

# An Analysis of the Impacts of MIPS Program Spending and the Commercialization of MIPS Funded Projects on the State of Maryland

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## Introduction and Summary

The Maryland Industrial Partnerships (MIPS) program of the Maryland Technology Enterprise Institute (Mtech) retained the Jacob France Institute of the Merrick School of Business at the University of Baltimore (JFI) to update its September 2012 analysis of the economic impact of the MIPS program and of the commercialization of MIPS-supported technologies that are being produced in the state of Maryland. The goals of this analysis are to:

- Analyze the economic impact of MIPS research funding;
- Analyze the economic impact of the in-state commercialization of MIPS-supported technologies; and
- Describe the State's return on investment in the MIPS program.

The key findings of this analysis are as follows:

- Over the thirty year history of the MIPS program, it has supported 1,185 joint university-industry research collaborations with 569 companies;
- Over these thirty years, total MIPS program spending of \$46.2 million have been augmented with \$24.1 million in company research support and matching funds, for a total of \$70.3 million in joint university-industry research funding supported by the program;
- This \$70.3 million in research funding is only part of the story of the impacts of MIPS on research at Maryland's public universities. In addition to spending \$24.1 million in direct research support to Maryland campuses, companies made in-kind \$120.6 million, an amount 2.6 times the MIPS program funding;
- In calendar 2017, the MIPS program spent a total of just over \$2.4 million on joint university-industry research. This \$2.4 million in direct research expenditures generated \$4.8 million in economic activity in Maryland, supported 24 jobs earning \$1.8 million in labor income, and generated \$179,722 in combined state and local government revenues;
- The main mission of the MIPS program is to accelerate the development and commercialization of technology in Maryland by linking the research capacity of Maryland public universities with leading Maryland businesses. The MIPS program tracks the results of this commercialization activity through its annual economic impact evaluation survey of participating businesses. According to the economic impact data collected by MIPS from these companies, 187 of the 569 companies<sup>1</sup> reported having current employment associated with MIPS supported technologies, including companies such as MedImmune (now part of AstraZeneca), Hughes Network Systems and Martek;
- Based on the economic analysis conducted as part of this report, the technology products developed and commercialized in collaboration with the MIPS program generated over \$4.7 billion in product sales and supported 7,150 jobs in Maryland in calendar 2017. When the multiplier-based economic impacts associated with this activity are included, the economic impacts associated with the production and sale of these commercialized technologies total

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<sup>1</sup> An additional 21 companies reported having \$26.4 million in cumulative revenues associated with MIPS technologies – but no current employment. These companies were excluded from this analysis which was based on current employment and IMPLAN estimated revenues.

almost \$7.5 billion in economic activity in Maryland, supporting 22,915 jobs earning \$2.2 billion in labor income<sup>2</sup>; and

- The 2017 economic impacts associated with MIPS supported technology generated an estimated \$166.1 million in estimated state revenues in the year 2017 alone.<sup>3</sup> The estimated 2017 state tax revenues associated with the production and sale of MIPS supported technology generates more than the \$60.2 million *lifetime costs*<sup>4</sup> of the program.

It is clear that by supporting the development and commercialization of new advanced technologies that have been produced and created jobs in Maryland; the MIPS program has contributed to Maryland's economic development success. If the \$60.2 million in total MIPS program spending (in 2017\$) is divided by the estimated 7,150 ongoing jobs supported by MIPS technology, the total state cost per job created is only \$8,420, a very low level of cost per job created. Even this low cost per direct job created is only part of the story of the economic and commercialization impacts of the MIPS program. According to the MIPS economic impact data collected, the reporting companies have also attracted an additional \$417.9 million<sup>5</sup> in federal and other grants to further develop the technologies commercialized and these companies have reported \$882.1 million in debt, equity, and venture capital funding to further develop and commercialize MIPS supported technologies. Thus, the \$46.2 million in State of Maryland MIPS spending assisted in catalyzing the development and commercialization of technologies that have attracted \$1.3 billion in additional grant, debt, equity, and venture capital funding into Maryland.<sup>6</sup>

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<sup>2</sup> This analysis differs from the 2011 report in that it is based solely on reported employment, and IMPLAN estimated revenues. In the 2011 report, the direct revenues were adjusted to reflect reported revenues for a selection of companies.

<sup>3</sup> The IMPLAN model used estimates combined state and local government revenues. State revenues were estimated based on U.S. Bureau of the Census data on the share of state revenues from each IMPLAN estimated revenue source.

<sup>4</sup> Lifetime costs of \$60.2 million differ from the \$46.2 million in program spending – because they are expressed in current 2017 \$s.

<sup>5</sup> One company which reported \$170 million in grants revenues was considered an outlier and excluded from this analysis.

<sup>6</sup> This analysis is based on self-reported data from the companies, provided to the MIPS program as part of their economic impact reporting system and was not validated by the JFI.

