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Michigan's University Research Corridor

Second Annual Economic Impact Report

Commissioned by Michigan's University Research Corridor

Michigan State University
University of Michigan
Wayne State University

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Summary of Findings

The University Research Corridor (URC) is an alliance of Michigan's three largest academic institutions: Michigan State University, the University of Michigan, and Wayne State University. In 2007 the URC universities asked Anderson Economic Group to undertake the first comprehensive study that benchmarks the economic impact of the URC's activities on Michigan's economy. This 2008 report is the second in a series of annual reports. While many benchmarks will likely not show large changes from year to year, over time these reports will reveal trends. We present the key findings of our analysis in Table 1 below, and in the remainder of this section.

TABLE 1. Key Benchmarks of the URC

	2007 Report	2008 Report	Change
Operational Expenditures	$6.5 Billion	$6.7 Billion	+ $0.2 Billion
Enrollment	133,331	135,816	+ 2,485
Net Economic Impact	$12.868 Billion	$13.322 Billion	+ $453.5 Million
Fiscal Impact on MI	$351.5 Million	$372.0 Million	+ $20.5 Million
Total R&D Expenditures	$1.369 Billion	$1.379 Billion	+ $10 Million
Rank among 7 Peer University Clusters:			
R&D Expenditures	4	5	- 1
Patent Grants	5	4	+ 1
Technology Licenses	6	5	+ 1

Analysis by Anderson Economic Group, LLC.
See remainder of report body for detailed sources and calculations.

URC STUDENTS

The URC had 135,816 students enrolled in the fall of 2007. This is an increase of 5.8% from the fall of 2001, and 1.9% higher than 2006. The students at the URC universities are drawn from throughout Michigan and around the world. Students from Michigan accounted for 77% of total enrollment in the fall of 2007, while 14% came from elsewhere in the U.S. and the remaining 9% came from other countries or territories. The URC has students from every county in Michigan, every state, and more than 150 countries. See "URC Students and Alumni" on page 5 for our complete analysis.

SCALE OF THE URC

The URC universities collectively spent $6.7 billion on operations in FY 2007. The $6.7 billion was used to pay the salaries of 48,760 full-time-equivalent staff and faculty, purchase supplies and equipment, and maintain buildings. This figure—$6.7 billion—is about 2% of all economic activity in the state, as measured by Michigan's Gross State Product.

In 2008, there were 552,320 known alums of a URC university living in Michigan, making up 7.2% of Michigan's population over the age of 18 years. These alums earned an estimated $25.2 billion in salary and wages in 2007, or 13.3% of all wage and salary income in Michigan. See Table 2 below for the scale of the URC.

TABLE 2. Scale of the URC, FY 2007

Category	Impact
Operational Expenditures (e.g. supplies, payroll, equipment)	$6.7 billion
Full-Time-Equivalent Employees	48,760
Enrolled Students	135,816
Known Alumni Living in Michigan	552,320
Wage and Salary Earnings of URC Alumni in Michigan	$25.2 billion

Base Data Sources: National Center for Education Statistics, IPEDS; URC Universities
Analysis: Anderson Economic Group, LLC

ECONOMIC IMPACT

We define *net economic impact* as the additional earnings to state residents caused by the operation of these institutions. In calculating the net economic impact, we follow a careful methodology that counts expenditures only once, takes into account substitution of one activity within the state by another, and uses very conservative multipliers for indirectly-caused activity. Among other conservative assumptions, we assume most URC students would attend college even if these research institutions were not located in Michigan, and that many employees of the URC would find other jobs in Michigan even if the URC institutions were not located here. We detail our methodology for the economic impact of the operational expenditures by URC universities in “Operational Expenditures Methodology” in Appendix B.

In FY 2007, Michigan’s residents were over $13.3 billion richer due to the URC. These new earnings to Michigan residents stem from expenditures by the URC universities on non-payroll items (such as supplies and equipment) and by employees, students, and alumni. We were careful only to include expenditures by URC employees, students, and alumni directly caused by the URC. This net economic impact figure—7.2% of all wage and salary income in Michigan—takes into account the economic activity that would have occurred in Michigan even without the URC. See Table 3 below.

In addition to $13.3 billion in new earnings, the URC generated 69,285 jobs in Michigan. Our complete analysis is in “Impact on Jobs and Income” on page 34.

TABLE 3. Net Economic Impact of URC, FY 2007

Impact Category	New Earnings in Michigan (millions)	
Non-payroll Operating Expenditures	$2,079.4	
University of Michigan Hospital Non-payroll Operating	$708.5	
Faculty & Staff Wages and Benefits	$3,909.7	
URC Student Expenditures	$1,599.0	
Subtotal: Impact of Operations		$8,296.6
Incremental Alumni Earnings		$5,025.1
TOTAL ECONOMIC IMPACT		**$13,321.7**

Source: Anderson Economic Group, LLC

FISCAL IMPACT

In 2007, we estimate that $2.42 billion in wages of URC employees and over $5 billion of the $25.2 billion in URC alumni earnings in Michigan was caused by the URC. We estimate that the tax revenue the state received because of these earnings, that otherwise would not exist in the state, is $372 million, up from our estimate of $351.6 million in last year's report.

This includes new tax revenue the state receives from personal income, sales and use, property, and gasoline taxes. Our complete analysis can be found in section VI, "Impact on State Revenue" on page 39.

COMPARISON WITH PEER UNIVERSITY CLUSTERS

To benchmark the URC against other university clusters in the nation, we selected a handful of the best-known groups of universities in California (North and South), Illinois, Massachusetts, North Carolina, and Pennsylvania. All of these clusters have three universities from the same state and are well known for their research and development activities. For example, the Northern California cluster includes UC San Francisco, UC Berkeley, and Stanford University; the North Carolina cluster includes Duke, University of North Carolina at Chapel Hill, and NC State; and the Massachusetts cluster includes MIT, Harvard, and Tufts. (See "Comparison with Peer University Clusters" on page 16 for a complete list of the comparison university clusters.)

Student Enrollment and Completions. The URC's 133,620 students in the fall of 2006 make it the largest research university cluster, in terms of enrollment, in our analysis.[1] The next largest is the Pennsylvania cluster (University of Pittsburgh, Pennsylvania State University, and Carnegie Mellon University) with just under 125,000 students enrolled in the fall of 2006.

1. Analysis compares peer university clusters is for 2006 based on data available at the time of this document's publication. Note that some university systems have many campuses and vary in how they count total enrolment such that it is difficult to get a perfect comparison. Nevertheless, tracking these figures over time will reveal trends in these benchmarks.

The URC universities award a variety of degrees each academic year. In terms of number of degrees granted, the URC ranks #1 in total number of degrees conferred in *Physical Science, Agriculture and Natural Resources* and *Medicine and Biological Science*. The URC is in the top three in total number of degrees awarded in *Engineering* and *Math and Computer Science*, *Business Management and Law, and Medicine and Biological Science.*

R&D Expenditures. In 2006, academic institutions in Michigan spent $1.47 billion on research and development, with the URC universities spending 94% of this amount, or $1.38 billion. Approximately 62% of funding for these R&D expenditures came from federal sources. In other words, the URC universities brought $855 million in federal dollars into the state of Michigan for research.

In 2006, the URC spent less on R&D than the California, North Carolina, and Pennsylvania clusters but more than the other two. The URC universities receive a smaller percentage of their funding from federal sources than all clusters except North Carolina, and rely on institutional funds for a significantly higher proportion of their R&D expenditures than all six comparison clusters. See Table 4 on page iv and "Comparison with Peer University Clusters" on page 16.

TABLE 4. Total Research and Development Expenditures, 2006

University Cluster	Total Expenditures (in millions)	Federally Funded Expenditures	Federal Share of Total Expenditures	Institutional Share of Total Expenditures
Michigan's URC	**$1,379**	**$855**	**62%**	**24%**
Northern California	$2,021	$1,273	63%	16%
Southern California	$2,016	$1,290	64%	19%
Illinois	$1,201	$769	64%	23%
Massachusetts	$1,183	$970	82%	2%
North Carolina	$1,432	$874	61%	16%
Pennsylvania	$1,387	$971	70%	13%
All U.S. Universities	*$47,760*	*$30,089*	*63%*	*19%*

Source: National Science Foundation, Integrated Science and Engineering Resources Data System

Analysis: Anderson Economic Group, LLC

Tech Transfers. An important indictor of the success of university research and development is its effectiveness at transferring technology to the private sector. In terms of volume, the URC ranks fourth in average annual number of invention disclosures and patents, and fifth in number of licenses granted. In terms of effectiveness of R&D expenditures, as measured by licensing revenue per expenditure, the URC is better than all comparison clusters except Northern California, Illinois, and Massachusetts. This means that a higher percentage of URC expenditures result in a product that is licensed and sold than three of the other comparison clusters. See Table 5 below.

TABLE 5. Average Annual Patent and Licensing Activity, 2002-2007

	Invention Disclosures	Patent Grants	Licenses/Options	Licensing Revenue (in millions)	Revenues per Expenditures
Michigan's URC	**454**	**126**	**122**	**36**	**2.6%**
Northern California	655	202	181	158	7.8%
Southern California	652	124	134	35	1.7%
Illinois	422	129	104	33.5	2.8%
Massachusetts	679	204	194	60	5.1%
North Carolina	382	71	119	6	0.4%
Pennsylvania	406	114	139	13.5	1.0%

Source: Universities' websites, Association of University Technology Managers 2005 Survey

ALTERNATIVE ENERGY IN THE URC

Research and Training Capacity. URC research facilities provide infrastructure and the expert knowledge base needed to advance alternative energy technologies. URC researchers are working in all areas of alternative energy, from solar and wind power to fuel cell and battery storage technology. Additionally, all three of the universities are working to provide training opportunities and degree programs for future alternative energy professionals.

Alternative Energy R&D. In 2007, the URC universities were granted more than $79.5 million for research and development for alternative energy. Some highlights of URC alternative energy research efforts include:

- **A Breadth of Alternative Energy Topics.** While this includes a diverse set of research topics, more than half of the grants were designated toward projects that focused on fuels (33%) or propulsion and power (25%). See "URC Alternative Energy Research and Development by Category, 2007" on page 28.
- **Success in Earning Federal Grants.** The majority of the grants received for alternative energy were issued by the federal government (71%). That is $56.8 million from federal agencies brought to the state for alternative energy research.
- **Securing Private Research Funding.** Private funding from 41 sources, including General Motors, Shell Oil Company, DTE Energy, Ford Motor Co., and Toyota, make up 11% of the awards or $8.4 million. Much of the alternative energy research done at the URC is in collaboration with the automotive industry.
- **Collaboration with the Auto Industry.** In 2007, the auto industry collaborated with the URC on $2.5 million in alternative energy research projects.

Economic Implications. Alternative energy R&D has led to innovations in technology with potential commercial value. Commercialization of these technologies helps the state diversify its economy to include the growing field of alternative energy industries. For example, U-M researchers have formed companies that support the solar and wind turbine industries. The research done at MSU's Great Lakes Bio-energy Research Center was a factor in Mascoma Corporation's decision to build one of the nation's first commercial wood-based bio-refineries in Michigan. Such initiatives will help Michigan build on the existing knowledge base and manufacturing infrastructure to attract companies to the state.

I. Introduction

WHAT IS MICHIGAN'S UNIVERSITY RESEARCH CORRIDOR?

The University Research Corridor (URC) is an alliance of Michigan's three largest academic institutions: Michigan State University, the University of Michigan, and Wayne State University. The purpose of this alliance is to accelerate economic development in Michigan by educating students, attracting talented workers to Michigan, supporting innovation, and encouraging the transfer of technology to the private sector.

The URC universities are present in communities throughout the state. Michigan State University is located in East Lansing, in close proximity to the state's capital. The University of Michigan's main campus is in Ann Arbor with branch campuses in Flint and Dearborn. Wayne State University is located in Detroit, the largest city in the state. Each URC university has research and teaching locations and partner hospitals located throughout the state, as shown by the map on page 4.

REPORT PURPOSE & FOCUS

Michigan's University Research Corridor universities asked Anderson Economic Group to undertake a comprehensive study that quantifies the economic impact of the URC's activities on the state of Michigan's economy. This report is to be the second in a series of annual reports and is intended to measure and benchmark the contributions of the URC universities to the state. The information in this report will help readers understand how the URC universities spend their time and money and track the URC's performance year-to-year.

We selected six comparison university clusters in five states. We compared Michigan's URC with some of the best universities (public and private) in each of these states. We present the list of peer university clusters in Table 6 below.

TABLE 6. Comparison Peer University Clusters

Michigan's URC	Michigan State University	University of Michigan	Wayne State University
Northern California	University of California, San Francisco	University of California, Berkeley	Stanford University
Southern California	University of California, Los Angeles	University of California, San Diego	University of Southern California
Illinois	University of Chicago	University of Illinois at Urbana-Champaign	Northwestern University
Massachusetts	Harvard University	Massachusetts Institute of Technology (MIT)	Tufts University
North Carolina	Duke University	University of North Carolina (Chapel Hill)	North Carolina State University
Pennsylvania	Penn State University (all campuses)	University of Pittsburgh (all campuses)	Carnegie Mellon University

Source: Anderson Economic Group, LLC

REPORT METHODOLOGY

In order to quantify the economic impact of the URC's activities, we asked ourselves the following question: What would the loss be to the state if the URC universities left Michigan? We then studied the loss in terms of jobs, earnings, tax revenue, research, and quality of life. The following six chapters of this report provide quantitative measures of how the URC is performing in those areas.

ABOUT THE REPORT'S AUTHORS

Anderson Economic Group, LLC is a consulting firm that specializes in economics, public policy, financial valuation, market research, and land use economics. Anderson Economic Group has completed economic and fiscal impact studies for a variety of public and private sector clients, including Michigan State University and Wayne State University. Brief bios of the report's authors are presented below. See "Appendix C: About the Authors" for bios of all project staff.

Caroline M. Sallee. Ms. Sallee is a Consultant at Anderson Economic Group, working in the Public Policy, Fiscal, and Economic Analysis practice area. Ms. Sallee's background is in applied economics and public finance.

Ms. Sallee's recent work includes an economic impact assessment for Michigan's University Research Corridor (Michigan State University, University of Michigan, and Wayne State University), economic and fiscal impact studies for Michigan State University, and the benchmarking of Michigan's business taxes with other states in a project for the Michigan House of Representatives. She has also completed several technology industry reviews, estimating the wages and employment of technology workers in Southeast Michigan and West Virginia.

Prior to joining Anderson Economic Group, Ms. Sallee worked for the U.S. Government Accountability Office (GAO) as a member of the Education, Workforce and Income Security team. She has also worked as a market analyst for Hábitus, a market research firm in Quito, Ecuador and as a legislative assistant for two U.S. Representatives.

Ms. Sallee holds a Masters degree in Public Policy from the Gerald R. Ford School of Public Policy at the University of Michigan and a Bachelor of Arts degree in economics and history from Augustana College in Illinois.

