State of Oklahoma
Incentive Evaluation Commission
Oklahoma Applied Research Support Program Draft Evaluation

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PFM Group Consulting LLC
BNY Mellon Center
1735 Market Street
42nd Floor
Philadelphia, PA 19103

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Key Findings & Recommendations

Incentive Overview

Through the Oklahoma Applied Research Support (OARS) program, the Oklahoma Center for the Advancement of Science and Technology (OCAST) provides funding to Oklahoma-based companies in support of research that will lead to innovation, new knowledge, or technology with the potential for commercial application. Awards granted under the program are made for up to $90,000 for early-stage projects and up to $500,000 for later-stage projects. All awards require a dollar-for-dollar match.

Retain, Reconfigure or Repeal: Retain the OARS program with modifications.

Key Findings

- **Value and number of awards made over time:** Between 2009 and 2021, OCAST issued $36.8 million in OARS grant awards (an average of $2.8 million per year). On a year-over-year basis, total grants awarded have declined, decreasing by a compound annual growth rate (CAGR) of -7.1 percent over the time period. In 2021, OARS award payments totaled $1.4 million, representing a decrease of nearly $0.9 million from the prior year.

- **Value of additional funding leveraged as a result of program funding:** According to data from the most recent annual Impact Report, recent OARs awards attracted $3.6 million in follow-on funds between 2016 and 2021.

- **Number and value of commercially successful products, processes or services developed as a result of program funding:** Recent OARS recipients reported filing 26 patent applications and having 27 granted; the reported value of the patents is estimated to be $136.0 million.

  Case studies or other longitudinal tracking of program recipient growth outcomes: Based on information collected by OCAST, in 2020 and 2021, prior OARS grant recipients formed 17 new companies, developed 115 new products or innovations, and filed 29 patents.
- **Economic activity associated with program funding:** In the aggregate, OCAST awarded just under $16.0 million in OARS grants between 2016 and 2021. OCAST reported a total financial impact of just under $178.5 million during the time period, as follows:

Total Payroll:	$ 77,864,294
Follow-on Funds Attracted:	$ 3,634,795
Impact on Capital Investments:	$ 23,452,500
Impact on Gross Sales:	$ 73,508,473
Total Financial Impact:	**$178,460,062**

- **State return on investment (ROI):** Based on the information outlined in the preceding bullet, OCAST estimates that the direct effect of its investments during this time period generated a return of 11 to 1 (Total Financial Impact of $178.5 million / $16.0 million in grant funds awarded = state ROI of 11.2).

  Notably, however, OCAST's analysis is not an assessment of the economic impacts of the program relative to the tax revenue foregone by the State. When accounting for the direct, indirect and induced impacts of the OARS funds awarded – as compared to the state tax revenue generated by these impacts, PFM finds that the OARS program generated $5.9 million in state tax revenue between 2016 and 2021, falling short of the $16.0 million in awards granted over the time period.

Table 1: Economic Impact of OARS Program, 2016-2021

Impact Type	Employment	Labor Income	Value Added	Economic Output	State Tax
Direct	314	$71,040,839	$84,847,113	$179,933,910	$2,480,705
Indirect	90	$23,048,552	$34,461,792	$71,838,399	$1,350,645
Induced	89	$20,130,398	$36,593,048	$68,411,146	$2,061,663
Total	**493**	**$114,219,788**	**$155,901,953**	**$320,183,456**	**$5,893,013**

Source: PFM; IMPLAN 2022
Note: Employment reflects permanent jobs; all other measures are cumulative over the survey period

- **An assessment of whether adequate protections are in place to ensure the fiscal impact of the incentive does not increase substantially beyond the state's expectations in future years:** OCAST has adequate projections in place to ensure the fiscal impact of the OARS program does not increase substantially beyond the state's expectations in future years.

- **Interaction or coordination with other programs or service offerings in the economic development or entrepreneurial support ecosystem:** OCAST does not currently track the OARS program's interaction or coordination with other programs or service offerings in the economic development or entrepreneurial support ecosystem outside of OCAST.

Recommendations

- **Further refine and improve data collection and reporting processes:** Data collection for any incentive program is indisputably a best practice, and this process is undoubtedly beneficial to OCAST and its stakeholders.

  While OCAST has begun collecting additional data points from its OARS grantees in recent years, it remains difficult to effectively evaluate the effectiveness of the program due to data collection and reporting process issues.

  To allow the program to be more easily or conclusively evaluated in the future, OCAST should consider collecting additional information from grant recipients as part of its already-established data collection and reporting processes and/or modifying its current practices.

  At present, the OCAST data collected is not presented in a manner conducive for accurately calculating economic impact. Of primary concern is that the surveys cover multiple award years in the aggregate, with grant recipients dropping in and out of the survey. This often leads to significant fluctuations in the aggregate program data over time. Additionally, recipients self-report the data, which can lead to variances in the way information is reported and is subject to error. Finally, it is not clear when revenue is reported or where it is generated (i.e., in Oklahoma or another state).

  To more accurately perform an economic impact analysis, the following information would be required on an annual basis – preferably for each class of recipients by group or cohort, since the awards most often last for multiple years:

  - Jobs data (including how many jobs existed prior to OCAST funding and how much other funding has been raised);
  - Payroll data;
  - Economic activity data (including gross sales and additional funding raised as a direct result of OARS funding);
  - Success or failure rate of each recipient; and

- Industry sector information.

Additionally, OCAST should consider conducting longitudinal case studies over a meaningful period of time for select companies. This would track the advance and development of the effects and benefits of applied research funded by the program, showing the synergy between grants, follow-on funding and capital investment.

Finally, for follow-on funding attained, OCAST should obtain data on when funds are spent and the purpose for fund expenditures.

Introduction

Oklahoma Incentive Evaluation Commission Overview

The Oklahoma Incentive Evaluation Commission (Commission) was created by House Bill (HB) 2182 of 2015 to produce objective evaluations of the State of Oklahoma's wide array of economic development incentives. The Commission is made up of five members appointed by the Governor, President Pro Tempore of the Senate and Speaker of the House of Representatives, along with representatives of the Department of Commerce, Office of Management and Enterprise Services and the Tax Commission.

Under the enabling legislation, each of the State's economic incentives must be evaluated once every four years according to a formal set of general criteria, including (but not limited to) economic output, fiscal impact, return on incentive and effectiveness of administration, as well as criteria specific to each incentive.

Since the Commission's inception, it has contracted with PFM Group Consulting LLC (PFM) to serve as the independent evaluator of each incentive scheduled for review in that year. PFM issues a final draft evaluation on each incentive with recommendations as to how Oklahoma can most effectively achieve the incentive's goals, including recommendations on whether the incentive should be retained, reconfigured or repealed. The evaluations are also to make recommendations, where needed, for any changes to State policy, rules or statutes that would allow the incentive to be more easily or conclusively evaluated in the future.

The Commission is charged with considering the independent evaluator's facts and findings – as well as all public comments – before voting to retain, repeal or modify each inventive under review. It then submits a final report to the Governor and Legislature. This incentive was last evaluated in 2018.

Summary of 2018 Evaluation Findings and Recommendations

Based on the preceding framework, significant findings and recommendations from the 2018 evaluation of the Oklahoma Applied Research Support Program are summarized in the following table:

Table 2: Summary of 2018 Evaluation Key Findings and Recommendations

Evaluation Category	Key Finding(s)
Overall Findings	- Oklahoma surpasses most states on investment in research and development (R&D) activities, but R&D performed as a share of state GDP lags most states - Statewide employment in R&D has decreased, and utility patents granted in the state have also declined - Since the program's inception, nearly $100 million in OARS awards have been made; private companies account for more than half of awards - Awards have been made to nearly 600 collaborative projects in 21 counties
Fiscal and Economic Impact	- 160 jobs are attributable to the program, and other economic impacts appear to be significant - Matching requirements have leveraged significant additional funding
Administrative Effectiveness	- Grantee surveys are beneficial but may lead to inconsistencies in data reporting
Retain, Reconfigure or Repeal	- Retain, with modifications (see below)
Recommendations	- Collect more detailed information from current and former grant recipients to allow for consistent analysis - Track business activity and funding sources prior to obtaining the state financial support, and after the state monies have been spent to measure the long-term effect of the program

Evaluation Category	Key Finding(s)
	- If a successful product or company is developed, the location where the product is sold, supported, and manufactured should be identified - In order to correctly and accurately perform an economic impact analysis, additional information should be collected

Source: State of Oklahoma Incentive Evaluation Commission, Tax Incentive Evaluation Report 2018

Based on PFM's analysis and consideration of other factors, the Commission voted 5-0 to approve the recommendation to retain the program with the suggested modifications. Since the Commission completed its review of this program in 2018, OCAST has made strategic modifications to its programming approach to have a more intentional focus on meeting the R&D needs of key industries within the state. These changes are discussed in the Program Usage & Administration section of this evaluation.

