SB 3053

RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

Establishes the Hawaii unmanned aerial systems test site chief operating officer position to, among other things, serve on the Pan-Pacific Unmanned Aerial Systems Test Range Complex management team. Establishes an advisory board to oversee and manage unmanned aerial systems test site operations. Appropriates the funds to staff and operate Hawaii's unmanned aerial systems test site activities.

PSM/HRE, WAM

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Congress of the United States
House of Representatives
Washington, DC 20515-1101

COMMITTEE ON
ARMED SERVICES
SUBCOMMITTEES:
Readiness
Seapower and Projection Forces

COMMITTEE ON
NATURAL RESOURCES
SUBCOMMITTEES:
Indian and Alaska Native Affairs
(Ranking Member)
Energy and Mineral Resources
Public Lands and
Environmental Regulation

To: The Honorable Will Espero, Chair
The Honorable Rosalyn Baker, Vice Chair
Members of the Senate Committee on Public Safety, Intergovernmental and Military Affairs

The Honorable Brian Taniguchi, Chair
The Honorable Gilbert Kahale, Vice Chair
Members of the Senate Committee on Higher Education

Re: SB3053, RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES
Date: Tuesday, February 11, 2014
Time: 2:45 p.m.
Place: State Capitol, Room 224

Testimony in Support of Senate Bill 3053

Chairs Espero and Taniguchi; Vice Chairs Baker and Kahele; and Members of the Committees,

I am pleased to submit this testimony in **support** of Senate Bill 3053, Relating to Unmanned Aerial Systems Test Sites, which would establish a Hawaii unmanned aerial systems test site chief operating officer to serve on the Pan-Pacific Unmanned Aerial Systems Test Range Complex management team, establish a Hawaii unmanned aerial systems test site advisory board to create an implementation plan and oversee test site development in the State, and appropriate funds for personnel and procurement costs associated with establishing the Hawaii unmanned aerial systems test site.

Our country's announced rebalance to the Asia-Pacific region will provide Hawaii with numerous valuable opportunities in research and development. Our location at our nation's doorstep to Asia and the Pacific could provide key geographical, political, and diplomatic benefits if we are prepared to exploit them.

Vital to enjoying those benefits will be our willingness and ability to participate in ongoing developments in the region. SB3053 represents an important step in preparing our state for meaningful engagement with U.S interests and our regional neighbors.

It is easy to foresee that unmanned aerial systems, otherwise known as UAVs, will have important applications beyond their current military uses, including public health and safety, environmental protection, natural resource management, public information, and education. As you may know, UAVs were deployed to monitor radiation levels after the nuclear disaster that occurred at Fukushima Daiichi in the wake of the tsunami and earthquake that devastated Japan in 2011. More recently, UAVs were utilized by California firefighters to battle wildfires last summer.

Experience in UAV technology will be a valuable personal and institutional asset in coming years; appropriately funded, managed and supported research and development would help place our state in an excellent position to benefit from these growing technological opportunities.

Ensuring that Hawaii enjoys a more robust economic future will depend in large part on our foresight in identifying new opportunities, and our willingness to invest wisely, both financially and with our manpower. I believe support for civilian applications of UAV technology is such an opportunity, and the provisions of SB3053 represent an appropriate and potentially rewarding investment of our resources.

Thank you for the opportunity to express my support for this measure. Please feel free to contact me if I can provide further information.

COLLEEN HANABUSA
Member of Congress

George R. Ariyoshi
999 Bishop Street, 23rd Floor
Honolulu, HI 96813

February 10, 2014

TESTIMONY IN SUPPORT OF SB3053 - RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

Dear Members of the 27th State Legislature,

I strongly support the intent of this bill to provide funding to establish a chief operating officer, an administrative assistant, and an advisory board to oversee and manage unmanned aerial systems (UAS) test site operations in Hawaii.

Our State, in collaboration with Alaska and Oregon, was most fortunate to have been selected by the Federal Aviation Administration as one of six national sites to research and demonstrate diverse applications of UAS, with the goal of safely integrating these technologies into the national air space. This designation will also provide unique opportunities for our state to advance both civil and commercial applications of UAS technologies in ways that can substantially benefit our local economy, while concurrently developing standards and procedures that will enhance operational safety, as well as protect individual privacy.

As others testifying on this measure have noted, UAS can support a broad range of activities such as emergency search and rescue operations, air quality monitoring, disaster assessment and management, agricultural monitoring, wildlife management, watershed management, flood and pollution control, hazardous spills monitoring, and many other applications with direct and lasting benefits to local communities.

In comparison with other aviation-related surveillance technologies (e.g., winged aircraft, helicopters), UAS would afford low-cost operating scenarios with significantly reduced safety risks and environmental impacts. In addition, UAS operations in Hawaii will provide substantial opportunities to advance science, technology, engineering and math (STEM) programs for both K-12 and university students, as well as multiple commercial applications in remote sensing, aerial tracking systems, and command and control software that can significantly expand and diversify our industrial base.

UAS research and development represents an emerging $70 Billion industry that will help launch the next generation of aviation technologies. By establishing a dedicated team to oversee and manage these operations in Hawaii, we will be able to participate as both a major contributor to and beneficiary of this global enterprise.

I would also direct your attention to two documents that I am submitting with this testimony, including a report from the Association for Unmanned Vehicle Systems International (AUVSI) and an economic impact study undertaken by the McDowell Group, which further highlight the multiple benefits UAS technologies will bring to our nation in general and Hawaii in particular.

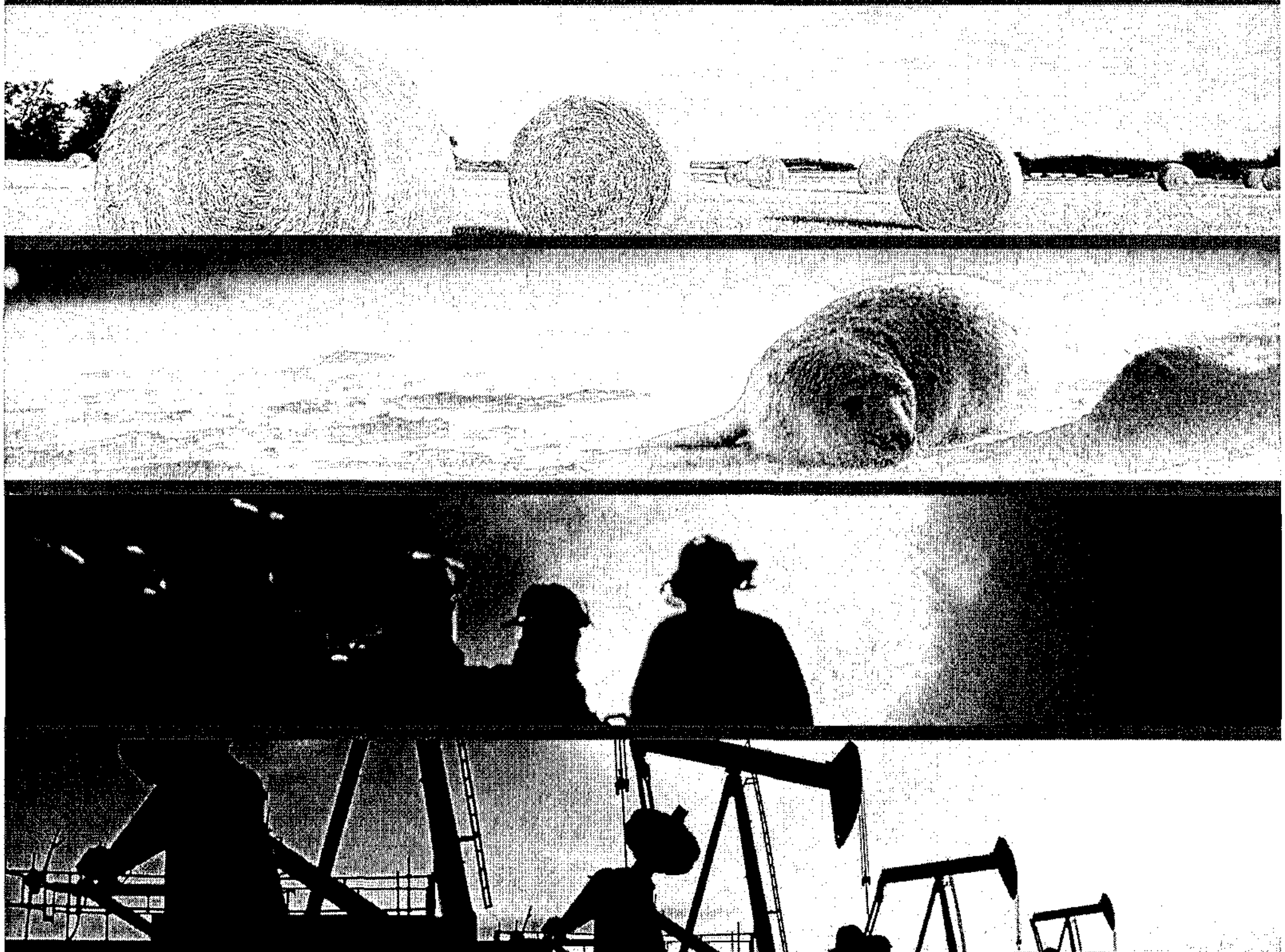
In summary, I would urge you pass SB3053 with the requested funding allocation, and would be happy to address any questions you may have concerning this recommendation. I can be reached by e-mail at kyahiku@wik.com , by phone at (808) 544-6765 or by fax at (808) 544-8398.

Thank you for the opportunity to testify on this bill.

Aloha,

George R. Ariyoshi

GRA:khy



THE ECONOMIC IMPACT
OF UNMANNED AIRCRAFT SYSTEMS INTEGRATION IN THE UNITED STATES

AUVSI®
ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

MARCH 2013

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About the Authors

Darryl Jenkins, author of "The Handbook of Airline Economics," is an airline analyst with more than 30 years of experience in the aviation industry. Jenkins also served as director of the Aviation Institute at George Washington University for more than 15 years. As an independent aviation consultant, Jenkins has worked for the majority of the world's top 50 airlines. In addition, he has consulted for the FAA, DOT, NTSB and other U.S. government agencies as well as many foreign countries. Jenkins also is the author of several aviation books and is a regular commentator for major media including ABC, CBS, NBC, MSNBC, CNN, FOX and major print publications. Jenkins was a member of the Executive Committee of the White House Conference on Aviation Safety and Security.

Dr. Bijan Vasigh is professor of economics and finance in the Department of Business Administration at Embry-Riddle Aeronautical University in Daytona Beach, Florida, and a managing director at Aviation Consulting Group LLC. Vasigh received a Ph.D. in economics from the State University of New York in 1984, and he has written and published many articles concerning the aviation industry. The articles have been published in numerous academic journals such as the "Handbook of Airline Economics," "Journal of Economics and Finance," "Journal of Transportation Management," "Transportation Quarterly," "Airport Business," "Journal of Business and Economics" and "Journal of Travel Research." He was a consultant with the International Civil Aviation Organization and provided assistance on the evolution of aeronautical charge structure for the Brazilian Institute of Civil Aviation. He is a member of the editorial board of "Journal of Air Transport Management," the "Southwest Journal of Pure and Applied Mathematics" and "Journal of Air Transportation World Wide." He is currently a member of the international faculty at the IATA Learning Center, where he is faculty leader of the Airline Finance and Accounting Management division.

Executive Summary

The purpose of this research is to document the economic benefits to the United States (U.S.) once Unmanned Aircraft Systems (UAS) are integrated into in the National Airspace System (NAS).

In 2012, the federal government tasked the Federal Aviation Administration (FAA) to determine how to integrate UAS into the NAS. In this research, we estimate the economic impact of this integration. In the event that these regulations are delayed or not enacted, this study also estimates the jobs and financial opportunity lost to the economy because of this inaction.

While there are multiple uses for UAS in the NAS, this research concludes that **precision agriculture** and **public safety** are the most promising commercial and civil markets. These two markets are thought to comprise **approximately 90%** of the known potential markets for UAS.

We conclude the following:

1. The economic impact of the integration of UAS into the NAS will total more than $13.6 billion (Table 19) in the first three years of integration and will grow sustainably for the foreseeable future, cumulating to more than $82.1 billion between 2015 and 2025 (Table 1);
2. Integration into the NAS will create more than 34,000 manufacturing jobs (Table 18) and more than 70,000 new jobs in the first three years (Table 19);
3. By 2025, total job creation is estimated at 103,776 (Table 1);
4. The manufacturing jobs created will be high paying ($40,000) and require technical baccalaureate degrees;
5. Tax revenue to the states will total more than $482 million in the first 11 years following integration (2015-2025); and
6. Every year that integration is delayed, the United States loses more than **$10 billion** in potential economic impact. This translates to a loss of **$27.6 million per day that UAS are not integrated into the NAS.**

Utility of UAS

The main inhibitor of U.S. commercial and civil development of the UAS is the lack of a regulatory structure. Because of current airspace restrictions, non-defense use of UAS has been extremely limited. However, the combination of greater flexibility, lower capital and lower operating costs could allow UAS to be a transformative technology in fields as diverse as urban infrastructure management, farming, and oil and gas exploration to name a few.

Present-day UAS have longer operational duration and require less maintenance than earlier models. In addition, they can be operated remotely using more fuel efficient technologies. These aircraft can be deployed in a number of different terrains and may be less dependent on prepared runways. Some argue the use of UAS in the future will be a more responsible approach to certain airspace operations from an environmental, ecological and human risk perspective.

UAS are already being used in a variety of applications, and many more areas will benefit by their use, such as[1]:

- **Wildfire mapping[2];**
- **Agricultural monitoring;**
- **Disaster management;**
- **Thermal infrared power line surveys;**
- **Law enforcement;**
- **Telecommunication;**
- **Weather monitoring;**
- **Aerial imaging/mapping;**
- **Television news coverage, sporting events, moviemaking[3];**
- **Environmental monitoring;**
- **Oil and gas exploration; and**
- **Freight transport.**

Applicable Markets

There are a number of different markets in which UAS can be used. This research is concentrated on the two markets, commercial and civil, with the largest potential. A third category (Other) summarizes all other markets:

1. Precision agriculture;
2. Public safety; and
3. Other.

> While we project more than 100,000 new jobs by 2025, states that create favorable regulatory and business environments for the industry and the technology will likely siphon jobs away from states that do not.

Public safety officials include police officers and professional firefighters in the U.S., as well as a variety of professional and volunteer emergency medical service providers who protect the public from events that pose significant danger, including natural disasters, man-made disasters and crimes.

Precision agriculture refers to two segments of the farm market: remote sensing and precision application. A variety of remote sensors are being used to scan plants for health problems, record growth rates and hydration, and locate disease outbreaks. Such sensors can be attached to ground vehicles, aerial vehicles and even aerospace satellites. Precision application, a practice especially useful for crop farmers and horticulturists, utilizes effective and efficient spray techniques to more selectively cover plants and fields. This allows farmers to provide only the needed pesticide or nutrient to each plant, reducing the total amount sprayed, and thus saving money and reducing environmental impacts.

As listed above, a large number of other markets will also use UAS

[1]Market Intel Group (MiG), November, 2010
[2]Predators improve wildfire mapping: Tests under way to use unmanned aircraft for civilian purposes, Tribune Business News, August 26, 2007
[3]Honeywell International Inc 2004-2012

once the airspace is integrated. We believe the impact of these other markets will be at least the size of the impact from public safety use.

With sensible regulations in place, we foresee few limitations to rapid growth in these industries. These products use off-the-shelf technology and thus impose few problems to rapidly ramping up production. The inputs (i.e., parts) to the UAS can be purchased from more than 100 different suppliers; therefore, prices will be stable and competitive. The inputs to the UAS can all be purchased within the U.S., although these products can be imported from any number of foreign countries without the need of an import license. UAS have a durable life span of approximately 11 years and are relatively easy to maintain. The manufacture of these products requires technical skills equivalent to a baccalaureate degree. Therefore, there will always be a plentiful market of job applicants willing to enter this market. In summary, there are no production problems on the horizon that will impact the manufacturing and output of this product. Most of the barriers of potential usage are governmental and regulatory. For this study, we assume necessary airspace integration in 2015, on par with current legislation.

Covering and justifying the cost of UAS is straightforward. In the precision agriculture market, the average price of the UAS is a fraction of the cost of a manned aircraft, such as a helicopter or crop duster, without any of the safety hazards. For public safety, the price of the product is approximately the price of a police squad car equipped with standard gear. It is also operated at a fraction of the cost of a manned aircraft, such as a helicopter, reducing the strain on agency budgets as well as the risk of bodily harm to the users in many difficult and dangerous situations. Therefore, the cost-benefit ratios of using UAS can be easily understood.

Economic Benefit

The economic benefits to the country are enormous and were estimated as follows. First, we forecast the number of sales in the three market categories. Next, we forecast the supplies needed to manufacture these products. Using estimated costs for labor, we forecast the number of direct jobs created. Using these factors, we forecast the tax revenue to the states.

In addition to direct jobs created by the manufacturing process, there is an additional economic benefit. The new jobs created and the income generated will be spread to local communities. As new jobs are created, additional money is spent at the local level, creating additional demand for local services which, in turn, creates even more jobs (i.e., grocery clerks, barbers, school teachers, home builders, etc.). These indirect and induced jobs are forecast and included in the total jobs created.

The economic benefits to individual states will not be evenly distributed. The following 10 states are predicted to see the most gains in terms of job creation and additional revenue as production of UAS increase, totaling more than $82 billion in economic impact from 2015-2025 (Table 1).

In rank order they are:

1) California
2) Washington
3) Texas
4) Florida
5) Arizona
6) Connecticut
7) Kansas
8) Virginia
9) New York
10) Pennsylvania

It is important to note that the projections contained in this report are based on the current airspace activity and infrastructure in a given state. As a result, states with an already thriving aerospace industry are projected to reap the most economic gains. However, a variety of factors—state laws, tax incentives, regulations, the establishment of test sites and the adoption of UAS technology by end users—will ultimately determine where jobs flow.

By 2025, we estimate more than 100,000 new jobs will be created nationally. For the purposes of this report, we base the 2025 state economic projections on the current aerospace employment in the states. We also presume that none of the states have enacted restrictive legislation or regulations that would limit the expansion of the technology. These landscapes will likely shift, however, as states work to attract UAS jobs in the years following integration. Future state laws and regulations could also cause some states to lose jobs while others stand to gain jobs. In conclusion, while we project more than 100,000 new jobs by 2025, states that create favorable regulatory and business environments for the industry and the technology will likely siphon jobs away from states that do not.

The trend in total spending, total economic impact and total employment impact was investigated for 2015 through 2025. The total spending in UAS development and total economic and employment impacts are expected to increase significantly in the next five years. This study demonstrates the significant contribution of UAS development and integration in the nation's airspace to the economic growth and job creation in the aerospace industry and to the social and economic progress of the citizens in the U.S. See Table 1 for the results of the total impact of UAS integration in the United States.

TO READ THE FULL REPORT ONLINE, VISIT http://www.auvsi.org/econreport

Table 1: Total Economic Impact of UAS Integration in the United States						
	2015 - 2017			2015-2025		
State	Economic Impact $(M)	Taxes ($M)	Jobs Created	Economic Impact ($M)	Taxes ($M)	Jobs Created
Alabama	$294	$2.43	1,510	$1,765	$14.60	2,231
Alaska	$19	$0.00	95	$112	$0.00	141
Arizona	$561	$2.59	2,883	$3,371	$15.55	4,260
Arkansas	$80	$0.94	411	$481	$5.63	608
California	$2,390	$13.64	12,292	$14,372	$82.03	18,161
Colorado	$232	$1.79	1,191	$1,392	$10.76	1,760
Connecticut	$538	$4.32	2,764	$3,232	$25.97	4,084
Delaware	$17	$0.16	88	$103	$0.97	131
Florida	$632	$0.00	3,251	$3,801	$0.00	4,803
Georgia	$379	$3.72	1,949	$2,279	$22.34	2,880
Hawaii	$32	$0.39	166	$194	$2.35	245
Idaho	$29	$0.36	149	$174	$2.16	220
Illinois	$204	$1.71	1,049	$1,226	$10.30	1,549
Indiana	$208	$1.18	1,067	$1,248	$7.12	1,577
Iowa	$159	$0.92	817	$956	$5.53	1,208
Kansas	$489	$4.84	2,515	$2,941	$29.13	3,716
Kentucky	$89	$0.90	459	$537	$5.41	678
Louisiana	$213	$1.44	1,097	$1,282	$8.67	1,620
Maine	$107	$1.26	548	$641	$7.56	810
Maryland	$335	$2.64	1,725	$2,017	$15.85	2,549
Massachusetts	$386	$3.36	1,985	$2,321	$20.22	2,933
Michigan	$188	$1.37	965	$1,128	$8.26	1,426
Minnesota	$142	$1.68	730	$853	$10.08	1,078
Mississippi	$162	$1.10	832	$973	$6.60	1,230
Missouri	$260	$1.73	1,338	$1,565	$10.37	1,978
Montana	$14	$0.15	74	$86	$0.91	109
Nebraska	$25	$0.22	128	$149	$1.30	189
Nevada	$38	$0.00	196	$229	$0.00	290
New Hampshire	$85	$0.00	439	$514	$0.00	649
New Jersey	$263	$3.24	1,353	$1,582	$19.50	1,999
New Mexico	$101	$0.73	518	$606	$4.41	765
New York	$443	$4.66	2,276	$2,661	$28.05	3,363
North Carolina	$153	$1.79	785	$918	$10.75	1,160
North Dakota	$14	$0.07	71	$83	$0.40	105
Ohio	$359	$2.43	1,844	$2,156	$14.60	2,725
Oklahoma	$106	$0.93	545	$637	$5.61	805
Oregon	$81	$0.41	416	$486	$2.47	614
Pennsylvania	$393	$2.02	2,021	$2,363	$12.12	2,986
Rhode Island	$42	$0.38	217	$253	$2.28	320
South Carolina	$99	$1.16	507	$593	$6.99	749
South Dakota	$9	$0.00	48	$56	$0.00	71
Tennessee	$112	$0.00	578	$675	$0.00	853
Texas	$1,087	$0.00	5,588	$6,533	$0.00	8,256
Utah	$143	$1.21	735	$859	$7.26	1,085
Vermont	$36	$0.47	184	$215	$2.81	271
Virginia	$463	$4.47	2,380	$2,783	$26.86	3,517
Washington	$1,312	$0.00	6,746	$7,888	$0.00	9,967
West Virginia	$47	$0.47	240	$280	$2.83	354
Wisconsin	$88	$0.96	450	$527	$5.76	665
Wyoming	$5	$0.00	24	$28	$0.00	36
Total	$13,657	$80.22	70,240	$82,124	$482.39	103,776

Forecast

In this chapter, we describe the methodology for the forecasts we used as inputs to the economic benefits section. In accomplishing this task, we were fortunate to obtain and use comparable product sales from other countries. In making the forecasts, we relied on four different methods:

1) Comparable sales from other countries;
2) Survey results;
3) Land ratios; and
4) A literature search on rates of adoption of new technology.

The four different methodologies yielded similar results and provide confidence in our final results.

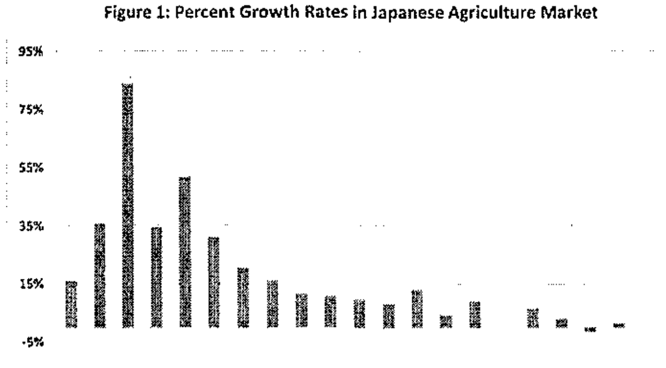
Throughout this study, we use the following terms. When we use the term output, we are referring to the UAS. The inputs to the UAS are the parts and labor that go into making these products. In turn, the parts that go into the inputs we refer to as derived demand.

As part of this section, we provide a detailed discussion of the factors that may make our forecasts inaccurate and their potential impact. Our forecasts are for an 11-year period. That unit of measurement was chosen as that is the expected life of a UAS. We did not include maintenance, training or other revenue streams, which makes our overall estimates conservative. In addition, there are multiple options on sales including leasing the equipment and having third-party providers as an outsourced service, all of which add to our conservative estimates.

Sales in Foreign Countries

Other countries have already adopted UAS technology from a zero base (i.e., first year of adoption). By now, these technologies have been operational for more than two decades. The growth curve is found to be logistic with a rapid beginning and then a leveling off of the market (Figure 1). The issue is not whether these products will be adopted once the airspace is integrated, but at what rate(s). The experience in Japan started out at rates of growth in excess of 20% annually. This was from no unmanned vehicles in 1990 (i.e., the zero base), where neither the companies nor the consumers had previous experience with this technology (see Appendix A for detailed data).

Figure 1: Percent Growth Rates in Japanese Agriculture Market



As is readily apparent, the growth rates in the early years in Japan were very high. The question of interest is: How fast will growth occur in the U.S.? We chose a short time period for growth in the U.S. (doubling the first year, 50% growth the next year and thereafter a 5% growth rate). Our justification is as follows. First, there is considerable experience with these products. American farmers are not starting out from a zero-knowledge base as did Japan. Second, UAS are not sold in the U.S. domestic market only because FAA regulations prohibit them in the nation's airspace. It is noted that the dampening of the Japanese growth curve happened within six years. The literature review found higher initial rates of product acceptance than the previous Japanese experience and lower leveling off of rates.

