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Empowering Michigan

Eleventh Annual Benchmarking Report of
Michigan's University Research Corridor

Commissioned by Michigan's University Research Corridor

Michigan State University
University of Michigan
Wayne State University

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I.Executive Summary

The University Research Corridor (URC) is an alliance of Michigan's three largest higher education 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.

In 2007, the presidents of the URC universities hired Anderson Economic Group (AEG) to perform the first annual independent analysis of the URC's economic impact and to benchmark its performance against peer universities across the nation. Since the inception of these reports, Anderson Economic Group has typically published the economic impact and benchmarking analyses in the same report. Starting this year, we will publish these analyses in two separate reports. This report is the 11th in the series that contains the benchmarking analysis.

PURPOSE OF REPORT

The purpose of this report is to compare the URC's collective performance to peer university clusters nationwide on their contributions to their state's economy as premier research universities. We benchmark the URC's performance along the following measures:

- Talent;
- Research and development (R&D) expenditures; and
- Technology transfer activities.

OVERVIEW OF APPROACH

Using data from institutional and public sources, we aggregate student enrollment, degrees awarded, R&D expenditures, and technology transfer activity metrics at each URC university and those of peer clusters.

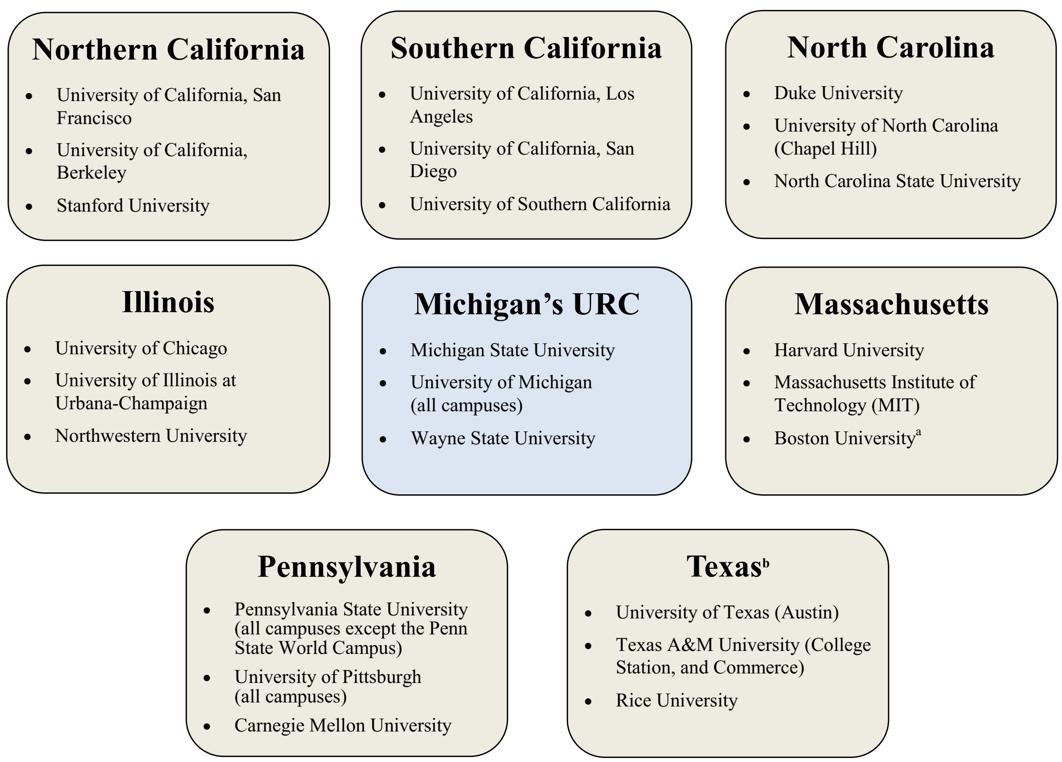
Talent. The URC universities are talent producers, attracting students to the state and preparing graduates to contribute to vital industries—including high-tech, medical, and other high-demand industries. Many of these students remain in the state after graduation, and many alumni become business owners and employees in Michigan. This attraction and retention of talent is vital to assuring innovation and development happens at companies in Michigan. Information about the URC's current students can be found in "Education and Talent Benchmarks" on page 8.

Research and Development (R&D). Each of the URC universities secures billions of dollars to support its faculty, staff, and students in research and development each year. These activities are vital to advancing technologies in both science and engineering (S&E) and non-S&E fields, and promoting basic, applied, and development research. The majority of the URC universities' R&D activities are funded by the federal government, which brings new economic activity into the state. See "Research and Development Benchmarks" on page 15 for details about the URC's R&D activities.

Technology Commercialization. R&D investment at the URC often leads to new inventions or start-up companies, supporting growth and dynamism in Michigan's economy. Patents and licensing activity bring in money to the universities and the state, and attract investment in new technologies. Start-ups that thrive and grow bring jobs and higher incomes to Michigan residents. See "Technology Commercialization Benchmarks" on page 20 for details about the URC's technology commercialization activities.

PEER UNIVERSITY CLUSTERS

FIGURE 1. **Comparison Peer University Clusters**



Source: Anderson Economic Group, LLC

a. In previous reports, we included Tufts in the Massachusetts cluster. Starting in 2013, Boston University has replaced Tufts University in the Massachusetts cluster.
b. The Texas cluster has been included as a peer cluster starting in 2013.

We compare the URC to seven groups of top research universities from across the country. Each cluster includes three universities from the same geographical area. We selected these peer clusters based on academic quality, research intensity, and size of the institutions. Figure 1 on page 2 shows the universities that make up the URC and each of the peer clusters.

KEY BENCHMARKS

The URC universities' combined performance is summarized in Table 1. The remainder of this executive summary and the report lay out these results in greater detail.

TABLE 1. Benchmarks at a Glance

	2007 Report (Data from FY 2006)	2018 Report (Data from FY 2016)	Change Since 2007 Report
Fall Enrollment (Degree-Seeking Only)[a]	129,767	136,554	+6,787
Degrees Granted (bachelors and advanced)	30,337	35,283	+4,947
Total R&D Expenditures	$1.483 billion	$2.280 billion	+$798 million
Innovation Power Composite Rank	--	3	--

Source: AEG analysis using base data from Bureau of Economic Analysis (BEA); U.S. Census Bureau; National Center for Education Statistics Integrated Postsecondary Education Data System (IPEDS); URC Universities National Science Foundation (NSF)

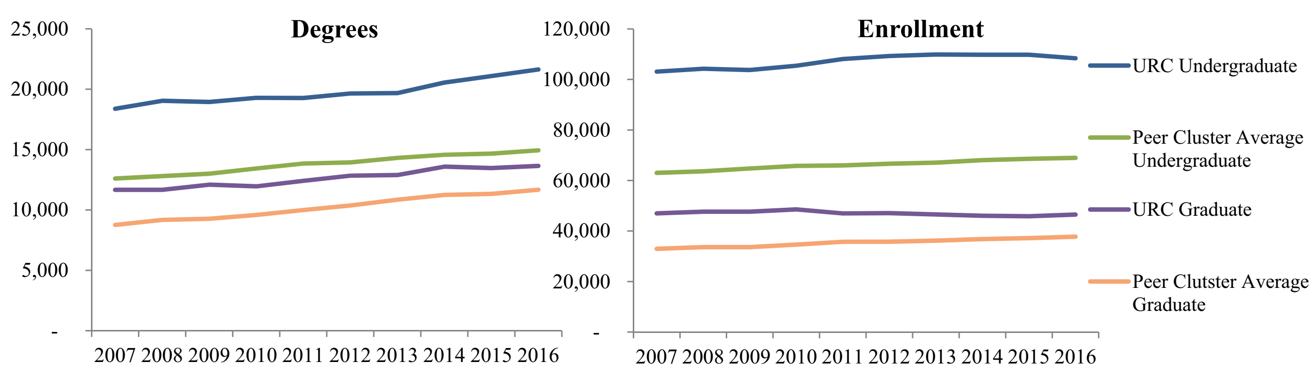
See remainder of report body for detailed sources and calculations.

a. Fall total enrollment for undergraduate and graduate students from the Integrated Postsecondary Education Data System. Information for all years was updated to reflect the most current information reported by the universities.

SUMMARY OF FINDINGS

1. The URC cluster is the largest among peer clusters, ranking first in student enrollment and in a virtual tie for first with California South and Texas for degrees awarded.

FIGURE 2. URC and Peer Cluster Degrees and Enrollment, 2007-2016



Source: AEG analysis using base data from IPEDS Completions and Enrollment, 2007-2016

Student enrollment at the URC has grown over time and has been consistently much higher than peer cluster averages. The URC cluster is the largest among all peer clusters, ranking first in enrollment. In 2016, the URC enrolled nearly 155,000 students, and awarded over 35,000 in undergraduate and graduate degrees. Figure 2 on page 3 shows the growth in student enrollment and degrees conferred since 2007. The California South and Texas clusters both also awarded just over 35,000 degrees in 2016.

2. Total R&D spending by URC universities was $2.3 billion in 2016, ranking fifth among peer clusters. However, the URC's R&D expenditures grew by 6.1% from 2015 to 2016, the third-fastest growth among peer clusters.

One in four of all R&D dollars spent by higher education institutions in the U.S. in 2016 was spent at the URC or one of its peer clusters. In 2016, the URC spent nearly $2.3 billion on research and development, $130 million more than in 2015. Overall, the URC ranks fifth among the eight clusters for total R&D in 2016. Table 2 below details the R&D expenditures in the base year of 2007 and the most recent year of 2016, and highlights the growth for the URC.

TABLE 2. R&D Spending for URC and Peer Clusters, 2007-2016

	2007 R&D Spending	2015 R&D Spending	2016 R&D Spending	Growth, 2015-2016	Growth, 2007-2016
URC	**$1,483**	**$2,150**	**$2,280**	**6.1%**	**53.8%**
Northern California	$2,116	$2,938	$3,135	6.7%	48.2%
Southern California	$2,185	$2,814	$2,826	0.5%	29.4%
Illinois	$1,291	$1,717	$1,760	2.5%	36.3%
Massachusetts	$1,385	$2,333	$2,419	3.7%	74.6%
North Carolina	$1,601	$2,472	$2,591	4.8%	61.8%
Pennsylvania	$1,428	$1,905	$2,045	7.4%	43.2%
Texas	$1,142	$1,666	$1,672	0.4%	46.3%
Peer Cluster Average	*$1,593*	*$2,263*	*$2,350*	*3.7%*	*47.6%*
All U.S. Universities	*$51,551*	*$68,808*	*$71,972*	*4.6%*	*39.6%*

Source: AEG analysis using base data from NSF HERD Survey

While the URC's ranking has stayed constant, its research spending has increased by more than 53% since 2007. This growth far surpassed the growth for the average for all U.S. institutions, as well as the growth for the peer cluster average (39.6% and 47.6%, respectively).

3. URC ranks seventh among peer clusters in technology transfer activities.

One important function of successful university R&D is the transfer of technology to the private sector. University research and development often leads to the production and sale of new products and services in the private sector. The average annual technology transfer activities for URC from 2012 to 2016 rank seventh among peer clusters. In 2016, the URC surpassed its five-year averages for all measures for patent and licensing activity except licensing revenue. The URC supported 20 start-ups in 2016, ranking seventh among peer clusters. Table 3 on page 5 details the average annual technology transfer activities for URC and its peer clusters.

