

FISCAL YEAR 2018

RESEARCH REPORT

ABOUT THIS REPORT

The FY 2018 Annual Research Report provides information on the impact and depth of the multidisciplinary, collaborative and groundbreaking research at Arizona's public universities.

The report is intended to document the contributions of Arizona's public universities to improving Arizona's economy, competitiveness and growth. New this year, the report categorizes research expenditures*, market share and national ranking by federal agency, source of funds, and research discipline. Technology transfer information (per ABOR policy 6-909.10) reflects university efforts in moving research into the market.

Research at Arizona's public universities infused more than \$1.35 billion into Arizona's economy in 2018, moving closer to our strategic goal of \$1.6 billion by 2025.

*Expenditures are equal to the research revenue received by the university.

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.

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ABOR EXECUTIVE DIRECTOR

John Arnold

EXECUTIVE SUMMARY

The research created at Arizona's public universities is an essential part of Arizona's economic future and the means by which new technologies are created and discoveries are made to enhance the lives of all Arizonans.

As part of the Board's strategic plan, the Board identified and approved metrics for the system in 2015. Three metrics were chosen to monitor Arizona public universities' progress toward their research goals:

- Total Research Activity (Expenditures)
- Invention Disclosures Transacted (NAU only)
- Licenses & Options Executed (ASU and UA only)

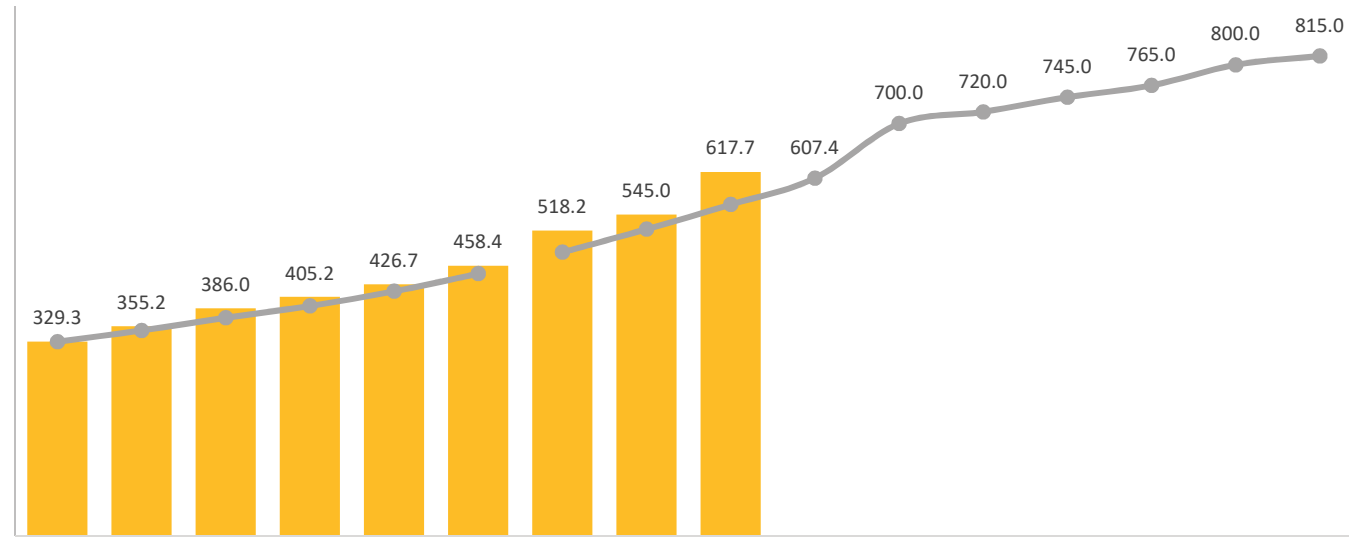
In fiscal year 2018, Arizona's public universities, as a system, met their metric goals. Total research grew by 12% to over \$1.357 billion — \$144 million above last year. All three universities realized growth in federal funding from the Department of Health and Human Services (including NIH) of more than \$25.7 million over the prior year. The Life Sciences, especially Biological and Biomedical Sciences, attract the largest investment of research dollars for all of the universities - \$292.5 million.

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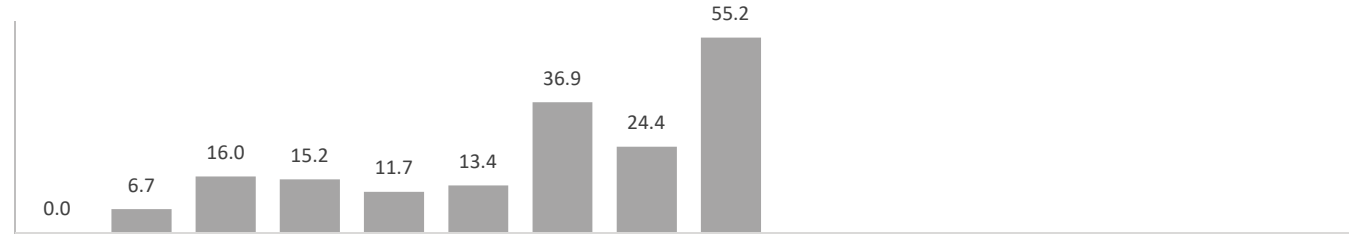
- 4 Arizona State University**
- 12 Northern Arizona University**
- 20 University of Arizona**

Exhibit R.ASU.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

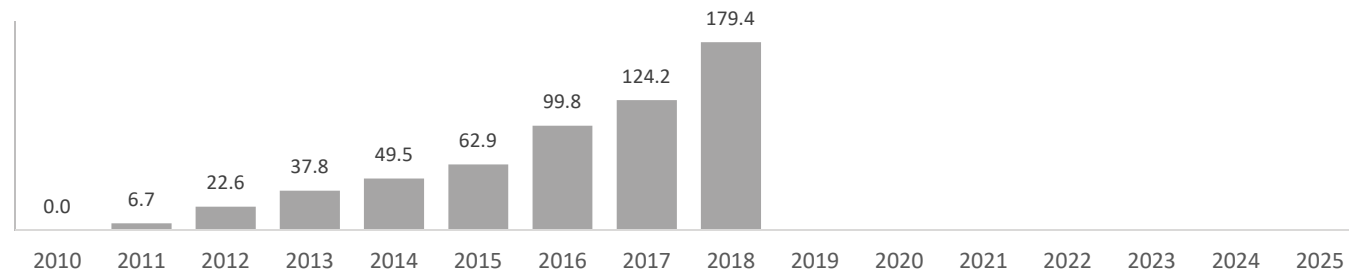


Exhibit R.ASU.2: Other Sponsored Project Expenditures

Other Sponsored Project Expenditures in Millions

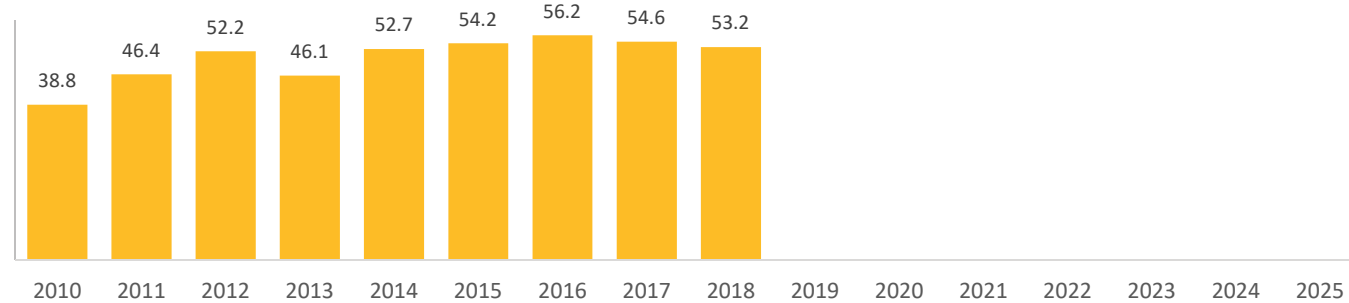


Exhibit R.ASU.3: Research Expenditures and Primary National Comparisons

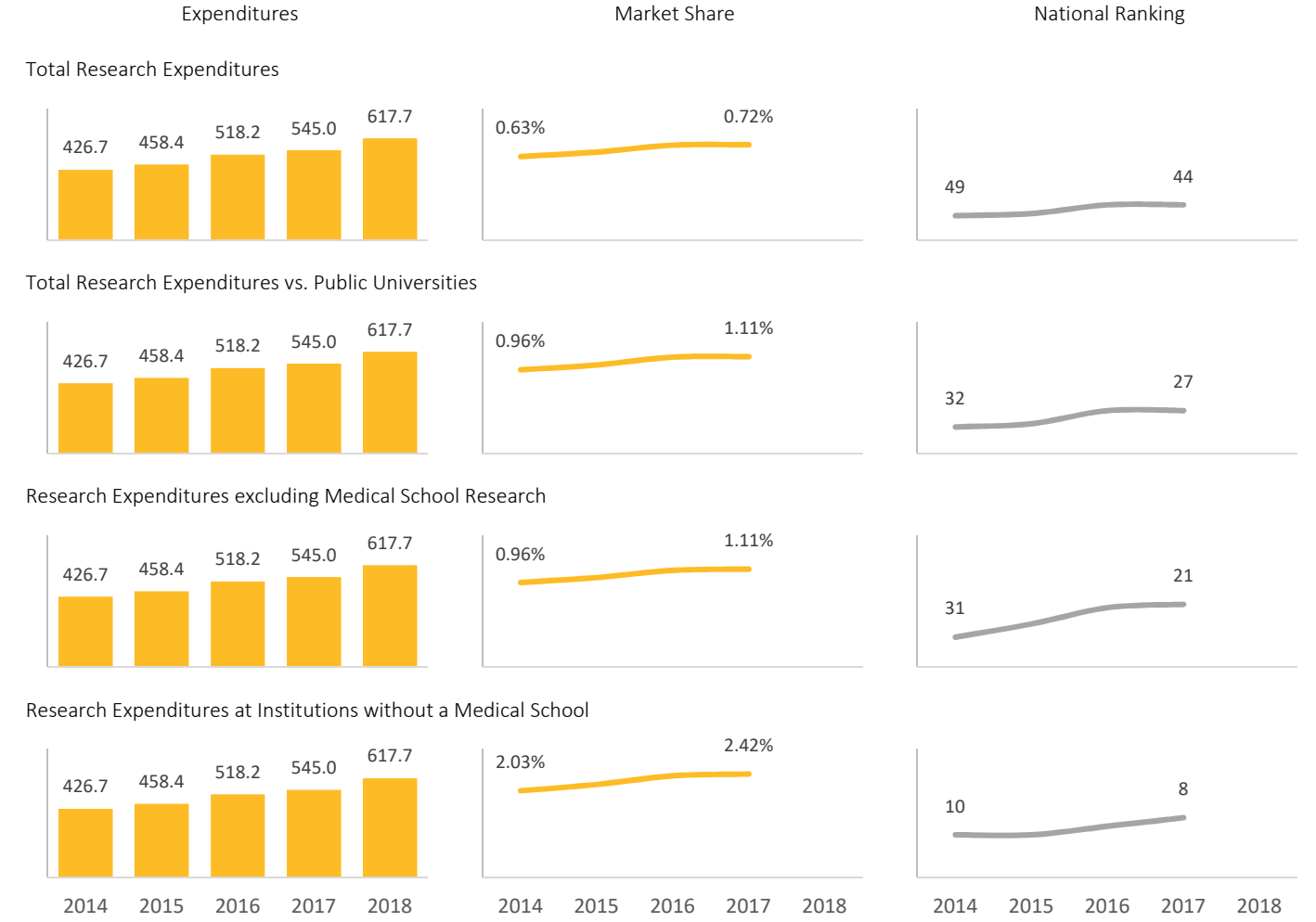


Exhibit R.ASU.4: Research Personnel and Facilities with National Comparisons

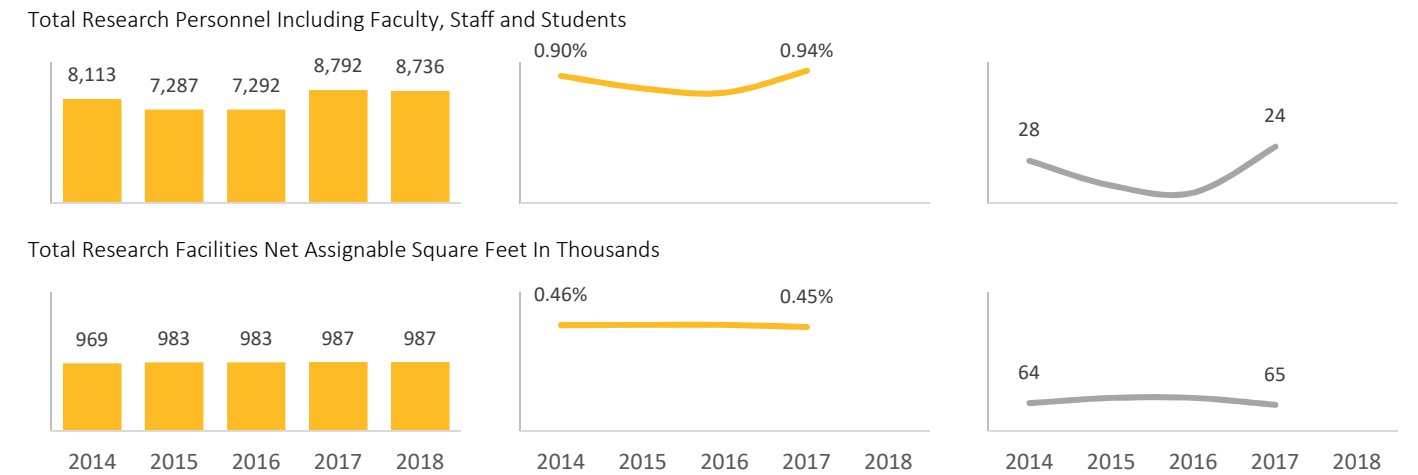


Exhibit R.ASU.5: Research Expenditures by Source of Funds with National Comparisons