2022 Criteria and Evaluation Approach

A key factor in evaluating the effectiveness of incentive programs is to determine whether they are meeting the stated goals as established in state statute or legislation and, as noted previously, the provisions of HB 2182 require that criteria specific to each incentive be used for the evaluation.

The intent of the Oklahoma Applied Research Support Program is to "support establishments of certain industries that hold promise for significant development of the state's economy by providing incentives connected to jobs created in the state."

In addition to this goal and the general evaluation factors previously described, the Commission has adopted the following criteria to assist in a determination of program effectiveness:

- Value and number of awards made over time
- Value of additional funding leveraged as a result of program funding
- Number and value of commercially successful products, processes or services developed as a result of program funding
- Interaction or coordination with other programs or service offerings in the economic development or entrepreneurial support ecosystem
- Case studies or other longitudinal tracking of program recipient growth outcomes
- Economic activity associated with program funding
- State return on investment

To conduct its 2022 review of the Oklahoma Applied Research Support Program, the PFM project team conducted the following activities:

- Submitted a data request to OCAST
- Reviewed and analyzed internal and external data and information
- Completed subject matter expert/internal stakeholder interviews with representatives from OCAST
- In collaboration with the Oklahoma City, Tulsa and State Chambers of Commerce, conducted external stakeholder interviews with industry representatives
- Benchmarked Oklahoma to other states

Background

Applied Research Background and History

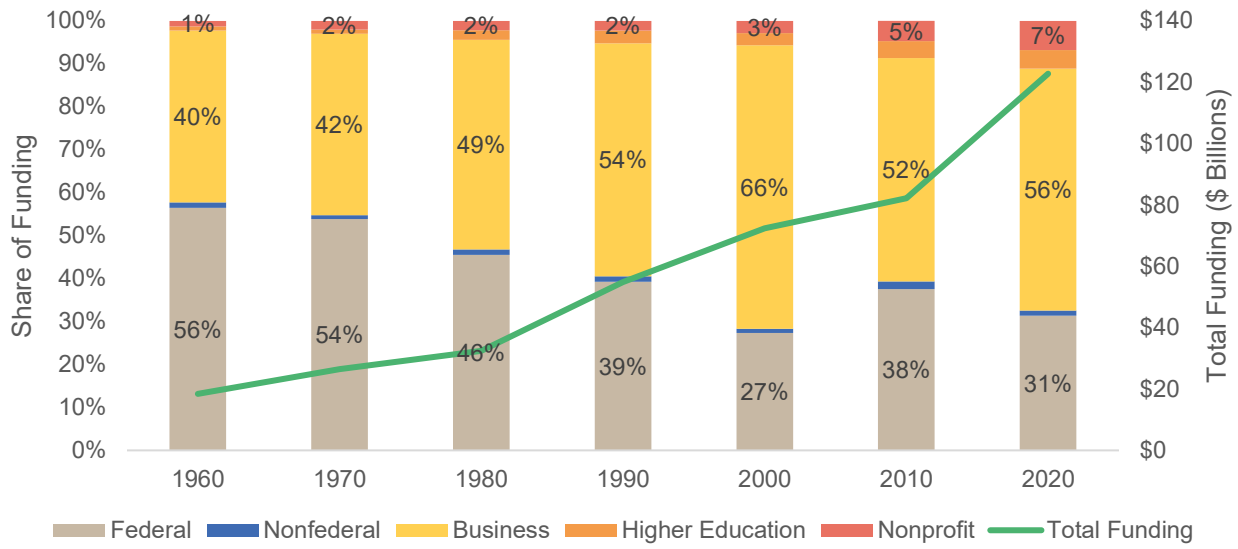
The term “research and development” covers three primary activities: basic research, applied research and experimental development. The National Science Foundation (NSF) defines applied research as “original investigation undertaken in order to acquire new knowledge” that is “aimed at solving a specific problem or meeting a specific commercial object.”[2] By contrast, basic research refers to “activity aimed at acquiring new knowledge or understanding without specific immediate commercial application or use.”

Because applied research increases scientific knowledge and contributes to the development of innovative technologies, it can play an important role in solving everyday problems that may have a positive impact on people and communities – including the State of Oklahoma.

R&D in the U.S. is funded and performed by several sectors, including the federal government, state governments, businesses, academia and nonprofit organizations – and for a variety of purposes.

The federal government and private industry have long been the primary funders of applied research activities in the U.S. While, in the aggregate, these two sources have consistently accounted for between 87 percent and 97 percent of all expenditures, the federal share has been declining, while the private industry share has been increasing. In 1960, the federal government accounted for 56 percent of the total, and private industry’s share was 40 percent. In the late 1970s, private industry took over as the predominant source, and as of 2020, the federal government’s share is 31 percent, while the private industry share is 56 percent. Nonfederal government and other sources (including higher education and nonprofit organizations) have consistently played a relatively minor role in the funding of applied research.

Figure 1: Applied Research Expenditures by Source of Funds, 1960-2020 (in constant 2012 $)



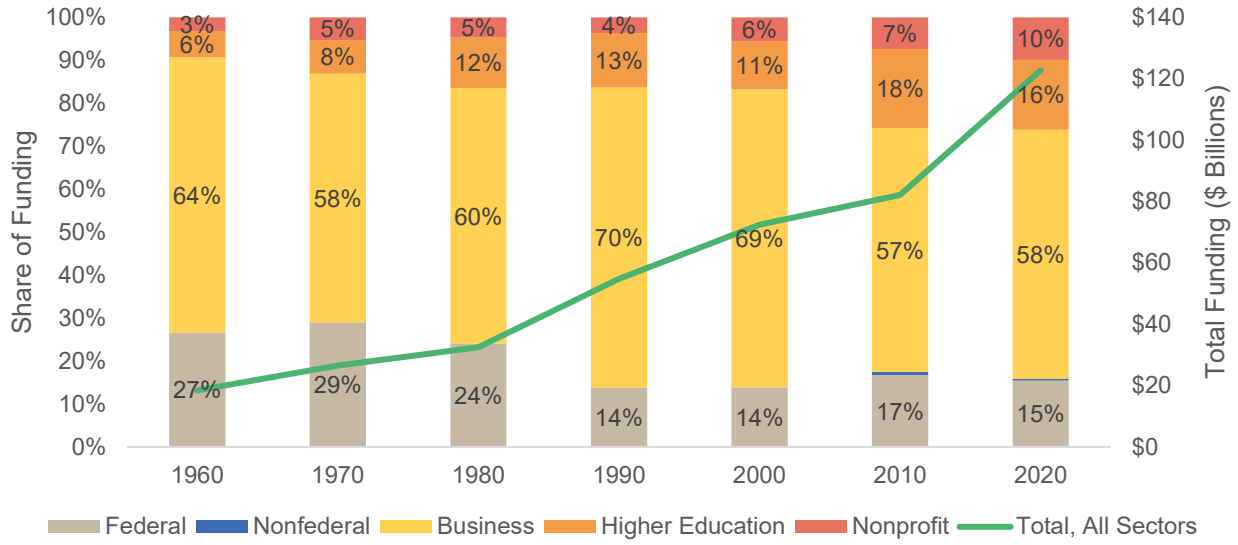
Source: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series)

[2] National Science Foundation, “Definitions of Research and Development: An Annotated Compilation of Official Sources,” (March 2018). Accessed electronically at https://www.nsf.gov/statistics/randdef/rd-definitions.pdf

Applied Research Performers

Private industry has consistently been the principal performer of applied research in the U.S., accounting for between 55 percent and 71 percent of all applied research conducted over the past six decades. Over time, however, its share of the total has declined, as has the share of federal applied research. Higher education has taken on a larger applied research role over time, with its share growing from 6 percent in 1960 to 16 percent in 2020.