TABLE 3. Average Annual Technology Transfer Activities for URC and Peer Clusters, 2012-2016

	Licenses/ Options	Licensing Revenue	Start-Ups	Patents Awarded	Invention Disclosures
URC	**203**	**$35.7**	**16**	**195**	**621**
Northern California	183	$130.9	43[a]	313	871
Southern California	137	$69.0	43[a]	269	984
Illinois	115	$195.6	23	186	510
Massachusetts	194	$97.3	37	394	1,281
North Carolina	306	$41.4	27	135	654
Pennsylvania	266	$25.5	32	139	711
Texas	103	$30.2	15	138	513

Source: AEG analysis using base data from NSF HERD 2016; University Technology Transfer Annual Reports; AUTM U.S. Licensing Activity Survey 2016; IPEDS 2016

a. Numbers differ by amount smaller than rounding threshold.

4. The URC ranks third among the peer clusters on our overall Innovation Power Ranking.

We compare the URC to peer clusters using our Innovation Power Rankings, a composite ranking system to benchmark the URC and its peer clusters on their overall innovation activity. We define innovation activity as performance on the following three components:

1. Talent;
2. Research spending; and
3. Technology transfer activity.

We rank the university clusters on each of these components separately, and then aggregate them to determine the overall composite ranking for innovation activity. These rankings capture how each cluster contributes to their regional economy through activities that foster innovation and growth. Overall, the URC ranks third out of the eight clusters on our Innovation Power Rankings. We summarize the rankings by component, as well as the composite rankings for each cluster, in Table 4 on page 6.

TABLE 4. Innovation Power Rankings for URC and Peer Clusters, 2016

	Talent	Research Spending	Technology Transfer	Composite Ranking
URC	2	5	7	3
Northern California	8	1	2	2
Southern California	1	2	3	1
Illinois	5	7	6	7
Massachusetts	7	4	1	5
North Carolina	6	3	4	4
Pennsylvania	4	6	5	6
Texas	3	8	8	7

Source: AEG analysis using base data from NSF HERD Survey 2016;University Technology Transfer Annual Reports; AUTM U.S. Licensing Activity Survey 2016; and IPEDS 2016

ABOUT ANDERSON ECONOMIC GROUP

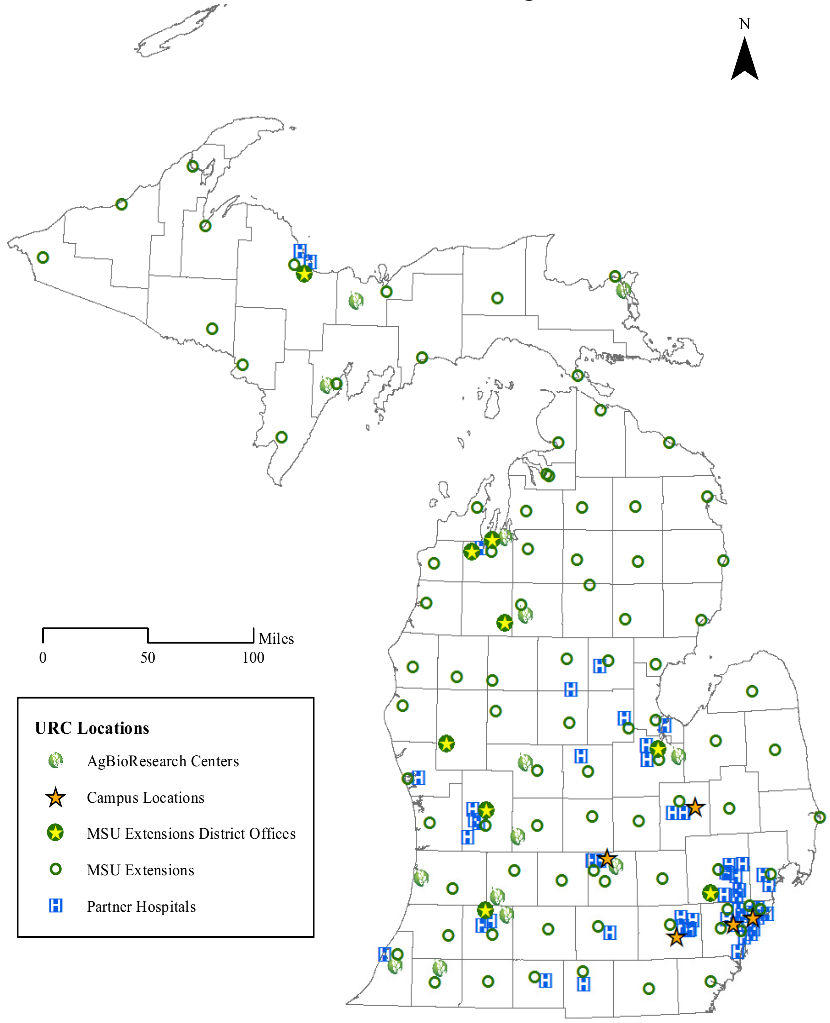
Anderson Economic Group, LLC is a boutique research and consulting firm, with offices in East Lansing, Michigan; Chicago, Illinois; New York, New York; and Istanbul, Turkey. The experts at AEG specialize in economics, public policy, business valuation, and industry analyses. They have conducted nationally-recognized economic and fiscal impact studies for private, public, and non-profit clients across the United States.

The consultants at Anderson Economic Group have extensive experience in evaluating the economic benefits of higher education institutions in Michigan and across the country. Our previous clients include institutions that together represent all nonprofit and public colleges and universities in Michigan. For more information, please see "Appendix C. About Anderson Economic Group" on page C-1 or visit www.AndersonEconomicGroup.com.

II.Michigan's University Research Corridor

Michigan's University Research Corridor (URC) is one of the nation's top academic research clusters and the leading engine for innovation in Michigan and the Great Lakes region. An alliance of Michigan State University, the University of Michigan, and Wayne State University, the URC universities are focused on increasing economic prosperity and connecting Michigan to the world. The URC universities educate Michigan residents, attract talented workers to Michigan, support innovation, and encourage the transfer of new technology to the private sector. The URC universities have main campuses in East Lansing, Ann Arbor, Flint, Dearborn, and Detroit, and their reach extends to all areas of the state. Each URC university has research, teaching locations, and partner hospitals located throughout the state, as shown on Map 1 below.

MAP 1.URC Presence in Michigan, 2016



Source: AEG map using base data from URC Universities

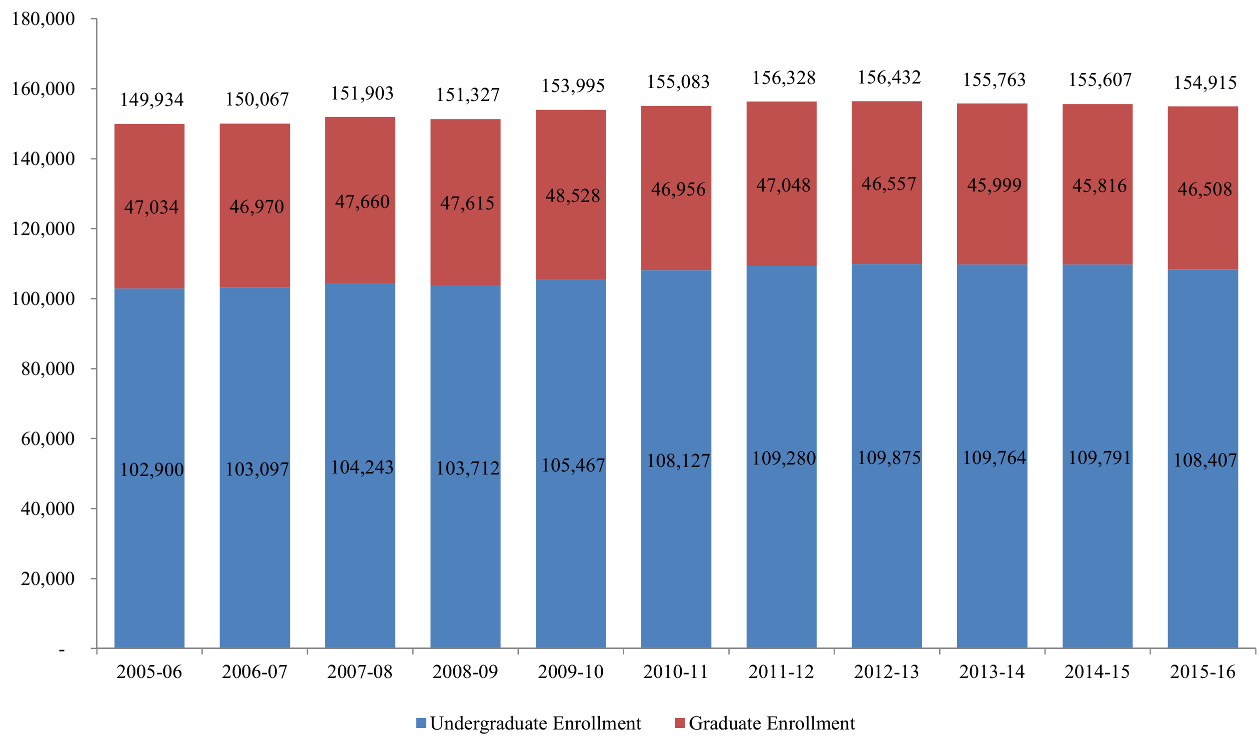
III.Education and Talent Benchmarks

Each year, we compare the URC to peer innovation clusters on metrics related to education, talent, research, and innovation. In this section, we compare URC universities to seven peer clusters on student enrollment and the quantity and nature of degrees awarded, measures of the talent generated and supported at each of these clusters.

STUDENT ENROLLMENT

Student enrollment at the URC has risen by 3.3% since 2005-2006, from just under 150,000 to nearly 155,000. While graduate enrollment increased by 1.5% in 2016, the reduction in the number of students enrolled at the undergraduate level resulted in a slight decrease in the total student enrollment compared to the prior year. Figure 3 below shows enrollment by level from 2006 to 2016.

FIGURE 3. Student Enrollment at the URC, 2006-2016

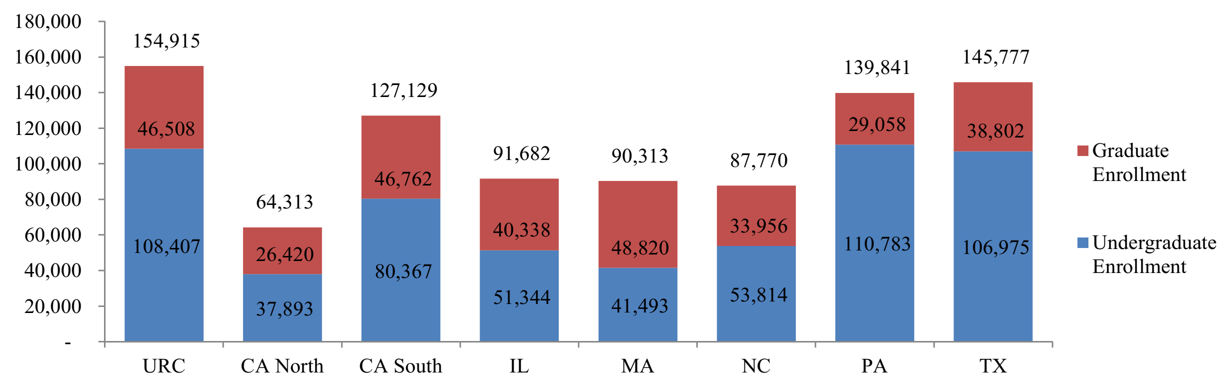


Note: Enrollment numbers are from the most recently available historical IPEDS data for "12-month Enrollment." Past reports used "Estimated Fall Enrollment." IPEDS has discontinued collecting "Estimated Fall Enrollment."

Source: AEG analysis using base data from IPEDS Enrollment, 2005-2006 to 2015-2016 12-month enrollment

As shown in Figure 4 below, the URC has the largest enrollment of any peer cluster, as it has since 2006. Table B-1 on page B-1 details the historical attendance for each of the clusters by level of student.

