by outside organizations. Argonne is managed by the UChicago Argonne LLC and Fermilab is managed by the University Research Association. The labs play a strong role in DOE's basic research portfolio and perform R&D that serves all three of DOE's major research missions in national security, energy, and fundamental science (especially physics). The labs are also important for their large-scale scientific user facilities, such as the Advanced Photon Source (APS) at Argonne. The APS produces intense X-ray beams that could aid in the development of improved semiconductors. These unique facilities enable researchers from Illinois and around the world to conduct experiments that would not otherwise be possible.

The U.S. Department of Agriculture funds a number of federal labs in the state, including the National Center for Agriculture Utilization Research in Peoria, which develops new uses for agricultural commodities, develops new environmental technology for agriculture, and transfers agricultural research results to users in the state. In FY 2005, USDA obligated a total of \$48 million in R&D funds to this lab, other research units in Urbana, and two Forest Service labs. DOD spent \$89 million on R&D in its labs in FY 2005, including the U.S. Army Construction Engineering Laboratories which conduct research aimed at improving the safety, environmental impacts, and operational efficiency of its infrastructure.

Table. Federal R&D to Illinois by Agency and Performer, Fiscal Year 2005
(obligations in millions of dollars)

	HHS	DOE	DOD	NSF	USDA	DHS	other	TOTAL
Federal Labs	0	2	89	0	48	15	1	155
Industry	24	12	175	1	0	17	14	243
Univs. / Colleges	629	50	57	187	16	0	21	961
FFRDCs *	12	614	4	0	0	13	0	643
Nonprofits	63	6	4	7	0	0	0	81
State / Local Govts.	5	0	0	0	0	0	0	6
Total Illinois	733	684	330	196	64	44	37	2,087
U.S. Total	28,889	8,594	53,814	4,082	2,315	1,454	11,589	110,736
IL % of U.S.	2.5%	8.0%	0.6%	4.8%	2.8%	3.1%	0.3%	1.9%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Table. Federal R&D to Indiana by Agency and Performer, Fiscal Year 2005
(obligations in millions of dollars)

	HHS	DOD	NSF	DOE	USDA	NASA	other	TOTAL
Federal Labs	0	75	0	0	6	0	2	83
Industry	12	100	2	0	0	3	0	117
Univs. / Colleges	203	17	85	21	13	12	4	354
FFRDCs *	0	0	0	0	0	0	0	0
Nonprofits	2	1	0	0	0	0	0	3
State / Local Govts.	0	0	0	0	0	0	0	1
Total Indiana	217	192	87	21	19	15	6	558
U.S. Total	28,889	53,814	4,082	8,594	2,315	8,821	4,221	110,736
IN % of U.S.	0.7%	0.4%	2.1%	0.2%	0.8%	0.2%	0.2%	0.5%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Indiana

Indiana's strength in R&D lies in its ties to the automobile industry, particularly General Motors (GM). Total R&D performed in Indiana in 2004 was \$5.1 billion, \$4.0 billion of which came from industry.

On the federal side, Indiana ranks 30th among the states in total federal R&D funds received in FY 2005, for a total of \$558 million. Of this amount, nearly half (\$217 million) came from DOD, which was distributed mostly to industrial firms and DOD labs in the state.

The federal government supplied \$354 million in R&D funds to Indiana universities in FY 2005, \$203 million of which came from the Department of Health and Human Services (HHS). Indiana University received \$169 million, of which \$133 million came from HHS and \$31 million from NSF. NSF supports the Indiana University Cyclotron Facility, which enables researchers to work with subatomic particles. The facility also receives funds from DOE. Purdue University received \$121 million in FY 2005.

Department of Defense (DOD) labs receive the largest share of federal funding for government labs in Indiana, \$75 million out of a total \$83 million in FY 2005. Most of the labs are engaged in the development of new weapons prototypes, but DOD labs also conduct research on the properties of high-temperature materials and metals. The Agricultural Research Service of the U.S. Department of Agriculture operates the National Soil Erosion Research Laboratory (NSERL) in West Lafayette on the Purdue campus. Receiving \$6 million in FY 2005 for R&D and employing about 20 people, the NSERL is described by the Agricultural Research Service as "the focal point for the U.S. Government's national research program in soil erosion by water."