Figure 2: U.S. Applied Research Expenditures by Performer, 1960-2020 (in constant 2012 $)



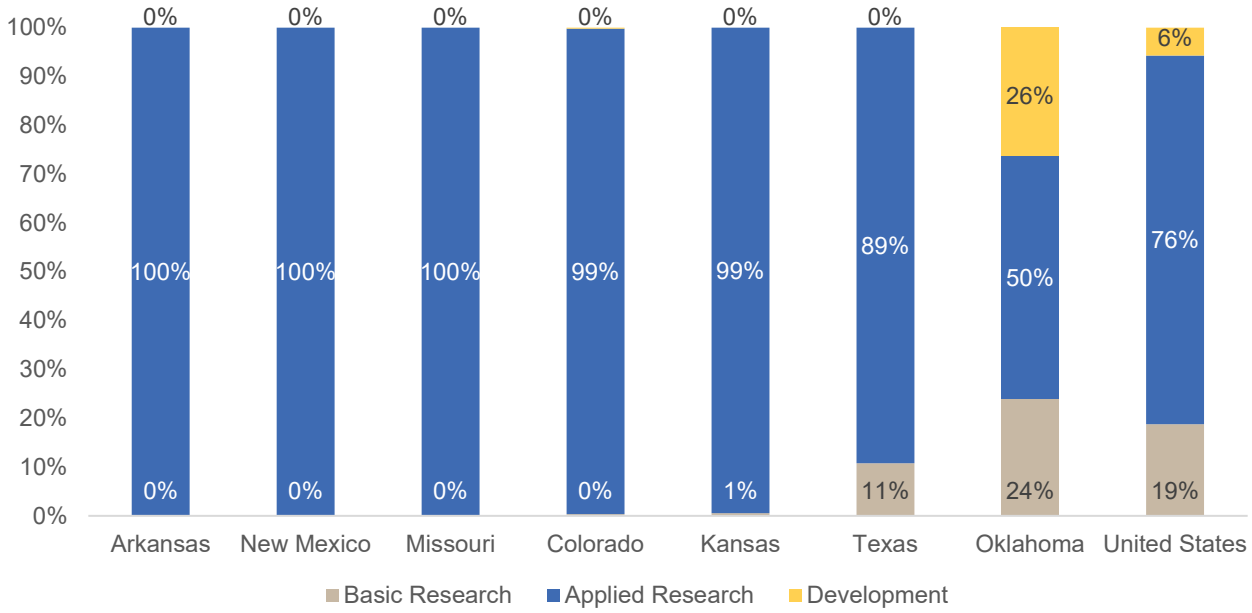
Source: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series)

Applied Research Investments by State

Oklahoma's allocation of investments in R&D is an outlier among neighboring states, as well as compared to the U.S. as a whole. In 2020, half of all Oklahoma expenditures for intramural R&D were attributable to applied research, as compared to more than three fourths across the nation as a whole.[3] As shown in the following figure, the states neighboring Oklahoma invest all or nearly all of their R&D funds into applied research activities.

[3] Intramural R&D activities are those carried out directly by the reporting agency itself or through funds transferred to another agency for performance of work. In this case, it refers to R&D conducted by a state agency.

Figure 3: State Government Expenditures for Intramural R&D by Type, 2020



Source: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series)

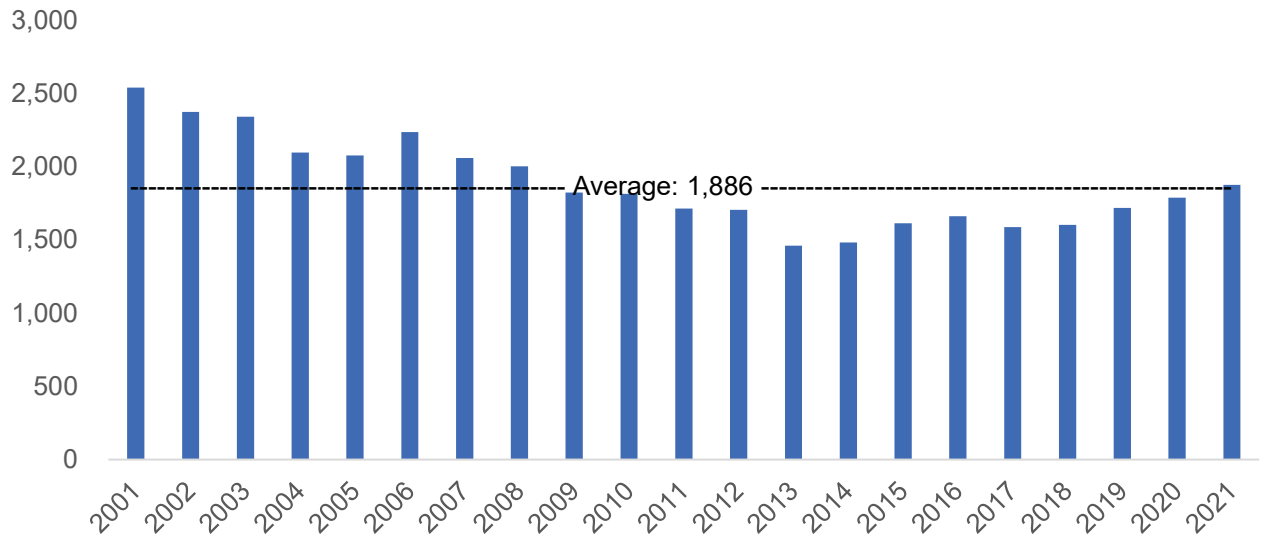
Per capita investments in applied research vary widely, averaging $0.90 per person in 2020 across the U.S. as a whole. Among neighboring states, at $0.25 per person, Oklahoma's per capita investment is greater than in Arkansas ($0.06) and Texas ($0.10) but lower than in Kansas ($0.34), New Mexico ($1.23), Missouri ($1.32) and Colorado ($2.07).

Industry Employment and Payroll

According to U.S. Bureau of Labor Statistics (BLS) data, in 2021, an estimated 1,877 Oklahomans were employed in the 'scientific research and development services' industry (equal to 0.1 percent of total private industry employment in the state).[4] As shown in the following figure, between 2001 and 2013, industry employment declined from 2,543 to 1,461 – a CAGR of -4.5 percent. Since 2013, however, employment has generally increased year-over-year, increasing by a CAGR of 3.2 percent between 2013 and 2021. Over the full time period, employment has averaged 1,886 and has decreased by a CAGR of -1.5 percent.

[4] North American Industry Classification System (NAICS) code 5417, Scientific Research and Development Services. This industry group comprises establishments engaged in conducting original investigation undertaken on a systematic basis to gain new knowledge (research) and/or the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes (experimental development). Techniques may include modeling and simulation.

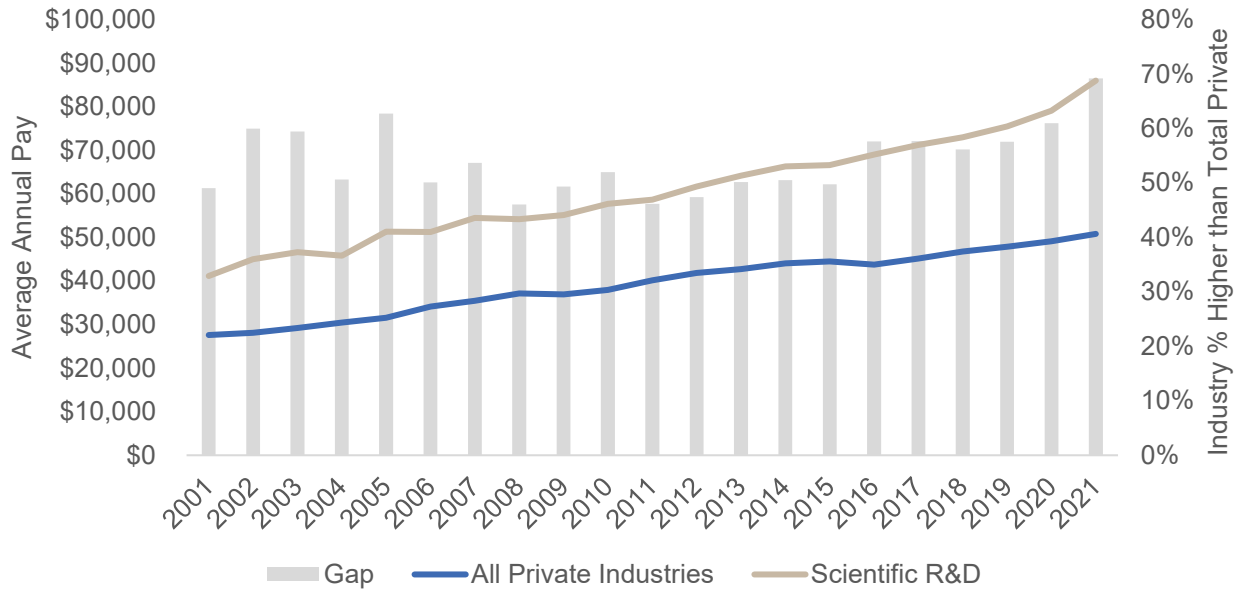
Figure 4: Oklahoma Employment, Scientific Research and Development Services, 2001-2021