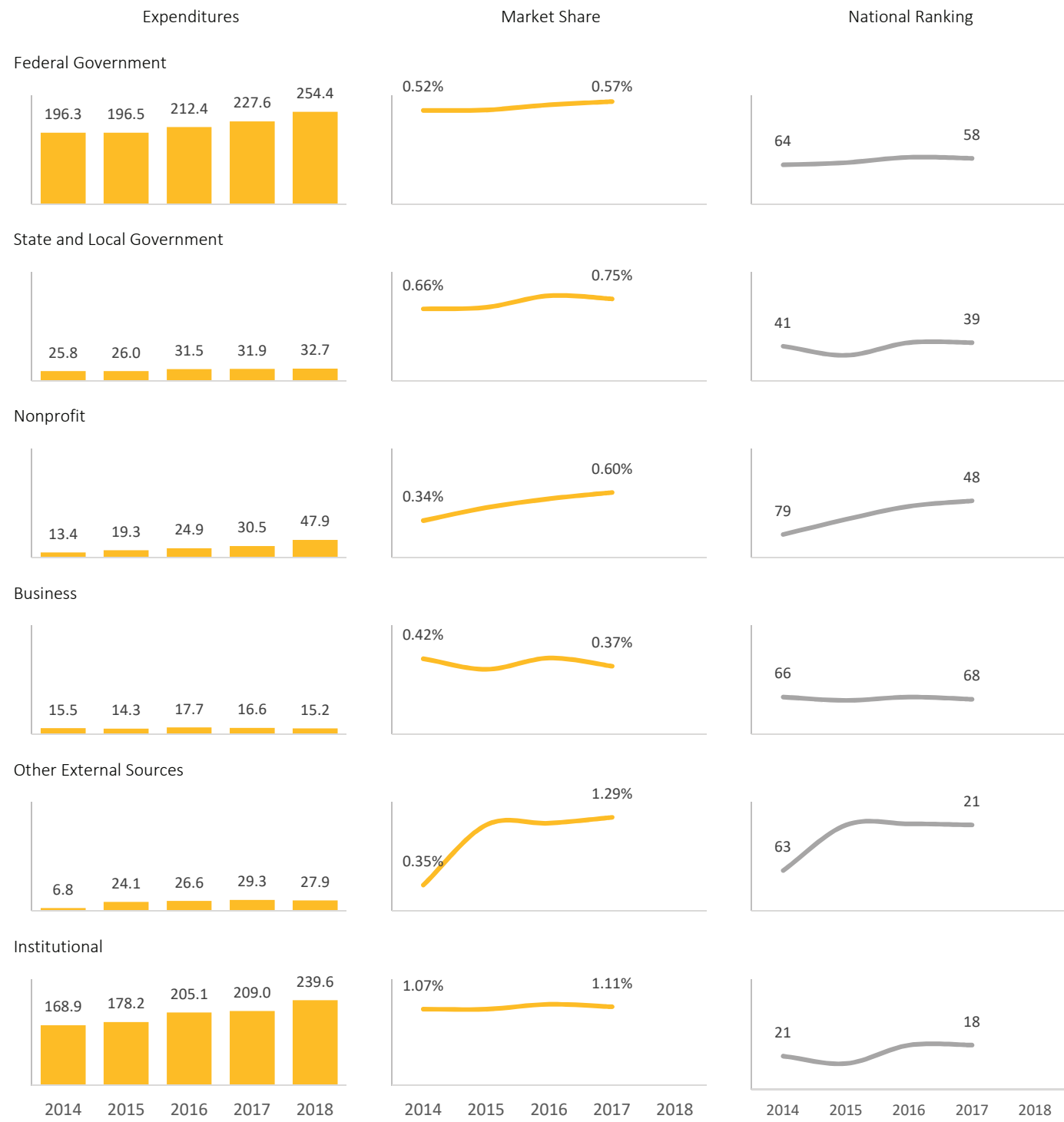


Exhibit R.ASU.6: Federally Funded Research Expenditures by Federal Agency with National Comparisons

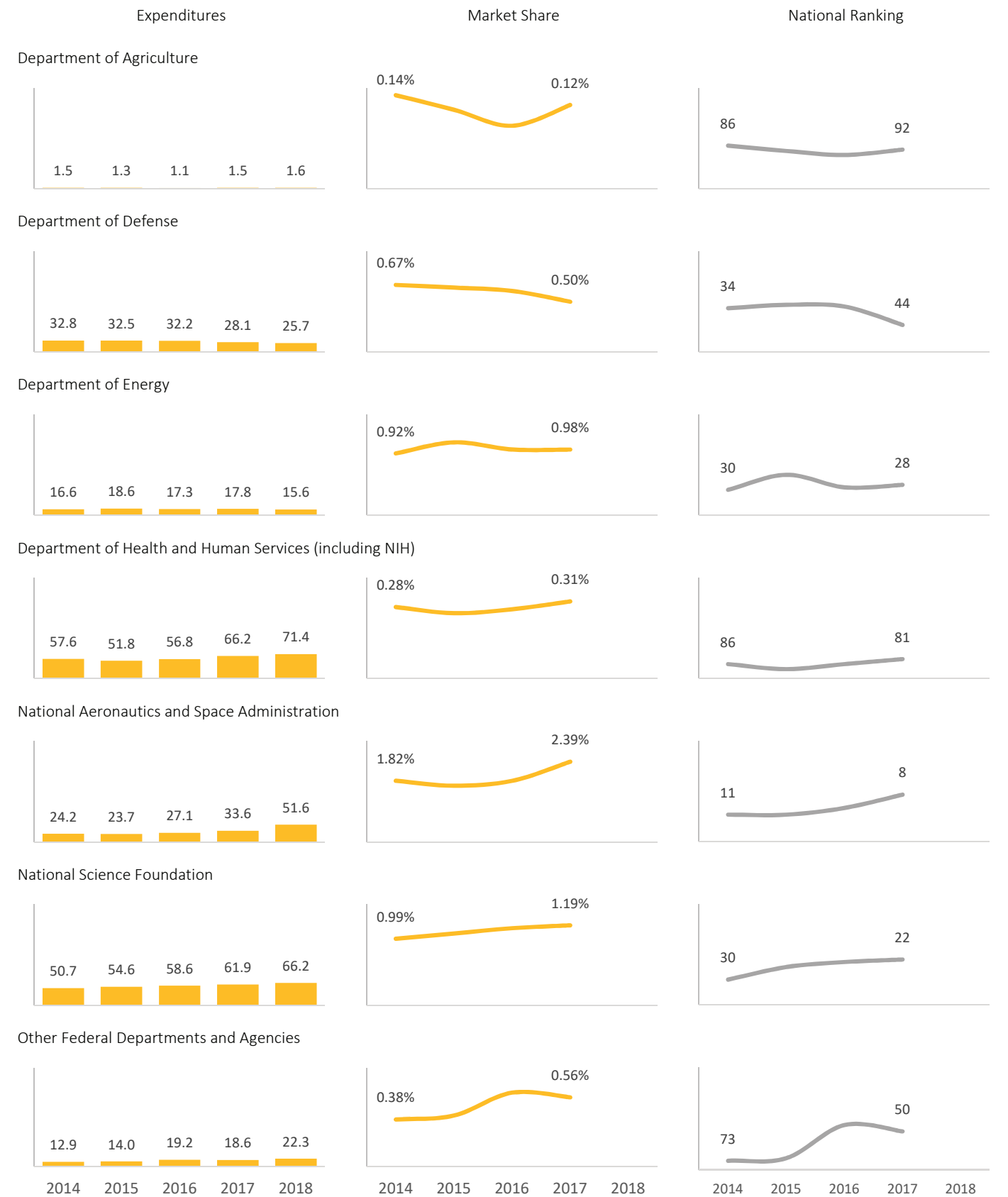


Exhibit R.ASU.7: Research Expenditures by Broad Disciplines with National Comparisons

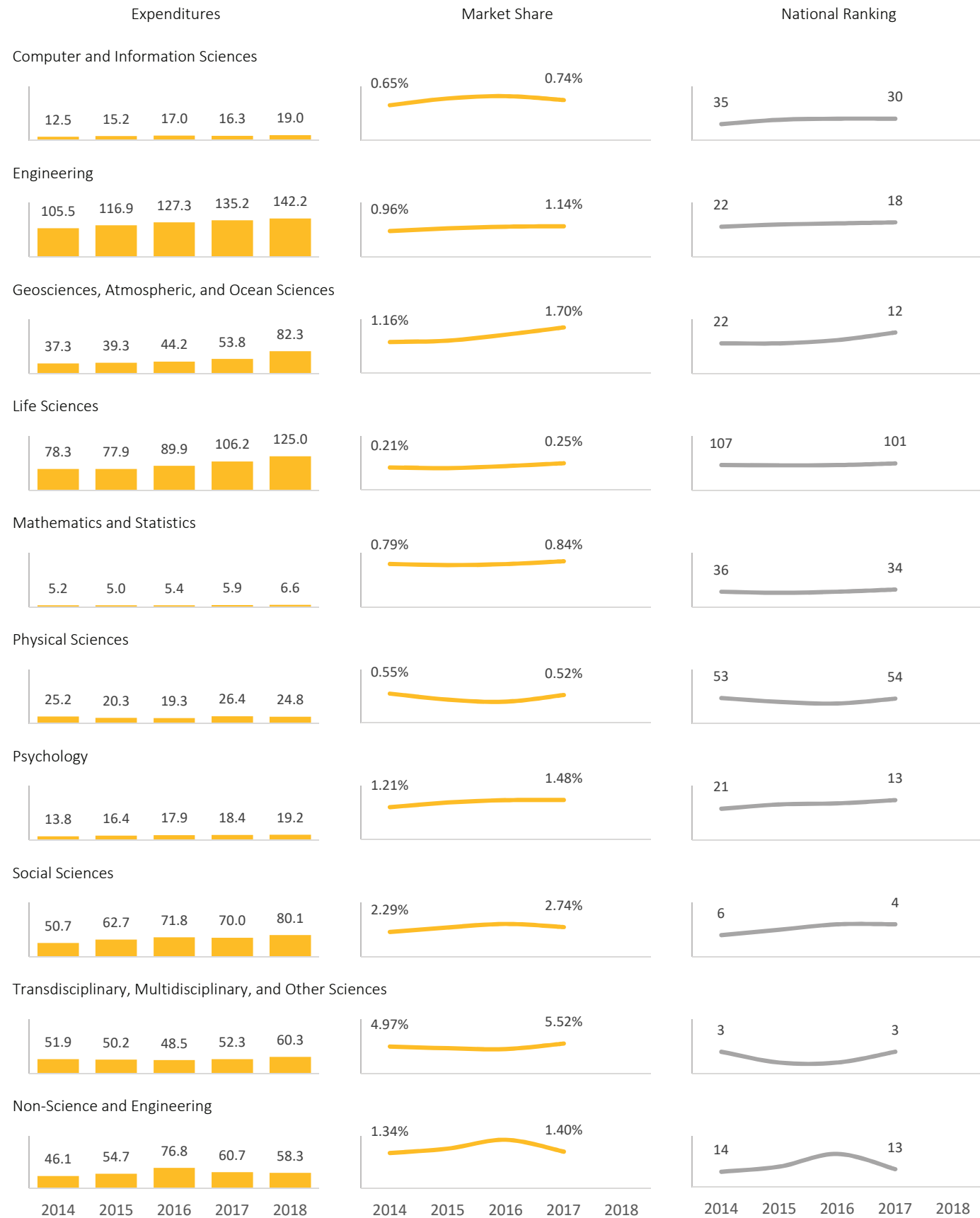
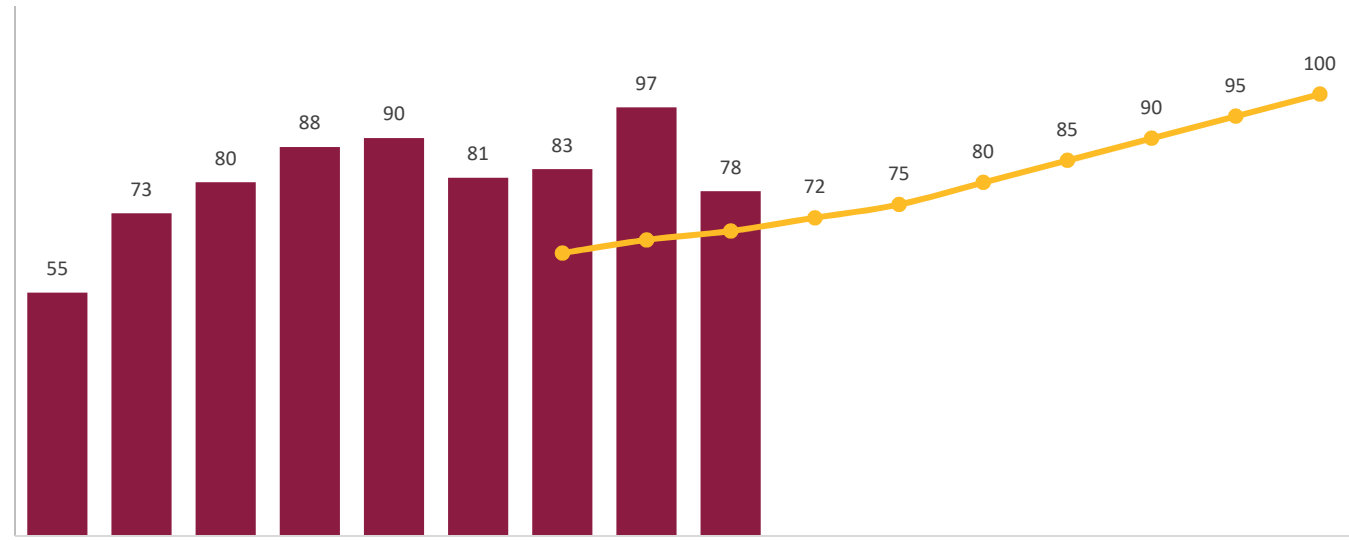