FIGURE 4. Student Enrollment for the URC and Peer Clusters, 2016



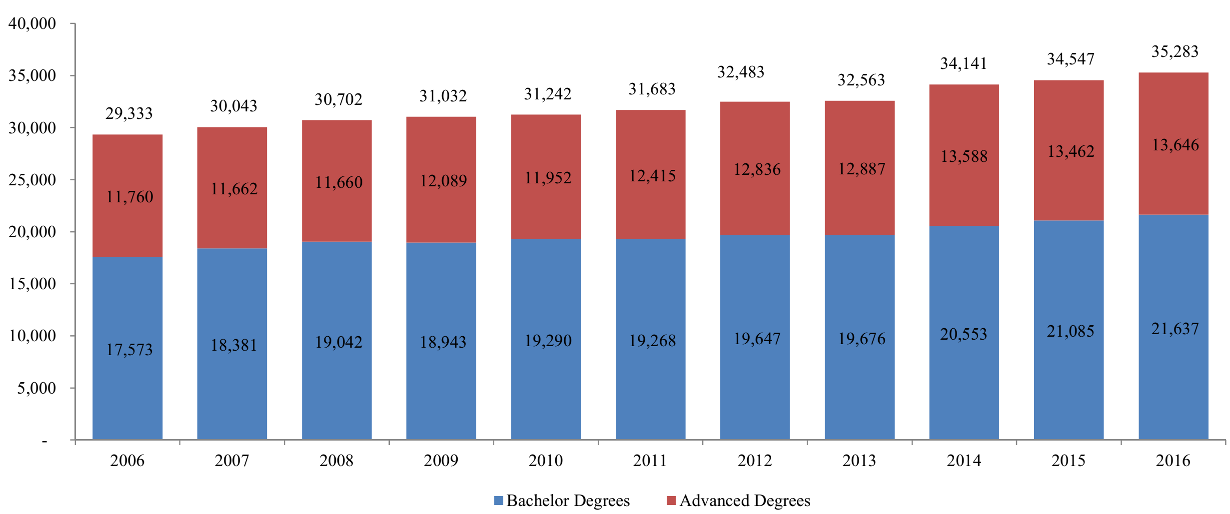
Source: AEG analysis using base data from IPEDS Enrollment, 2015-2016 12-month enrollment

TOTAL DEGREES GRANTED

The number of total degrees awarded by the URC has been on the rise. Since 2006, the number of degrees conferred has increased by over 20%, up from 29,000 to over 35,000. Figure 5 below shows the history of degrees granted by type, showing that the URC has consistently increased completions for each year since 2006.

The number of degrees awarded at the URC universities has increased by over 20% since 2006.

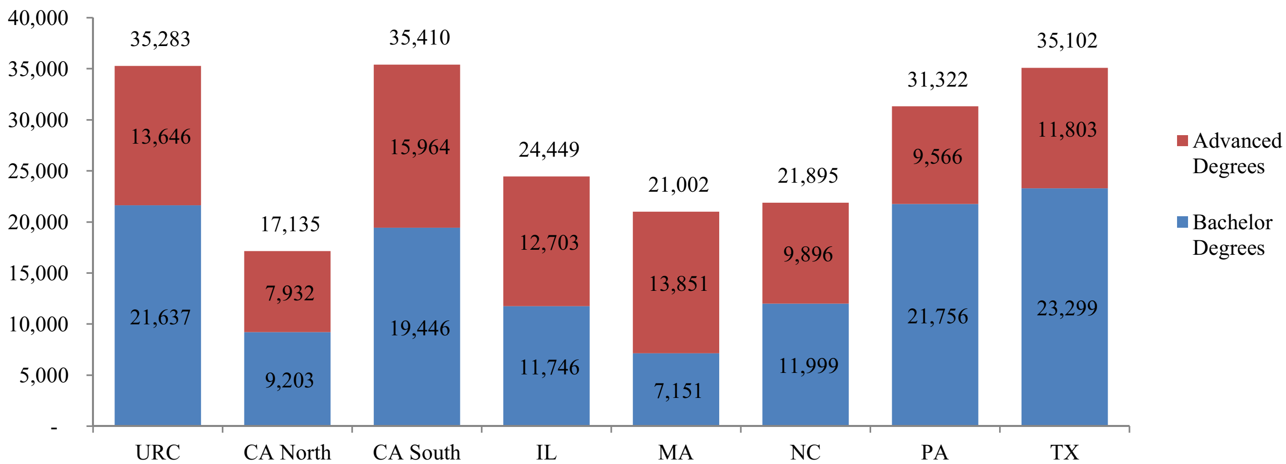
FIGURE 5. Completions by Level of Degree for the URC, 2006-2016



Source: AEG analysis using base data from IPEDS Completions, 2006-2016

In 2016, the URC ranked second in total number of degrees (undergraduate and graduate) conferred, but was virtually tied with California South (1st) and Texas (3rd). As shown in Figure 6 below, the URC issued more than 21,000 bachelor degrees and more than 13,000 advanced degrees. Table B-2 on page B-1 details the number of degrees conferred for each cluster between 2006 and 2016.

FIGURE 6. Completions by Level of Degree for the URC and Peer Clusters, 2016



Source: AEG analysis using base data from IPEDS Completions, 2016

DEGREES BY PROGRAM

The URC offers degrees in nearly every subject categorized by the U.S. Department of Education. We benchmark the number of degrees granted by the URC and the peer university clusters by the following subject areas.

- Physical Science, Agriculture, and Natural Resources
- Business, Management, and Law
- Engineering, Mathematics, and Computer Science
- Liberal Arts
- Medicine and Biological Science
- Other

In 2016, the URC awarded the highest number of advanced degrees in the Medicine and Biological Science fields of any peer university innovation cluster.

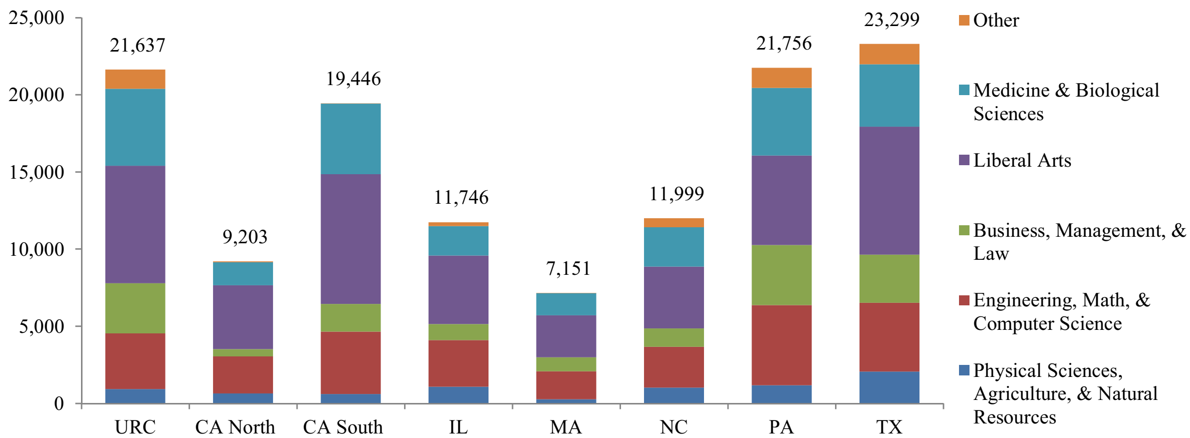
See “Academic Program Definitions” on page A-1 for the composition of each program area.

Undergraduate Degrees Conferred

The URC conferred the third largest number of bachelor degrees overall in 2016, behind the Texas cluster and the Pennsylvania cluster, as shown in

Figure 7 below. For a detailed list of bachelor degrees conferred by field of study, see Table B-3 on page B-2.

FIGURE 7. Undergraduate Degrees Conferred by Area for the URC and Peer Clusters, 2016

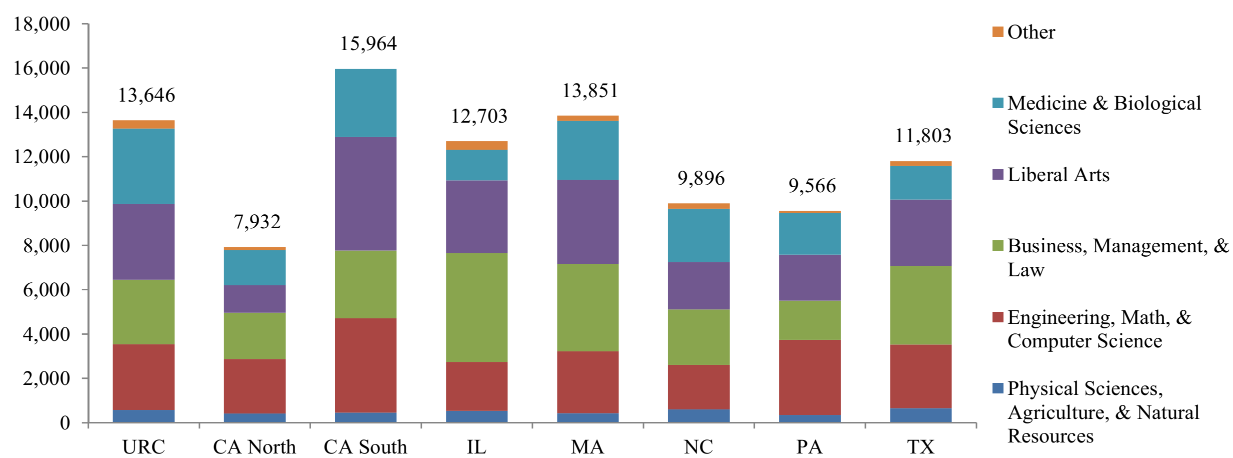


Source: AEG analysis using base data from IPEDS Completions, 2016

Graduate Degrees Conferred

The URC has been the leading cluster in producing graduates with advanced degrees in biology and medical fields for several years, and that trend continued in 2016. The URC awarded the highest number of advanced degrees in *Medicine and Biological Science* fields, and the third-highest amount of advanced degrees overall, as shown in Figure 8 on page 11. Table B-4 on page B-2 lists the amount of advanced degrees conferred by field of study.

FIGURE 8. Graduate Degrees Conferred by Area for the URC and Peer Clusters, 2016



Source: AEG analysis using base data from IPEDS Completions, 2016

HIGH-TECH AND HIGH-DEMAND DEGREES

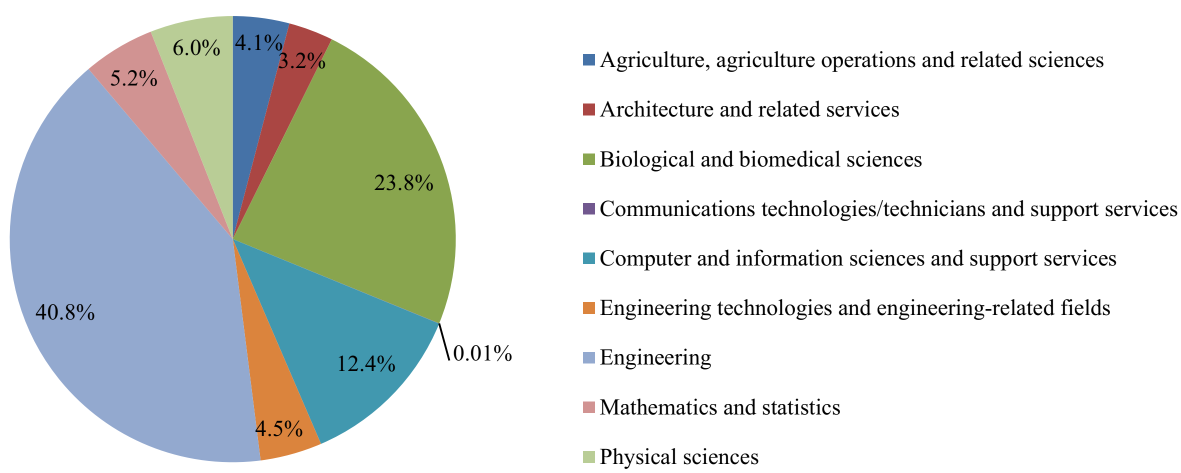
In this section, we identify the number of degrees awarded in each cluster that prepare students for jobs in high-tech industries or jobs that are in particularly high demand. See "High-Tech, High-Demand, and Medical Degrees" on page A-2 for further description of our methodology.