Source: U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages

In 2021, the average scientific R&D services industry pay in Oklahoma was $86,050, significantly higher than the average across all private industries in the state ($50,842). Average industry pay has consistently surpassed the average pay across all private industries in Oklahoma, and the size of that variance has widened in recent years. In 2008, for example, industry pay was 46.1 percent higher than the private industry average (the smallest gap for the 2001-2021 period); in 2021, industry pay was 69.2 percent higher. In addition, average pay for the industry increased by a CAGR of 3.8 percent between 2001 and 2021, faster than the rate of growth across all private industries in the state (3.1 percent).

Figure 5: Oklahoma Average Annual Pay, Scientific R&D and Total Private Industry, 2001-2021



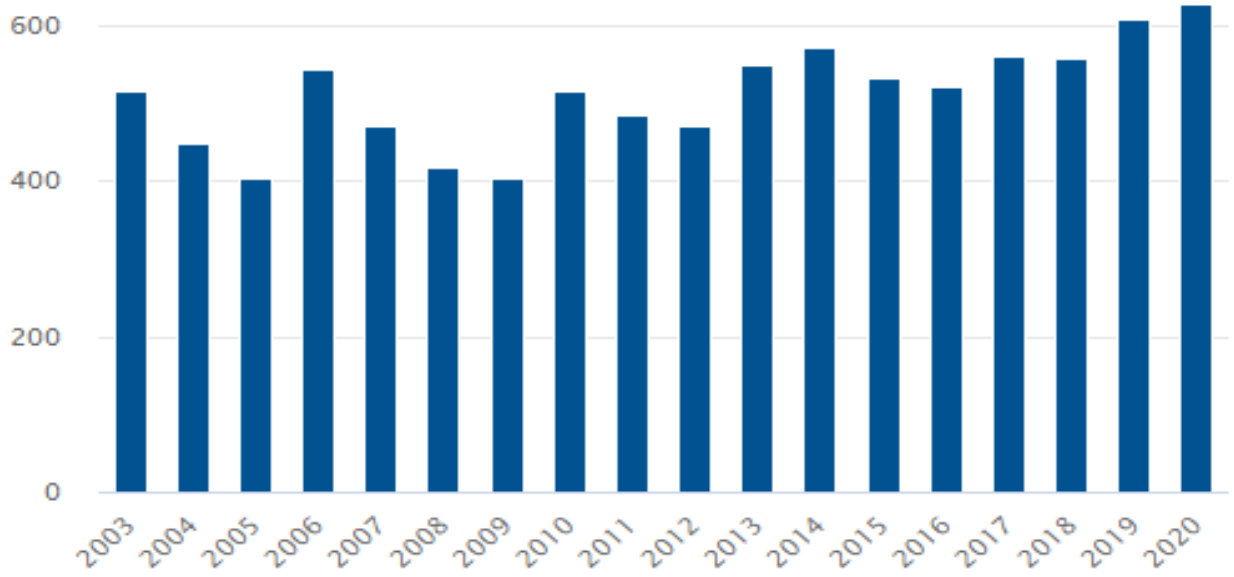
Source: U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages

Applied Research Patent Activity

It can be useful to analyze patent data made available by the U.S. Patent and Trademark Office and National Science Foundation as an indicator of the development of commercially successful products. Specifically, utility patents are granted to anyone who invents or discovers a new and useful process, machine, article of manufacture, or composition of matter, or a new and useful improvement.

As shown in the following figure, 516 utility patents were issued to Oklahoma residents in 2003. By 2020, the total issued increased to 626 – a CAGR of 1.1 percent.[5]

Figure 6: Utility Patents Issued to Oklahoma Residents, 2003-2020

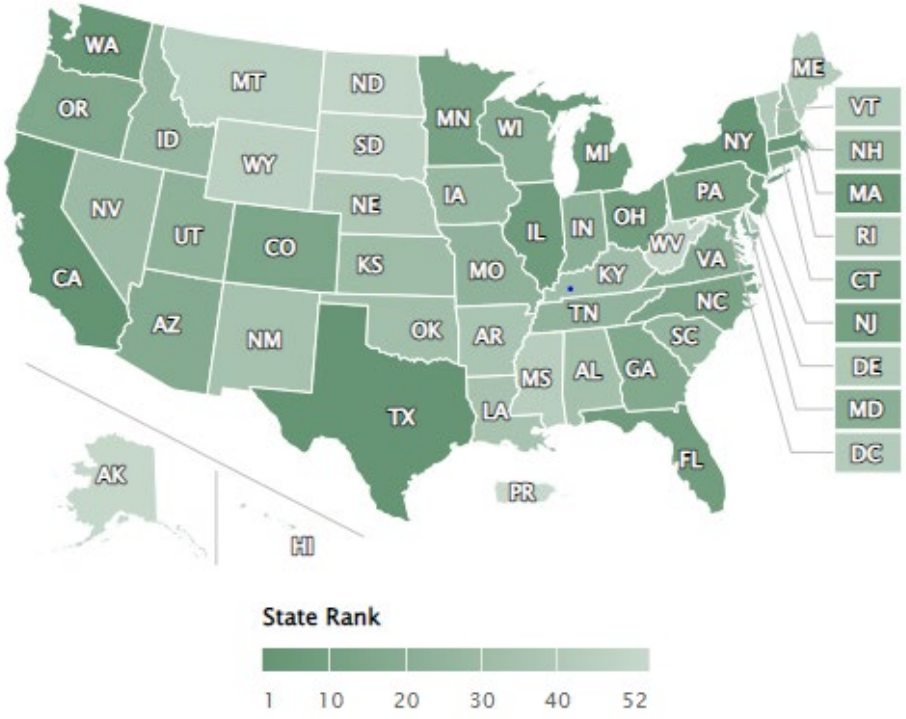


Source: National Science Foundation

In 2020, Oklahoma ranked 33rd nationally for the number of utility patents issued to state residents. Among the six neighboring states, four ranked higher: Texas (2nd), Colorado (14th), Missouri (24th) and Kansas (31st). Only New Mexico and Arkansas ranked lower than Oklahoma, at 35th and 37th, respectively.

[5] National Science Foundation, "Utility Patents Issued to State Residents." Accessed electronically at https://www.nsf.gov/statistics/states/html5/?stateID=37&code=UTIL&year=2020

Figure 7: Utility Patents Issued to State Residents, 2020



Source: National Science Foundation, Utility Patents Issued to State Residents, 2020

Program Usage & Administration

Program Characteristics

The Economic Development Act of 1987 authorized the creation of OCAST, the State's agency for technology-based economic development. OCAST's mandate is to "expand and diversify Oklahoma's economy and provide new and higher quality jobs for Oklahomans" by encouraging "the development of new products, new processes and whole new industries in Oklahoma."[6] The Act created a variety of mechanisms to promote productive partnerships between higher education and a business with the intent to increase the rate of technological innovation and knowledge transfer, thereby improving economic competitiveness and spurring economic growth across the state.

The OARS program, administered by OCAST, is one of these mechanisms. Research funded under the program must "lead to innovation, new knowledge or technology"[7] and must have the potential for commercial application. The purpose of the OARS program is two-fold:

- Assist in the accelerated development of technology in the state by supporting applied research activities in existing and emerging technical areas in which the results have (1) a high probability of leading to commercially successful products, processes or services within a reasonable period of time; and (2) a significant potential for stimulating economic growth within the state of Oklahoma.

- Encourage and sustain partnerships among institutions of higher education, non-profit research organizations and private enterprises by encouraging collaborative projects designed to promote increased knowledge and technology transfer.