Adoption Rates of New Technology

There are many factors that influence the rate at which new technologies are adopted and diffused into a society. We found considerable literature on this topic. The conclusion from the brief search we conducted is that new technologies are either accepted or rejected quickly. There is already a trade association that is doing outreach to the primary targets and showing products in their trade show(s). Because there is previous experience in this field, we reject the notion that these products will not be adopted. However, it is suggested that a follow up to this study be conducted on adoption of new technology. There is considerable literature on this topic, which needs to be investigated, and will help develop further adoption strategies.

Methodology

We performed three separate forecasts for this study:

1) The estimated number of sales by state;
2) The estimated sales by state for the inputs to the final product; and
3) The estimated sales by state for the derived demand for the final products.

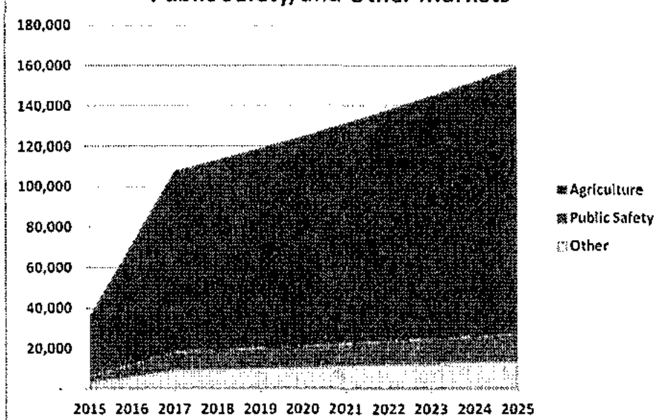
To complete these forecasts, we developed a telephone survey and pilot-tested it on five participants to refine our survey questions. We next conducted 30 telephone interviews with industry experts. An industry expert was defined as a person with more than three years of practical and relevant experience. Each interview lasted about 30 minutes. The participants were guaranteed confidentiality so we cannot divulge the individual results. However, we were able to obtain a reasonable estimate on what the group as a whole felt was the size of the market and the cost structure. Because there was considerable variance in these estimates, we ignored the outliers and calculated the average cost structure. We estimate that approximately 60% of the overall cost of a UAS is parts with an average annual labor cost of $37,000. In this report, we use $40,000 and hold it at a constant cost, as we do with the parts numbers. Thus the results can be interpreted as constant dollars over the entire term, as we are not forecasting the inflation rate. As for profitability, we consider this a competitive industry with a normal rate of return.

We found that almost all respondents considered agriculture to be far and above the largest market given that the public safety market is limited by the number of first-response teams. We next looked at some simple ratios between UAS sales in Japan and the amount of arable farmland and imputed these ratios to the United States. The survey results indicated an agricultural market of approximately 150,000 unit sales per year at maturity (i.e., 2020), and the Japanese land ratio indicated a market size of 165,000 unit sales per year. For the purposes of this forecast, we used 100,000 unit sales per year as a conservative benchmark. See Figure 2 for total expected sales for 2015-2025. Actual sales could be a multiple of this estimate.

As to the public safety market, the consensus was that the agriculture market will be at least 10 times the public safety market. Our follow-up task to the questionnaire was to find the number of first-response domestic teams and survey a small number of this group. We found their purchase issues to be minimal. They simply have a budget given to them by the local governmental unit that oversees them, and they work within it. Purchases of this size are not uncommon and public safety officials have all of the appearances of being early adopters, especially when safety is involved.

During the survey interviews, we discovered that there were unlimited uses of UAS. For example, many respondents discussed the potential uses of UAS for real estate purposes or for examining oil pipelines. In the case of oil pipelines, the consensus of the experts was that the total annual sale was approximately 1,000 units. For real estate personnel, there was not a consensus. From the surveys and follow-up calls with other professionals, we estimate that the aggregate size for other sales was approximately 10% of the total. In reality, this figure is a lower boundary and should be interpreted as at least 10% of the total. Depending on the promotions to this segment, the final price and, most importantly, the federal regulations, this segment could be significantly larger. We estimate the lower boundary at 10% to be conservative.

Figure 2: Annual UAS Sales for Agriculture, Public Safety, and Other Markets



In making the first round of forecasts, we tried several different methods but ultimately used a ratio of the number of direct aerospace and defense (A&D) industry employees in each state[4] to the total number of direct A&D industry employees in the U.S. For example, Alabama has an estimated 23,090 direct A&D industry employees out of a total of 1,040,796 direct A&D employees in the U.S., or 2.22% of the total. So we took the total forecast of agriculture sales and multiplied by 2.22% for Alabama. See Table 2 for a complete list of states and their estimated manufacturing distribution.

For the inputs, we find no constraints. There are plenty of manufacturers of these parts; they are off-the-shelf and require little lead time. If one supply line goes down, there are multiple sources as backups. For the input forecast, we relied on the size of the aerospace labor force in each state as the metric. These numbers were obtained from a Deloitte report, commissioned by the Aerospace Industries Association, titled "The Aerospace and Defense Industry in the U.S.: A Financial and Economic Impact Study"[5]. In this forecast, we also looked at employment and taxes. Using the estimated labor dollar amount, we simply divided by 40,000 to find the number of jobs. Subtracting adjacent years yields the number of new jobs created. We used marginal state tax rates for the $40,000 income range, the assumption being that states will hold this rate constant over time.

Table 2: Estimated Manufacturing Distribution

State	Manufacturing Distribution	State	Manufacturing Distribution
Alabama	2.22%	Montana	0.11%
Alaska	0.15%	Nebraska	0.19%
Arizona	4.10%	Nevada	0.30%
Arkansas	0.61%	New Hampshire	0.67%
California	15.58%	New Jersey	1.99%
Colorado	1.77%	New Mexico	0.78%
Connecticut	3.95%	New York	3.30%
Delaware	0.13%	North Carolina	1.17%
Florida	4.74%	North Dakota	0.11%
Georgia	2.83%	Ohio	2.71%
Hawaii	0.25%	Oklahoma	0.81%
Idaho	0.22%	Oregon	0.63%
Illinois	1.56%	Pennsylvania	3.00%
Indiana	1.59%	Rhode Island	0.32%
Iowa	1.24%	South Carolina	0.76%
Kansas	3.54%	South Dakota	0.07%
Kentucky	0.69%	Tennessee	0.81%
Louisiana	1.65%	Texas	8.43%
Maine	0.82%	Utah	1.10%
Maryland	2.53%	Vermont	0.27%
Massachusetts	2.90%	Virginia	3.55%
Michigan	1.44%	Washington	9.02%
Minnesota	1.09%	West Virginia	0.36%
Mississippi	1.25%	Wisconsin	0.67%
Missouri	1.97%	Wyoming	0.04%

4Deloitte, The Aerospace and Defense Industry in the U.S., A financial and economic impact study, March, 2012
5http://www.deloitte.com/view/en_US/us/Industries/Aerospace-Defense-Manufacturing/b4c8ae98118f5310VgnVCM3000001c56f00aRCRD.htm

Necessary Conditions for the Forecasts

We now turn our attention to the conditions that must happen to validate this forecast:

1) The FAA must develop new regulations integrating UAS into the nation's airspace;
2) Job growth distribution will mimic current aerospace manufacturing employment;
3) Creative destruction of existing jobs will have a net-zero impact;
4) There must be sufficient capital available to smaller manufacturing companies;
5) There must be financing available to UAS purchasers;
6) There must be insurance to cover liabilities;
7) Gross Domestic Product (GDP) needs to grow at least 3% annually over the designated time period;
8) The adoption rate(s) of this product in the U.S. will mimic Japan; and
9) Other unforeseen factors.

The FAA Must Develop New Regulations Integrating UAS into the Nation's Airspace

Perhaps the single most important aspect of this forecast is that the FAA develops new guidelines allowing the integration of UAS in the nation's airspace. In the absence of these guidelines, this report is simply the opportunity cost to the economy (new jobs, tax revenue, etc.) of a good idea that was hindered due to government interference or inaction. The FAA regulatory process, like all government entities, is slow and unpredictable.

Job Growth Distribution Will Mimic Current Aerospace Manufacturing Employment

The employment growth described in this report is all new employment, that is, jobs that do not currently exist. To project the statewide distribution of this employment, we used current aerospace manufacturing employment. However, there are many external factors that will affect this distribution that are impossible to predict in this report. These include, among other things, tax incentives, test sites and where new product development will actually occur.

Creative Destruction of Existing Jobs Will Have a Net Zero Impact

As UAS are introduced, some uses will replace existing capabilities, because there are efficiencies to be gained by using a UAS versus a traditional capability. As such, there is likely to be some job destruction from UAS. However, UAS will still need many similar capabilities to manned systems including training, maintenance and pilots. Any jobs that will be made immaterial by UAS will be transitioned to regular UAS operations. Because of the efficient use of UAS, there will be job creation in other areas. For instance, a farmer that saves money because he or she can use less pesticide since UAS can provide precision application will spend less money on pesticides and less on taxes due to pesticide use. That money back into the farmer's pocket will provide economic impact to the U.S. that is not calculated in this report. To simplify, we generalize that there will be a net-zero impact of job creation in the application of these systems. A detailed analysis of this potential job creation is recommended for further research.

There Must be Sufficient Capital Available to Smaller Manufacturing Companies

One of the biggest problems with growing companies is their access to capital. As companies grow, their need for capital to buy new equipment, hire additional personnel, rent extra space and all of the other requirements are seldom met from working capital. The need for short-term working capital to accommodate growth can stymie any otherwise well thought out business plan.

There Must be Financing Available to UAS Purchasers

While the costs of these purchases are not the same as other farm equipment, they are seldom made as a cash purchase. Farm implements, such as tractors, are usually bought with company financing as they do not have serial numbers like cars. Banks may finance a tractor, but usually at a higher interest rate with the credit worthiness of the person as the collateral. This means that the industry or consortia of companies will need to be created for these purchases. There is probably less of a need for these arrangements for public safety, but they are only a shadow market compared to the agriculture market. It is clear that offering financing from a small company standpoint, outside of normal banking realms, is impossible and impractical at this time. This may be one of the most important factors outside of regulation reform to move this industry forward.

Insurance to Cover Liabilities Must be Supplied

One of the many great unknowns about the infant commercial UAS industry is its product liability exposure. Suppose a UAS used by a public safety agency malfunctions and crashes into a building. The assumption is that this event is covered by the local government's umbrella insurance policy. What if this happens elsewhere? Perhaps the thrust of this argument is that the industry as a whole needs to start collecting relevant data in this realm. A Google search on this topic turned up little information, as governments use UAS mainly for wartime purposes. However, anything mechanical can malfunction, and a UAS is no exception. There will be issues of proper maintenance and liability, as there always are with aircraft of any type, in addition to workmen's compensation and other potential problems. The long-term issue is the need for industry-wide data collection.

GDP Needs to Grow at Least 3% Annually Over the Designated Time Period

All studies of this nature require GDP assumptions. The typical scenario is that over a longer time period, the economy will grow at 3% per year. This is our assumption as well. Our forecast is that with new and improved products, they will grow at a slightly higher rate.

There may be several problems with this assumption. First, the current economic stagnation may persist. If so, this may favor sunken capital over new capital. Thus, we may see growth, but at a much later date, and significantly slower growth thereafter. If this happens, it has the potential to make our forecast inaccurate.

The Adoption Rate(s) of this Product in the U.S. Will Mimic Japan

Consumers in different counties or even different segments of the same country can react differently to the same product offering. Our assumption is that consumers in both countries will react similarly.

Other Unforeseen Factors

Any researcher knows that economic analysis and forecasts may not include hundreds of unforeseen events that impact economic estimates that were not taken into account. Any of these may materially affect our forecast.

Discussion of Forecast Results

In this section, we will discuss the forecast results for the year 2015, which is the first forecast year. Table 3 shows the rank ordering of UAS manufacturing by state for agriculture uses in 2015, and Table 4 shows it for public safety. Other markets besides agriculture and public safety are estimated to have the same total economic impact as the public safety market, so in the following we only show the agriculture and public safety markets. Final economic impact calculations include agriculture, public safety and other markets (i.e., the public safety total economic impact multiplied by two to account for "other markets").

Table 3: 2015 Total UAS Agriculture Sales Inputs

State	Labor	Parts	Taxes	Employment
California	$65,438,414	$ 98,157,622	$2,094,029	1,636
Washington	$37,902,240	$ 56,853,360	$ -	948
Texas	$35,422,907	$ 53,134,361	$ -	886
Florida	$19,927,882	$ 29,891,823	$ -	498
Arizona	$17,225,796	$ 25,838,695	$ 396,882	431
Connecticut	$16,575,698	$ 24,863,547	$ 663,028	414
Virginia	$14,907,071	$ 22,360,607	$ 685,725	373
Kansas	$14,873,981	$ 22,310,972	$ 743,699	372
New York	$13,878,051	$ 20,817,077	$ 716,107	347
Pennsylvania	$12,598,434	$ 18,897,651	$ 309,418	315
Massachusetts	$12,175,124	$ 18,262,685	$ 516,225	304
Georgia	$11,882,156	$ 17,823,233	$ 570,343	297
Ohio	$11,362,400	$ 17,043,599	$ 372,687	284
Maryland	$10,645,314	$ 15,967,971	$ 404,522	266
Alabama	$ 9,317,676	$ 13,976,514	$ 372,707	233
New Jersey	$ 8,353,625	$ 12,530,438	$ 497,876	209
Missouri	$ 8,276,550	$ 12,414,825	$ 264,850	207
Colorado	$ 7,416,208	$ 11,124,313	$ 274,696	185
Louisiana	$ 6,918,647	$ 10,377,970	$ 221,397	173
Indiana	$ 6,686,613	$ 10,029,919	$ 181,876	167
Illinois	$ 6,571,201	$ 9,856,802	$ 262,848	164
Michigan	$ 6,060,323	$ 9,090,485	$ 210,899	152
Mississippi	$ 5,268,583	$ 7,902,874	$ 168,595	132
Iowa	$ 5,193,121	$ 7,789,682	$ 141,253	130
North Carolina	$ 4,898,943	$ 7,348,414	$ 274,341	122
Utah	$ 4,636,240	$ 6,954,360	$ 185,450	116
Minnesota	$ 4,561,989	$ 6,842,984	$ 257,296	114
Maine	$ 3,444,594	$ 5,166,891	$ 192,897	86
Oklahoma	$ 3,410,294	$ 5,115,440	$ 143,232	85
Tennessee	$ 3,390,117	$ 5,085,175	$ -	85
New Mexico	$ 3,271,880	$ 4,907,821	$ 112,553	82
South Carolina	$ 3,185,523	$ 4,778,285	$ 178,389	80
Kentucky	$ 2,877,624	$ 4,316,437	$ 138,126	72
Wisconsin	$ 2,825,568	$ 4,238,352	$ 146,930	71
New Hampshire	$ 2,817,497	$ 4,226,246	$ -	70
Oregon	$ 2,632,274	$ 3,948,411	$ 63,175	66
Arkansas	$ 2,565,690	$ 3,848,535	$ 143,679	64
West Virginia	$ 1,504,791	$ 2,257,186	$ 72,230	38
Rhode Island	$ 1,364,360	$ 2,046,539	$ 58,326	34
Nevada	$ 1,255,001	$ 1,882,501	$ -	31
Vermont	$ 1,150,888	$ 1,726,333	$ 71,815	29
Hawaii	$ 1,041,126	$ 1,561,689	$ 59,969	26
Idaho	$ 932,978	$ 1,399,467	$ 55,232	23
Nebraska	$ 807,478	$ 1,211,217	$ 33,074	20
Alaska	$ 611,763	$ 917,644	$ -	15
Delaware	$ 557,285	$ 835,928	$ 24,743	14
Montana	$ 462,857	$ 694,286	$ 23,328	12
North Dakota	$ 453,576	$ 680,364	$ 10,233	11
South Dakota	$ 305,881	$ 458,822	$ -	8
Wyoming	$ 155,765	$ 233,648	$ -	4

Table 4: 2015 Total UAS Public Safety Sales Inputs

State	Labor	Parts	Taxes	Employment
California	$ 2,804,503	$ 4,206,755	$ 89,744	70
Washington	$ 1,624,382	$ 2,436,573	$ -	41
Texas	$ 1,518,125	$ 2,277,187	$ -	38
Florida	$ 854,052	$ 1,281,078	$ -	21
Arizona	$ 738,248	$ 1,107,373	$ 17,009	18
Connecticut	$ 710,387	$ 1,065,581	$ 28,415	18
Virginia	$ 638,874	$ 958,312	$ 29,388	16
Kansas	$ 637,456	$ 956,184	$ 31,873	16
New York	$ 594,774	$ 892,160	$ 30,690	15
Pennsylvania	$ 539,933	$ 809,899	$ 13,261	13
Massachusetts	$ 521,791	$ 782,687	$ 22,124	13
Georgia	$ 509,235	$ 763,853	$ 24,443	13
Ohio	$ 486,960	$ 730,440	$ 15,972	12
Maryland	$ 456,228	$ 684,342	$ 17,337	11
Alabama	$ 399,329	$ 598,993	$ 15,973	10
New Jersey	$ 358,013	$ 537,019	$ 21,338	9
Missouri	$ 354,709	$ 532,064	$ 11,351	9
Colorado	$ 317,838	$ 476,756	$ 11,773	8
Louisiana	$ 296,513	$ 444,770	$ 9,488	7
Indiana	$ 286,569	$ 429,854	$ 7,795	7
Illinois	$ 281,623	$ 422,434	$ 11,265	7
Michigan	$ 259,728	$ 389,592	$ 9,039	6
Mississippi	$ 225,796	$ 338,695	$ 7,225	6
Iowa	$ 222,562	$ 333,844	$ 6,054	6
North Carolina	$ 209,955	$ 314,932	$ 11,757	5
Utah	$ 198,696	$ 298,044	$ 7,948	5
Minnesota	$ 195,514	$ 293,271	$ 11,027	5
Maine	$ 147,625	$ 221,438	$ 8,267	4
Oklahoma	$ 146,155	$ 219,233	$ 6,139	4
Tennessee	$ 145,291	$ 217,936	$ -	4
New Mexico	$ 140,223	$ 210,335	$ 4,824	4
South Carolina	$ 136,522	$ 204,784	$ 7,645	3
Kentucky	$ 123,327	$ 184,990	$ 5,920	3
Wisconsin	$ 121,096	$ 181,644	$ 6,297	3
New Hampshire	$ 120,750	$ 181,125	$ -	3
Oregon	$ 112,812	$ 169,218	$ 2,707	3
Arkansas	$ 109,958	$ 164,937	$ 6,158	3
West Virginia	$ 64,491	$ 96,737	$ 3,096	2
Rhode Island	$ 58,473	$ 87,709	$ 2,500	1
Nevada	$ 53,786	$ 80,679	$ -	1
Vermont	$ 49,324	$ 73,986	$ 3,078	1
Hawaii	$ 44,620	$ 66,930	$ 2,570	1
Idaho	$ 39,985	$ 59,977	$ 2,367	1
Nebraska	$ 34,606	$ 51,909	$ 1,417	1
Alaska	$ 26,218	$ 39,328	$ -	1
Delaware	$ 23,884	$ 35,825	$ 1,060	1
Montana	$ 19,837	$ 29,755	$ 1,000	0
North Dakota	$ 19,439	$ 29,158	$ 439	0
South Dakota	$ 13,109	$ 19,664	$ -	0
Wyoming	$ 6,676	$ 10,013	$ -	0

The next series of tables we refer to as derived demand. The products that are used as inputs are manufactured by other companies, and the platform manufacturer must buy inputs for their finished goods. Table 5 shows the results for the derived demand for inputs for agriculture and Table 6 for public safety.

Table 5: 2015 Total UAS Agriculture Derived Demand				
State	Labor	Parts	Taxes	Employment
California	$39,263,049	$58,894,573	$1,256,418	982
Washington	$22,741,344	$34,112,016	$ -	569
Texas	$21,253,744	$31,880,616	$ -	531
Florida	$11,956,729	$17,935,094	$ -	299
Arizona	$10,335,478	$15,503,217	$ 238,129	258
Connecticut	$ 9,945,419	$14,918,128	$ 397,817	249
Virginia	$ 8,944,243	$13,416,364	$ 411,435	224
Kansas	$ 8,924,389	$13,386,583	$ 446,219	223
New York	$ 8,326,831	$12,490,246	$ 429,664	208
Pennsylvania	$ 7,559,061	$11,338,591	$ 185,651	189
Massachusetts	$ 7,305,074	$10,957,611	$ 309,735	183
Georgia	$ 7,129,293	$10,693,940	$ 342,206	178
Ohio	$ 6,817,440	$10,226,160	$ 223,612	170
Maryland	$ 6,387,188	$ 9,580,782	$ 242,713	160
Alabama	$ 5,590,606	$ 8,385,908	$ 223,624	140
New Jersey	$ 5,012,175	$ 7,518,263	$ 298,726	125
Missouri	$ 4,965,930	$ 7,448,895	$ 158,910	124
Colorado	$ 4,449,725	$ 6,674,588	$ 164,818	111
Louisiana	$ 4,151,188	$ 6,226,782	$ 132,838	104
Indiana	$ 4,011,968	$ 6,017,952	$ 109,126	100
Illinois	$ 3,942,721	$ 5,914,081	$ 157,709	99
Michigan	$ 3,636,194	$ 5,454,291	$ 126,540	91
Mississippi	$ 3,161,150	$ 4,741,725	$ 101,157	79
Iowa	$ 3,115,873	$ 4,673,809	$ 84,752	78
North Carolina	$ 2,939,366	$ 4,409,048	$ 164,604	73
Utah	$ 2,781,744	$ 4,172,616	$ 111,270	70
Minnesota	$ 2,737,193	$ 4,105,790	$ 154,378	68
Maine	$ 2,066,757	$ 3,100,135	$ 115,738	52
Oklahoma	$ 2,046,176	$ 3,069,264	$ 85,939	51
Tennessee	$ 2,034,070	$ 3,051,105	$ -	51
New Mexico	$ 1,963,128	$ 2,944,692	$ 67,532	49
South Carolina	$ 1,911,314	$ 2,866,971	$ 107,034	48
Kentucky	$ 1,726,575	$ 2,589,862	$ 82,876	43
Wisconsin	$ 1,695,341	$ 2,543,011	$ 88,158	42
New Hampshire	$ 1,690,498	$ 2,535,748	$ -	42
Oregon	$ 1,579,364	$ 2,369,046	$ 37,905	39
Arkansas	$ 1,539,414	$ 2,309,121	$ 86,207	38
West Virginia	$ 902,874	$ 1,354,312	$ 43,338	23
Rhode Island	$ 818,616	$ 1,227,924	$ 34,996	20
Nevada	$ 753,001	$ 1,129,501	$ -	19
Vermont	$ 690,533	$ 1,035,800	$ 43,089	17
Hawaii	$ 624,676	$ 937,014	$ 35,981	16
Idaho	$ 559,787	$ 839,680	$ 33,139	14
Nebraska	$ 484,487	$ 726,730	$ 19,845	12
Alaska	$ 367,058	$ 550,586	$ -	9
Delaware	$ 334,371	$ 501,557	$ 14,846	8
Montana	$ 277,714	$ 416,572	$ 13,997	7
North Dakota	$ 272,146	$ 408,218	$ 6,140	7
South Dakota	$ 183,529	$ 275,293	$ -	5
Wyoming	$ 93,459	$ 140,189	$ -	2

Table 6: 2015 Total UAS Public Safety Derived Demand				
State	Labor	Parts	Taxes	Employment
California	$ 1,682,702	$2,524,053	$53,846	42
Washington	$ 974,629	$1,461,944	$ -	24
Texas	$ 910,875	$1,366,312	$ -	23
Florida	$ 512,431	$ 768,647	$ -	13
Arizona	$ 442,949	$ 664,424	$10,206	11
Connecticut	$ 426,232	$ 639,348	$17,049	11
Virginia	$ 383,325	$ 574,987	$17,633	10
Kansas	$ 382,474	$ 573,711	$19,124	10
New York	$ 356,864	$ 535,296	$18,414	9
Pennsylvania	$ 323,960	$ 485,940	$ 7,956	8
Massachusetts	$ 313,075	$ 469,612	$13,274	8
Georgia	$ 305,541	$ 458,312	$14,666	8
Ohio	$ 292,176	$ 438,264	$ 9,583	7
Maryland	$ 273,737	$ 410,605	$10,402	7
Alabama	$ 239,597	$ 359,396	$ 9,584	6
New Jersey	$ 214,808	$ 322,211	$12,803	5
Missouri	$ 212,826	$ 319,238	$ 6,810	5
Colorado	$ 190,703	$ 286,054	$ 7,064	5
Louisiana	$ 177,908	$ 266,862	$ 5,693	4
Indiana	$ 171,941	$ 257,912	$ 4,677	4
Illinois	$ 168,974	$ 253,461	$ 6,759	4
Michigan	$ 155,837	$ 233,755	$ 5,423	4
Mississippi	$ 135,478	$ 203,217	$ 4,335	3
Iowa	$ 133,537	$ 200,306	$ 3,632	3
North Carolina	$ 125,973	$ 188,959	$ 7,054	3
Utah	$ 119,218	$ 178,826	$ 4,769	3
Minnesota	$ 117,308	$ 175,962	$ 6,616	3
Maine	$ 88,575	$ 132,863	$ 4,960	2
Oklahoma	$ 87,693	$ 131,540	$ 3,683	2
Tennessee	$ 87,174	$ 130,762	$ -	2
New Mexico	$ 84,134	$ 126,201	$ 2,894	2
South Carolina	$ 81,913	$ 122,870	$ 4,587	2
Kentucky	$ 73,996	$ 110,994	$ 3,552	2
Wisconsin	$ 72,657	$ 108,986	$ 3,778	2
New Hampshire	$ 72,450	$ 108,675	$ -	2
Oregon	$ 67,687	$ 101,531	$ 1,624	2
Arkansas	$ 65,975	$ 98,962	$ 3,695	2
West Virginia	$ 38,695	$ 58,042	$ 1,857	1
Rhode Island	$ 35,084	$ 52,625	$ 1,500	1
Nevada	$ 32,271	$ 48,407	$ -	1
Vermont	$ 29,594	$ 44,391	$ 1,847	1
Hawaii	$ 26,772	$ 40,158	$ 1,542	1
Idaho	$ 23,991	$ 35,986	$ 1,420	1
Nebraska	$ 20,764	$ 31,146	$ 850	1
Alaska	$ 15,731	$ 23,597	$ -	0
Delaware	$ 14,330	$ 21,495	$ 636	0
Montana	$ 11,902	$ 17,853	$ 600	0
North Dakota	$ 11,663	$ 17,495	$ 263	0
South Dakota	$ 7,866	$ 11,798	$ -	0
Wyoming	$ 4,005	$ 6,008	$ -	0

Forecast Conclusion

In this section, we outline the assumptions and methodology used in making our forecasts. We drew on experience in Japan for comparable sales. Japan and the U.S. are both countries that readily adapt new technologies. We conclude the following:

1) If the FAA adopts new rules allowing for commercial use of UAS in the nation's airspace, these products will be received rapidly into the marketplace;

2) The doubling rate can take place over either a three-year or six-year period. With the known rates of change in newer technologies, it is likely to be a three-year scenario given the fact that the potential marketplace is well aware of the product(s) unlike the introduction in Japan; and

3) The commercial agriculture market is by far the largest segment, dwarfing all others.