Michigan Governor Rick Snyder announced a Marshall Plan for talent in October 2017, a plan for investment to encourage education and training for high-tech jobs. The URC universities are perhaps the biggest source of that education and training in Michigan. The degrees that we focus on in this section are crucial to the growth of vital industries in the state.

Benchmarking High-Tech Degrees

The URC awarded 10,669 high-tech degrees in 2016. As shown in Figure 9, the largest share of these degrees was awarded in engineering, with the second largest share being awarded in biological and biomedical sciences. A breakdown of high-tech degrees by cluster category can be found in Table B-5 on page B-3.

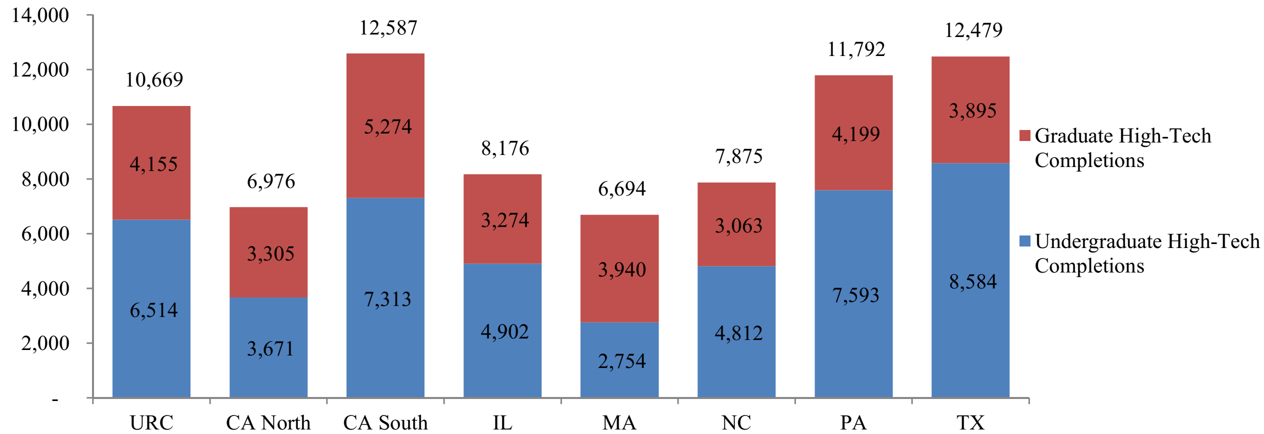
FIGURE 9. URC Completion of Undergraduate and Graduate High-Tech Degrees by Field of Study, 2016



Source: AEG analysis using base data from IPEDS Completions, 2016

As shown in Figure 10 on page 13, the URC awarded the fourth-highest number of undergraduate high-tech degrees, and the third-highest number of advanced high-tech degrees in the 2016 academic year. The URC's total high-tech degrees conferred increased by 7.9% since the previous year. This growth surpassed the peer cluster average, which was 6.3%.

FIGURE 10. Completion of High-Tech Degrees for the URC and Peer Clusters, 2016

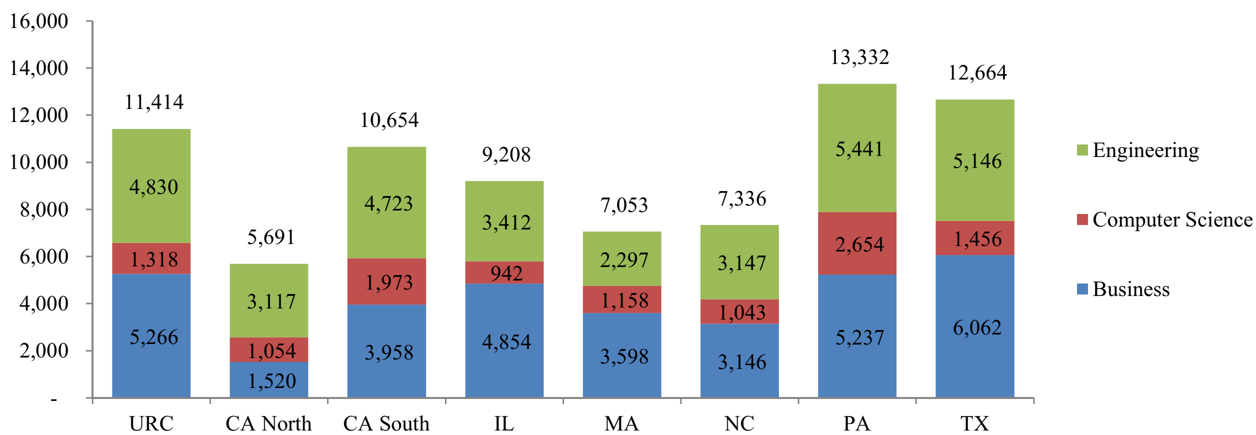


Source: AEG analysis using base data from IPEDS Completions, 2016

Benchmarking High-Demand Degrees

High-demand degrees include those in computer science, engineering, and business.[1] Figure 11 below shows the total number of high-demand degrees conferred by academic area for the URC and each peer cluster. The URC conferred the third-highest number of high-demand degrees overall in 2016.

FIGURE 11. Completion of High-Demand Degrees for the URC and Peer Clusters, 2016



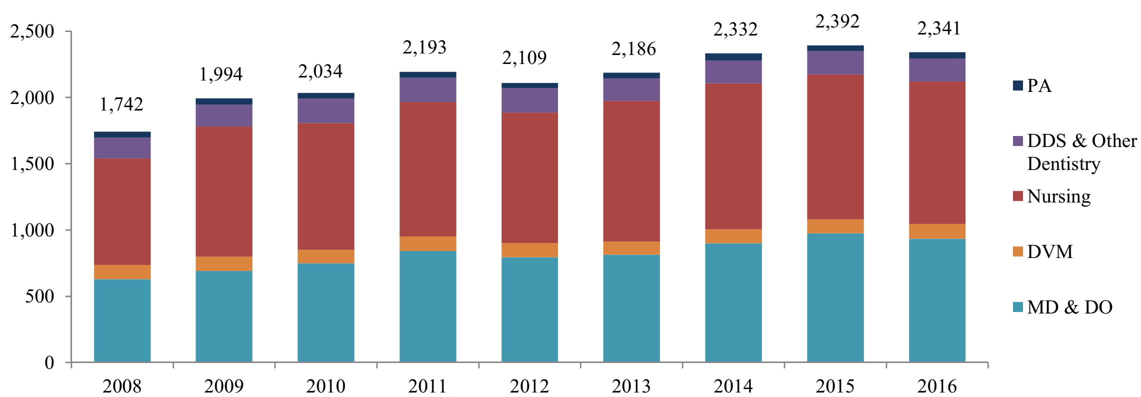
Source: AEG analysis using base data from IPEDS Completions, 2016

1. High-demand degrees include the three fields of study with the highest demand among employers according to the *2017 Job Outlook Report* by the National Association of Colleges and Employers. See "High-Demand Degree Definition" on page A-2 for more information.

Medical Education

The URC universities offer allopathic (MD) and osteopathic (DO) medical schools, along with schools of dentistry (DDS and other dentistry), veterinary medicine (DVM), and physician assistant (PA) programs. Figure 12 shows medical graduates for the URC from 2008 to 2016. The number of medical graduates increased by 28% overall between 2008 and 2016, and the number of graduates receiving DO degrees increased by 123%. For a list of degrees included in these categories, see "Benchmarking Metrics" on page A-1.

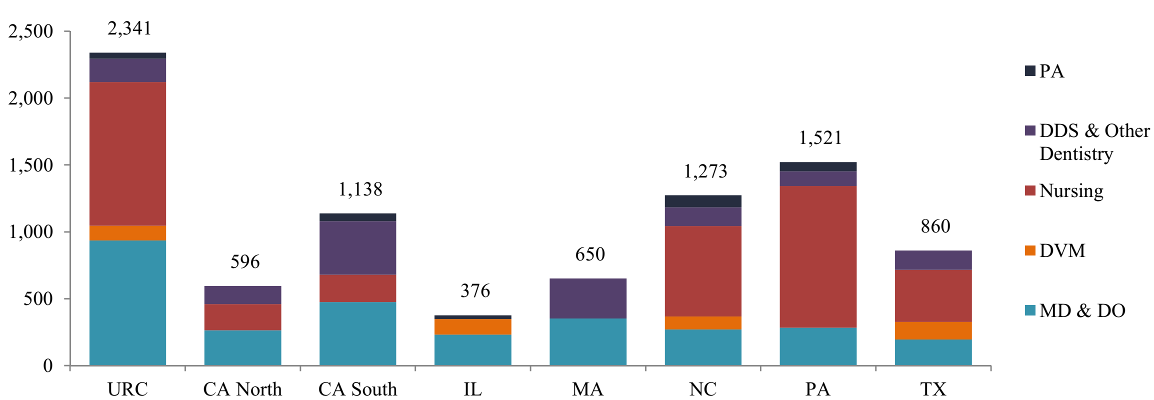
FIGURE 12. URC Medical Graduates by Field of Study, 2008-2016



Source: AEG analysis using base data from IPEDS Completions, 2008-2016

As shown in Figure 13, the URC had the most medical graduates in 2016, far more than any other peer cluster. The URC is the only cluster among the peers that offers a DO program, and it was also the leader in the number of MD and nursing graduates in 2016. See Table B-7 on page B-4.

FIGURE 13. Medical Graduates by Field of Study for the URC and Peer Clusters, 2016



Source: AEG analysis using base data from IPEDS Completions, 2016

IV.Research and Development Benchmarks

In the previous chapter, we highlighted how the URC universities contribute to the talent pool in Michigan by educating students in all fields of study. The URC also plays a big role in research and development activity in Michigan.

Universities across the country secure funding to support billions of dollars for research and development by faculty, staff, and students. Nearly every university in the defined peer clusters is classified as an institution engaging in very high research activity.[2] This section highlights the URC's research and development, and benchmarks the URC against its peers in academic R&D expenditures.

Academic R&D Expenditures

Total R&D expenditures by the eight university clusters totaled nearly $19 billion in 2016, about 26% of R&D expenditures by all U.S. colleges and universities.[3] In 2016, the URC had the fifth-largest R&D expenditures of the eight university clusters at $2.28 billion, accounting for more than 92% of R&D spending at colleges or universities in Michigan.

Using the most recent data available from the National Science Foundation (NSF), we show the sources for R&D expenditures for each university cluster in Figure 5 on page 16. Higher education institutions in Michigan spent nearly $1.3 billion in R&D from federally-financed sources.[4] Ninety-four percent of the federally-funded R&D in Michigan was conducted at the URC.

The URC accounted for 94% of federally-funded R&D expenditures at higher education institutions in Michigan.