Exhibit R.ASU.8: Research Expenditures by Detailed Disciplines

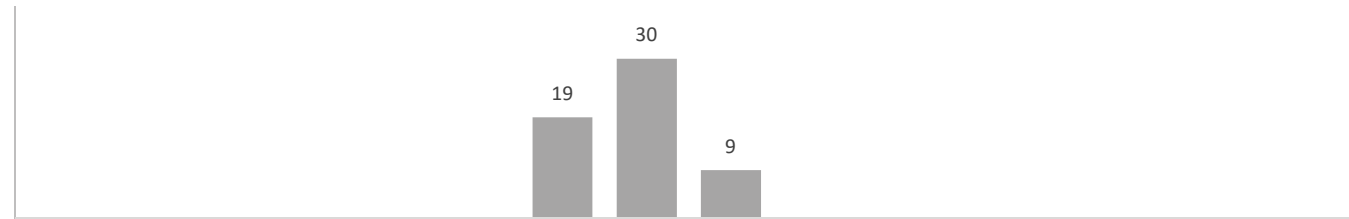
Research Discipline	2018 Expenditures	% of Discipline	% of Total
Computer and Information Sciences	18,967,000	100.0%	3.1%
Computer and Information Sciences	18,967,000	100.0%	3.1%
Engineering	142,175,000	100%	23%
Aerospace, Aeronautical and Astronautical Engineering	15,000	0.0%	0.0%
Bioengineering and Biomedical Engineering	13,769,000	9.7%	2.2%
Chemical Engineering	4,175,000	2.9%	0.7%
Civil Engineering	21,898,000	15.4%	3.5%
Electrical, Electronic and Communications Engineering	51,809,000	36.4%	8.4%
Industrial and Manufacturing Engineering	2,101,000	1.5%	0.3%
Mechanical Engineering	8,584,000	6.0%	1.4%
Metallurgical and Materials Engineering	4,672,000	3.3%	0.8%
Other Engineering	35,152,000	24.7%	5.7%
Geosciences, Atmospheric and Ocean Sciences	82,299,000	100.0%	13.3%
Atmospheric Science and Meteorology	0	0.0%	0.0%
Geological and Earth Sciences	82,299,000	100.0%	13.3%
Ocean Sciences and Marine Sciences	0	0.0%	0.0%
Other Geosciences, Atmospheric, and Ocean Sciences	0	0.0%	0.0%
Life Sciences	125,014,000	100.0%	20.2%
Agricultural Sciences	0	0.0%	0.0%
Biological and Biomedical Sciences	96,535,000	77.2%	15.6%
Health Sciences	26,836,000	21.5%	4.3%
Natural Resources and Conservation	21,000	0.0%	0.0%
Other Life Sciences	1,622,000	1.3%	0.3%
Mathematics and Statistics	6,571,000	100.0%	1.1%
Mathematics and Statistics	6,571,000	100.0%	1.1%
Physical Sciences	24,779,000	100.0%	4.0%
Astronomy and Astrophysics	0	0.0%	0.0%
Chemistry	11,314,000	45.7%	1.8%
Materials Science	0	0.0%	0.0%
Physics	12,359,000	49.9%	2.0%
Other Physical Sciences	1,106,000	4.5%	0.2%
Psychology	19,187,000	100.0%	3.1%
Psychology	19,187,000	100.0%	3.1%
Social Sciences	80,110,000	100.0%	13.0%
Anthropology	16,089,000	20.1%	2.6%
Economics	7,234,000	9.0%	1.2%
Political Science and Government	15,386,000	19.2%	2.5%
Sociology, Demography and Population Studies	7,344,000	9.2%	1.2%
Other Social Sciences	34,057,000	42.5%	5.5%
Other Sciences	60,289,000	100.0%	9.8%
Transdisciplinary, Multidisciplinary and Other Sciences	60,289,000	100.0%	9.8%
Non-Science and Engineering	58,326,000	100.0%	9.4%
Business Management and Business Administration	10,562,000	18.1%	1.7%
Communication and Communications Technologies	4,118,000	7.1%	0.7%
Education	16,615,000	28.5%	2.7%
Humanities	14,715,000	25.2%	2.4%
Law	3,936,000	6.7%	0.6%
Social Work	5,560,000	9.5%	0.9%
Visual and Performing Arts	2,820,000	4.8%	0.5%
Other Non-Science and Engineering	0	0.0%	0.0%

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

Licenses and Options and Enterprise Goals



Actual to Enterprise Goal Differences



Cumulative Actual to Enterprise Goal Differences

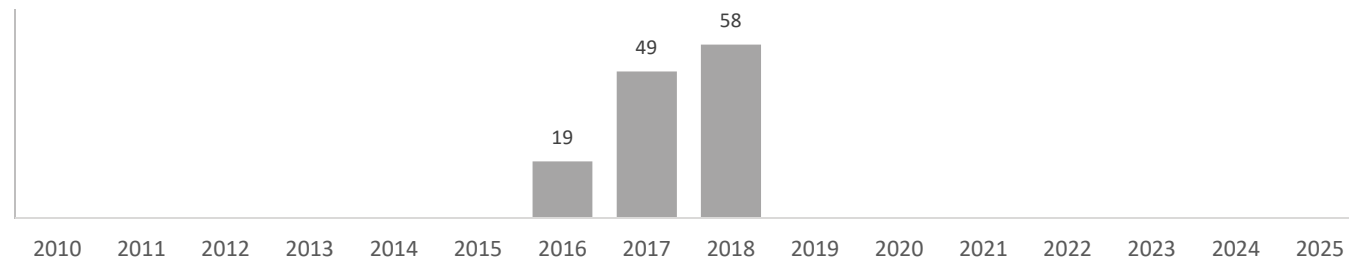


Exhibit TTA.ASU.2: Invention Disclosures

Invention Disclosures

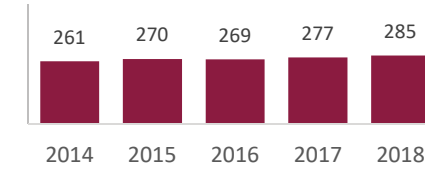
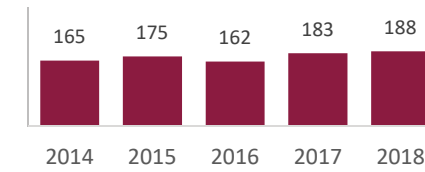


Exhibit TTA.ASU.3: Patents

New Patent Applications



US Patents Issued

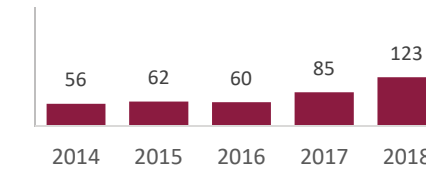
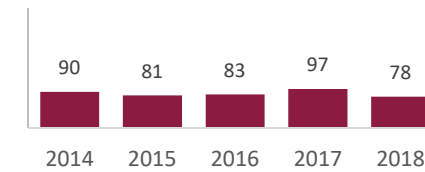
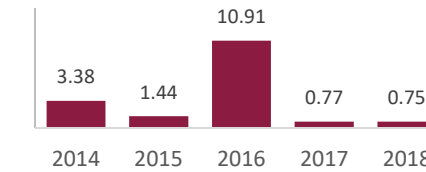


Exhibit TTA.ASU.4: Licenses and Options

Licenses and Options Executed



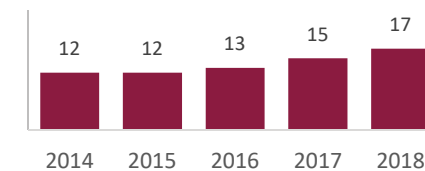
Licenses and Options Income (in Millions)



Intellectual Property Income	2014	2015	2016	2017	2018
Licenses and Options	3,376,965	1,436,333	10,907,198	770,443	750,757
Licensee Legal Reimbursements	941,229	1,133,341	1,204,692	1,439,171	1,698,294
Other Revenue	9,469	18,204	357	219,596	3,609
Total	4,327,663	2,587,878	12,112,247	2,429,210	2,452,660
Royalty Distributions	2014	2015	2016	2017	2018
Inventors	-1,005,051	-368,171	-1,520,699	-188,875	-258,026
Laboratories	-618,461	-138,661	-855,257	-114,923	-149,979
University	-611,253	-253,487	-1,158,996	-119,217	-170,570
Undistributed	86,930	31,898	16,878	151,984	14,422
Total	-1,142,784	-360,250	-1,997,375	-82,156	-306,127

Exhibit TTA.ASU.5: Startups

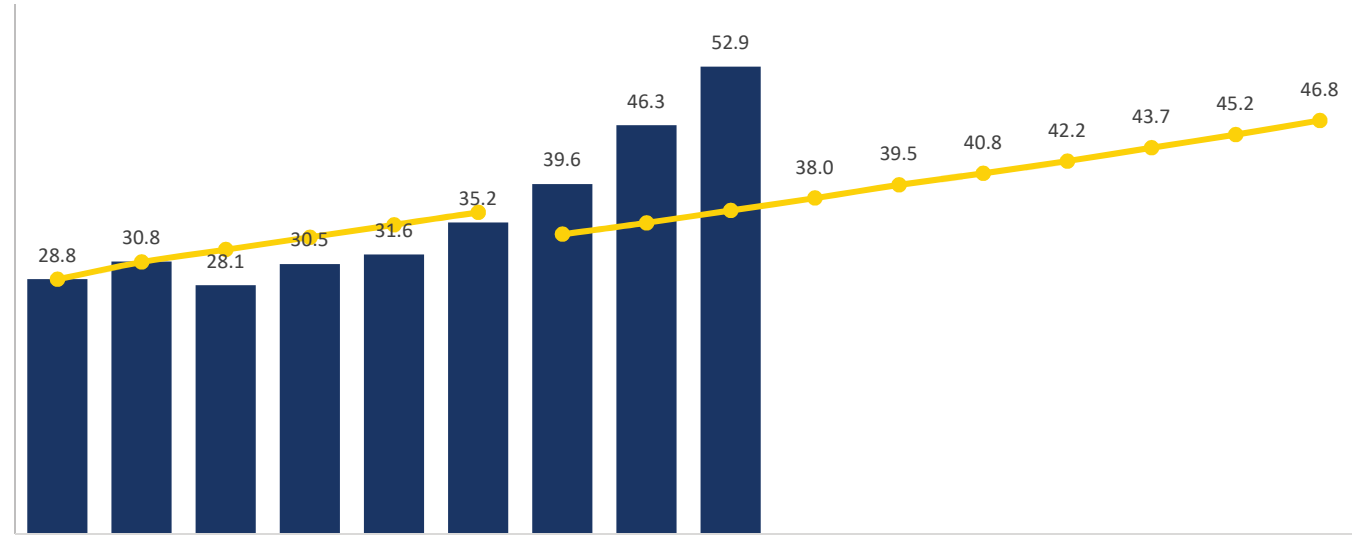
Startups



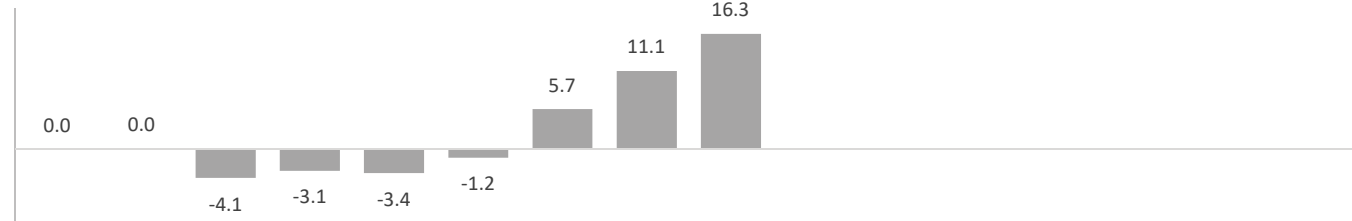
Startup Funding Over Last Five Years	2014	2015	2016	2017	2018
Active Startup Companies that Received Funding		5	8	16	11
Private Equity Funding Received by Active Startup Companies		75,700,000	93,365,000	46,140,717	48,239,000
Grant Funding Received by Active Startup Companies		0	0	0	2,311,000