Agriculture is an important product group. It has the potential for bringing a more reliable, cost-effective and safe method to domestic farmers for a variety of uses. In the event that a new set of regulations is not enacted and UAS are not integrated in the U.S. National Airspace System (NAS), this study estimates the lost jobs, lost tax revenue, and total economic loss to the states and nation. In addition, a delay in airspace integration will impact the U.S. in terms of a lag in technology development, manufacturing, job development and economic stimulus. With U.S. integration of UAS, more than 103,000 good paying jobs with benefits will be created.

While this section shows the huge potential available to the nation, the exact calculations of these benefits are laid out in the next section, where we estimate the total economic impact of NAS integration.

Economic Impact Analysis

Economic impact is based on the theory that a dollar flowing into a local economy from the outside is a benefit to the regional economy. The financial return for residents is in the form of new jobs, more earnings and new tax revenues that follow because of the initial development of a new business organization, and through new spending, in the municipality due to the operation of such a business or industry. These earnings, for instance, are generated for residents who are not directly associated with the business but who are the beneficiaries of the positive externalities that the business or industry can provide to communities.

External benefits, or positive externalities, are those returns that are generated by a business but that are not captured by the business or local region. When the employees of a company spend money at local businesses, such as restaurants, gas stations and retail stores, their spending will benefit the owners and employees of those establishments, thereby creating a positive incremental impact.

According to Davis (1990) an impact analysis is purposely designed to produce quantitative results of the effects that a certain segment of an industry has in the local economy. From an industry's standpoint, these impact studies are based on the grounds of aggregate economic growth that may be derived from additional spending by the business. The range of the impact can be limited to the city, county, state or national levels.

There are various methodologies that aid the economic valuation of specific organizations in their local economies. From the literature review, we concluded that Economic Impact Analysis (EIA) mostly relies on input-output economic models. Economists evaluate the impact that one sector has on another in terms of indirect and induced effects. The total economic impact is then the sum of the direct, indirect and induced effects.

Direct Impacts

Direct impacts are consequences of economic activities carried out by a company or organization in the economy. For example, institutions (public or private) have a direct impact on the local economy because of the activities conducted by the institution, management, employees, visitors and other related events. Employing labor, purchasing locally produced goods and services, and contracting for construction and capital improvements are all examples of activities that generate direct impacts. Some direct impacts, such as UAS, occur on site. Others, such as local production of goods and services for use at the institution, may occur off site.

Expenditures by management, owners and visitors also generate direct impacts, but only those expenditures that lead to local business activity are relevant for a regional economic assessment. For this reason, it is important to distinguish between (a) the local value-added component of expenditures and (b) the regional import component. Thus, the manufacturers of UAS expenditures on utilities, supplies, professional services, meals and entertainment generate significant economic benefits to the local and national economy. In most parts of the country, only the former component is relevant for the analysis. The following is a list of local value-added components:

- Direct Spending Effects:
  Construction, maintenance, operations
- Direct Business Cost Savings:
  Value of user benefits
- Other Business Cost Savings:
  Logistics/inventory/ processing, scale economies
- Regional Business Markets:
  Tourism, business relocation effects
- Personal Cost Savings:
  Effect on disposable income

The distinguishing feature of a direct impact is that it is an immediate consequence of the manufacturers of UAS' economic activity.

Indirect Impacts

In addition to the direct effect of an economic activity, there are also indirect effects and induced effects. Indirect impacts derive from off-site economic activities that are attributable to the business activities of the manufacturers of UAS' presence. For example, if we are looking at the job impacts of a new UAS being manufactured in Arizona, the direct effect is the number of new jobs created by the company itself. The indirect effect is the number of new jobs created at those firms that supply ancillary services for individuals who are employed at the UAS manufacturing facility and for customers of the firm. These can include, but are not limited to, hotels, restaurants and other businesses that may expand because of the presence of the UAS manufacturing facility. These suppliers and clients employ labor, purchase locally produced goods and services, and invest in capital expansion and improvements. Indirect impacts differ from direct impacts in that they originate entirely off site.

Examples of indirect impacts would be:

- Ancillary business expansion due to the UAS firm;
- New capital investment in response to the UAS firm; and
- Supplies and equipment that may be purchased because of the new business opportunities created by the UAS manufacturing facility.

Induced Impacts

Induced impacts are the result of spending of the wages and salaries of the direct and indirect employees on items such as food, housing, transportation and medical services. In other words, induced effects are the multiplier effects caused by successive rounds of spending throughout the economy as a result of the direct and indirect effects discussed above.

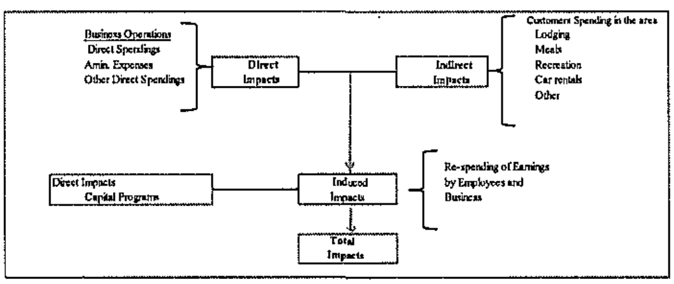
For example, most of the take-home income earned by the manufacturers of UAS employees is spent locally. Some of this spending becomes income to local businesses and their employees that provide services to the firm's employees. Then part of these second-round incomes are also spent locally and thus become income to another set of individuals. As successive rounds of spending occur, additional income is created. Although some of the induced impacts occur locally, some are felt outside the region because of the regional import components of the goods and services purchased. More economically self-sufficient regions have higher multipliers than do regions that are more dependent on regional imports, because more of the spending and respending is accomplished in the area. Similarly, two or more counties considered together as one economic region would have a higher multiplier than would each individual county.

Total Impact

The total impact is the sum of direct impacts, indirect impacts and induced impacts. Total impact is expressed in economic output, earnings or jobs.

Total Impacts = Direct Impacts + Indirect Impacts + Induced Impacts

Economic Impact Overview



Economists sometimes say that the direct economic impacts are "multiplied" through their indirect economic impacts. The ratio of the total (direct + indirect) economic impacts to the direct economic impacts is frequently referred to as the economic multiplier. The employment multiplier is the ratio of total employment to direct employment. The income multiplier is the ratio of total income to direct income created.

Multipliers are not directly observed; rather, they are inferred from an economic model. The direct measure is generally the most accurate since it can be measured more easily, but it only represents a part of the impact, so other multipliers are added to get the total. However, it should be emphasized that the sum of the multipliers is very important since these are virtually the only tools available to researchers attempting to identify the overall impact of activity within a regional economy.

Although a variety of methods can be used to generate economic multipliers, input-output (I-O) models are the most popular tool for such analysis and will be our focus. IMPLAN is a standard economic impact software package used to generate indirect, induced employment and sales estimates. IMPLAN utilizes user-supplied estimates of the direct sales and/or employment and provides associated indirect and induced effects estimates. Direct effects are the changes in the industries to which a final demand change was made; indirect effects are the changes in interindustry purchases as the response to demand of the directly affected industry; and induced effects generally reflect changes in household spending resulting from activity generated by the direct and indirect effects (MIG, p.102).

$$Multiplier = \frac{indirect\ impacts}{direct\ impacts}$$

Previous Economic Impact Studies

Conducting an economic impact study is important, because it is a useful tool to evaluate the economic impact of a business in a community in terms of jobs, income and tax revenue. Ten studies were selected from the literature to illustrate the different facets of economic impact and approaches used to assess impact. The purpose is to illustrate the range of values that may be achieved by different economic entities. The 10 examples are listed below:

- Marshall County Hospital Impact in Marshall County, Kentucky;
- Port of Baltimore impact in Maryland;
- University of Florida in Florida;
- Intel impact in Washington County;
- Intel impact in Oregon;
- Intel impact in Portland, Oregon Metro;
- Boeing impact in Arizona;
- All Acute Care Hospital Systems impact in New Hampshire;
- National Aeronautics and Space Administration (NASA) impact in Florida; and
- Nike impact in Oregon.

Methodology

The aircraft industry, undoubtedly, provides significant economic and social benefits for the regional, state and national economies. Most economic impact analyses utilize input-output models to provide detailed descriptions on how money invested in an economy travels and, through multiplier effects, creates additional employment and income. The basis of these input-output models is a summation of expenditures of the manufacturer (operations, capital and payroll) and the application of the multipliers to account for the interdependency of economic activity in a local economy (Siegfried et al., 2007). There are two well-known input-output programs: Regional Input-Output Modeling System (RIMS II) and the more advanced Impact Analysis for Planning (IMPLAN) software.

To more effectively use the multipliers for impact analysis, users must provide geographically and industrially detailed information on the initial changes in output, earnings or employment that are associated with the project or program under study.

RIMS II was developed by the Bureau of Economic Analysis (BEA) and is based on an accounting framework called an I-O table, which shows the industrial distribution of inputs purchased and outputs sold for each industry (BEA, 2010). There are two sources for the I-O table: BEA's national I-O table, which shows the input and output structure of nearly 500 U.S. industries, and BEA's regional economic accounts, which are used to adjust the national I-O table to show a region's industrial structure and trading patterns. RIMS II has several advantages:

- Multipliers can be estimated for any region and for any industry;
- Low-cost estimates of regional multipliers because of data source accessibility are available; and
- Expensive surveys and RIMS II-based estimates are similar in magnitude.

IMPLAN is a more specialized software; it captures the actual dollar amounts of all business transactions taking place in a regional economy by utilizing Social Accounting Matrices (SAMs) accounts (IMPLAN, 2011). IMPLAN's advantages are:

- SAMs are a better measure of economic flow as they include "nonmarket" transactions (i.e., taxes and unemployment benefits);
- Multiplier Models are built directly from the region-specific SAMs, which reflect the region's unique structure;
- Trade Flows Method tracks regional purchases by estimating trade flows, allowing for more accurate capturing of indirect effects; and
- Data accessibility is cost effective and efficient.

For this study, we have utilized IMPLAN's input-output software to estimate the direct, indirect and induced effects of UAS integration in the NAS upon the local economy. The estimated economic impacts of this integration for each of the 50 states are provided in Appendix B.

Data

The most common economic measures used in economic impact analysis are:

- Employment [broken down to include full-time equivalents (FTEs)];
- Annual labor income;
- Taxes; and
- Total output or revenue.

This analysis is based on the following data provided by our own forecasts for the 50 states from 2015 through 2025:

1) Total spending by agriculture and public safety in payroll, parts, and taxes;
2) Total direct employment by agriculture and public safety; and
3) State adjustment factors.

Results

For this study, we used IMPLAN's input-output software to estimate the direct, indirect, induced and total effects of UAS integration on the economy of the state of Arizona. Because of the unique nature of manufacturing UAS and the specialized type of workers required, specific project payroll, parts, and taxes for agriculture and public safety were provided. Using the parts manufacturing distribution data in Table 7, we subtracted 4.10% (Arizona) from all values to get a distribution relative to Arizona. We then used this to modify the existing IMPLAN model for the rest of the states. Table 7 shows the adjustment factors to modify the multipliers for all states based on the Arizona multipliers that were derived from the IMPLAN's input output software.

Table 7: State Multiplier Adjustment Factors Based on State of Arizona's Multiplier

State	Abbreviation	Adjustment Factors	State	Abbreviation	Adjustment Factors
Alabama	AL	-1.88%	Montana	MT	-3.99%
Alaska	AK	-3.96%	Nebraska	NE	-3.91%
Arizona	AZ	0.00%	Nevada	NV	-3.80%
Arkansas	AR	-3.49%	New Hampshire	NH	-3.43%
California	CA	11.48%	New Jersey	NJ	-2.11%
Colorado	CO	-2.34%	New Mexico	NM	-3.32%
Connecticut	CT	-0.15%	New York	NY	-0.80%
Delaware	DE	-3.97%	North Carolina	NC	-2.93%
Florida	FL	0.64%	North Dakota	ND	-3.99%
Georgia	GA	-1.27%	Ohio	OH	-1.40%
Hawaii	HI	-3.85%	Oklahoma	OK	-3.29%
Idaho	ID	-3.88%	Oregon	OR	-3.47%
Illinois	IL	-2.54%	Pennsylvania	PA	-1.10%
Indiana	IN	-2.51%	Rhode Island	RI	-3.78%
Iowa	IA	-2.86%	South Carolina	SC	-3.34%
Kansas	KS	-0.56%	South Dakota	SD	-4.03%
Kentucky	KY	-3.42%	Tennessee	TN	-3.29%
Louisiana	LA	-2.45%	Texas	TX	4.33%
Maine	ME	-3.28%	Utah	UT	-3.00%
Maryland	MD	-1.57%	Vermont	VT	-3.83%
Massachusetts	MA	-1.20%	Virginia	VA	-0.55%
Michigan	MI	-2.66%	Washington	WA	4.92%
Minnesota	MN	-3.02%	West Virginia	WV	-3.74%
Mississippi	MS	-2.85%	Wisconsin	WI	-3.43%
Missouri	MO	-2.13%	Wyoming	WY	-4.06%

Economic Impact ... Total Impacts

Total Economic and Employment Impacts of Agriculture Spending

Table 8 presents the estimated total economic and employment impacts of agriculture spending in all 50 states in 2015. The total economic impact in all 50 states is $2,096.5 million with total job creation of 21,565. The state with the largest economic and employment impacts is California with a total economic impact of about $366.9 million and creation of 3,774 new jobs. Following California are Washington, Texas, Florida and Arizona. The state with the least economic and employment impacts is Wyoming with an estimated $723,647 and creation of seven new jobs.

The average economic and employment impacts of agriculture spending per state are $41,929,742 and creation of 431 new jobs. The standard deviation of economic and employment impacts of agriculture spending are $61,565,404 and 633 new jobs. The large standard deviation indicates the wide variability (spread) of economic and employment impacts among states.

Total Economic and Employment Impacts of Public Safety and Other Spending

Table 9 presents the estimated total economic and employment impacts in 2015 of public safety spending in all 50 states. Since the total spending for "other markets" is considered equivalent to the public safety estimates, these data are not repeated. The total economic impact of the public safety market in all 50 states is approximately $89.8 million with creation of 924 new jobs. As with agriculture spending, the state with the largest economic and employment impacts is California with a total of more than $15.7 million and creation of 162 new jobs. This is followed in descending order by the states of Washington, Texas, Florida and Arizona. The state of Wyoming has the least economic and employment impacts with $31,013 and no new jobs created.

The average economic and employment impacts of public safety spending per state are $1,796,989 and creation of 18 new jobs. The standard deviation of economic and employment impacts of public safety spending is $2,638,517 and creation of 27 new jobs. The large standard deviation again indicates the wide variability among states.

Table 8: 2015 Total Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Total Multipliers	Total Economic Impact	Total Employment Impact
	Payrol	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	1.9043	$45,068,872	464
Alaska	$611,763	$917,644	$0	$1,529,406	1.8623	$2,848,213	29
Arizona	$17,225,798	$25,838,695	$396,882	$43,461,373	1.9800	$86,053,519	885
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	1.8718	$12,275,065	126
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	2.2143	$366,887,512	3,774
Colorado	$7,416,206	$11,124,313	$274,696	$18,815,217	1.8893	$35,547,590	366
Connecticut	$16,575,698	$24,863,547	$663,026	$42,102,272	1.9598	$82,512,034	849
Delaware	$557,285	$835,926	$24,743	$1,417,956	1.8594	$2,636,547	27
Florida	$19,927,882	$29,891,823	$0	$49,819,705	1.9477	$97,033,840	998
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	1.9216	$58,177,847	598
Hawaii	$1,041,126	$1,561,889	$59,969	$2,662,784	1.8604	$4,953,844	51
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	1.8602	$4,441,558	46
Illinois	$6,571,201	$9,856,802	$262,846	$16,690,851	1.8750	$31,295,346	322
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	1.8850	$31,853,499	328
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	1.8589	$24,396,309	251
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	1.9792	$75,068,387	772
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	1.8681	$13,697,259	141
Louisiana	$6,916,647	$10,377,970	$221,397	$17,516,014	1.8684	$32,730,657	337
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	1.8584	$16,362,066	168
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	1.9061	$51,498,841	530
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	1.9142	$59,252,213	609
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	1.8748	$28,800,128	296
Minnesota	$4,581,989	$6,642,984	$257,296	$11,682,269	1.8677	$21,781,620	224
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	1.8621	$24,840,511	256
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	1.9064	$39,950,946	411
Montana	$462,857	$694,286	$23,328	$1,180,471	1.8589	$2,194,378	23
Nebraska	$807,476	$1,211,217	$33,074	$2,051,770	1.8600	$3,816,291	39
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	1.8666	$5,856,462	60
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	1.8612	$13,109,815	135
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	1.8883	$40,375,517	415
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	1.8642	$15,458,419	159
New York	$13,876,051	$20,817,077	$718,107	$35,411,235	1.9184	$67,932,913	699
North Carolina	$4,898,843	$7,348,414	$274,341	$12,521,698	1.8711	$23,429,348	241
North Dakota	$453,576	$680,364	$10,233	$1,144,172	1.8585	$2,126,445	22
Ohio	$11,362,400	$17,043,599	$372,667	$28,778,666	1.9129	$55,050,748	566
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	1.8753	$16,256,813	167
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	1.8685	$12,414,050	128
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	1.8964	$60,315,956	620
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	1.8638	$6,465,942	67
South Carolina	$3,165,523	$4,778,285	$178,389	$8,142,198	1.8585	$15,132,275	156
South Dakota	$305,881	$458,822	$0	$764,703	1.8673	$1,427,930	15
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	2.0342	$17,240,439	177
Texas	$35,422,907	$53,134,361	$0	$88,557,268	1.8834	$166,786,758	1,716
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	1.8619	$21,925,827	226
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	1.8578	$5,478,720	56
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	1.8720	$71,048,771	731
Washington	$37,902,240	$56,853,360	$0	$94,755,601	2.1250	$201,355,651	2,071
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	1.8662	$7,155,398	74
Wisconsin	$2,825,586	$4,238,352	$146,930	$7,210,850	1.8642	$13,442,468	138
Wyoming	$155,765	$233,648	$0	$389,413	1.8583	$723,647	7
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$2,096,487,320	21,565
Average						$41,929,742	431
STD						$61,565,404	633

Table 9: 2015 Total Economic & Employment Impacts of Public Safety Spending

State	Direct Spending				State Total Multipliers	Total Economic Impact	Total Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	1.9043	$1,931,523	20
Alaska	$26,218	$39,328	$0	$65,546	1.8623	$122,066	1
Arizona	$738,246	$1,107,373	$17,009	$1,862,630	1.9800	$3,688,008	38
Arkansas	$109,958	$164,937	$6,158	$281,053	1.8718	$526,075	5
California	$2,804,503	$4,206,755	$89,744	$7,101,003	2.2143	$15,723,751	162
Colorado	$317,838	$476,756	$11,773	$806,366	1.8893	$1,523,468	16
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	1.9598	$3,536,230	36
Delaware	$23,884	$35,825	$1,060	$60,770	1.8594	$112,995	1
Florida	$854,052	$1,281,078	$0	$2,135,130	1.9477	$4,158,593	43
Georgia	$509,235	$763,853	$24,443	$1,297,531	1.9216	$2,493,336	26
Hawaii	$44,620	$66,930	$2,570	$114,119	1.8604	$212,308	2
Idaho	$39,985	$59,977	$2,367	$102,329	1.8602	$190,353	2
Illinois	$281,623	$422,434	$11,265	$715,322	1.8750	$1,341,229	14
Indiana	$286,569	$429,854	$7,795	$724,217	1.8850	$1,365,150	14
Iowa	$222,562	$333,844	$6,054	$562,460	1.8589	$1,045,556	11
Kansas	$637,456	$956,184	$31,873	$1,625,514	1.9792	$3,217,217	33
Kentucky	$123,327	$184,990	$5,920	$314,237	1.8681	$587,025	6
Louisiana	$296,513	$444,770	$9,488	$750,772	1.8684	$1,402,742	14
Maine	$147,625	$221,438	$8,267	$377,331	1.8584	$701,231	7
Maryland	$456,228	$684,342	$17,337	$1,157,906	1.9061	$2,207,065	23
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	1.9142	$2,539,381	26
Michigan	$259,728	$389,592	$9,039	$658,359	1.8748	$1,234,291	13
Minnesota	$195,514	$293,271	$11,027	$499,812	1.8677	$933,498	10
Mississippi	$225,796	$338,695	$7,225	$571,717	1.8621	$1,064,593	11
Missouri	$354,709	$532,064	$11,351	$898,124	1.9064	$1,712,183	18
Montana	$19,837	$29,755	$1,000	$50,592	1.8589	$94,045	1
Nebraska	$34,606	$51,909	$1,417	$87,933	1.8600	$163,555	2
Nevada	$53,766	$80,679	$0	$134,464	1.8666	$250,991	3
New Hampshire	$120,750	$181,125	$0	$301,875	1.8612	$561,849	6
New Jersey	$358,013	$537,019	$21,338	$916,369	1.8883	$1,730,379	18
New Mexico	$140,223	$210,335	$4,824	$355,382	1.8642	$662,504	7
New York	$594,774	$892,160	$30,690	$1,517,624	1.9184	$2,911,411	30
North Carolina	$209,955	$314,932	$11,757	$536,644	1.8711	$1,004,115	10
North Dakota	$19,439	$29,158	$439	$49,036	1.8585	$91,133	1
Ohio	$486,960	$730,440	$15,972	$1,233,372	1.9129	$2,359,318	24
Oklahoma	$146,155	$219,233	$6,139	$371,527	1.8753	$696,725	7
Oregon	$112,812	$169,218	$2,707	$284,737	1.8685	$532,031	5
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	1.8964	$2,584,970	27
Rhode Island	$58,473	$87,709	$2,500	$148,681	1.8638	$277,112	3
South Carolina	$136,522	$204,784	$7,645	$348,951	1.8585	$648,526	7
South Dakota	$13,109	$19,664	$0	$32,773	1.8673	$61,197	1
Tennessee	$145,291	$217,936	$0	$363,227	2.0342	$738,876	8
Texas	$1,516,125	$2,277,187	$0	$3,795,311	1.8834	$7,148,090	74
Utah	$198,696	$298,044	$7,948	$504,688	1.8619	$939,678	10
Vermont	$49,324	$73,986	$3,078	$126,387	1.8578	$234,802	2
Virginia	$638,874	$958,312	$29,388	$1,626,574	1.8720	$3,044,947	31
Washington	$1,624,382	$2,436,573	$0	$4,060,954	2.1250	$8,629,528	89
West Virginia	$64,491	$96,737	$3,096	$164,323	1.8662	$306,660	3
Wisconsin	$121,096	$181,644	$6,297	$309,036	1.8642	$576,106	6
Wyoming	$6,676	$10,013	$0	$16,689	1.8583	$31,013	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$89,849,448	924
Average						$1,796,989	18
STD						$2,638,517	27
MAX						$15,723,751	162
MIN						$31,013	0

Total Economic and Employment Impacts of Agriculture, Public Safety and Other Spending

Table 10 presents the estimated total economic and employment impacts of agriculture, public safety and other spending in 2015 all 50 states. The total economic impact of these markets in all 50 states is more than $2,276 million with total job creation of 23,413. The state with the largest economic and employment impact is California with a total of more than $398.3 million and creation of 4,097 new jobs. Following California in descending rank order are Washington, Texas, Florida and Arizona. In addition, the order of job creation was similar to estimated total economic impact. Wyoming has the least economic and employment impacts with $785,674 and eight new jobs created.

The average economic and employment impacts of agriculture, public safety and other spending per state are approximately $45.5 million and creation of 468 new jobs. The standard deviation of economic and employment impacts is approximately $66.8 million and 688 new jobs created. As with agriculture, public safety and other state estimates, there is a wide variability of economic and employment impacts and job creation among states.