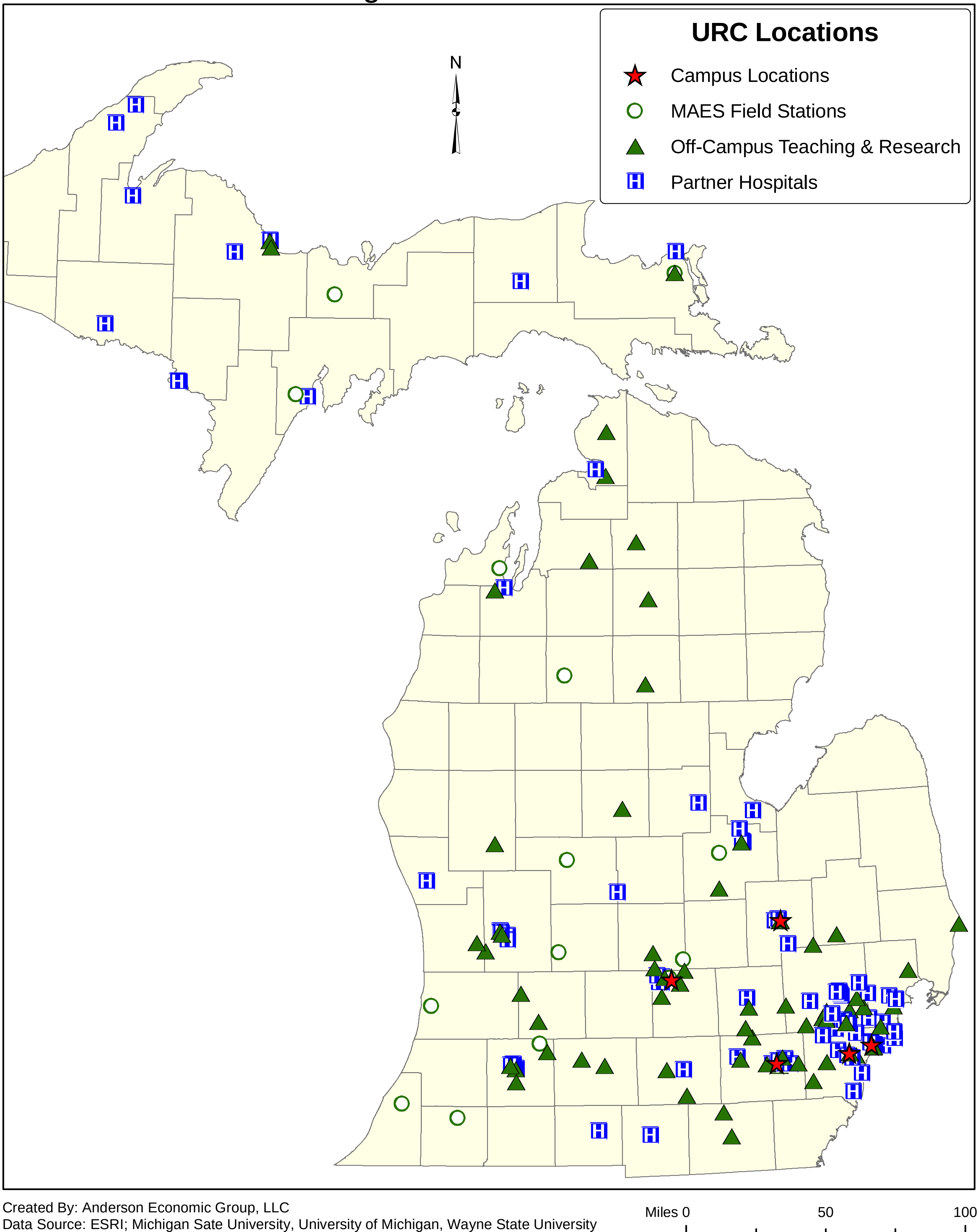
Patrick L. Anderson. Mr. Anderson founded the consulting firm of Anderson Economic Group in 1996, and serves as a Principal and Chief Executive Officer in the company.

Mr. Anderson's views are often cited in news reports throughout the United States, and his articles have been published by The Wall Street Journal, The Detroit News, The Detroit Free Press, American Outlook, Business Economics, and other publications. His book Business Economics and Finance was published in 2004, and his paper on "Pocketbook Issues and the Presidency" was awarded the Edmund Mennis Award for the best contributed paper in 2004 by the National Association for Business Economics. Mr. Anderson also contributed the chapter on commercial damages to the book Litigation Economics, published in 2005, and is the executive editor of the State Economic Handbook 2008.

Prior to founding Anderson Economic Group, Mr. Anderson served as the Chief of Staff of the Michigan Department of State, and as Deputy Budget Director for the State of Michigan under Governor John Engler. Prior to his involvement in State Government, Mr. Anderson served as an officer in Alexander Hamilton Life Insurance, an economist for Manufacturers National Bank of Detroit, and a graduate fellow with the Central Intelligence Agency in Washington DC.

Mr. Anderson is a graduate of the University of Michigan, where he earned a Master's degree in public policy and a Bachelor's degree in political science. He is a member of the National Association for Business Economics and the National Association of Forensic Economists. The Michigan Chamber of Commerce awarded Mr. Anderson its 2006 Leadership Michigan Distinguished Alumni award for his civic and professional accomplishments.

URC's Presence in Michigan



Created By: Anderson Economic Group, LLC
Data Source: ESRI; Michigan Sate University, University of Michigan, Wayne State University
September 2007

II. URC Students and Alumni

URC STUDENT ENROLLMENT

The University Research Corridor had 135,816 students enrolled in the fall of 2007. This represents an increase in enrollment of 7,518 (5.8%) from the fall of 2001, when total URC enrollment was 128,298.

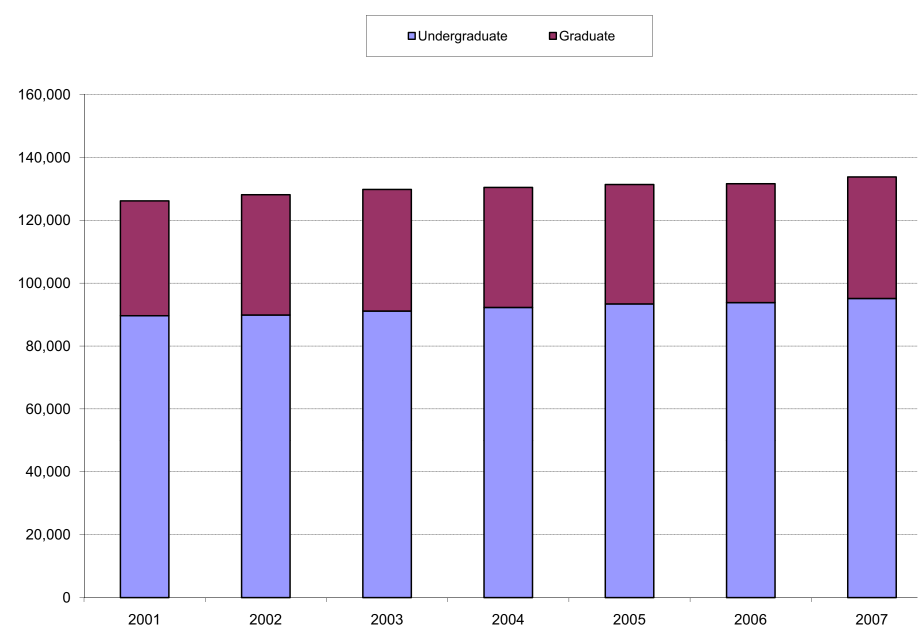
TABLE 6. URC Enrollment, Fall 2001-2007

	2001	2002	2003	2004	2005	2006	2007	2001-2007 CAGR
Undergraduate	89,637	89,871	91,116	92,283	93,397	93,821	95,124	1.00%
Graduate	36,543	38,265	38,698	38,167	37,969	37,814	38,667	0.95%
Other	2,118	2,099	2,024	2,052	1,965	1,985	2,025	-0.75%
TOTAL	128,298	130,235	131,838	132,502	133,331	133,620	135,816	0.95%

Source: Offices of the Registrar—University of Michigan, Michigan State University, Wayne State University.

Approximately 70% of total enrollment is comprised of undergraduate students, 29% graduate students (including doctoral and professional), and 1% enrolled in some other program, such as certificate programs. As shown in Figure 1, the ratio of undergraduate to graduate students has remained constant from 2001 to 2007, while total enrollment has slightly increased.

FIGURE 1. URC Enrollment, Fall 2001-2007



Data Source: *Offices of the Registrar, URC Universities*

Analysis: Anderson Economic Group, LLC

The students at the URC are drawn from throughout Michigan, across the United States, and around the world. Students from Michigan accounted for 77% of total enrollment in fall 2007. Another 14% came from elsewhere in the United States, and the remaining 9% came from other countries or territories. In all, the URC has students from every county in Michigan, every state, and more than 150 different countries. The majority of international students come from China, The Republic of Korea, India, and Canada while others come from as far away as South Africa, Russia, Iran, Finland, and Uruguay.

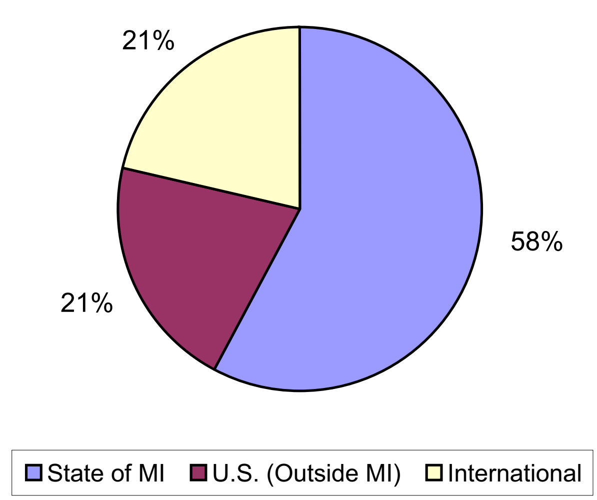
TABLE 7. Origin of URC Students, Fall 2001-2007

	2001	2002	2003	2004	2005	2006	2007
State of Michigan	100,960	100,688	102,888	103,655	103,562	103,868	104,406
Other States	16,743	17,409	17,652	18,036	18,478	18,685	19,740
International and other (including territories)	10,595	12,138	11,298	10,811	11,977	11,067	11,670
TOTAL ENROLLMENT	128,298	130,235	131,838	132,502	134,017	133,620	135,816

Source: Offices of the Registrar—University of Michigan, Michigan State University, Wayne State University

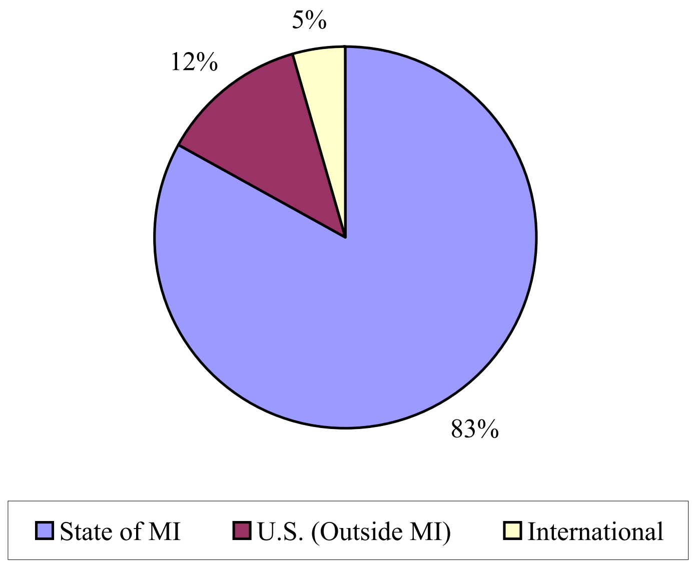
A greater share of the URC's graduate students come from outside the state than the undergraduate student population. As shown in Figure 2 and Figure 3 on page 7, almost half of the URC's graduate students come from outside Michigan, while less than a quarter of the URC's undergraduate student are from outside Michigan. The diversity of student origins within Michigan's schools is important to the state's developing economy and the URC has accomplished that diversity.

FIGURE 2. Origin of URC Graduate Students, Fall 2007



Data Source: *Offices of the Registrar, URC Universities*
Analysis: Anderson Economic Group, LLC

FIGURE 3. Origin of URC Undergraduate Students, Fall 2007



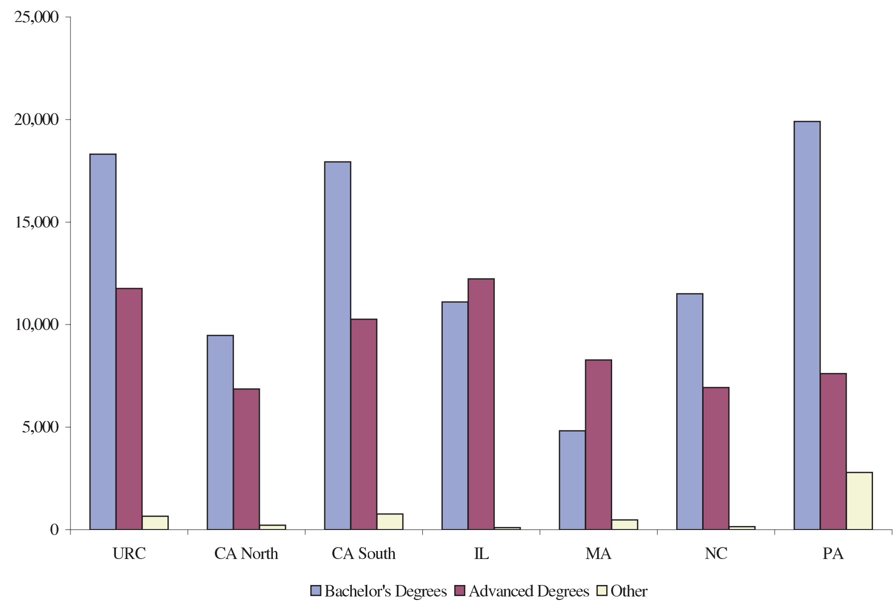
Data Source: *Offices of the Registrar, URC Universities*
Analysis: Anderson Economic Group, LLC

DEGREES GRANTED IN URC AND COMPARISON CLUSTERS

We compared the URC's enrollment and degrees granted with other peer university clusters in five states: California, Illinois, Massachusetts, North Carolina, and Pennsylvania. We present the list of peer university clusters in Table 6 on page 1.

The URC's fall 2006 enrollment of 133,620 students make it the largest research university cluster, in terms of enrollment, of those in our analysis. The next largest is the Pennsylvania cluster, with just under 125,000 students enrolled in fall 2006. As shown in Figure 4, the URC awarded more bachelor's degrees (18,311) than any of the comparison clusters besides Pennsylvania, and were second only to the Illinois cluster in terms of advanced degrees awarded (11,765 versus 12,232).

FIGURE 4. Completions by Type of Degree, 2005-06 academic year



Data Source: National Center for Education Statistics, IPEDS Enrollment
Analysis: Anderson Economic Group, LLC

Total enrollment (undergraduate and graduate) at these university clusters has grown slightly in the past four years. The average annual growth rate for the URC was just over 0.5% during the 5-year period, and most of our comparison university clusters experienced annual growth that was similar to the URC. Graduate and professional enrollment includes master's and Ph.D programs, as well as post-secondary programs that prepare students for licensure in a particular field such as dentistry, law, and medicine. See Table A-1, "Total Enrollment, Fall 2001- 2006," on page A-1 for the enrollment growth rates by university cluster.

The URC ranks first among the university clusters in our study for total number of degrees (undergraduate and graduate) conferred in *Physical Science, Agriculture and Natural Resources*, as well as in *Medicine and Biological Science*. The URC is in the top three in number of *Engineering* and *Math and Computer Science* and *Business Management and Law* degrees awarded.[2] While the URC confers more degrees in medicine, the physical sciences, and business than most of our comparison university clusters, this is partially a result of the URC teaching thousands more students each year overall than these comparison schools.

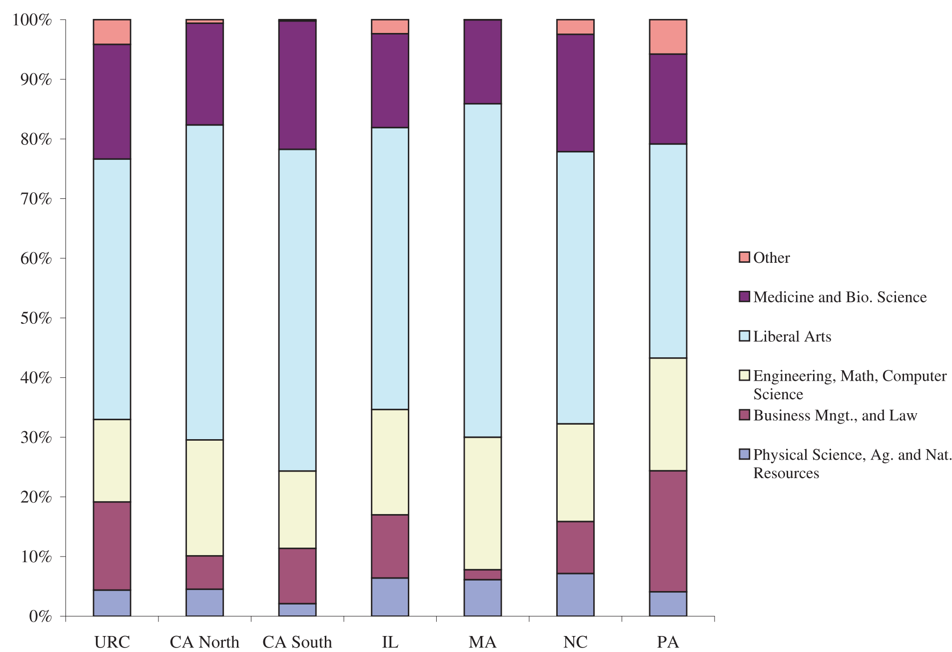
To put the number of degrees awarded into context, Figure 5, "Undergraduate Degrees Conferred by Area, 2005-2006," and Figure 6, "Graduate Degrees Con-

2. See the academic program definitions at the end of this section for information on the composition of each academic program area.

ferred by Area, 2005-2006," illustrate the concentration of type of degree conferred, as measured by the total numbers of degrees awarded during the 2005-06 academic year.