The majority of university funding for R&D comes from the federal government, as shown in Table 5 on page 16. While the URC received 53% of its funding in 2016 from the federal government, the URC received less federal

2. "Very high research activity" is a classification designated by the Carnegie Foundation for the Advancement of Teaching, assigned to doctorate-granting institutions with the highest level of research activity. Carnegie classifications have been the leading framework for recognizing and describing institutional diversity in U.S. higher education for the past four decades. The exceptions are UCSF, which is classified as a medical school and medical center, and some of the University of Michigan, Pennsylvania State University, and the University of Pittsburgh campuses.
3. NSF National Center for Science and Engineering Statistics, Higher Education Research and Development (HERD) Survey, FY 2016.
4. This data comes from the NSF HERD survey and includes respondents that only filled out the short-form survey. As a result this number includes both public and private colleges and universities receiving federal research funding.

funding as a percentage of total funding when compared to its peers, except for the Texas cluster (44%) and Northern California cluster (52%).

The URC relies on institutional funds (which come from the universities themselves rather than outside entities) for a significantly higher proportion of its R&D spending than the other seven comparison clusters, as well as the average U.S. university. In 2016, the URC universities relied on their own funds for 35% of total R&D expenditures. This share is also greater than the public university average, which was 27%.

TABLE 5. Source of Funding for URC and Peer Clusters, 2016

	Federal Government	State & Local Government	Institution	Industry[a]	Non-Profits	All Other Sources
URC	53%	2%	35%	4%	4%	2%
Northern California	52%	4%	19%	8%	12%	6%
Southern California	53%	3%	19%	6%	10%	9%
Illinois	61%	2%	23%	6%	7%	2%
Massachusetts	54%	0%	21%	9%	10%	5%
North Carolina	54%	5%	20%	13%	6%	1%
Pennsylvania	64%	3%	20%	3%	4%	4%
Texas	44%	14%	25%	7%	7%	2%
All U.S. Universities	54%	6%	25%	6%	6%	3%

Source: AEG analysis using base data from NSF HERD Survey, 2016

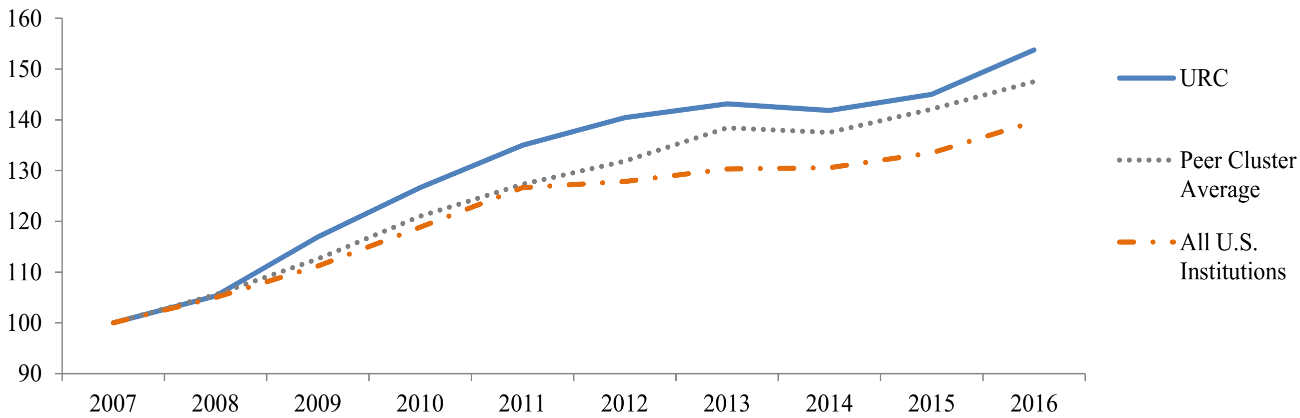
a. This category is labeled "business" in the latest NSF survey, but we have kept the category label "industry" for consistency with prior reports.

From 2007 to 2016, the URC increased R&D expenditures by more than 53%.

From 2015 to 2016, total R&D spending at the URC increased by 6.1%, placing the URC third out of the eight clusters in terms of one-year growth. The growth in R&D spending at the URC exceeded the average growth for institutions across the U.S. As shown in Table 14 on page 17, the URC increased its R&D spending by more than 53% since 2007, which is the third-highest out of its peer clusters during that time, behind only Massachusetts (75%) and North Carolina (62%).

Figure 14 on page 17 compares the growth in URC R&D spending against the average spending of its peers between 2007 and 2016. See Table B-8 on page B-4 for detailed spending data.

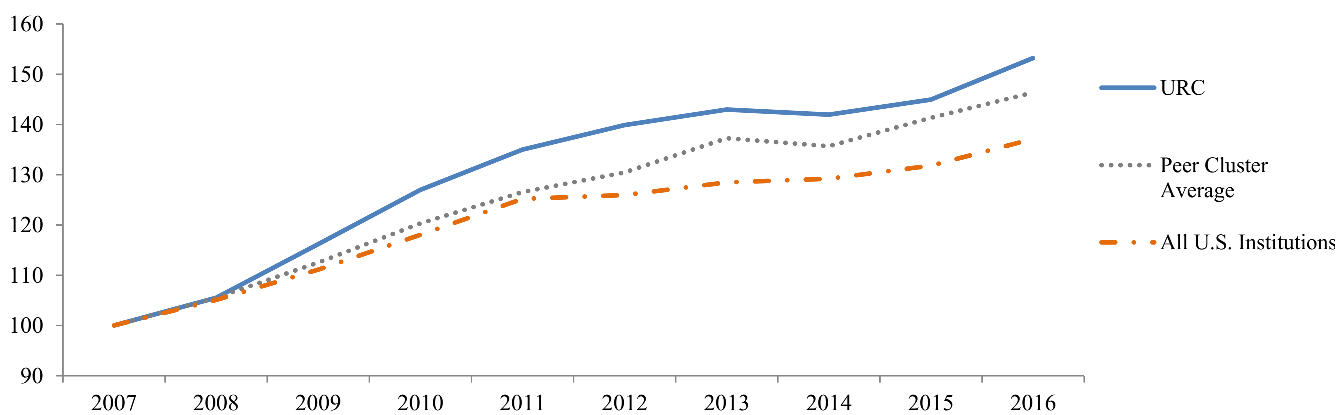
FIGURE 14. Growth in R&D Spending, 2007-2016 (2007 value=100)



Source: AEG analysis using base data from NSF HERD Survey

Between 2015 and 2016, the URC increased science and engineering (S&E) R&D expenditures by 5.7%. This growth exceeded the average increase for all institutions across the U.S. as well as the peer cluster average. Since 2007, the URC increased its S&E R&D spending by 53%, which is the third-highest of the clusters and is higher than the average increase for peer clusters, as well as the average for all U.S. institutions. Figure 15 below shows the growth in R&D spending on S&E for the URC, and the average of its peers. See Table B-9 on page B-5 for the detailed spending amounts for the past two years.

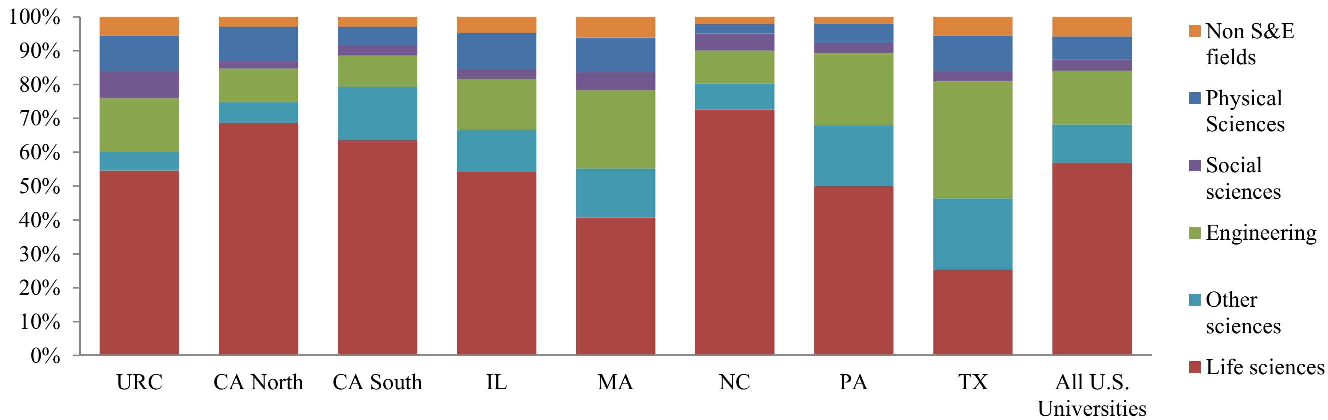
FIGURE 15. Growth in R&D Spending on S&E 2007-2016 (2007 value=100)



Source: AEG analysis using base data from NSF HERD Survey

Research priorities vary across the university clusters, resulting in variation in which fields receive higher a share of R&D funding. By and large, universities focus the greatest share of their spending on S&E fields, as shown in Figure 16 on page 18. Table B-10 on page B-5 details spending amounts by field.

FIGURE 16. R&D Expenditures by Field, 2016



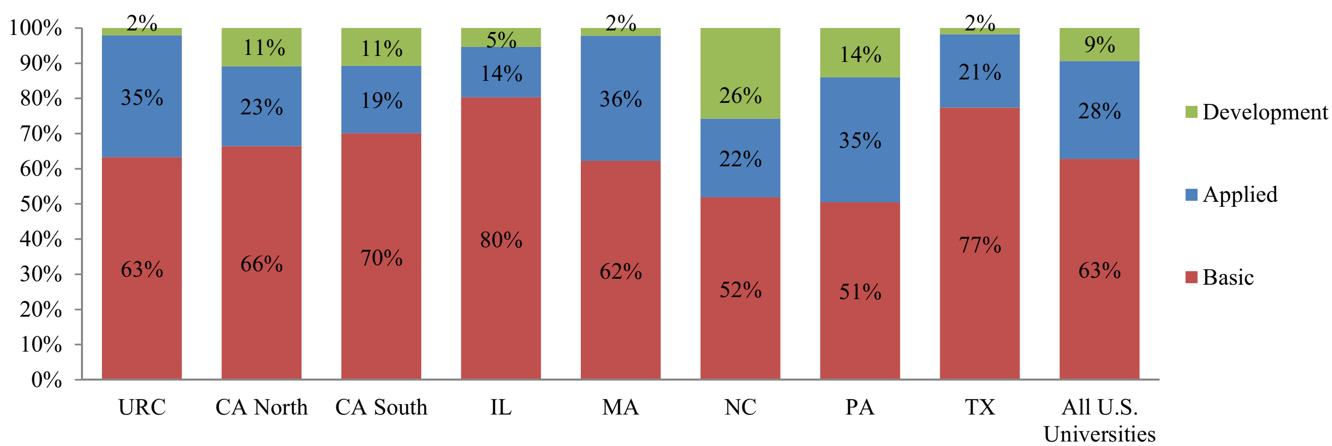
Source: AEG analysis using base data from NSF HERD Survey, 2016

The shares of R&D spending by field for the URC are mostly consistent with national averages. The only exception is in the "other sciences" category, where the URC spends a significantly lower share on environmental sciences and a higher share on social sciences than the national average.

Expenditures by Research Type

There are three general categories of academic research: basic, applied, and development.

FIGURE 17. Share of R&D Expenditures Spent on Basic, Applied, And Development Research by URC and Peer Clusters, 2016



Source: AEG analysis using base data from NSF HERD Survey, 2016

The NSF defines *basic research* as research undertaken primarily to acquire knowledge without any particular application or use in mind, and *applied research* as research conducted to meet a specific, recognized need. *Development* is the systematic use of research towards the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes.

In Figure 17 on page 18, we show the percentage of R&D funds going toward basic research, applied research, and development. The URC spends the second-highest amount of their funding on applied research (35%) behind only the Massachusetts cluster (36%).

V.Technology Commercialization Benchmarks

An important function of successful university R&D is the transfer of new technology to the private sector. University R&D expenditures support the research activity of students, faculty, and staff at the university. Technology transfer (or technology commercialization) offices at universities support moving developments and discoveries made in the university setting to the private sector.