Exhibit R.NAU.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

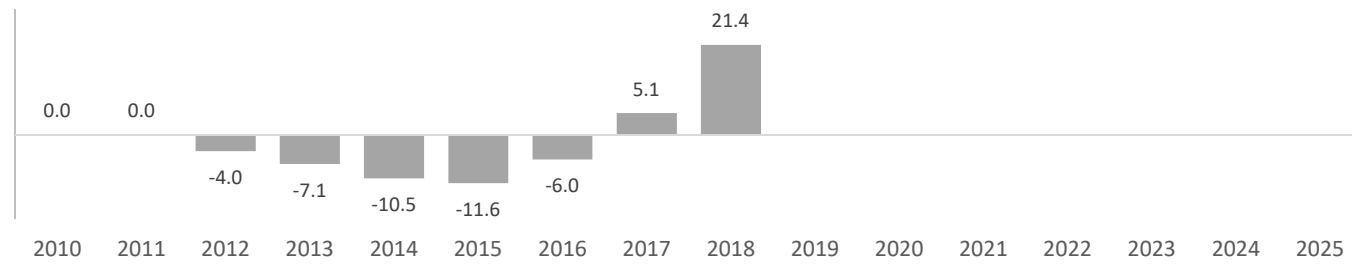


Exhibit R.NAU.2: Other Sponsored Project Expenditures

Other Sponsored Project Expenditures in Millions

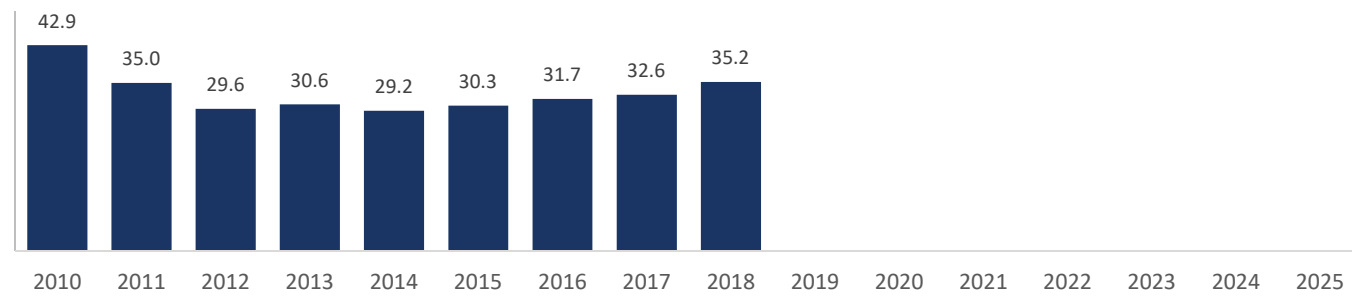


Exhibit R.NAU.3: Research Expenditures and Primary National Comparisons

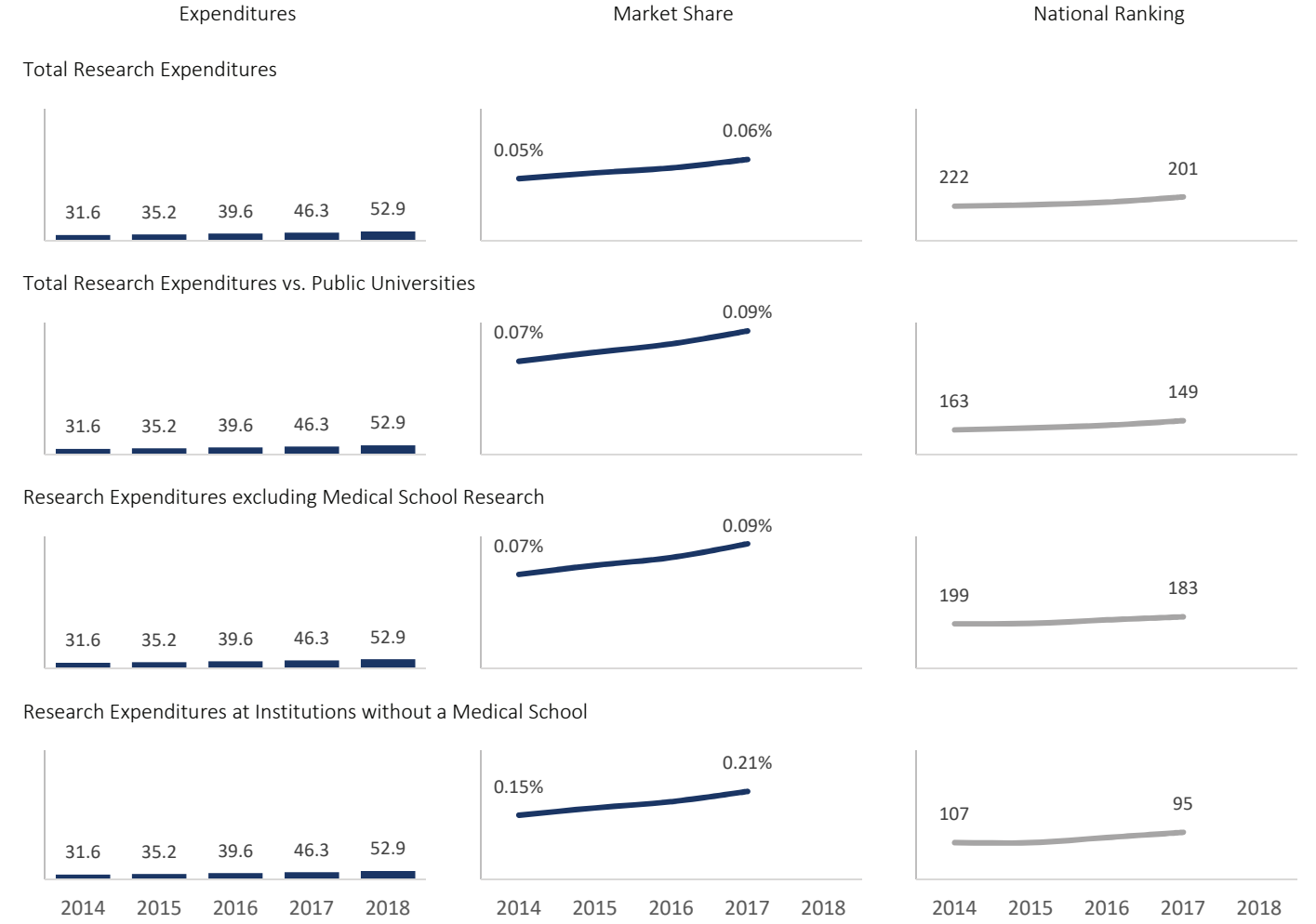


Exhibit R.NAU.4: Research Personnel and Facilities with National Comparisons

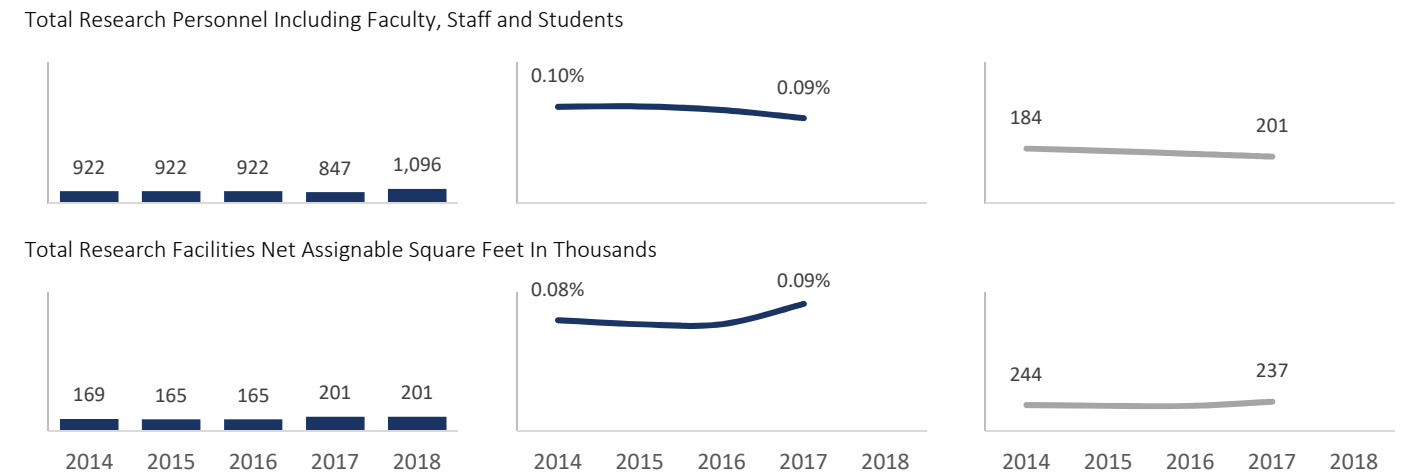


Exhibit R.NAU.5: Research Expenditures by Source of Funds with National Comparisons

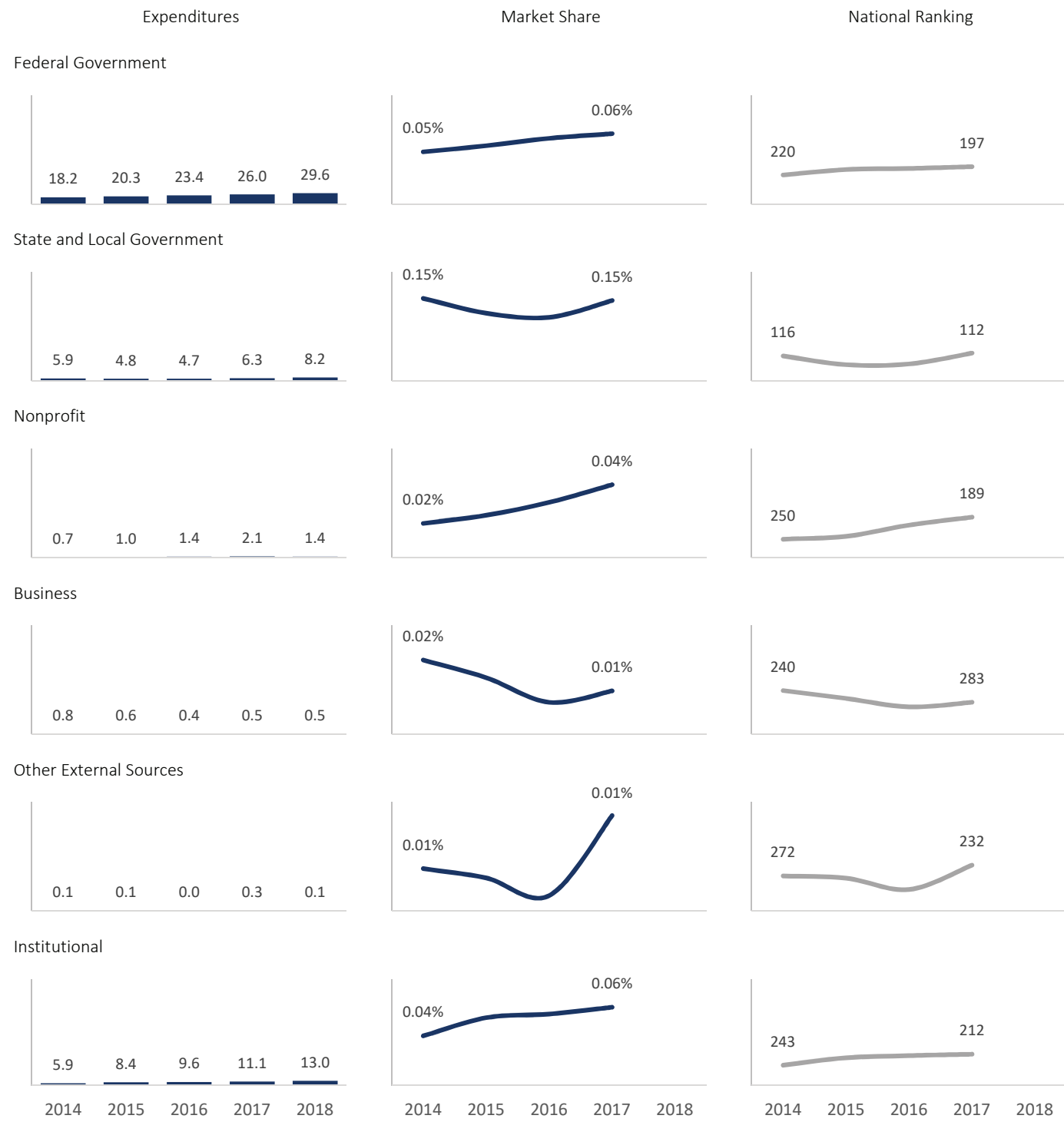


Exhibit R.NAU.6: Federally Funded Research Expenditures by Federal Agency with National Comparisons