As shown in Figure 5, after accounting for total number of undergraduate degrees conferred, the URC ranks #5 in *Physical Science, Agriculture, and Natural Resources* degrees conferred, #2 in *Business Management and Law*, #6 in *Engineering, Math, Computer Science*, and #3 in *Medicine and Biological Science.* The Southern California university cluster (UCLA, UCSD, USC) ranks first in medical and physical science undergraduate degree share, while Massachusetts is the most concentrated in granting engineering degrees.

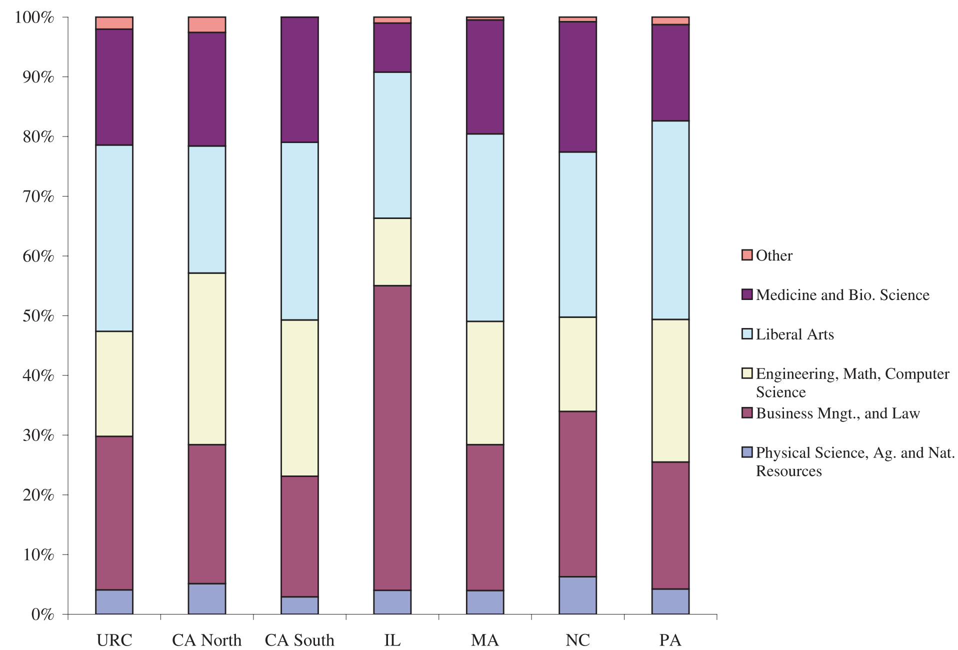
FIGURE 5. Undergraduate Degrees Conferred by Area, 2005-2006



Data Source: National Center for Education Statistics, IPEDS
Analysis: Anderson Economic Group, LLC

As shown in Figure 6, as a share of total graduate degrees conferred, the URC ranks #4 in *Physical Science, Agriculture, and Natural Resources*, #3 in *Business Management and Law*, #5 in *Engineering, Math, Computer Science*, and #3 in *Medicine and Biological Science.* Graduate degrees in the liberal arts make up the largest share of total graduate degrees conferred in the URC.

FIGURE 6. Graduate Degrees Conferred by Area, 2005-2006



Data Source: National Center for Education Statistics, IPEDS
Analysis: Anderson Economic Group, LLC

Academic Program Definitions. The academic program areas used in this section are based on the National Center for Education Statistics (NCES) Classification of Instructional Programs (CIP) codes for 2000. The composition of each program area follows.

The *Physical Science, Agriculture, and Natural Resources* academic program area includes the following fields of study: agriculture, agriculture operations, and related sciences; natural resources and conservation; physical sciences.

The *Business, Management, and Law* academic program area includes the following fields of study: legal professions and studies; business, management, marketing, and related support services.

The *Engineering, Mathematics, and Computer Science* academic program area includes the following fields of study: architecture and related services; computer and information sciences and support services; engineering; mathematics and statistics.

The *Liberal Arts* academic program area includes the following fields of study: area, ethnic, cultural, and gender studies; communication, journalism, and related programs; education; foreign languages, literatures, and linguistics; family and consumer sciences/human sciences; English language and literature/letters; liberal arts and sciences, general studies and humanities; library science; multi/interdisciplinary studies; philosophy and religious studies; theology and religious vocations; public administration and social service professions; social sciences; visual and performing arts; history.

The *Medicine and Biological Science* academic program area includes the following fields of study: biological and biomedical sciences; psychology; health professions and related clinical sciences.

The *Other* academic program area includes the following fields of study: personal and culinary services; parks, recreation, leisure, and fitness studies; security and protective services; construction trades; mechanic and repair technologies/technicians; precision production; transportation and materials moving; undesignated field of study; communications technologies/technicians and support services; engineering technologies/technicians; military technologies; science technologies/technicians.

MEDICAL EDUCATION IN THE URC

Medical Schools. The URC sponsors the only medical schools in the state of Michigan that provide Doctor of Medicine (M.D.) and Doctor of Osteopathic Medicine (D.O.) degrees. Michigan's URC has four medical schools. All three Research Corridor universities have allopathic (M.D.) medical schools and Michigan State has an osteopathic (D.O.) medical school.

These medical schools train students through a combination of classes taught on campus and in clinical settings. Students typically spend the first two years of their medical education in a classroom on campus and the next two years in clerkships at hospitals located throughout Michigan. For example, Michigan State's College of Human Medicine has students at six community campuses, five of which are located outside East Lansing. MSU's College of Osteopathic Medicine has 13 partner hospitals in which they place third- and fourth-year medical students. University of Michigan trains students primarily in its own hospital and health centers and in other locations in Southeast Michigan. Wayne State trains many students in hospitals close to its medical school in Detroit.

In 2006, Michigan's URC graduated 647 students from its medical schools, growing 1.2% since 2005. As shown in "Completions and Awards by Academic Program Area, 2005-06 academic year" on page A-2, URC institutions graduate the most students in medicine and biological science compared to the other university clusters in this report.[3]

3. The *Medicine and Biological Science* academic program area includes the following fields of study: Biological and biomedical sciences; psychology; health professions and related clinical sciences.

TABLE 8. URC Medical School Graduates, 2000-2006

University	Degree Granted	2000	2005	2006	% Change from 2005
Michigan State University	M.D.	102	117	120	*2.6%*
Michigan State University	D.O.	107	122	138	*13.1%*
University of Michigan	M.D.	160	162	165	*1.8%*
Wayne State University	M.D.	243	238	224	*-5.9%*
TOTAL	M.D. & D.O.	612	639	647	*1.2%*

Source: National Center for Education Statistics, IPEDS
Analysis: Anderson Economic Group, LLC

Dentistry Program. The University of Michigan School of Dentistry offers students a Doctor of Dental Surgery (DDS) program and a dental hygiene program.[4] In addition, the school teaches all specialty programs (endodontics, oral and maxillofacial surgery, orthodontics, oral diagnosis, oral pathology, pediatric dentistry, and periodontics) and continuing education programs for practicing dentists.

In 2006, the University of Michigan School of Dentistry program graduated 111 students with a DDS degree. The same year, 36 students graduated with a dental hygienist degree. See Table 9 below.

TABLE 9. Graduates from the University of Michigan School of Dentistry

Program	2000	2005	2006	Change 2005-2006
Dentistry (DDS)	95	104	111	*7*
Dental Hygiene (Bachelor's and Master's Degree)	28	27	36	*9*
TOTAL	123	131	147	*16*

Source: National Center for Education Statistics, IPEDS
Analysis: Anderson Economic Group, LLC

Veterinary Medicine. Michigan State University hosts the only school of veterinary medicine in the state and one of only 28 veterinary schools in the country.[5] Its College of Veterinary Medicine offers a four-year Doctor of Veterinary Medicine (DVM) degree requiring five semesters of classroom training and four semesters of

4. The DDS (Doctor of Dental Surgery) and DMD (Doctor of Dental Medicine) are the same degree. The majority of dental schools award the DDS degree; however, some award a DMD degree. The amount of education required for the degrees and the essence of the degrees are the same.
5. Information provided by MSU's College of Veterinary Medicine.

clinical work. Third- and fourth-year veterinary students spend three weeks in equine and food-animal practices throughout Michigan to experience the daily routine of large-animal practice.[6]

As seen in Table 10 below, the college has issued 214 students a Doctorate in Veterinary Medicine in 2005 and 2006. The college also operates the Veterinary Teaching Hospital (VTH), the only tertiary referral center for veterinary medicine in the state of Michigan. Every year, the VTH sees more than 24,000 animals from all parts of the state.

TABLE 10. Graduates from Michigan State's College of Veterinary Medicine

Program	2000	2005	2006	Change 2000-2006
Veterinary Medicine (DVM)	106	110	104	-6
Veterinary Biomedical and Clinical Sciences - Master's Degree	0	6	1	-5
Veterinary Biomedical and Clinical Sciences - Doctor's Degree	0	4	4	0
Total Degrees Granted	106	120	109	-11

Source: National Center for Education Statistics

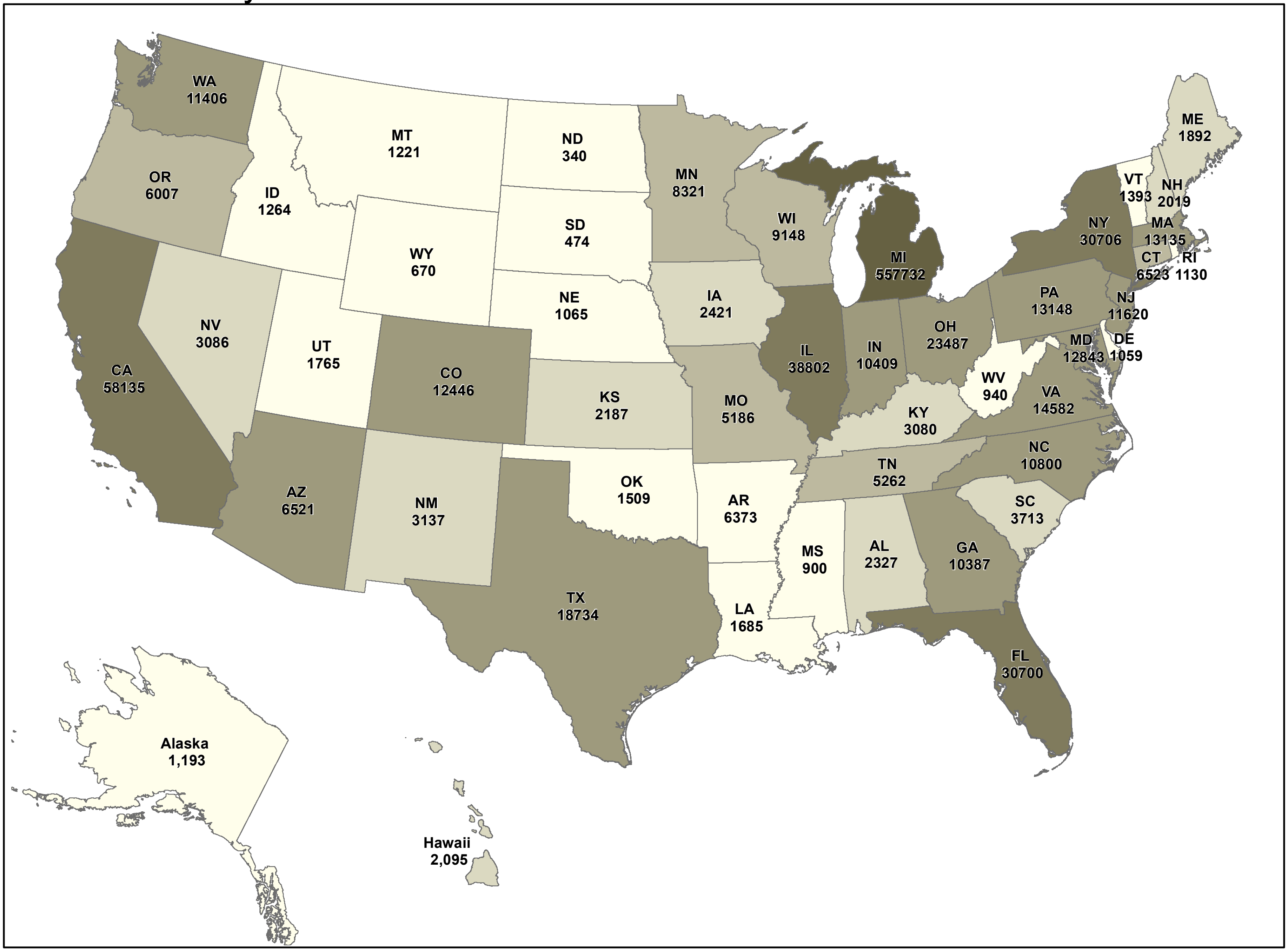
The college houses over 15 research centers and facilities, through which it provides research and service programs. In particular, the college's Diagnostic Center for Population and Animal Health runs over 1.5 million tests a year to provide an early warning system for impending epidemics; to identify infectious animal disease, contaminants, and regulatory diseases, and to diagnose nutritional diseases. The Veterinary Extension within the college focuses on solving and preventing animal health management problems to ensure its safety for human consumption. The program is currently researching Johnes Disease, Avian Influenza, and Mad Cow Disease.[7]

NUMBER OF URC ALUMNI

As of the academic year ending in May 2007, there were 552,320 URC alumni living in Michigan, making up 7.3% of Michigan's population over the age of 18 years.[8] URC universities currently have alumni in every state in the U.S. (see "URC Alumni by State, 2007" on page 14), and in every county in Michigan (see "URC Alumni by Michigan County, 2006" on page 15.

8. According to the U.S. Census Bureau's American Factfinder estimate, Michigan had 7,618,222 residents over age 18 in 2006 (the most recent year for which an estimate available).