Iowa

Federal support for R&D in Iowa addresses a number of national missions and supports a variety of R&D-performing institutions. Although most of the federal government's spending of \$480 million for R&D in Iowa in FY 2005 went to the state's universities, federal support also sustains several USDA agricultural research laboratories and a federally funded research and development center (FFRDC) that performs research for DOE.

The University of Iowa in Iowa City received \$182 million in R&D obligations in FY 2005 from federal sources, nearly all of which (\$160 million) came from the National Institutes of Health (NIH) and the Food and Drug Administration (FDA) within the Department of Health and Human Services (HHS). The university relies on the federal government to fund over 60 percent of its research.

Iowa State University in Ames received about \$86 million in FY 2005 from federal sources for its R&D. Iowa State relies on the federal government for only 47 percent of its research funding, an unusually low number for a large university, because it draws heavily on state, local, and institutional funds to finance its research. About a third of its federal funding comes from the Department of Agriculture.

Ames Laboratory, located on the Iowa State campus, is an FFRDC operated by Iowa State that performs R&D for DOE. The laboratory employs approximately 400 people, including 230 scientists and engineers, and received \$27 million in R&D funds in FY 2005. Originally established in the 1940s to develop uranium for nuclear weapons, the laboratory now conducts a varied portfolio of R&D activities centered around energy research, including environmental restoration, materials research, and industrial technology.

The U.S. Department of Agriculture (USDA) maintains a number of laboratories in Ames, which together received \$69 million for R&D in FY 2005 from USDA's Agricultural Research Service. The National Animal Disease Center, with 160 employees, is the major USDA center for research on livestock and poultry diseases that occur in the United States. The center also works closely with another USDA lab, the National Veterinary Services Laboratories, to combat animal pathogens. The lab complex is in expansion mode with the recent expansion of the Ames facility to be a comprehensive animal research center, including homeland security-related research on protecting the food supply.

Table. Federal R&D to Iowa by Agency and Performer, Fiscal Year 2005
(obligations in millions of dollars)

	HHS	USDA	DOD	DOE	NSF	NASA	other	TOTAL
Federal Labs	0	69	0	0	0	0	2	70
Industry	1	0	82	3	1	1	0	89
Univs. / Colleges	195	26	11	4	34	9	4	283
FFRDCs *	0	0	0	27	0	0	0	27
Nonprofits	3	0	0	4	0	0	0	7
State / Local Govts.	3	0	0	0	0	0	1	4
Total Iowa	202	94	93	39	35	10	6	480
U.S. Total	28,889	2,315	53,814	8,594	4,082	8,821	4,221	110,736
IA % of U.S.	0.7%	4.1%	0.2%	0.5%	0.9%	0.1%	0.1%	0.4%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Table. Federal R&D to Michigan by Agency and Performer, FY 2005
(obligations in millions of dollars)

	HHS	DOD	NSF	DOE	USDA	NASA	other	TOTAL
Federal Labs	1	93	0	0	7	0	13	114
Industry	21	156	2	5	0	6	13	204
Univs. / Colleges	482	47	126	28	25	17	11	736
FFRDCs *	0	0	0	0	0	0	0	0
Nonprofits	35	13	0	2	0	0	0	50
State / Local Govts.	3	1	0	0	0	0	0	4
Total Michigan	542	311	128	35	31	23	38	1,109
U.S. Total	28,889	53,814	4,082	8,594	2,315	8,821	4,221	110,736
MI % of U.S.	1.9%	0.6%	3.1%	0.4%	1.3%	0.3%	0.9%	1.0%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Michigan

Michigan is a national leader in the performance of R&D. In 2004, nearly \$16.8 billion of R&D was performed in Michigan, second in the nation behind only California. Over 90 percent of Michigan's R&D was performed by industrial firms, nearly all of that with industry's own funds.

The automobile industry has long been the core of Michigan's R&D enterprise. The Big Three automakers are headquartered near Detroit, and although in recent years they have diversified their operations, the bulk of their R&D activities are performed within the state. General Motors, Ford, and Chrysler, are, in descending order, the top three employers in the state. General Motors alone has over a dozen major R&D labs in the state, including several in Warren, engaged in development of a wide range of automotive technologies.

Michigan's companies are self-reliant in their R&D, receiving only \$204 million in federal R&D funds in 2005, most of that for DOD weapons development contracts, compared to \$15.0 billion of R&D with their own funds.