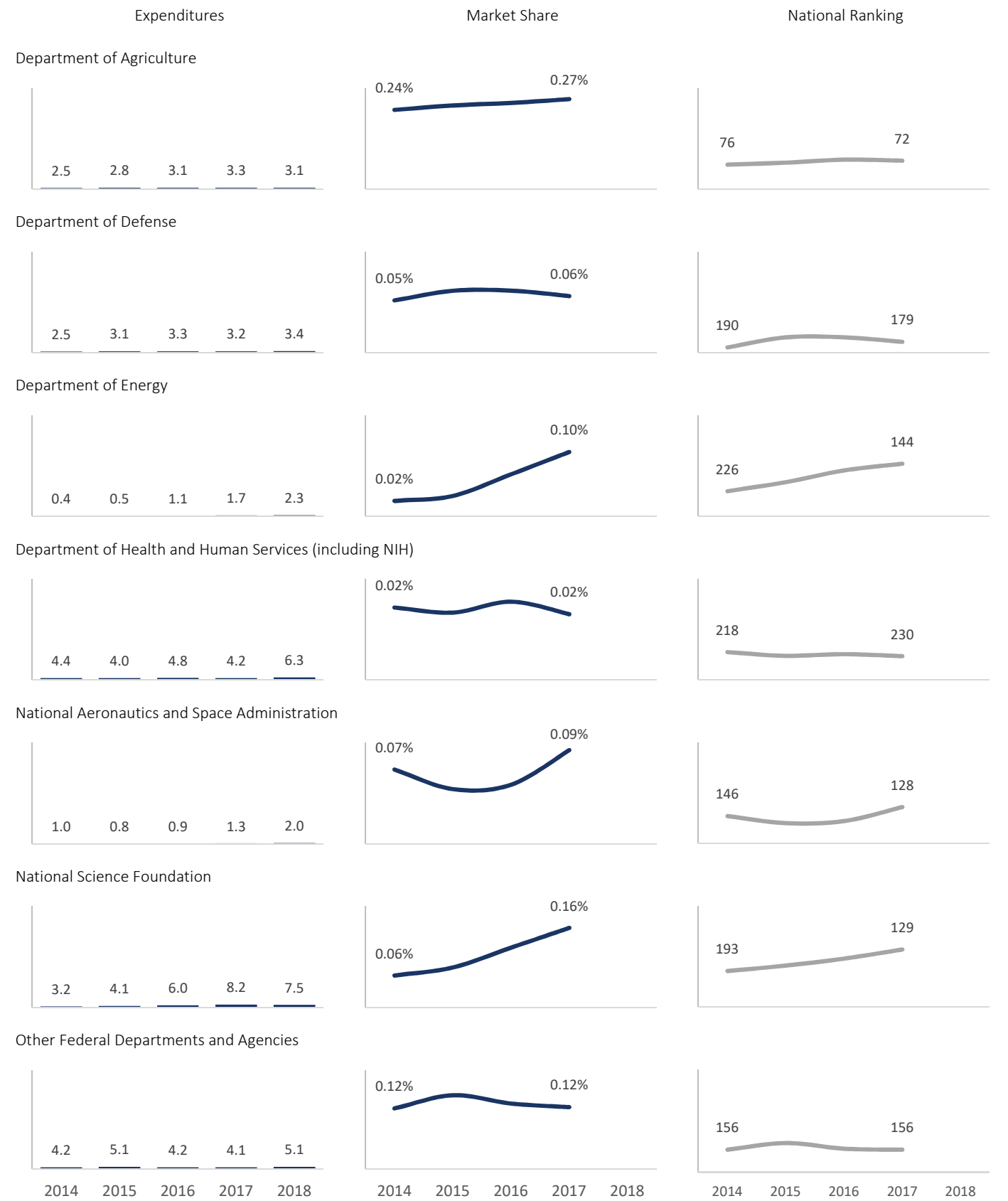


Exhibit R.NAU.7: Research Expenditures by Broad Disciplines with National Comparisons

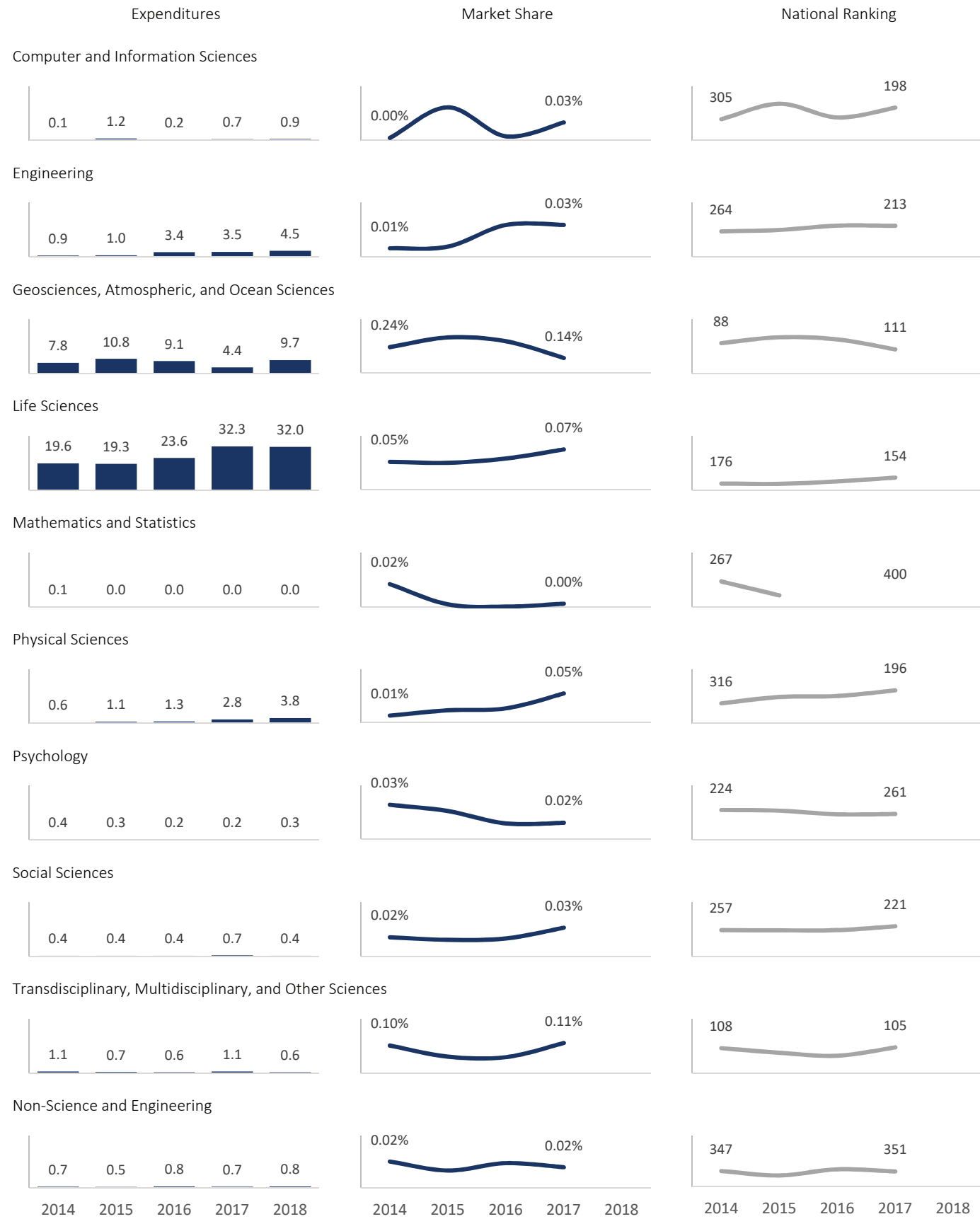
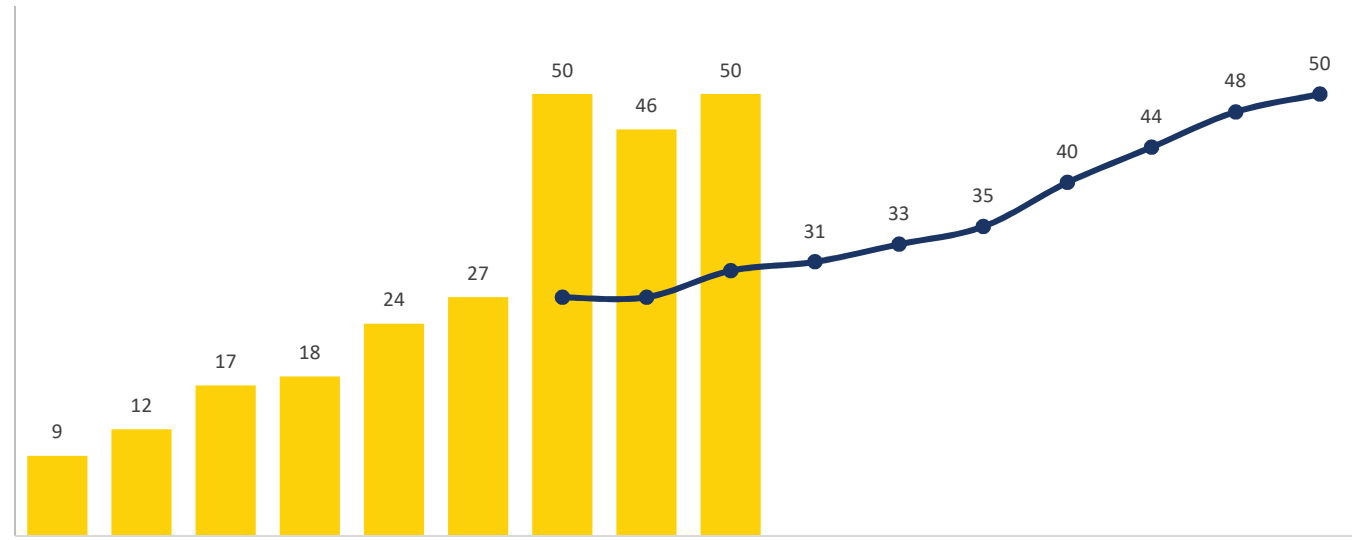


Exhibit R.NAU.8: Research Expenditures by Detailed Disciplines

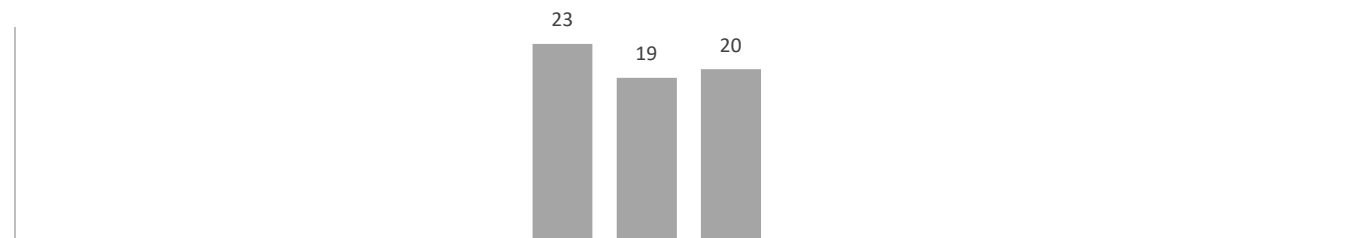
Research Discipline	2018 Expenditures	% of Discipline	% of Total
Computer and Information Sciences	908,000	100.0%	1.7%
Computer and Information Sciences	908,000	100.0%	1.7%
Engineering	4,454,000	100%	8%
Aerospace, Aeronautical and Astronautical Engineering	0	0.0%	0.0%
Bioengineering and Biomedical Engineering	1,240,000	27.8%	2.3%
Chemical Engineering	0	0.0%	0.0%
Civil Engineering	532,000	11.9%	1.0%
Electrical, Electronic and Communications Engineering	1,530,000	34.4%	2.9%
Industrial and Manufacturing Engineering	0	0.0%	0.0%
Mechanical Engineering	244,000	5.5%	0.5%
Metallurgical and Materials Engineering	23,000	0.5%	0.0%
Other Engineering	885,000	19.9%	1.7%
Geosciences, Atmospheric and Ocean Sciences	9,714,000	100.0%	18.4%
Atmospheric Science and Meteorology	10,000	0.1%	0.0%
Geological and Earth Sciences	4,810,000	49.5%	9.1%
Ocean Sciences and Marine Sciences	0	0.0%	0.0%
Other Geosciences, Atmospheric, and Ocean Sciences	4,894,000	50.4%	9.3%
Life Sciences	31,974,000	100.0%	60.4%
Agricultural Sciences	2,395,000	7.5%	4.5%
Biological and Biomedical Sciences	22,687,000	71.0%	42.9%
Health Sciences	2,036,000	6.4%	3.8%
Natural Resources and Conservation	4,129,000	12.9%	7.8%
Other Life Sciences	727,000	2.3%	1.4%
Mathematics and Statistics	21,000	100.0%	0.0%
Mathematics and Statistics	21,000	100.0%	0.0%
Physical Sciences	3,763,000	100.0%	7.1%
Astronomy and Astrophysics	1,945,000	51.7%	3.7%
Chemistry	1,355,000	36.0%	2.6%
Materials Science	16,000	0.4%	0.0%
Physics	324,000	8.6%	0.6%
Other Physical Sciences	123,000	3.3%	0.2%
Psychology	276,000	100.0%	0.5%
Psychology	276,000	100.0%	0.5%
Social Sciences	371,000	100.0%	0.7%
Anthropology	52,000	14.0%	0.1%
Economics	128,000	34.5%	0.2%
Political Science and Government	43,000	11.6%	0.1%
Sociology, Demography and Population Studies	40,000	10.8%	0.1%
Other Social Sciences	108,000	29.1%	0.2%
Other Sciences	624,000	100.0%	1.2%
Transdisciplinary, Multidisciplinary and Other Sciences	624,000	100.0%	1.2%
Non-Science and Engineering	794,000	100.0%	1.5%
Business Management and Business Administration	10,000	1.3%	0.0%
Communication and Communications Technologies	3,000	0.4%	0.0%
Education	534,000	67.3%	1.0%
Humanities	16,000	2.0%	0.0%
Law	0	0.0%	0.0%
Social Work	53,000	6.7%	0.1%
Visual and Performing Arts	0	0.0%	0.0%
Other Non-Science and Engineering	178,000	22.4%	0.3%

