MEASURING THE IMPACT OF RESEARCH ON WASHINGTON'S ECONOMY

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TechAlliance

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Washington state boasts a vibrant research community with four powerhouse institutes: in the Greater Seattle Area – at Fred Hutch Cancer Research Center (Fred Hutch) and University of Washington (UW) – and across Eastern Washington – at Pacific Northwest National Laboratory (PNNL) and Washington State University (WSU).

These "Big 4" institutes lead the field of research and development (R&D) in a number of subject areas from life sciences and agriculture, to artificial intelligence and clean energy. The innovation is evident through the number of generated tech licenses, earned royalties, and company spin-offs. There is little doubt that the combined economic impact of these four institutes is significant. This white paper seeks to track and quantify the individual impact of the four institutes.

INVESTMENT IN R&D FROM PUBLIC AND PRIVATE ENTITIES

Research expenditures – or the dollars spent on research and development – are used here to help quantify the overall investment in R&D. The funding sources are typically separated into public (federal and non-federal) and private sources (businesses, nonprofits, and institution funds), as shown in the two tables below.

The National Science Foundation conducts an annual Higher Education Research and Development Survey to track total expenditures at research universities, with separate rankings for public and private institutes. In fiscal year 2016, UW ranked 3rd nationally and WSU ranked 44th of 393 public research institutions.[i] Last year, the big four research institutes in Washington state expended over $2.7B in R&D from public funding sources (mostly federal) and $765M from private sources and institution funds.

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Table 1. Research Expenditures from Public Funding Sources

	Public Funding 2017	Average Growth 10 Years	Total Difference 10 Years
FHCRC	$315M	1%	$30M
PNNL	$1B	2%	$110M
UW	$1B	5%	$380M
WSU	$200M	6%	$58M

Table 2. Research Expenditures from Private Funding Sources

	Private Funding 2017	Average Growth 10 Years	Total Difference 10 Years
FHCRC	$240M	13%	$120M
PNNL			
UW	$375M	11%	$235M
WSU	$150M	5%	$16M

Funding from private sources has been growing at a steadily higher rate than from public sources. This is true at both private research institutes, like Fred Hutch, and public institutes such as the University of Washington. Diversity in funding sources - public (both local and state), as well as private, remains critical to the health of our research community.

CONNECTING THE DOTS BETWEEN INVESTMENT AND OUTPUT

Research and development products come in many forms: licenses, patents, publications, royalties, and startups. While there is risk that a research project results in none of these, the potential gains of innovation far exceed the risk of failure, which can still inform future research initiatives. From these measurable products of R&D, the Tech Alliance has narrowed its focus to tech licenses, royalty incomes, and new startups.

While the data for this section focuses on the economic impact of higher education institutes, it is important to highlight the effectiveness of the other two pillars of research in Washington. At Fred Hutch Cancer Research Center, 33 companies have spun-out of Fred Hutch with 18 currently active. As of 2017, these active startups have 1,165 employees and have raised more than $2.3 billion in capital since such data tracking began.[ii] At PNNL, there are 103 businesses with roots in the Laboratory, 69 of which are in Washington state, with an estimated revenue of over $586M and 3,097 employees.[iii]

The University of Washington is recognized for the massive amount of research conducted on campus, ranked consistently 2nd or 3rd among public institutes for at least the past five years.[iv] By juxtaposing data from higher education research institutes in each state, we can uncover potential links between the investment made in research and the direct impact that investment has on innovation and the state's economy.

Table 3. R&D Investment and Direct Impact

	Total Expenditures		10-Year Cumulative Total		
	10-Year Cumulative	FY 2016 Rank	Tech Licenses	Royalty Income	New Startups
Harvard University	$7.7B	3	476	$170M	21
New York University	$4.2B	10	405	$1.68B	78
Stanford University	$7.3B	4	900	$725M	100
Univ. of Washington	$11.1B	3	2603	$380M	134

How does UW stack up against peer institutes in other tech & innovation driven states?

The University of Washington holds strong among its peer universities also located in technology and innovation driven states – ranked first among the four universities, with the lowest cost (expenditures) for each new tech license. For every $1,000 dedicated to research over the past ten years, the University of Washington has earned roughly $34 in royalty income, surpassing Harvard, but falling far behind NYU and Stanford. And finally, for the total research expenditures per startup, UW is on par with NYU and Stanford for overall cost effectiveness, while Harvard remains at a distant fourth.