Although Michigan's R&D enterprise is overwhelmingly company-based, the University of Michigan is one of the top research universities in the country and received \$474 million for R&D in FY 2005, ranking it fifth among the universities receiving the most federal R&D funds. Over the past decade, its share of federal R&D has grown substantially, and now receives twice as much in R&D funding than a decade ago. The University of Michigan Medical Center is especially competitive in securing research grants, and helped the university secure \$350 million in funds for biomedical research from NIH in FY 2005.

Michigan State in East Lansing is also a strong research university, receiving \$134 million from the federal government for R&D in FY 2005, placing it in 55th place among U.S. universities. NIH and NSF each account for about a third of this funding, with other agencies, led by USDA, accounting for the remaining third. Wayne State in Detroit received \$93 million in federal R&D in 2005.

Federal labs in Michigan, which received approximately \$114 million for R&D in FY 2005, are dominated by DOD labs, which account for over three-quarters of the total. DOD labs in the state mostly perform development work on new weapons systems. USDA maintains agricultural and forestry research units in East Lansing. The Environmental Protection Agency funds the National Vehicle and Fuel Emissions Laboratory in Ann Arbor, which is the primary lab for EPA's research on controlling air pollution from motor vehicles.

Minnesota

Minnesota ranks 26th among the states in federal support for R&D with \$763 million in obligations for fiscal year 2005, but is a strong performer of private R&D. Of the \$6.0 billion total spent on R&D in the state in 2004, almost \$5.2 billion was performed by industrial firms, nearly all with firms' own funds.

The 3M Company, headquartered in St. Paul, is a key performer of R&D in the state. 3M maintains labs in St. Paul. Many of 3M's products are developed and tested in Minnesota, and 3M conducts basic and applied research in a variety of fields related to ceramics, electronics, magnetic recording, and information processing.

The largest employer in the state, after the state government, is the University of Minnesota, which employs nearly 20,000 people and is the 18th largest university recipient of federal R&D funds, a total of \$330 million in obligations for FY 2005. The university depends on the federal government to finance 55 percent of its total research, according to NSF statistics.

The National Institutes of Health is by far the largest sponsor of R&D at the University of Minnesota. In FY 2005, the Department of Health and Human Services obligated \$221 million in R&D funds to the university, nearly all of which came from NIH. Although NIH's share of Minnesota's federal R&D portfolio has been declining over time, it still accounts for a majority of federal funds. The next largest sponsor, NSF, trailed far behind in FY 2005 with a total of \$46 million for R&D.

Private industry obtains significant funding for R&D from the Department of Defense (DOD), totaling \$209 million in FY 2005. DOD is the second-largest federal sponsor of R&D in Minnesota, after NIH, but unlike NIH obligates nearly all of its funds to private firms. While some of these funds go toward research, most of these funds are obligated for the development, testing, and evaluation of weapons systems prototypes.

The U.S. Department of Agriculture obligated \$24 million for R&D in its labs in FY 2005, including the North Central Soil Conservation Research (NCSCRL) in Morris. The NCSCRL conducts research on agricultural problems in the transitional subhumid zone of the U.S., encompassing most of Minnesota, the Dakotas, and Iowa.

The Mayo Clinic in Rochester is a world-famous medical facility, employing 2500 physicians and scientists; its foundation receives federal R&D funding to perform research, primarily from the NIH for clinical research. Mayo received \$186 million in federal R&D funding in 2005, nearly all from NIH, making it the 5th largest nonprofit recipient of federal R&D funds.

Table. Federal R&D to Minnesota by Agency and Performer, FY 2005
(obligations in millions of dollars)

	HHS	DOD	NSF	USDA	EPA	DOE	other	TOTAL
Federal Labs	0	3	0	24	23	0	3	55
Industry	30	166	3	0	0	5	6	209
Univs. / Colleges	222	8	49	13	2	8	9	312
FFRDCs *	0	0	0	0	0	0	0	0
Nonprofits	182	3	0	0	0	0	0	186
State / Local Govts.	2	0	0	0	0	0	0	2
Total Minnesota	436	180	52	38	25	13	19	763
U.S. Total	28,889	53,814	4,082	2,315	641	8,594	12,402	110,736
MN % of U.S.	1.5%	0.3%	1.3%	1.6%	3.9%	0.1%	0.2%	0.7%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Table. Federal R&D to Ohio by Agency and Performer, Fiscal Year 2005
(obligations in millions of dollars)