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

Invention Disclosures and Enterprise Goals



Actual to Enterprise Goal Differences



Cumulative Actual to Enterprise Goal Differences

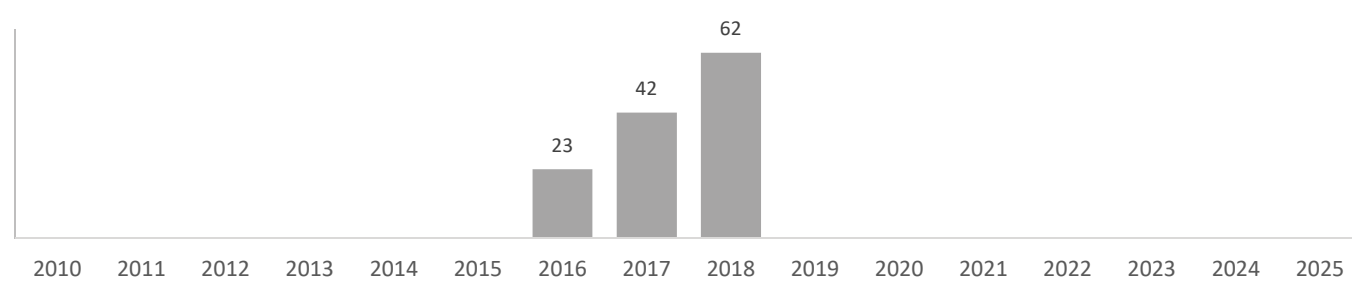


Exhibit TTA.NAU.2: Invention Disclosures

Invention Disclosures

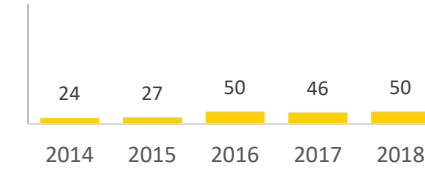
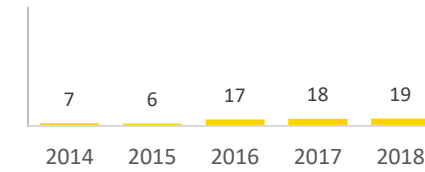


Exhibit TTA.NAU.3: Patents

New Patent Applications



US Patents Issued

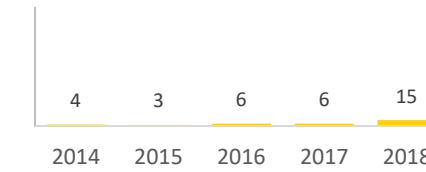
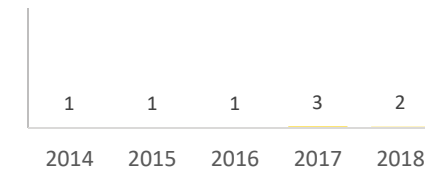
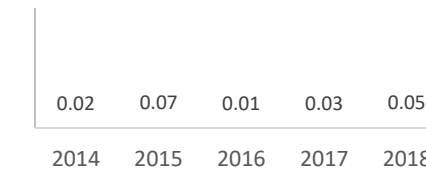


Exhibit TTA.NAU.4: Licenses and Options

Licenses and Options Executed



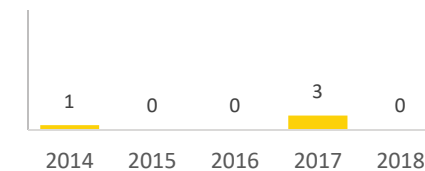
Licenses and Options Income (in Millions)



	2014	2015	2016	2017	2018
Intellectual Property Income					
Licenses and Options	22,975	69,365	5,286	30,070	53,628
Licensee Legal Reimbursements	9,100	5,542	0	14,902	13,079
Other Revenue	0	0	3,236	0	40,549
Total	32,075	74,907	8,522	44,972	107,256
Royalty Distributions					
Inventors	0	-21,240	-19,430	0	0
Laboratories	0	0	0	0	0
University	0	-21,240	-26,287	0	0
Undistributed	0	6,383	0	30,070	0
Total	0	-14,857	-26,287	30,070	0

Exhibit TTA.NAU.5: Startups

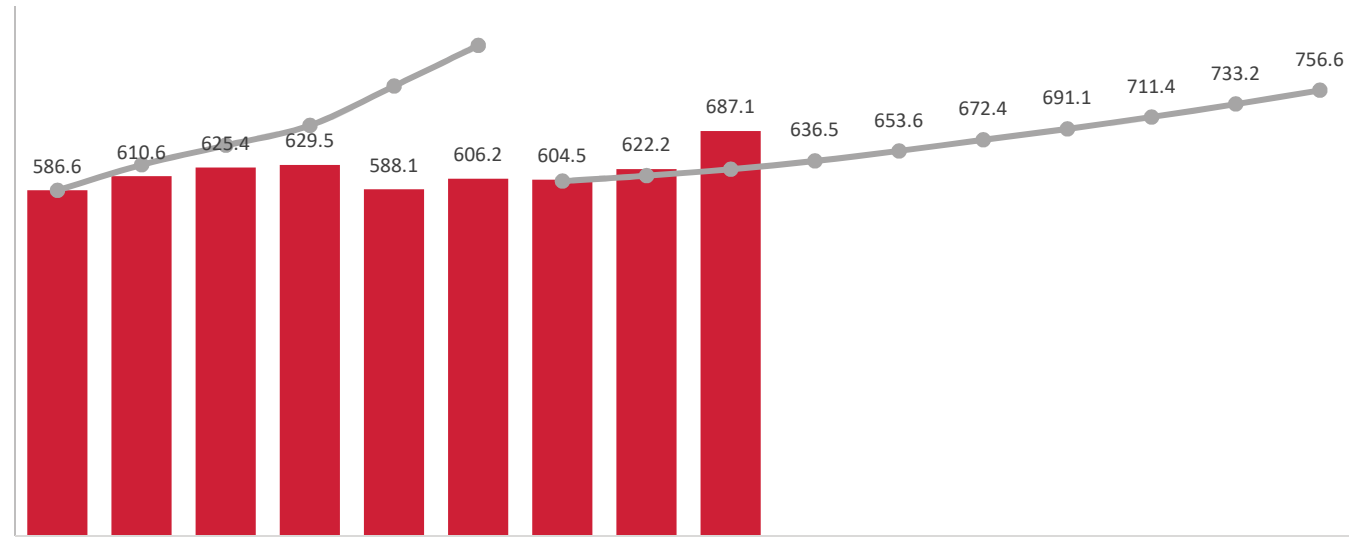
Startups



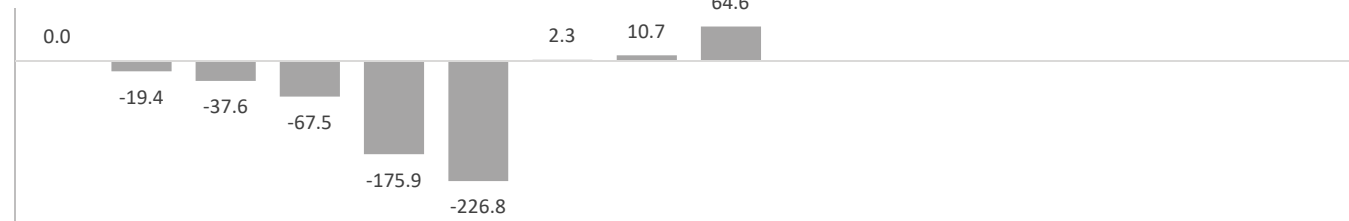
	2014	2015	2016	2017	2018
Startup Funding Over Last Five Years					
Active Startup Companies that Received Funding		0	0	1	0
Private Equity Funding Received by Active Startup Companies		0	0	0	0
Grant Funding Received by Active Startup Companies		0	0	150,000	0

