



FISCAL YEAR 2019

RESEARCH AND TECHNOLOGY TRANSFER ACTIVITY REPORT

ABOUT THIS REPORT

The Arizona Board of Regents' Research and Technology Transfer Activity Report is an annual report examining the research and technology transfer activities at Arizona's public universities as well as the facilities used and personnel engaged to support these activities. Research expenditures are reported in total, by funding source and research discipline. Research expenditures data is complimented with comparative national market share and rankings information. Technology transfer activities reported span the technology transfer process from discovery through commercialization.

Data in this report utilizes the definitions and standards established by related national surveys. Research expenditures and research personnel are reported consistent with the National Science Foundation's annual Higher Education Research and Development Survey. Research facilities data reflects the National Science Foundation's biannual Survey of Science and Engineering Research Facilities. Technology transfer activities are reported under the Association of University Technology Managers' annual Licensing Activity Survey standards.

The technology transfer portions of this report are required by ABOR Policy 6-909.10.

ABOUT THE ARIZONA BOARD OF REGENTS

The Arizona Board of Regents is committed to ensuring access for qualified residents of Arizona to undergraduate and graduate institutions; promoting the discovery, application, and dissemination of new knowledge; extending the benefits of university activities to Arizona's citizens outside the university; and maximizing the benefits derived from the state's investment in education.

MEMBERS

Larry Penley, Chair
Lyndel Manson, Chair Elect
Karrin Taylor Robson, Secretary
Ron Shoopman, Treasurer
Bill Ridenour
Fred DuVal
Kathryn Hackett King
Cecilia Mata
Anthony Rusk, Student Regent
Nikhil Dave, Student Regent
Gov. Doug Ducey, Ex-Officio
Superintendent Kathy Hoffman, Ex-Officio

ABOR EXECUTIVE DIRECTOR

John Arnold

EXECUTIVE SUMMARY

Research expenditures across Arizona's public universities grew year-over-year by 5.5 percent to reach \$1.433 billion. All three universities exceeded their research expenditures goals, collectively exceeding the enterprise plan goal of \$1.282 billion by \$150.9 million.

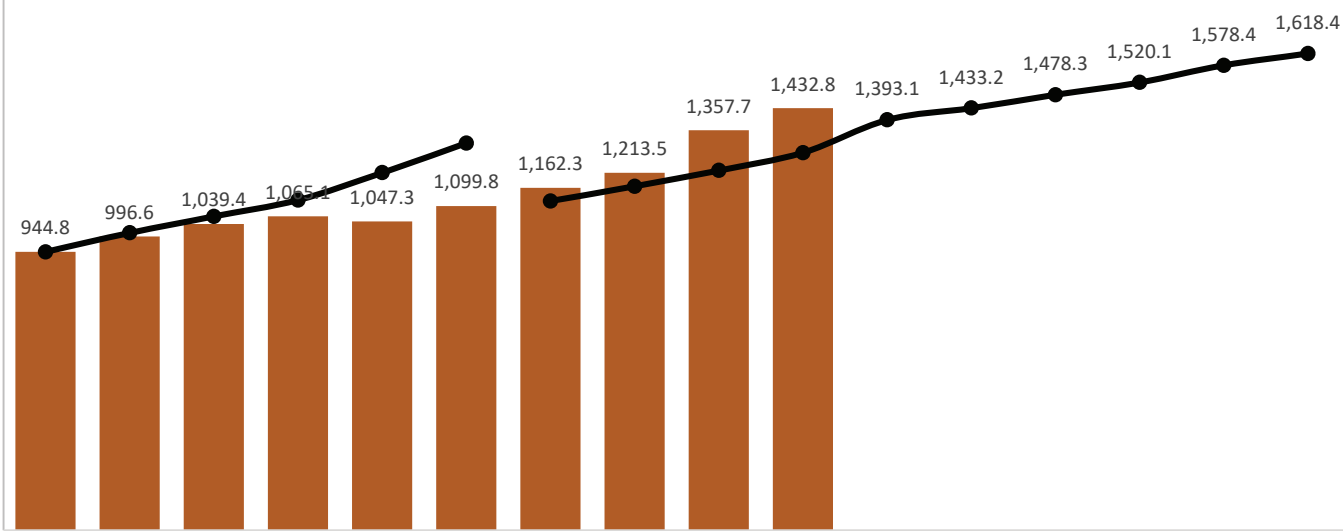
Arizona State University, Northern Arizona University and the University of Arizona all improved their total research expenditure-based national rankings and now rank 41st, 196th and 35th respectively among all U.S. universities and 24th, 144th and 20th among U.S. public universities. Arizona public universities made \$630 million in federally funded research expenditures, awarded by federal government agencies through highly competitive grant and contract programs. The universities' research activities provided wages and/or tuition support for 19,714 faculty staff and students.

Growing research at the universities fueled technology transfer activity with increases in invention disclosures received, new patent applications, and licenses and options income. ASU and UArizona collectively executed 177 licenses and options, exceeding the enterprise plan goal of 173. NAU recorded 50 invention disclosures, exceeding the enterprise plan goal of 31.

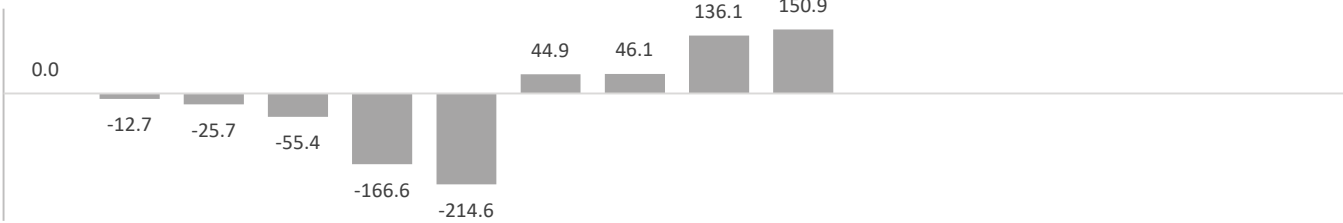
Arizona Public University Enterprise

Exhibit E.R.1: Total Research Expenditures and Enterprise Goals

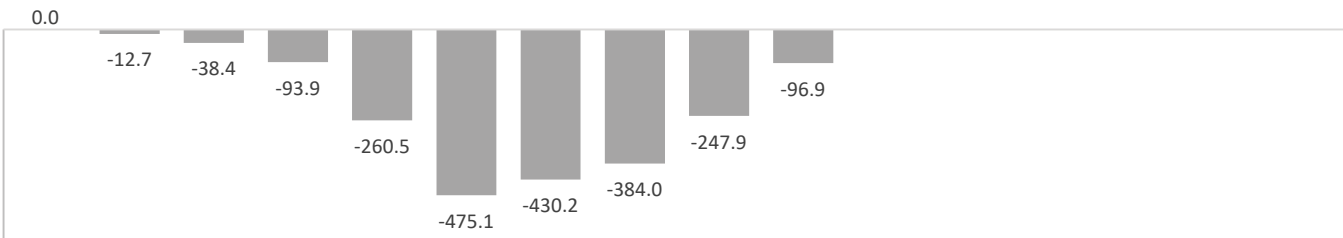
Total Research Expenditures and Enterprise Goals in Millions



Actual to Enterprise Goal Differences in Millions



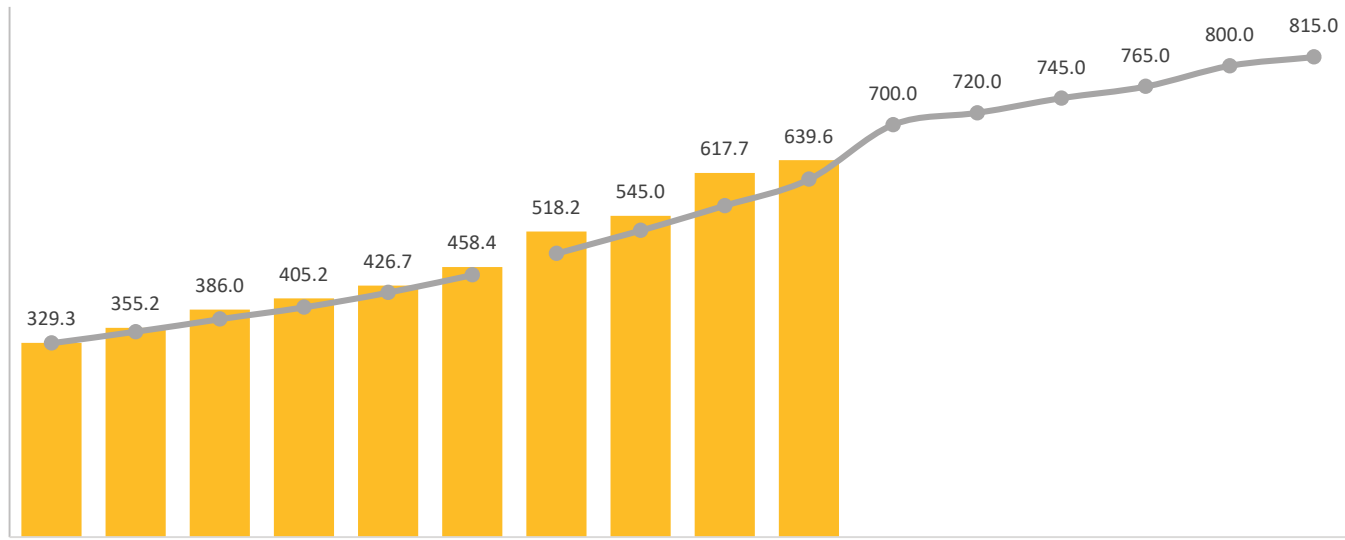
Cumulative Actual to Enterprise Goal Differences in Millions



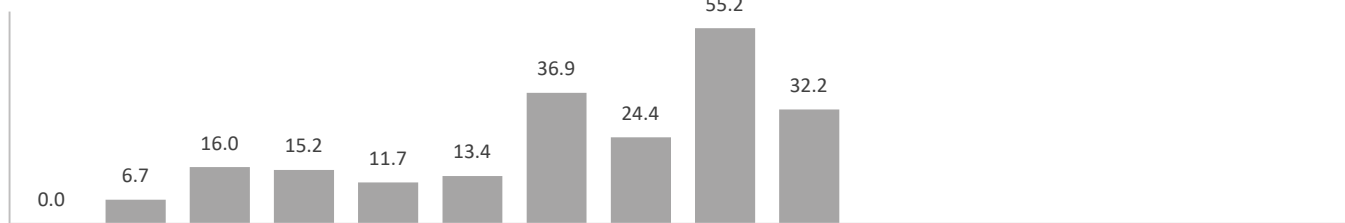
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