Table 10: 2015 Total Economic & Employment Impacts of Agriculture, Public Safety and Other Spending

State	Direct Spending				State Total Multipliers	Total Economic Impact	Total Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$10,116,334	$15,174,501	$404,653	$25,695,488	1.9043	$48,931,919	503
Alaska	$664,199	$996,299	$0	$1,660,498	1.8623	$3,092,346	32
Arizona	$18,702,293	$28,053,440	$430,901	$47,186,634	1.9800	$93,429,535	961
Arkansas	$2,785,606	$4,178,410	$155,994	$7,120,010	1.8718	$13,327,235	137
California	$71,047,421	$106,571,132	$2,273,517	$179,892,071	2.2143	$398,335,013	4,097
Colorado	$8,051,883	$12,077,825	$298,242	$20,427,950	1.8893	$38,594,526	397
Connecticut	$17,996,472	$26,994,708	$719,859	$45,711,039	1.9598	$89,584,494	921
Delaware	$605,052	$907,578	$26,864	$1,539,495	1.8594	$2,862,537	29
Florida	$21,635,988	$32,453,979	$0	$54,089,966	1.9477	$105,351,026	1,084
Georgia	$12,900,626	$19,350,939	$619,230	$32,870,795	1.9216	$63,164,520	650
Hawaii	$1,130,366	$1,695,548	$65,109	$2,891,023	1.8604	$5,378,459	55
Idaho	$1,012,948	$1,519,422	$59,967	$2,592,338	1.8602	$4,822,263	50
Illinois	$7,134,447	$10,701,671	$285,378	$18,121,496	1.8750	$33,977,804	350
Indiana	$7,259,751	$10,889,627	$197,465	$18,346,843	1.8850	$34,583,799	356
Iowa	$5,638,246	$8,457,369	$153,360	$14,248,976	1.8589	$26,487,421	272
Kansas	$16,148,894	$24,223,341	$807,445	$41,179,679	1.9792	$81,502,821	838
Kentucky	$3,124,278	$4,686,417	$149,965	$7,960,660	1.8681	$14,871,309	153
Louisiana	$7,511,674	$11,267,511	$240,374	$19,019,556	1.8684	$35,536,142	366
Maine	$3,739,845	$5,609,768	$209,431	$9,559,045	1.8584	$17,764,528	183
Maryland	$11,557,769	$17,336,654	$439,195	$29,333,618	1.9061	$55,912,810	575
Massachusetts	$13,218,706	$19,828,059	$560,473	$33,607,237	1.9142	$64,330,974	662
Michigan	$6,579,779	$9,869,669	$228,976	$16,678,425	1.8748	$31,268,710	322
Minnesota	$4,953,017	$7,429,525	$279,350	$12,661,892	1.8677	$23,648,616	243
Mississippi	$5,720,176	$8,580,264	$183,046	$14,483,485	1.8621	$26,969,697	277
Missouri	$8,985,968	$13,478,953	$287,551	$22,752,472	1.9064	$43,375,313	446
Montana	$502,531	$753,796	$25,328	$1,281,654	1.8589	$2,382,467	25
Nebraska	$876,691	$1,315,036	$35,909	$2,227,636	1.8600	$4,143,402	43
Nevada	$1,362,572	$2,043,859	$0	$3,406,431	1.8666	$6,358,445	65
New Hampshire	$3,058,997	$4,588,496	$0	$7,647,493	1.8612	$14,233,514	146
New Jersey	$9,069,651	$13,604,476	$540,551	$23,214,678	1.8883	$43,836,276	451
New Mexico	$3,552,327	$5,328,491	$122,200	$9,003,018	1.8642	$16,783,427	173
New York	$15,067,598	$22,601,397	$777,488	$38,446,484	1.9184	$73,755,734	759
North Carolina	$5,318,852	$7,978,278	$297,856	$13,594,986	1.8711	$25,437,578	262
North Dakota	$492,454	$738,681	$11,110	$1,242,244	1.8585	$2,308,711	24
Ohio	$12,336,320	$18,504,479	$404,631	$31,245,430	1.9129	$59,769,383	615
Oklahoma	$3,702,605	$5,553,907	$155,509	$9,412,021	1.8753	$17,650,363	182
Oregon	$2,857,897	$4,286,846	$68,590	$7,213,333	1.8685	$13,478,112	139
Pennsylvania	$13,678,300	$20,517,450	$335,939	$34,531,689	1.8964	$65,485,895	674
Rhode Island	$1,481,305	$2,221,957	$63,326	$3,766,588	1.8638	$7,020,166	72
South Carolina	$3,458,568	$5,187,852	$193,680	$8,840,100	1.8585	$16,429,327	169
South Dakota	$332,100	$498,149	$0	$830,249	1.8673	$1,550,324	16
Tennessee	$3,680,698	$5,521,047	$0	$9,201,746	2.0342	$18,718,191	193
Texas	$38,459,156	$57,688,734	$0	$96,147,891	1.8834	$181,084,937	1,863
Utah	$5,033,632	$7,550,448	$201,345	$12,785,425	1.8619	$23,805,183	245
Vermont	$1,249,536	$1,874,304	$77,971	$3,201,811	1.8578	$5,948,324	61
Virginia	$16,184,820	$24,277,230	$744,502	$41,206,552	1.8720	$77,138,665	793
Washington	$41,151,004	$61,726,505	$0	$102,877,509	2.1250	$218,614,707	2,249
West Virginia	$1,633,773	$2,450,659	$78,421	$4,162,853	1.8662	$7,768,716	80
Wisconsin	$3,067,760	$4,601,640	$159,524	$7,828,923	1.8642	$14,594,678	150
Wyoming	$169,117	$253,675	$0	$422,792	1.8583	$785,674	8
TOTAL	$456,000,000	$684,000,000	$13,370,225	$1,153,370,225		$2,276,186,016	23,413
Average						$45,523,720	468
STD						$66,842,436	688
MAX						$398,335,013	4,097
MIN						$785,674	8

Economic Impact ... Agriculture Spending

Total Economic and Employment Impacts of Agriculture Direct Spending

Tables 11, 12 and 13 show the 2015 direct, indirect and induced impacts respectively, of agriculture spending. Table 11 presents the total economic and employment impacts of direct agriculture spending in all 50 states. The nationwide total economic impact is an estimated $1,058,841,630 with about 11,094 newly created jobs. The largest economic and employment impacts of direct agriculture spending is in California with total economic impact of more than $185,307,769 and creation of 1,942 new jobs. As before, the order of job creation was similar to overall economic impact. The state with least economic and employment impacts is Wyoming with $365,503 and four newly created jobs.

The average economic and employment impacts of direct agriculture spending per state are approximately $21,176,833 and an estimated 222 new jobs. The standard deviation of economic and employment impacts of direct agriculture spending is approximately $31,094,684 and new job creation of 326. This again reflects the wide spread of economic and employment impacts among states.

Total Economic and Employment Impacts of Agriculture Indirect Spending

The total economic and employment impact of indirect agriculture spending in all 50 states is shown in Table 12. The nationwide total economic impact is approximately $487,060,836, with an estimated 5,103 new jobs. The largest economic and employment impacts of indirect agriculture spending is in the state of California with a total economic impact of approximately $85,230,970 and creation of 893 new jobs. The order of job creation was similar to overall economic impact. Wyoming has the least economic and employment impact with $168,110 and creation of two new jobs.

The average economic and employment impacts of indirect agriculture spending per state are $9,741,217 and creation of 102 jobs. The standard deviation of economic and employment impacts of indirect agriculture spending is $14,302,673 and job creation of 150. The large standard deviation indicates the wide variability of economic and employment impacts among states.

Table 11: 2015 Direct Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Direct Multipliers	Direct Economic Impact	Direct Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	0.9618	$22,762,822	238
Alaska	$611,763	$917,644	$0	$1,529,406	0.9405	$1,438,407	15
Arizona	$17,225,796	$25,838,695	$396,882	$43,461,373	1	$43,461,373	455
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	0.9453	$6,199,187	65
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	1.1184	$185,307,769	1942
Colorado	$7,416,206	$11,124,313	$274,696	$18,815,217	0.9542	$17,953,480	188
Connecticut	$16,575,698	$24,863,547	$663,028	$42,102,272	0.9898	$41,672,829	437
Delaware	$557,285	$835,928	$24,743	$1,417,956	0.9391	$1,331,602	14
Florida	$19,927,882	$29,891,823	$0	$49,819,705	0.9837	$49,007,644	513
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	0.9705	$29,382,598	308
Hawaii	$1,041,126	$1,561,689	$59,969	$2,662,784	0.9396	$2,501,952	26
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	0.9395	$2,243,223	24
Illinois	$6,571,201	$9,856,802	$262,848	$16,690,851	0.947	$15,806,236	166
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	0.952	$16,087,285	169
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	0.9388	$12,320,864	129
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	0.9996	$37,913,480	397
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	0.9435	$6,917,918	72
Louisiana	$6,918,647	$10,377,970	$221,397	$17,518,014	0.9436	$16,529,998	173
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	0.9386	$8,263,794	87
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	0.9627	$26,010,042	273
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	0.9668	$29,926,360	314
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	0.9468	$14,544,464	152
Minnesota	$4,561,989	$6,842,984	$257,296	$11,662,269	0.9433	$11,001,018	115
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	0.9405	$12,546,319	131
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	0.9628	$20,176,653	211
Montana	$462,857	$694,286	$23,328	$1,180,471	0.9388	$1,108,226	12
Nebraska	$807,478	$1,211,217	$33,074	$2,051,770	0.9394	$1,927,432	20
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	0.9427	$2,957,724	31
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	0.94	$6,621,119	69
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	0.9537	$20,391,956	214
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	0.9415	$7,807,157	82
New York	$13,878,051	$20,817,077	$716,107	$35,411,235	0.9689	$34,308,946	359
North Carolina	$4,898,943	$7,348,414	$274,341	$12,521,698	0.945	$11,833,004	124
North Dakota	$453,576	$680,364	$10,233	$1,144,172	0.9386	$1,073,920	11
Ohio	$11,362,400	$17,043,599	$372,687	$28,778,686	0.9661	$27,803,088	291
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	0.9471	$8,210,378	86
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	0.9437	$6,269,810	66
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	0.9578	$30,463,311	319
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	0.9413	$3,265,582	34
South Carolina	$3,185,523	$4,778,285	$178,389	$8,142,198	0.9386	$7,642,267	80
South Dakota	$305,881	$458,822	$0	$764,703	0.9431	$721,192	8
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	1.0274	$8,707,515	91
Texas	$35,422,907	$53,134,361	$0	$88,557,268	0.9512	$84,235,673	883
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	0.9403	$11,073,019	116
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	0.9383	$2,767,081	29
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	0.9455	$35,884,943	376
Washington	$37,902,240	$56,853,360	$0	$94,755,601	1.0732	$101,691,710	1065
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	0.9425	$3,613,739	38
Wisconsin	$2,825,568	$4,238,352	$146,930	$7,210,850	0.9415	$6,789,015	71
Wyoming	$155,765	$233,648	$0	$389,413	0.9386	$365,503	4
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$1,058,841,630	11,094
Average						$21,176,833	222
STD						$31,094,684	326

Table 12: 2015 Indirect Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Indirect Multipliers	Indirect Economic Impact	Indirect Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	0.4424	$10,470,235	110
Alaska	$611,763	$917,644	$0	$1,529,406	0.4327	$661,774	7
Arizona	$17,225,796	$25,838,695	$396,882	$43,461,373	0.46	$19,992,232	209
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	0.4349	$2,852,032	30
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	0.5144	$85,230,970	893
Colorado	$7,416,208	$11,124,313	$274,696	$18,815,217	0.4389	$8,257,999	87
Connecticut	$16,575,698	$24,863,547	$663,028	$42,102,272	0.4553	$19,169,165	201
Delaware	$557,285	$835,928	$24,743	$1,417,956	0.432	$612,557	6
Florida	$19,927,882	$29,891,823	$0	$49,819,705	0.4525	$22,543,417	236
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	0.4464	$13,515,087	142
Hawaii	$1,041,126	$1,561,689	$59,969	$2,662,784	0.4322	$1,150,855	12
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	0.4322	$1,031,954	11
Illinois	$6,571,201	$9,856,802	$262,848	$16,690,851	0.4356	$7,270,535	76
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	0.4379	$7,399,813	78
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	0.4319	$5,668,280	59
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	0.4598	$17,439,594	183
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	0.434	$3,182,169	33
Louisiana	$6,918,647	$10,377,970	$221,397	$17,518,014	0.4341	$7,604,570	80
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	0.4317	$3,800,852	40
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	0.4428	$11,963,485	125
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	0.4447	$13,765,259	144
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	0.4356	$6,691,560	70
Minnesota	$4,561,989	$6,842,984	$257,296	$11,662,269	0.4339	$5,060,258	53
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	0.4326	$5,770,906	60
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	0.4429	$9,281,512	97
Montana	$462,857	$694,286	$23,328	$1,180,471	0.4319	$509,846	5
Nebraska	$807,478	$1,211,217	$33,074	$2,051,770	0.4321	$886,570	9
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	0.4337	$1,360,735	14
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	0.4324	$3,045,715	32
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	0.4387	$9,380,257	98
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	0.4331	$3,591,375	38
New York	$13,878,051	$20,817,077	$716,107	$35,411,235	0.4457	$15,782,787	165
North Carolina	$4,898,943	$7,348,414	$274,341	$12,521,698	0.4347	$5,443,162	57
North Dakota	$453,576	$680,364	$10,233	$1,144,172	0.4318	$494,054	5
Ohio	$11,362,400	$17,043,599	$372,687	$28,778,686	0.4444	$12,789,248	134
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	0.4357	$3,777,069	40
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	0.4341	$2,884,099	30
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	0.4406	$14,013,506	147
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	0.433	$1,502,175	16
South Carolina	$3,185,523	$4,778,285	$178,389	$8,142,198	0.4318	$3,515,801	37
South Dakota	$305,881	$458,822	$0	$764,703	0.4338	$331,728	3
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	0.4726	$4,005,423	42
Texas	$35,422,907	$53,134,361	$0	$88,557,268	0.4376	$38,752,660	406
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	0.4326	$5,094,319	53
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	0.4316	$1,272,804	13
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	0.4349	$16,505,935	173
Washington	$37,902,240	$56,853,360	$0	$94,755,601	0.4937	$46,780,840	490
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	0.4336	$1,662,512	17
Wisconsin	$2,825,568	$4,238,352	$146,930	$7,210,850	0.4331	$3,123,019	33
Wyoming	$155,765	$233,648	$0	$389,413	0.4317	$168,110	2
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$487,060,836	5,103
Average						$9,741,217	102
STD						$14,302,673	150

Total Economic and Employment Impacts of Agriculture Induced Spending

Table 13 presents the total economic and employment impacts of induced agriculture spending in 2015 in all 50 states. The estimated nationwide total economic impact is $550,584,654 with the creation of 5,770 new jobs. The largest economic and employment impacts of induced agriculture spending is in the state of California with a total economic impact of approximately $96,348,773 and creation of 1,010 new jobs. The order of job creation was similar to economic impact. The state of Wyoming has the least amount economic and employment impact with $190,034 and the creation of two new jobs. The average economic and employment impacts of induced agriculture spending per state are an estimated 11,011,693 and creation of 115 jobs. The standard deviation of economic and employment impacts of induced agriculture spending is approximately $16,168,047 and 169 jobs. There is wide variability in economic and employment impacts among states as is evidenced by the large standard deviation.

Table 13: 2015 Induced Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Induced Multipliers	Induced Economic Impact	Induced Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	0.5001	$11,835,815	124
Alaska	$611,763	$917,644	$0	$1,529,408	0.4891	$748,033	8
Arizona	$17,225,796	$25,838,695	$396,882	$43,461,373	0.52	$22,599,914	237
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	0.4916	$3,223,866	34
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	0.5815	$96,348,773	1,010
Colorado	$7,416,208	$11,124,313	$274,696	$18,815,217	0.4962	$9,336,111	98
Connecticut	$16,575,698	$24,863,547	$663,028	$42,102,272	0.5147	$21,670,040	227
Delaware	$557,285	$835,926	$24,743	$1,417,956	0.4883	$692,368	7
Florida	$19,927,882	$29,891,823	$0	$49,819,705	0.5115	$25,482,779	267
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	0.5047	$15,280,162	160
Hawaii	$1,041,126	$1,561,689	$59,969	$2,662,784	0.4886	$1,301,036	14
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	0.4885	$1,166,381	12
Illinois	$6,571,201	$9,856,802	$262,848	$16,690,851	0.4924	$8,218,575	86
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	0.4951	$8,366,402	88
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	0.4882	$6,407,164	67
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	0.5198	$19,715,313	207
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	0.4906	$3,597,171	38
Louisiana	$6,918,647	$10,377,970	$221,397	$17,518,014	0.4907	$8,596,089	90
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	0.4881	$4,297,419	45
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	0.5006	$13,525,114	142
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	0.5027	$15,560,593	163
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	0.4924	$7,564,104	79
Minnesota	$4,561,989	$6,842,984	$257,296	$11,662,269	0.4905	$5,720,343	60
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	0.489	$6,523,285	68
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	0.5007	$10,492,781	110
Montana	$462,857	$694,286	$23,328	$1,180,471	0.4882	$576,306	6
Nebraska	$807,478	$1,211,217	$33,074	$2,051,770	0.4885	$1,002,289	11
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	0.4902	$1,538,004	16
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	0.4888	$3,442,982	36
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	0.4959	$10,603,304	111
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	0.4896	$4,059,887	43
New York	$13,878,051	$20,817,077	$716,107	$35,411,235	0.5038	$17,840,160	187
North Carolina	$4,898,943	$7,348,414	$274,341	$12,521,698	0.4914	$6,153,162	64
North Dakota	$453,576	$680,364	$10,233	$1,144,172	0.4881	$558,471	6
Ohio	$11,362,400	$17,043,599	$372,687	$28,778,686	0.5024	$14,458,412	152
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	0.4925	$4,269,466	45
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	0.4907	$3,260,142	34
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	0.498	$15,839,141	166
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	0.4895	$1,698,186	18
South Carolina	$3,185,523	$4,778,285	$178,389	$8,142,198	0.4881	$3,974,207	42
South Dakota	$305,881	$458,822	$0	$764,703	0.4904	$375,010	4
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	0.5342	$4,527,501	47
Texas	$35,422,907	$53,134,361	$0	$88,557,268	0.4946	$43,800,425	459
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	0.489	$5,758,488	60
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	0.4879	$1,438,835	15
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	0.4916	$18,657,893	196
Washington	$37,902,240	$56,853,360	$0	$94,755,601	0.5581	$52,883,101	554
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	0.4901	$1,879,145	20
Wisconsin	$2,825,568	$4,238,352	$146,930	$7,210,850	0.4896	$3,530,432	37
Wyoming	$155,765	$233,648	$0	$389,413	0.488	$190,034	2
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$550,584,654	5,770
Average						$11,011,693	115
STD						$16,168,047	169

Total Economic and Employment Impacts of Public Safety and Other Direct Spending

Tables 14, 15, and 16 show the 2015 direct, indirect, and induced impacts respectively, of public safety spending. Since the impacts to "other" markets are equivalent to public safety, that data is not presented. Table 14 presents the total economic and employment impacts of direct public safety spending in all 50 states. The total economic impact is approximately $45,378,927 with a total job creation of 475. The largest economic and employment impacts of direct public safety spending is in the state of California with a total economic impact of $7,941,762 and creation of 83 new jobs. The state of Wyoming has the least economic and employment impacts among public safety direct spending with $15,664 and no new jobs created. The average economic and employment impacts of direct public safety spending per state are approximately $907,579 and creation of 10 new jobs. The standard deviation of economic and employment impacts of direct public safety spending are approximately $1,332,629 and new job creation of 14. The large standard deviation again indicates the variability of economic and employment impacts of direct public safety spending among states.

Total Economic and Employment Impacts of Public Safety and Other Indirect Spending

The total economic and employment impact of indirect public safety spending in 2015 in all 50 states is shown in Table 15. The nationwide total economic impact is approximately $20,874,036 creation of an estimated 219 new jobs. The largest economic and employment impacts of indirect public safety spending is in the state of California with total economic impact of more than $3,652,756 and creation of 38 new jobs. Wyoming has the least economic and employment impacts with $7,205 and no new jobs created.

The economic and employment impacts of indirect public safety spending per state averages approximately $417,481 and creation of four new jobs. The standard deviation of economic and employment impacts of indirect public safety spending are $612,972 creation of six new jobs. As with public safety direct spending, there is a wide variability of economic and employment impacts among the states.

Table 14: 2015 Direct Economic & Employment Impacts of Public Safety Spending

State	Direct Spending				State Direct Multipliers	Direct Economic Impact	Direct Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	0.9618	$975,550	10
Alaska	$26,218	$39,328	$0	$65,546	0.9405	$61,646	1
Arizona	$738,248	$1,107,373	$17,009	$1,862,630	1	$1,862,630	20
Arkansas	$109,958	$164,937	$6,158	$281,053	0.9453	$265,679	3
California	$2,804,503	$4,206,755	$89,744	$7,101,003	1.1184	$7,941,762	83
Colorado	$317,838	$476,756	$11,773	$806,366	0.9542	$769,435	8
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	0.9898	$1,785,978	19
Delaware	$23,884	$35,825	$1,060	$60,770	0.9391	$57,069	1
Florida	$854,052	$1,281,078	$0	$2,135,130	0.9837	$2,100,328	22
Georgia	$509,235	$763,853	$24,443	$1,297,531	0.9705	$1,259,254	13
Hawaii	$44,620	$66,930	$2,570	$114,119	0.9396	$107,227	1
Idaho	$39,985	$59,977	$2,367	$102,329	0.9395	$96,136	1
Illinois	$281,623	$422,434	$11,265	$715,322	0.947	$677,410	7
Indiana	$286,569	$429,854	$7,795	$724,217	0.952	$689,455	7
Iowa	$222,562	$333,844	$6,054	$562,460	0.9388	$528,037	6
Kansas	$637,456	$956,184	$31,873	$1,625,514	0.9996	$1,624,863	17
Kentucky	$123,327	$184,990	$5,920	$314,237	0.9435	$296,482	3
Louisiana	$296,513	$444,770	$9,488	$750,772	0.9436	$708,428	7
Maine	$147,625	$221,438	$8,267	$377,331	0.9386	$354,163	4
Maryland	$456,228	$684,342	$17,337	$1,157,906	0.9627	$1,114,716	12
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	0.9668	$1,282,558	13
Michigan	$259,728	$389,592	$9,039	$658,359	0.9488	$623,334	7
Minnesota	$195,514	$293,271	$11,027	$499,812	0.9433	$471,472	5
Mississippi	$225,796	$338,695	$7,225	$571,717	0.9405	$537,699	6
Missouri	$354,709	$532,064	$11,351	$898,124	0.9628	$864,714	9
Montana	$19,837	$29,755	$1,000	$50,592	0.9388	$47,495	0
Nebraska	$34,606	$51,909	$1,417	$87,933	0.9394	$82,604	1
Nevada	$53,786	$80,679	$0	$134,464	0.9427	$126,760	1
New Hampshire	$120,750	$181,125	$0	$301,875	0.94	$283,762	3
New Jersey	$358,013	$537,019	$21,338	$916,369	0.9537	$873,941	9
New Mexico	$140,223	$210,335	$4,824	$355,382	0.9415	$334,592	4
New York	$594,774	$892,160	$30,690	$1,517,624	0.9689	$1,470,426	15
North Carolina	$209,955	$314,932	$11,757	$536,644	0.945	$507,129	5
North Dakota	$19,439	$29,158	$439	$49,036	0.9386	$46,025	0
Ohio	$486,960	$730,440	$15,972	$1,233,372	0.9661	$1,191,561	12
Oklahoma	$146,155	$219,233	$6,139	$371,527	0.9471	$351,873	4
Oregon	$112,812	$169,218	$2,707	$284,737	0.9437	$268,706	3
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	0.9578	$1,305,570	14
Rhode Island	$58,473	$87,709	$2,500	$148,681	0.9413	$139,954	1
South Carolina	$136,522	$204,784	$7,645	$348,951	0.9386	$327,526	3
South Dakota	$13,109	$19,664	$0	$32,773	0.9431	$30,908	0
Tennessee	$145,291	$217,936	$0	$363,227	1.0274	$373,179	4
Texas	$1,518,125	$2,277,187	$0	$3,795,311	0.9512	$3,610,100	38
Utah	$198,696	$298,044	$7,948	$504,688	0.9403	$474,558	5
Vermont	$49,324	$73,986	$3,078	$126,387	0.9383	$118,589	1
Virginia	$638,874	$958,312	$29,388	$1,626,574	0.9455	$1,537,926	16
Washington	$1,624,382	$2,436,573	$0	$4,060,954	1.0732	$4,358,216	46
West Virginia	$64,491	$96,737	$3,096	$164,323	0.9425	$154,875	2
Wisconsin	$121,096	$181,644	$6,297	$309,036	0.9415	$290,958	3
Wyoming	$6,676	$10,013	$0	$16,689	0.9386	$15,664	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$45,378,927	475
Average						$907,579	10
STD						$1,332,629	14
MAX						$7,941,762	83
MIN						$15,664	0