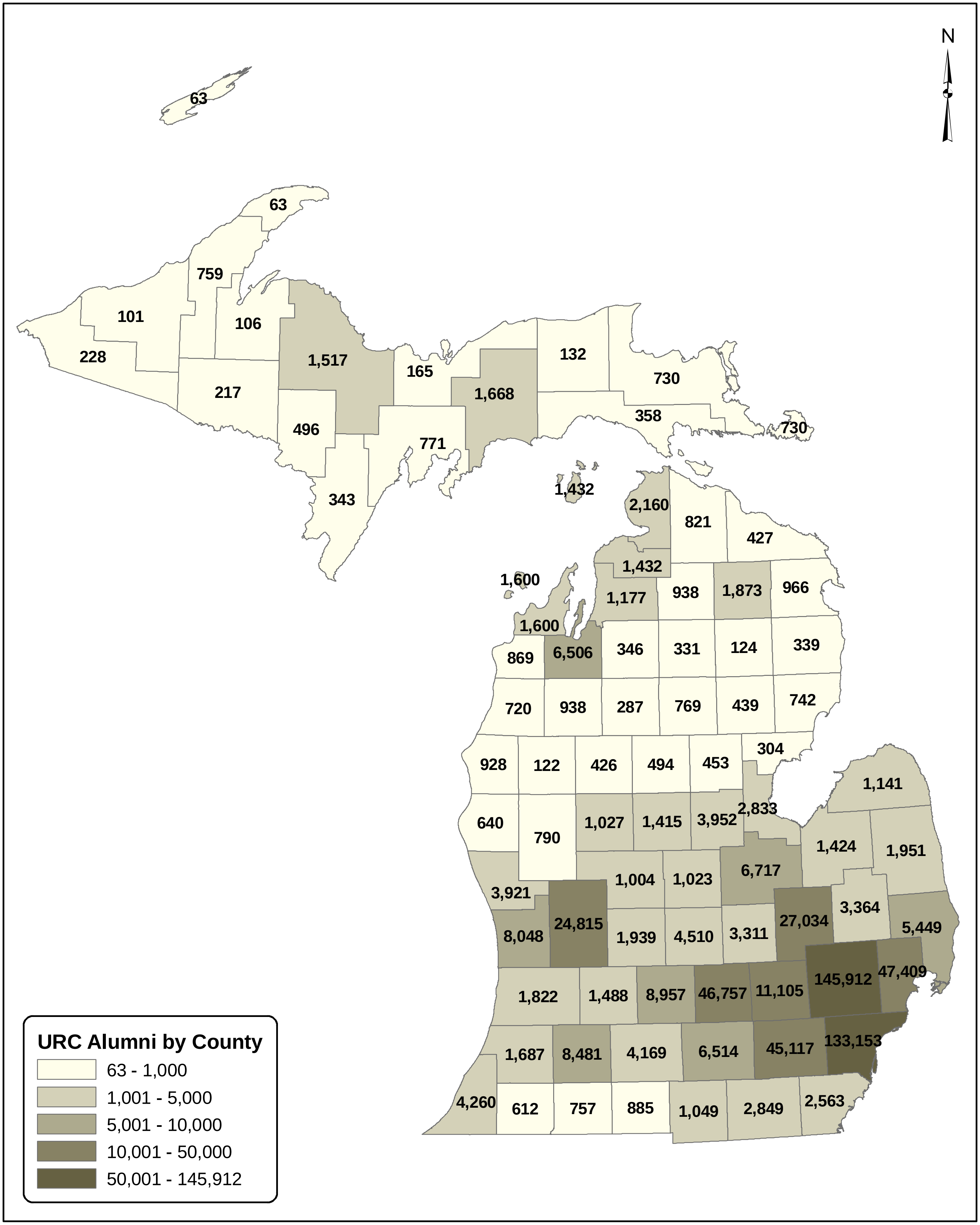
URC Alumni by State



Created By: Anderson Economic Group, LLC
Data Source: ESRI; University Alumni Associations
September 2008

Miles 0 500 1,000 2,000

URC Alumni by County



Data: ESRI, Inc. 2007; analysis by Anderson Economic Group, LLC

III. Comparison with Peer University Clusters

COMPARISON PEER UNIVERSITY CLUSTERS

To judge how the URC compares with other university clusters in the nation, we selected a handful of the best-known groups of universities in California (North and South), Illinois, Massachusetts, North Carolina, and Pennsylvania. Each of these clusters has three universities from the same state and are well known for their research and development activities. We present the list of peer university clusters in Table 11 below.

TABLE 11. Comparison Research University Clusters

Michigan's URC	Michigan State University	University of Michigan (all campuses)	Wayne State University
Northern California	University of California, San Francisco	University of California, Berkeley	Stanford University
Southern California	University of California, Los Angeles	University of California, San Diego	University of Southern California
Illinois	University of Chicago	University of Illinois at Urbana-Champaign	Northwestern University
Massachusetts	Harvard University	Massachusetts Institute of Technology (MIT) - Excludes Lincoln Lab	Tufts University
North Carolina	Duke University	University of North Carolina (Chapel Hill)	North Carolina State University
Pennsylvania	Penn State University (all campuses)	University of Pittsburgh (all campuses)	Carnegie Mellon University

Source: Anderson Economic Group, LLC

ACADEMIC R&D EXPENDITURES

We first compared the research and development expenditures for each of the clusters. In relation to the comparable university clusters, the URC has received less federal funding as a percentage of total than all the clusters except North Carolina. The URC relies on institutional funds for a significantly higher proportion of its R&D spending than the other six comparison clusters.[9] See Table 12 on page 17.

9. Data is from the National Science Foundation Integrated Science and Engineering Resources Data System.The spending reported by MIT to the NSF does not include spending for the Lincoln Lab, which, according to MIT's Technology Licensing Office, is approximately $500 million but is not classified as academic R&D. Lincoln Lab includes communications, space surveillance, missile defense, tactical surveillance systems, and air traffic control.

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TABLE 12. Source of Funding for R&D Expenditures (in millions), 2006

	Total R&D Expenditures	Federal Government	State & Local Government	Industry	Institution	Other
Michigan's URC	**$1,379**	**62%**	**5%**	**4%**	**24%**	**5%**
Northern California	$2,021	63%	3%	5%	16%	14%
Southern California	$2,016	64%	2%	4%	19%	11%
Illinois	$1,201	64%	4%	2%	23%	7%
Massachusetts	$1,183	82%	0%	8%	2%	8%
North Carolina	$1,432	61%	9%	13%	16%	2%
Pennsylvania	$1,387	70%	6%	8%	13%	2%
All U.S. Universities	*$47,760*	*63%*	*6%*	*5%*	*19%*	*7%*

Source: National Science Foundation: Integrated Science and Engineering Resources Data System

Note: 2006 data is the most recent available from this source. Our 2007 annual report reported 2005 data.

Analysis: Anderson Economic Group, LLC

In 2006, the URC had the fourth highest R&D spending of seven university clusters at $1.38 billion. As shown in Table 13 on page 17, the URC's R&D expenditures grew at a slower rate between 2005 and 2006 than every cluster except Northern California, which had a negative growth rate. While Michigan's six-year annual growth rate is not significantly behind the other clusters, slower growth in the last couple years could place Michigan further behind in terms of R&D expenditures

TABLE 13. Growth in Total Academic R&D Expenditures

	Annual Growth 2000 - 2006 (CAGR)	Annual Growth 2005 - 2006
Michigan's URC	**7.7%**	**0.8%**
Northern California	8.2%	-0.1%
Southern California	8.3%	3.3%
Illinois	7.6%	1.7%
Massachusetts	7.2%	2.1%
North Carolina	8.0%	4.2%
Pennsylvania	8.0%	2.8%
All U.S. Universities	*15.1%*	*4.3%*

Source: NSF, Integrated Science and Engineering Resources Data System

Analysis: Anderson Economic Group, LLC

Share of science and engineering R&D expenditures for the URC is fairly consistent with U.S. university averages. As shown in Table 14 on page 18, there was slightly higher than average spending (as a percentage of total spending) for life and social sciences and slightly lower than average spending for environmental sciences. The seven comparison university clusters deviated significantly from the U.S. average for life sciences; the North Carolina and Northern California clusters spent significantly more, and the other university clusters spent significantly less. Furthermore, Massachusetts, Illinois and Northern California spent more on the physical sciences.

TABLE 14. Share of Total R&D Expenditures by Science and Engineering Fields, 2006

	Environmental Sciences[a]	Life Sciences[b]	Math & Computer Sciences	Physical Sciences[c]	Psychology	Social Sciences[d]	Sciences, Other	Engineering[e]
Michigan's URC	**1%**	**64%**	**2%**	**8%**	**2%**	**9%**	**0%**	**14%**
Northern California	1%	66%	2%	10%	1%	3%	2%	15%
Southern California	8%	63%	10	6%	1%	3%	1%	9%
Illinois	4%	54%	9%	11%	2%	3%	1%	16%
Massachusetts	5%	50%	5%	14%	1%	3%	2%	21%
North Carolina	3%	74%	3%	5%	1%	4%	1%	9%
Pennsylvania	4%	48%	12%	7%	3%	3%	1%	23%
All U.S. Universities	*5%*	*60%*	*4%*	*8%*	*2%*	*4%*	*2%*	*15%*

Source: National Science Foundation, Survey of Research and Development Expenditures at Universities and Colleges, FY 2004.

Analysis: Anderson Economic Group, LLC

a. Environmental sciences includes atmospheric and earth sciences, oceanography and other miscellaneous environmental sciences.
b. Life sciences includes agricultural, biological, medical and other miscellaneous life sciences.
c. Physical sciences includes astronomy, chemistry, physics other miscellaneous physical sciences.
d. Social sciences includes economics, political sciences, sociology and other miscellaneous social sciences.
e. Engineering includes aeronautical, biomedical, bioengineering, chemical, civil, electrical, mechanical. metallurgical, and other.

TECHNOLOGY TRANSFERS

Beyond the direct impact of the initial R&D spending, these innovations also lead to the production and sale of new products and services. The pharmaceutical, medical, computer technology, consumer electronic, telecommunication, agricultural products, and manufacturing industries are among the many industries benefiting from research and development conducted at universities. Research and development is also important to universities for its role in attracting and retaining high quality professors and students, who in turn benefit business enterprises that need a high quality workforce and research partnerships.

The success of academic research and development activities is often measured in terms of technology transfer. Common indicators include R&D expenditures, the number of patent applications filed, and the number of inventions disclosed in a given year. While these statistics show activity, they do not necessarily indicate the effectiveness of the activity. Other statistics, such as the number of patents granted, the number of licenses or options entered into, the royalty revenue, and the number of new start-ups are perhaps more telling indicators of technology transfer. We examined these indicators and attempted to find others to demonstrate the performance of the URC relative to the average U.S. institution and our comparison groups.

Since we have already examined expenditures, we will begin with invention disclosures, which is the process by which the university becomes aware of an innovation and decides whether to apply for a patent. In exchange for the disclosure, the inventor receives some assurance that if his or her idea is successful, the inventor also will benefit.

The URC performs well against the comparison university clusters in terms of its technology transfer activities. It lags behind the Northern California and Massachusetts clusters in invention disclosures, licensing revenue, and patent grants and the California-South cluster in every measure except licensing revenue. In terms of the numbers of new licenses/options, the URC ranked 6th. See Table 15 on page 20.

TABLE 15. Average Annual Patent and Licensing Activity,[a] 2002-2007

	Invention Disclosures	Patent Grants	Licenses/Options	Licensing Revenue (in millions)
Michigan's URC[b]	**454**	**126**	**122**	**$36.3**
Northern California[c]	655	202	181	$158.2
Southern California[d]	652	124	134	$34.7
Illinois[e]	422	129	104	$33.5
Massachusetts[f]	679	204	194	$59.8
North Carolina[g]	382	71	119	$6.2
Pennsylvania[h]	406	114	139	$13.5

Source: Universities' websites, Association of Technology Managers (AUTM) 2002-2006 Surveys

a. Average includes FY2002-2007 data where available. Some reported statistics are based on averages of less than 6 years.

b. Michigan State, the University of Michigan, and Wayne State information was obtained from the URC website.

c. The University of California provided statistics for all their campuses through their Office of Technology and the office's Annual Reports for 2002-2007. Stanford University provided all statistics for 2002-2007 through their website except the number of patents issued, which was provided by their Office of Technology Licensing.

d. The University of California provided statistics for all their campuses through their Office of Technology and the office's Annual Reports for 2002-2007.

e. Northwestern University provided all statistics for 2002-2007 through their website and Technology Transfer Program Office. University of Chicago provided all statistics through their Technology Office Five Year Report and through their office.University of Illinois, Urbana-Champaign provided all statistics through their Office of Technology Management website.

f. MIT, and Tufts reported 2002-2007 data on their websites. Harvard data was collected from their Office of Technology Development and 2005-2006 AUTM surveys. Data was unavailable for Harvard's 2007 disclosures, licensing revenue, and licenses/options.

g. Data for UNC Chapel Hill and NC State University was collected from their Offices of Technology Development. Duke information was provided from the 2002-2006 AUTM surveys. No information was available for Duke in 2007.

h. Data was collected from University of Pittsburgh's Office of Technology Management, Penn State's Intellectual Property office, CMU's Center for Technology Transfer, and 2002-2006 AUTM surveys.

The URC, Massachusetts, and Pennsylvania clusters only have one university in the United States Patent Office's list of the top ten grant-receiving universities in the country for 2005. In contrast, all the universities from the Northern California cluster and two of the three universities from the Southern California cluster are among the top ten grant-receiving universities. These representatives are grouped together in the University of California system. However, neither the North Carolina or Illinois clusters have any representatives on the list, suggesting that though the URC is not the leading cluster in the field of patent grants, it is still a leader in tech transfer activities. See Table 16 below.

TABLE 16. Top 10 Grant-Receiving Universities by First Named Assignee, 2005[a]

	2005 Patent Grants	Rank
University of California, The Regents of	388	1
Massachusetts Institute of Technology	136	2
California Institute of Technology	101	3
Stanford University	90	4
University of Texas	89	5
Wisconsin Alumni Research Foundation	77	6
Johns Hopkins University	71	7
University of Michigan	*71*	*7*
Columbia University	57	9
University of Pennsylvania	43	10

Source: USPTO, "U.S. Colleges and Universities - Utility Patent Grants 1969-2005"

Analysis: Anderson Economic Group, LLC

a. These numbers may differ slightly from the numbers reported by universities as the USPTO only captures the first named assignee.

The URC has helped cultivate an average of 15 start-ups annually between 2002 and 2007. As shown in Table 17 on page 21 this is more than was cultivated by the North Carolina or the Illinois cluster, and fewer than those of the Massachusetts, Northern California, Southern California, and Pennsylvania clusters.

TABLE 17. Average Annual Number of Start-ups[a] Cultivated at University Clusters, 2002-2007

Michigan's URC	**15**
Northern California	31
Southern California	24
Illinois	13
Massachusetts	30
North Carolina	7
Pennsylvania	18

Sources: Universities' websites, AUTM [b]

a. Average includes 2002-2007 data where available. Some universities and some reported statistics are based on averages of less than 6 years. See footnotes in Table 15 on page 20 for data limitations.

b. See footnotes in Table 15 on page 20 for data limitations.

To measure the success of each University's research and development spending, we examined the amount of licensing revenue generated by each dollar of spending. Since licensing revenue can have large year-to-year changes caused by the sale of a large license, we compared the average revenue over a six-year period (2002-2007) to the 2006 expenditures. Table 18 shows that the URC has done better than the U.S. average, North Carolina, Pennsylvania, and Southern California clusters in terms of revenues earned per R&D dollar spent.

TABLE 18. 2002-2007 Average Annual Licensing Revenue as a Percent of 2006 Expenditures

	Licensing Revenue[a] (in millions)	Total R&D Expenditures[b]	Revenues per Expenditures
Michigan's URC	**$36.3**	**$1,379**	**2.6%**
Northern California	$158.2	$2,021	7.8%
Southern California	$34.7	$2,016	1.7%
Illinois	$33.5	$1,202	2.8%
Massachusetts	$59.8	$1,183	5.1%
North Carolina	$6.2	$1,432	0.4%
Pennsylvania	$13.5	$1,387	1.0%
All AUTM[c] institutions	$1,249	$40,597	3.1%

Sources: Universities' websites, AUTM, National Science Foundation, Integrated Science and Engineering Resources Data System

Analysis: Anderson Economic Group, LLC

a. See footnotes in Table 15 on page 20 for data limitations. Revenue for U.S. is from 2006.

b. Total expenditures is from 2006.

c. The Association of University Technology Managers' 2006 survey tracks the licensing revenue for 158 post-secondary institutions and university systems, which approximately 80% of all R&D expenditures reported by NSF for all U.S. institutions.

IV. Alternative Energy Research and Development

Our annual benchmarking studies for the URC have included a section highlighting a particular aspect of the URC universities's work. In this 2008 report, we highlight the URC's contribution to alternative energy infrastructure, research, and workforce development.

Michigan's wealth of natural resources and highly skilled manufacturing and engineering base makes the state an attractive location for the alternative energy industry. The URC adds another element, providing state-of-the-art research capacity and knowledge to further advance the field. The unique blend of existing infrastructure and expertise gives Michigan's alternative energy industry a comparative advantage over other states and can be a significant asset in attracting new alternative energy companies to Michigan.

WHY THE INTEREST IN ALTERNATIVE ENERGY?