Exhibit ASU.R.1: Research Expenditures and Enterprise Goals

Research Expenditures and Enterprise Goals in Millions



Actual to Enterprise Goal Differences in Millions



Cumulative Actual to Enterprise Goal Differences in Millions

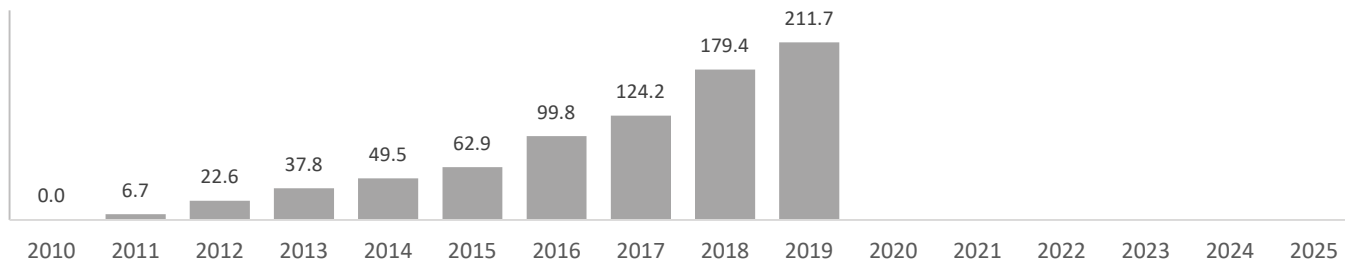


Exhibit ASU.R.2: Other Sponsored Project Expenditures

Other Sponsored Project Expenditures in Millions

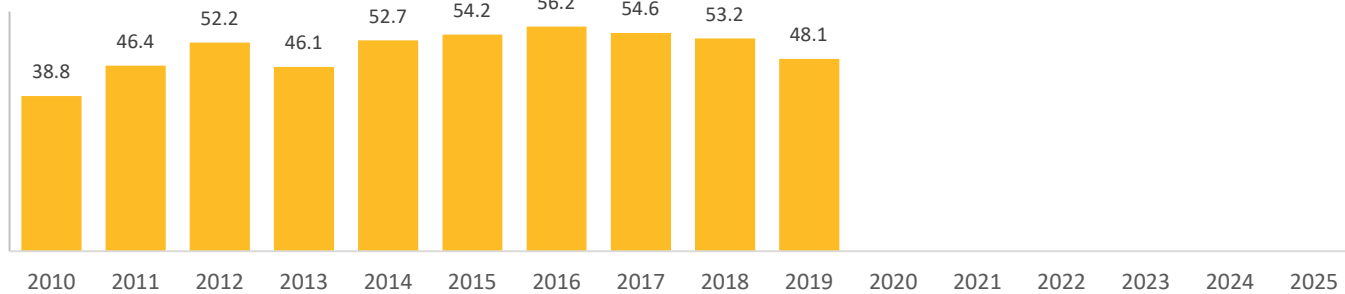


Exhibit ASU.R.3: Research Expenditure National Comparisons

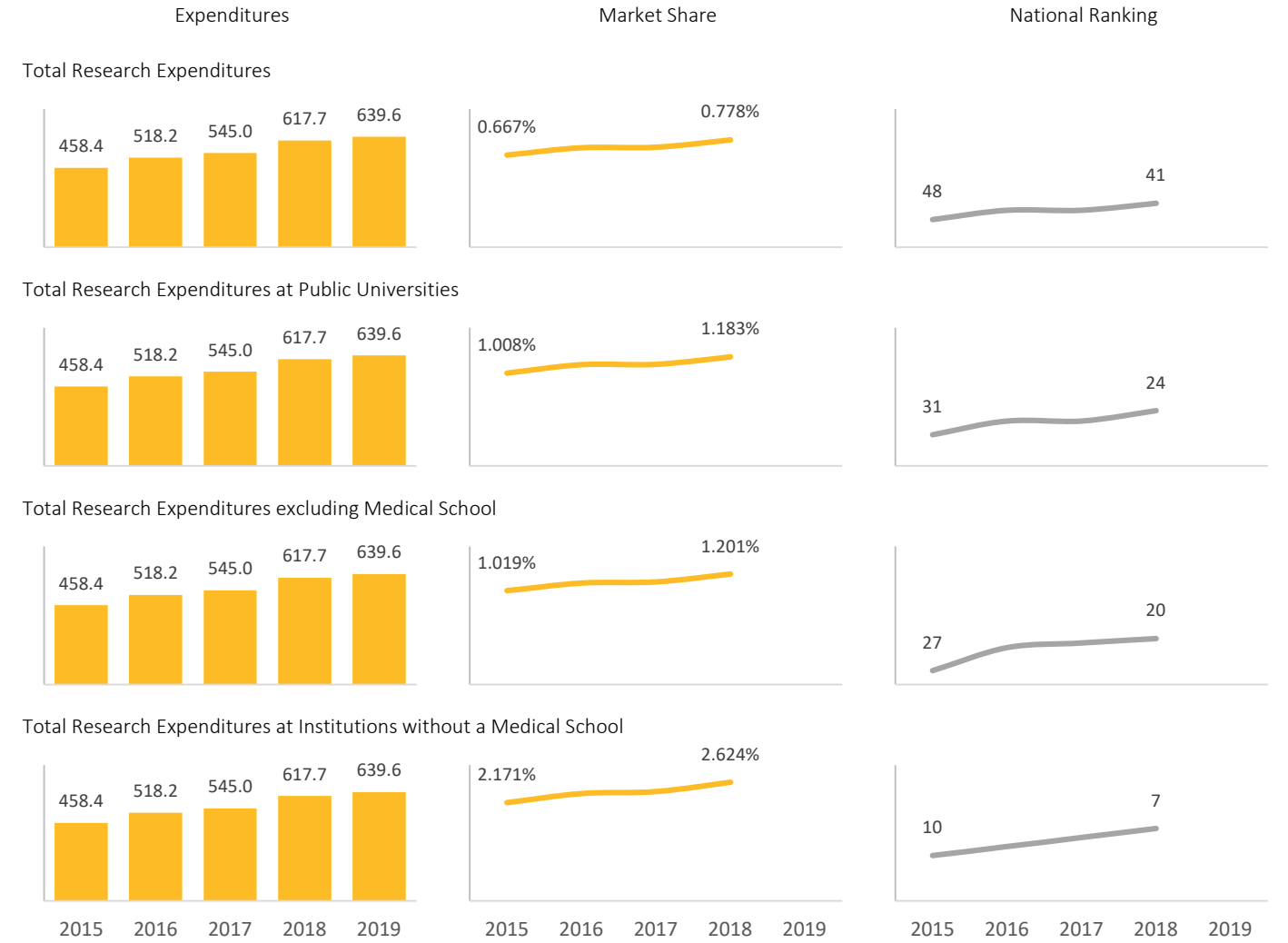


Exhibit ASU.R.4: Research Personnel and Facilities

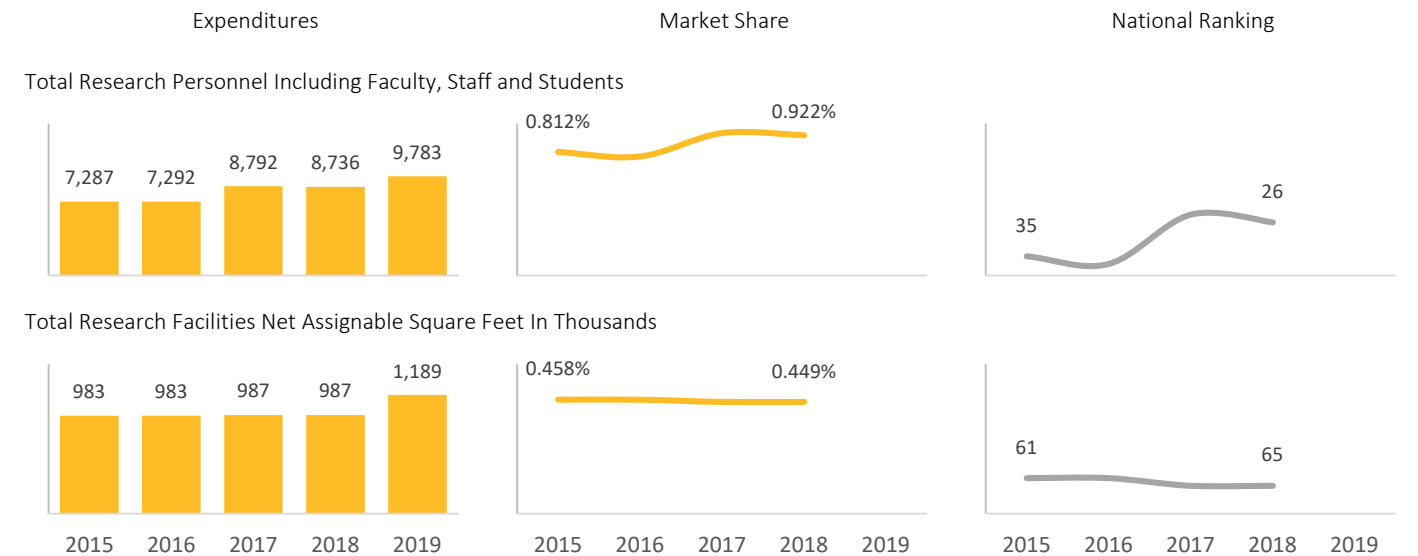


Exhibit ASU.R.5: Research Expenditures by Sponsor Group

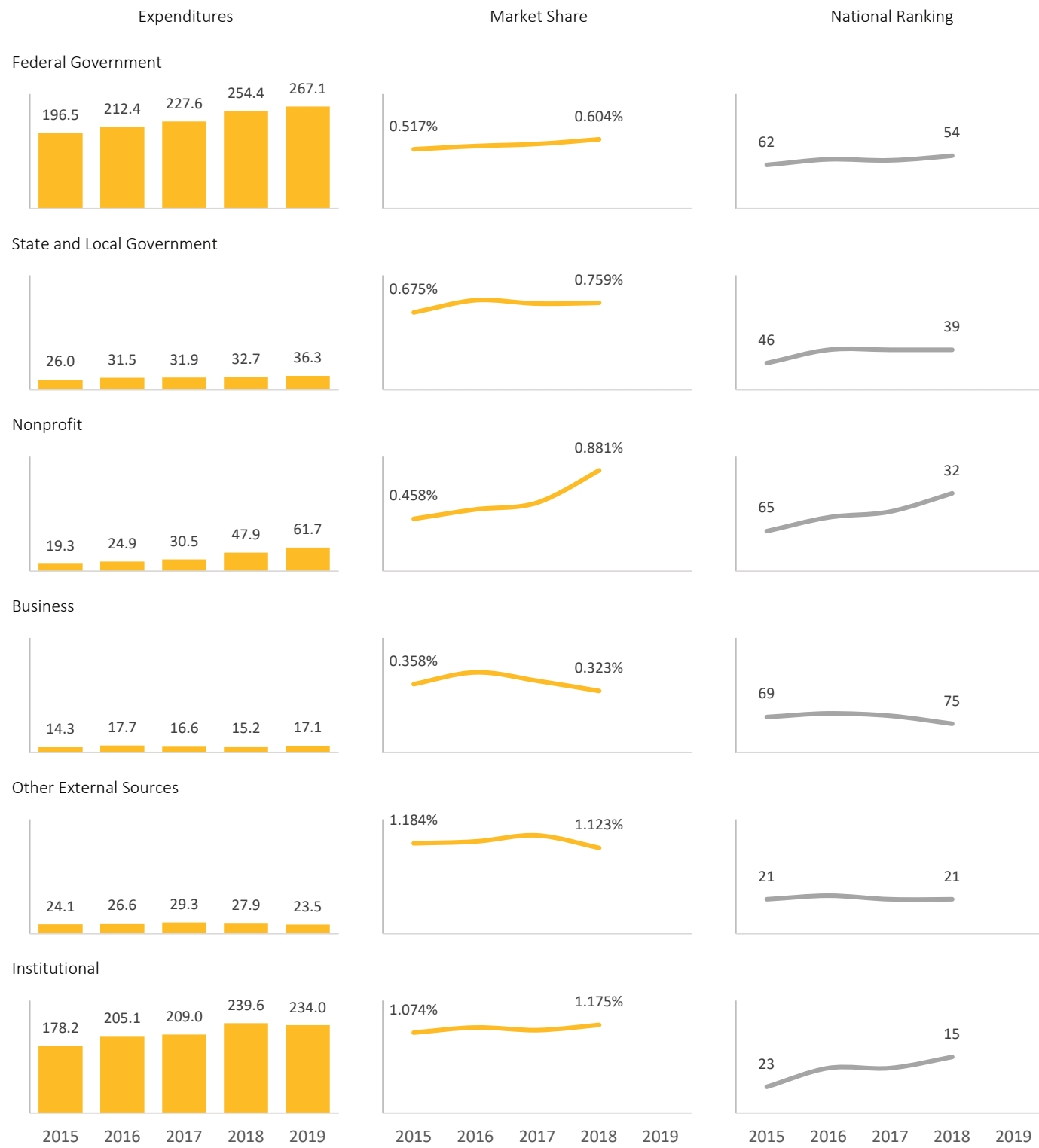
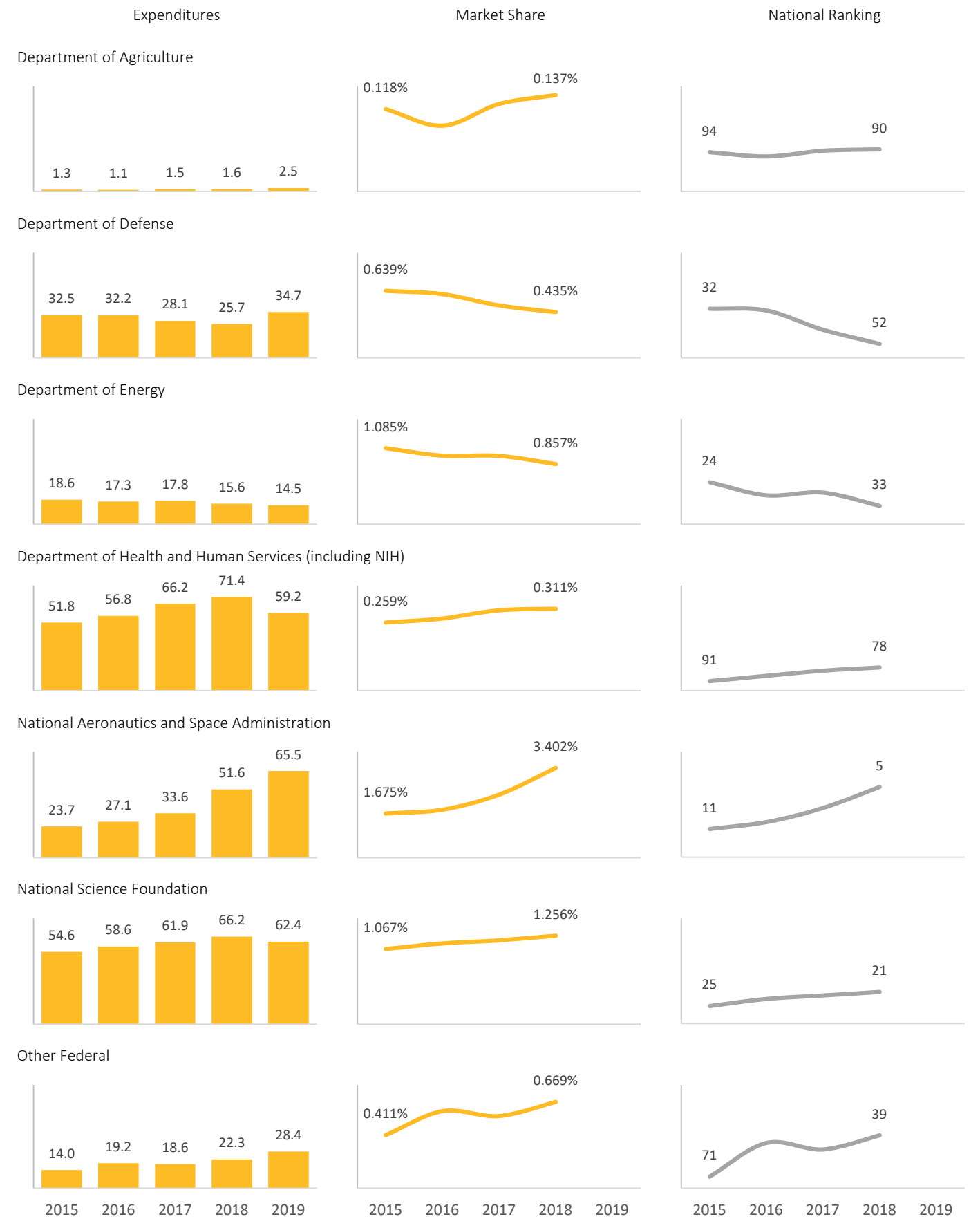
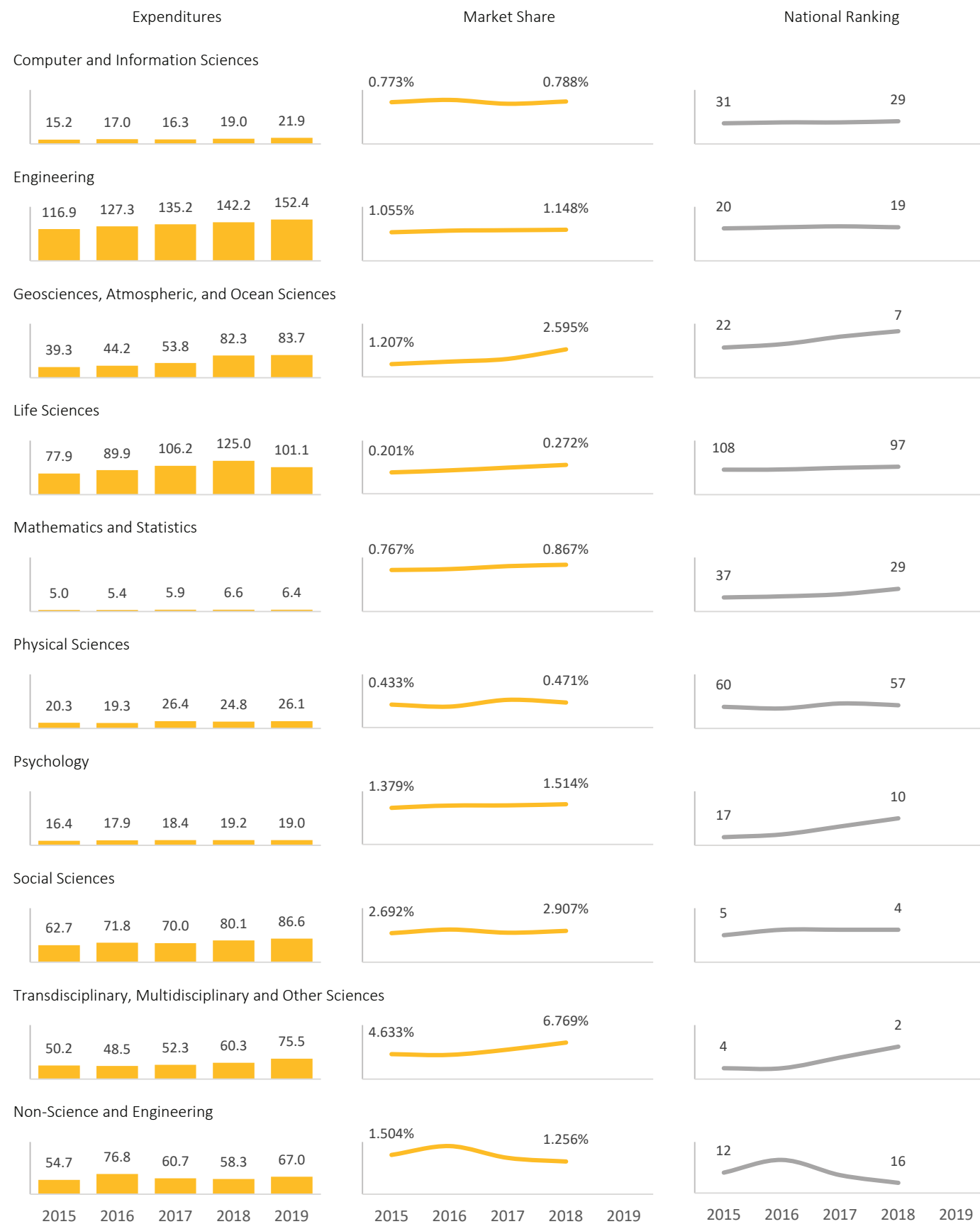