Table 4. Research Expenditures per Tech License (10-year cumulative)

	10-Yr Expenditures	Total Licenses	Total Spent per License	Rank
Harvard University	$7.7B	476	$16.2M	4
New York University	$4.2B	405	$10.2M	3
Stanford University	$7.3B	900	$8.1M	2
Univ. of Washington	$11.1B	2603	$4.3M	1

Table 5. $1,000 in Research Expenditures per $ __ Earned from Royalties (10-year cumulative)

	10-Yr Expenditures	Total Royalties	$1K Spent per $ Earned	Rank
Harvard University	$7.7B	$170M	$22	4
New York University	$4.2B	$1.68B	$405	1
Stanford University	$7.3B	$725M	$100	2
Univ. of Washington	$11.1B	$380M	$34	3

Table 6. Research Expenditures per New Startup (10-year cumulative)

	10-Yr Expenditures	Total Startups	Total Spent per Startup	Rank
Harvard University	$7.7B	21	$366M	4
New York University	$4.2B	78	$53M	1
Stanford University	$7.3B	100	$73M	2
Univ. of Washington	$11.1B	134	$83M	3

ALIGNING RESEARCH WITH STRATEGIC ECONOMIC SECTORS

Impact from such innovation and economic development transcends the walls of the institutions. Efforts in research and development tackle today's most pressing issues across a wide range of fields. The Washington governor's office has identified eight key industries of strategic importance to the state's economic prosperity:[v]

- Aerospace
- Agriculture
- Clean Energy
- Forest Products & Rural Economic Development
- Information and Communication Technology
- Life Sciences and Global Health
- Maritime
- Military & Defense

Washington's four powerhouse research institutes align much of their research with these economic sectors (often incentivized further by state funding). Washington State University is the state's only land-grant university and exemplifies the way investment in research projects aligns with these key economic sectors. WSU is known for its innovation and technology in many areas: food science, agriculture, clean energy, life sciences, etc.

Peptide, a neurodegenerative disease drug for the treatment of dementia, cancer, and deficits in wound healing came from research that originated in WSU labs. This cutting-edge medicine is licensed by M3 Biotechnology and exhibits high efficiency in patients with Parkinson's.[vi] M3 is a key part of the region's effort to rebuild the life sciences sector and, foundational to this kind of success story, are strong research institutions.

The table below captures the economic impact of WSU's research by sector as defined by the National Science Foundation:

Table 7. WSU Expenditures (Public & Private) by Sector[vii]

	WSU Expenditures 2005 ($M)	WSU Expenditures 2016 ($M)	Avg. Annual Percent Growth
Life Sciences	110.4	185.1	4.8
Physical Sciences	15.6	40.8	9.1
Engineering	25.8	46.1	5.4
Environmental Sciences*	3.3	9.8	10.4
Math and Computer Sciences	1.2	5.7	15.2
Other**	26.4	46.6	5.3

* 2017 renamed to: Geosciences, atmospheric sciences, and ocean sciences
** Social sciences, Psychology, Sciences not elsewhere classified, and All non-Science/Engineering fields

LOOKING AHEAD AT THE FUTURE OF R&D IN WASHINGTON

The "Big 4" in Washington – Fred Hutch, PNNL, UW, and WSU – represent a tremendous investment in research. This investment leads to new startups, cutting-edge technologies, and more jobs. However, the heavy reliance on federal funding must be augmented by a commensurate commitment from industry and the state. Often these are used as matches, but should also be seen as investment in the state's own R&D needs and a significant commitment to institutions, so fundamental to our economy.

In FY 2017, the ratio of federal expenditures to all other funding sources (state, industry, and institution funds) was 2.6 to 1.[viii] Federal funding is almost triple that of state and private funding, presenting a great opportunity for businesses, state and local government to be larger contributors. An increased investment of $150M in FY 2017, could result in significantly more tech licenses, startups, and higher royalties — creating jobs, paying taxes, and strengthening Washington's industries.

"Federal funding is almost triple that of state and private funding, presenting a great opportunity for businesses, state and local government to be larger contributors."

Research drives innovation and propels Washington's economy forward. This state would not be the international tech hub that it is without our 'Big 4", and we cannot grow without continued investment in these research institutes so critical to keeping our state competitive.

[i] https://ncsesdata.nsf.gov/herd/2016/html/HERD2016_DST_36.html
[ii] https://www.fredhutch.org/en/diseases/business-development/investors-industry.html
[iii] https://www.pnnl.gov/about/pdf/FY16_Economic_Impact_Flier_FINAL.pdf
[iv] https://nsf.gov/statistics/srvyherd/#tabs-2
[v] https://www.governor.wa.gov/issues/issues/economy
[vi] https://news.wsu.edu/2015/04/13/dementia-drug-aiming-for-clinical-trials-next-year/
[vii] 2005 Source: https://wayback.archive-it.org/5902/20160210165615/http:/www.nsf.gov/statistics/nsf07318/tables/tab36.xls
2016 Source: https://ncsesdata.nsf.gov/herd/2016/html/HERD2016_DST_22.html
[viii] This figure excludes federal expenditures from PNNL so as not to overstate the ratio of federal to non-federal sources; including the federal expenditures at PNNL, the ratio is closer to 4:1.

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