Increased electricity demand, rising fuel costs, regulatory changes motivated in part by environmental concerns, and the potential economic gains from diversifying into this market, have spurred interest in Michigan's alternative energy prospects. Tapping into Michigan's natural resources and existing infrastructure to provide energy could have positive economic benefits to the state by lowering the net cost to Michigan's economy of energy use and providing employment in industries such as the production of biofuels.This report defines alternative energy as coming from non-fossil fuel sources such as agricultural products, wind, water, sun, and nuclear power.

NATURAL RESOURCE ADVANTAGE

We evaluated the energy generation potential of Michigan's natural resources including biomass, wind, water, and sun. By comparing the amount of biomass, water, wind, and sun that each state has available for harvesting, we were able to rank Michigan and the other 49 states from 1 through 50, with "1" indicating the state that has the most obtainable energy from that resource. Energy potential for each resource is based on estimates from the Department of Energy, American Wind Energy Association, and the National Renewable Energy Laboratory.

Based on our evaluation, biomass and wind are the most promising natural resources for Michigan. As shown in Table 19, Michigan's resources give it a leg up in producing energy from wind and biomass. However, as shown in the next sections, Michigan's existing infrastructure and URC leadership in research and development give Michigan an advantage for other renewable resources as well.

TABLE 19. Michigan's State Ranking in Renewable Energy Potential[a]

Energy Source	Potential Ranking[b] (out of 50 states)
Biomass	22
Hydroelectric	37
Wind	14
Solar	44

Source: Anderson Economic Group, LLC

a. See Table 5 on page 4 and Table 6 on page 5 for more information about Michigan's potential supply of alternative energy.

b. Wind and hydroelectric ranking assumes each state has maximized its potential electrical output from that resource. Biomass ranking refers to tonnage of available biomass, but does not account for changes in land use. Solar ranking accounts for photovoltaic energy density of each state. A ranking of "1" indicates the state with the most energy potential from that resource.

INFRASTRUCTURE

In 2006, the manufacturing industry in Michigan employed approximately 650,000 workers, or 4.6% of the U.S. workforce. Those employees work in vehicle and parts manufacturing, as well as in transportation, machinery, and primary metal manufacturing. Michigan's manufacturing industry was the state's largest industry in terms of gross domestic product (GDP), producing about $63.2 billion in 2006. Motor vehicle, body, trailer, and parts manufacturing contributed the highest amount of total GDP (35.8%) of Michigan manufacturing.

The state of Michigan is the largest hub for vehicle manufacturing and production in the country, with 22.5% of all auto supplier plants located in the state.[10] Along with physical manufacturing power is a transportation infrastructure already in place to ship resources and goods. Additionally, Michigan is home to 65,000 R&D professionals and 330 laboratories that allow for tests of specific energy technologies.[11]

Several companies are already taking advantage of the manufacturing infrastructure and are contributing to further research and development of products. Efforts by the big 3 auto companies will be discussed in a later section. Among the other companies taking advantage of Michigan's infrastructure are Dow Corning's Hemlock Semiconductor Corporation, which is in part owned by ShinEtsu and Mitsubishi and based in Hemlock, Michigan. Hemlock is the world's leading producer of polycrystalline silicon, which is one the primary materials needed for solar panels. In 2007, Hemlock invested $1 billion to expand its operations.

10. Klier, Thomas, "Determinants of Supplier Plant Location: Evidence from the Auto Industry," Chicago Federal Reserve Bank, 2005.

11. Michigan Economic Development Corporation

RESEARCH AND TRAINING CAPACITY IN THE URC

URC research facilities and the faculty that run them provide the infrastructure and knowledge base needed to further develop alternative energy technologies. The URC universities have many research centers that are not only on the cutting edge of research and development, but serve as a training ground for students who are mentored by experts in their respective field. Additionally, research centers foster collaborative efforts within the public and private sectors to further alternative energy production and use.

Existing Research Infrastructure

For each school we provide one detailed example of existing alternative energy research below. We then list several more research initiatives underway at URC universities that support Michigan's alternative energy research infrastructure.

Great Lakes Bio-energy Research Center. Last year, MSU received a five-year, $50 million grant from the Department of Energy to help establish the Great Lakes Bio-energy Research Center (GLBRC). The GLBRC forms a partnership between MSU and the University of Wisconsin-Madison to accelerate research on the development of cellulosic ethanol production. The leader of the GLBRC is a MSU Distinguished Professor of plant biology and of biochemistry and molecular biology. Research at the center was also a factor in Mascoma Corporation's decision to build one of the nation's first commercial wood-based bio-refineries in Michigan, which is currently in the planning phase.

Michigan Memorial Phoenix Energy Institute. The mission of the Michigan Memorial Phoenix Energy Institute (MMPEI) at U-M was broadened in 2006 to encompass research on the "development of energy policies that will promote world peace, the responsible use of the environment, and economic prosperity." MMPEI, which coordinates more than $40 million worth of energy research per year, seeks to help implement scientific and technological advancements in sustainable energy. In 2007, MMPEI received a $2 million grant from the US Department of Energy to coordinate efforts among the DOE, General Motors, Ford Motor Company, and DTE Energy to conduct a two-year study on plug-in hybrid vehicles.

Center for Automotive Research. At WSU, the Center for Automotive Research conducts research and coordinates intstructional programs aimed at preparing graduate students in areas such as combustion, fuel economy, alternate and renewable fuels, and biofuels. The Center's new Advanced Propulsion Laboratory will be housed in WSU's new $27.3 million engineering facility, currently under construction. The new laboratory will provide resources using fuel cells and other emerging sustainable technologies used to power homes, businesses, and vehicles.

Other URC Centers and Institutes. Other research institutes and centers that focus on alternative energy R&D include:

- The Office of Biobased Technology (OBT), which serves as a clearinghouse for all bioeconomy information and research at MSU. OBT strives to integrate scientific developments and natural resources with public and private sector initiatives in order to enhance the economy, environment, and quality of life locally and globally.

- The MSU Michigan Biotechnology Institute (MBI), which focuses on the development and commercial use of sustainable biobased technologies. The organization also partners with commercial businesses and inventors to help them lower their business risk and move forward with beneficial ideas and technology.
- The U-M Erb Institute for Global Sustainable Enterprise that fosters global enterprise through interdisciplinary research and education initiatives. This includes an interdisciplinary education program through the Ross School of Business and the School of Natural Resources and Environment.
- U-M's DTE Power Electronics and Electric Drive Laboratory, which pursues power electronics for alternate sources of energy, including fuel cells and hybrid vehicles. The laboratory is funded through grants from DTE Energy and the National Science Foundation.
- WSU's Smart Sensors and Integrated Microsystems Laboratory, which works to efficiently break down fuels into hydrogen in order to power fuel cells. Researchers at the laboratory are developing a highly energized gas, advanced sensors, and software to improve fuel cell technology. Additionally, researchers are uniting wind, solar, and fuel cell power to generate electricity that is adaptive in diverse weather conditions.

Education Initiatives

The URC universities also are training the next generation of alternative energy industry workers, ensuring that companies looking to locate in Michigan will find the skilled workforce they need.

In 2003, Wayne State University developed Master's, Graduate Certificate (for continuing education), and Undergraduate programs in Alternative Energy Technology. The multi-disciplinary engineering program equips students with the knowledge and skills needed to design and integrate alternative energy systems. Additionally, three leading alternative energy companies, Ballard Power Systems Corporation, Delphi Corporation, and Energy Conversion Devices, collaborated with WSU to develop the university's Alternative Energy Technology degree program.

Also at WSU is the Hybrid Electric Vehicle Technology (HEVT) project, funded by the National Science Foundation. The HEVT project developed and delivered a hybrid electric vehicle curriculum for Macomb Community College instructors and automotive engineers. Through this project, Macomb Community College has become the first community college in the state—and one of the first in the nation—to train automotive technician students on servicing hybrid electric vehicles. WSU also worked collaboratively to create a specialized industrial-based laboratory on the Macomb Community College South campus. Plans to expand the program to other community colleges are under way.

The University of Michigan offers many degree programs that are in part or entirely dedicated to energy. Two examples are a Master of Engineering in Energy Systems and a Master of Engineering Sustainable Systems. The former is the first in the nation to specifically develop leaders who can design and implement energy systems that respond to expanding environmental and energy needs. The latter confers a dual degree from the School of Natural Resources and Environment and the College of Engineering.

In addition to the degree programs specific to alternative energy, U-M is focusing on an interdisciplinary approach to energy. Outside of engineering at U-M, 13 departments and 57 faculty members are contributing to the dialogue on alternative energy in fields such as economics, policy, geology, natural resources, architecture and urban planning, and business. A five-year initiative to hire new junior faculty members with an interdisciplinary research and teaching interests began in 2008 and has already led to eleven new authorized positions with a focus on energy and sustainability.

MSU's efforts to train workers in preparation for Michigan's new bioeconomy is being supported by a three-year, $15 million grant from the U.S. Department of Labor's "Workforce Innovations for Regional Economic Development" (WIRED) program. More than 300 Michigan workers have been trained to build and operate biofuel plants that produce biofuel or refine grain-based ethanol. The biorefinery operations training is held through a partnership between Mid-Michigan Innovation Team, the Prima Civitas Foundation, and the Lansing Economic Area Partnership.

As a land grant university, MSU has a unique role in getting the benefits of research from the laboratory to Michigan's communities. In June 2008, MSU Extension and the MSU Land Policy Institute ran a Citizen Planner Academy on wind power. Local planning and zoning officials participating in this two-day training event learned how to set up their regulations on wind turbine installation and to avoid barriers, such as public uncertainty, to wind turbines in their communities.

Collaborations Among the URC

Adding to their work as individual institutions, the URC universities are taking advantage of their proximity and different specializations to collaborate and produce research they could not do alone. In order to advance "revolutionary but feasible outcomes" in alternative energy, the URC granted $900,000 in research funding for URC faculty for up to three years. Thirteen research projects that address energy materials, clean energy sources, transmission and storage, and/or energy policy were considered. Two multi-institutional winners were chosen, including a team of researchers representing all three URC universities. That project proposes to utilize the strengths from each university to develop more efficient low-cost thermoelectric materials for industry. This technology could be applied to power generation and heating and cooling systems to improve energy efficiency of industrial processes. The other project involves researchers from U-M and MSU, in collaboration with Lansing-based Technova Corporation, to develop more cost-efficient and plentiful ethanol from switchgrass or corn stover (leaves and stalks).

DIVERSITY OF RESEARCH PROJECTS AND FUNDING

The URC universities were granted more than $79.5 million for research and development in alternative energy in 2007. As shown in Table 20, the research includes a diverse set of topics from wind energy to fuel cells. Not surprising, given the URC's collaboration with the automotive industry in Southeast Michigan, more than half of the grants were designated toward projects that focused on fuels (33%) or propulsion and power (25%).

TABLE 20. URC Alternative Energy Research and Development by Category, 2007

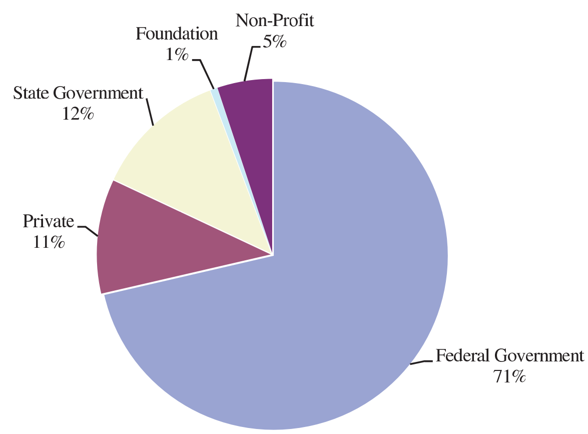
Category	Total Grants	Percentage of Total
Education	$162,727	0.2%
Efficiency	$4,961,986	6.2%
Enabling Technology	$3,245,259	4.1%
Energy Storage	$2,388,162	3.0%
Fuel Cells	$1,472,661	1.9%
Fuels	$26,342,276	33.1%
Hydrogen	$426,373	0.5%
Lighting	$1,691,891	2.1%
Nuclear Power	$4,941,387	6.2%
Policy	$767,362	1.0%
Propulsion & Power	$19,852,568	24.9%
Solar & Thermoelectric	$5,814,863	7.3%
Sustainability	$5,623,436	7.1%
Sustainable Living & Design	$1,046,165	1.3%
Transportation Infrastructure	$274,713	0.4%
Wind & Hydro	$553,447	0.7%
Total	**$79,565,276**	**100%**

Data Source: Michigan State University, University of Michigan, Wayne State University
Analysis: Anderson Economic Group, LLC

As illustrated in Figure 9 below, the majority of grants received for alternative energy are issued by the federal government (71%). The URC received funding from many federal agencies including the Departments of Energy, Defense, Health and Human Services, and Agriculture. The URC universities brought $56.8 million in federal research dollars on alternative energy topics to the state in 2007. Additional funding stems from 17 separate agencies and institutions including the National Science Foundation, the U.S. Army, and the National Aeronautics and Space Administration.

Private funding from 41 sources, including General Motors, Shell Oil Company, DTE Energy, Ford Motor Company, Toyota, and Battelle Memorial Institute, make up 11% of the awards or $8.4 million. State government (12%), Non-profit organizations (5%), and Foundations (1%) provide the remaining R&D funding.

FIGURE 9. URC Alternative Energy R&D Awards by Source



Data Source: *Michigan State University, University of Michigan, Wayne State University*
Analysis: Anderson Economic Group, LLC

COMMERCIALIZATION OF ALTERNATIVE ENERGY RESEARCH

Michigan State, the University of Michigan, and Wayne State University all work with their faculty and students to help them obtain patents and license their new technology through technology transfer offices. Technology transfer offices will often conduct patent searches and analyze the invention's commercialization potential, and if the product receives a patent, will help the faculty member market the product to potential licensing partners and investors.

Varied university departments conduct research applicable to the alternative energy industry. Many different fields are relevant to alternative energy as the technologies and processes needed to make alternative energy commercially viable are numerous. Some of the $79.5 million in research and development in the URC in 2007 went towards projects in fields such as mechanical, electrical, and computer engineering, geological sciences, physics, natural resources and environment, urban planning, cell and molecular biology, and forestry. Many times, this research and development leads to innovations in technology with potential commercial value.

MSU's expertise in plant science has helped the school become a leader in biomass research, conversion, and integration. Researchers at MSU's Biomass Conversion Research Laboratory are developing an integrated process for breaking down cellulosic material, estimating the performance, and defining the costs. Integrating pretreatment of cellulosic material with other operations is a vital step in facilitating improvement in biomass fuel production. In 2004, the MSU Product Center helped connect Michigan farmers with an MSU Extension educator to launch a biodiesel production facility, Michigan Biodiesel, LLC.

MSU researchers and technology are one key reason why Mascoma Corporation, in partnership with MSU and Michigan Technological University, and Michigan forestry company J.M. Longyear, plans to develop the state's first cellulosic ethanol plant in Chippewa County. MSU will provide expertise in parts of the production process for cellulosic ethanol, which is ethanol produced not from sugar, but from cellulose, which is the building block of all plant matter and is available from all plants, including Michigan's sustainable forests.

MSU professor Keith Promislow is working on research that is important to the development of fuel cells that are more reliable, can operate at higher temperatures, and cost less to manufacture than those currently available. He is a long-time collaborator with Ballard Power Systems, a Canadian firm that is one of the fuel cell industry's leaders. His research includes mathematical modeling of nano-scale properties of polymer electrolyte membrane (PEM) fuel cells.

MSU's Krishnamurty Jayaraman is an example of MSU professors working with industry to bring advanced solar energy closer to the marketplace. His work, supported by Midland-based Dow Chemical and NASA's Jet Propulsion Laboratory, is part of a familiar story in American technology, where the space program pushes technology forward that could later improve products used by average consumers. His current work includes research on producing large, injection-molded plastic pieces to tight enough tolerances that they can replace certain glass components in solar collection, realizing a significant reduction in the mass of the components.

U-M professor Sridhar Kota is the founder of FlexSys, Inc., which is developing high-efficiency adaptive blades for both the wind turbine and air vehicle industries. The blades adjust their shape, morphing in response to wind conditions in order to maximize energy collection and efficiency and to reduce structural loads when wind gusts are high.