Exhibit ASU.R.6: Federal Research Expenditures by Federal Agency



Arizona State University

Exhibit ASU.R.7: Total Research Expenditures by Broad Discipline



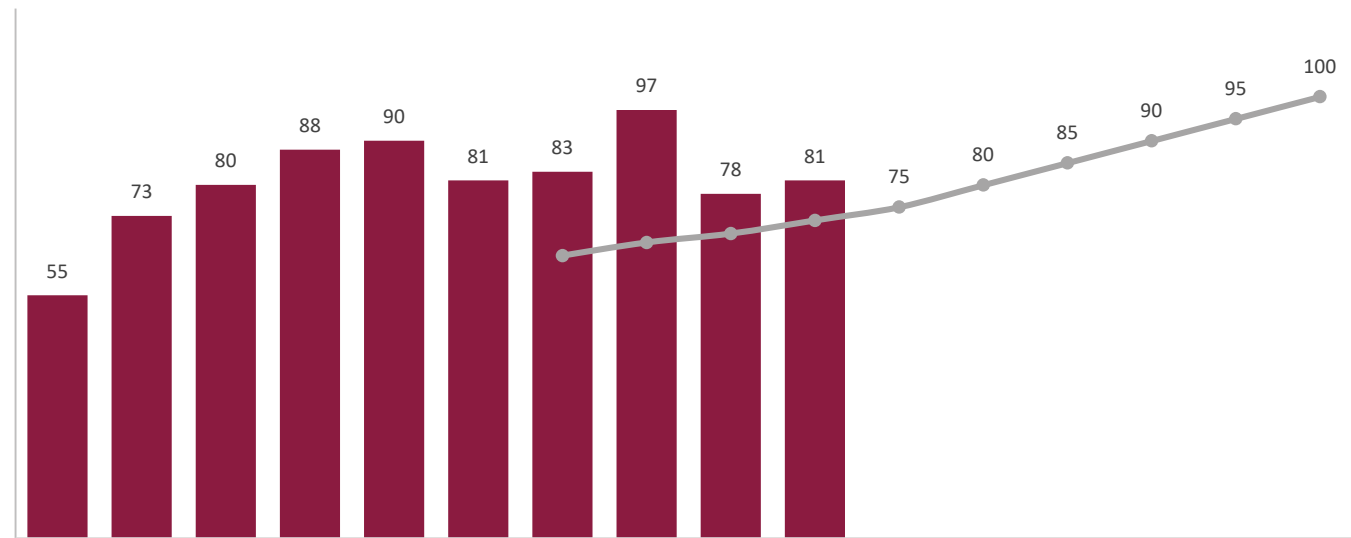
Arizona State University

Exhibit ASU.R.8: Total Research Expenditures by Detailed Discipline

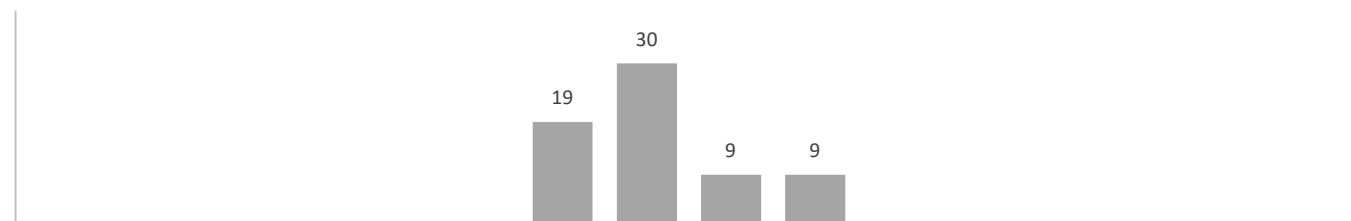
Research Discipline	2019 Expenditures	% of Discipline	% of Total
Computer and Information Sciences	21,871,000	100.0%	3.4%
Computer and Information Sciences	21,871,000	100.0%	3.4%
Engineering	152,395,000	100%	23.8%
Aerospace, Aeronautical and Astronautical Engineering	0	0.0%	0.0%
Bioengineering and Biomedical Engineering	13,536,000	8.9%	2.1%
Chemical Engineering	6,688,000	4.4%	1.0%
Civil Engineering	24,164,000	15.9%	3.8%
Electrical, Electronic and Communications Engineering	49,531,000	32.5%	7.7%
Industrial and Manufacturing Engineering	2,445,000	1.6%	0.4%
Mechanical Engineering	12,032,000	7.9%	1.9%
Metallurgical and Materials Engineering	4,694,000	3.1%	0.7%
Other Engineering	39,305,000	25.8%	6.1%
Geosciences, Atmospheric and Ocean Sciences	83,703,000	100.0%	13.1%
Atmospheric Science and Meteorology	0	0.0%	0.0%
Geological and Earth Sciences	83,703,000	100.0%	13.1%
Ocean Sciences and Marine Sciences	0	0.0%	0.0%
Other Geosciences, Atmospheric, and Ocean Sciences	0	0.0%	0.0%
Life Sciences	101,129,000	100.0%	15.8%
Agricultural Sciences	0	0.0%	0.0%
Biological and Biomedical Sciences	67,597,000	66.8%	10.6%
Health Sciences	31,611,000	31.3%	4.9%
Natural Resources and Conservation	764,000	0.8%	0.1%
Other Life Sciences	1,157,000	1.1%	0.2%
Mathematics and Statistics	6,367,000	100.0%	1.0%
Mathematics and Statistics	6,367,000	100.0%	1.0%
Physical Sciences	26,050,000	100.0%	4.1%
Astronomy and Astrophysics	0	0.0%	0.0%
Chemistry	14,026,000	53.8%	2.2%
Materials Science	0	0.0%	0.0%
Physics	11,934,000	45.8%	1.9%
Other Physical Sciences	90,000	0.3%	0.0%
Psychology	18,986,000	100.0%	3.0%
Psychology	18,986,000	100.0%	3.0%
Social Sciences	86,570,000	100.0%	13.5%
Anthropology	18,377,000	21.2%	2.9%
Economics	8,089,000	9.3%	1.3%
Political Science and Government	16,964,000	19.6%	2.7%
Sociology, Demography and Population Studies	4,422,000	5.1%	0.7%
Other Social Sciences	38,718,000	44.7%	6.1%
Other Sciences	75,517,000	100.0%	11.8%
Transdisciplinary, Multidisciplinary and Other Sciences	75,517,000	100.0%	11.8%
Non-Science and Engineering	67,049,000	100.0%	10.5%
Business Management and Business Administration	23,031,000	34.3%	3.6%
Communication and Communications Technologies	6,302,000	9.4%	1.0%
Education	15,817,000	23.6%	2.5%
Humanities	6,394,000	9.5%	1.0%
Law	4,508,000	6.7%	0.7%
Social Work	7,465,000	11.1%	1.2%
Visual and Performing Arts	3,532,000	5.3%	0.6%
Other Non-Science and Engineering	0	0.0%	0.0%

Exhibit ASU.TTA.1: Licenses and Options Executed and Enterprise Goals

Licenses and Options Executed and Enterprise Goals



Actual to Enterprise Goal Differences



Cumulative Actual to Enterprise Goal Differences

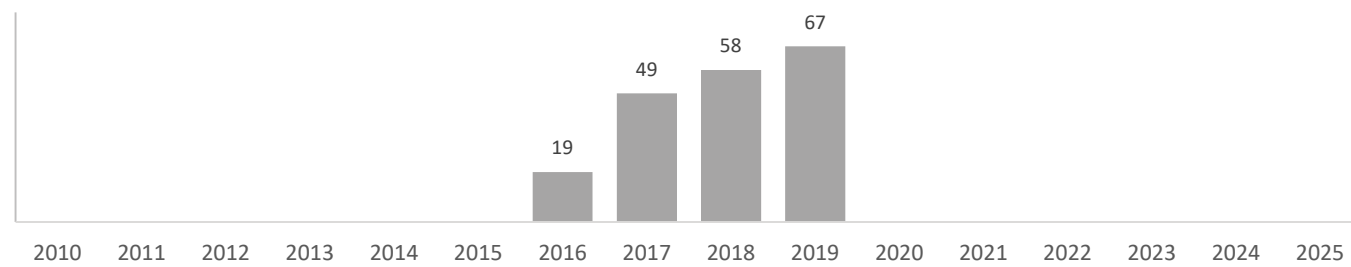


Exhibit ASU.TTA.2: Invention Disclosures

Invention Disclosures Received

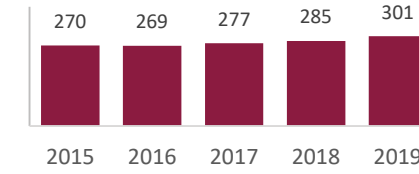
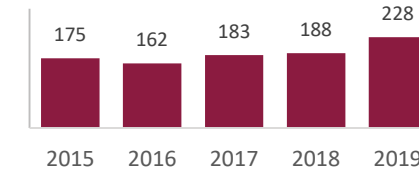


Exhibit ASU.TTA.3: Patents

New Patent Applications



US Patents Issued

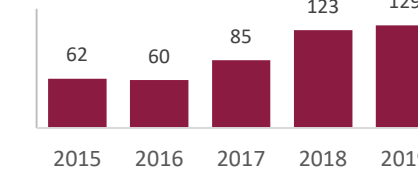
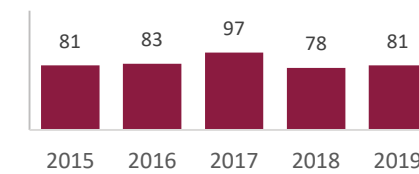
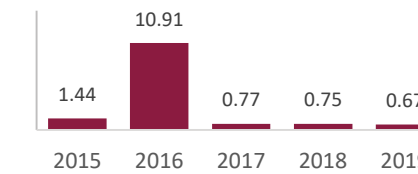