Table 15: 2015 Indirect Economic & Employment Impacts of Public Safety Spending

State	Direct Spending				State Indirect Multipliers	Indirect Economic Impact	Indirect Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	0.4424	$448,724	5
Alaska	$26,218	$39,328	$0	$65,546	0.4327	$28,362	0
Arizona	$738,248	$1,107,373	$17,009	$1,862,630	0.46	$856,810	9
Arkansas	$109,958	$164,937	$6,158	$281,053	0.4349	$122,230	1
California	$2,804,503	$4,206,755	$89,744	$7,101,003	0.5144	$3,652,756	38
Colorado	$317,838	$476,756	$11,773	$806,366	0.4389	$353,914	4
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	0.4553	$821,538	9
Delaware	$23,884	$35,825	$1,060	$60,770	0.432	$26,252	0
Florida	$854,052	$1,281,078	$0	$2,135,130	0.4525	$966,146	10
Georgia	$509,235	$763,853	$24,443	$1,297,531	0.4464	$579,218	6
Hawaii	$44,620	$66,930	$2,570	$114,119	0.4322	$49,322	1
Idaho	$39,985	$59,977	$2,367	$102,329	0.4322	$44,227	0
Illinois	$281,623	$422,434	$11,265	$715,322	0.4356	$311,594	3
Indiana	$286,569	$429,854	$7,795	$724,217	0.4379	$317,135	3
Iowa	$222,562	$333,844	$6,054	$562,460	0.4319	$242,926	3
Kansas	$637,456	$956,184	$31,873	$1,625,514	0.4598	$747,411	8
Kentucky	$123,327	$184,990	$5,920	$314,237	0.434	$136,379	1
Louisiana	$296,513	$444,770	$9,488	$750,772	0.4341	$325,910	3
Maine	$147,625	$221,438	$8,267	$377,331	0.4317	$162,894	2
Maryland	$456,228	$684,342	$17,337	$1,157,906	0.4428	$512,721	5
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	0.4447	$589,940	6
Michigan	$259,728	$389,592	$9,039	$658,359	0.4356	$286,781	3
Minnesota	$195,514	$293,271	$11,027	$499,812	0.4339	$216,868	2
Mississippi	$225,796	$338,695	$7,225	$571,717	0.4326	$247,325	3
Missouri	$354,709	$532,064	$11,351	$898,124	0.4429	$397,779	4
Montana	$19,837	$29,755	$1,000	$50,592	0.4319	$21,851	0
Nebraska	$34,606	$51,909	$1,417	$87,933	0.4321	$37,996	0
Nevada	$53,786	$80,679	$0	$134,464	0.4337	$58,317	1
New Hampshire	$120,750	$181,125	$0	$301,875	0.4324	$130,531	1
New Jersey	$358,013	$537,019	$21,338	$916,369	0.4387	$402,011	4
New Mexico	$140,223	$210,335	$4,824	$355,382	0.4331	$153,916	2
New York	$594,774	$892,160	$30,690	$1,517,624	0.4457	$676,405	7
North Carolina	$209,955	$314,932	$11,757	$536,644	0.4347	$233,279	2
North Dakota	$19,439	$29,158	$439	$49,036	0.4318	$21,174	0
Ohio	$486,960	$730,440	$15,972	$1,233,372	0.4444	$548,111	6
Oklahoma	$146,155	$219,233	$6,139	$371,527	0.4357	$161,874	2
Oregon	$112,812	$169,218	$2,707	$284,737	0.4341	$123,604	1
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	0.4406	$600,579	6
Rhode Island	$58,473	$87,709	$2,500	$148,681	0.433	$64,379	1
South Carolina	$136,522	$204,784	$7,645	$348,951	0.4318	$150,677	2
South Dakota	$13,109	$19,664	$0	$32,773	0.4338	$14,217	0
Tennessee	$145,291	$217,936	$0	$363,227	0.4726	$171,661	2
Texas	$1,518,125	$2,277,187	$0	$3,795,311	0.4376	$1,660,828	17
Utah	$198,696	$298,044	$7,948	$504,688	0.4326	$218,328	2
Vermont	$49,324	$73,986	$3,078	$126,387	0.4316	$54,549	1
Virginia	$638,874	$958,312	$29,388	$1,626,574	0.4349	$707,397	7
Washington	$1,624,382	$2,436,573	$0	$4,060,954	0.4937	$2,004,893	21
West Virginia	$64,491	$96,737	$3,096	$164,323	0.4336	$71,251	1
Wisconsin	$121,096	$181,644	$6,297	$309,036	0.4331	$133,844	1
Wyoming	$6,676	$10,013	$0	$16,689	0.4317	$7,205	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$20,874,036	219
Average						$417,481	4
STD						$612,972	6
MAX						$3,652,756	38
MIN						$7,205	0

Total Economic and Employment Impacts of Public Safety and Other Induced Spending

Table 16 presents the total economic and employment impacts of induced public safety spending in 2015 in all 50 states. The total economic impact is estimated to be $23,596,485 with total new job creation of 247. The largest economic and employment impacts of induced public safety spending is in the state of California with a total economic impact of approximately $4,129,233 and creation of 43 new jobs. Following California are the states of Washington, Texas, Florida and Arizona. The order of job creation was similar to economic impact. The state with least economic and employment impacts is Wyoming with $8,144 and no new jobs created.

The average economic and employment impacts of induced public safety spending per state are an estimated $471,930 and creation of five jobs. The standard deviation of economic and employment impacts of induced public safety spending are approximately $692,916 and creation of seven new jobs. The large standard deviation indicates the wide variability of economic and employment impacts among states.

Table 16: 2015 Induced Economic & Employment Impacts of Public Safety Spending

State	Direct Spending				State Induced Multipliers	Induced Economic Impact	Induced Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	0.5001	$507,249	5
Alaska	$26,218	$39,328	$0	$65,546	0.4891	$32,059	0
Arizona	$738,248	$1,107,373	$17,009	$1,862,630	0.52	$968,568	10
Arkansas	$109,958	$164,937	$6,158	$281,053	0.4916	$138,166	1
California	$2,804,503	$4,206,755	$89,744	$7,101,003	0.5815	$4,129,233	43
Colorado	$317,838	$476,756	$11,773	$806,366	0.4962	$400,119	4
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	0.5147	$928,716	10
Delaware	$23,884	$35,825	$1,060	$60,770	0.4883	$29,674	0
Florida	$854,052	$1,281,078	$0	$2,135,130	0.5115	$1,092,119	11
Georgia	$509,235	$763,853	$24,443	$1,297,531	0.5047	$654,864	7
Hawaii	$44,620	$66,930	$2,570	$114,119	0.4886	$55,759	1
Idaho	$39,985	$59,977	$2,367	$102,329	0.4885	$49,988	1
Illinois	$281,623	$422,434	$11,265	$715,322	0.4924	$352,225	4
Indiana	$286,569	$429,854	$7,795	$724,217	0.4951	$358,560	4
Iowa	$222,562	$333,844	$6,054	$562,460	0.4882	$274,593	3
Kansas	$637,456	$956,184	$31,873	$1,625,514	0.5198	$844,942	9
Kentucky	$123,327	$184,990	$5,920	$314,237	0.4906	$154,164	2
Louisiana	$296,513	$444,770	$9,488	$750,772	0.4907	$368,404	4
Maine	$147,625	$221,438	$8,267	$377,331	0.4881	$184,175	2
Maryland	$456,228	$684,342	$17,337	$1,157,906	0.5006	$579,648	6
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	0.5027	$666,883	7
Michigan	$259,728	$389,592	$9,039	$658,359	0.4924	$324,176	3
Minnesota	$195,514	$293,271	$11,027	$499,812	0.4905	$245,158	3
Mississippi	$225,796	$338,695	$7,225	$571,717	0.489	$279,569	3
Missouri	$354,709	$532,064	$11,351	$898,124	0.5007	$449,691	5
Montana	$19,837	$29,755	$1,000	$50,592	0.4882	$24,699	0
Nebraska	$34,606	$51,909	$1,417	$87,933	0.4885	$42,955	0
Nevada	$53,786	$80,679	$0	$134,464	0.4902	$65,914	1
New Hampshire	$120,750	$181,125	$0	$301,875	0.4888	$147,556	2
New Jersey	$358,013	$537,019	$21,338	$916,369	0.4959	$454,427	5
New Mexico	$140,223	$210,335	$4,824	$355,382	0.4896	$173,995	2
New York	$594,774	$892,160	$30,690	$1,517,624	0.5038	$764,579	8
North Carolina	$209,955	$314,932	$11,757	$536,644	0.4914	$263,707	3
North Dakota	$19,439	$29,158	$439	$49,036	0.4881	$23,934	0
Ohio	$486,960	$730,440	$15,972	$1,233,372	0.5024	$619,646	6
Oklahoma	$146,155	$219,233	$6,139	$371,527	0.4925	$182,977	2
Oregon	$112,812	$169,218	$2,707	$284,737	0.4907	$139,720	1
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	0.498	$678,820	7
Rhode Island	$58,473	$87,709	$2,500	$148,681	0.4895	$72,779	1
South Carolina	$136,522	$204,784	$7,645	$348,951	0.4881	$170,323	2
South Dakota	$13,109	$19,664	$0	$32,773	0.4904	$16,072	0
Tennessee	$145,291	$217,936	$0	$363,227	0.5342	$194,036	2
Texas	$1,518,125	$2,277,187	$0	$3,795,311	0.4946	$1,877,181	20
Utah	$198,696	$298,044	$7,948	$504,688	0.489	$246,792	3
Vermont	$49,324	$73,986	$3,078	$126,387	0.4879	$61,664	1
Virginia	$638,874	$958,312	$29,388	$1,626,574	0.4916	$799,624	8
Washington	$1,624,382	$2,436,573	$0	$4,060,954	0.5581	$2,266,419	24
West Virginia	$64,491	$96,737	$3,096	$164,323	0.4901	$80,535	1
Wisconsin	$121,096	$181,644	$6,297	$309,036	0.4896	$151,304	2
Wyoming	$6,676	$10,013	$0	$16,689	0.488	$8,144	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$23,596,485	247
Average						$471,930	5
STD						$692,916	7
MAX						$4,129,233	43
MIN						$8,144	0

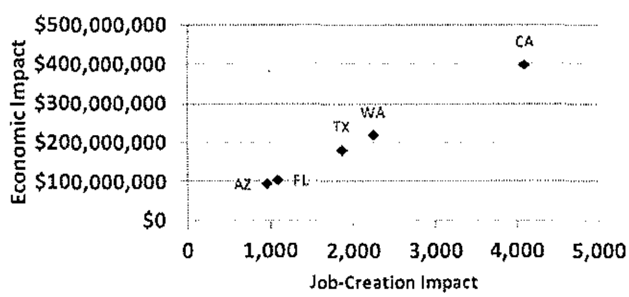
Total Economic and Employment Impacts of UAS Development in the Top Five States

A comparison of the total economic and job creation impacts of UAS integration in the U.S. in the top five states is presented in Table 17. The orders of output and job multipliers are consistent with the order of the states in terms of direct spending. California is the number one state with the highest direct spending of $179,892,071 and the highest direct employment of 2,108, which resulted in the highest contribution to total economic impact of approximately $398,335,013 and total new job creation impact of approximately 4,097. In addition, California has the highest multipliers for job and output creation. Figure 2 graphically shows the total economic and job creation impacts of the top five states in the U.S.

Table 17: 2015 Total Economic and Employment Impacts of UAS Development in the Top Five States

State	Direct jobs	Total job Creation Impact	Job multiplier	Direct spending	Total Economic impact	Output multiplier
California	2108	4,097	1.94	179,892,071	398,335,013	2.21
Washington	1157	2,249	1.94	102,877,509	218,614,707	2.13
Texas	958	1,863	1.94	96,147,891	181,084,937	1.88
Florida	557	1,084	1.94	54,089,966	105,351,026	1.95
Arizona	494	961	1.94	47,186,634	93,429,535	1.98

Figure 2: 2015 Economic and Job Impacts of the Top Five States



Total Economic and Employment Impacts of UAS Development in the United States From 2015-2025

UAS integration into the NAS will have tremendous economic and job creation impacts on the aerospace industry and aid in driving economic development in many states across the country. In today's economic environment, job creation will continue to be extremely important for the aerospace industry and the U.S. economy. Note that the economic impact of UAS integration will not stop with the primary UAS market. Similar to other industries, job growth will stretch into many additional sectors, and the economic growth in the aerospace industry will support the growth in many other businesses across multiple U.S. industries, including the hospitality and entertainment industries.

The total direct spending in UAS development and the total economic and employment impacts are expected to increase significantly in the next 11 years from 2015 through 2025, as seen in Table 18. The expected total direct spending in UAS development in 2015 is an estimated $1,153,370,225. This amount is expected to increase by 100% in 2016 to approximately $2,306,740,450. In 2017, total direct spending is expected to increase by 50% to an estimated $3,460,110,675. This rate of growth is expected to decrease in 2018 to approximately 5% with total spending of $3,633,116,209 and to level off at 5% between 2019 and 2025, with total spending in 2025 of 5,112,159,353.

Table 18: Direct Spending and Employment in the U.S. from 2015-2025

Year	Total Direct Spending	Total Direct Employment	Percent Change Over Previous Year
2015	$ 1,153,370,225	11,400	
2016	$ 2,306,740,450	22,800	100%
2017	$ 3,460,110,675	34,200	50%
2018	$ 3,633,116,209	35,910	5%
2019	$ 3,814,772,019	37,706	5%
2020	$ 4,005,510,620	39,591	5%
2021	$ 4,205,786,151	41,570	5%
2022	$ 4,416,075,459	43,649	5%
2023	$ 4,636,879,232	45,831	5%
2024	$ 4,868,723,193	48,123	5%
2025	$ 5,112,159,353	50,529	5%

The expected total economic and employment impacts in the U.S. for UAS integration for the 11-year period from 2015 through 2025 is shown in Table 19. In 2015, the expected total economic and employment impacts are estimated to be $2,276,186,016 with creation of 23,413 jobs. These amounts are expected to increase by 100% in 2016 (from 2015) to approximately $4,552,372,033 in economic impact and job creation of 46,826. In 2017, the economic and employment impacts are expected to increase by approximately 50% to $6,828,558,049 and 70,240 jobs. This rate of growth is expected to decrease in 2018 to approximately 5% and level off at 5% through 2025. By 2025, the expected total economic impact is estimated to be $10,088,890,263 and total employment impact 103,776.

Table 19: Economic & Employment Impacts in the U.S. from 2015-2025

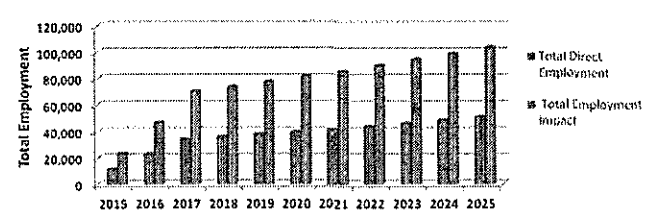
Year	Total Direct Spending	Total Economic Impact	Total Employment Impact	Percent Change Over Previous Year
2015	$1,153,370,225	$ 2,276,186,016	23,413	
2016	$2,306,740,450	$ 4,552,372,033	46,826	100%
2017	$3,460,110,675	$ 6,828,558,049	70,240	50%
2018	$3,633,116,209	$ 7,169,985,952	73,752	5%
2019	$3,814,772,019	$ 7,528,485,249	77,439	5%
2020	$4,005,510,620	$ 7,904,909,512	81,311	5%
2021	$4,205,786,151	$ 8,300,154,987	85,377	5%
2022	$4,416,075,459	$ 8,715,162,737	89,645	5%
2023	$4,636,879,232	$ 9,150,920,874	94,128	5%
2024	$4,868,723,193	$ 9,608,466,917	98,834	5%
2025	$5,112,159,353	$10,088,890,263	103,776	5%

Figure 3 graphically compares total spending and economic impacts from 2015 to 2025. There are high growth rates for both spending and total economic impact in the first three years (2015-2017) but both spending and total economic impact growth are expected to decrease to 5% in 2018 and level off at 5% through 2025.

Figure 3: Total Spending and Economic Impact in the U.S. from 2015 - 2025

Direct employment and total employment impact from 2015 to 2025 are compared in Figure 4. There are high growth rates for both direct and total employment impacts in the first three years (2015-2017) to approximately 100% and 50% in 2016 and 2017, respectively. The growth rate of both direct employment and total employment impacts are expected to decrease to 5% in 2018 and level off at 5% through 2025.

Figure 4: Total Employment Impact in the U.S. from 2015 through 2025



Conclusion

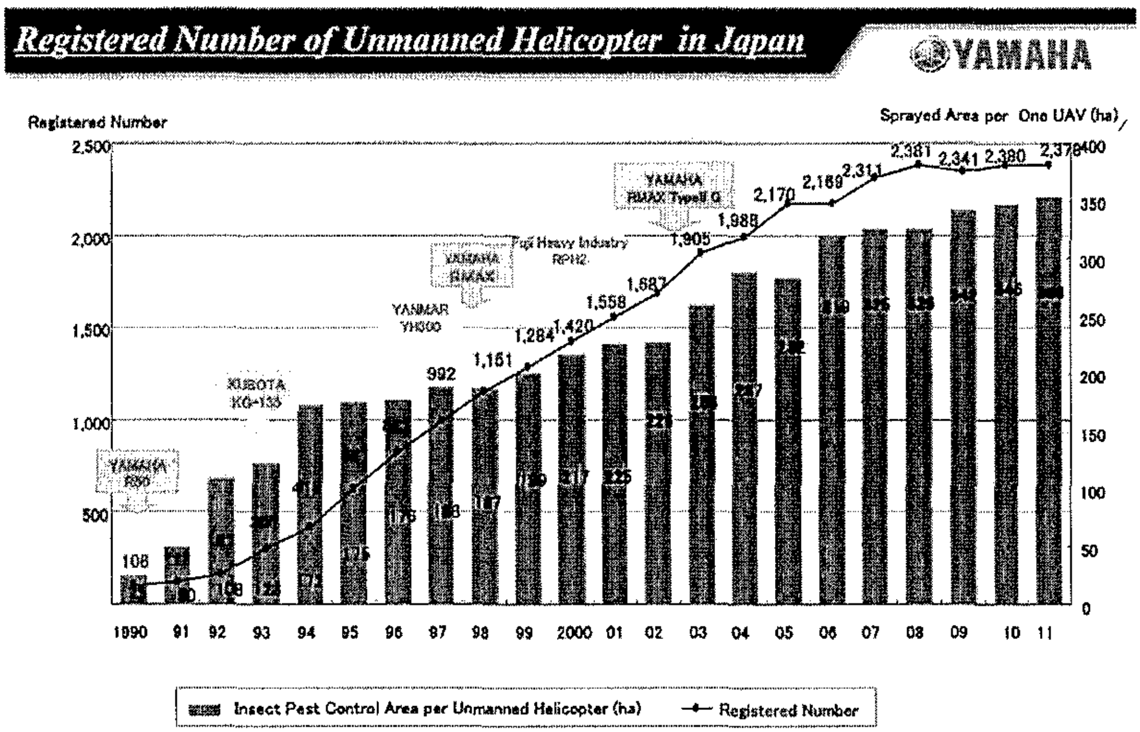
UAS integration into the NAS is expected to have enormous economic and job creation impacts in the United States. These impacts have been demonstrated to be due to direct, indirect and induced effects of total spending in UAS development. The results of these economic impacts are as follows:

During the 11-year period 2015-2025:

- UAS integration is expected to contribute $82.1 billion to the nation's economy by agriculture, public safety and other activities;
- 103,776 new jobs will be created, with 844,741 job years worked over the time period;
- UAS integration is expected to contribute $75.6 billion economic impact by agriculture, $3.2 billion by public safety and $3.2 billion by other activities;
- The manufacturing jobs created will be high paying ($40,000) and require technical baccalaureate degrees; and
- In the first three years, U.S. airspace integration will create more than 34,000 manufacturing jobs and more than 70,000 new jobs.

This study demonstrates the significant contribution of UAS integration to the economic growth and job creation in the aerospace industry and to the social and economic progress of the citizens in the United States.

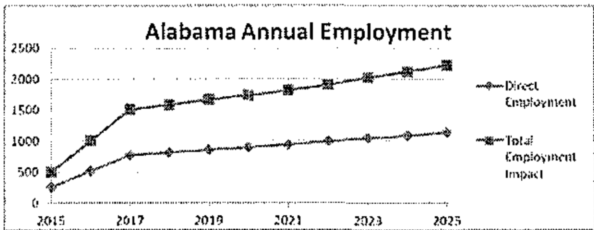
Appendix A

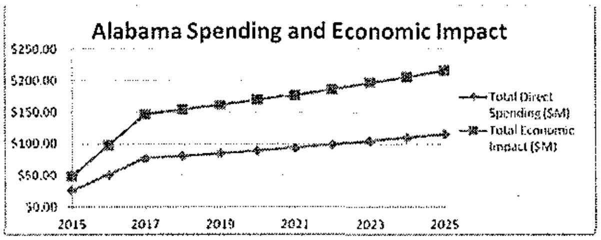


Sato, Akira (2011, October). Civil UAV Applications in Japan and Related Safety & Certification. Presented at the 1st Annual Agricultural UAS Conference: Precision Agriculture, Atlanta, GA.

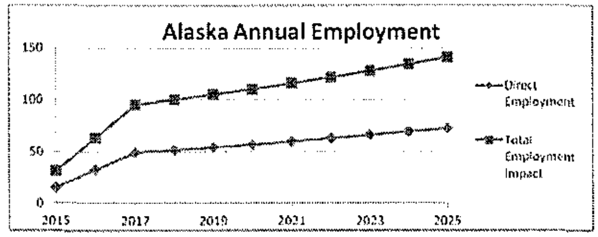
Appendix B
State Level Detailed Economic Impact

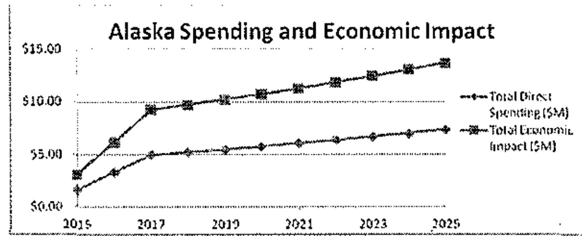
Alabama Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	259	503	$25.70	$48.93	$404.65	
2016	518	1007	$51.39	$97.86	$809.31	100%
2017	777	1510	$77.09	$146.80	$1,213.96	50%
2018	816	1585	$80.94	$154.14	$1,274.66	5%
2019	856	1665	$84.99	$161.84	$1,338.39	5%
2020	899	1748	$89.24	$169.93	$1,405.31	5%
2021	944	1835	$93.70	$178.43	$1,475.58	5%
2022	991	1927	$98.38	$187.35	$1,549.35	5%
2023	1041	2023	$103.30	$196.72	$1,626.82	5%
2024	1093	2125	$108.47	$206.56	$1,708.16	5%
2025	1148	2231	$113.89	$216.88	$1,793.57	5%



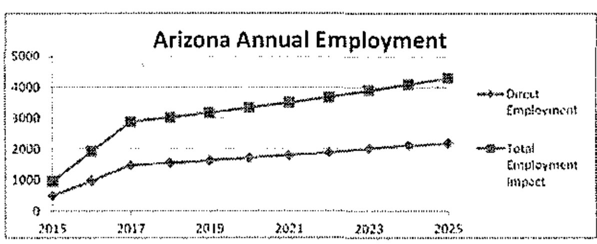


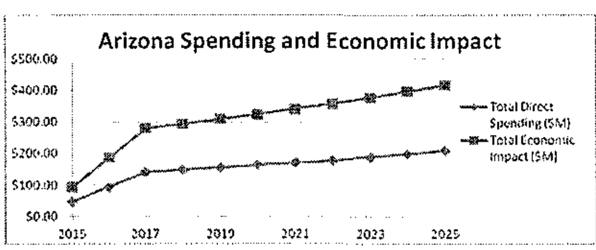
Alaska Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	16	32	$1.66	$3.09	$0.00	
2016	33	64	$3.32	$6.18	$0.00	100%
2017	49	95	$4.98	$9.28	$0.00	50%
2018	52	100	$5.23	$9.74	$0.00	5%
2019	54	105	$5.49	$10.23	$0.00	5%
2020	57	110	$5.77	$10.74	$0.00	5%
2021	60	116	$6.06	$11.28	$0.00	5%
2022	63	122	$6.36	$11.84	$0.00	5%
2023	66	128	$6.68	$12.43	$0.00	5%
2024	69	134	$7.01	$13.05	$0.00	5%
2025	73	141	$7.36	$13.71	$0.00	5%



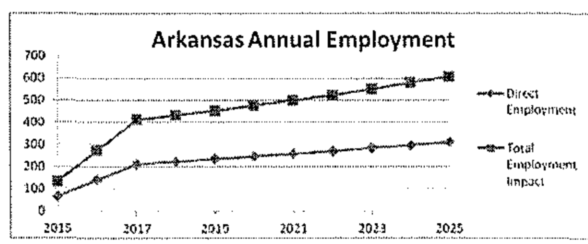


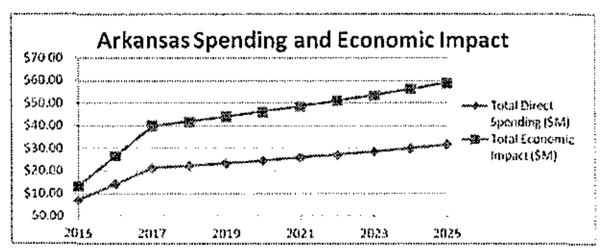
Arizona Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	494	961	$47.19	$93.43	$430.90	
2016	989	1922	$94.37	$186.86	$861.80	100%
2017	1483	2883	$141.56	$280.29	$1,292.70	50%
2018	1557	3027	$148.64	$294.30	$1,357.34	5%
2019	1635	3179	$156.07	$309.02	$1,425.20	5%
2020	1717	3338	$163.87	$324.47	$1,496.46	5%
2021	1803	3504	$172.07	$340.69	$1,571.29	5%
2022	1893	3680	$180.67	$357.73	$1,649.85	5%
2023	1988	3864	$189.70	$375.61	$1,732.34	5%
2024	2087	4057	$199.19	$394.39	$1,818.96	5%
2025	2191	4260	$209.15	$414.11	$1,909.91	5%





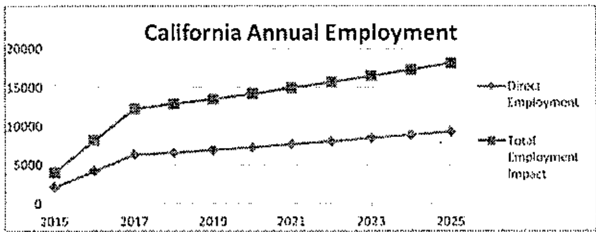
Arkansas Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	71	137	$7.12	$13.33	$155.99	
2016	141	274	$14.24	$26.65	$311.99	100%
2017	212	411	$21.36	$39.98	$467.98	50%
2018	222	432	$22.43	$41.98	$491.38	5%
2019	233	453	$23.55	$44.08	$515.95	5%
2020	245	476	$24.73	$46.28	$541.75	5%
2021	257	500	$25.96	$48.60	$568.83	5%
2022	270	525	$27.26	$51.03	$597.28	5%
2023	284	551	$28.62	$53.58	$627.14	5%
2024	298	579	$30.06	$56.26	$658.50	5%
2025	313	608	$31.56	$59.07	$691.42	5%