	DOD	HHS	NASA	EPA	NSF	DHS	other	TOTAL
Federal Labs	423	17	5	101	0	40	17	602
Industry	657	31	84	12	3	4	22	813
Univs. / Colleges	40	566	21	0	69	0	36	734
FFRDCs *	0	0	0	0	0	0	0	0
Nonprofits	35	141	40	1	0	13	11	242
State / Local Govts.	0	3	1	0	0	0	1	5
Total Ohio	1,154	758	151	115	74	57	87	2,396
U.S. Total	53,814	28,889	8,821	641	4,082	1,454	13,035	110,736
OH % of U.S.	2.1%	2.6%	1.7%	17.9%	1.8%	3.9%	0.7%	2.2%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Ohio

Ohio is the largest recipient of federal R&D funds in the Midwest, ranking 14th among the 50 states and the District of Columbia. The federal government obligated \$2.4 billion in R&D funds to the state in FY 2005, about half of which came from the Department of Defense.

Like the other Midwest states, Ohio's R&D enterprise relies heavily on private industry funding of R&D geared to the development of commercial products. In calendar year 2004, \$7.8 billion worth of R&D was performed in the state. Of that amount, \$5.5 billion or over 70 percent was performed by industry and \$5.1 billion was funded by industry (65 percent).

Two Ohio universities rank among the top 50 university recipients of federal R&D funds. Case Western Reserve, near Cleveland, received \$288 million in federal R&D obligations in FY 2005, nearly all of which came from NIH. Case Western is unusually dependent on federal grants to support its research; 83 percent of its R&D funding comes from federal sources.

The Ohio State University received \$220 million in federal R&D funding in 2005, of which roughly half (\$117 million) came from NIH to fund a wide range of medical research at the Ohio State Medical Center. NSF is the second largest source, with \$36 million in obligations in FY 2005. The Department of Agriculture obligated \$16 million. The University of Cincinnati received \$111 million in federal R&D in FY 2005, nearly all of it from NIH.

NASA is the third largest federal supporter of R&D in Ohio after DOD and NIH, with a total of \$151 million in FY 2005. NASA operates the Glenn Research Center near Cleveland and Sandusky, and employs 2,500 people, about half of whom are scientists and engineers. But NASA support for the center has been steadily shrinking over the past two decades. There are hopes that the Constellation Systems program to develop replacements for the Space Shuttle in the next decade, work that Glenn is heavily involved in, may revive the center's fortunes in the future. At the moment, most of NASA's support for Glenn appears in non-R&D funding categories.

The Environmental Protection Agency also has a strong R&D presence in Ohio. One of the agency's major labs, the National Risk Management Research Laboratory (NRMRL), is located in Cincinnati. Its research focuses on environmental risk management and the scientific understanding and the development and application of technology to prevent, control, or remediate important environmental problems. In recent years, EPA's presence in Cincinnati has grown with the establishment in 2002 of the National Homeland Security Research Center (NHSRC) to focus on R&D related to threat and consequence assessment, decontamination, water and infrastructure protection, response enhancement, and technology testing and evaluation. As a result, Ohio's share of the EPA R&D portfolio has expanded dramatically. EPA obligated \$115 million for R&D activities in FY 2005, mostly at the Cincinnati labs, amounting to 18 percent of EPA's total R&D obligations.

Finally, the major sponsor of R&D in Ohio is DOD, with a total of \$1.2 billion in FY 2005. Although most of these funds (\$657 million) went to private defense contractors, \$423 million in R&D obligations in FY 2005 went to DOD labs in the state. The Air Force maintains a number of labs at Wright-Patterson Air Force Base near Dayton that develop and test technologies for aircraft fighter systems and missile guidance.

Wisconsin

The University of Wisconsin at Madison dominates federal funding for R&D in the state of Wisconsin, receiving \$419 million of a total \$706 million in federal R&D funds to the state in FY 2005. The university ranked tenth in FY 2005 among the universities receiving the most federal funds for R&D. The federal government finances nearly 60 percent of the university's research.

Federal support at the university helps to sustain research in a wide variety of fields. The university is a world leader in organ transplantation and transplant technology, and has two pioneering cancer centers: the McArdle Laboratory for Cancer Research and the University of Wisconsin Comprehensive Cancer Center. The university is also a world leader in the emerging field of embryonic stem cell research. HHS funded \$239 million of R&D in FY 2005. NSF funding, totaling \$110 million in FY 2005, sustains the Materials Research Science and Engineering Center, and NASA funds the Space Science and Engineering Center.