Exhibit ASU.TTA.4: Licenses and Options

Licenses and Options Executed



Licenses and Options Income (in Millions)

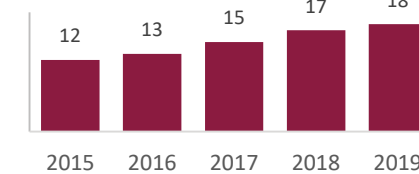


Intellectual Property Income	2015	2016	2017	2018	2019
Licenses and Options Income	1,436,333	10,907,198	770,443	750,757	673,945
Legal Fees Reimbursed	1,133,341	1,204,692	1,439,171	1,698,294	2,115,725
Other Revenue	18,204	357	219,596	3,608	4,827,623
Total	2,587,878	12,112,247	2,429,210	2,452,659	7,617,293

Royalty Distributions	2015	2016	2017	2018	2019
Inventors	-368,171	-1,520,699	-188,875	-258,026	-188,069
Laboratories and Units	-138,661	-855,257	-114,923	-149,979	-130,679
University	-253,487	-1,158,996	-119,217	-170,570	-128,903
Undistributed	31,898	16,878	151,984	14,422	27,200
Total	-360,250	-1,997,375	-82,156	-306,127	-232,382

Exhibit ASU.TTA.5: Startups

Startups



Cumulative Active Startups

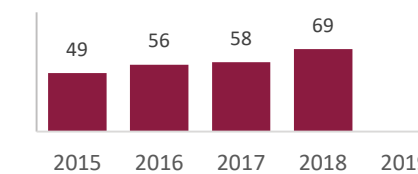
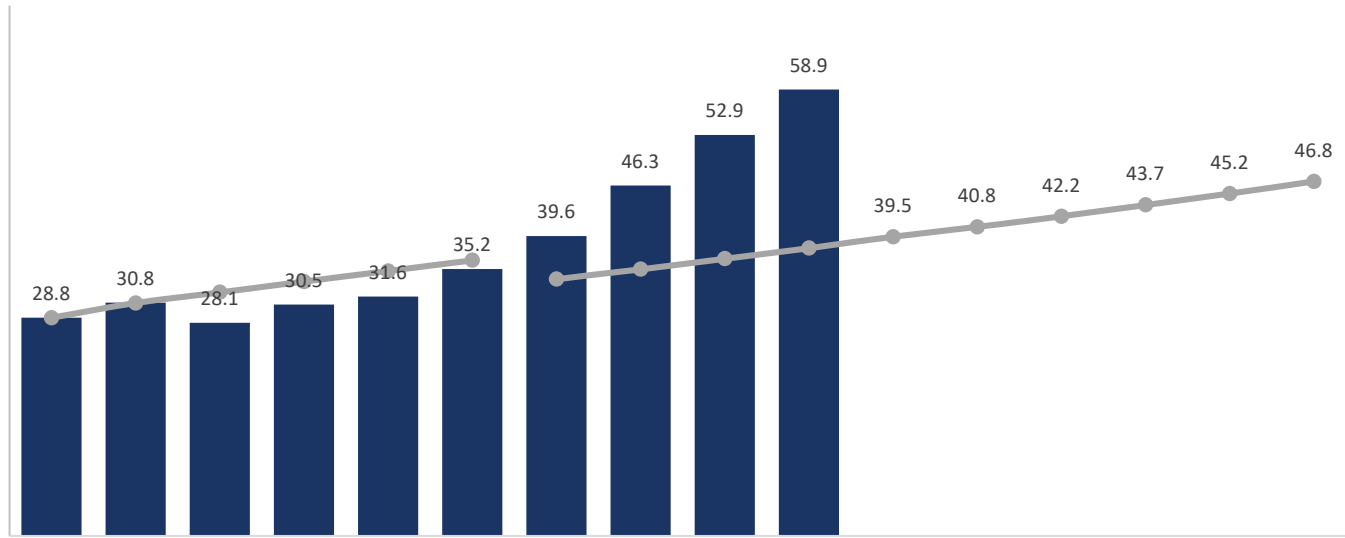
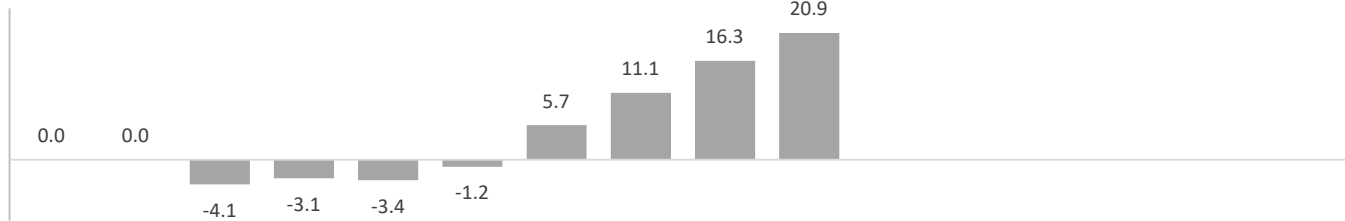