## MIPS Program Funding – A 30 Year History

The Maryland Industrial Partnerships (MIPS) is one of the core programs through which the University System of Maryland supports private sector technology commercialization and development. MIPS promotes the development and commercialization of products and processes through industry/university research partnerships. MIPS provides matching funds to help Maryland companies pay for the university research. Projects are initiated by the companies to meet their own research and development goals. Through MIPS, Maryland firms have the opportunity to leverage their research and development funds and gain access to the creative talents and extensive research base of the University System of Maryland. MIPS matching funds are awarded on a competitive basis for projects based on proposals submitted jointly by Maryland companies and researchers from any of the 13 University System institutions. MIPS awards up to \$100,000 per year for projects with established large and small companies and up to \$90,000 for start-up firms. Through the MIPS program, two types of projects can receive funding:

- Research and Development - The research may be in engineering, computer science, physical sciences and life sciences; and
- Education and Training - MIPS also supports projects designed to help a company plan and develop industrial training programs for its employees.

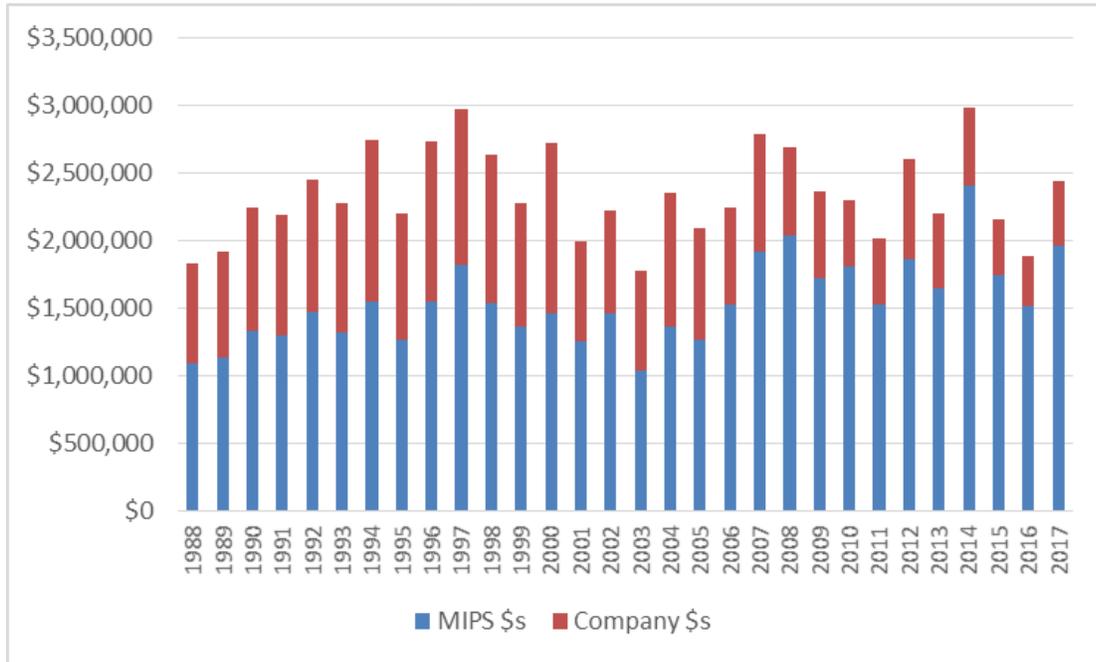
As presented in Table 1, over the thirty year history of MIPS, it has supported 1,185 joint university-industry research collaborations. Total MIPS program spending of \$46.2 million has been augmented with \$24.1 million in company research support and matching funds, for a total of \$70.3 million in joint university-industry research funding supported by the program. As presented in Chart 1, MIPS program funding has ranged from a low of \$1 million in 2003 to a high of \$2.4 million in 2014, with company match spending ranging from a low of \$366,989 in 2016 to a high of almost \$1.3 million in 2000. The \$70.3 million in total (State and private) MIPS research funding is only part of the story of the impact of MIPS on research at Maryland's public universities. In addition to spending \$24.1 million in direct research support to MIPS projects at Maryland campuses, companies made in-kind research and equipment contributions of \$120.6 million over the thirty year history of the program, an amount 2.6 times the level of direct state support.