Solar researchers at U-M are seeking new, more cost-effective ways to gather sunlight and reduce the high cost of installing conventional solar panels. Professors are developing photovoltaic films, inks, and fibers that could be painted, printed or woven onto other materials that are easier to install and lower the cost for clean, renewable solar energy. Professor Stephen Forrest and his group are employing a new "vapor phase deposition" manufacturing technique to make thin-film organic solar cells with rougher surfaces that absorb more light because of their greater surface area. This technology is being commercialized through Forrest's company Global Photonic. Other U-M solar innovations have been patented, but are approximately 2 to 10 years away from commercialization. Professors are developing silicon inks that act as solar cells that are more efficient than many of the thin film technologies currently being developed. With grants from the Air Force Office of Scientific Research, professors are developing organic photovoltaic fibers that could be woven into energy-harvesting clothes, tarps, and other textiles.

In collaboration with the Environmental Protection Agency's National Vehicle and Fuel Emissions Laboratory, professors and students from U-M are testing hydraulic-electric hybrid vehicles. The Xebra, a small electric truck, uses a hydraulic launch system to capture, store, and reuse energy lost used during braking. Researchers estimate they can improve city mileage by 45%, and triple acceleration and hill-climbing ability. Manufacturers of a small gasoline-powered version of the Xebra claim that even without regenerative braking the vehicle will reach 72mpg.

Wayne State University co-founded “TechTown,” a 47-acre, multi-million dollar research and business technology park. TechTown is a community of entrepreneurs, investors, and corporate partners that empowers entrepreneurs to build successful technology businesses. Among its 39 tenants is NextEnergy, a non-profit corporation founded in 2002 to advance alternative energy technology in Michigan. Three other alternative energy-focused corporations reside there as well. Multiple patents have been issued to Wayne State professors for alternative energy discoveries, including a power booster to increase efficiency and reduce emissions for hybrid vehicles.

Additionally, Dr. Simon Ng, Professor of Chemical Engineering and Director of the Alternative Energy Technology Program in the College of Engineering at Wayne State University, and Director of the National Biofuels Energy Laboratory that resides at NextEnergy, is leading research in many areas of biodiesel fuel production and characterization. One area of focus is heterogeneous catalyst development for continuous biodiesel production using a variety of low-cost feedstocks. WSU's Technology Commercialization Office is managing three patented catalyst formulations and has facilitated industry engagement with a major global biodiesel producer, as well as a catalyst company and a fuel additive company. Dr. Ng's catalysts have the potential to replace homogeneous catalysts used in biodiesel production today with the benefit of a continuous biodiesel production process, elimination of environmentally hazardous waste water and sludge, and the flexibility to use feedstocks other than expensive soybeans.

URC'S COLLABORATION WITH THE AUTOMOTIVE INDUSTRY

The automotive industry is a pillar of Michigan’s economy. Michigan produces the most cars and light trucks of any state in the country, producing about 22% of the industry’s U.S. production in 2007.[12] Michigan was also home to almost a fifth of the country’s automotive workers in 2005.[13]

Michigan is second, only behind California, in the amount of industry-performed research and development at approximately $16.7 billion.[14] More than 330 automotive R&D and technical centers spend approximately $12.4 billion annually and employ 65,000 professionals in the state of Michigan.[15]

12. Automotive News 2008 Market Data: North American Production

13. U.S. Census Bureau, County Business Patterns, Michigan Automotive Industry Employment, 2005.

14. National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, “Top 10 States in Industry R&D performance and share of R&D, by selected industry, 2005. Science and Engineering Indicators, 2008.

15. Michigan Economic Development Corporation.

The research expertise available at the URC universities encourages numerous collaborative efforts with the auto industry. In 2007, the auto industry collaborated with the URC on $2.5 million in alternative energy research projects, many focusing on fuels, and power and propulsion. General Motors' sponsored several U-M projects in 2007 on various aspects of hybrid vehicles and engine systems and powertrain research, which totaled $1.8 million. GM also funds non-energy related research at U-M in the areas of manufacturing and materials processing. In 2007, the total energy and non-energy related funding by GM was $3.75 million.

The University of Michigan runs several automotive research centers and laboratories that collaborate with the auto industry. The U-M Transportation Energy Center has a $12 million cooperative agreement to provide basic and applied research expertise for the U.S. Army's National Automotive Center until 2012. The research team is working to develop an on-board fuel cell generator that converts jet and diesel fuel into a synthetic gas to power fuel cells. The military uses jet fuel to power heaters, stoves, electric engines, tanks, and other vehicles. According to the U.S. Department of Energy, idling civilian tractor-trailers burn $1 billion worth of diesel every year during loading, unloading, and power-generation at rest stops. Converting some of that fuel would improve efficiency by more than 50 percent.

Researchers at U-M's Automotive Research Center and Lay Automotive Laboratory formulate new energy conversion options and propulsion systems, as well as test hybrid vehicles and the impact of synthetic fuels. One project uses low temperature combustion, mixing air and fuel, to control emissions. General Motors funds and uses this research to help increase fuel efficiency and meet new emission standards. The University of Michigan Transportation Research Institute, which is in part supported by the all major auto makers, studies alternative fuel infrastructures and estimates the costs associated with various fuels.

Researchers at U-M are also identifying challenges and opportunities for energy policy and alternative energy prospects, as they relate to the auto industry. U-M is leading a multi-disciplinary, multi-university study on the optimal greenhouse gas policy from the automotive market perspective. General Motors Corp., Ford Motor Co., and Daimler-Chrysler are part of the 12 member external advisory board. Additionally, U-M's Michigan Memorial Phoenix Energy Institute is coordinating efforts among several university departments, General Motors Corp., Ford Motor Co., DTE Energy, and the Pacific Northwest National Laboratory to explore the public's willingness to buy plug-in hybrid electric vehicles, where cars would plug in, how this would affect the existing electrical grid, and how the car's electricity demands would affect power plant greenhouse gas emissions.

Another example of the URC working with the automotive industry on alternative energy projects is the National Biofuel Energy Lab (NBEL). The NBEL, a consortium that includes WSU, NextEnergy, Bosch, Delphi, DaimlerChrysler, and Biodiesel Industries, is working to establish a sound technical basis for biodiesel fuel and to gain a comprehensive understanding of the relationship between a biofuel's chemical composition and its performance.

In conjunction with Titan Energy Development Inc., NextEnergy, and the U.S. Army National Automotive Center, students and faculty from WSU are working to develop a power generation product that will supply grid power, clean water, communications, lighting, and HVAC (high voltage alternating current). The hardware will run on synthetically produced, biodiesel, and petroleum-based fuels and will be the first of its kind optimized for multi-fuel application.

Support for MSU's Energy & Automotive Research Laboratories comes in part from the Ford Motor Company and General Motors Corporation. The new research complex, which focuses on engine efficiency and reducing vehicle emissions, features a state-of-the-art powertrain lab and two engine test cells. Two engineering teams from MSU are also partnering with Ford Motor Co. to optimize diesel engine performance using biofuels. The chemical engineering team is working on refining the fuels, while the mechanical engineering team, along with Ford, is testing the fuels and creating engines to maximize fuel performance.

As a result of long-standing relationships and URC expertise in energy research, many companies decide to locate near the URC universities. Recently Toyota Motor Corporation announced its plans to spend $100 million to establish a new research center located in the Ann Arbor area. U-M mechanical engineering professor Noboru Kikuchi will serve as the new director.

V. Impact on Jobs and Income

SCALE OF OPERATIONS & EXPENDITURES

The University Research Corridor makes significant contributions to the state's economy. URC institutions spent $6.7 billion on operations in FY 2007 (July 1, 2006 to June 30, 2007) and employed 48,760 full-time-equivalent faculty and staff throughout Michigan.[16] Most operational spending went toward instruction (22% of total), research (14%), and the University of Michigan Hospital (28%). See Table 21 below.

TABLE 21. Operational Expenditures by the URC, FY 2007

	Expenditures ($ in millions)	% of Total
Instruction	1,455	22%
Research[a]	929	14%
Public Services	337	5%
Academic Support	304	4%
Student Services and Scholarships and Fellowships	249	4%
Institutional Support	256	4%
Operation and Maintenance of Plants	454	7%
Auxiliary Enterprises	449	7%
Depreciation and Other Expenses	416	6%
University of Michigan Hospital	1,861	28%
Total Operational Expenditures	**$6,711**	**100%**

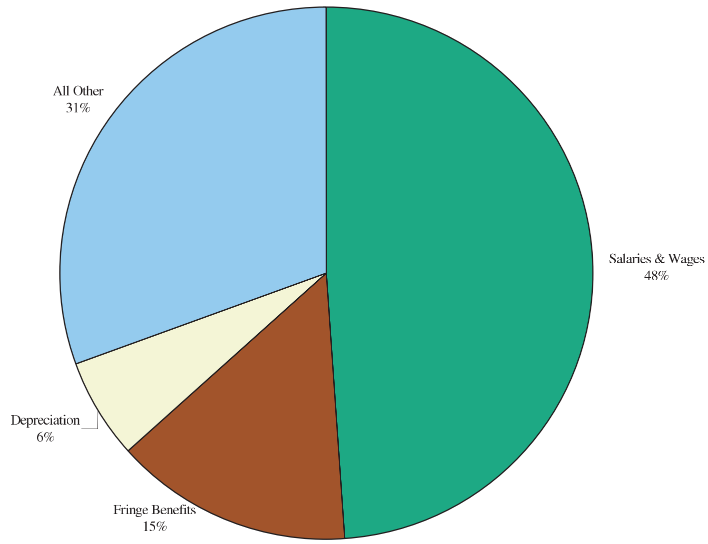
Data Source: IPEDS Finance FY 2006

a. The data reported to IPEDS for research expenditures is lower than the research expenditures reported to the National Science Foundation. Research expenditures reported to IPEDS only include direct research costs. Indirect costs, while included in NSF reporting, are counted in other spending categories when reported to IPEDS.

We can also examine these expenditures by function, as shown in Figure 10 on page 35. Almost half (48%) of all operational expenditures were for salaries and wages for faculty and staff. Fringe benefits made up 15% of expenditures, while depreciation accounted for 6%. The remaining 31% paid for supplies, equipment, and any other expenditure not included in the previous categories.

16. Faculty and staff count is full-time-equivalent positions in fall 2006. Figure includes the University of Michigan Hospital doctors and staff.

FIGURE 10. URC Operational Expenditures by Function, FY 2007



Data Source: National Center for Education Statistics, IPEDS Finance
Analysis: Anderson Economic Group, LLC

URC expenditures encourage even more economic activity throughout the state of Michigan than indicated by total spending listed in Table 21. The dollars the URC spends on supplies, equipment, and staff and faculty salaries are then re-spent as businesses and households throughout Michigan purchase other goods and services.

DEFINITION OF ECONOMIC IMPACT

We define *net economic impact* as the new economic activity directly or indirectly caused by the URC, excluding any economic activity associated with Research Corridor universities that merely replaces or displaces other economic activity in the state. For example, we exclude expenditures by students who would have attended another college in Michigan if the URC did not exist. Since these students would have stayed in Michigan and spent money in the state, we do not count these expenditures as new economic activity caused by the URC. We also exclude all expenditures by URC universities that go to firms outside Michigan.

To quantify the economic impact of URC universities' operational expenditures, we asked, in effect: "What would be the loss to the state if the three Research Corridor universities closed their doors?"

ECONOMIC IMPACT OF OPERATIONAL EXPENDITURES

The expenditures shown in Table 21 on page 34, pay the salaries of professors, researchers, doctors, administrative staff, and purchase supplies, equipment, and maintenance of buildings. As the URC makes purchases, the money is then re-spent throughout the Michigan, creating a "multiplier" effect, generating more economic activity for the state.

In FY 2007, the URC's operations resulted in $8.3 billion in new earnings to households (compared to $8.08 billion in last year's benchmarking report) and 69,285 jobs in the state. This takes into account the economic activity that would replace lost URC economic activity. For example, we account for the substitution of some URC staff and faculty to other jobs in Michigan. Therefore, not all current earnings by URC faculty and staff count as new earnings in our economic impact figure.

As shown in Table 22, we estimate that the net economic impact of URC non-payroll expenditures (excluding U-M hospital) was $2.08 billion in FY 2007. This includes the direct expenditures by URC universities for materials and supplies and the additional indirect economic activity that resulted from these expenditures. U-M Hospital generated $708 million in net economic activity from its non-payroll operating expenditures. Finally, faculty and staff expenditures, after accounting for substitution, resulted in $3.9 billion in net new earnings, while student expenditures resulted in $1.6 billion in net new earnings. See Table 22 below.

TABLE 22. Net Economic Impact of URC Operations, FY 2007

Impact Category	New Earnings in Michigan (in billions)
Non-payroll Operating Expenditures by the URC	$2.08
University of Michigan Hospital Non-payroll Operating Expenditures	$0.71
URC Faculty & Staff Expenditures	$3.91
URC Student Expenditures in Michigan	$1.60
TOTAL ECONOMIC IMPACT FROM OPERATIONS	**$8.29**

Source: Anderson Economic Group, LLC

As shown in Table 22, URC universities' non-payroll operating expenditures, including those by U-M hospital, resulted in a net economic impact of $2.79 billion in Michigan ($2.08 billion plus $0.71 billion). Table 23 on page 37 breaks down this $2.79 billion into impact by industry in Michigan. As the URC spends money on such items as books, desks, computers, and insurance policies other businesses receive and re-spend this income. We estimated the portion of spending that occurs in Michigan, and used the U.S. Department of Commerce's Regional Input-Output Modeling System (RIMS II) multipliers to estimate how direct expenditures by the URC universities' indirectly affect other industries in the state.[17]

17. The U.S. Department of Commerce's RIMS II is based on input-output tables that show the distribution of inputs purchased by industry and outputs sold.

TABLE 23. Net Economic Impact of URC's Non-Payroll Expenditures by Industry, FY 2007

Industry	New Earnings in Michigan (in millions)
Agriculture	$16.6
Mining	$1.2
Utilities	$46.4
Construction	$13.1
Manufacturing	$234.2
Wholesale Trade	$77.7
Retail Trade	$116.1
Transportation	$66.4
Information	$56.1
Finance and Insurance	$103.9
Real Estate, Rental, and Leasing	$279.3
Professional, Scientific, & Technical Services	$87.6
Management of Companies & Enterprises	$36.7
Administrative & Waste Management Services	$76.4
Educational Services	$980.1
Health Care & Social Assistance	$460.6
Arts, Entertainment, and Recreation	$17.2
Accommodation and Food Services	$63.1
Other Services	$55.1
TOTAL NET ECONOMIC IMPACT, NON-PAYROLL EXPENDITURES	**$2,787.9**

Source: Anderson Economic Group, LLC

As illustrated in Table 23, the industries benefiting the most (in terms of level of new earnings) include manufacturing, real estate, educational services, and health care. All of these industries experienced new earnings in 2007 above $230 million.

WAGE EARNINGS OF MICHIGAN-RESIDENT URC ALUMNI

Alumni of URC universities contribute greatly to the state's economy. We calculated the earnings in 2007 of 552,320 URC alums living in Michigan using a model that accounts for the higher wages of URC alumni over the average college graduate's salary, the university of the graduate, and the alum's year of graduation. We detail our methodology in Appendix B of our first annual benchmarking study, released in 2007.

We estimate that in 2007 URC alumni earned over $25.2 billion, or 13.3% of all wage and salary income in Michigan. This is up from our estimate of $25.0 billion in 2006. While much of these earnings cannot be said to have been *caused* by the

URC universities, this figure shows the scale of the URC's role in attracting and educating Michigan's workforce.College Choices and Earnings in Michigan

TABLE 24. Michigan Earnings of URC Alumni by Age and Degree, 2006 ($Millions)

	21-24 Years	25-34 Years	35-44 Years	45-64 Years	Over 65 Years	Total
Bachelor Degree	317	4,563	3,566	6,446	401	15,232
Advanced Degree	4	2,260	2,526	4,650	490	9,930
Total Earnings	321	6,823	6,093	11,095	891	$25,223
memo: Earnings as a % of wages & salary income in Michigan						*13.3%*

Source: Anderson Economic Group, LLC

Like all educational institutions, Research Corridor universities strive to increase the knowledge and skills of the students they teach. An increase in the usable knowledge and skills adds to their *human capital* and often allows a person to earn a higher wage—much like adding physical capital (e.g. buildings and equipment) allows a factory to increase production. For some small share of the URC's students, having access to a research university in Michigan is the difference between going to college and not. For others, it is the difference between remaining in the state for their college degree or pursuing their education outside Michigan. For the remainder of the students, the existence of URC universities simply means finding the right mix of features, location, and price, whatever their specific reason for choosing Michigan State, the University of Michigan, or Wayne State.