Exhibit NAU.R.1: Research Expenditures and Enterprise Goals

Research Expenditures and Enterprise Goals in Millions



Actual to Enterprise Goal Differences in Millions



Cumulative Actual to Enterprise Goal Differences in Millions

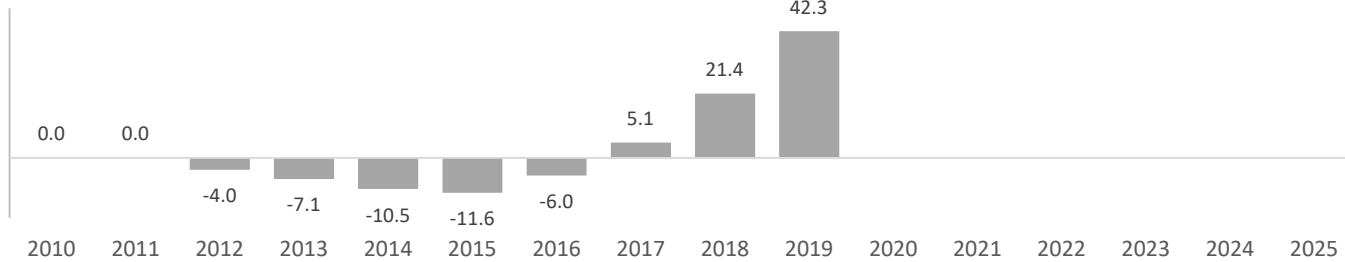


Exhibit NAU.R.2: Other Sponsored Project Expenditures

Other Sponsored Project Expenditures in Millions

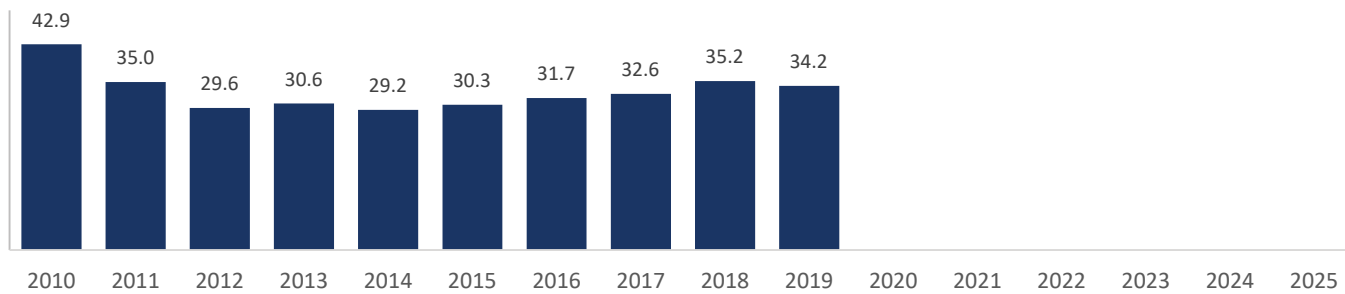


Exhibit NAU.R.3: Research Expenditure National Comparisons

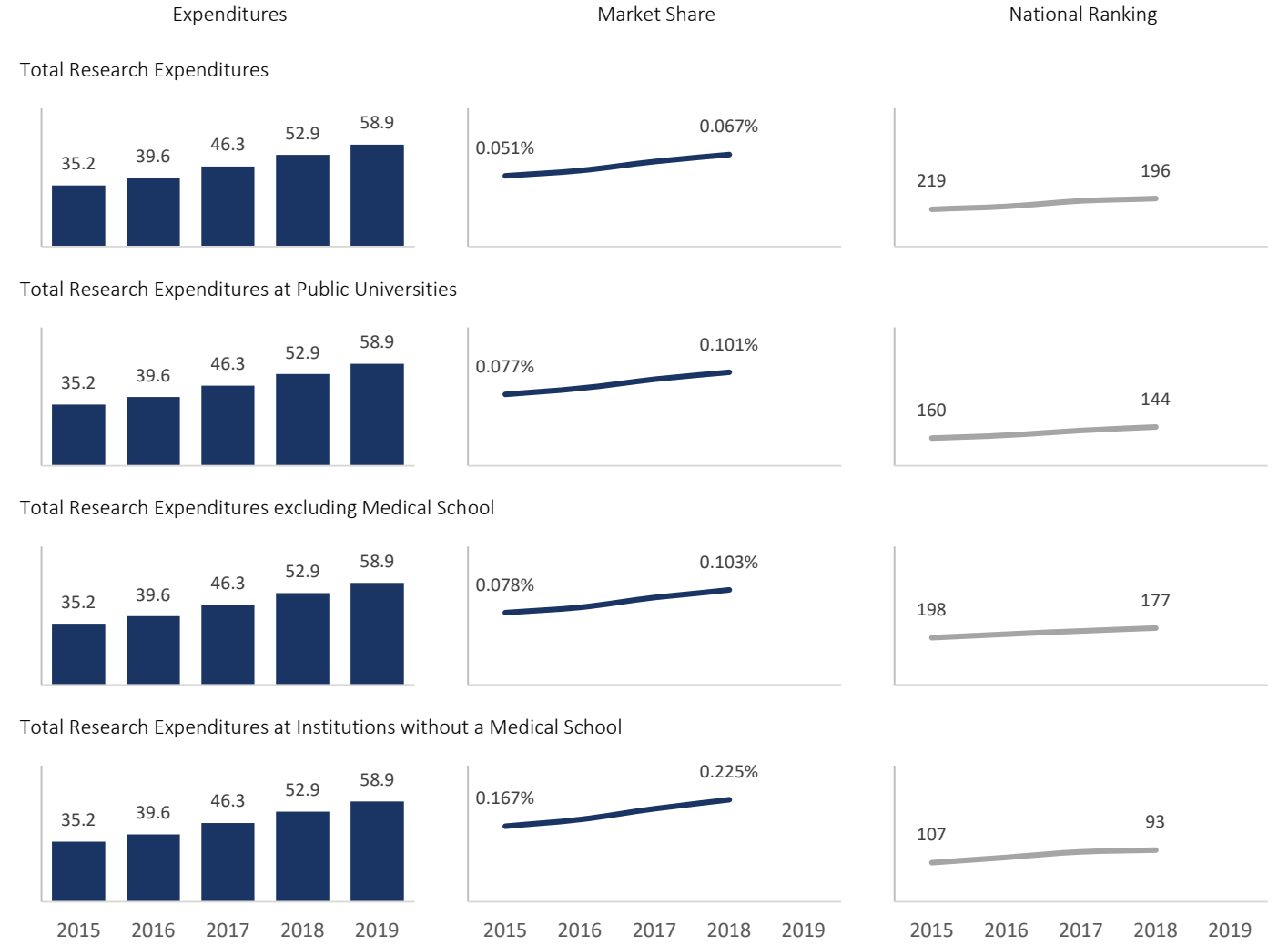


Exhibit NAU.R.4: Research Personnel and Facilities

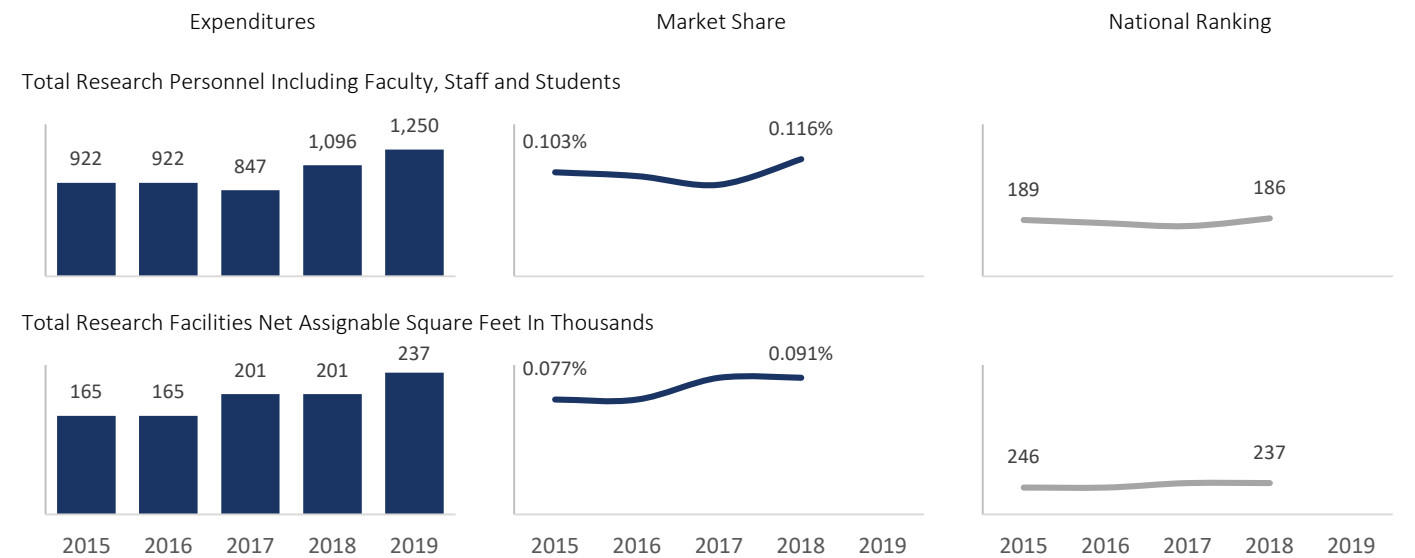


Exhibit NAU.R.5: Research Expenditures by Sponsor Group

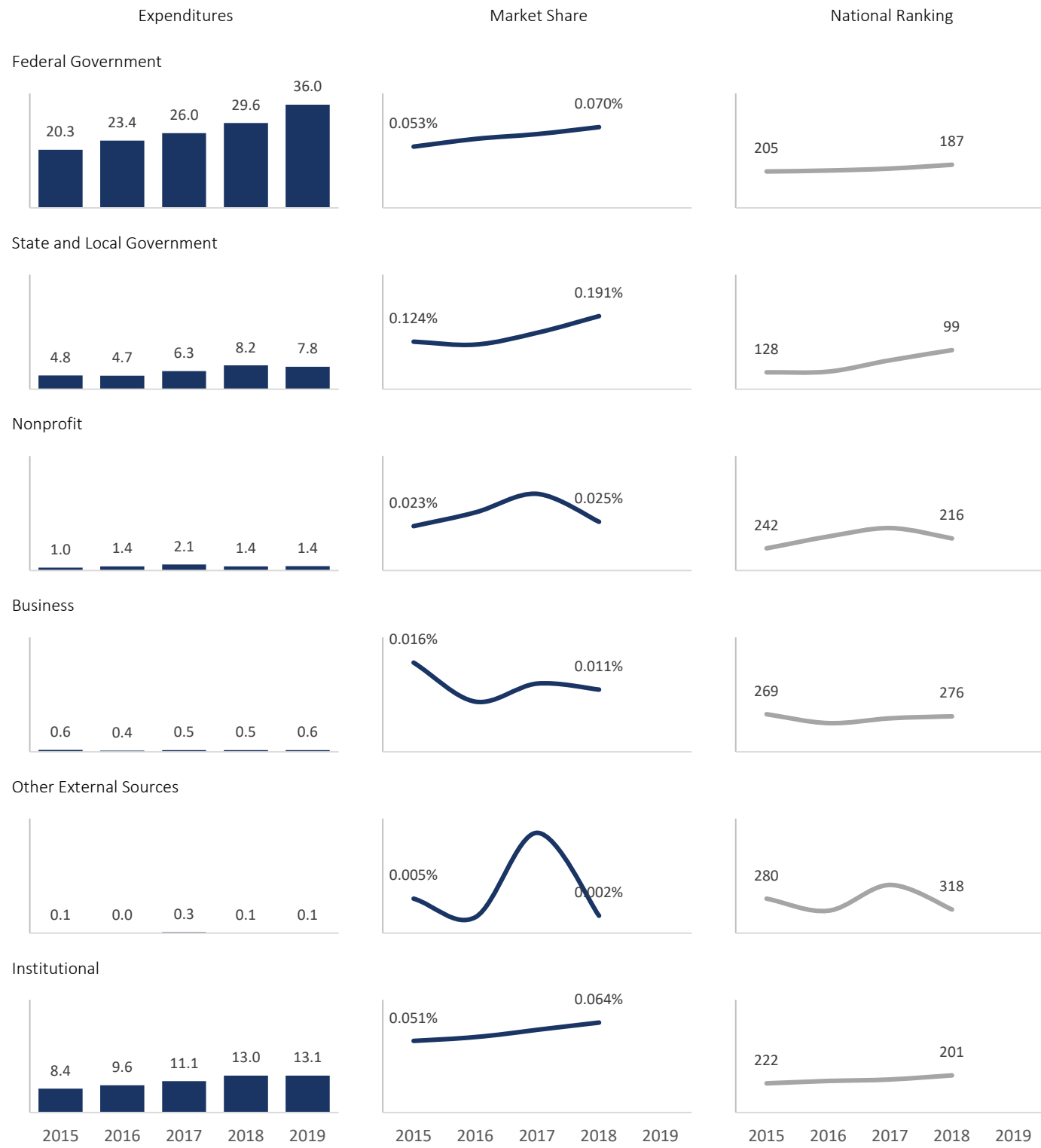


Exhibit NAU.R.6: Federal Research Expenditures by Federal Agency

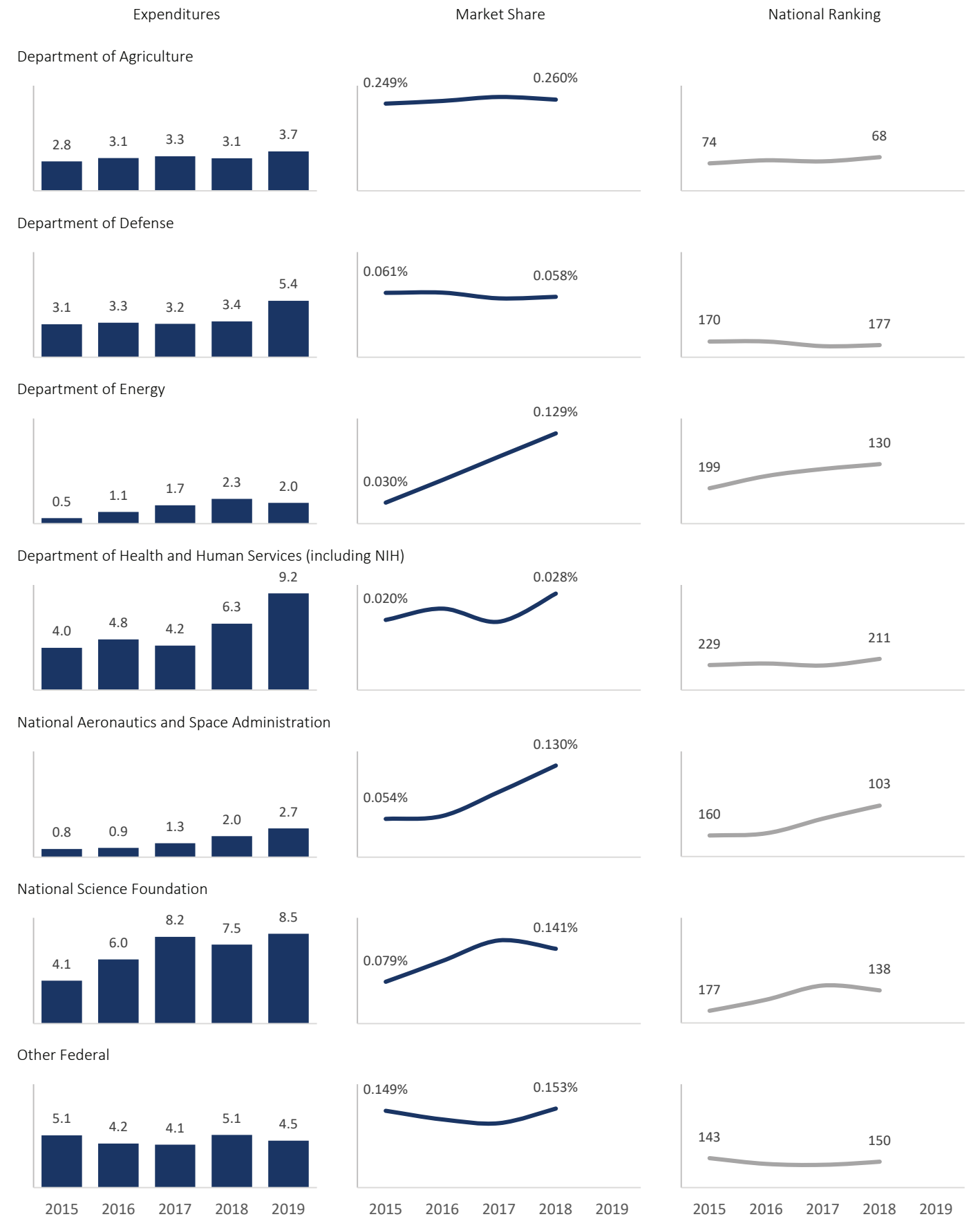


Exhibit NAU.R.7: Total Research Expenditures by Broad Discipline

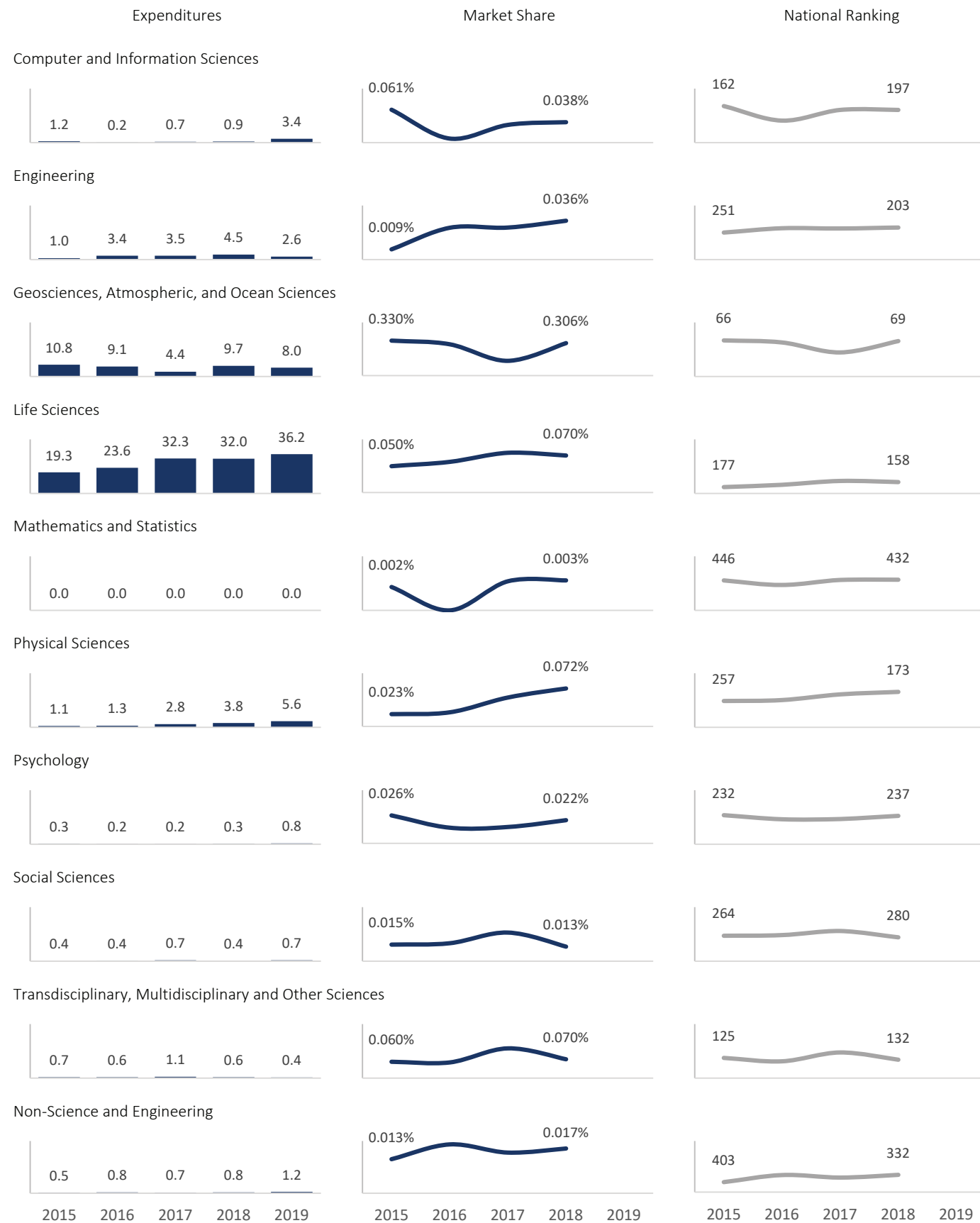
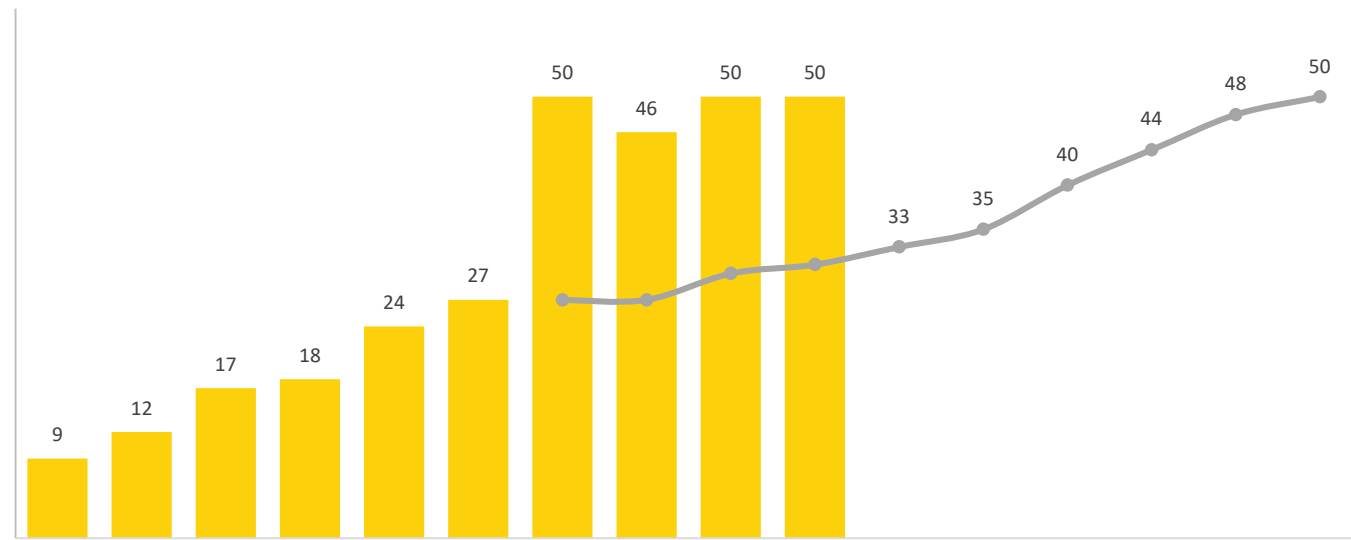