**Table 1: MIPS Program - 30 Years of Activity - Projects and Funding by Campus**

| Campus                         | # of Projects | MIPS Funding (\$s)  | Company Funding (\$s) | Total Funding (\$s) |
|--------------------------------|---------------|---------------------|-----------------------|---------------------|
| Total                          | <u>1,185</u>  | <u>\$46,220,309</u> | <u>\$24,068,905</u>   | <u>\$70,289,214</u> |
| Bowie State                    | 22            | \$684,396           | \$507,487             | \$1,191,883         |
| Frostburg State                | 10            | \$665,223           | \$150,000             | \$815,223           |
| Johns Hopkins                  | 5             | \$224,394           | \$176,000             | \$400,394           |
| Morgan State                   | 1             | \$45,455            | \$5,000               | \$50,455            |
| Salisbury University           | 12            | \$436,405           | \$127,533             | \$563,938           |
| St. Mary's College of Maryland | 4             | \$267,095           | \$36,440              | \$303,535           |
| Towson University              | 12            | \$522,223           | \$160,575             | \$682,798           |
| UMB                            | 219           | \$10,691,809        | \$5,034,835           | \$15,726,644        |
| UMBC                           | 120           | \$4,894,438         | \$2,460,349           | \$7,354,787         |
| UMBI                           | 26            | \$1,060,494         | \$453,000             | \$1,513,494         |
| UMCES                          | 32            | \$1,624,455         | \$415,307             | \$2,039,762         |
| UMCP                           | 695           | \$23,378,453        | \$14,292,226          | \$37,670,679        |
| UMES                           | 25            | \$1,679,578         | \$210,609             | \$1,890,187         |
| UMUC                           | 2             | \$45,891            | \$39,544              | \$85,435            |

Source: MIPS

**Figure 1: MIPS and Company Spending by Year**



## The Economic Contribution of 2017 MIPS Research Spending

In 2017, the MIPS program funded 33 projects with total research spending of \$2,442,804, consisting of \$1,958,924 million in MIPS program spending and \$483,880 in company research support. As presented in Table 2, the \$2.4 million in 2017 MIPS research project funding directly supported an estimated 8 jobs at participating universities with an estimated \$1.0 million in labor income. The \$2.4 million 2017 MIPS program funding generated an estimated \$1.2 million in *Indirect Impacts*, from in-State purchases from Maryland suppliers, and \$1.1 million in *Induced Impacts*, from the increase in local activity generated by the increase in Maryland incomes, for a total increase in Maryland economic activity of \$4.8 million.<sup>7</sup> The Maryland economic activity associated with MIPS research supported a total of 24 jobs earning \$1.8 million in labor income and supported an estimated \$179,722 in State and local government revenues.

**Table 2: Economic Impact of 2017 MIPS Research Funding Economic Impacts of Operations**

| Item                               | Direct Impact | Indirect Impact | Induced Impact | Total Impact |
|------------------------------------|---------------|-----------------|----------------|--------------|
| Output (\$s)                       | \$2,442,804   | \$1,208,880     | \$1,135,186    | \$4,786,870  |
| Employment (# of Jobs)             | 8.3           | 7.4             | 7.8            | 23.5         |
| Labor Income (\$s)                 | \$954,044     | \$481,587       | \$380,831      | \$1,816,462  |
| Average Labor Income per Job (\$s) | \$114,945     | \$65,079        | \$48,824       | \$77,296     |
| Fiscal Impact (\$s)                | --            | --              | --             | \$179,722    |

Source: JFI and IMPLAN

The output impacts of 2017 MIPS research spending are presented by sector in Table 3, the employment impacts by sector in Table 4, and the labor income impacts are presented in Table 5. As presented in these tables, the impacts of the MIPS research spending are concentrated in the professional scientific and technical services, real estate, health and social services, and finance and insurance sectors of the Maryland economy.

<sup>7</sup> For a more detailed description of the terms, model, and methodology used in this economic impact analysis, see the methodology section below.

**Table 3: Output Impact of 2017 MIPS Research Funding**

| Item                                         | Direct Impact      | Indirect Impact    | Induced Impact     | Total Impact       |
|----------------------------------------------|--------------------|--------------------|--------------------|--------------------|
| <b>Total</b>                                 | <b>\$2,442,804</b> | <b>\$1,208,880</b> | <b>\$1,135,184</b> | <b>\$4,786,868</b> |
| Natural Resources                            | \$0                | \$934              | \$1,352            | \$2,286            |
| Mining                                       | \$0                | \$512              | \$612              | \$1,124            |
| Utilities                                    | \$0                | \$27,001           | \$28,803           | \$55,804           |
| Construction                                 | \$0                | \$13,680           | \$16,026           | \$29,706           |
| Manufacturing                                | \$0                | \$7,881            | \$21,731           | \$29,612           |
| Wholesale Trade                              | \$0                | \$10,398           | \$47,558           | \$57,956           |
| Retail Trade                                 | \$0                | \$1,785            | \$103,918          | \$105,703          |
| Transportation & Warehousing                 | \$0                | \$26,290           | \$29,230           | \$55,520           |
| Information                                  | \$0                | \$52,237           | \$61,819           | \$114,056          |
| Finance & Insurance                          | \$0                | \$61,978           | \$116,096          | \$178,074          |
| Real Estate                                  | \$0                | \$292,739          | \$247,142          | \$539,881          |
| Professional Scientific & Technical Services | \$2,442,804        | \$535,202          | \$48,979           | \$3,026,985        |
| Management of Companies                      | \$0                | \$31,590           | \$10,528           | \$42,118           |
| Administrative & Waste Services              | \$0                | \$102,727          | \$32,422           | \$135,149          |
| Educational Services                         | \$0                | \$51               | \$26,866           | \$26,917           |
| Health & Social Services                     | \$0                | \$7                | \$179,016          | \$179,023          |
| Arts, Entertainment & Recreation             | \$0                | \$3,711            | \$22,238           | \$25,949           |
| Accommodation & Food Services                | \$0                | \$13,701           | \$62,027           | \$75,728           |
| Other Services                               | \$0                | \$20,743           | \$71,360           | \$92,103           |
| Government                                   | \$0                | \$5,713            | \$7,461            | \$13,174           |