The Medical College of Wisconsin in Milwaukee is also competitive for federal R&D funds, gaining \$85 million in federal support in 2005, nearly all from NIH.

The Department of Agriculture funds a number of research units in Madison. These federal labs conduct research on cereal crops, plant disease, dairy products, and vegetable crops. USDA's Forest Service maintains two laboratories in Madison and Rhinelander that conduct forestry management research. USDA's Wisconsin labs received \$51 million in FY 2005.

Table. Federal R&D to Wisconsin by Agency and Performer, FY 2005
(obligations in millions of dollars)

	HHS	NSF	USDA	DOD	DOE	NASA	other	TOTAL
Federal Labs	0	0	51	1	0	0	10	62
Industry	17	2	0	48	0	15	3	84
Univs. / Colleges	335	118	17	18	28	10	7	533
FFRDCs *	0	0	0	0	0	0	0	0
Nonprofits	23	0	0	0	0	0	2	25
State / Local Govts.	1	0	0	0	0	0	0	1
Total Wisconsin	376	119	68	68	28	25	22	706
U.S. Total	28,889	4,082	2,315	53,814	8,594	8,821	4,221	110,736
WI % of U.S.	1.3%	2.9%	2.9%	0.1%	0.3%	0.3%	0.5%	0.6%

Source: National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2005, 2006, and 2007*, 2008.

R&D data are for the 11 largest R&D supporting agencies only.

* Federally Funded Research and Development Centers. Government-owned, contractor-operated laboratories.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

Sidebar: **Committee on Institutional Cooperation Universities**

The Committee on Institutional Cooperation (CIC) is a consortium of 12 primarily Midwestern research universities, including the 11 members of the Big Ten Conference and the University of Chicago. Together, the CIC universities are a major force in federally funded R&D, as shown in Table 6, and are major economic presences in their local communities, collectively employing 33,000 full-time faculty and educating nearly half a million students. Together, these 12 universities perform \$6.5 billion in R&D from all funding sources (2006 data).

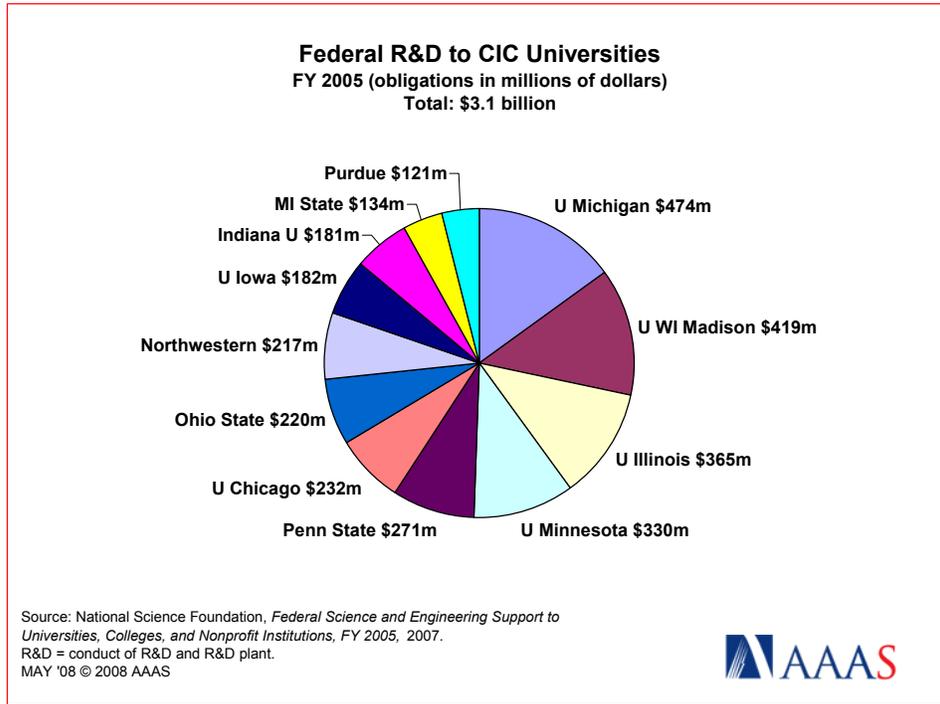


Chart 7.