Exhibit NAU.R.8: Total Research Expenditures by Detailed Discipline

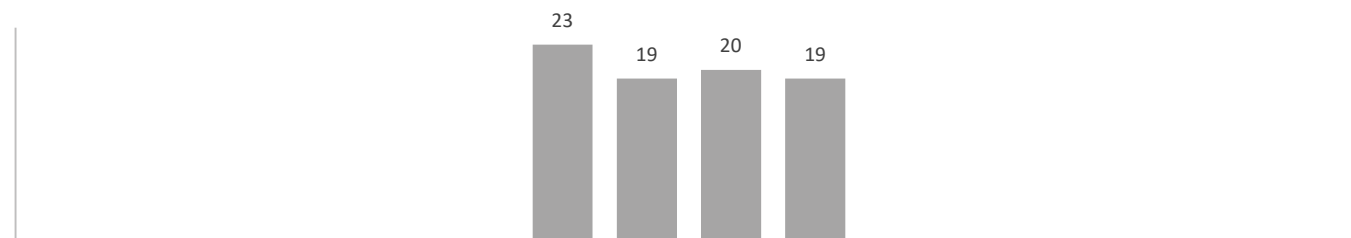
Research Discipline	2019 Expenditures	% of Discipline	% of Total
Computer and Information Sciences	3,383,000	100.0%	5.7%
Engineering	2,613,000	100%	4.4%
Aerospace, Aeronautical and Astronautical Engineering	0	0.0%	0.0%
Bioengineering and Biomedical Engineering	1,040,000	39.8%	1.8%
Chemical Engineering	0	0.0%	0.0%
Civil Engineering	131,000	5.0%	0.2%
Electrical, Electronic and Communications Engineering	513,000	19.6%	0.9%
Industrial and Manufacturing Engineering	0	0.0%	0.0%
Mechanical Engineering	394,000	15.1%	0.7%
Metallurgical and Materials Engineering	0	0.0%	0.0%
Other Engineering	535,000	20.5%	0.9%
Geosciences, Atmospheric and Ocean Sciences	7,984,000	100.0%	13.6%
Atmospheric Science and Meteorology	9,000	0.1%	0.0%
Geological and Earth Sciences	4,893,000	61.3%	8.3%
Ocean Sciences and Marine Sciences	8,000	0.1%	0.0%
Other Geosciences, Atmospheric, and Ocean Sciences	3,074,000	38.5%	5.2%
Life Sciences	36,247,000	100.0%	61.5%
Agricultural Sciences	2,275,000	6.3%	3.9%
Biological and Biomedical Sciences	26,195,000	72.3%	44.5%
Health Sciences	2,807,000	7.7%	4.8%
Natural Resources and Conservation	4,302,000	11.9%	7.3%
Other Life Sciences	668,000	1.8%	1.1%
Mathematics and Statistics	0	0.0%	0.0%
Physical Sciences	5,643,000	100.0%	9.6%
Astronomy and Astrophysics	3,532,000	62.6%	6.0%
Chemistry	1,387,000	24.6%	2.4%
Materials Science	53,000	0.9%	0.1%
Physics	538,000	9.5%	0.9%
Other Physical Sciences	133,000	2.4%	0.2%
Psychology	750,000	100.0%	1.3%
Social Sciences	724,000	100.0%	1.2%
Anthropology	36,000	5.0%	0.1%
Economics	125,000	17.3%	0.2%
Political Science and Government	146,000	20.2%	0.2%
Sociology, Demography and Population Studies	0	0.0%	0.0%
Other Social Sciences	417,000	57.6%	0.7%
Other Sciences	421,000	100.0%	0.7%
Non-Science and Engineering	1,151,000	100.0%	2.0%
Business Management and Business Administration	56,000	4.9%	0.1%
Communication and Communications Technologies	13,000	1.1%	0.0%
Education	983,000	85.4%	1.7%
Humanities	1,000	0.1%	0.0%
Law	0	0.0%	0.0%
Social Work	98,000	8.5%	0.2%
Visual and Performing Arts	0	0.0%	0.0%
Other Non-Science and Engineering	0	0.0%	0.0%

Exhibit NAU.TTA.1: Invention Disclosures Received and Enterprise Goals

Invention Disclosures Received and Enterprise Goals



Actual to Enterprise Goal Differences



Cumulative Actual to Enterprise Goal Differences

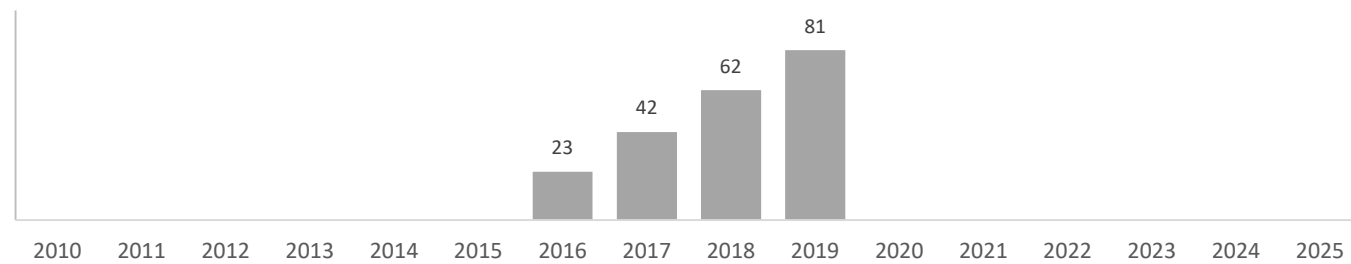


Exhibit NAU.TTA.2: Invention Disclosures

Invention Disclosures Received

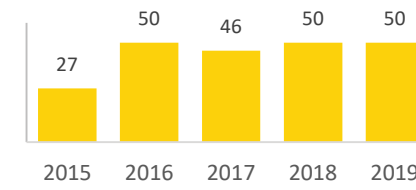
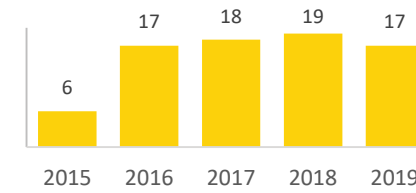


Exhibit NAU.TTA.3: Patents

New Patent Applications



US Patents Issued

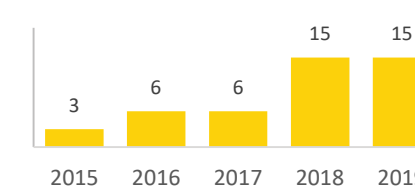
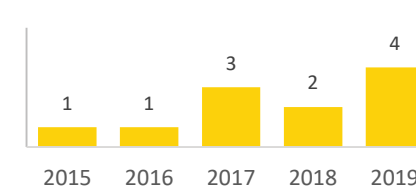
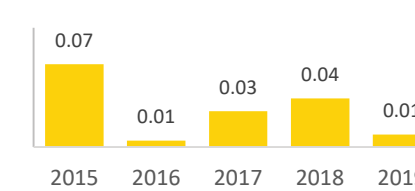


Exhibit NAU.TTA.4: Licenses and Options

Licenses and Options Executed



Licenses and Options Income (in Millions)

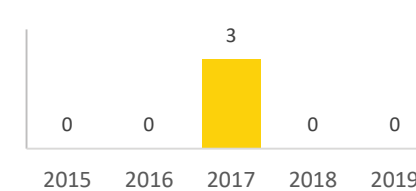


Intellectual Property Income	2015	2016	2017	2018	2019
Licenses and Options Income	69,365	5,286	30,070	40,549	10,500
Legal Fees Reimbursed	5,542	0	14,902	13,079	15,515
Other Revenue	0	3,236	0	40,548	0
Total	74,907	8,522	44,972	94,176	26,015

Royalty Distributions	2015	2016	2017	2018	2019
Inventors	-21,240	-19,430	0	0	-2,619
Laboratories and Units	0	0	0	0	0
University	-21,240	-26,287	0	0	0
Undistributed	6,383	0	30,070	0	0
Total	-14,857	-26,287	30,070	0	0

Exhibit NAU.TTA.5: Startups

Startups



Cumulative Active Startups

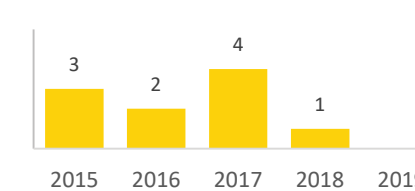
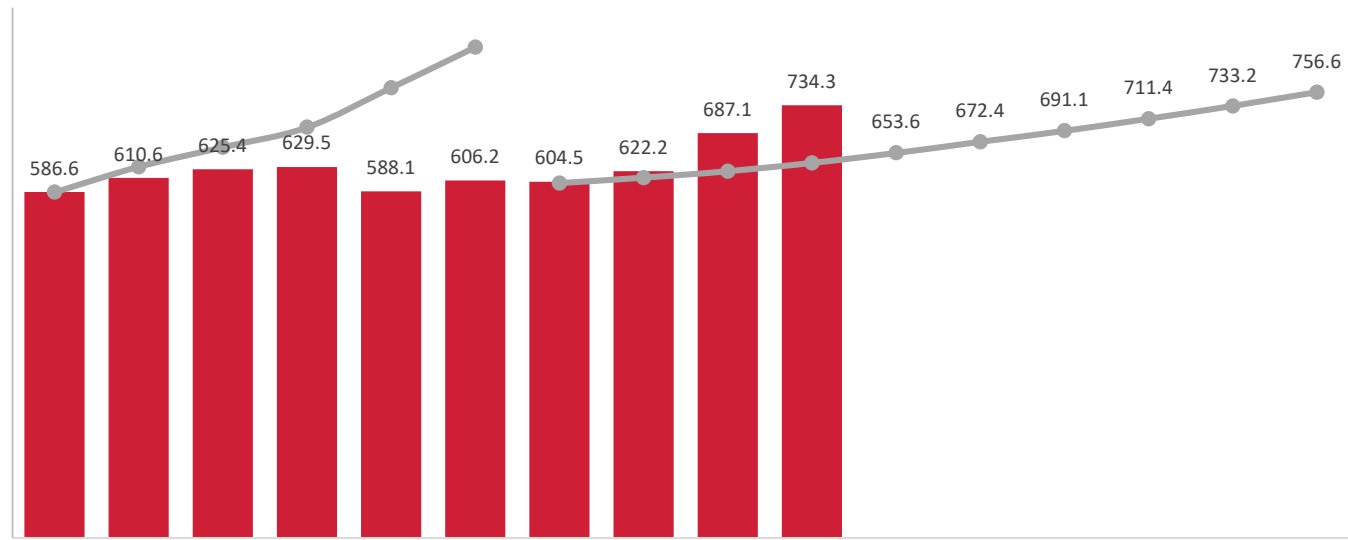
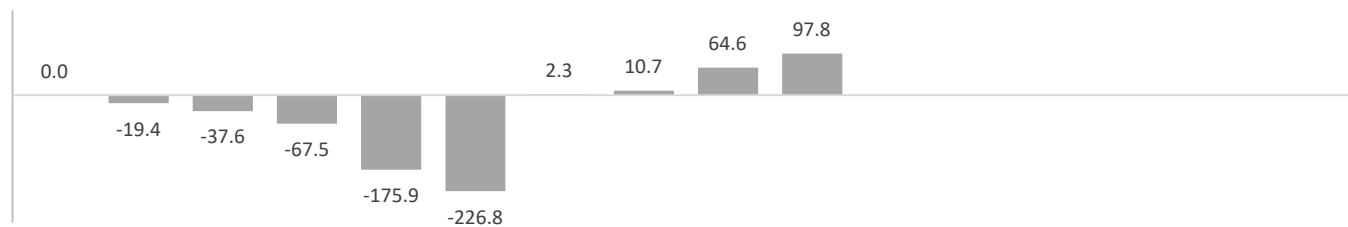