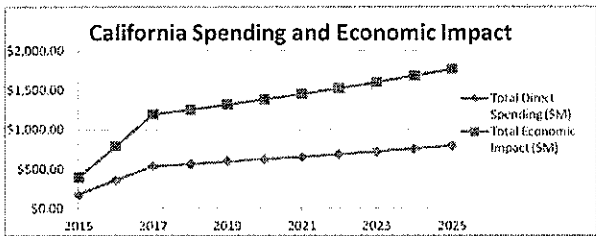




California Economic Impact

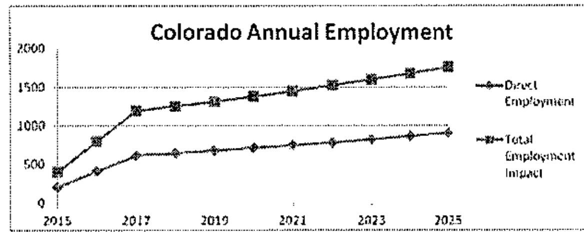
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	2108	4097	$179.89	$398.34	$2,273.52	
2016	4216	8195	$359.78	$796.67	$4,547.03	100%
2017	6324	12292	$539.68	$1,195.01	$6,820.55	50%
2018	6640	12907	$566.66	$1,254.76	$7,161.58	5%
2019	6972	13552	$594.99	$1,317.49	$7,519.66	5%
2020	7321	14230	$624.74	$1,383.37	$7,895.64	5%
2021	7687	14941	$655.98	$1,452.54	$8,290.42	5%
2022	8071	15688	$688.78	$1,525.16	$8,704.95	5%
2023	8475	16472	$723.22	$1,601.42	$9,140.19	5%
2024	8898	17296	$759.38	$1,681.49	$9,597.20	5%
2025	9343	18161	$797.35	$1,765.57	$10,077.06	5%

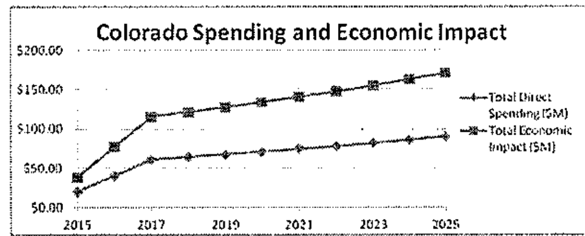




Colorado Economic Impact

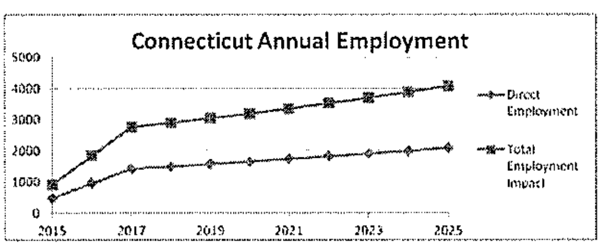
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	204	397	$20.43	$38.59	$298.24	
2016	408	794	$40.86	$77.19	$596.48	100%
2017	613	1191	$61.28	$115.78	$894.73	50%
2018	643	1251	$64.35	$121.57	$939.46	5%
2019	675	1313	$67.57	$127.65	$986.43	5%
2020	709	1379	$70.94	$134.03	$1,035.76	5%
2021	745	1448	$74.49	$140.74	$1,087.54	5%
2022	782	1520	$78.22	$147.77	$1,141.92	5%
2023	821	1596	$82.13	$155.16	$1,199.02	5%
2024	862	1676	$86.23	$162.92	$1,258.97	5%
2025	905	1760	$90.54	$171.07	$1,321.92	5%

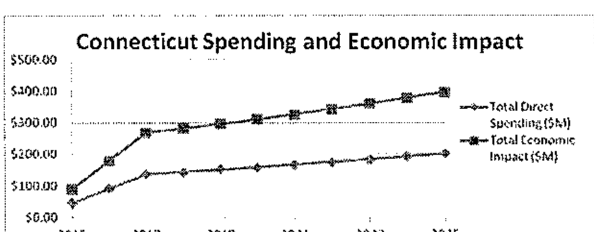




Connecticut Economic Impact

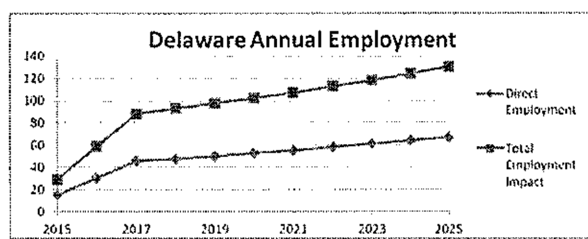
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	474	921	$45.71	$89.58	$719.86	
2016	948	1843	$91.42	$179.17	$1,439.72	100%
2017	1422	2764	$137.13	$268.75	$2,159.58	50%
2018	1493	2903	$143.99	$282.19	$2,267.56	5%
2019	1568	3048	$151.19	$296.30	$2,380.93	5%
2020	1646	3200	$158.75	$311.12	$2,499.98	5%
2021	1729	3360	$166.69	$326.67	$2,624.98	5%
2022	1815	3528	$175.02	$343.01	$2,756.23	5%
2023	1906	3705	$183.77	$360.16	$2,894.04	5%
2024	2001	3890	$192.96	$378.16	$3,038.74	5%
2025	2101	4084	$202.61	$397.07	$3,190.68	5%

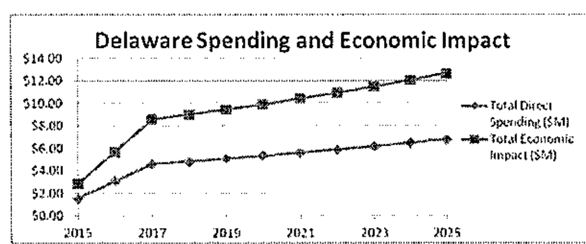




Delaware Economic Impact

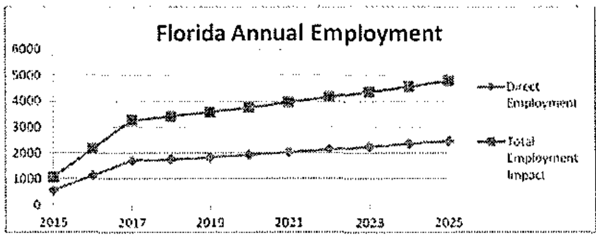
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	15	29	$1.54	$2.86	$26.86	
2016	30	59	$3.08	$5.73	$53.73	100%
2017	45	88	$4.62	$8.59	$80.59	50%
2018	48	93	$4.85	$9.02	$84.62	5%
2019	50	97	$5.09	$9.47	$88.85	5%
2020	53	102	$5.35	$9.94	$93.30	5%
2021	55	107	$5.61	$10.44	$97.96	5%
2022	58	113	$5.89	$10.96	$102.86	5%
2023	61	118	$6.19	$11.51	$108.00	5%
2024	64	124	$6.50	$12.08	$113.40	5%
2025	67	131	$6.82	$12.69	$119.07	5%

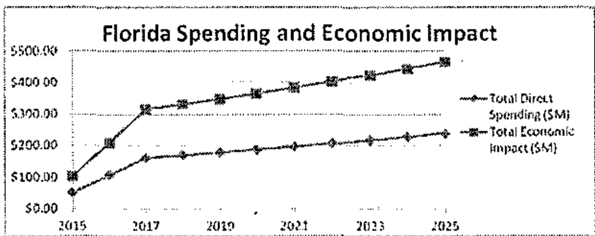




Florida Economic Impact

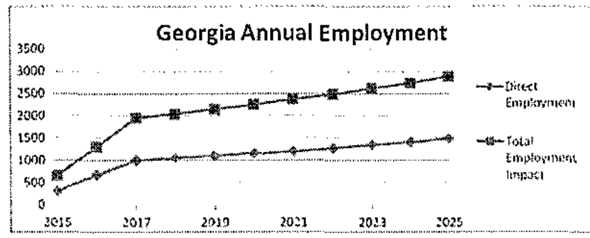
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	557	1084	$54.09	$105.35	$0.00	
2016	1115	2167	$108.18	$210.70	$0.00	100%
2017	1672	3251	$162.27	$316.05	$0.00	50%
2018	1756	3414	$170.38	$331.86	$0.00	5%
2019	1844	3584	$178.90	$348.45	$0.00	5%
2020	1936	3763	$187.85	$365.87	$0.00	5%
2021	2033	3952	$197.24	$384.16	$0.00	5%
2022	2135	4149	$207.10	$403.37	$0.00	5%
2023	2241	4357	$217.46	$423.54	$0.00	5%
2024	2353	4574	$228.33	$444.72	$0.00	5%
2025	2471	4803	$239.75	$466.95	$0.00	5%

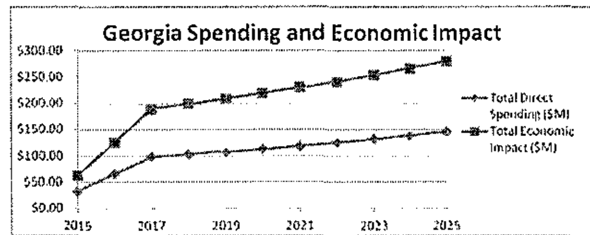




Georgia Economic Impact

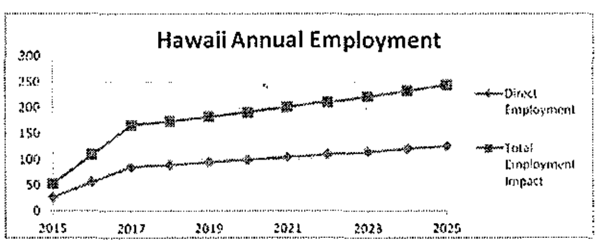
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	334	650	$32.87	$63.16	$619.23	
2016	668	1299	$65.74	$126.33	$1,238.46	100%
2017	1003	1949	$98.61	$189.49	$1,857.69	50%
2018	1053	2047	$103.54	$198.97	$1,950.57	5%
2019	1106	2149	$108.72	$208.92	$2,048.10	5%
2020	1161	2256	$114.16	$219.36	$2,150.51	5%
2021	1219	2369	$119.86	$230.33	$2,258.03	5%
2022	1280	2488	$125.86	$241.85	$2,370.94	5%
2023	1344	2612	$132.15	$253.94	$2,489.48	5%
2024	1411	2743	$138.76	$266.64	$2,613.96	5%
2025	1481	2880	$145.70	$279.97	$2,744.65	5%

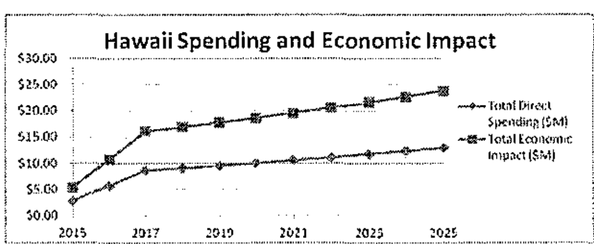




Hawaii Economic Impact

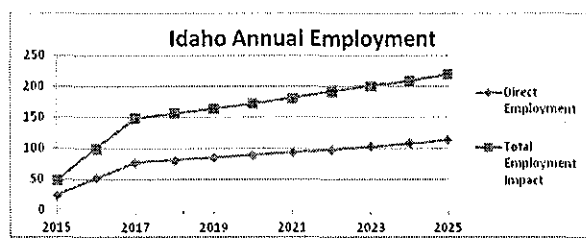
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	28	55	$2.89	$5.38	$65.11	
2016	57	111	$5.78	$10.76	$130.22	100%
2017	85	166	$8.67	$16.14	$195.33	50%
2018	90	174	$9.11	$16.94	$205.09	5%
2019	94	183	$9.56	$17.79	$215.35	5%
2020	99	192	$10.04	$18.68	$226.12	5%
2021	104	202	$10.54	$19.61	$237.42	5%
2022	109	212	$11.07	$20.59	$249.29	5%
2023	114	222	$11.62	$21.62	$261.76	5%
2024	120	234	$12.20	$22.70	$274.84	5%
2025	126	245	$12.81	$23.84	$288.59	5%

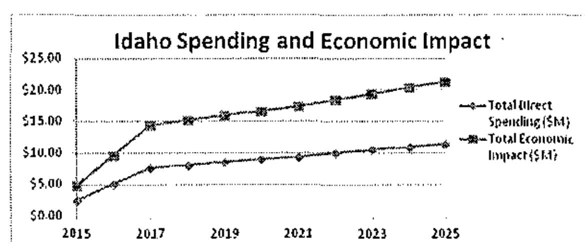




Idaho Economic Impact

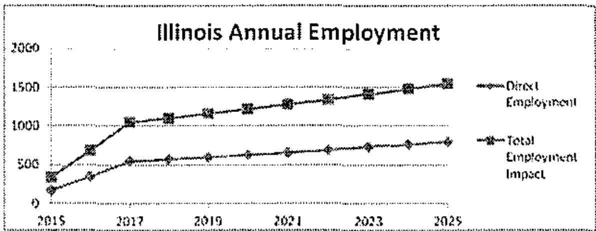
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	26	50	$2.59	$4.82	$59.97	
2016	51	99	$5.18	$9.64	$119.93	100%
2017	77	149	$7.78	$14.47	$179.90	50%
2018	80	156	$8.17	$15.19	$188.89	5%
2019	84	164	$8.57	$15.95	$198.34	5%
2020	89	172	$9.00	$16.75	$208.26	5%
2021	93	181	$9.45	$17.58	$218.67	5%
2022	98	190	$9.93	$18.46	$229.60	5%
2023	103	199	$10.42	$19.39	$241.08	5%
2024	108	209	$10.94	$20.36	$253.14	5%
2025	113	220	$11.49	$21.37	$265.79	5%

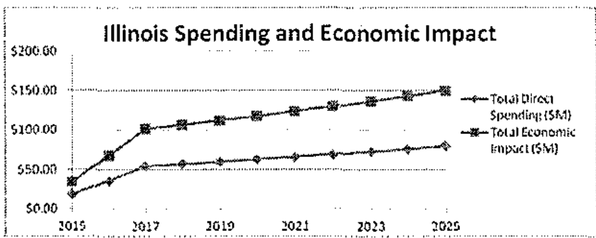




Illinois Economic Impact

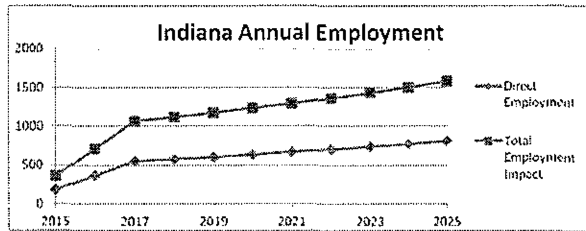
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	180	350	$18.12	$33.98	$285.38	
2016	360	699	$36.24	$67.96	$570.76	100%
2017	539	1049	$54.36	$101.93	$856.13	50%
2018	566	1101	$57.08	$107.03	$898.94	5%
2019	595	1156	$59.94	$112.38	$943.89	5%
2020	624	1214	$62.93	$118.00	$991.08	5%
2021	656	1274	$66.08	$123.90	$1,040.64	5%
2022	688	1338	$69.38	$130.10	$1,092.67	5%
2023	723	1405	$72.85	$136.60	$1,147.30	5%
2024	759	1475	$76.50	$143.43	$1,204.67	5%
2025	797	1549	$80.32	$150.60	$1,264.90	5%

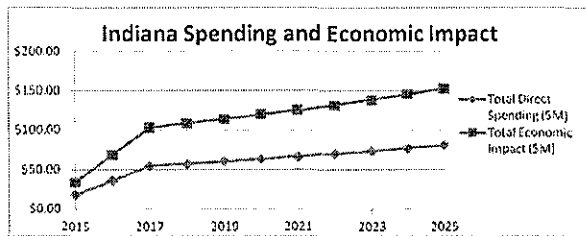




Indiana Economic Impact

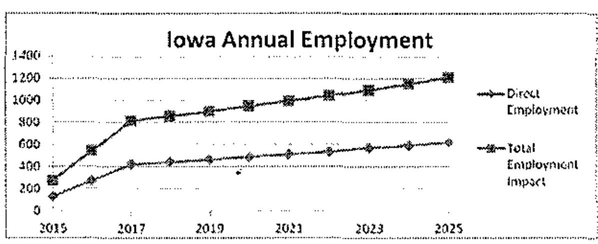
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	183	356	$18.35	$34.58	$197.47	
2016	366	711	$36.69	$69.17	$394.93	100%
2017	549	1067	$55.04	$103.75	$592.40	50%
2018	576	1121	$57.79	$108.94	$622.02	5%
2019	605	1177	$60.68	$114.39	$653.12	5%
2020	636	1235	$63.72	$120.11	$685.77	5%
2021	667	1297	$66.90	$126.11	$720.06	5%
2022	701	1362	$70.25	$132.42	$756.06	5%
2023	736	1430	$73.76	$139.04	$793.87	5%
2024	773	1502	$77.45	$145.99	$833.56	5%
2025	811	1577	$81.32	$153.29	$875.24	5%

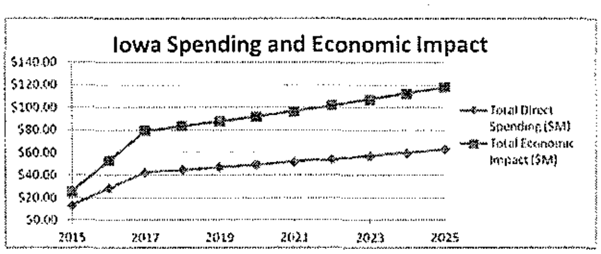




Iowa Economic Impact

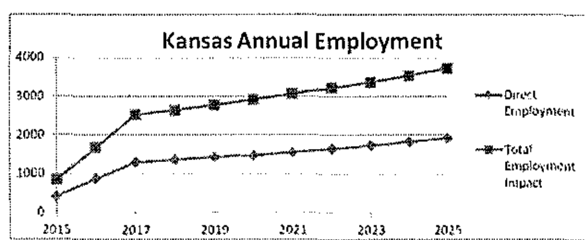
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	140	272	$14.25	$26.49	$153.36	
2016	280	545	$28.50	$52.97	$306.72	100%
2017	420	817	$42.75	$79.46	$460.08	50%
2018	441	858	$44.88	$83.44	$483.08	5%
2019	464	901	$47.13	$87.61	$507.24	5%
2020	487	946	$49.48	$91.99	$532.60	5%
2021	511	994	$51.96	$96.59	$559.23	5%
2022	537	1043	$54.56	$101.42	$587.19	5%
2023	563	1095	$57.28	$106.49	$616.55	5%
2024	592	1150	$60.15	$111.81	$647.38	5%
2025	621	1208	$63.16	$117.40	$679.75	5%

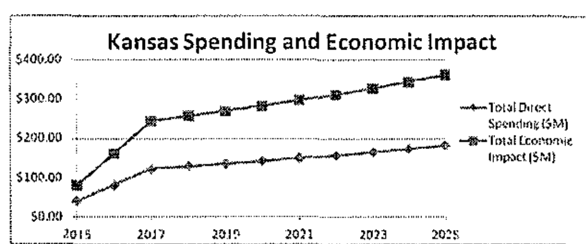




Kansas Economic Impact

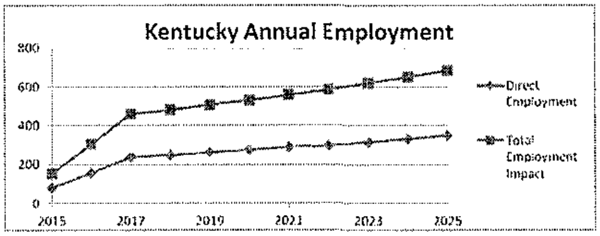
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	431	838	$41.18	$81.50	$807.44	
2016	863	1677	$82.36	$163.01	$1,614.89	100%
2017	1294	2515	$123.54	$244.51	$2,422.33	50%
2018	1359	2641	$129.72	$256.73	$2,543.45	5%
2019	1426	2773	$136.20	$269.57	$2,670.62	5%
2020	1498	2911	$143.01	$283.05	$2,804.15	5%
2021	1573	3057	$150.16	$297.20	$2,944.36	5%
2022	1651	3210	$157.67	$312.06	$3,091.58	5%
2023	1734	3370	$165.55	$327.66	$3,246.16	5%
2024	1821	3539	$173.83	$344.05	$3,408.47	5%
2025	1912	3716	$182.52	$361.25	$3,578.89	5%

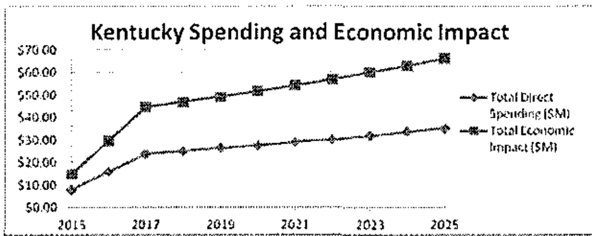




Kentucky Economic Impact

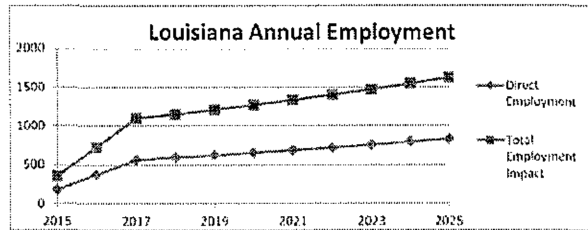
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	79	153	$7.96	$14.87	$149.97	
2016	157	306	$15.92	$29.74	$299.93	100%
2017	236	459	$23.88	$44.61	$449.90	50%
2018	248	482	$25.08	$46.84	$472.39	5%
2019	260	506	$26.33	$49.19	$496.01	5%
2020	273	531	$27.65	$51.65	$520.81	5%
2021	287	558	$29.03	$54.23	$546.85	5%
2022	301	586	$30.48	$56.94	$574.19	5%
2023	316	615	$32.00	$59.79	$602.90	5%
2024	332	646	$33.60	$62.78	$633.05	5%
2025	349	678	$35.28	$65.92	$664.70	5%

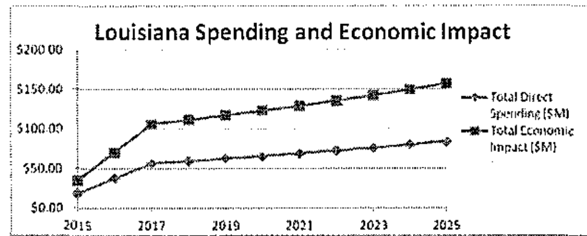




Louisiana Economic Impact

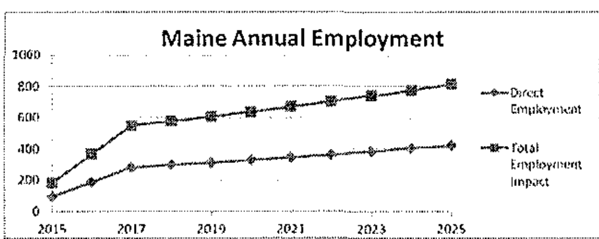
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	188	366	$19.02	$35.54	$240.37	
2016	376	731	$38.04	$71.07	$480.75	100%
2017	564	1097	$57.06	$106.61	$721.12	50%
2018	592	1151	$59.91	$111.94	$757.18	5%
2019	622	1209	$62.91	$117.54	$795.04	5%
2020	653	1269	$66.05	$123.41	$834.79	5%
2021	686	1333	$69.36	$129.58	$876.53	5%
2022	720	1400	$72.82	$136.06	$920.35	5%
2023	756	1470	$76.46	$142.87	$966.37	5%
2024	794	1543	$80.29	$150.01	$1,014.69	5%
2025	833	1620	$84.30	$157.51	$1,065.42	5%

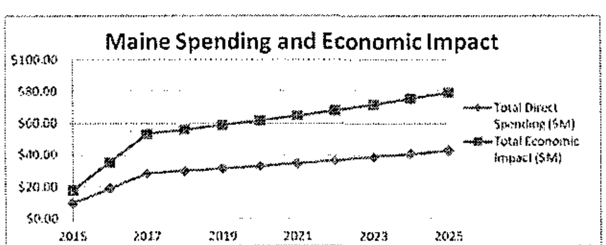




Maine Economic Impact

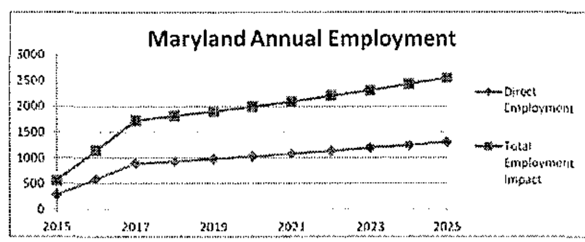
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	94	183	$9.56	$17.76	$209.43	
2016	188	365	$19.12	$35.53	$418.86	100%
2017	282	548	$28.68	$53.29	$628.29	50%
2018	296	576	$30.11	$55.96	$659.71	5%
2019	311	604	$31.62	$58.76	$692.69	5%
2020	326	635	$33.20	$61.69	$727.33	5%
2021	343	666	$34.86	$64.78	$763.70	5%
2022	360	700	$36.60	$68.02	$801.88	5%
2023	378	735	$38.43	$71.42	$841.97	5%
2024	397	771	$40.35	$74.99	$884.07	5%
2025	417	810	$42.37	$78.74	$928.28	5%