The main components of estimating the additional earnings of URC graduates are: (1) projecting the additional earnings of URC graduates, and (2) allowing for substitution of earnings that would have occurred even if the individual had not attended a URC university. We detail our methodology in Appendix B of our first annual benchmarking study, released in 2007. Note that using this methodology assumes that most of the current earnings of Michigan-resident URC alumni are earnings they would have had even without the URC.

METHODOLOGY

In calculating the net economic impact, we follow a careful methodology that counts expenditures only once, takes into account substitution of one activity within the state by another, and uses very conservative multipliers for indirectly-caused activity. We detail our methodology for the economic impact of the operational expenditures by Research Corridor universities in "Operational Expenditures Methodology" in Appendix B.

VI. Impact on State Revenue

This section provides an estimate of tax revenue the state of Michigan receives because of the URC's presence in Michigan. We calculate new tax revenue by first calculating the new wage and salary income these groups receive because of the URC.[18] Then, we estimate the income, sales, property, and transportation taxes generated as a result of this additional income. This estimate is, by necessity, an approximation, as the actual tax revenue collected by the state government is the result of millions of individual purchasing and tax planning decisions by URC employees and alumni. While we do not estimate *every* tax and fee the state collects because of the URC, we provide an estimate of most *new tax revenue* the state collects from (1) earnings of employees at URC universities and (2) earnings by graduates of the URC living in Michigan.

ADDITIONAL INCOME DUE TO THE URC

In "Impact on Jobs and Income" on page 34, we estimate that $2.42 billion in wages of URC employees in Michigan was *caused by* the URC in 2007. This figure accounts for substitution of URC employees for other Michigan wages that would have been paid in the absence of the URC. See "Impact on Jobs and Income" on page 34.

In "Impact on Jobs and Income" on page 34, we estimated the earnings of URC alums that was caused by the URC in 2007. We estimate that URC alums living in Michigan in 2007 earned $4.2 billion more due to the URC.

CATEGORIZING INCOME

We categorize the earnings of employees and alumni caused by the URC into *marginal* and *average* income. The portion of alumni earnings that is earned *in addition to* what would have been earned without the URC is treated as "marginal income." We treat entire new salary and wage income for an employee or alum that is earned only because of the URC as "average income." This matters because people spend their first $1,000 of income differently than their last, and the state government taxes this income differently because of exemptions. Our methodology for this analysis is detailed in Appendix B of our first annual benchmarking study, released in 2007.

Employee Earnings. The income of URC employees is treated as average income. The earnings of URC employees comes largely from out-of-state income sources, so it is reasonable as a first approximation to treat URC employee jobs as jobs that would not exist without the URC, meaning each employee's entire income generates net new tax revenue. While it is possible that some of the income of URC

18. As described in the first annual benchmarking study, released in 2007, we use a conservative methodology to estimate the current earnings caused by the URC. Specifically, we assume that most URC graduates would have attended college somewhere else if these institutions were not in Michigan, and would have earned wages near those of the average for college graduates of their age.

employees could be treated as marginal income, treating it as average income is more conservative because average income is taxed at a lower average rate than is marginal income, as shown in Table 25 on page 40.

URC Alumni. For some graduates, attending a URC university likely had no impact on their annual Michigan earnings (and therefore to the taxes they pay to the state of Michigan). Other graduates will earn extra income due to the URC, and therefore will pay additional taxes to the state. The proportion of their additional income that goes to taxes depends on whether their additional Michigan income due to the URC represents a pay boost (for graduates who would still be working in Michigan without the URC) or if their entire Michigan income is due to the URC (for graduates who otherwise would not be working in Michigan). As described below, we apply different effective tax rates to "average" and "marginal" income.

EFFECTIVE TAX RATES ON INCOME

This analysis recognizes that average and marginal income are taxed and spent differently. To account for this difference, we estimate an "effective rate" for each type of income that is taxed, which is the amount we anticipate they will pay in taxes divided by their income.[19] Table 25 below shows the percentage of income we assume is paid to the State of Michigan. Note that our analysis includes major taxes such as income, sales, state-level property, and gasoline taxes, but does not consider additional, non-sales taxes on alcohol and tobacco, nor other state taxes and fees.

TABLE 25. Percentage of Income Paid to State of Michigan

Tax	On Additional Marginal Income	On Additional Average Income
Personal Income Tax	4.35%	2.08%
Sales and Use Tax	1.70%	2.62%
Property Tax	0.38%	0.47%
Transportation Tax	0.11%	0.24%

Source: Analysis by Anderson Economic Group

Income Tax. The tax rate on marginal income in Michigan was 3.90% at the start of 2007, though it has since been raised to 4.35%. We do not attempt to estimate the proportion of marginal income going toward tax exempt expenditures. To calculate the 2.08% income tax rate on average income, we divided the state's revenue from the income tax in 2005 by the state's personal income.[20]

19. For example, if someone makes $10,000 and spends $7,000 of that on items subject to the 6% state sales and use tax, he or she will pay 6% of $7,000, or $420 in taxes. His or her effective sales tax rate is $420 divided by $10,000, or 4.2%.

20. Base data source for the income tax in 2005 was the Michigan Senate Fiscal Agency. Revenue from income tax in 2005 was $7,060,300,000. According to the U.S. Bureau of Economic Analysis, personal income was $338,829,970,366 in 2005.

Sales Tax. We calculate the sales and use tax burden using data from the U.S. Bureau of Labor Statistics' 2005 Consumer Expenditure Survey. First, we identified spending categories subject to the sales and use tax.[21] We estimate that consumers in the middle 20% of earners (making between $33,381 and $53,358 in income) spent approximately 43.6% of their 2005 income on goods subject to the sales and use tax, yielding an effective rate on *income* of 43.6% times the 6% sales tax rate, or 2.62% of their entire income. This is the effective sales tax rate on additional average income. To calculate the effective rate on marginal income, we calculated the proportion subject to sales tax of the additional spending done by people in the middle 20% of earners and the second highest 20% of earners (making between $53,358 and $85,147 in income). We estimate that 28.4% of this additional income is spent in sales-taxable categories, resulting in an effective sales tax on marginal income of 28.4% times the 6% sales tax, or 1.70%.

Property Tax. We estimate the proportion of expenditures that goes toward property taxes on average using the 2005 Consumer Expenditure Survey. We find that, on average, people in the middle 20% of income spend 2.8% of their income on property taxes. We multiply 2.8% by the proportion state property taxes to all state and local property taxes (16.7%) to arrive at an effective rate on income of 0.47%.[22] We also find that 2.3% of the additional income earned by earners in the second highest quintile goes toward property taxes. Again multiplying by 16.7% of taxes going to the state government, we estimate the effective property tax rate on marginal income to be 0.38%.

Transportation Taxes. We estimate the proportion of expenditures that goes toward gasoline using the Consumer Expenditure Survey. We find that, on average, people in the middle 20% of income spend 4.7% of their income on gasoline. We multiply this rate by 6.3%, the effective rate of the gasoline tax,[23] resulting in an effective rate on income of 0.30%. We also find that 2.1% of the additional income earned by earners in the second highest quintile goes toward fuel. Again multiplying by the 6.3% effective gas tax rate, we estimate the effective gas tax rate on marginal income to be 0.13%.

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21. We identified 15 such spending categories, including travel; alcoholic beverages; housing maintenance; repairs, and other household expenses; postage and stationery; clothing; vehicles and vehicle maintenance; entertainment; personal care products, and others. Although we are aware that some expenditures currently are subject to the state's sales and use tax, but are not reported, we did not account for evasion or avoidance in this analysis.

22. See 2004 U.S. Census of Governments State and Local Finance data.

23. Gasoline is not taxed as a percentage of its price, but rather at a per-unit rate of $0.15 per gallon. The gasoline tax of $0.19 per gallon is divided by $3 per gallon of gasoline to yield a 6.3% effective rate.

TOTAL ADDITIONAL STATE TAX REVENUES

We find over $1.22 billion in income categorized as “marginal, and “$5.44 billion in “average” income ($3.02 billion from alumni and $2.42 billion from URC employees). We calculate the additional taxes to the State of Michigan due to the URC universities by multiplying this income by the effective tax rates identified in the preceding section. Table 25 below shows the results of this analysis: $372 million in additional tax revenue to the state of Michigan paid by URC graduates in 2007.

TABLE 26. Additional Tax Revenue to State of Michigan Caused by URC, 2007

	Effective Tax Rate on Marginal Income	Marginal Income and Tax Receipts (million)	Effective Tax Rate on Average Income	Average Income and Tax Receipts (million)
Total Additional Income		$1,220		$5,440
Personal Income	3.90%	$47.6	2.08%	$113.4
Sales and Use Tax	1.70%	$20.8	2.62%	$142.3
Property Tax	0.38%	$4.7	0.47%	$25.4
Gasoline Tax	0.13%	$1.6	0.30%	$16.2
Subtotal		$74.7(A)		$297.3 (B)
			Total Tax Receipts (A+B)	$372.0

Base Data Sources: AEG; 2005 Consumer Expenditure Survey by BLS

Appendix A: Data

TABLE A-1. Total Enrollment, Fall 2001- 2006

	2001	2002	2003	2004	2005	2006	2001-2006 CAGR
Michigan's URC							
Undergraduate Enrollment	89,637	89,871	91,9116	92,283	93,397	93,821	0.92%
Graduate Enrollment	36,543	38,265	38,698	38,167	37,969	37,814	-0.69%
Other	2,118	2,099	2,024	2,052	1,965	1,985	-1.29%
TOTAL	128,298	130,235	131,838	132,502	133,331	133,620	0.82%
Northern California							
Undergraduate Enrollment	30,582	31,230	30,286	29,443	30,058	30,285	-0.19%
Graduate Enrollment	23,711	23,739	23,366	24,950	25,394	24,325	0.51%
Other	838	1	1	55	35	31	-48.28%
TOTAL	54,293	64,969	53,652	54,393	55,452	54,641	0.18%
Southern California							
Undergraduate Enrollment	58,870	60,132	61,968	61,759	62,387	63,530	1.54%
Graduate Enrollment	29,995	31,677	30,798	31,030	31,394	32,717	1.75%
Other	159	153	176	226	496	304	13.84%
TOTAL	89,024	91,962	92,942	93,015	94,277	96,551	1.64%
Illinois							
Undergraduate Enrollment	41,988	42,625	42,941	43,292	44,664	45,458	1.60%
Graduate Enrollment	27,186	28,079	29,029	29,012	29,489	30,029	2.01%
Other	2,034	2,370	2,158	1,328	1,485	1,493	-6.00%
TOTAL	71,208	73,074	74,128	73,632	75,638	76,980	1.57%
Massachusetts							
Undergraduate Enrollment	18,625	18,862	18,718	18,567	19,627	19,090	0.49%
Graduate Enrollment	25,128	25,856	25,982	26,091	25,372	26,579	1.13%
Other	2,554	2,729	2,736	2,601	2,766	2,894	-2.53%
TOTAL	46,307	47,447	47,436	47,259	47,765	48,563	0.96%
North Carolina							
Undergraduate Enrollment	44,465	44,946	45,363	45,580	46,065	47,184	1.19%
Graduate Enrollment	22,241	23,207	23,073	24,025	25,434	25,036	2.40%
Other	3,148	3,278	3,252	3,106	2,982	2,826	-2.13%
TOTAL	69,854	71,431	71,688	72,711	74,481	75,046	1.44%

TABLE A-1. Total Enrollment, Fall 2001- 2006 (Continued)

(Continued)	2001	2002	2003	2004	2005	2006	2001-2006 CAGR
Pennsylvania							
Undergraduate Enrollment	94,048	94,924	94,280	93,207	91,926	95,435	0.29%
Graduate Enrollment	22,956	24,438	25,048	24,659	24,278	24,548	1.35%
Other	6,206	5,859	5,507	5,007	4,700	4,681	-5.48%
TOTAL	123,210	125,221	124,845	122,873	120,904	124,664	0.23%

Source: *NCES, IPEDS Enrollment*

TABLE A-2. Completions and Awards by Academic Program Area, 2005-06 academic year

	Physical Science, Ag, and Nat. Resources	Business, Mngt, and Law	Engineering, Math, Computer Science	Liberal Arts	Medicine and Bio. Science	Other
Michigan's URC						
Bachelor's Degrees	801	2,703	2,534	7,993	3,519	761
Advanced Degrees	479	3,025	2,069	3,672	2,282	238
Other	154	9	7	397	68	18
TOTAL	1,434	5,737	4,610	12,062	5,869	1,017
Northern California						
Bachelor's Degrees	428	529	1,840	5,001	1,613	58
Advanced Degrees	352	1,597	1,972	1,460	1,306	176
Other	0	0	17	159	44	0
TOTAL	780	2,126	3,829	6,620	2,963	234
Southern California						
Bachelor's Degrees	376	1,660	2,326	9,672	3,859	39
Advanced Degrees	299	2,073	2,685	3,053	2,148	3
Other	56	50	212	300	150	0
TOTAL	731	3,783	5,223	13,025	6,157	42
Illinois						
Bachelor's Degrees	711	1,175	1,962	5,249	1,747	263
Advanced Degrees	490	6,240	1,382	2,992	1,005	123
Other	0	20	0	17	63	0
TOTAL	1,201	7,435	3,344	8,258	2,815	386

TABLE A-2. Completions and Awards by Academic Program Area, 2005-06 academic year (Continued)

	Physical Science, Ag, and Nat. Resources	Business, Mngt, and Law	Engineering, Math, Computer Science	Liberal Arts	Medicine and Bio. Science	Other
Massachusetts						
Bachelor's Degrees	295	80	1,071	2,694	678	2
Advanced Degrees	329	2,021	1,709	2,598	1,580	40
Other	3	309	8	65	90	0
TOTAL	627	2,410	2,788	5,357	2,348	42
North Carolina						
Bachelor's Degrees	822	1,003	1,883	5,248	2,263	283
Advanced Degrees	435	1,918	1,094	1,917	1,511	54
Other	124	0	0	1	25	0
TOTAL	1,381	2,921	2,977	7,166	3,799	337
Pennsylvania						
Bachelor's Degrees	811	4,040	3,761	7,143	2,998	1,151
Advanced Degrees	321	1,619	1,818	2,531	1,227	96
Other	43	394	169	1,353	586	247
TOTAL	1,175	6,053	5,748	11,027	4,811	1,494

Source: National Center for Education Statistics, IPEDS Enrollment

TABLE A-3. Undergraduate Degrees Conferred 2005-2006, Percentage of Total Degrees Conferred

	Physical Science, Ag. and Nat. Resources	Business Mngt., and Law	Engineering, Math, Computer Science	Liberal Arts	Medicine and Bio. Science	Other
Michigan's URC	**4.37%**	**14.76%**	**13.84%**	**43.65%**	**19.22%**	**4.16%**
Northern California	4.52%	5.59%	19.43%	52.81%	17.03%	0.61%
Southern California	2.10%	9.26%	12.97%	53.94%	21.52%	0.22%
Illinois	6.40%	10.58%	17.66%	47.26%	15.73%	2.37%
Massachusetts	6.12%	1.66%	22.22%	55.89%	14.07%	0.04%
North Carolina	7.15%	8.72%	16.37%	45.63%	19.67%	2.46%
Pennsylvania	4.07%	20.30%	18.90%	35.89%	15.06%	5.78%

Source: National Center for Education Statistics, IPEDS Enrollment

Analysis: Anderson Economic Group, LLC

TABLE A-4. Graduate Degrees Conferred 2005-2006, Percentage of Total Degrees Conferred

	Physical Science, Ag. and Nat. Resources	Business Mngt., and Law	Engineering, Math, Computer Science	Liberal Arts	Medicine and Bio. Science	Other
Michigan's URC	**4.07%**	**25.71%**	**17.59%**	**31.21%**	**19.40%**	**2.02%**
Northern California	5.13%	23.27%	28.73%	21.27%	19.03	2.56%
Southern California	2.13%	20.20%	26.17%	29.75%	20.93%	0.03%
Illinois	4.01%	51.01%	11.30%	24.46%	8.22%	1.01%
Massachusetts	3.97%	24.42%	20.65%	31.39%	19.09%	0.48%
North Carolina	6.28%	27.68%	15.79%	27.67%	21.81%	0.78%
Pennsylvania	4.22%	21.27%	23.88%	33.25%	16.12%	1.26%

Source: National Center for Education Statistics, IPEDS Enrollment

Analysis: Anderson Economic Group, LLC

TABLE A-5. Michigan's Biomass Potential

Biomass Resources	Thousand Dry Tonnes	National Rank[a]
Crop Residues	3,586	14
Forest Residues	1,275	17
Primary Mill Residues (unused)	1,314 (41)	17
Secondary Mill Residues	86	10
Urban Wood Residues	1,196	8
Switch grass	1,451	16
Willow or Hybrid Poplar	1,410	12
Total Biomass	**10,318**	**22**

Source: U.S. Department of Energy, NREL/TP-560-39181, "A Geographic Perspective on the Current Biomass Resource Availability in the U.S.," Dec. 2005.