Source: JFI and IMPLAN

**Table 4: Employment Impact of 2017 MIPS Research Funding**

| Item                                         | Direct Impact | Indirect Impact | Induced Impact | Total Impact |
|----------------------------------------------|---------------|-----------------|----------------|--------------|
| <b>Total</b>                                 | <b>8.3</b>    | <b>7.4</b>      | <b>7.8</b>     | <b>23.5</b>  |
| Natural Resources                            | 0.0           | 0.0             | 0.0            | 0.0          |
| Mining                                       | 0.0           | 0.0             | 0.0            | 0.0          |
| Utilities                                    | 0.0           | 0.0             | 0.0            | 0.0          |
| Construction                                 | 0.0           | 0.1             | 0.1            | 0.2          |
| Manufacturing                                | 0.0           | 0.0             | 0.0            | 0.0          |
| Wholesale Trade                              | 0.0           | 0.0             | 0.2            | 0.2          |
| Retail Trade                                 | 0.0           | 0.0             | 1.3            | 1.3          |
| Transportation & Warehousing                 | 0.0           | 0.2             | 0.2            | 0.4          |
| Information                                  | 0.0           | 0.1             | 0.1            | 0.2          |
| Finance & Insurance                          | 0.0           | 0.3             | 0.5            | 0.8          |
| Real Estate                                  | 0.0           | 1.1             | 0.4            | 1.5          |
| Professional Scientific & Technical Services | 8.3           | 3.7             | 0.4            | 12.4         |
| Management of Companies                      | 0.0           | 0.1             | 0.0            | 0.1          |
| Administrative & Waste Services              | 0.0           | 1.3             | 0.4            | 1.7          |
| Educational Services                         | 0.0           | 0.0             | 0.3            | 0.3          |
| Health & Social Services                     | 0.0           | 0.0             | 1.7            | 1.7          |
| Arts, Entertainment & Recreation             | 0.0           | 0.1             | 0.3            | 0.4          |
| Accommodation & Food Services                | 0.0           | 0.2             | 0.9            | 1.1          |
| Other Services                               | 0.0           | 0.2             | 0.9            | 1.1          |
| Government                                   | 0.0           | 0.0             | 0.1            | 0.1          |

Source: JFI and IMPLAN

**Table 5: Labor Income Impact of 2017 MIPS Research Funding**

| Item                                         | Direct Impact           | Indirect Impact         | Induced Impact          | Total Impact              |
|----------------------------------------------|-------------------------|-------------------------|-------------------------|---------------------------|
| <b>Total</b>                                 | <b><u>\$954,044</u></b> | <b><u>\$481,586</u></b> | <b><u>\$380,832</u></b> | <b><u>\$1,816,462</u></b> |
| Natural Resources                            | \$0                     | \$371                   | \$458                   | \$829                     |
| Mining                                       | \$0                     | \$94                    | \$85                    | \$179                     |
| Utilities                                    | \$0                     | \$2,864                 | \$3,207                 | \$6,071                   |
| Construction                                 | \$0                     | \$5,279                 | \$6,013                 | \$11,292                  |
| Manufacturing                                | \$0                     | \$1,707                 | \$2,847                 | \$4,554                   |
| Wholesale Trade                              | \$0                     | \$3,616                 | \$16,539                | \$20,155                  |
| Retail Trade                                 | \$0                     | \$812                   | \$43,342                | \$44,154                  |
| Transportation & Warehousing                 | \$0                     | \$8,794                 | \$10,270                | \$19,064                  |
| Information                                  | \$0                     | \$15,893                | \$12,982                | \$28,875                  |
| Finance & Insurance                          | \$0                     | \$23,225                | \$37,209                | \$60,434                  |
| Real Estate                                  | \$0                     | \$31,648                | \$11,491                | \$43,139                  |
| Professional Scientific & Technical Services | \$954,044               | \$290,359               | \$25,997                | \$1,270,400               |
| Management of Companies                      | \$0                     | \$16,008                | \$5,335                 | \$21,343                  |
| Administrative & Waste Services              | \$0                     | \$59,002                | \$17,236                | \$76,238                  |
| Educational Services                         | \$0                     | \$31                    | \$16,693                | \$16,724                  |
| Health & Social Services                     | \$0                     | \$4                     | \$102,667               | \$102,671                 |
| Arts, Entertainment & Recreation             | \$0                     | \$1,673                 | \$7,591                 | \$9,264                   |
| Accommodation & Food Services                | \$0                     | \$5,991                 | \$24,061                | \$30,052                  |
| Other Services                               | \$0                     | \$9,967                 | \$31,879                | \$41,846                  |
| Government                                   | \$0                     | \$4,248                 | \$4,930                 | \$9,178                   |