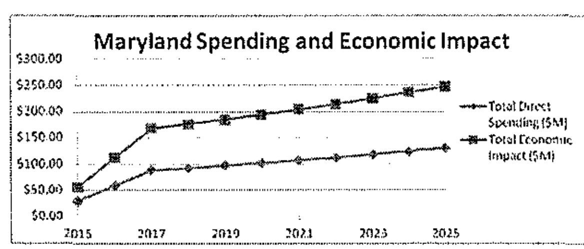




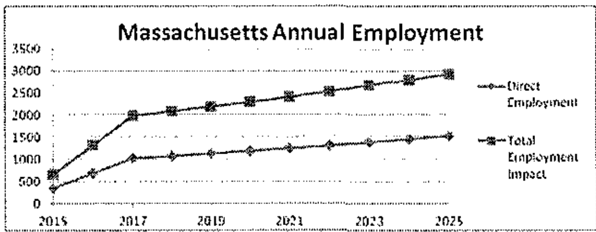
Maryland Economic Impact

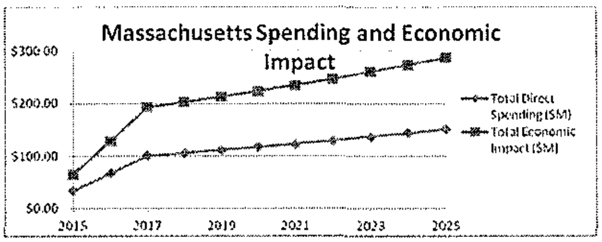
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	296	575	$29.33	$55.91	$439.20	
2016	592	1150	$58.67	$111.83	$878.39	100%
2017	888	1725	$88.00	$167.74	$1,317.59	50%
2018	932	1812	$92.40	$176.13	$1,383.46	5%
2019	979	1902	$97.02	$184.93	$1,452.64	5%
2020	1028	1997	$101.87	$194.18	$1,525.27	5%
2021	1079	2097	$106.97	$203.89	$1,601.53	5%
2022	1133	2202	$112.31	$214.08	$1,681.61	5%
2023	1190	2312	$117.93	$224.79	$1,765.69	5%
2024	1249	2428	$123.83	$236.02	$1,853.98	5%
2025	1311	2549	$130.02	$247.83	$1,946.67	5%



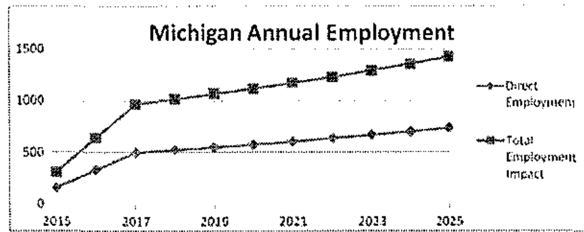


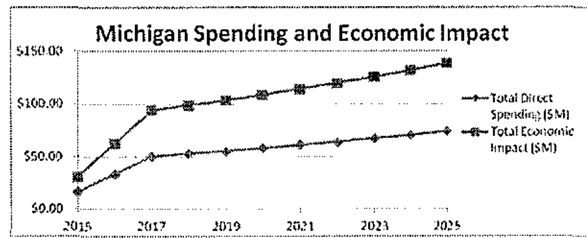
Massachusetts Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	340	662	$33.61	$64.33	$560.47	
2016	681	1323	$67.21	$128.66	$1,120.95	100%
2017	1021	1985	$100.82	$192.99	$1,681.42	50%
2018	1072	2084	$105.86	$202.64	$1,765.49	5%
2019	1126	2189	$111.16	$212.77	$1,853.76	5%
2020	1182	2298	$116.71	$223.41	$1,946.45	5%
2021	1241	2413	$122.55	$234.58	$2,043.78	5%
2022	1303	2534	$128.68	$246.31	$2,145.96	5%
2023	1369	2660	$135.11	$258.63	$2,253.26	5%
2024	1437	2793	$141.87	$271.56	$2,365.93	5%
2025	1509	2933	$148.96	$285.14	$2,484.22	5%



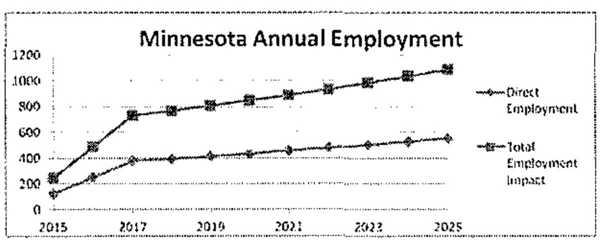


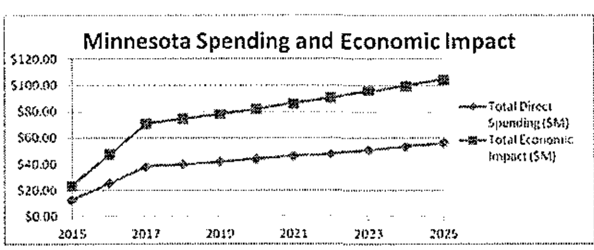
Michigan Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	165	322	$16.68	$31.27	$228.98	
2016	331	643	$33.36	$62.54	$457.95	100%
2017	496	965	$50.04	$93.81	$686.93	50%
2018	521	1013	$52.54	$98.50	$721.28	5%
2019	547	1064	$55.16	$103.42	$757.34	5%
2020	575	1117	$57.92	$108.59	$795.21	5%
2021	603	1173	$60.82	$114.02	$834.97	5%
2022	633	1231	$63.86	$119.72	$876.71	5%
2023	665	1293	$67.05	$125.71	$920.55	5%
2024	698	1358	$70.40	$131.99	$966.58	5%
2025	733	1426	$73.92	$138.59	$1,014.91	5%



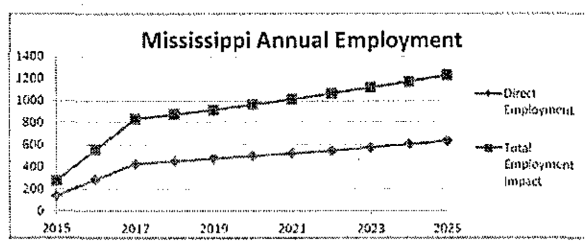


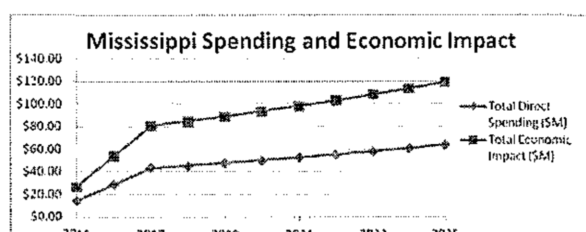
Minnesota Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	125	243	$12.66	$23.65	$279.35	
2016	250	487	$25.32	$47.30	$558.70	100%
2017	375	730	$37.99	$70.95	$838.05	50%
2018	394	766	$39.88	$74.49	$879.95	5%
2019	414	805	$41.88	$78.22	$923.95	5%
2020	435	845	$43.97	$82.13	$970.15	5%
2021	456	887	$46.17	$86.24	$1,018.66	5%
2022	479	931	$48.48	$90.55	$1,069.59	5%
2023	503	978	$50.90	$95.07	$1,123.07	5%
2024	528	1027	$53.45	$99.83	$1,179.22	5%
2025	555	1078	$56.12	$104.82	$1,238.18	5%



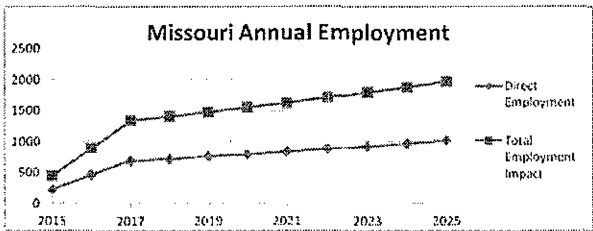


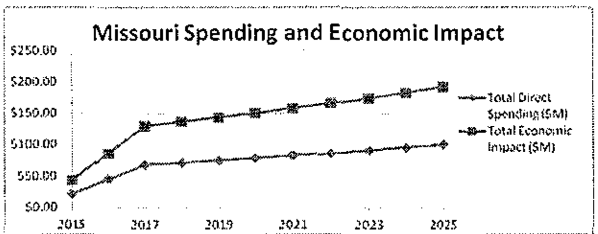
Mississippi Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	143	277	$14.48	$26.97	$183.05	
2016	285	555	$28.97	$53.94	$366.09	100%
2017	428	832	$43.45	$80.91	$549.14	50%
2018	450	874	$45.62	$84.95	$576.59	5%
2019	472	918	$47.90	$89.20	$605.42	5%
2020	496	963	$50.30	$93.66	$635.69	5%
2021	520	1012	$52.81	$98.35	$667.48	5%
2022	546	1062	$55.46	$103.26	$700.85	5%
2023	574	1115	$58.23	$108.43	$735.90	5%
2024	602	1171	$61.14	$113.85	$772.69	5%
2025	633	1230	$64.20	$119.54	$811.33	5%



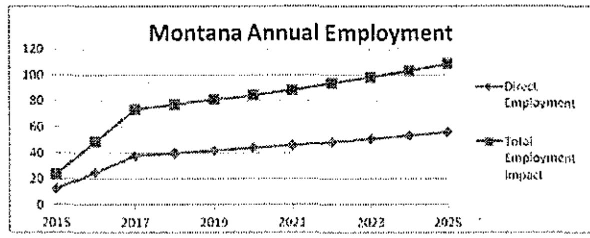


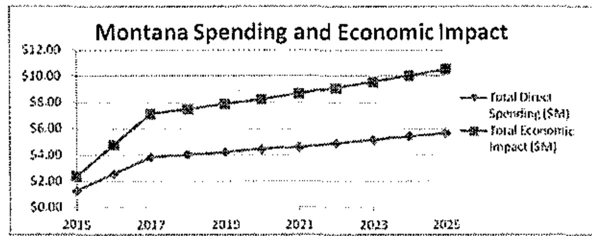
Missouri Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	230	446	$22.75	$43.38	$287.55	
2016	459	892	$45.50	$86.75	$575.10	100%
2017	689	1338	$68.26	$130.13	$862.65	50%
2018	723	1405	$71.67	$136.63	$905.79	5%
2019	759	1476	$75.25	$143.46	$951.07	5%
2020	797	1549	$79.02	$150.64	$998.63	5%
2021	837	1627	$82.97	$158.17	$1,048.56	5%
2022	879	1708	$87.12	$166.08	$1,100.99	5%
2023	923	1794	$91.47	$174.38	$1,156.04	5%
2024	969	1883	$96.05	$183.10	$1,213.84	5%
2025	1017	1978	$100.85	$192.26	$1,274.53	5%



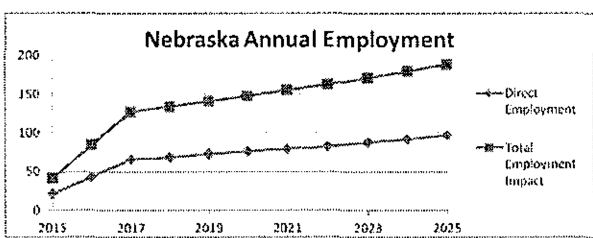


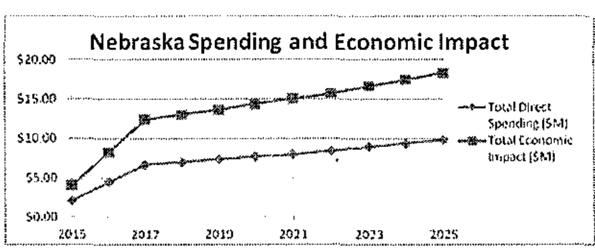
Montana Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	13	25	$1.28	$2.38	$25.33	
2016	25	49	$2.56	$4.76	$50.66	100%
2017	38	74	$3.84	$7.15	$75.98	50%
2018	40	77	$4.04	$7.50	$79.78	5%
2019	42	81	$4.24	$7.88	$83.77	5%
2020	44	85	$4.45	$8.27	$87.96	5%
2021	46	89	$4.67	$8.69	$92.36	5%
2022	48	94	$4.91	$9.12	$96.98	5%
2023	51	99	$5.15	$9.58	$101.82	5%
2024	53	103	$5.41	$10.06	$106.92	5%
2025	56	109	$5.68	$10.56	$112.26	5%



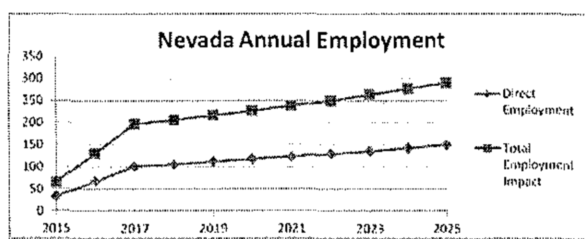


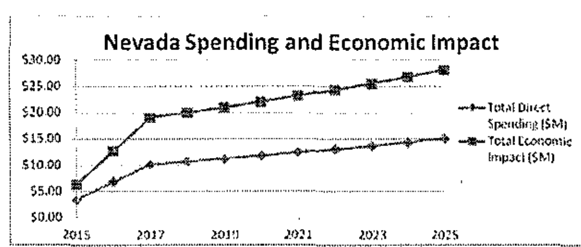
Nebraska Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	22	43	$2.23	$4.14	$35.91	
2016	44	85	$4.46	$8.29	$71.82	100%
2017	66	128	$6.68	$12.43	$107.73	50%
2018	69	134	$7.02	$13.05	$113.11	5%
2019	73	141	$7.37	$13.70	$118.77	5%
2020	76	148	$7.74	$14.39	$124.71	5%
2021	80	155	$8.12	$15.11	$130.94	5%
2022	84	163	$8.53	$15.86	$137.49	5%
2023	88	171	$8.96	$16.66	$144.37	5%
2024	93	180	$9.40	$17.49	$151.58	5%
2025	97	189	$9.87	$18.37	$159.16	5%





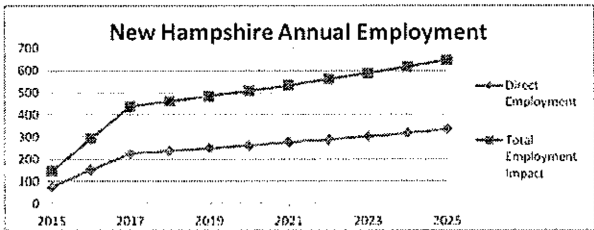
Nevada Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	34	65	$3.41	$6.36	$0.00	
2016	67	131	$6.81	$12.72	$0.00	100%
2017	101	196	$10.22	$19.08	$0.00	50%
2018	106	206	$10.73	$20.03	$0.00	5%
2019	111	216	$11.27	$21.03	$0.00	5%
2020	117	227	$11.83	$22.08	$0.00	5%
2021	123	238	$12.42	$23.19	$0.00	5%
2022	129	250	$13.04	$24.35	$0.00	5%
2023	135	263	$13.69	$25.56	$0.00	5%
2024	142	276	$14.38	$26.84	$0.00	5%
2025	149	290	$15.10	$28.18	$0.00	5%

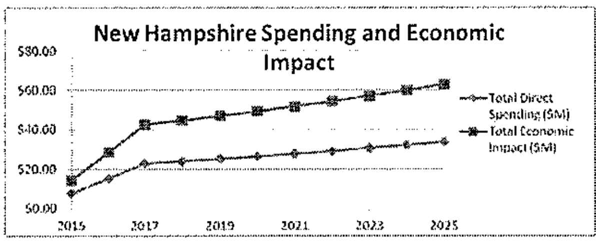




New Hampshire Economic Impact

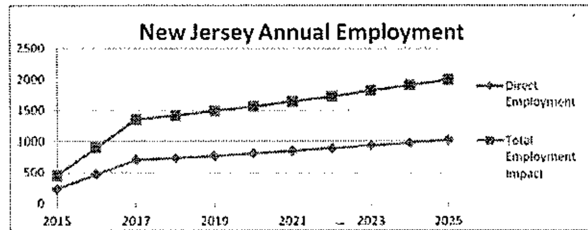
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	75	146	$7.65	$14.23	$0.00	
2016	151	293	$15.29	$28.47	$0.00	100%
2017	226	439	$22.94	$42.70	$0.00	50%
2018	237	461	$24.09	$44.84	$0.00	5%
2019	249	484	$25.29	$47.08	$0.00	5%
2020	262	508	$26.56	$49.43	$0.00	5%
2021	275	534	$27.89	$51.90	$0.00	5%
2022	288	561	$29.28	$54.50	$0.00	5%
2023	303	589	$30.75	$57.22	$0.00	5%
2024	318	618	$32.28	$60.08	$0.00	5%
2025	334	649	$33.90	$63.09	$0.00	5%

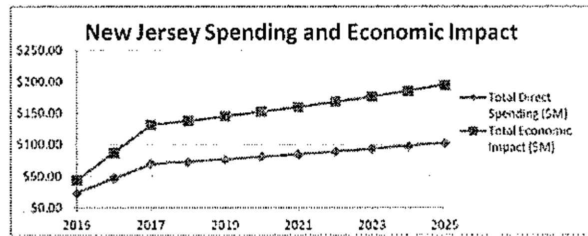




New Jersey Economic Impact

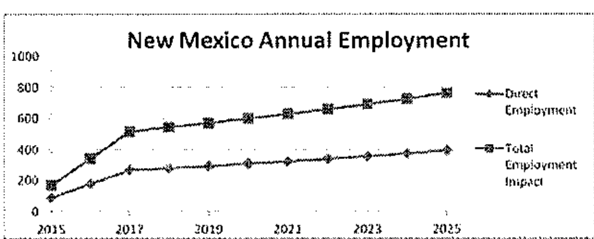
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	232	451	$23.21	$43.84	$540.55	
2016	464	902	$46.43	$87.67	$1,081.10	100%
2017	696	1353	$69.64	$131.51	$1,621.65	50%
2018	731	1420	$73.13	$138.08	$1,702.74	5%
2019	767	1491	$76.78	$144.99	$1,787.87	5%
2020	806	1566	$80.62	$152.24	$1,877.27	5%
2021	846	1644	$84.65	$159.85	$1,971.13	5%
2022	888	1726	$88.89	$167.84	$2,069.69	5%
2023	933	1813	$93.33	$176.23	$2,173.17	5%
2024	979	1903	$98.00	$185.05	$2,281.83	5%
2025	1028	1999	$102.90	$194.30	$2,395.92	5%

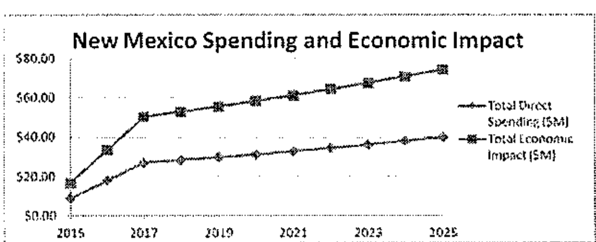




New Mexico Economic Impact

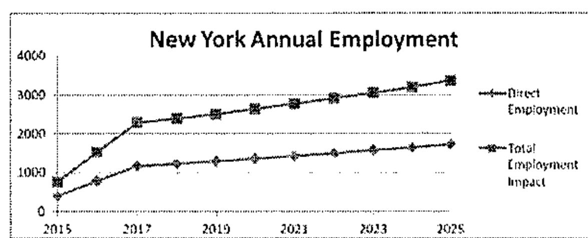
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	89	173	$9.00	$16.78	$122.20	
2016	178	345	$18.01	$33.57	$244.40	100%
2017	266	518	$27.01	$50.35	$366.60	50%
2018	280	544	$28.36	$52.87	$384.93	5%
2019	294	571	$29.78	$55.51	$404.18	5%
2020	308	600	$31.27	$58.29	$424.39	5%
2021	324	630	$32.83	$61.20	$445.60	5%
2022	340	661	$34.47	$64.26	$467.89	5%
2023	357	694	$36.19	$67.47	$491.28	5%
2024	375	729	$38.00	$70.85	$515.84	5%
2025	394	765	$39.90	$74.39	$541.64	5%

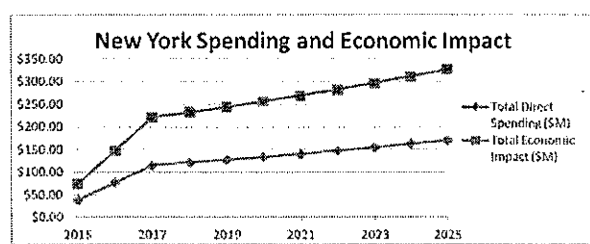




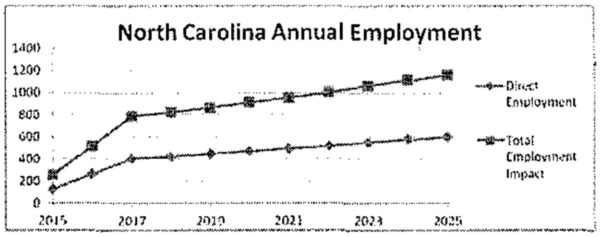
New York Economic Impact

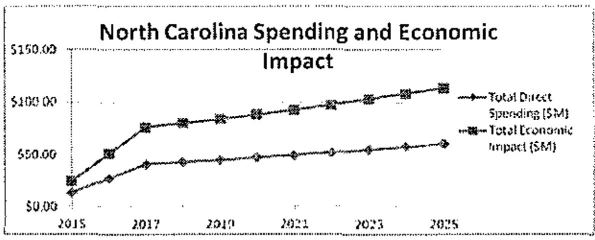
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	390	759	$38.45	$73.76	$777.49	
2016	781	1517	$76.89	$147.51	$1,554.98	100%
2017	1171	2276	$115.34	$221.27	$2,332.46	50%
2018	1229	2390	$121.11	$232.33	$2,449.09	5%
2019	1291	2509	$127.16	$243.95	$2,571.54	5%
2020	1355	2635	$133.52	$256.14	$2,700.12	5%
2021	1423	2766	$140.20	$268.95	$2,835.12	5%
2022	1494	2905	$147.21	$282.40	$2,976.88	5%
2023	1569	3050	$154.57	$296.52	$3,125.73	5%
2024	1648	3203	$162.29	$311.35	$3,282.01	5%
2025	1730	3363	$170.41	$326.91	$3,446.11	5%



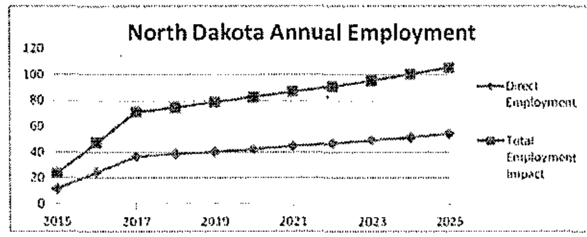


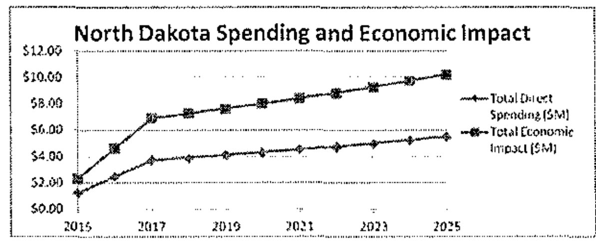
North Carolina Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	135	262	$13.59	$25.44	$297.86	
2016	269	523	$27.19	$50.88	$595.71	100%
2017	404	785	$40.78	$76.31	$893.57	50%
2018	424	824	$42.82	$80.13	$938.25	5%
2019	445	865	$44.97	$84.13	$985.16	5%
2020	467	909	$47.21	$88.34	$1,034.42	5%
2021	491	954	$49.57	$92.76	$1,086.14	5%
2022	515	1002	$52.05	$97.40	$1,140.44	5%
2023	541	1052	$54.66	$102.27	$1,197.47	5%
2024	568	1105	$57.39	$107.38	$1,257.34	5%
2025	597	1160	$60.26	$112.75	$1,320.21	5%



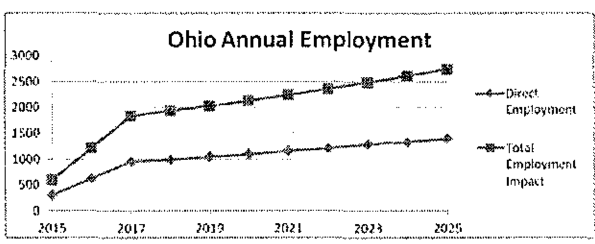


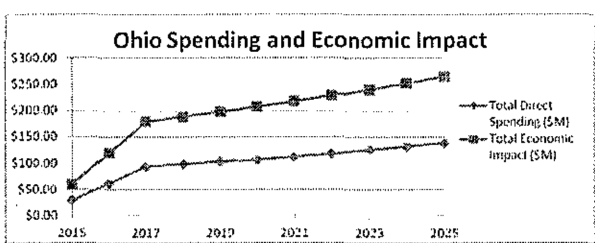
North Dakota Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	12	24	$1.24	$2.31	$11.11	
2016	24	47	$2.48	$4.62	$22.22	100%
2017	37	71	$3.73	$6.93	$33.33	50%
2018	38	75	$3.91	$7.27	$35.00	5%
2019	40	79	$4.11	$7.64	$36.75	5%
2020	42	82	$4.31	$8.02	$38.58	5%
2021	45	87	$4.53	$8.42	$40.51	5%
2022	47	91	$4.76	$8.84	$42.54	5%
2023	49	95	$4.99	$9.28	$44.66	5%
2024	52	100	$5.24	$9.75	$46.90	5%
2025	54	105	$5.51	$10.23	$49.24	5%