Tech transfer allows technology innovation and improvements to reach a larger audience. These offices assist with invention disclosures, patent applications, licensing, and entrepreneurial support. Patents and licensing activity bring in money to the universities and the state, and attract investment in new technologies. Start-ups that thrive and grow bring jobs and higher incomes to Michigan residents.

This section describes the URC's technology transfer activities, and benchmarks the URC against its peers in technology commercialization.[5]

Patents and Licensing

Patent and licensing activity includes invention disclosures, patents issued, licensing and options agreements, and licensing revenue. While the number of patent applications and invention disclosures in a single year may provide a rough indication of success of the research and development at a university, it will not necessarily show the effectiveness of that research and development reaching the private sector. We find that the statistics on other services provided by tech transfer offices, such as patents granted, number of licenses, royalty revenue, and the number of new start-ups more directly reflect the impact of innovation on the private sector.

Since these numbers tend to be volatile, we focus on the most recent 5-year averages to make meaningful comparisons. In Table 6 on page 21, we show each of these metrics for the URC, and we benchmark the URC's performance against peer clusters.

In 2016, the URC surpassed its five-year averages for all measures for patent and licensing activity, except licensing revenue. Among its peer clusters, the URC ranks sixth in invention disclosures, fourth in average annual number of patent grants, third in licenses and options issued, and sixth in licensing revenue.

5. For a more in-depth discussion about technology commercialization at the URC universities, see "Embracing Entrepreneurship: The URC's Growing Support for Entrepreneurs in Michigan and Throughout the World," Anderson Economic Group LLC, East Lansing, May 2013.

TABLE 6. Average Annual Patent and Licensing Activity for URC and Peer Clusters, 2012-2016

	Invention Disclosures	Rank	U.S. Patent Grants	Rank	Licenses/ Options	Rank	Licensing Revenue (in millions)	Rank
URC	621	6	195	4	203	3	$35.7	6
Northern California	871	3	313	2	183	5	$130.9	2
Southern California	984	2	269	3	137	6	$69.0	4
Illinois	510	8	186	5	115	7	$195.6	1
Massachusetts	1281	1	394	1	194	4	$97.3	3
North Carolina	654	5	135	8	306	1	$41.4	5
Pennsylvania	711	4	139	6	266	2	$25.5	8
Texas	513	7	138	7	103	8	$30.2	7

Source: AEG analysis using base data from universities' websites and technology transfer offices; Association of Technology Managers (AUTM) Surveys
See "Methodology" on page A-1 for detailed sources by cluster.

One measure of R&D success is the amount of licensing revenue generated by each dollar spent in the science and engineering fields. Since licensing revenue can have large year-to-year variations, we compared the average revenue to the S&E R&D expenditures over a five-year period (2012-2016). Table 7 below shows that the URC is sixth on this metric, ahead of the North Carolina and Pennsylvania clusters.

TABLE 7. Average Annual Licensing Revenue as a Percentage of S&E R&D Expenditures at URC and Peer Clusters, 2012-2016

	Average Licensing Revenue 2012-2016 (in millions)	Average S&E R&D Expenditures 2012-2016 (in millions)	Licensing Revenue as a Percentage of S&E R&D Expenditures	Rank
URC	$35.5	$2,031	1.8%	6
Northern California	$130.9	$2,745	4.8%	2
Southern California	$69.0	$2,670	2.6%	4
Illinois	$195.6	$1,644	11.9%	1
Massachusetts	$97.3	$2,092	4.7%	3
North Carolina	$41.4	$2,401	1.7%	7
Pennsylvania	$25.5	$1,920	1.3%	8
Texas	$30.2	$1,496	2.0%	5

Source: AEG analysis using base data from universities' websites and technology transfer offices; Association of Technology Managers (AUTM) Surveys, NSF HERD Survey, 2016
See "Appendix A. Methodology" on page A-1 for detailed sources by cluster

Start-ups

Over the past several years, the URC has developed and expanded incubators, small business and start-up support services, and grant programs for different stages of business development. These services, along with the relationships the URC has fostered with local communities and businesses, contribute to the success of start-ups at the URC universities for students, alumni, and the community.[6] The URC's reach spans farther than only those start-ups, which use URC-licensed technology.

In 2016, URC produced 20 start-ups, ranking last among its peers. The URC ranked seventh among its peers based on the most recent five-year average. On average, 16 new companies are started each year with licensed technology from a URC university. Since 2002, the URC has cultivated 230 start-up companies, 81 of which have formed within the past five years. Table 8 below shows the number of start-ups for the URC and peer clusters from 2012 through 2016.

TABLE 8. Number of Start-ups Cultivated at University Clusters, 2012-2016

	2012	2013	2014	2015	2016	Average, 2012-16	Rank
URC	14	10	15	22	20	16	7
Northern California	34	25	42	51	63	43[c]	2
Southern California	32	38	48	55	44	43[c]	1
Illinois[a]	20	20	20	28	27	23	6
Massachusetts[b]	30	29	38	45	42	37	3
North Carolina	19	31	26	28	29	27	5
Pennsylvania	24	42	25	30	41	32	4
Texas	6	8	18	19	24	15	8

Source: AEG analysis using base data from universities' websites and technology transfer offices; Association of Technology Managers (AUTM) Surveys.
See "Appendix A. Methodology" on page A-1 for detailed sources by cluster

a. The five-year average (2006-2010) for the University of Chicago's start-ups was used as the 2011 number because it was unavailable.

b. The five-year average (2010-2014) for the Boston University's start-ups was used as the 2015 number and the five-year average (2011-2015) was used as the 2016 number because they were unavailable.

c. Numbers differ by amount smaller than rounding threshold.

6. For a detailed discussion of the resources the URC offers to start-ups and other entrepreneurial endeavors, see "Embracing Entrepreneurship: The URC's Growing Support for Entrepreneurs in Michigan and Throughout the World," Anderson Economic Group LLC, East Lansing, May 2013.

VI.Innovation Power Rankings

In the previous sections, we compared the URC to seven peer clusters on enrollment, degrees, research, and technology transfer activity. In this section, we report our Innovation Power Rankings, a composite ranking of the innovation activity for the URC and each of its peer innovation clusters. This composite ranking incorporates the performance of each cluster on many of the metrics discussed earlier in the report, and provides a way to benchmark the URC's overall innovation activity to that of its peer clusters. It is a way to capture the contribution that the university clusters make to their regional economy as a result of their research, talent, and technology transfer activities, and is based on the relative positions of clusters within each category.

COMPONENTS OF INNOVATION POWER RANKINGS

The purpose of the Innovation Power Rankings is to capture the URC and each peer innovation cluster's measurable contributions to innovation from its efforts in the following categories:

- Talent;
- Research spending; and
- Technology transfer activity.

Talent

For the talent component, we rank each university cluster on the total number of degrees awarded and on the total number of high-tech degrees awarded.

We include a talent metric in the composite ranking because the number of degrees awarded approximates a university's contribution to an educated and productive workforce. High-technology degrees reflect graduates that may work in fields in which technology and innovation are key components of the industry. "High-Tech, High-Demand, and Medical Degrees" on page A-2 provides a list of which fields of study are included in high-technology degrees.

Research Spending

Each peer university cluster engages in a high level of research activity, with nearly every school in the peer clusters classified as a very high level research university.

We include total research spending and research spending in S&E fields to determine the research ranking. We do not adjust research spending activity to measure spending per student, spending per research faculty, or any other ratio. As a result, we capture the sheer volume of research at universities.

Technology Transfer Activity

As discussed in “Technology Commercialization Benchmarks” on page 20, technology transfer and commercialization is an important aspect of a university’s contribution to industry. By ranking each cluster on technology transfer activity, we capture how its research and technology efforts are utilized in the private and public sectors. We rank each university cluster on the most recent five-year averages for the following metrics:

- Licensing revenue;
- Start-up companies;
- Patent grants issued;
- Technology licenses issued; and
- Invention disclosures.

See “Appendix A. Methodology” on page A-1 for more details on how we measured the metrics in each component of the composite ranking.

RANKINGS BY CATEGORY

As shown in Table 9, the URC ranks fifth in research, seventh in technology transfer, and second in talent.

We combine these rankings by weighting each cluster’s performance in each category to determine the overall ranking for innovation activity. Research spending and talent each account for 40% of the overall ranking, and technology transfer activity accounts for 20%. These weights reflect the relative time, size of investment, and priority of purpose among research universities.

TABLE 9. Innovation Power Rankings for URC and Peer Clusters, 2016

	Talent	Research Spending	Technology Transfer	Composite Ranking
URC	2	5	7	3
Northern California	8	1	2	2
Southern California	1	2	3	1
Illinois	5	7	6	7
Massachusetts	7	4	1	5
North Carolina	6	3	4	4
Pennsylvania	4	6	5	6
Texas	3	8	8	7

Source: AEG analysis using base data from NSF HERD Survey 2016;University Technology Transfer Annual Reports; AUTM U.S. Licensing Activity Survey 2016; and IPEDS 2016

Overall, the URC ranks third when compared to its peer innovation clusters on in our Innovation Power Rankings. See “Appendix A. Methodology” on page

A-1 for details on how we determined rankings by category. A more detailed display of the URC and peer cluster rankings by metric can be found in Table A-1 on page A-7.

Appendix A. Methodology

This appendix describes the methods used to benchmark the URC against its peer clusters in terms of education and research metrics. The methodology used in this report is consistent with the methodology for benchmarking used in reports in previous years.

BENCHMARKING METRICS

Below we include definitions of degree categories created by AEG and describe any changes to methodology compared to previous years' reports.

Total Degree Completions

The completions data contained in "Total Degrees Granted" on page 9 may not exactly match the numbers in our previous reports. While we continued to use completion data from the Integrated Postsecondary Education Data System (IPEDS) for this analysis, we no longer include second majors. Including both first and second majors over-represented degrees awarded as it double-counts students who may have two majors, but only one degree.

Academic Program Definitions

The academic program areas used in "Degrees by Program" on page 10 are based on the National Center for Education Statistics' Classification of Instructional Programs (CIP) codes from the Integrated Postsecondary Education Data System (IPEDS). The composition of each program area is as 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; and physical sciences.

The *Business, Management, and Law* academic program area includes the following fields of study: legal professions and studies; and 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; and 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; and history.

The *Medicine and Biological Science* academic program area includes the following fields of study: biological and biomedical sciences; psychology; and 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 fields of study; communications technologies/technicians and support services; engineering technologies/technicians; military technologies; and science technologies/technicians.

High-Tech, High-Demand, and Medical Degrees

In the following section, we define these categories of degrees and provide a basic reasoning for how they were created.

High-Tech Degree Definition. AEG's definition of high-tech degrees is one that we use regularly to assess Michigan's high-tech industry in Southeast Michigan.[7] As with the academic definitions, we used the CIP codes in IPEDS to pull degrees that fit our definition of high-tech. These degrees include:

- agriculture, agriculture operations, and related sciences (we include only 10% of this field of study as most agriculture is not high-tech)
- architecture and related services
- biological and biomedical sciences
- communications technologies/technicians and support services
- computer and information sciences and support services
- engineering technologies/technicians
- engineering
- mathematics and statistics
- physical sciences

High-Demand Degree Definition. The three fields of study with the highest demand among employers are business, computer science and engineering, according to a survey done by the National Association of Colleges and Employers. Their 2017 *Job Outlook Report* surveyed approximately 169 employers from a variety of sectors and found that computer science,

7. Anderson Economic Group, *Driving Southeast Michigan Forward*, prepared for Automation Alley (November 2008).

engineering, accounting, finance, and business administration were in the most demand by employers.