Exhibit R.UA.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

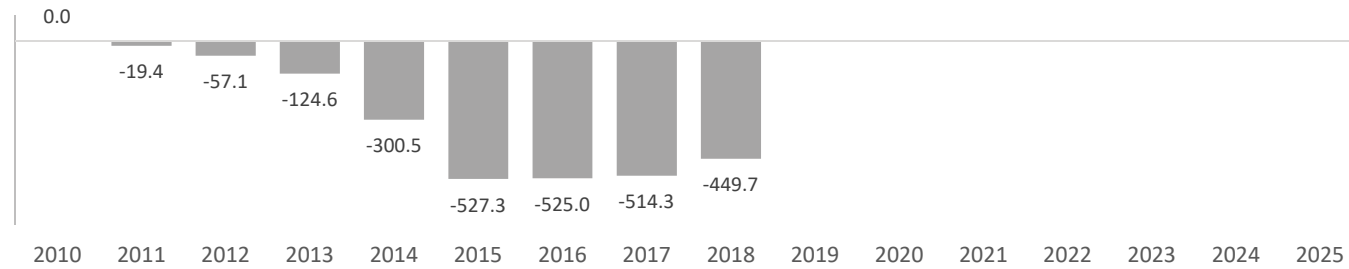


Exhibit R.UA.2: Other Sponsored Project Expenditures

Other Sponsored Project Expenditures in Millions

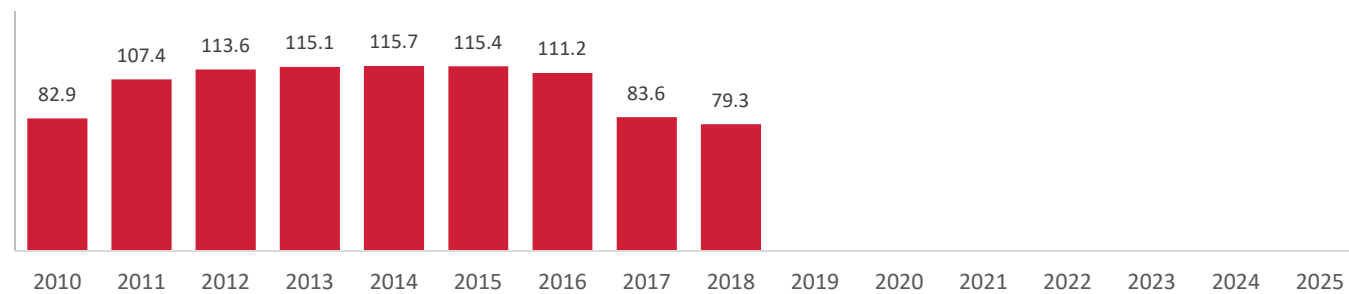


Exhibit R.UA.3: Research Expenditures and Primary National Comparisons

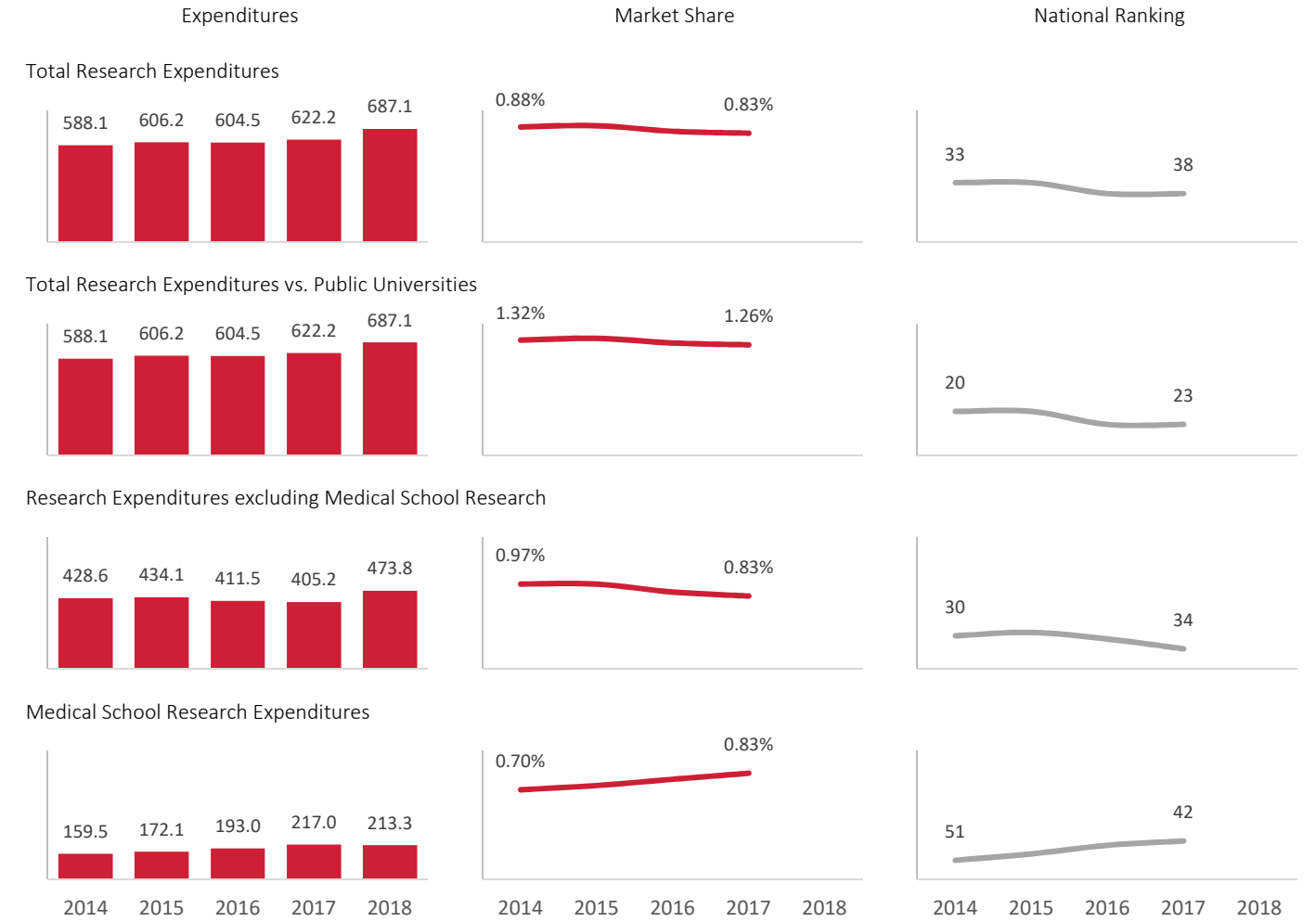


Exhibit R.UA.4: Research Personnel and Facilities with National Comparisons

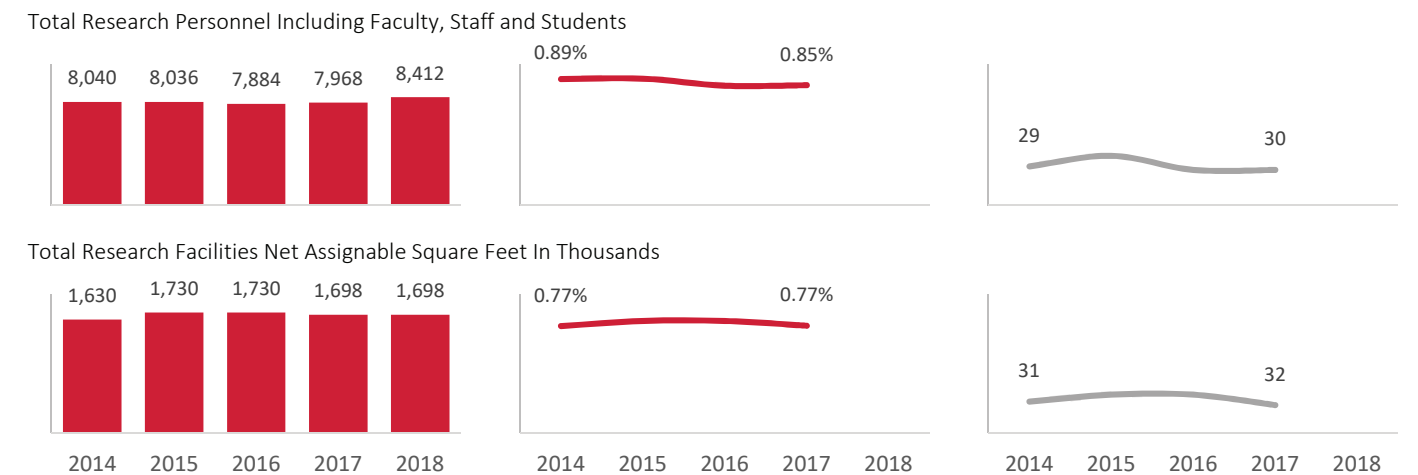


Exhibit R.UA.5: Research Expenditures by Source of Funds with National Comparisons

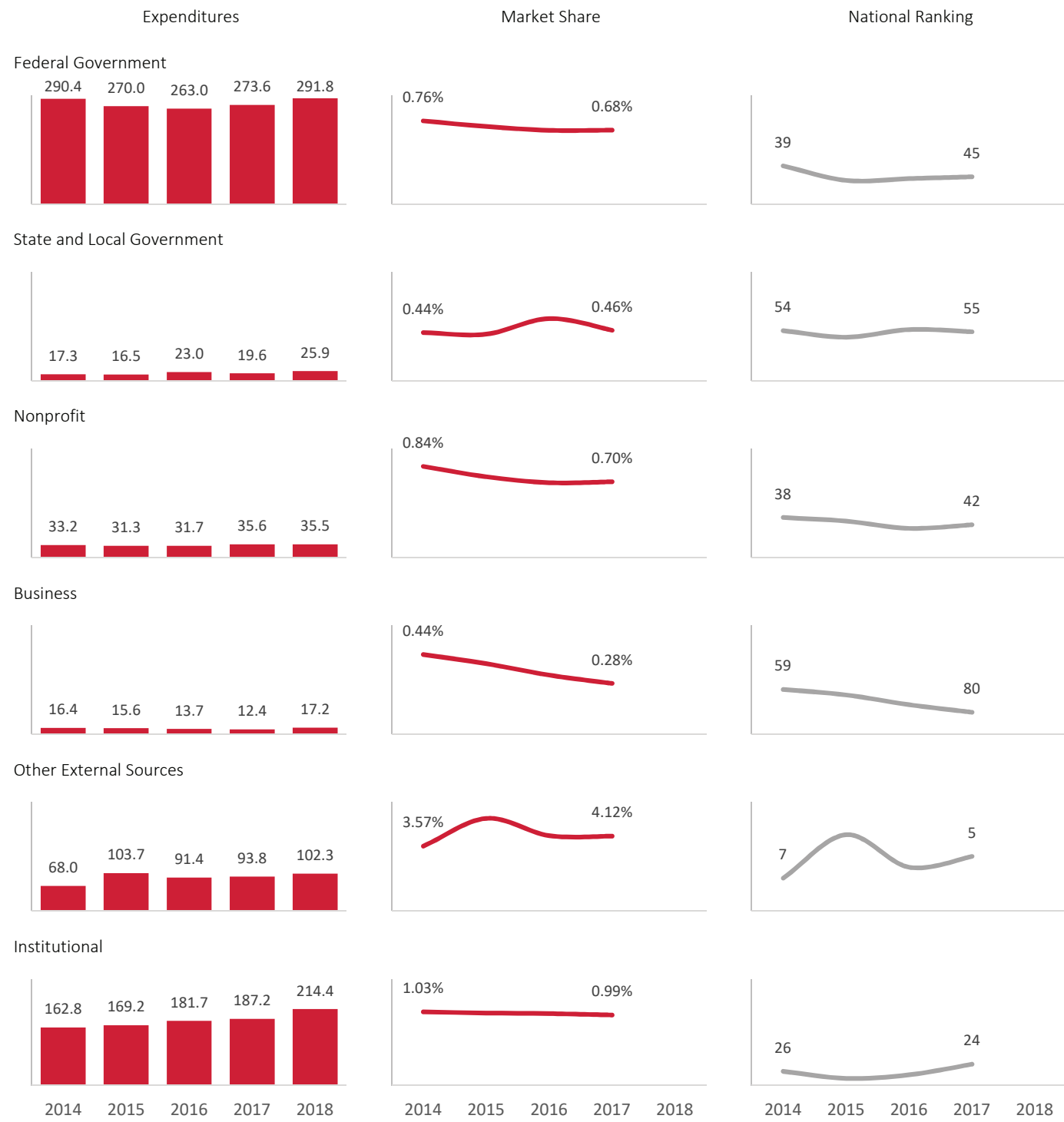


Exhibit R.UA.6: Federally Funded Research Expenditures by Federal Agency with National Comparisons

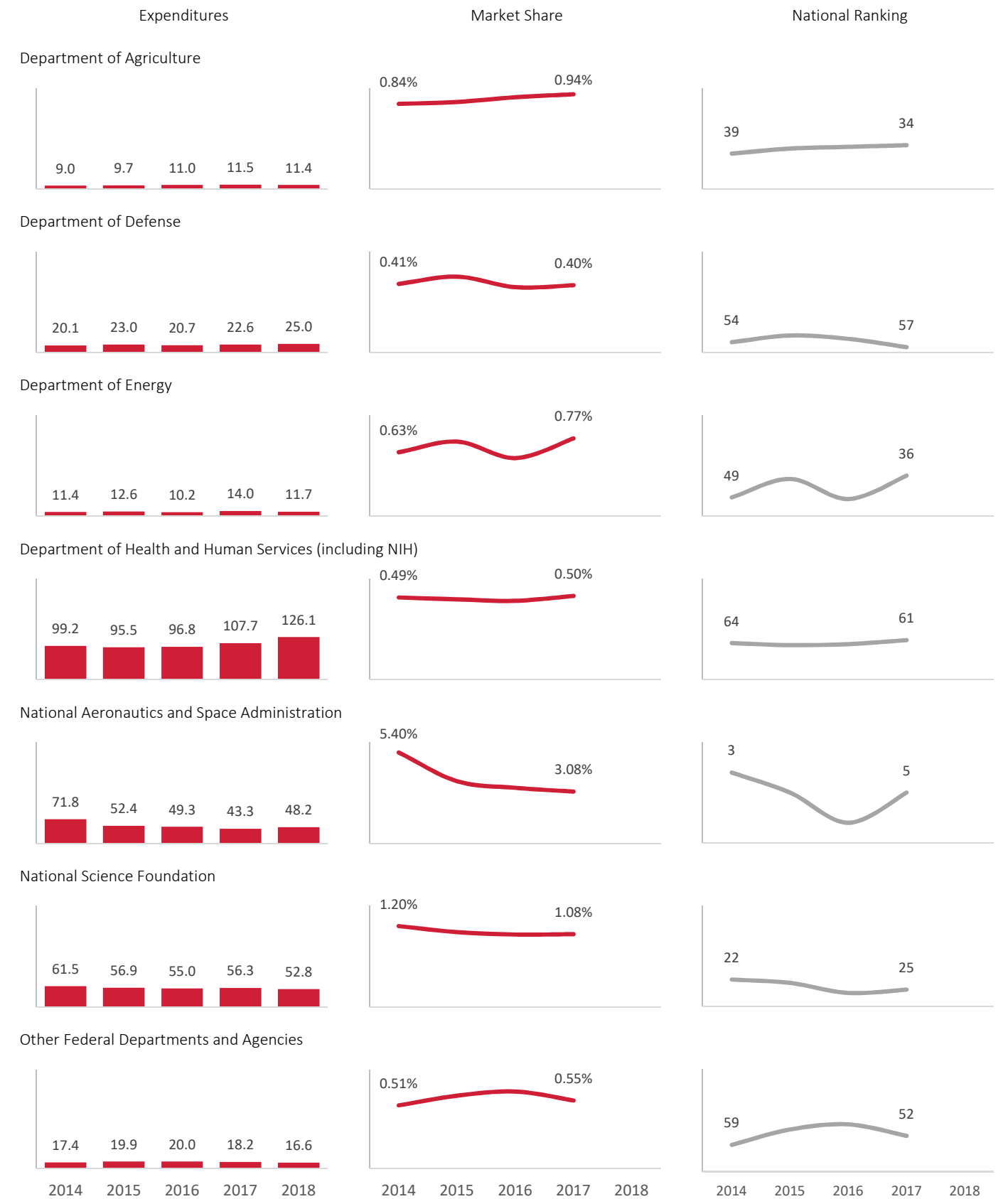


Exhibit R.UA.7: Research Expenditures by Broad Disciplines with National Comparisons