The OARS program provides funds based on two distinct funding categories, summarized in the following:

Table 3: OARS Award Summary

	Proof of Concept	Accelerated
Project Type	Early stage applied projects, including exploratory development and product definition	Later stage projects that are in preparation to scale and go to market
Funding Level	Maximum of $90,000	Maximum of $500,000
Project Period	1 or 2 years	1, 2 or 3 years
Required Match	1:1	1:1
Review Criteria	Technical Merit: 70% Economic Impact: 30%	Technical Merit: 50% Economic Impact: 50%

Source: OCAST

In recent years, OCAST has made strategic changes to the OARS program in order to better address the needs of Oklahoma's advanced technology industries, provide greater support for the creation of partnerships between the private and public sectors, and encourage technology transfer. Among these targeted program modifications are the following:

Table 4: Summary of Recent OARS Program Changes

	Original OARS Program	Updated OARS Program
Eligibility	All applicants	Only focused on solving industry innovation needs
Research Topics	All topics	Only those needs identified and defined by an Oklahoma industry

[6] 74 O.S. § 5060.1a, 5060.2a
[7] 74 O.S. § 5060.19

	Original OARS Program	Updated OARS Program
Areas of Technology Focus	All technology areas	Only those targeted to top areas of greatest importance to Oklahoma industry
Follow-On Support Provided	No specific follow-on support	Help now available for commercialization of OARS accelerated R&D

Source: OCAST

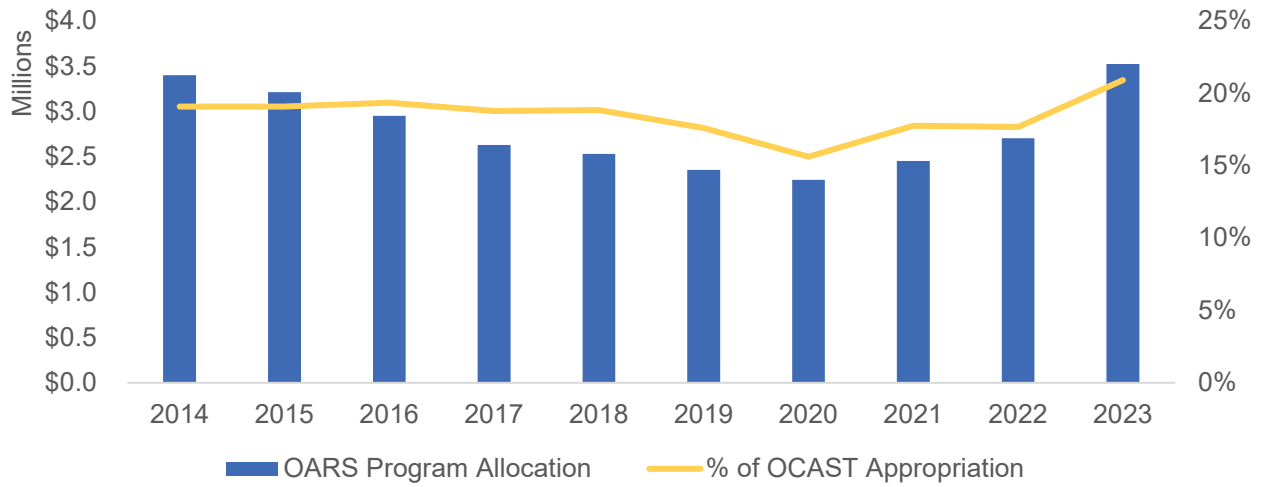
OCAST updated the OARS program to only accept applications focused on an industry identified and defined innovation need, targeted to the four primary areas of interest to industry in Oklahoma. Further programmatic changes include the following:

- OCAST now requires OARS projects to be focused on solutions to industry-identified and validated needs. Oklahoma Innovation Model (OIM) partners can assist with validating industry needs to help ensure the company has identified the actual problem and not merely a symptom.[8]
- OCAST requires that the private sector company identifying the need be the applicant organization.
- Upon project completion, the OIM can work with the company and principal investigator to support any necessary work on the results of the R&D to develop a working prototype and then to apply that innovation. OIM will assist in benefit analysis, based on the availability of funds.
- Rather than applying OCAST funding thinly across all tech sectors, beginning in FY2022, the state appropriation dedicated to OARS is targeted to Oklahoma industry in three areas: (1) biotech (human health and agricultural science); (2) aerospace, autonomous systems and defense; and (3) energy diversification.[9]

OARS Program Allocation

Between 2014 and 2023, OCAST allocated approximately 15 to 21 percent of its total appropriation to the OARS program, equal to between $2.2 million and $3.5 million per year. During that time frame, funds designated for the program have been effectively flat, increasing by a CAGR of 0.4 percent.

Figure 8: OARS Program Allocation, 2014-2023



Source: OCAST 2018 and 2023 Business Plans

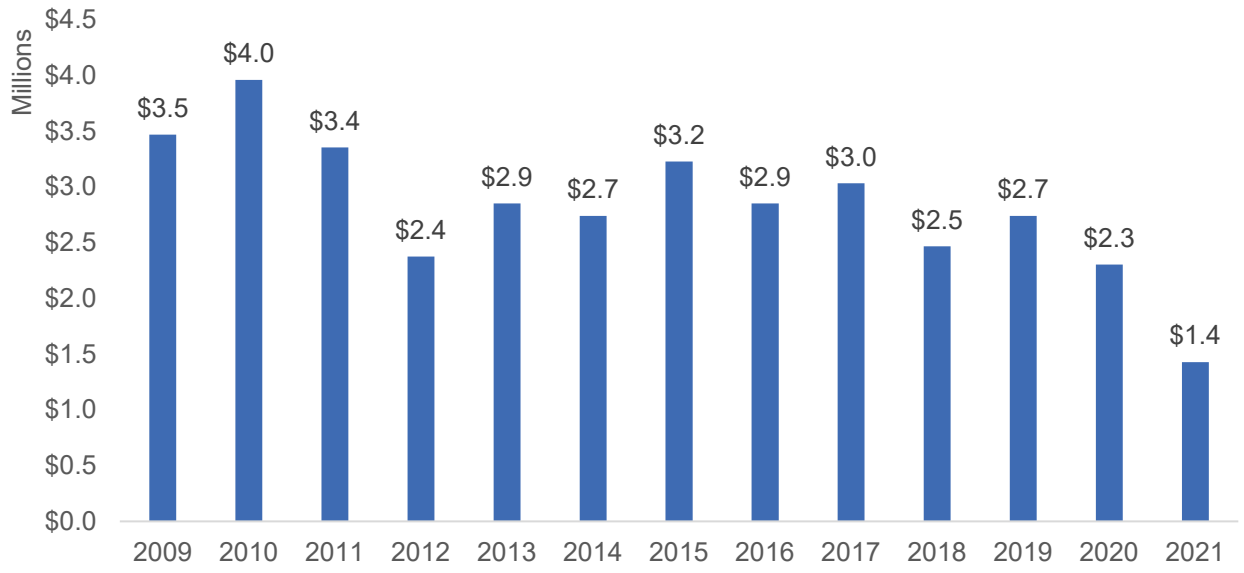
[8] The OIM is a public-private partnership with i2e, the Oklahoma Manufacturing Alliance (OMA), the New Product Development Center at OSU, and the OK Catalyst programs at the Tom Love Innovation Hub at OU. OCAST is the hub of the OIM.
[9] Oklahoma Science and Innovation, "2021-2026 Science and Innovation Strategic Plan," (May 2021). Accessed electronically at https://oklahoma.gov/content/dam/ok/en/innovation/documents/Oklahoma--Science--and--Innovation--2021-2026--Strategic--Plan.pdf

Historic Use of the Program

Program grantees are predominantly commercial entities. According to OCAST data, the sector comprised nearly 58 percent of the final, total OARS award amounts between 2018 and 2021. Public colleges and universities also comprise a meaningful share of the total (30.7 percent). Nonprofits comprise an additional 8.1 percent, while private educational institutions account for the remaining 3.5 percent.[10] The nature of the research funded by the OARS program varies considerably. Common research areas include energy and environment; biotechnology; cyber security; aerospace; and manufacturing.

Between 2009 and 2021, OCAST issued an average of $2.8 million in OARS grant payments annually, equal to $36.8 million in the aggregate over the time period. Total payments issued annually have declined over time, decreasing by a CAGR of -7.1 percent. The following figure summarizes OARS grant payments issued by year.