The CIC institutions collectively received \$3.1 billion in federal R&D funds in FY 2005, 12 percent of all federal R&D to universities and colleges from just 12 institutions. All 12 CIC institutions are ranked among the top 100 university recipients of federal R&D, and all receive more than \$100 million annually in federal R&D funding (see Chart 7). In addition, they collectively received \$430 million in industry R&D funding in 2006.

HHS supported 60 percent of total federal R&D to CIC institutions, with \$1.9 billion in support (see Chart 8). NSF is the second largest funding source with 19 percent totaling \$598 million; CIC institutions are especially competitive for NSF funds and won 18 percent of all NSF funding to universities. DOD, DOE, and USDA are also major supporters of R&D at CIC institutions, each sending more than \$100 million annually for R&D activities.

The University of Michigan (\$474 million) and the University of Wisconsin Madison (\$419 million) lead the pack in federal R&D funds received, with each school winning more than \$400 million annually. Combined with the University of Illinois (Chicago and Urbana-Champaign) and the University of Minnesota, the four top CIC institutions account for more than half the federal R&D funding going to the 12 CIC institutions combined. Penn State, outside the Midwest but a member of the CIC, is the fifth-ranked CIC institution.

Although NIH is the dominant federal funding source for most of the schools, with the University of Michigan ranking 9th among top university recipients of NIH R&D, there are other pockets of strength in

the CIC. Penn State is especially competitive for DOD funds, receiving \$93 million in FY 2005 to be the 2nd largest university recipient of DOD R&D funding. The University of Illinois and the University of Wisconsin Madison both receive more than \$100 million annually from NSF and rank among the top 10 recipients of NSF R&D funds. Madison is also the 3rd largest university recipient of DOE R&D funds with \$26 million in FY 2005, followed closely by the University of Illinois with \$20 million. And Michigan State is the 3rd largest university recipient of USDA R&D funds with \$23 million, just behind Iowa State University at #1 with \$25 million. The fledgling Department of Homeland Security (DHS), just starting up its extramural R&D program, made the University of Michigan its 2nd largest university recipient of R&D funds in 2005.

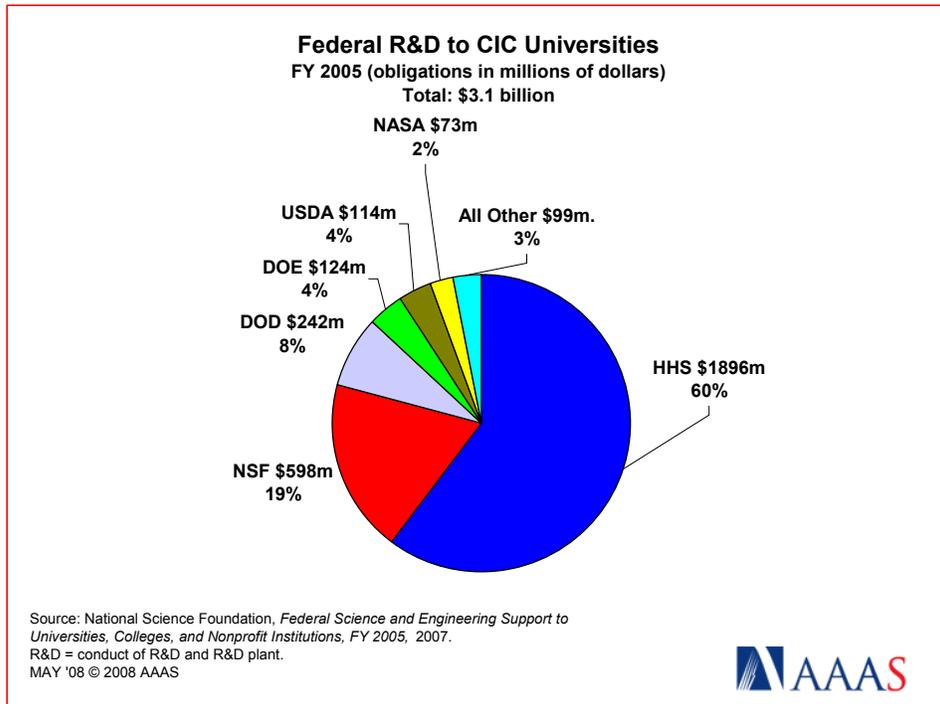


Chart 8.