Exhibit UA.R.1: Research Expenditures and Enterprise Goals

Research Expenditures and Enterprise Goals in Millions



Actual to Enterprise Goal Differences in Millions



Cumulative Actual to Enterprise Goal Differences in Millions

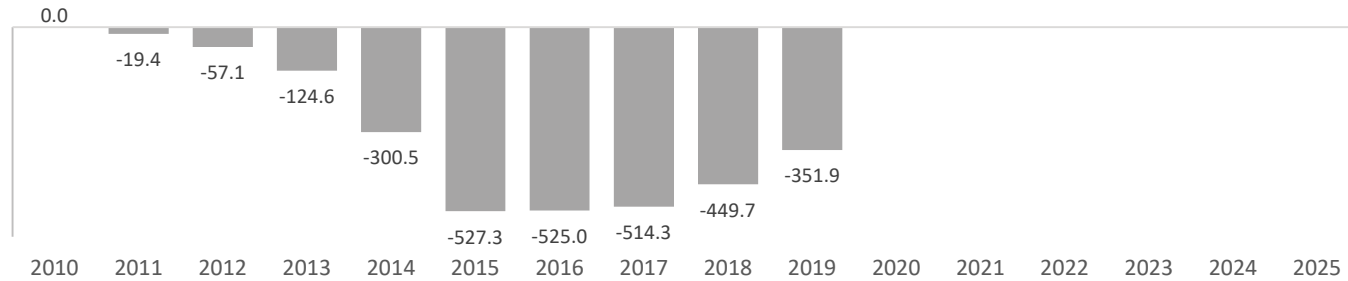


Exhibit UA.R.2: Other Sponsored Project Expenditures

Other Sponsored Project Expenditures in Millions

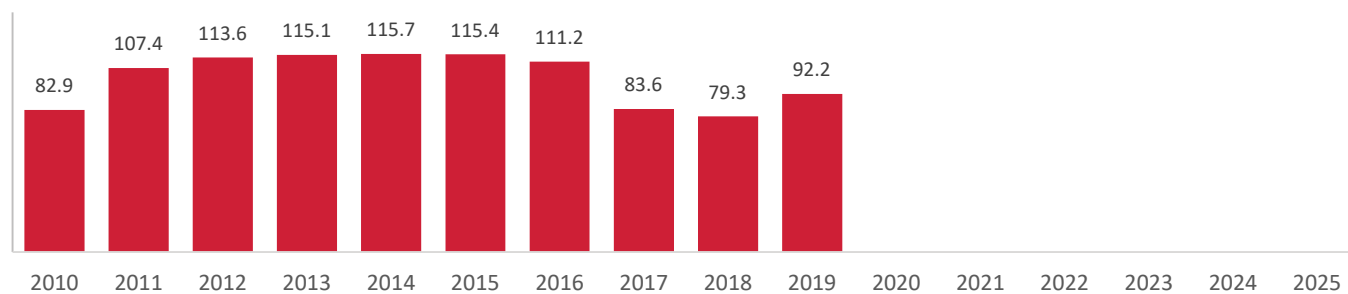


Exhibit UA.R.3: Research Expenditure National Comparisons

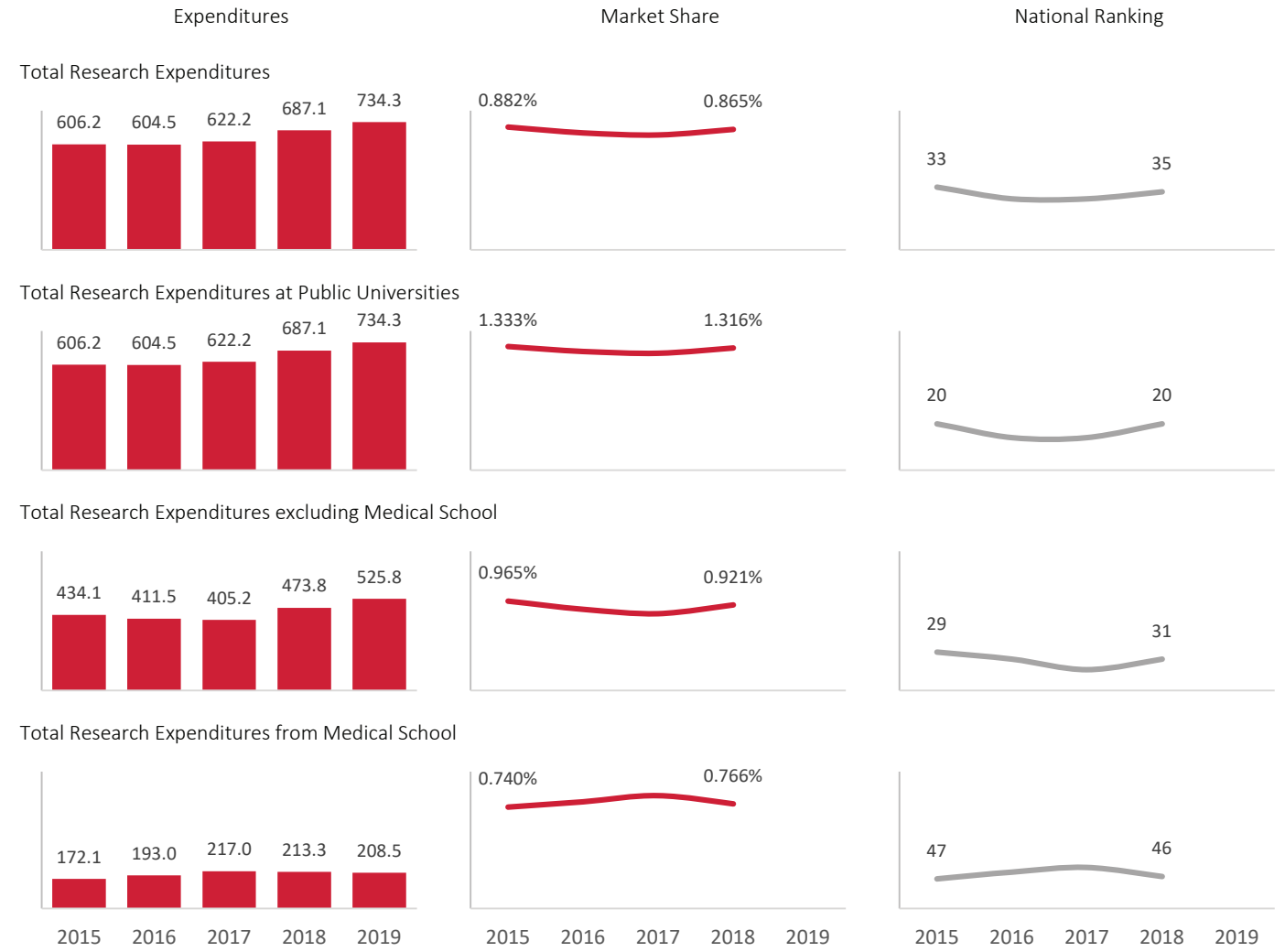


Exhibit UA.R.4: Research Personnel and Facilities

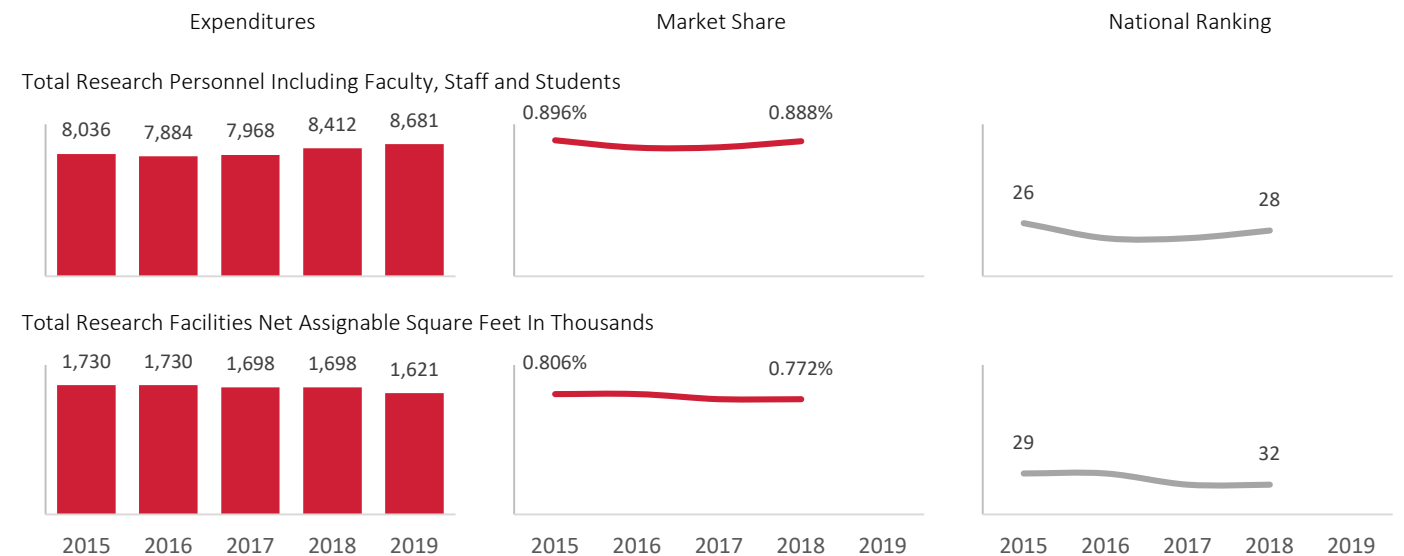


Exhibit UA.R.5: Research Expenditures by Sponsor Group

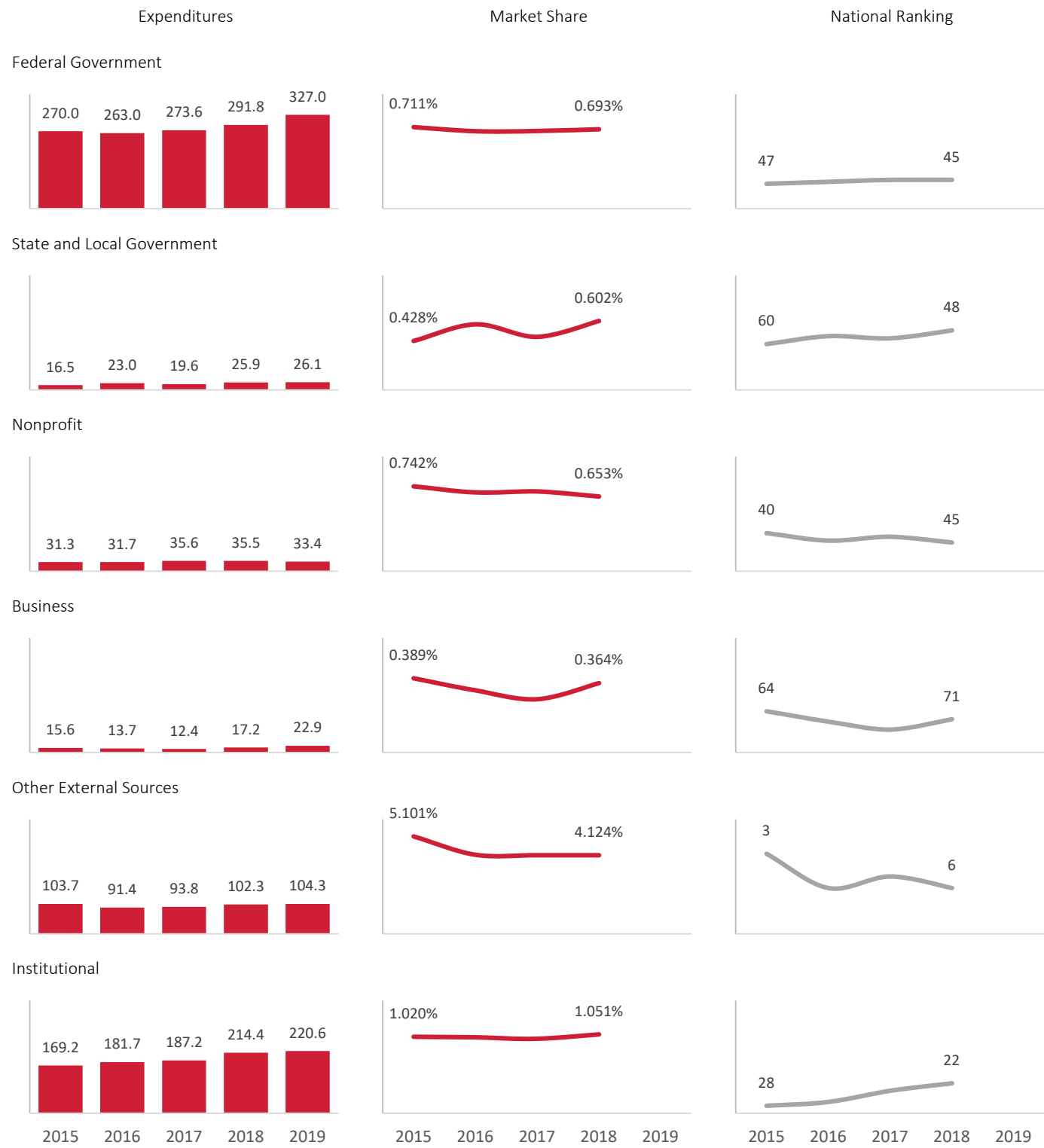


Exhibit UA.R.6: Federal Research Expenditures by Federal Agency

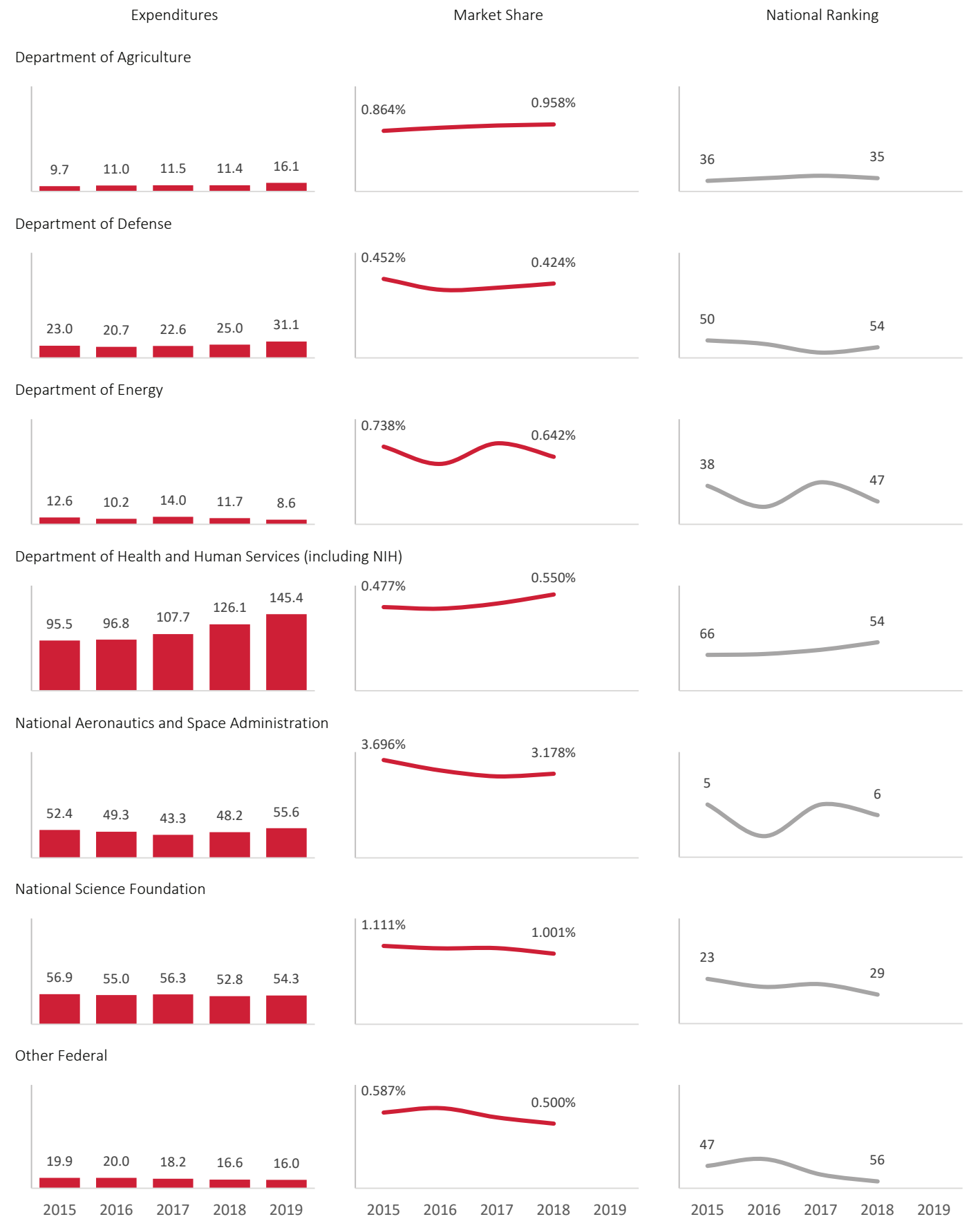


Exhibit UA.R.7: Total Research Expenditures by Broad Discipline

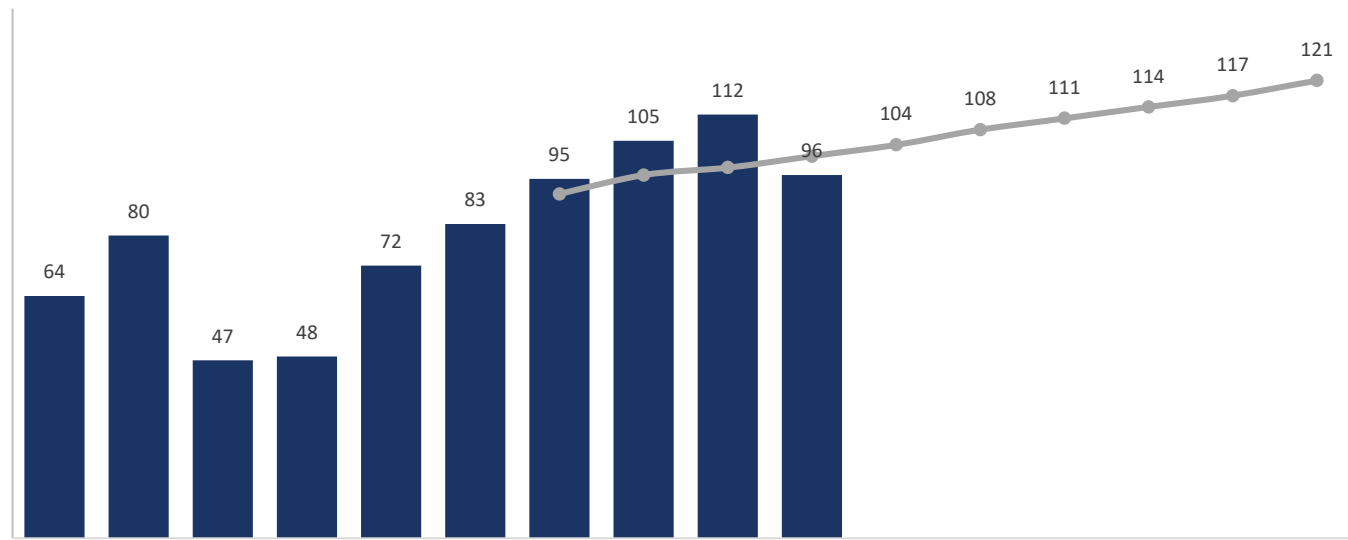


Exhibit UA.R.8: Total Research Expenditures by Detailed Discipline

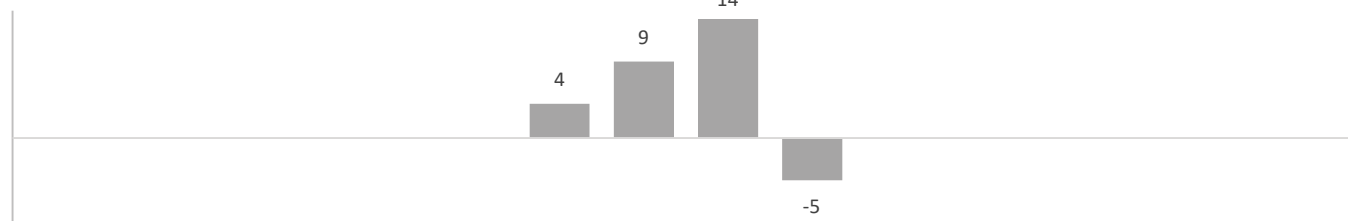
Research Discipline	2019 Expenditures	% of Discipline	% of Total
Computer and Information Sciences	12,370,000	100.0%	1.7%
Computer and Information Sciences	12,370,000	100.0%	1.7%
Engineering	75,555,000	100%	10.3%
Aerospace, Aeronautical and Astronautical Engineering	1,880,000	2.5%	0.3%
Bioengineering and Biomedical Engineering	6,922,000	9.2%	0.9%
Chemical Engineering	4,347,000	5.8%	0.6%
Civil Engineering	3,558,000	4.7%	0.5%
Electrical, Electronic and Communications Engineering	41,402,000	54.8%	5.6%
Industrial and Manufacturing Engineering	3,572,000	4.7%	0.5%
Mechanical Engineering	3,836,000	5.1%	0.5%
Metallurgical and Materials Engineering	6,139,000	8.1%	0.8%
Other Engineering	3,899,000	5.2%	0.5%
Geosciences, Atmospheric and Ocean Sciences	31,075,000	100.0%	4.2%
Atmospheric Science and Meteorology	5,180,000	16.7%	0.7%
Geological and Earth Sciences	22,374,000	72.0%	3.0%
Ocean Sciences and Marine Sciences	2,208,000	7.1%	0.3%
Other Geosciences, Atmospheric, and Ocean Sciences	1,313,000	4.2%	0.2%
Life Sciences	426,393,000	100.0%	58.1%
Agricultural Sciences	51,474,000	12.1%	7.0%
Biological and Biomedical Sciences	200,691,000	47.1%	27.3%
Health Sciences	161,471,000	37.9%	22.0%
Natural Resources and Conservation	12,754,000	3.0%	1.7%
Other Life Sciences	3,000	0.0%	0.0%
Mathematics and Statistics	2,449,000	100.0%	0.3%
Mathematics and Statistics	2,449,000	100.0%	0.3%
Physical Sciences	139,315,000	100.0%	19.0%
Astronomy and Astrophysics	113,523,000	81.5%	15.5%
Chemistry	13,060,000	9.4%	1.8%