Source: JFI and IMPLAN

## The Economic Impact of the Commercialization of MIPS Funded Projects That Have Been Commercialized in Maryland

The MIPS program tracks the results of the development and commercialization of its supported projects through an annual economic impact evaluation survey of participating businesses. The research conducted by the MIPS program has found that MIPS supported technologies have generated \$34.9 billion in cumulative sales over the past 30 years.<sup>8</sup> According to the economic impact data collected by MIPS from these companies, the technology developed and commercialized in Maryland through the program has had impressive results. The MIPS program provided economic impact evaluation survey data for all of the 569 different companies that have participated in the program over the past thirty years. In the MIPS Economic Impact Evaluation Form, firms are asked to provide data on the economic impacts associated with each research effort that leads to the development and commercialization of a new product or service. Firms are specifically asked to provide the following information.

Economic Impact for MIPS Dollars. Measurable results: estimate of jobs, increased sales, improved competitiveness, revitalization of an industry, etc. Consider impact relative to company's size and stage of development.

The MIPS program provided Economic Impact data for all 569 companies that have participated in the program. Of the 569 companies, 187 companies reported current employment based on MIPS technologies. This analysis was based on the reported level of net added jobs created by these companies based on MIPS developed technologies. Because employment data was most widely reported and also the easiest to report for the firms,<sup>9</sup> this economic impact analysis was based entirely on the reported employment level associated with each MIPS supported commercialized product or service, with the associated company revenues estimated by IMPLAN, based on standard relationships of revenues per employee.<sup>10</sup>

In 2017, the 187 companies reporting employment based on MIPS supported commercialized technologies had associated direct employment of 7,150 jobs and generated \$4.7 billion in IMPLAN estimated revenues. As presented in Table 6, these 7,150 jobs and \$4.7 billion in estimated MIPS supported product sales/company revenues generated \$7.5 billion in Maryland economic activity, supported a total of 22,915 jobs earning \$2.2 billion in labor income, and support an estimated \$291.2 million in State and local government revenues. These economic impact estimates include \$1.3 million in *Indirect Impacts*, from in-State purchases from Maryland suppliers, and \$1.4 billion in *Induced Impacts*, from the increase local activity generated by the increase in Maryland incomes, for a total increase in Maryland economic activity of \$7.5 billion.

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<sup>8</sup> This is an undercount of actual revenues as only 94 companies reported revenues.

<sup>9</sup> Only 94 firms reported revenues.

<sup>10</sup> In the 2011 report –direct revenues were forced to equal the reported revenues for the five commercialized projects that accounted for the overwhelming share of total impacts with the induced and indirect impacts based IMPLAN estimated revenues. This update did not make this adjustment, yielding a lower estimate of direct sales and total impacts.

**Table 6: Economic Impact of Company Commercialization of MIPS Technology, 2017 EIS Data**  
**Economic Impacts of Company Employment and Revenues**

| Item                               | Direct Impact                       | Indirect Impact | Induced Impact  | Total Impact    |
|------------------------------------|-------------------------------------|-----------------|-----------------|-----------------|
| Output (\$s)                       | \$4,748,484,811                     | \$1,338,639,297 | \$1,376,661,199 | \$7,463,785,307 |
| Employment (# of Jobs)             | 7,150                               | 6,358           | 9,407           | 22,915          |
| Labor Income (\$s)                 | \$1,228,583,598                     | \$509,634,848   | \$461,839,853   | \$2,200,058,299 |
| Average Labor Income per Job (\$s) | \$171,830                           | \$80,158        | \$49,095        | \$96,010        |
| Fiscal Impact (\$s)                | --                                  | --              | --              | \$291,152,270   |
|                                    | Estimated State Government Revenues |                 |                 | \$166,083,830   |
|                                    | Estimated Local Government Revenues |                 |                 | \$125,068,439   |

Source: JFI and IMPLAN

The 2017 output impacts of the commercialization of MIPS supported technologies are presented by sector in Table 7, the employment impacts by sector in Table 8, and the labor income impacts are presented in Table 9. As presented in these tables, the impacts of the commercialization, production, and sale of MIPS supported technologies are concentrated in the manufacturing, professional scientific and technical services, and wholesale sectors of the Maryland economy.