**Table 6. Federal R&D to Committee on Institutional Cooperation Universities,
Fiscal Year 2005**
(obligations in millions of dollars)

	HHS	NSF	DOD	DOE	USDA	NASA	other	TOTAL
U Michigan (5)	350	62	25	14	1	11	10	474
U WI Madison (10)	239	110	15	26	16	9	4	419
U Illinois (38, 49)*	185	100	30	20	16	6	8	365
U Minnesota (18)	221	46	19	7	13	6	17	330
Penn State (24)	84	47	93	13	15	12	6	271
U Chicago (30)	169	45	2	4	1	2	8	232
Ohio State (32)	117	36	14	9	16	6	23	220
Northwestern (34)	158	27	15	8	0	3	6	217
U Iowa (41)	160	9	7	1	0	4	2	182
Indiana U (46)	133	31	7	4	0	2	3	181
MI State (55)	40	46	4	11	23	4	7	134
Purdue (64)	40	37	12	7	12	8	6	121
Total CIC	1,896	598	242	124	114	73	99	3,145
U.S. Total	16,005	3,328	2,504	940	727	1,091	838	25,433
CIC % of U.S.	11.8%	18.0%	9.7%	13.2%	15.7%	6.7%	11.8%	12.4%

Source: National Science Foundation, *Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2005*, 2007.

Figures may differ from other tables because of differing survey methods.

Figures in parentheses denote national rank among universities and colleges in federal R&D funds received.

R&D = conduct of R&D and R&D plant (facilities and capital equipment).

* - Urbana-Champaign and Chicago ranked separately.

Appendix 1: **Definitions and Notes**

Unless otherwise indicated, all dollar figures in this report refer to research and development (R&D), which includes both the conduct of R&D and support for R&D facilities.

This report uses the National Science Foundation's definitions for R&D. These definitions, which are used by NSF and the Office of Management and Budget (OMB) in the collection of federal government statistics for R&D, are below. AAAS also uses these definitions.

Research is systematic study directed toward more complete scientific knowledge or understanding of the subject studied. The federal government classifies research as either basic or applied according to the objective of the sponsoring agency.

- In **basic research** the objective is to gain knowledge or understanding of phenomena without specific applications in mind.
- In **applied research** the objective is to gain knowledge or understanding necessary for meeting a specific need.

Development is the systematic use of the knowledge or understanding gained from research directed toward the production of materials; devices; systems; or methods, including design, development, and improvement of prototypes and new processes. It excludes quality control, routine product testing, and production.

R&D funding normally includes those personnel, program supervision, and administrative support costs directly associated with R&D activities. Laboratory equipment is also included. Defense R&D also includes testing, evaluation, prototype development, and other activities that precede actual production.

Funding for **R&D facilities** (also known as R&D plant) includes construction, repair, or alteration of physical plant (e.g., reactors, wind tunnels, particle accelerators, or laboratories) used in the conduct of R&D (R&D facilities construction). It also includes major capital equipment used for R&D.

Figures may vary between tables. Data are collected using a variety of surveys which yield data that are not always perfectly consistent. In particular, for the state R&D surveys some surveys collect data from the top 11 federal R&D funding agencies, while other surveys include more federal agencies. Some data are collected by surveying the sources of R&D funds (such as federal agencies) while other data are based on a survey of recipients. Please refer to the original source for complete information on how the data are collected.

(Definitions adapted from National Science Foundation, *Federal R&D Funding by Budget Function: Fiscal Years 2007-2009*, Arlington, VA, 2008.)

Appendix 2: **Related Publications**

AAAS Report XXXIII: Research and Development FY 2009, Intersociety Working Group, 2008. AAAS Publication Number 08-1A. \$19.95; \$15.96 for AAAS members. Available online at <http://www.aaas.org/spp/rd/rd09main.htm> (The latest edition of the annual AAAS report on R&D in the federal budget.)

The above publication may be ordered online from the AAAS R&D web site's Publications page:

<http://www.aaas.org/spp/rd/pubs.htm>

AAAS World Wide Web Site

Updated information on federal funding for R&D, including the complete text of this publication and the other publications listed above, is available on the AAAS R&D Budget and Policy Program home page at: <http://www.aaas.org/spp/rd>

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