Materials Science	3,707,000	2.7%	0.5%
Physics	8,970,000	6.4%	1.2%
Other Physical Sciences	55,000	0.0%	0.0%
Psychology	2,670,000	100.0%	0.4%
Psychology	2,670,000	100.0%	0.4%
Social Sciences	19,450,000	100.0%	2.6%
Anthropology	3,926,000	20.2%	0.5%
Economics	2,422,000	12.5%	0.3%
Political Science and Government	866,000	4.5%	0.1%
Sociology, Demography and Population Studies	4,722,000	24.3%	0.6%
Other Social Sciences	7,514,000	38.6%	1.0%
Other Sciences	6,013,000	100.0%	0.8%
Transdisciplinary, Multidisciplinary and Other Sciences	6,013,000	100.0%	0.8%
Non-Science and Engineering	18,980,000	100.0%	2.6%
Business Management and Business Administration	4,760,000	25.1%	0.6%
Communication and Communications Technologies	265,000	1.4%	0.0%
Education	3,691,000	19.4%	0.5%
Humanities	1,014,000	5.3%	0.1%
Law	1,129,000	5.9%	0.2%
Social Work	0	0.0%	0.0%
Visual and Performing Arts	6,738,000	35.5%	0.9%
Other Non-Science and Engineering	1,383,000	7.3%	0.2%

Exhibit UA.TTA.1: Licenses and Options Executed and Enterprise Goals

Licenses and Options Executed and Enterprise Goals



Actual to Enterprise Goal Differences



Cumulative Actual to Enterprise Goal Differences

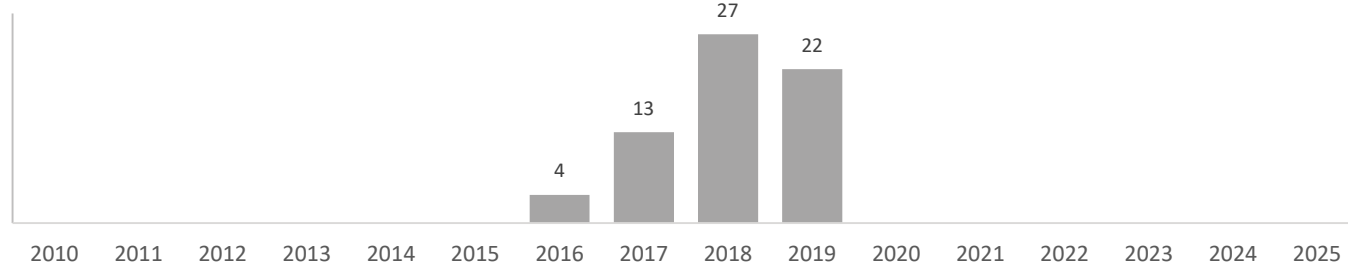


Exhibit UA.TTA.2: Invention Disclosures

Invention Disclosures Received

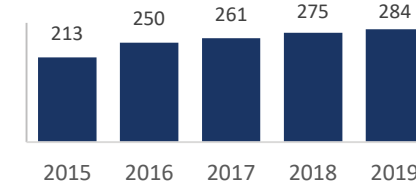
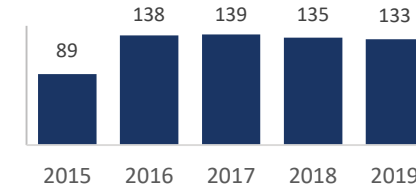


Exhibit UA.TTA.3: Patents

New Patent Applications



US Patents Issued

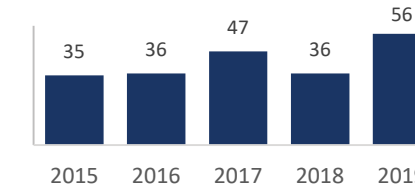
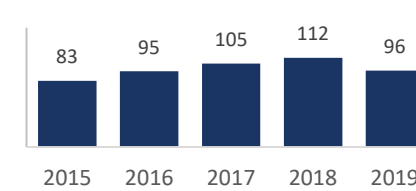
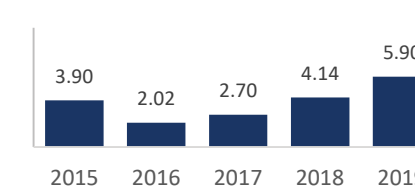


Exhibit UA.TTA.4: Licenses and Options

Licenses and Options Executed



Licenses and Options Income (in Millions)

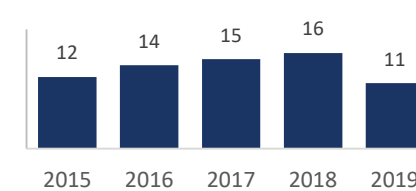


Intellectual Property Income	2015	2016	2017	2018	2019
Licenses and Options Income	3,895,882	2,015,807	2,703,261	4,141,604	5,901,957
Legal Fees Reimbursed	778,984	697,099	629,368	651,410	828,539
Other Revenue	0	0	0	0	0
Total	4,674,866	2,712,906	3,332,629	4,793,014	6,730,496

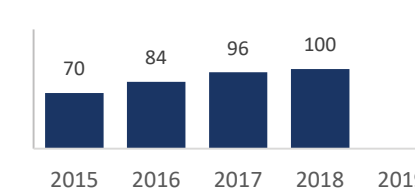
Royalty Distributions	2015	2016	2017	2018	2019
Inventors	-1,380,435	-631,552	-946,141	-1,403,012	-1,904,368
Laboratories and Units	-1,296,680	-604,742	-865,044	-1,276,847	-1,708,098
University	-990,526	-507,454	-729,881	-1,383,993	-1,839,490
Undistributed	228,241	272,058	150,000	77,751	450,000
Total	-2,058,965	-840,138	-1,444,925	-2,583,089	-3,097,588

Exhibit UA.TTA.5: Startups

Startups



Cumulative Active Startups





2700 N CENTRAL AVE., SUITE 400 | PHOENIX, AZ 85004 | AZREGENTS.EDU