Analysis: Anderson Economic Group, LLC

a. National rank of "1" indicates the state with the most biomass resources.

TABLE A-6. Michigan's Renewable Energy Potential from Biomass, Water, and Wind

Resource	Current Production	Ethanol Potential	Biodiesel Potential	Electricity Potential	Electricity Potential as% of Total Net Electricity Generation in 2005
Biomass[a]	314 million gallons of ethanol; 35 million gallons biodiesel	712 million gallons	111 million gallons	2.1 billion kWh	*1.7%*
Water[b]	1.274 billion kWh	--	--	5.4 billion kWh	*4.4%*
Wind[c]	22 million kWh	--	--	65 billion kWh	*53.4%*

memo: By maximizing electricity potential from all three resources, Michigan could have generated almost 60% of its net generation in 2005 from these renewable resources.

Source: U.S. Department of Energy, Energy Efficiency and Renewable Energy, the Energy Information Administration, the American Wind Energy Association, and the National Renewable Energy Laboratory
Analysis: Anderson Economic Group, LLC

a. Biomass assumes 30% crop usage limit for corn production and a 2005 technology ethanol yield that includes 65.3 gal/dry metric ton for agricultural residues using biochemical conversion or 63.2 gal of ethanol per dry metric ton of forestry residue and urban wood waste using thermochemical conversion. Electricity potential assumes 4.4 kWh/gallon ethanol. Data obtained from the US Department of Energy, Energy Efficiency and Renewable Energy.

b. Considers hydropower plants unused, with power, and without power. Electricity potential is annualized based on 613,000 KW and 8760 hours per year. Data obtained from the American Wind Energy Association.

c. Current wind production is based on 2590 KW power capacity of existing wind projects annualized based on 8760 hours per year. Additional power capacity of projects currently under construction is 528,000 KW or 4.6 billion kWh. Electricity potential is based on the annual average amount of generated electricity from average wind density (7.46 million KW) with estimated land-use exclusions annualized based on 8760 hours per year. Data obtained from the National Renewable Energy Laboratory. and Elliott, D.L., Wendell, L.L., Gower, G.L., "An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States. Pacific Northwest Lab, 1991.

Appendix B. Methodology

OPERATIONAL EXPENDITURES METHODOLOGY

In order to quantify the economic impact of the URC's activities, we asked ourselves the following question: What would the loss be to the state if the Research Corridor universities left Michigan? We then studied the loss in terms of jobs, earnings, and output.

We quantified the *net economic impact*, which we define as the new economic activity directly or indirectly caused by the University Research Corridor, excluding any economic activity that replaces or displaces other activity in the state. We followed the following steps to calculate the economic impact of the URC's operational expenditures.

Determined In-State Expenditures. The first step in estimating the economic impact of the URC's operational expenditures was to determine the payroll and non-payroll expenditures by the URC that remained within the state. We did this in the following steps.

1. We obtained salary, fringe benefit, and non-payroll expenditures for the Research Corridor universities for fiscal year 2006-07 from the National Center for Education Statistics Integrated Postsecondary Education Data System (IPEDS).
2. We relied on information provided by the universities to determine the percentage of expenditures that went to businesses located outside of Michigan.
3. We used data from the universities and the 2006 Consumer Expenditure Survey from the U.S. Bureau of Labor Statistics to calculate URC student expenditures in Michigan, and to account for a percentage of expenditures that go to firms outside Michigan.

Accounted for Likely Substitution. After calculating the non-payroll and payroll expenditures by the URC and student expenditures, we accounted for spending that would have occurred even if the URC were not part of the state's economy. For instruction of Michigan residents, we used a substitution effect of 10%. One way to think about this is that 10% of URC students from Michigan would remain in Michigan for their college degree if the URC disappeared, and that the spending associated with their education would also remain in the state. Thus, this is not *new* economic activity caused by the URC.

We used a zero substitution effect for out-of-state students who come to Michigan. It is unlikely that most out-of-state students would come to Michigan for their bachelor's or advanced degree if the URC were not in operation. We counted the expenditures on the instruction of and spending by these students as new economic activity caused by the URC.

Most research dollars come from out-of-state sources. URC universities receive 94% of all federal research dollars in Michigan. To account for a small increase in research expenditures by other universities in Michigan in the absence of the URC, we chose a small substitution effect of 2% for research expenditures.

We used a substitution effect of 30% for faculty and staff expenditures. We assumed that almost all tenured faculty would leave the URC, but about half the staff would find jobs in Michigan. We used a substitution effect appropriate to the payroll share of staff and faculty that would leave the state. For hospital faculty and staff, we use a 14% substitution effect, assuming that some staff would go to other hospitals in Michigan if the URC universities did not exist.

Finally, we used a substitution effect of 30% for non-payroll hospital expenditures. Based on the operations of the hospital, we accounted for some of the clinical care currently provided by UMHS being taken up by other hospitals in Michigan. We assumed that speciality clinics and most research would go elsewhere.
See Table B-1 below.

TABLE B-1. Substitution Effect Parameters for URC Expenditures Analysis

Category	Parameter
Instruction of Resident MSU Students	0.10
Instruction of Non-resident MSU Students	0.00
Research Dollars	0.02
Student Expenditures	0.06
Faculty Expenditures	0.30
Hospital Expenditures	0.30
Hospital Faculty and Staff	0.14

Source: Anderson Economic Group, LLC

Direct and Indirect Impacts. The *direct* economic impact is calculated as the in-state non-payroll operational expenditures by the URC and the in-state expenditures of URC faculty, staff, and students, after accounting for substitution. This is spending that only occurs in the state because of the URC. See Table B-2 on page B-4.

We calculated the *indirect* economic impact of URC's expenditures by multiplying the direct expenditures by U.S. Department of Commerce's Regional Multipliers (RIMS II). See Table B-2 on page B-4.

HUMAN CAPITAL METHODOLOGY

See our first annual benchmarking study, released in 2007, for our detailed methodology in estimating certain parameters used in alumni earnings

Incremental Alumni Earnings in 2007 Caused by URC

We estimate the additional 2007 earnings using data on URC alumni ($5,025.1 million), using outputs from our human capital model simulation (regarding sorting graduates, as detailed in Appendix B of our 2007 report), and using other data, such as wage and workforce participation data, which were part of our human capital simulation model used in our 2007 analysis.

We followed the following methodology:

1. Estimate the current earnings of Michigan-based URC alumni as detailed in our 2007 URC economic impact report.
2. Estimate the proportion of URC alumni in each counterfactual group (as detailed in our 2007 URC economic impact report) by assuming that all past years' graduating classes exhibited the same behavior as our estimates for the current year's graduating class.
3. Use census and workforce participation data (identical to the human capital simulation model inputs detailed above) to calculate each counterfactual category's total earnings.
4. Subtract the current earnings from the counterfactual earnings to find the *additional* earnings of current URC alumni due to the URC.

Table B-2. Net Economic Impact of URC's Operations

FY 2007 (July 1, 2006 - June 30, 2007)

Direct Expenditures In-State, After Likely Substitution

					Impact in State of Michigan
A.	Instruction of In-State Students (Non-payroll)		$ 1,112,138,036		
	less: expenditures out of state	*40%*	$ (444,855,215)		
	Subtotal: Expenditures in state		$ 667,282,822		
	less: substitution of higher expenditures by other MI colleges & univ.	*10%*	$ (66,728,282)		
				$	600,554,540
B.	Instruction of Out-of-State Students (Non-payroll)		$ 349,868,856		
	less: expenditures out of state	*40%*	$ (139,947,542)		
	Subtotal: Expenditures in state		$ 209,921,313		
	less: substitution of out-of-state students to other MI colleges & univ.	*0%*	$ -		
				$	209,921,313
C.	Research Expenditures (Non-payroll)		$ 290,655,065		
	less: expenditures out of state	*50%*	$ (145,327,533)		
	Subtotal: Expenditures in state		$ 145,327,533		
	less: substitution of more research dollars coming into other MI colleges & univ.	*2%*	$ (2,906,551)		
				$	142,420,982
D.	Student Living Expenses (excludes tuition and fee expenditures)		$ 1,372,399,314		
	less: expenditures out of state	*5%*	$ (68,619,966)		
	Subtotal: Expenditures in state		$ 1,303,779,348		
	less: likely substitution of students to other colleges in MI	*6%*	$ (78,226,761)		
				$	1,225,552,587
E.	URC Employee Earnings & Fringe Benefits, After Taxes (excluding Hospital)		$ 2,720,288,848		
	less: expenditures out of state, savings	*20%*	$ (544,057,770)		
	Subtotal: Expenditures in state		$ 2,176,231,078		
	less: likely substitution to jobs with other universities in Michigan	*30%*	$ (652,869,324)		
				$	1,523,361,755
F.	Hospital Expenditures (Non-payroll)		$ 575,884,000		
	less: expenditures out of state	*20%*	$ (115,176,800)		
	Subtotal: Expenditures in state		$ 460,707,200		
	less: likely substitution of higher spending by other MI hospitals	*30%*	$ (138,212,160)		
				$	322,495,040
G.	Hospital Employee Earnings & Fringe Benefits, After Taxes		$ 1,113,120,140		
	less: expenditures out of state, savings	*20%*	$ (222,624,028)		
	Subtotal: Expenditures in state		$ 890,496,112		
	less: likely substitution to jobs with other health care systems in Michigan	*14%*	$ (124,669,456)		
				$	765,826,656
	Total Direct Expenditures (in state, after substitution)			**$**	**4,790,132,873**

Data Sources: National Center for Education Statistics, IPEDS Finance; URC Universities; 2005 Consumer Expenditure Survey

Indirect Expenditures In-State, After Likely Substitution

A.	Instruction of In-State Students (Non-payroll)	*2.1822*	$	709,975,577
B.	Instruction of Out-of-State Students (Non-payroll)	*2.1822*	$	248,168,977
C.	Research Expenditures (Non-payroll)	*2.1822*	$	168,370,085
D.	Student Living Expenses (excludes tuition and fee expenditures)	*1.3047*	$	373,425,873
E.	URC Employee Earnings & Fringe Benefits, After Taxes (excluding Hospital)	*1.6781*	$	1,032,991,606
F.	Hospital Expenditures (Non-payroll)	*2.1968*	$	385,962,064
G.	Hospital Employee Earnings & Fringe Benefits, After Taxes	*1.7672*	$	587,542,211
	Total Indirect Expenditures (in state, after substitution)		**$**	**3,506,436,392**

Table B-2. Economic Impact of URC's Operations (continued)

Total Direct & Indirect Expenditures In-State, After Likely Substitution		Impact in State of Michigan
A.	Instruction of In-State Students (Non-payroll)	$ 1,310,530,116
B.	Instruction of Out-of-State Students (Non-payroll)	$ 458,090,290
C.	Research Expenditures (Non-payroll)	$ 310,791,067
D.	Student Living Expenses (excludes tuition and fee expenditures)	$ 1,598,978,461
E.	URC Employee Earnings & Fringe Benefits, After Taxes (excluding Hospital)	$ 2,556,353,361
F.	Hospital Expenditures (Non-payroll)	$ 708,457,104
G.	Hospital Employee Earnings & Fringe Benefits, After Taxes	$ 1,353,368,867
	TOTAL NET ECONOMIC IMPACT OF UNIVERSITY OPERATIONS	**$ 8,296,569,265**

Jobs Impact on the State, After Likely Substitution

A.	Number of FTE Faculty, Excluding Hospital		8,241	
	less likely substitution to other jobs in Michigan	*12%*	(989)	
	Subtotal: New faculty jobs in Michigan		7,252	
	** Indirect Employment Multiplier*	*2.20*	8,702	
	Total Faculty in Michigan Caused by URC Operations			15,955
B.	Number of FTE Faculty, Hospital		1,849	
	less likely substitution to other jobs in Michigan	*8%*	(148)	
	Subtotal: New faculty jobs in Michigan		1,701	
	** Indirect Employment Multiplier*	*1.93*	1,589	
	Total Faculty in Michigan Caused by URC Operations			3,290
C.	Number of FTE Staff, Excluding Hospital		28,206	
	less likely substitution to other jobs in Michigan	*40%*	(11,282)	
	Subtotal: New staff jobs in Michigan		16,924	
	** Indirect Employment Multiplier*	*2.00*	16,924	
	Total Staff in Michigan Caused by URC Operations			33,847
D.	Number of FTE Staff in Hospital		10,464	
	less likely substitution to other jobs in Michigan	*20%*	(2,093)	
	Subtotal: New staff jobs in Michigan		8,371	
	** Indirect Employment Multiplier*	*1.93*	7,821	
	Total Staff in Michigan Caused by URC Operations			16,192
	Total Direct & Indirect Jobs Caused by URC			**69,285**

Appendix C: About the Authors

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Ms. Sallee is a consultant at Anderson Economic Group, working in the Public Policy, Fiscal, and Economic Analysis practice area. Ms. Sallee's background is in applied economics and public finance.

Ms. Sallee's recent work includes economic and fiscal impact studies for Michigan State University, and the benchmarking of Michigan's business taxes with other states in a project for the Michigan House of Representatives. She has also completed several technology industry reviews, estimating the wages and employment of technology workers in Southeast Michigan and West Virginia.

Prior to joining Anderson Economic Group, Ms. Sallee worked for the U.S. Government Accountability Office (GAO) as a member of the Education, Workforce and Income Security team. She also has worked as a market analyst for Hábitus, a market research firm in Quito, Ecuador and as a legislative assistant for two U.S. Representatives.

Ms. Sallee holds a master's degree in public policy from the Gerald R. Ford School of Public Policy at the University of Michigan and a Bachelor of Arts degree in economics and history from Augustana College.

PATRICK L. ANDERSON

Mr. Anderson, principal and CEO, founded the consulting firm of Anderson Economic Group in 1996. Since founding the firm, he has successfully directed projects for state governments, cities, counties, nonprofit organizations, and corporations in over half of the United States.

Prior to founding Anderson Economic Group, Mr. Anderson served as the chief of staff of the Michigan Department of State and as a deputy director of the Michigan Department of Management and Budget, where he was involved in the largest state privatization project in U.S. history and the landmark 1994 school finance reform constitutional amendment. Prior to his involvement in state government, Mr. Anderson was an assistant vice president of Alexander Hamilton Life Insurance, an economist for Manufacturers National Bank of Detroit, and a graduate fellow with the Central Intelligence Agency.

Mr. Anderson has written over 100 articles published in periodicals such as *The Wall Street Journal, The Detroit News, The Detroit Free Press, Crain's Detroit Business*. His book *Business Economics and Finance* was published by CRC Press in August 2004, and his paper on "Pocketbook Issues and the Presidency" was awarded the Edmund Mennis Award for best contributed paper in 2004 by the National Association for Business Economics. He is a graduate of the University of Michigan, where he earned a master's degree in public policy and a bachelor's degree in political science.

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