In addition to the employment and product sales associated with the development and commercialization of MIPS supported technologies, the MIPS program also impacts the Maryland economy through the grant, venture capital, debt, and equity funding that participating companies attract in order to further develop each associated technology. According to the MIPS economic impact data collected, the reporting companies have also attracted an additional \$417.9 million in federal and other grants to further develop the MIPS supported technologies commercialized and these companies raised a reported \$882.1 million in debt, equity, and venture capital funding to further develop and commercialize MIPS supported technologies. Thus, the \$46.2 million in State of Maryland MIPS spending assisted in catalyzing the development and commercialization of technologies that have attracted \$1.3 billion in additional grant, debt, equity, and venture capital funding into Maryland.

**Table 7: Output Impact of Company Commercialization of MIPS Technology, 2017 EIS Data, By Sector**

| Item                                         | Direct Impact          | Indirect Impact        | Induced Impact         | Total Impact           |
|----------------------------------------------|------------------------|------------------------|------------------------|------------------------|
| <b>Total</b>                                 | <b>\$4,748,484,811</b> | <b>\$1,338,639,296</b> | <b>\$1,376,661,197</b> | <b>\$7,463,785,304</b> |
| Natural Resources                            | \$3,027,808            | \$2,819,990            | \$1,640,617            | \$7,488,415            |
| Mining                                       | \$0                    | \$5,926,623            | \$742,441              | \$6,669,064            |
| Utilities                                    | \$174,524,886          | \$72,184,994           | \$34,984,146           | \$281,694,026          |
| Construction                                 | \$2,706,995            | \$32,388,147           | \$19,424,036           | \$54,519,178           |
| Manufacturing                                | \$4,166,835,123        | \$130,481,491          | \$26,374,571           | \$4,323,691,185        |
| Wholesale Trade                              | \$20,703,418           | \$273,027,548          | \$57,681,518           | \$351,412,484          |
| Retail Trade                                 | \$802,704              | \$10,787,986           | \$125,980,040          | \$137,570,730          |
| Transportation & Warehousing                 | \$0                    | \$57,394,503           | \$35,401,287           | \$92,795,790           |
| Information                                  | \$72,489,787           | \$89,680,152           | \$75,062,318           | \$237,232,257          |
| Finance & Insurance                          | \$0                    | \$62,863,698           | \$140,970,071          | \$203,833,769          |
| Real Estate                                  | \$0                    | \$79,946,224           | \$299,479,209          | \$379,425,433          |
| Professional Scientific & Technical Services | \$260,613,950          | \$149,866,028          | \$59,359,937           | \$469,839,915          |
| Management of Companies                      | \$36,843,313           | \$245,900,548          | \$12,770,603           | \$295,514,464          |
| Administrative & Waste Services              | \$1,020,848            | \$78,139,804           | \$39,289,811           | \$118,450,463          |
| Educational Services                         | \$0                    | \$198,610              | \$32,426,485           | \$32,625,095           |
| Health & Social Services                     | \$1,573,844            | \$7,000                | \$217,277,422          | \$218,858,266          |
| Arts, Entertainment & Recreation             | \$0                    | \$5,105,465            | \$26,939,511           | \$32,044,976           |
| Accommodation & Food Services                | \$0                    | \$10,362,209           | \$75,211,791           | \$85,574,000           |
| Other Services                               | \$7,342,135            | \$22,181,211           | \$86,591,426           | \$116,114,772          |
| Government                                   | \$0                    | \$9,377,065            | \$9,053,957            | \$18,431,022           |

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Source: JFI and IMPLAN

**Table 8: Employment Impact of Company Commercialization of MIPS Technology, 2017 EIS Data, By Sector**

| Item                                         | Direct Impact       | Indirect Impact     | Induced Impact      | Total Impact         |
|----------------------------------------------|---------------------|---------------------|---------------------|----------------------|
| <b>Total</b>                                 | <b><u>7,150</u></b> | <b><u>6,358</u></b> | <b><u>9,407</u></b> | <b><u>22,915</u></b> |
| Natural Resources                            | 50                  | 49                  | 16                  | 115                  |
| Mining                                       | 0                   | 33                  | 4                   | 37                   |
| Utilities                                    | 187                 | 52                  | 25                  | 264                  |
| Construction                                 | 15                  | 196                 | 114                 | 325                  |
| Manufacturing                                | 4,809               | 183                 | 53                  | 5,045                |
| Wholesale Trade                              | 80                  | 1,055               | 223                 | 1,358                |
| Retail Trade                                 | 16                  | 130                 | 1,516               | 1,663                |
| Transportation & Warehousing                 | 0                   | 373                 | 240                 | 612                  |
| Information                                  | 562                 | 165                 | 130                 | 856                  |
| Finance & Insurance                          | 0                   | 287                 | 575                 | 862                  |
| Real Estate                                  | 0                   | 263                 | 439                 | 702                  |
| Professional Scientific & Technical Services | 1,188               | 1,075               | 430                 | 2,693                |
| Management of Companies                      | 150                 | 1,001               | 52                  | 1,203                |
| Administrative & Waste Services              | 5                   | 975                 | 542                 | 1,522                |
| Educational Services                         | 0                   | 3                   | 400                 | 403                  |
| Health & Social Services                     | 14                  | 0                   | 2,042               | 2,056                |
| Arts, Entertainment & Recreation             | 0                   | 92                  | 332                 | 424                  |
| Accommodation & Food Services                | 0                   | 168                 | 1,149               | 1,318                |
| Other Services                               | 74                  | 195                 | 1,064               | 1,333                |
| Government                                   | 0                   | 63                  | 62                  | 124                  |