Figure 9: OARS Program Award Payments, FY2009-FY2021



Source: OCAST data

Because all awards provided under the program require a dollar-for-dollar match of non-state dollars, the $36.8 million in OARS funds awarded between 2009 and 2021 have attracted – at a minimum – the same amount of outside support for research activities.

Program Administration

OCAST administers the OARS program under the governance of the Oklahoma Science and Technology Research and Development (OSTRaD) Board. The Board is responsible for establishing an Applied Research Committee (ARC) that acts in an advisory capacity to the OSTRaD Board and staff in the development of program specifications, organization and evaluation of peer reviews, awarding of contracts and on-going evaluation of contract performance. The Board approves all specifications of the Program, including the ARC's recommended funding allocation for each competition. Administration of the program includes the following components:

[10] Per OCAST data, "AR-HR 2018-2022."

Eligibility Determination – Matching Funds

In order to qualify for funding, the applicant organization must provide documentation verifying that not less than 50 percent of the total direct cost of the proposed project will be provided by sources other than OCAST and other than state-appropriated money. Funds received from federal or private grants or contracts may be used as matching funds. For higher education or nonprofit institutions, machinery or equipment may be considered as part of the matching funds. For private enterprises, in-kind services may not be considered as part of the matching funds. The following table summarizes OARS program fund matching requirements by applicant type.

Table 5: OARS Program Fund Matching Requirements

Applicant Type	Salary	In-Kind Services	Indirect Costs	Non-State Grants or Contracts	Cash
Public Institutions of Higher Education	Yes, if salary does not originate from State funds	Yes	No	Yes	Yes
Private Institutions of Higher Education	Yes	Yes	Yes, up to 50%	Yes	Yes
Nonprofit Research Foundations	Yes	Yes	Yes, up to 50%	Yes	Yes
Private Companies	Yes	Yes, if from third party	Yes, up to 50%	Yes	Yes

Review and Award Process

In order to be considered for an award, each application must include:

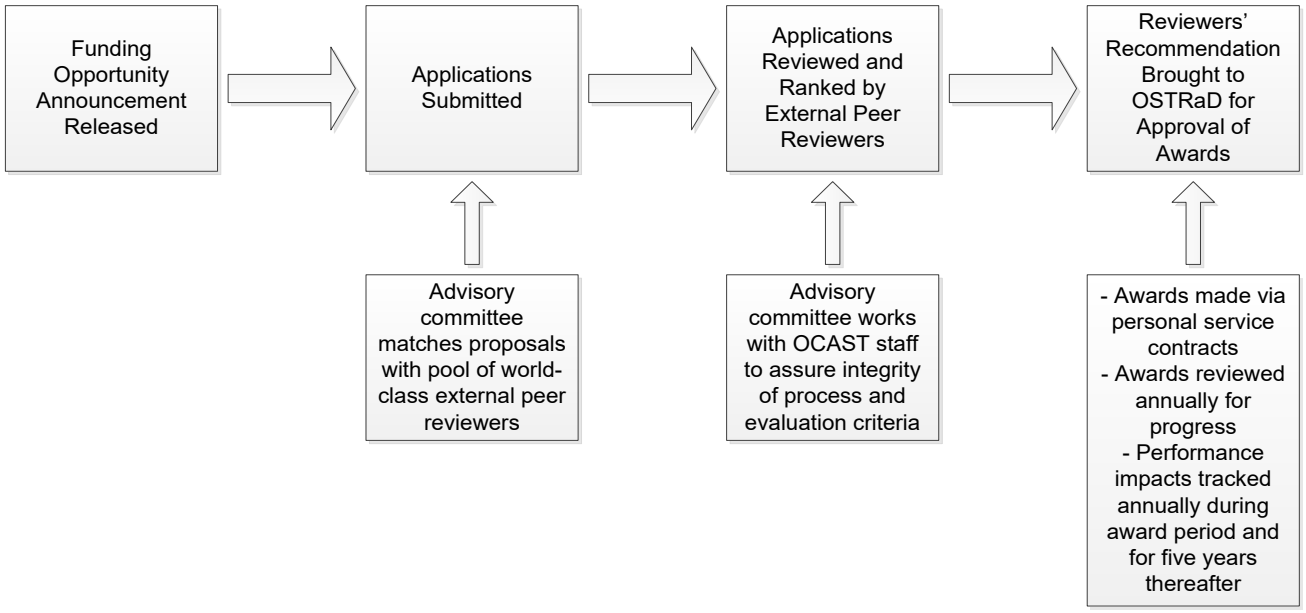
- A description of the potential commercial application of the applied research project and the potential to enhance employment opportunities in Oklahoma
- A recommendation from the application organization
- Other information that may be required by the OSTRaD Board

Following the application deadline, a panel reviews and ranks all applications for funding according to criteria specified in the solicitation. The peer reviewers, the majority of whom reside outside of the State, are nominated and approved by the ARC. The panel's recommendations are then approved by the OSTRaD Board.

The length of a contract may be no shorter than one year; the maximum period is recommended by the ARC and approved by the OSTRaD Board. A contract is not awarded until documentation that the matching funds and/or machinery or equipment to be matched by OCAST has been received by the applicant organization.

The review and award process is illustrated in the following figure.

Figure 10: OCAST Review and Award Process



Source: OCAST

Progress Reports and Performance Evaluation

Grantees are required to submit an annual progress report 60 days prior to the ending date of each contract funding period, except at the end of the final contract period when a final report is submitted 30 days after the end of the contract. Reviewers evaluate annual project performance; continued funding is contingent upon a satisfactory annual performance evaluation and the availability of funds.

In general, the annual progress report provides:

- A summary of progress to date and plans for the subsequent contract period
- A listing of submitted and/or published journal articles and publications that incorporate any portion of the work supported by the contract
- A listing of all presently funded research grants or contracts
- A detailed budget for the subsequent year

The final report incorporates:

- A summary of research completed on the project during the entire funding period
- A listing of submitted and/or published journal articles and publications that incorporate any portion of the work supported by the contract
- A listing of all presently funded research grants or contracts

Program Reporting

Annually, OCAST produces an 'Impact Report' detailing a summary of "success stories" and the following performance measures attributable to each of its programs:

- Number of new companies formed
- Number of jobs created or retained

- Total payroll
- Patents granted
- Value of annual licenses and royalties
- Gross sales
- Capital investments
- Cost avoidance
- Total financial impact and leverage

To collect and report on this information, OCAST requires OARS program grantees to respond to an annual survey during the project funding period and for five years after the funding period ends. In fact, grant applications state that grantees are required to provide OCAST with the requested information during and after the funding period. This information may include but is not limited to (1) impact survey information; (2) site visits; and (3) reverse site visits, where the grantee may be required to present project-related information to OCAST staff, the OCAST Board of Directors, members of the Oklahoma Legislature, and other interested parties.

Grantees' self-reported information and data is aggregated and reported on a six-year rolling basis in OCAST's annual Impact Reports. This means, for example, that the impacts reported in the 2022 Impact Report reflect activity associated with projects funded between 2016 and 2021, including activity occurring in the years after funding for past projects has ended.

OCAST policy stipulates that a prior OARS program grantee with a delinquent progress report – or a grantee that has not responded to other OCAST requests for information (including impact survey data) - may not be eligible to submit an application for new project funding. Further, any grantee who has a delinquent progress report at the time of review will not be eligible for review, and any grantee with a delinquent progress report at the time of award notification will not receive a contract until the progress report has been submitted. In the latter case, if the delinquent report has not been submitted within 60 days of the award date, OCAST will void the award and return the money to the OARS program.

Economic & Fiscal Impact

Economic and Fiscal Impact

The economic and fiscal impact analysis is based on a review of data provided by OCAST. It reflects the activity self-reported by grant recipients while they are receiving OARS funds, as well as the years immediately following the end of their respective funding periods. The economic impacts associated with new jobs were estimated using the IMPLAN input-output economic impact model software. The methodology for using the IMPLAN model is explained in **Appendix A.**

During the most recent five-year period (2017-2021), the OARS program provided $15,981,220 in grants.