For the purposes of this analysis we combined the three business related majors (accounting, finance, and business administration) into one category due to substantial overlap between these degrees at the undergraduate level in many universities. Our data source (IPEDS) does not distinguish clearly between them.

Additionally, for engineering degrees awarded, we included "engineering" and "engineering technologies/technicians," because the IPEDS database presents highly related concentrations under each and they likely signal similar skill sets in the entry-level job market.

Medical Degrees. For this analysis, we used the following IPEDS categories to represent the medical field:

- Medicine Doctor's degree—professional practice
- Osteopathic Medicine/Osteopathy Doctor's degree—professional practice
- Veterinary Medicine Doctor's degree—professional practice
- Registered Nursing, Nursing Administration, Nursing Research, and Clinical Nursing (Bachelor's, Master's, and Doctor's degrees)
- Dentistry Doctor's degree—professional practice
- Advanced/Graduate Dentistry and Oral Sciences (Master's and Doctor's degrees)
- Dental Support Services and Allied Professions (Bachelor's and Master's degrees)
- Physician Assistant (Master's degree)

R&D Expenditures

The data reported to IPEDS for research expenditures are lower than the research expenditures reported to the National Science Foundation because they include different things. 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.

The science and engineering (S&E) fields used in "Academic R&D Expenditures" on page 15 are based on the NSF's survey of higher education institutions. The composition of each S&E field is as follows:

- Environmental sciences includes atmospheric and earth sciences, oceanography, and other miscellaneous sciences.
- Life sciences includes agricultural, biological, medical, and other miscellaneous life sciences.

- Physical sciences includes astronomy, chemistry, physics, and other miscellaneous physical sciences.
- Social sciences includes economics, political sciences, sociology, and other miscellaneous social sciences.
- Engineering includes aeronautical, biomedical, bioengineering, chemical, civil, electrical, mechanical, metallurgical, and other engineering fields.

Technology Transfer Information

For information on invention disclosures, patent grants, licenses and options, and licensing revenue, we relied on data provided by the URC universities, universities in each peer cluster, as well as the Association of University Technology Managers (AUTM) Surveys. For each cluster, we obtained the data from the following detailed sources:

- *URC*: Michigan State University, the University of Michigan, and Wayne State University information was obtained from the URC.
- *Northern California*: The University of California provided statistics for all their campuses through their Office of Technology and its Annual Reports for 2005-2016. Stanford University provided all statistics for 2005-2013 through their website and Office of Technology Licensing. Stanford's 2014, 2015 and 2016 data was obtained through the AUTM survey.
- *Southern California*: The University of California provided statistics for all their campuses through their Office of Technology and its Annual Reports for 2005-2016. USC data for 2006 and 2013-2016 was collected from the AUTM survey and through USC's Stevens Institute for 2007-2012.
- *Illinois*: Northwestern University provided all statistics for 2006-2009 through their website. Northwestern data for 2010, 2014, and 2015 was collected from the AUTM survey. Northwestern data for invention disclosures and patent grants in 2016 was obtained from its FY2016 Impact Report, while the rest of the 2016 data was collected from the AUTM survey as those numbers were not made available in the said report. Northwestern data for 2011 was collected from the Innovation and New Ventures Office, and data for 2012 and 2013 was found on page 61 of their annual report entitled "Northwestern University Research: Creating New Knowledge, Annual Report 2012." University of Chicago provided all statistics through their Office of Technology & Intellectual Property for 2005-2012 and the AUTM survey for 2013 through 2016. University of Illinois, Urbana-Champaign provided all statistics through their Office of Technology Management website.
- *Massachusetts*: MIT reported 2004-2016 data on their website via downloadable reports; however, licensing revenue and patent numbers were obtained and/or verified through AUTM, as patent data was not made available and licensing revenue numbers were unreadable in said reports. Boston University data for 2005-2016 was obtained through AUTM. Harvard data was collected from the 2006 and 2014 AUTM survey and through Harvard's Office of Technology Development for 2007-2013, 2015 and 2016.
- *North Carolina*: Data for UNC-Chapel Hill was collected from their Office of Technology Development for 2002-2014 and from the AUTM survey for 2015

and 2016. Data for Duke University was provided by AUTM in 2006, 2014, 2015, and 2016 and through their Office of Licensing & Ventures for 2007-2013. North Carolina State University data were collected from their Office of Technology Transfer.

- *Pennsylvania*: Pennsylvania cluster data from 2002-2013 was obtained from the University of Pittsburgh's Office of Technology Management, Penn State's Intellectual Property office, Carnegie Mellon's Center for Technology Transfer and Enterprise Creation, and the 2006 AUTM surveys. The 2014-2016 data for all were collected from the AUTM survey.
- *Texas*: Data for Texas A&M was provided by their Technology Commercialization office for 2002-2013 and by AUTM for 2014-2016. Data for The University of Texas at Austin from 2005-2016 was provided by their Office of Technology Commercialization, while data from 2002-2004 was provided by AUTM (with the exception of number of licenses/options, which had no data reported for the aforementioned years). Rice University also had no license/option numbers to report (via AUTM) for 2002-2004, however, the rest of the university data from 2002-2006 was reported to and obtained from AUTM. Rice University data for 2007-2013 was from their Office of Technology Transfer and the data for 2014-2016 was from the AUTM survey.

INNOVATION POWER RANKINGS

In 2013, we included a new element: a composite ranking, which rates the URC's performance relative to its peer clusters for research spending, talent, and technology transfer activity. We ranked the URC on each of those three components separately, and then combined the rankings for an overall, composite ranking.

Talent

The talent component is based on the total number of degrees awarded, as well as the number of high-technology degrees awarded. High-tech degrees are listed in "High-Tech Degree Definition" on page A-2. We weighted these ranks at 80% and 20%, respectively, to determine the overall ranking for talent.

Research

For the research component, the clusters are ranked on total research spending, as well as spending on science and engineering R&D. We weighted these ranks at 80% and 20%, respectively, to determine the ranking for research.

Technology Transfer

The technology transfer and commercialization rankings are composed of each cluster's ranks for the five-year averages (2012-2016) of the following five measures:

- Licensing revenue
- Start-up companies

- Patent grants issued
- Technology licenses issued
- Invention disclosures

Licensing revenues and start-ups provide the strongest direct measures of how valuable university R&D efforts are to the private sector. Therefore, we weighted rankings for licensing revenues and start-up companies as half of the total technology transfer ranking, and the other three measures are equally weighted to make up the other half of the overall ranking.

Overall Composite Ranking

Once we determine the overall rankings for research, talent, and technology transfer activity, we use a weighted average to combine them into a single composite ranking for each cluster. We weight talent and research at 40% each, and weight tech transfer and commercialization at 20% of the final ranking. What metrics to include and how to weight them involves subjective judgement. Our goal is to combine the metrics for which we have high-quality data (those included in this report) into the best possible overall measure of a cluster's contribution to innovation.

We weight research and talent more heavily than technology transfer for two reasons. First, for most universities, research and educating students are more closely related to the institution's core mission than technology transfer, even though the latter is important and becoming increasingly emphasized. Second, while we believe the technology transfer metrics we use are the best available, they do not capture the universities' impacts on technology and practices outside of the universities as well as the talent and research metrics in their respective areas. University R&D reaches practical application outside the universities through a variety of channels, including formal technology transfer, research partnerships, and the education of students who may take what they have learned in the lab with them to the outside world. Table A-1 on page A-7 displays the detailed rankings by metric for the URC and peer clusters

TABLE A-1. 2016 Innovation Power Rankings for URC and Peer Clusters, Detailed

Cluster		Talent (40% of Composite)	Research Spending Rank (40% of Composite)	Technology Transfer (20% of Composite)	Composite Ranking
URC	Category Rank:	2	5	7	3
	Subcategory Ranks:	Degrees (80%): 2 High-tech Degrees (20%): 4	Total R&D (80%): 5 Total R&D in S&E (20%): 5	Licensing Revenue (25%): 6 Start-up Companies (25%): 7 Patent Grants Issued (17%): 4 Tech. Licenses Issued (17%): 3 Invention Disclosures (17%): 6	
Northern Cal.	Category Rank:	8	1	2	2
	Subcategory Ranks:	Degrees (80%): 8 High-tech Degrees (20%): 7	Total R&D (80%): 1 Total R&D in S&E (20%): 1	Licensing Revenue (25%): 2 Start-up Companies (25%): 2 Patent Grants Issued (17%): 2 Tech. Licenses Issued (17%): 5 Invention Disclosures (17%): 3	
Southern Cal.	Category Rank:	1	2	3	1
	Subcategory Ranks:	Degrees (80%): 1 High-tech Degrees (20%): 1	Total R&D (80%): 2 Total R&D in S&E (20%): 2	Licensing Revenue (25%): 4 Start-up Companies (25%): 1 Patent Grants Issued (17%): 3 Tech. Licenses Issued (17%): 6 Invention Disclosures (17%): 2	
Illinois	Category Rank:	5	7	7	7
	Subcategory Ranks:	Degrees (80%): 5 High-tech Degrees (20%): 5	Total R&D (80%): 7 Total R&D in S&E (20%): 7	Licensing Revenue (25%): 1 Start-up Companies (25%): 6 Patent Grants Issued (17%): 5 Tech. Licenses Issued (17%): 7 Invention Disclosures (17%): 8	
Mass.	Category Rank:	7	4	1	5
	Subcategory Ranks:	Degrees (80%): 7 High-tech Degrees (20%): 8	Total R&D (80%): 4 Total R&D in S&E (20%): 4	Licensing Revenue (25%): 3 Start-up Companies (25%): 3 Patent Grants Issued (17%): 1 Tech. Licenses Issued (17%): 4 Invention Disclosures (17%): 1	
N. Carolina	Category Rank:	6	3	4	4
	Subcategory Ranks:	Degrees (80%): 6 High-tech Degrees (20%): 6	Total R&D (80%): 3 Total R&D in S&E (20%): 3	Licensing Revenue (25%): 5 Start-up Companies (25%): 5 Patent Grants Issued (17%): 8 Tech. Licenses Issued (17%): 1 Invention Disclosures (17%): 5	
Penn.	Category Rank:	4	6	5	6
	Subcategory Ranks:	Degrees (80%): 4 High-tech Degrees (20%): 3	Total R&D (80%): 6 Total R&D in S&E (20%): 6	Licensing Revenue (25%): 8 Start-up Companies (25%): 4 Patent Grants Issued (17%): 6 Tech. Licenses Issued (17%): 2 Invention Disclosures (17%): 4	
Texas	Category Rank:	3	8	8	7
	Subcategory Ranks:	Degrees (80%): 3 High-tech Degrees (20%): 2	Total R&D (80%): 8 Total R&D in S&E (20%): 8	Licensing Revenue (25%): 7 Start-up Companies (25%): 8 Patent Grants Issued (17%): 7 Tech. Licenses Issued (17%): 8 Invention Disclosures (17%): 7	

Source: AEG analysis using base data from NSF HERD Survey 2016;University Technology Transfer Annual Reports; AUTM U.S. Licensing Activity Survey 2016; and IPEDS 2016

Appendix B. Additional Data and Tables

This appendix contains additional detailed data for some of the numbers, tables, and figures presented throughout the report.

EDUCATION AND TALENT BENCHMARKS

The following tables present additional data for students and degrees for the URC and its peer clusters.