Source: JFI and IMPLAN

**Table 9: Labor Income Impact of Company Commercialization of MIPS Technology, 2017 EIS Data, By Sector**

| Item                                         | Direct Impact                 | Indirect Impact             | Induced Impact              | Total Impact                  |
|----------------------------------------------|-------------------------------|-----------------------------|-----------------------------|-------------------------------|
| <b>Total</b>                                 | <b><u>\$1,228,583,597</u></b> | <b><u>\$509,634,849</u></b> | <b><u>\$461,839,854</u></b> | <b><u>\$2,200,058,300</u></b> |
| Natural Resources                            | \$1,511,970                   | \$1,088,296                 | \$556,310                   | \$3,156,576                   |
| Mining                                       | \$0                           | \$714,851                   | \$102,721                   | \$817,572                     |
| Utilities                                    | \$32,160,849                  | \$8,060,807                 | \$3,894,893                 | \$44,116,549                  |
| Construction                                 | \$955,467                     | \$12,577,826                | \$7,288,185                 | \$20,821,478                  |
| Manufacturing                                | \$1,000,491,706               | \$30,666,186                | \$3,454,944                 | \$1,034,612,836               |
| Wholesale Trade                              | \$7,199,714                   | \$94,946,648                | \$20,059,026                | \$122,205,388                 |
| Retail Trade                                 | \$373,997                     | \$4,907,404                 | \$52,543,808                | \$57,825,209                  |
| Transportation & Warehousing                 | \$0                           | \$21,478,013                | \$12,439,901                | \$33,917,914                  |
| Information                                  | \$36,666,308                  | \$29,065,490                | \$15,755,771                | \$81,487,569                  |
| Finance & Insurance                          | \$0                           | \$23,821,648                | \$45,178,091                | \$68,999,739                  |
| Real Estate                                  | \$0                           | \$9,084,102                 | \$13,949,429                | \$23,033,531                  |
| Professional Scientific & Technical Services | \$125,082,316                 | \$83,667,077                | \$31,510,159                | \$240,259,552                 |
| Management of Companies                      | \$18,670,158                  | \$124,608,833               | \$6,471,437                 | \$149,750,428                 |
| Administrative & Waste Services              | \$323,641                     | \$40,702,260                | \$20,891,283                | \$61,917,184                  |
| Educational Services                         | \$0                           | \$118,672                   | \$20,145,269                | \$20,263,941                  |
| Health & Social Services                     | \$968,478                     | \$4,067                     | \$124,579,807               | \$125,552,352                 |
| Arts, Entertainment & Recreation             | \$0                           | \$2,307,141                 | \$9,188,694                 | \$11,495,835                  |
| Accommodation & Food Services                | \$0                           | \$4,330,040                 | \$29,174,685                | \$33,504,725                  |
| Other Services                               | \$4,178,993                   | \$11,239,892                | \$38,676,484                | \$54,095,369                  |
| Government                                   | \$0                           | \$6,245,596                 | \$5,978,957                 | \$12,224,553                  |

Source: JFI and IMPLAN

## Some Measures of the Return on Investment on the State of Maryland's Investment in the MIPS Program

It was outside of the scope of this project to conduct a full analysis of the State of Maryland's return on investment in the MIPS program. There is insufficient data available on the annual economic impacts associated with the program to prepare this type of return on investment estimate. However, the Jacob France Institute prepared some simple measures of the leveraging impact of the MIPS program, in terms of the job and tax benefits associated with the commercialization of MIPS supported technologies.<sup>11</sup> Selected measures of the leveraging impacts of the MIPS program are presented in Table 10.

As described above, the 2017 economic impacts associated with MIPS supported technology generated an estimated \$166.1 million in estimated state revenues in the year 2017 alone.<sup>12</sup> Thus, the estimated 2017 state tax revenues associated with the production and sale of MIPS supported technology generates more than the \$46.2 million *lifetime costs* of the program. After adjusting for inflation, the lifetime costs of the MIPS program in 2017 dollars is \$60.2 million. When 2017 state government revenues are compared to the lifetime costs of the program, 2017 state government revenues *alone* are almost three times (2.76) the *lifetime* costs of the program (all in 2017\$).