As discussed previously, OCAST conducts an annual survey of grant recipients collecting economic evaluation and company status data over this period, which represents the active grants. Once awarded, most grants are annually recurring during this period. As a result of the ongoing nature of grants and the ramp up of economic activity associated with companies over the award period, a cumulative, multi-year measurement of the economic impacts of the OARS program should most appropriately take place, rather than measuring program activity in a single year. The results of the OCAST survey data for 2021, covering the most recent active award period is shown in the following table.

Table 6: OARS Program Participant Survey Results, 2017-2021

Measure	Result
Survey Response Rate	100%
Jobs Created or Retained	314
Total Payroll	$77,864,294
Average Annual Wage*	$74,110
Follow-on Funds Attracted	$3,634,795
Patent Applications	26
Patents Granted	57
Value of Patents	$79,880,000
Impact on Capital Investments	$23,452,500
Impact on Gross Sales	$73,508,473
Companies Formed	13
Total Financial Impact (Direct Effect)	$178,460,062
Grant Funds Awarded 2017-2021	**$15,981,220**
Direct Effect of Investment	11:1

Source: PFM analysis of OCAST OARS program participant survey, 2021
** Annual wage data is not consistent with the number of jobs created and reflects only the summary of OCAST survey response data*

Through the survey data, OCAST has measured the “Total Financial Impact” of the program by adding together the following factors (self-reported by grantees):

Total Payroll:	$77,864,294
Follow-on Funds Attracted:	$3,634,795
Impact on Capital Investments:	$23,452,500
Impact on Gross Sales:	$73,508,473
Total Financial Impact:	**$178,460,062**

The sum of these four elements is $178.5 million, which OCAST has labeled Total Financial Impact. In measuring the impacts of economic activity associated with the initial investment of the OARS grant program, the Total Financial Impact can be renamed the Direct Effect of economic activity. OCAST then compares the Direct Effect with the initial grant investment which results in a 11:1 ratio. OCAST has identified this ratio the “Return on Investment.” PFM has renamed this ratio as the Direct Effect of Investment for consistency within

the context of measuring economic impacts. The 11:1 ratio remains unchanged, reflecting substantial economic activity associated with the OARS Grant Program.

PFM then used IMPLAN economic impact software to determine the economic output activity associated with the program, by calculating the indirect and induced economic impacts associated with the Program direct effects. The Direct Effect survey data of $178.5 million is converted to Direct Impact through the use of IMPLAN resulting in $179.9 million in Direct Economic Impacts of the program, due to the spending nature of associated businesses.

The economic impact analysis then calculates the indirect and induced economic effects and reveals total economic activity associated with the OARS Grant Program reaches $320.2 million, over the survey period and is associated with 493 new and retained jobs.

Table 7: Economic Impact of OARS Program, 2017-2021

Impact Type	Employment	Labor Income	Value Added	Economic Output	State Tax
Direct	314	$71,040,839	$84,847,113	$179,933,910	$2,480,705
Indirect	90	$23,048,552	$34,461,792	$71,838,399	$1,350,645
Induced	89	$20,130,398	$36,593,048	$68,411,146	$2,061,663
Total	**493**	**$114,219,788**	**$155,901,953**	**$320,183,456**	**$5,893,013**

Source: PFM; IMPLAN 2022
Note: Employment reflects permanent jobs; all other measures are cumulative over the survey period

What is unclear from the survey data is how much of the Direct Effect activity would have occurred without or "but for" the Grant Program. The participant survey data does not ask a question such as, "How much of the follow-on funds attracted would have occurred without the OARS Grant?" This question could be asked for all of the direct effect measures including employment, payroll, follow-on funds, capital investments and gross sales. The additional information gained from these questions would answer how much of the total economic activity is directly caused by the OARS program, rather than simply associated with it.

The total state tax revenue from all economic activity associated with the program is nearly $5.9 million. Despite the inability to know what portions of activity are directly caused by the program, all state tax generated by activity associated with the program of $5.9 million is less than the total state grant expenditure of $16.0 million over the survey period. The OARS program costs more in State grant expenditures than is generated in state tax revenues. Total economic activity associated with the program is significantly greater, by a factor of 20:1, than state grant costs for the program.

It is important to discuss in the context of the OARS program that applied scientific research is not and does not always have direct product and market output results. Some applied scientific research can take decades to produce actionable or otherwise economically meaningful results. It is for this reason other measures are associated with the program such as patents granted, patent applications, and patent values which can be a reflection of the potential to accrue longer term benefits. Over the survey period 26 patents were applied for and 57 patents were granted, with patent value estimated at $79.9 million.

Further, as discussed in the subsequent chapter, research has shown that there are "spillovers" associated with R&D into other firms, across both geographic and technological space.

Additionally, to more accurately evaluate the effects of the OARS grant program, longer period, longitudinal case studies for some selected companies could be conducted. This would track the advance and development of the effects and benefits of applied scientific research showing the synergy between grants, follow on funding, and capital investment. Anecdotally, some companies describe how the OARS grants became an effective financial bridge for the company before larger federal or private grants were received,

thereby contributing to the survival of the company. Also, grants may fund the final component of a research project allowing decades of prior work to come to fruition. This type of case study information is important for gauging the effect and value of the OARS grant program. The examples cited are known conditions. It would be useful to conduct case study evaluations in a more formal fashion so it may be communicated as part of the economic impact evaluation.

Program Benchmarking

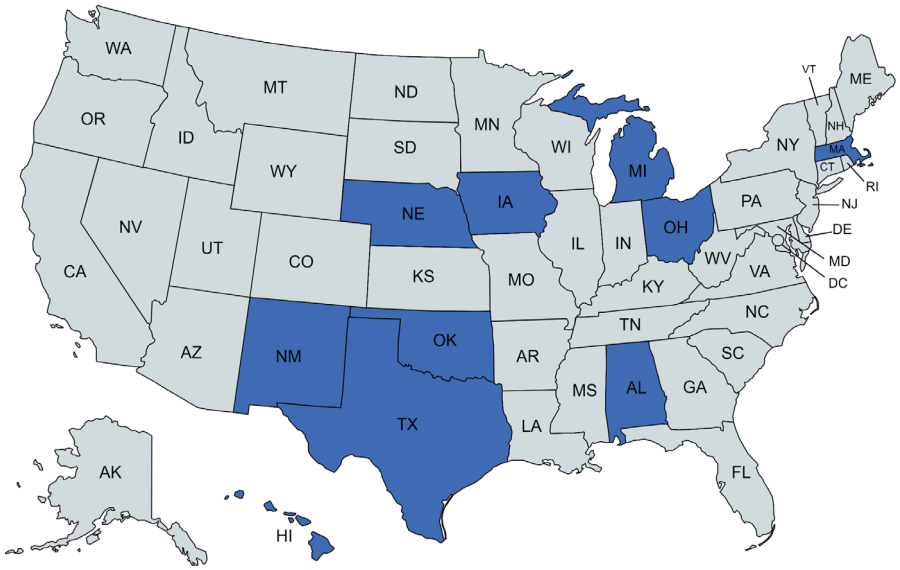
Benchmarking Introduction

For evaluation purposes, benchmarking provides information related to how peer states use and evaluate similar incentives. At the outset, it should be understood that no states are 'perfect peers' – there will be multiple differences in economic, demographic and political factors that will have to be considered in any analysis; likewise, it is exceedingly rare that any two state incentive programs will be exactly the same.[13] These benchmarking realities must be taken into consideration when making comparisons – and, for the sake of brevity, the report will not continually re-make this point throughout the discussion.