Enrollment

TABLE B-1. Student Enrollment for the URC and Peer Clusters, 2007-2016

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
URC	150,067	151,903	151,327	153,995	155,083	156,328	156,432	155,763	155,607	154,915
Northern Cal.	60,891	64,001	61,941	63,428	64,281	62,615	63,548	64,451	63,498	64,313
Southern Cal.	104,739	106,441	108,196	111,145	112,467	114,651	116,445	120,986	124,506	127,129
Illinois	83,477	83,892	84,676	85,874	88,425	89,335	90,051	90,932	91,080	91,682
Mass.	83,120	83,859	85,510	85,325	86,581	87,099	88,948	88,928	89,885	90,313
N. Carolina	80,003	84,655	86,030	87,371	89,229	89,772	89,367	88,324	88,029	87,770
Penn.	138,826	140,105	143,001	145,215	143,880	142,272	139,830	140,610	140,215	139,841
Texas	120,614	117,770	118,995	124,095	126,804	130,483	134,511	139,696	142,875	145,777

Source: AEG analysis using base data from IPEDS Enrollment, 12-Month Enrollment 2006-2007 to 2015-2016

Degrees

TABLE B-2. Number of Degrees Conferred for the URC and Peer Clusters, 2007-2016

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
URC	30,043	30,702	31,032	31,242	31,683	32,483	32,563	34,141	34,547	35,283
Northern Cal.	15,420	15,592	15,833	15,946	16,599	16,856	17,144	16,872	17,044	17,135
Southern Cal.	27,147	28,392	28,599	29,582	31,401	32,180	32,552	33,265	34,208	35,410
Illinois	20,497	21,256	21,340	22,129	22,618	23,061	23,207	23,730	24,154	24,449
Mass.	18,317	19,167	19,115	19,420	19,676	20,008	20,140	20,464	20,576	21,002
N. Carolina	17,062	17,370	18,000	18,524	19,381	20,727	21,105	21,744	21,553	21,895
Penn.	26,409	26,695	27,240	29,642	30,458	30,286	30,255	31,885	31,095	31,322
Texas	24,638	25,378	25,689	25,913	26,705	26,951	31,763	32,769	33,264	35,102

Source: AEG analysis using base data from IPEDS Completions, 2007-2016

TABLE B-3. Number of Undergraduate Degrees Conferred by Field of Study, 2016

	Phys. Sci. Agriculture, & Natural Resources	Engineering, Math. & Comp. Sci.	Business, Manag-ement, & Law	Liberal Arts	Medicine & Biological Sci.	Other	Total
URC	925	3,605	3,250	7,625	4,983	1,249	21,637
Northern Cal.	647	2,405	467	4,144	1,480	60	9,203
Southern Cal.	615	4,030	1,807	8,395	4,588	11	19,446
Illinois	1,076	3,027	1,035	4,444	1,915	249	11,746
Mass.	263	1,812	912	2,721	1,436	7	7,151
N. Carolina	1,030	2,631	1,207	3,998	2,547	586	11,999
Penn.	1,167	5,200	3,889	5,812	4,391	1,297	21,756
Texas	2,054	4,464	3,120	8,307	4,040	1,314	23,299

Source: AEG analysis using base data from IPEDS Completions, 2016

TABLE B-4. Number of Advanced Degrees Conferred by Field of Study, 2016

	Phys. Sci., Agriculture, & Natural Resources	Engineering, Mathematics, & Comp. Sci.	Business, Manage-ment, & Law	Liberal Arts	Medicine & Biological Sci.	Other	Total
URC	574	2,965	2,912	3,418	3,402	370	13,646
Northern Cal.	416	2,458	2,087	1,239	1,586	146	7,932
Southern Cal.	457	4,255	3,050	5,130	3,072	0	15,964
Illinois	533	2,212	4,907	3,285	1,374	392	12,703
Mass.	426	2,789	3,947	3,802	2,654	233	13,851
N. Carolina	601	2,007	2,502	2,137	2,411	238	9,896
Penn.	350	3,386	1,767	2,081	1,887	95	9,566
Texas	658	2,869	3,554	2,986	1,511	225	11,803

Source: AEG analysis using base data from IPEDS Completions, 2016

TABLE B-5. Number of High-Tech Degrees Conferred by Cluster, 2016

	Ag. & Related Sci.	Arch. & Related Services	Bio. & Biomed. Sci.	Comm. Tech., Comp. & Info. Sci. & Support Serv.	Eng., Eng. Tech. & Eng.-related Fields	Math. & Stat.	Phys. Sci.
URC	437	345	2,543	1,319	4,830	555	640
Northern Cal.	29	265	1,273	1,054	3,117	633	605
Southern Cal.	0	605	3,408	1,973	4,723	984	894
Illinois	702	272	1,230	942	3,412	835	783
Mass.	0	481	1,513	1,158	2,297	665	580
N. Carolina	464	155	1,941	1,043	3,147	531	594
Penn.	360	144	1,672	2,654	5,441	532	989
Texas	1,237	447	2,416	1,456	5,146	726	1,051

Source: AEG analysis using base data from IPEDS Completions, 2016

TABLE B-6. Medical Degrees Conferred by Cluster, 2016[a]

	MD	DO	DDS	DVM	Other Dentistry	Nursing	Physician Assistant
URC	634	301	114	110	60	1076	46
Northern Cal.	264	0	107	0	29	196	0
Southern Cal.	475	0	289	0	112	204	58
Illinois	231	0	0	116	0	0	29
Mass.	351	0	232	0	67	0	0
N. Carolina	269	0	79	98	62	676	89
Penn.	282	0	87	0	22	1061	69
Texas	194	0	105	132	39	390	0

Source: AEG analysis using base data from IPEDS Completions 2016

a. For a list of degrees included in these categories, see “Benchmarking Metrics” on page A-1.

TABLE B-7. Number of Medical Degrees Conferred for the URC and Peer Clusters, 2008-2016[a]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	% Change, 2008-2016
URC	1,742	1,994	2,034	2,193	2,109	2,186	2,332	2,392	2,341	34.4%
Northern Cal.	564	525	610	621	609	572	550	566	596	5.7%
Southern Cal.	1,123	1,073	1,075	1,054	1,107	1,086	1,111	1,095	1,138	1.3%
Illinois	361	384	377	401	408	383	416	411	376	4.2%
Mass.	584	578	608	573	609	610	572	648	650	11.3%
N. Carolina	898	954	948	749	1,177	1,115	1,206	1,281	1,273	41.8%
Penn.	940	931	946	1,069	1,147	1,499	1,322	1,406	1,521	61.8%
Texas	549	545	605	648	698	714	805	819	860	56.6%

Source: AEG analysis using base data from IPEDS Completions 2008 - 2016

a. For a list of degrees included in these categories, see "Benchmarking Metrics" on page A-1

RESEARCH AND DEVELOPMENT

The following tables present additional data for research and development funding and expenditures for the URC and its peer clusters.

TABLE B-8. Growth in R&D Expenditures for URC and Peer Clusters, FY2015-2016

	R&D Expenditure (million)			
	FY2015	FY2016	Growth 2015-2016	Rank Growth 2015-2016
URC	$2,150	$2,280	6.1%	3
Northern Cal.	$2.938	$3,135	6.7%	2
Southern Cal.	$2,814	$2,828	0.5%	7
Illinois	$1,717	$1,760	2.5%	6
Mass.	$2,333	$2,419	3.7%	5
N. Carolina	$2,472	$2,591	4.8%	4
Penn.	$1,905	$2,045	7.4%	1
Texas	$1,666	$1,672	0.4%	8
All U.S. Universities	$68,808	$71,972	4.6%	

Source: AEG analysis using base data from NSF HERD Survey, 2015-2016

TABLE B-9. Growth in Science and Engineering R&D Expenditures for URC and Peer Clusters, FY2015-2016

	S&E R&D Expenditure (million)			
	FY2015	FY2016	Growth 2015-2016	Rank Growth 2015-2016
URC	$2,036	$2,152	5.7%	3
Northern Cal.	$2,844	$3,041	6.9%	1
Southern Cal.	$2,736	$2,743	0.3%	7
Illinois	$1,650	$1,675	1.5%	6
Mass.	$2,186	$2,271	3.9%	5
N. Carolina	$2,431	$2,536	4.3%	4
Penn.	$1,878	$2,005	6.7%	2
Texas	$1,578	$1,579	0.1%	8
All U.S. Universities	$65,158	$67,787	4.0%	

Source: AEG analysis using base data from NSF HERD Survey, 2015-2016

TABLE B-10. R&D Spending by Field, FY2016 (thousands)

	Env. Sci.	Life Sci.	Math & Comp. Sci.	Phys. Sci.	Psycho -logy	Social Sci.	Other Sci.	Engin.	All Non-S&E Fields
URC	$16,899	$1,245,448	$54,641	$235,534	$35,377	$184,107	$18,335	$361,984	$127,966
Northern Cal.	$27,789	$2,151,213	$50,153	$315,697	$31,018	$69,024	$85,522	$310,682	$93,687
Southern Cal.	$217,948	$1,798,232	$147,442	$150,288	$47,381	$89,940	$32,749	$259,491	$80,040
Illinois	$16,341	$954,824	$136,775	$187,712	$34,561	$50,074	$28,331	$265,904	$85,146
Mass.	$98,741	$985,500	$115,165	$245,051	$22,430	$131,139	$115,098	$558,054	$148,155
N. Carolina	$52,512	$1,881,614	$70,580	$72,725	$61,497	$130,257	$15,002	$252,026	$54,821
Penn.	$57,265	$1,021,982	$225,605	$117,245	$54,448	$60,898	$31,828	$435,486	$40,681
Texas	$188,868	$422,431	$137,858	$173,464	$14,575	$52,876	$11,895	$576,957	$92,972

Note: Fields determined by NSF. See “R&D Expenditures” on page A-3 for further description of S&E fields.

Source: AEG analysis using base data from NSF HERD Survey, 2016

Appendix C. About Anderson Economic Group

ANDERSON ECONOMIC GROUP

Anderson Economic Group, LLC is a boutique consulting firm founded in 1996, with offices in East Lansing, Chicago, New York, and Istanbul. Our team has a deep understanding of advanced economic modeling techniques and extensive experience in several industries in multiple states and countries. We are experts across a variety of fields in tax policy, strategy and business valuation, public policy and economic analysis, and market and industry analysis.

Relevant publications from our team include:

- *University Research Corridor Annual Economic Impact Reports,* published annually since 2007. This series of reports benchmarks Michigan's research universities (Wayne State University, Michigan State University, and the University of Michigan) against peer clusters across the country, as well as evaluates the collective economic impact on the state of Michigan.
- "Higher Education Performance Tracker", *Business Leaders for Michigan*, published in 2016.
- "2014 Study on Higher Education in the Loop and South Loop," published in 2014.
- "America's Urban Campus: The Economic, Social, and Cultural Contributions of Chicago's Colleges and Universities," published in 2014.
- "The Economic Footprint of Michigan's Fifteen Public Universities," published in 2013.

Past clients of Anderson Economic Group include:

- *Governments:* The government of Canada; the states of Michigan, North Carolina, and Wisconsin; the cities of Detroit, Cincinnati, and Sandusky; counties such as Oakland County, and Collier County; and authorities such as the Detroit-Wayne County Port Authority.
- *Corporations:* Ford Motor Company, First Merit Bank, Lithia Motors, Spartan Stores, Nestle, and InBev USA; automobile dealers and dealership groups representing Toyota, Honda, Chrysler, Mercedes-Benz, General Motors, Kia, and other brands.
- *Nonprofit organizations:* Convention and visitor bureaus of Lansing, Ann Arbor, Traverse City, and Detroit, and Experience Grand Rapids; higher education institutions including Michigan State University, Wayne State University, and University of Michigan; trade associations such as the Michigan Manufacturers Association, Service Employees International Union, Automation Alley, the Michigan Chamber of Commerce, and Business Leaders for Michigan.

Please visit www.AndersonEconomicGroup.com for more information.

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Prior to joining AEG, she worked as an engineer in the petrochemicals industry in Louisiana and as an AmeriCorps VISTA at a non-profit organization in New Orleans. She has also served as a graduate research assistant at Michigan State University.

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