**Table 10: Measures of the Leveraging Impacts of the MIPS Program**

| Item                                                                   |                      |  |               |
|------------------------------------------------------------------------|----------------------|--|---------------|
| Thirty Year Cost of the Program (Current \$s)                          | \$46,220,309         |  |               |
| Thirty Year Cost of the Program (2017 \$s)                             | \$60,205,694         |  |               |
| <u>Selected Leveraging Measures</u>                                    |                      |  |               |
| Estimated 2017 State Government Revenues - Commercialized Technologies | \$166,083,830        |  |               |
| 2017 State Gov't Revenues/Lifetime Program Costs (2017 \$s)            | \$2.76               |  |               |
| Jobs Created Associated with Commercialized Technologies               | 7,150                |  | Per \$ of     |
| Cost per Job Created (Current \$s)                                     | \$6,464              |  | Lifetime Cost |
| Cost per Job Created (2017\$)                                          | \$8,420              |  | (Current \$s) |
| EIS Reported Commercialization Related Grants/Contracts                | \$417,894,992        |  | \$9.04        |
| EIS Reported Commercialization Related Investment                      | <u>\$882,072,103</u> |  | \$19.08       |
| Total                                                                  | \$1,299,967,095      |  | \$28.13       |

Source: JFI and IMPLAN

<sup>11</sup> This analysis is based on the reported economic impacts associated with the development, commercialization, production and sale of MIPS supported technologies and did not ascertain the extent to which the MIPS provided assistance led to or caused this outcome.

<sup>12</sup> The IMPLAN model used estimates combined state and local government revenues. State revenues were estimated based on U.S. Bureau of the Census data on the share of state and local revenues from each IMPLAN estimated revenue source.

It is clear that by supporting the commercialization of new advanced technologies that have been produced in and created jobs in Maryland, the MIPS program has contributed to Maryland's economic development success. If the \$46.2 million in total MIPS program spending is divided by the estimated 7,150 ongoing jobs supported by MIPS technology, the total state cost per job created is only \$6,464 (\$8,420 in 2017 \$s), a very low level of cost per job created. Even this low cost per direct job created is only part of the story of the economic and commercialization impacts of the MIPS program. According to the MIPS economic impact data collected, the reporting companies have also attracted an additional \$417.9 million in federal and other grants to further develop the MIPS supported technologies commercialized and these companies also reported \$882.1 million in debt, equity, and venture capital funding to further develop and commercialize MIPS supported technologies. Thus, the \$46.2 million in State of Maryland MIPS spending assisted in catalyzing the development and commercialization of technologies that have attracted \$1.3 billion in additional grant, debt, equity, and venture capital funding into Maryland, an amount 28 times the cost of the program. Several MIPS supported companies have also been acquired over the past several years and the acquisition cost of these companies has totaled over \$18.7 billion dollars. ***While it is impossible to ascertain the exact extent to which the MIPS program fully contributed to the actual commercialization of each technology, it is never-the-less clear that the MIPS program has supported the development and commercialization of new products and technologies that have made a significant contribution to the Maryland economy.***

## Economic Impact Methodology and Terms

The JFI prepared this analysis of the economic contribution of the MIPS program on the Maryland economy using the IMPLAN input-output model for the State of Maryland. IMPLAN is one of the most widely used models in the nation, and can be used to analyze the impacts of companies, projects, or of entire industries. An input-output analysis examines the relationships among businesses and among businesses and final consumers. Input-output analysis is based on the use of multipliers, which describe the response of an economy to a change in demand or production. Multipliers measure the effects on an economy from a source of economic activity, in this case the jobs and revenues associated with MIPS supported research and technologies.

The economic activity generated in a city, county, region or state is greater than the simple total of spending associated with the event or activity being studied. This is because as this money is earned it is, in turn, spent, earned and re-spent by other businesses and workers in the local economy through successive cycles of spending, earning and spending. However, the spending in each successive cycle is less than in the preceding cycle because a certain portion of spending “leaks” out of the economy in each round of spending. Leakages occur through purchases of goods or services from outside of the region and federal taxation. The IMPLAN multipliers used in this analysis capture the effects of these multiple rounds of spending. This analysis focuses on three measures of economic impact:

- **Output.** The total value of production or sales in all industries;
- **Employment.** The total number of full and part time jobs in all industries; and
- **Labor Income.** The wages and salaries, including benefits, and other labor income earned by the workers holding the jobs created.

Four measures of the economic activity and impact of research and company/product revenue/sales are included in this report:

- **Direct effects.** The change in economic activity being analyzed—in this case in this case the jobs and revenues associated with MIPS supported research and technologies;
- **Indirect effects.** The changes in inter-industry purchases, for example the purchase of goods or services to support the production or sale of MIPS supported technology products, in response to the change in demand from the directly affected industries;
- **Induced effects.** The changes in spending from households as income and population increase due to changes in production; and
- **Total effects.** The combined total of direct, indirect and induced effects.