Peer State Programs: Key Findings

In addition to Oklahoma, nine states (highlighted in the following U.S. map) were identified that provide comparable grant programs aimed at supporting R&D activities. These grant programs are described in the following discussion; a detailed comparison of key characteristics is provided in **Appendix B.**

Table 8: States with Comparable R&D Programs



- **Alabama's** Research and Development Enhancement Fund (ARDEF) Program provides grants for Alabama research entities to conduct research and development activities within the State.[14]
- The **Hawaii** Small Business Innovation Research (SBIR) Grant Matching Program provides matching grants to help companies further the development of new products to solve critical issues.[15]
- BioConnect **Iowa** helps entrepreneurs prepare winning applications for the federal Small Business Administration's Small Business Innovation Research and Technology Transfer (SBIR/STTR) programs, which award funds to qualifying businesses to stimulate high-tech development.[16]

[13] The primary instances of exactly alike state incentive programs occur when states choose to 'piggyback' onto federal programs.
[14] Alabama Department of Economic and Community Affairs, "Alabama Research and Development Enhancement Fund Program." Accessed electronically at https://adeca.alabama.gov/ardef/
[15] U.S. SBA, "Innovate Hawaii." Accessed electronically at https://www.sbir.gov/node/867989#:~:text=The%20HSBIR%20program%20provides%20matching,for%20companies%20receiving%20SBIR%20awards
[16] BioConnect Iowa, "Matching Financial Assistance." Accessed electronically at https://bioconnectiowa.org/sbir-outreach/#:~:text=BioConnect%20Iowa%20provides%20financial%20assistance,financial%20assistance%20for%20qualifying%20businesses

- **Massachusetts'** Collaborative Research Matching Grant Program provides investments to support R&D partnerships that bring together world-class research institutions and class-leading companies in the form of a matching grant for capital expenditures.[17]

- The **Michigan** Translational Research and Commercialization Program (MTRAC) was created in 2012 to accelerate the transfer of new technologies from Michigan's institutions of higher learning into the commercial market by way of licenses or startups. In 2016 the program expanded as a statewide program to support translational research throughout the state of Michigan. The expansion reinforces the commitment to entrepreneurship, innovation and economic growth by providing a pathway to accelerate the creation and transfer of new technologies into the commercial market.[18]

- The **Nebraska** Academic Research and Development Grant provides a matching competitive grant to businesses that conduct research and development activities in conjunction with a Nebraska college or university.[19]

- **New Mexico's** Small Business Innovation Research Matching Grant encourages the creation and expansion of commercial enterprises based in New Mexico through the acceleration of the commercialization of innovation and technologies developed with federal SBIR awards.[20]

- **Ohio's** Research and Development Center Grant helps fund R&D centers that support the development and commercialization of emerging technologies and/or products that align with one or more of JobsOhio's targeted industries (Advanced Manufacturing, Aerospace & Aviation, Automotive, Healthcare, Financial Services, Food Processing, Information Technology, Logistics & Distribution and Shale Energy & Petrochemicals).[21]

- Enacted in 2015, the **Texas** Governor's University Research Initiative is aimed at helping Texas public institutions of higher education recruit distinguished researchers from around the world to the State of Texas. The program seeks to bolster both the standing of Texas public colleges and universities and economic development efforts statewide. Matching grants paid on a cost-reimbursement basis. The state's grant contribution may not exceed $5 million per distinguished researcher.[22]

Benchmarking Program Evaluations

While no evaluations of the preceding state grant programs were identified, one recent study conducted by the Lundquist College of Business at the University of Oregon aimed to redefine how the impact of publicly funded research is measured. Using investments made by the U.S. Small Business Administration's Small Business Innovation Research (SBIR) program, the authors of the study developed a methodology to trace how technology generated by one firm's R&D "spills over" and benefits other firms across both geographic

[17] Innovation Institute at MassTech Collaborative, "Collaborative Research Matching Grant Program." Accessed electronically at https://innovation.masstech.org/projects-and-initiatives/collaborative-research-matching-grant-program
[18] Michigan Economic Development Corporation, "University Programs." Accessed electronically at https://www.michiganbusiness.org/services/entrepreneurial-opportunity/university-programs/
[19] Nebraska Department of Economic Development, "Nebraska Academic Research and Development Grants." Accessed electronically at https://opportunity.nebraska.gov/programs/business/nebraska-academic-research-and-development-grant/#:~:text=Nebraska%20Academic%20Research-,and%20Development%20Grants,driven%20by%20the%20academic%20component
[20] New Mexico Economic Development Department, "SBIR Awardees." Accessed electronically at https://edd.newmexico.gov/business-development/edd-programs-for-business/office-of-science-technology/new-mexico-small-business-innovation-research-sbir-matching-grant/sbir-awardees/
[21] JobsOhio, "Research and Development Center Grant Program." Accessed electronically at https://www.jobsohio.com/programs-services/incentives/research-and-development-center-grant/
[22] Texas Economic Development, "Governor's University Research Initiative." Accessed electronically at https://gov.texas.gov/business/page/guri

and technological space. The study estimated that for every patent produced by grant recipients, three more are produced by others who benefit from spillovers. Further, 60 percent of the spillovers occur within the U.S., and many occur in technological areas substantially different from those targeted by the grants.[23]

[23] American Economic Review, "Estimating Spillovers from Publicly Funded R&D: Evidence from the U.S. Department of Energy," (Vol. 112, No. 7, July 2022). Accessed electronically at https://www.aeaweb.org/articles?id=10.1257/aer.20210678

Appendices

Appendix A: IMPLAN Economic Impact Methodology

The economic impact methodology utilized to determine the multiplier effects is IMPLAN (Impact Analysis for PLANning), a proprietary model; PFM has obtained a license for use of the IMPLAN model for these evaluations.

IMPLAN's Social Accounting Matrices (SAMs) capture the actual dollar amounts of all business transactions taking place in a regional economy as reported each year by businesses and governmental agencies. SAM accounts are a better measure of economic flow than traditional input-output accounts because they include "non-market" transactions. Examples of these transactions would be taxes and unemployment benefits.

Multipliers

SAMs can be constructed to show the effects of a given change on the economy of interest. These are called Multiplier Models. Multiplier Models study the impacts of a user-specified change in the chosen economy for 440 different industries. Because the Multiplier Models are built directly from the region-specific SAMs, they will reflect the region's unique structure and trade situation.

Multiplier Models are the framework for building impact analysis questions. Derived mathematically, these models estimate the magnitude and distribution of economic impacts, and measure three types of effects which are displayed in the final report. These are the direct, indirect, and induced changes within the economy. Direct effects are determined by the Event as defined by the user (i.e., a $10 million order is a $10 million direct effect). The indirect effects are determined by the amount of the direct effect spent within the study region on supplies, services, labor, and taxes. Finally, the induced effect measures the money that is re-spent in the study area as a result of spending from the indirect effect. Each of these steps recognizes an important leakage from the economic study region spent on purchases outside of the defined area. Eventually, these leakages will stop the cycle.

Appendix B: Summary of Comparable Grant Programs

State	Program Name	Annual Award Total	Award Amounts	Matching Funds Requirement
Oklahoma	Oklahoma Applied Research Support Program	$3.5m (FY2023)	Proof-of-Concept: Up to $90,000 for early-stage R&D for 1-2 years Accelerated: Up to $500,000 for later-stage R&D for 1-3 years	100%
Alabama	Alabama Research and Development Enhancement Fund (ARDEF) Program	$970,000	10% of the contract research expenses for qualified research conducted in Alabama during the fiscal year preceding the fiscal year for which grant funds are being awarded, minus 50% of the contract research expenses conducted in Alabama, on average, over the three fiscal years preceding the fiscal year for which the grant amount is being determined. 25% percent of consortium research expenses for qualified research conducted in Alabama during the fiscal year preceding the fiscal year for which grant funds are being awarded, minus 50% of the consortium research expenses conducted in Alabama, on average, over the three fiscal years preceding the fiscal year for which the grant amount is being determined.	50%
Hawaii	Hawaii Small Business Innovation Research (SBIR) Grant Matching Program	N/A; $10.1m since inception	Not to exceed $500,000 per award	50%
Iowa	BioConnect Iowa SBIR Outreach Program	N/A	Total of $50,000: Phase I: $25,000 Phase II: $25,000	50%
Massachusetts	Collaborative Research Matching Grant Program	Est. $8m in 2022	Level One: Up to $5m Level Two: Up to $1m	100%
Michigan	Michigan Translational Research and Commercialization Statewide Program	N/A	$30,000-$50,000 of direct costs	100%
Nebraska	Nebraska Academic Research and Development Grant Program	N/A	Phase I R&D awards are capped at $100,000. Phase II R&D awards are capped at $400,000. Businesses are eligible to apply for Phase II awards if they have successfully completed a Phase I award as determined by DED.	100%; for value-added agriculture projects, 25%

State	Program Name	Annual Award Total	Award Amounts	Matching Funds Requirement
New Mexico	New Mexico Small Business Innovation Research (SBIR) Matching Grant	N/A	Phase I: Up to $25,000 Phase II: Up to $100,000	50%
Ohio	Research and Development Center Grant	N/A; total program funding of $100 million	Flexible	None
Texas	Governor's University Research Initiative	N/A	Not to exceed $5 million per distinguished researcher	N/A