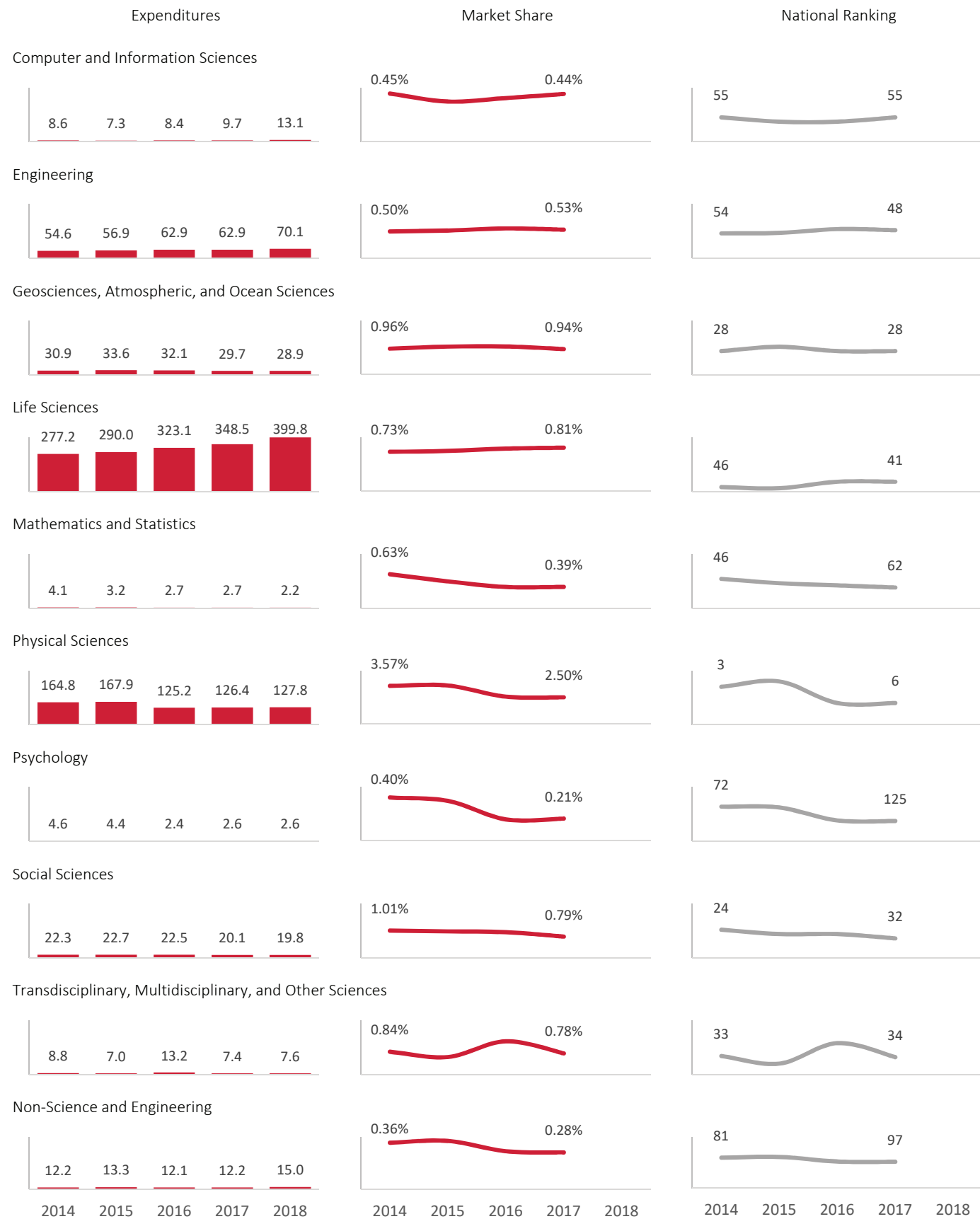
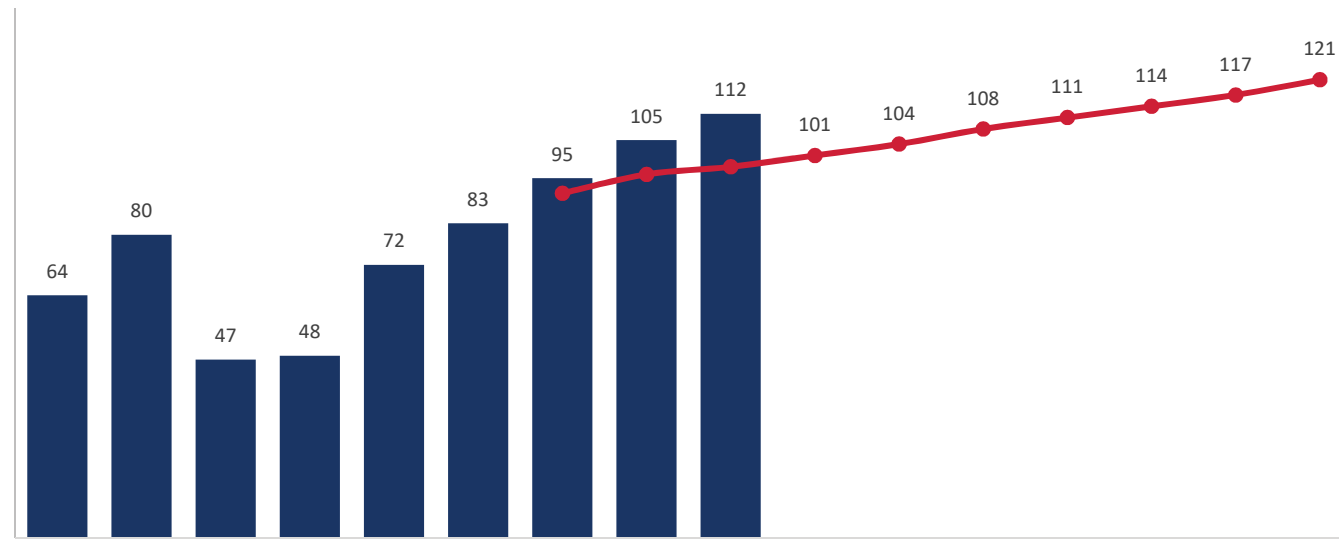


Exhibit R.UA.8: Research Expenditures by Detailed Disciplines

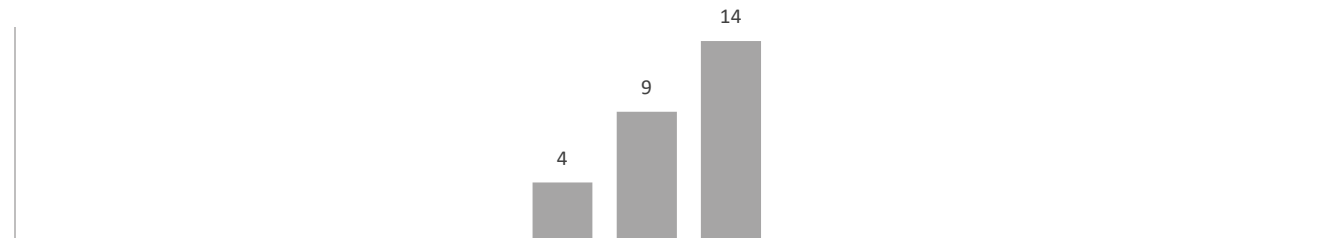
Research Discipline	2018 Expenditures	% of Discipline	% of Total
Computer and Information Sciences	13,089,000	100.0%	1.9%
Computer and Information Sciences	13,089,000	100.0%	1.9%
Engineering	70,100,000	100%	10%
Aerospace, Aeronautical and Astronautical Engineering	1,562,000	2.2%	0.2%
Bioengineering and Biomedical Engineering	6,627,000	9.5%	1.0%
Chemical Engineering	4,378,000	6.2%	0.6%
Civil Engineering	4,854,000	6.9%	0.7%
Electrical, Electronic and Communications Engineering	37,242,000	53.1%	5.4%
Industrial and Manufacturing Engineering	3,073,000	4.4%	0.4%
Mechanical Engineering	3,926,000	5.6%	0.6%
Metallurgical and Materials Engineering	5,229,000	7.5%	0.8%
Other Engineering	3,209,000	4.6%	0.5%
Geosciences, Atmospheric and Ocean Sciences	28,947,000	100.0%	4.2%
Atmospheric Science and Meteorology	6,104,000	21.1%	0.9%
Geological and Earth Sciences	19,668,000	67.9%	2.9%
Ocean Sciences and Marine Sciences	2,041,000	7.1%	0.3%
Other Geosciences, Atmospheric, and Ocean Sciences	1,134,000	3.9%	0.2%
Life Sciences	399,791,000	100.0%	58.2%
Agricultural Sciences	46,176,000	11.6%	6.7%
Biological and Biomedical Sciences	174,310,000	43.6%	25.4%
Health Sciences	167,653,000	41.9%	24.4%
Natural Resources and Conservation	11,628,000	2.9%	1.7%
Other Life Sciences	24,000	0.0%	0.0%
Mathematics and Statistics	2,233,000	100.0%	0.3%
Mathematics and Statistics	2,233,000	100.0%	0.3%
Physical Sciences	127,849,000	100.0%	18.6%
Astronomy and Astrophysics	104,787,000	82.0%	15.3%
Chemistry	13,525,000	10.6%	2.0%
Materials Science	3,332,000	2.6%	0.5%
Physics	6,151,000	4.8%	0.9%
Other Physical Sciences	54,000	0.0%	0.0%
Psychology	2,628,000	100.0%	0.4%
Psychology	2,628,000	100.0%	0.4%
Social Sciences	19,835,000	100.0%	2.9%
Anthropology	3,715,000	18.7%	0.5%
Economics	2,510,000	12.7%	0.4%
Political Science and Government	1,108,000	5.6%	0.2%
Sociology, Demography and Population Studies	4,080,000	20.6%	0.6%
Other Social Sciences	8,422,000	42.5%	1.2%
Other Sciences	7,569,000	100.0%	1.1%
Transdisciplinary, Multidisciplinary and Other Sciences	7,569,000	100.0%	1.1%
Non-Science and Engineering	15,028,000	100.0%	2.2%
Business Management and Business Administration	3,153,000	21.0%	0.5%
Communication and Communications Technologies	384,000	2.6%	0.1%
Education	5,074,000	33.8%	0.7%
Humanities	4,763,000	31.7%	0.7%
Law	61,000	0.4%	0.0%
Social Work	0	0.0%	0.0%
Visual and Performing Arts	788,000	5.2%	0.1%
Other Non-Science and Engineering	805,000	5.4%	0.1%

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

Licenses and Options and Enterprise Goals



Actual to Enterprise Goal Differences



Cumulative Actual to Enterprise Goal Differences

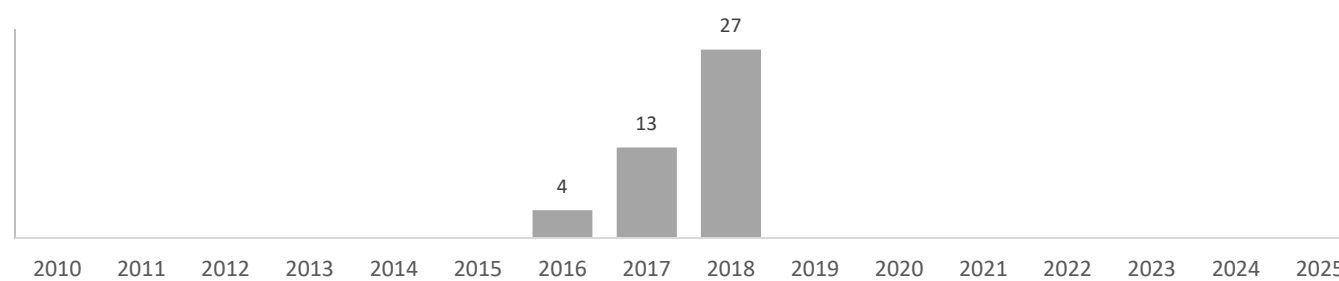


Exhibit TTA.UA.2: Invention Disclosures

Invention Disclosures

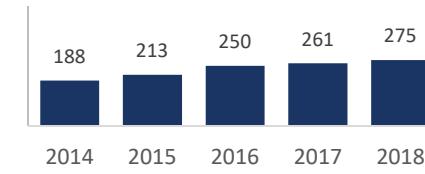
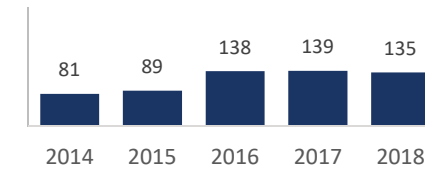


Exhibit TTA.UA.3: Patents

New Patent Applications



US Patents Issued

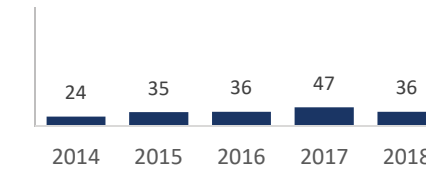
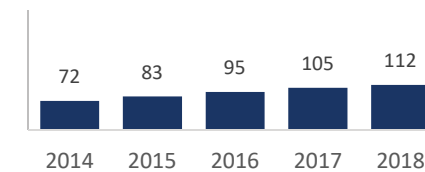
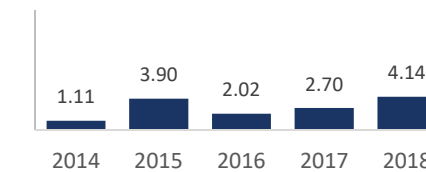


Exhibit TTA.UA.4: Licenses and Options

Licenses and Options Executed



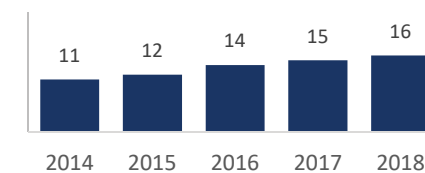
Licenses and Options Income (in Millions)



Intellectual Property Income	2014	2015	2016	2017	2018
Licenses and Options	1,112,331	3,895,882	2,015,807	2,703,261	4,141,604
Licensee Legal Reimbursements	515,211	778,984	697,099	629,368	651,410
Other Revenue	0	0	0	0	0
Total	1,627,542	4,674,866	2,712,906	3,332,629	4,793,014
Royalty Distributions	2014	2015	2016	2017	2018
Inventors	-364,627	-1,380,435	-631,552	-946,141	-1,403,012
Laboratories	-314,162	-1,296,680	-604,742	-865,044	-1,276,847
University	-208,156	-990,526	-507,454	-729,881	-1,383,994
Undistributed	225,026	228,241	272,059	150,000	77,751
Total	-297,292	-2,058,965	-840,137	-1,444,925	-2,583,090

Exhibit TTA.UA.5: Startups

Startups



Startup Funding Over Last Five Years	2014	2015	2016	2017	2018
Active Startup Companies that Received Funding		11	15	18	23
Private Equity Funding Received by Active Startup Companies		1,800,000	63,330,000	20,427,000	14,319,000
Grant Funding Received by Active Startup Companies		6,100,000	3,576,507	11,601,733	17,250,541



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