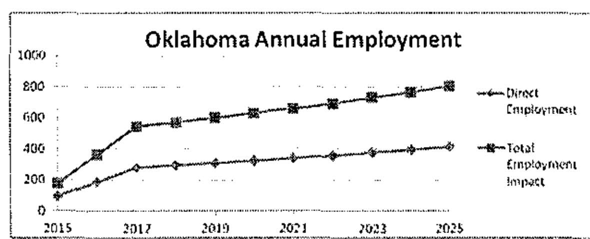


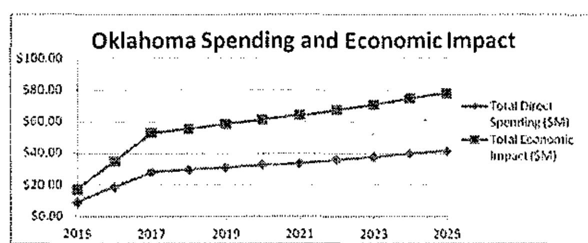
Ohio Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	316	615	$31.25	$59.77	$404.63	
2016	633	1230	$62.49	$119.54	$809.26	100%
2017	949	1844	$93.74	$179.31	$1,213.89	50%
2018	996	1937	$98.42	$188.27	$1,274.59	5%
2019	1046	2033	$103.34	$197.69	$1,338.32	5%
2020	1098	2135	$108.51	$207.57	$1,405.23	5%
2021	1153	2242	$113.94	$217.95	$1,475.50	5%
2022	1211	2354	$119.63	$228.85	$1,549.27	5%
2023	1272	2472	$125.62	$240.29	$1,626.73	5%
2024	1335	2595	$131.90	$252.30	$1,708.07	5%
2025	1402	2725	$138.49	$264.92	$1,793.47	5%



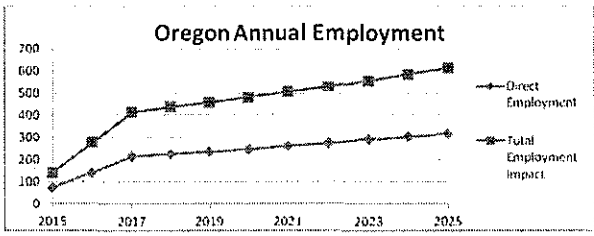


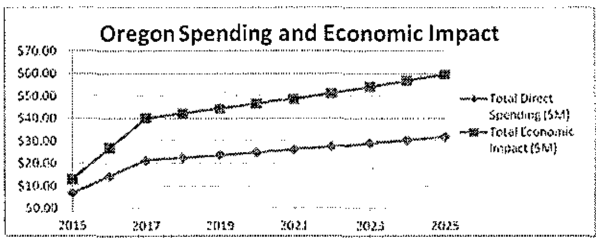
Oklahoma Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	93	182	$9.41	$17.65	$155.51	
2016	187	363	$18.82	$35.30	$311.02	100%
2017	280	545	$28.24	$52.95	$466.53	50%
2018	294	572	$29.65	$55.60	$489.85	5%
2019	309	600	$31.13	$58.38	$514.35	5%
2020	324	631	$32.69	$61.30	$540.06	5%
2021	341	662	$34.32	$64.36	$567.07	5%
2022	358	695	$36.04	$67.58	$595.42	5%
2023	375	730	$37.84	$70.96	$625.19	5%
2024	394	766	$39.73	$74.51	$656.45	5%
2025	414	805	$41.72	$78.23	$689.27	5%



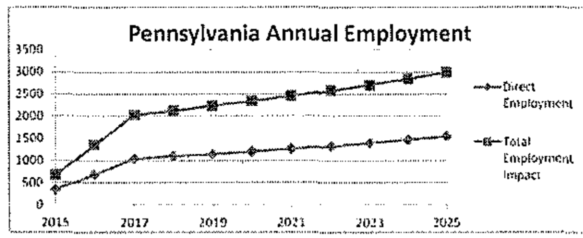


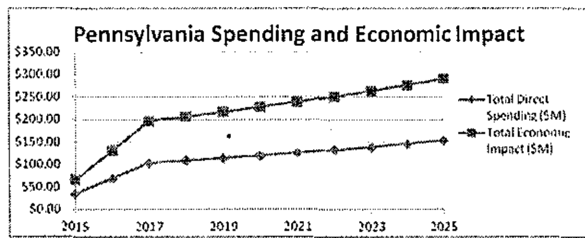
Oregon Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	71	139	$7.21	$13.48	$68.59	
2016	143	277	$14.43	$26.96	$137.18	100%
2017	214	416	$21.64	$40.43	$205.77	50%
2018	225	437	$22.72	$42.46	$216.06	5%
2019	236	459	$23.86	$44.58	$226.86	5%
2020	248	481	$25.05	$46.81	$238.20	5%
2021	260	506	$26.30	$49.15	$250.11	5%
2022	273	531	$27.62	$51.61	$262.62	5%
2023	287	557	$29.00	$54.19	$275.75	5%
2024	301	585	$30.45	$56.90	$289.54	5%
2025	316	614	$31.97	$59.74	$304.01	5%



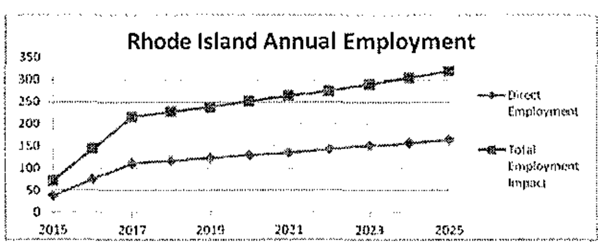


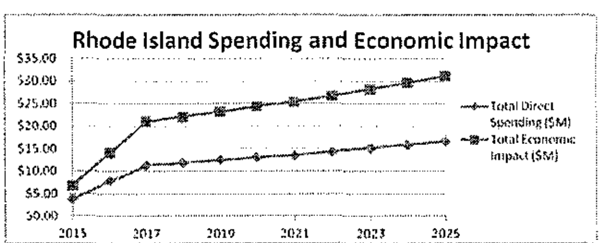
Pennsylvania Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	347	674	$34.53	$65.49	$335.94	
2016	693	1347	$69.06	$130.97	$671.88	100%
2017	1040	2021	$103.60	$196.46	$1,007.82	50%
2018	1092	2122	$108.77	$206.28	$1,058.21	5%
2019	1146	2228	$114.21	$216.59	$1,111.12	5%
2020	1203	2339	$119.92	$227.42	$1,166.67	5%
2021	1264	2456	$125.92	$238.80	$1,225.01	5%
2022	1327	2579	$132.22	$250.74	$1,286.26	5%
2023	1393	2708	$138.83	$263.27	$1,350.57	5%
2024	1463	2843	$145.77	$276.44	$1,418.10	5%
2025	1536	2986	$153.06	$290.26	$1,489.00	5%



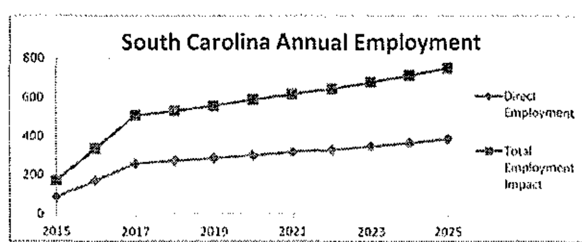


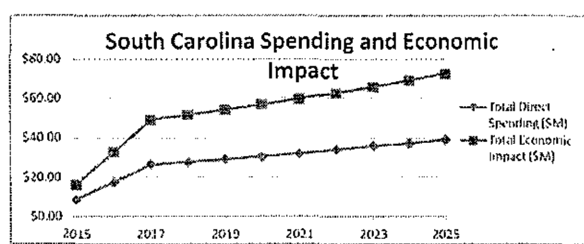
Rhode Island Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	37	72	$3.77	$7.02	$63.33	
2016	74	144	$7.53	$14.04	$126.65	100%
2017	111	217	$11.30	$21.06	$189.98	50%
2018	117	227	$11.86	$22.11	$199.48	5%
2019	123	239	$12.46	$23.22	$209.45	5%
2020	129	251	$13.08	$24.38	$219.92	5%
2021	135	263	$13.73	$25.60	$230.92	5%
2022	142	276	$14.42	$26.88	$242.46	5%
2023	149	290	$15.14	$28.22	$254.59	5%
2024	157	305	$15.90	$29.63	$267.32	5%
2025	165	320	$16.69	$31.12	$280.68	5%





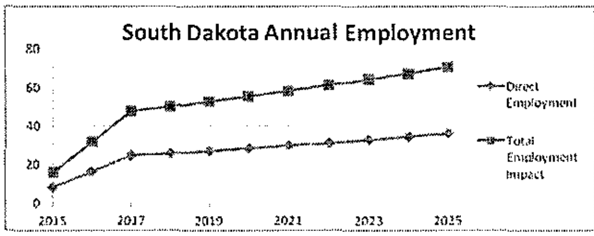
South Carolina Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	87	169	$8.84	$16.43	$193.68	
2016	174	338	$17.68	$32.86	$387.36	100%
2017	261	507	$26.52	$49.29	$581.04	50%
2018	274	532	$27.85	$51.75	$610.09	5%
2019	288	559	$29.24	$54.34	$640.60	5%
2020	302	587	$30.70	$57.06	$672.63	5%
2021	317	616	$32.24	$59.91	$706.26	5%
2022	333	647	$33.85	$62.91	$741.57	5%
2023	350	679	$35.54	$66.05	$778.65	5%
2024	367	713	$37.32	$69.35	$817.58	5%
2025	385	749	$39.18	$72.82	$858.46	5%

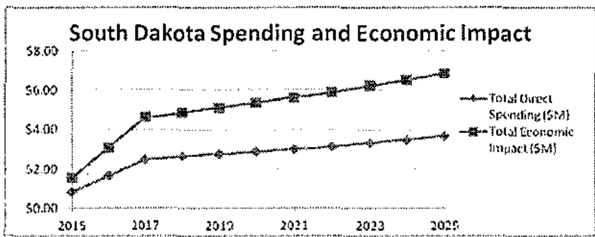




South Dakota Economic Impact

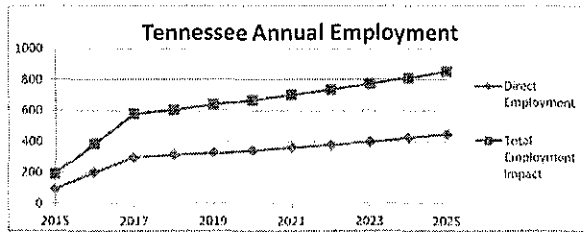
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	8	16	$0.83	$1.55	$0.00	
2016	16	32	$1.66	$3.10	$0.00	100%
2017	25	48	$2.49	$4.65	$0.00	50%
2018	26	50	$2.62	$4.88	$0.00	5%
2019	27	53	$2.75	$5.13	$0.00	5%
2020	28	55	$2.88	$5.38	$0.00	5%
2021	30	58	$3.03	$5.65	$0.00	5%
2022	31	61	$3.18	$5.94	$0.00	5%
2023	33	64	$3.34	$6.23	$0.00	5%
2024	35	67	$3.50	$6.54	$0.00	5%
2025	36	71	$3.68	$6.87	$0.00	5%

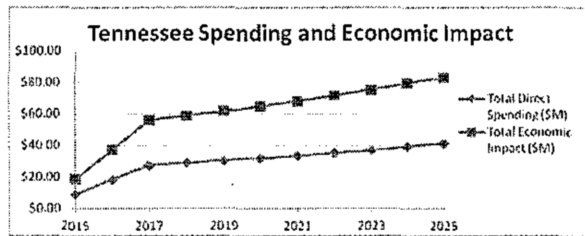




Tennessee Economic Impact

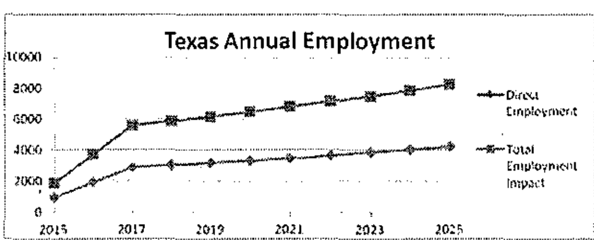
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	99	193	$9.20	$18.72	$0.00	
2016	198	385	$18.40	$37.44	$0.00	100%
2017	297	578	$27.61	$56.15	$0.00	50%
2018	312	606	$28.99	$58.96	$0.00	5%
2019	328	637	$30.43	$61.91	$0.00	5%
2020	344	669	$31.96	$65.01	$0.00	5%
2021	361	702	$33.55	$68.26	$0.00	5%
2022	379	737	$35.23	$71.67	$0.00	5%
2023	398	774	$36.99	$75.25	$0.00	5%
2024	418	813	$38.84	$79.02	$0.00	5%
2025	439	853	$40.79	$82.97	$0.00	5%

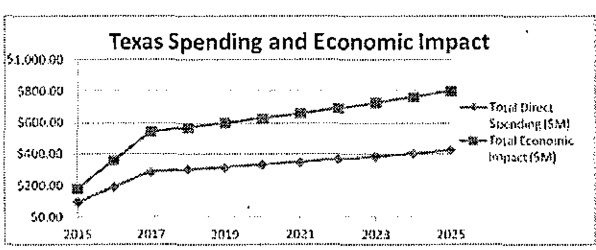




Texas Economic Impact

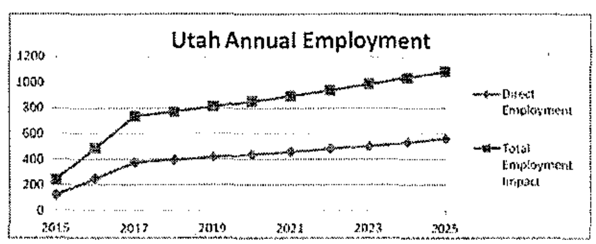
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	958	1863	$96.15	$181.08	$0.00	
2016	1916	3725	$192.30	$362.17	$0.00	100%
2017	2875	5588	$288.44	$543.25	$0.00	50%
2018	3018	5867	$302.87	$570.42	$0.00	5%
2019	3169	6161	$318.01	$598.94	$0.00	5%
2020	3328	6469	$333.91	$628.89	$0.00	5%
2021	3494	6792	$350.61	$660.33	$0.00	5%
2022	3669	7132	$368.14	$693.35	$0.00	5%
2023	3852	7488	$386.54	$728.01	$0.00	5%
2024	4045	7863	$405.87	$764.41	$0.00	5%
2025	4247	8256	$426.16	$802.63	$0.00	5%

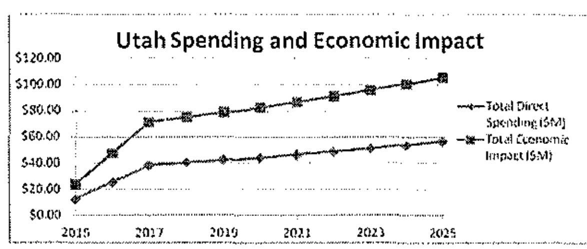




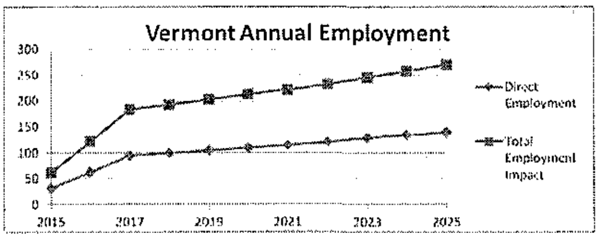
Utah Economic Impact

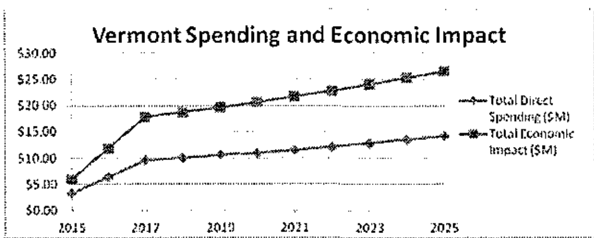
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	126	245	$12.79	$23.81	$201.35	
2016	252	490	$25.57	$47.61	$402.69	100%
2017	378	735	$38.36	$71.42	$604.04	50%
2018	397	771	$40.27	$74.99	$634.24	5%
2019	417	810	$42.29	$78.74	$665.95	5%
2020	437	850	$44.40	$82.67	$699.25	5%
2021	459	893	$46.62	$86.81	$734.21	5%
2022	482	938	$48.95	$91.15	$770.92	5%
2023	506	984	$51.40	$95.70	$809.47	5%
2024	532	1034	$53.97	$100.49	$849.94	5%
2025	558	1085	$56.67	$105.51	$892.44	5%



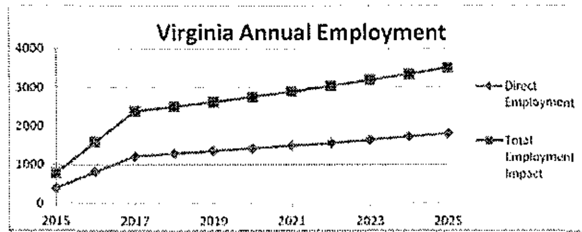


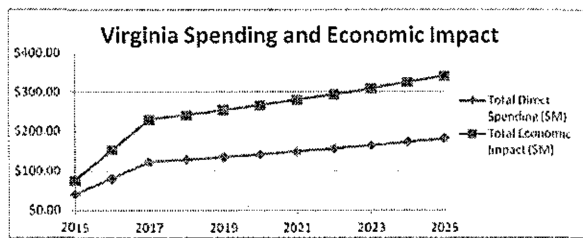
Vermont Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	31	61	$3.20	$5.95	$77.97	
2016	63	122	$6.40	$11.90	$155.94	100%
2017	94	184	$9.61	$17.84	$233.91	50%
2018	99	193	$10.09	$18.74	$245.61	5%
2019	104	202	$10.59	$19.67	$257.89	5%
2020	109	212	$11.12	$20.66	$270.78	5%
2021	115	223	$11.68	$21.69	$284.32	5%
2022	121	234	$12.26	$22.78	$298.54	5%
2023	127	246	$12.87	$23.91	$313.47	5%
2024	133	258	$13.52	$25.11	$329.14	5%
2025	140	271	$14.19	$26.37	$345.60	5%



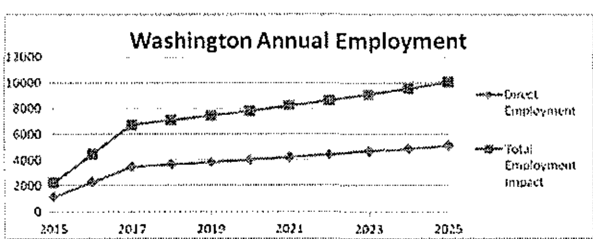


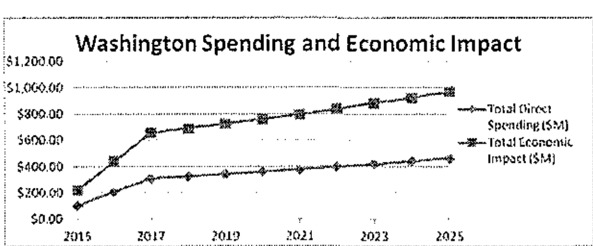
Virginia Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	408	793	$41.21	$77.14	$744.50	
2016	816	1587	$82.41	$154.28	$1,489.00	100%
2017	1225	2380	$123.62	$231.42	$2,233.51	50%
2018	1286	2499	$129.80	$242.99	$2,345.18	5%
2019	1350	2624	$136.29	$255.14	$2,462.44	5%
2020	1418	2756	$143.11	$267.89	$2,585.56	5%
2021	1489	2893	$150.26	$281.29	$2,714.84	5%
2022	1563	3038	$157.77	$295.35	$2,850.58	5%
2023	1641	3190	$165.66	$310.12	$2,993.11	5%
2024	1723	3349	$173.95	$325.63	$3,142.77	5%
2025	1809	3517	$182.64	$341.91	$3,299.90	5%



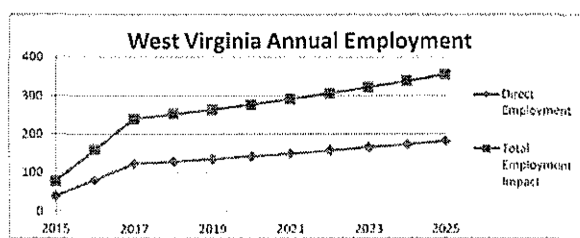


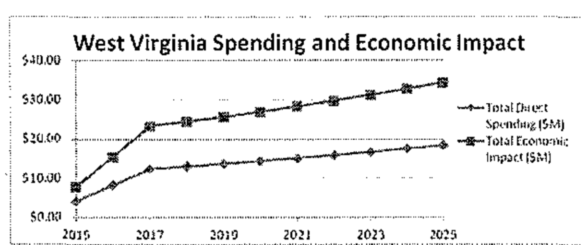
Washington Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	1157	2249	$102.88	$218.61	$0.00	
2016	2314	4497	$205.76	$437.23	$0.00	100%
2017	3470	6746	$308.63	$655.84	$0.00	50%
2018	3644	7083	$324.06	$688.64	$0.00	5%
2019	3826	7438	$340.27	$723.07	$0.00	5%
2020	4017	7809	$357.28	$759.22	$0.00	5%
2021	4218	8200	$375.14	$797.18	$0.00	5%
2022	4429	8610	$393.90	$837.04	$0.00	5%
2023	4651	9040	$413.60	$878.89	$0.00	5%
2024	4883	9492	$434.28	$922.84	$0.00	5%
2025	5127	9967	$455.99	$968.98	$0.00	5%



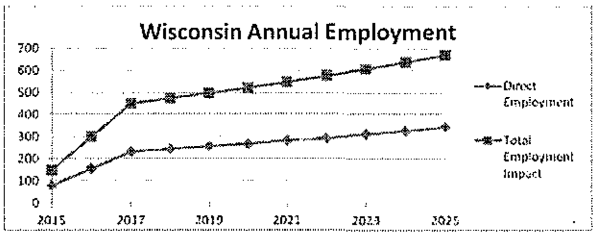


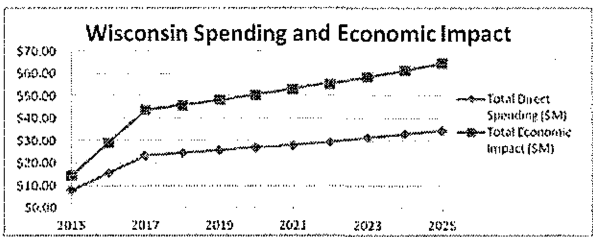
West Virginia Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	41	80	$4.16	$7.77	$78.42	
2016	82	160	$8.33	$15.54	$156.84	100%
2017	123	240	$12.49	$23.31	$235.26	50%
2018	129	252	$13.11	$24.47	$247.03	5%
2019	136	264	$13.77	$25.70	$259.38	5%
2020	143	278	$14.46	$26.98	$272.35	5%
2021	150	291	$15.18	$28.33	$285.96	5%
2022	157	306	$15.94	$29.75	$300.26	5%
2023	165	321	$16.74	$31.23	$315.28	5%
2024	174	337	$17.57	$32.79	$331.04	5%
2025	182	354	$18.45	$34.43	$347.59	5%



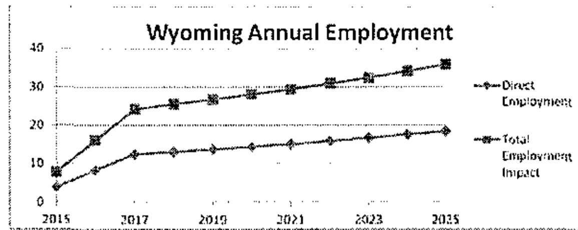


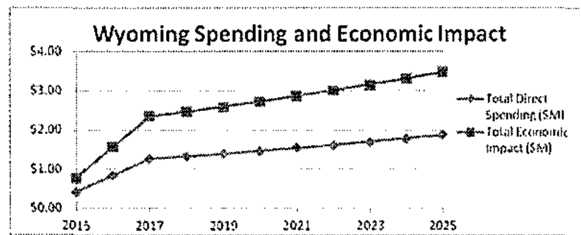
Wisconsin Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	77	150	$7.83	$14.59	$159.52	
2016	154	300	$15.66	$29.19	$319.05	100%
2017	232	450	$23.49	$43.78	$478.57	50%
2018	243	473	$24.66	$45.97	$502.50	5%
2019	255	497	$25.89	$48.27	$527.62	5%
2020	268	521	$27.19	$50.69	$554.01	5%
2021	282	547	$28.55	$53.22	$581.71	5%
2022	296	575	$29.98	$55.88	$610.79	5%
2023	310	604	$31.47	$58.67	$641.33	5%
2024	326	634	$33.05	$61.61	$673.40	5%
2025	342	665	$34.70	$64.69	$707.07	5%





Wyoming Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	4	8	$0.42	$0.79	$0.00	
2016	8	16	$0.85	$1.57	$0.00	100%
2017	12	24	$1.27	$2.36	$0.00	50%
2018	13	25	$1.33	$2.47	$0.00	5%
2019	14	27	$1.40	$2.60	$0.00	5%
2020	14	28	$1.47	$2.73	$0.00	5%
2021	15	29	$1.54	$2.86	$0.00	5%
2022	16	31	$1.62	$3.01	$0.00	5%
2023	17	32	$1.70	$3.16	$0.00	5%
2024	18	34	$1.78	$3.32	$0.00	5%
2025	18	36	$1.87	$3.48	$0.00	5%





** Some states have zero tax revenue, because those states do not have a state income tax.

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AUVSI FAST FACTS

MISSION

The mission of AUVSI is to advance the unmanned systems and robotics community through education, advocacy and leadership.

MEMBERS

AUVSI represents more than 7,000 individual members and more than 600 corporate members from 60+ allied countries involved in the fields of government, industry and academia. AUVSI members work in the defense, civil and commercial markets.

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- **AUVSI's Unmanned Systems Conference and Exhibition** – More than 8,000 attendees and 600+ exhibitors from more than 40 countries and an average annual growth rate of 20% make this the leading event for the global unmanned systems and robotics marketplace. www.auvsishow.org
- **AUVSI's Unmanned Systems Program Review** – Providing the latest information on government and industry programs for ground, air and maritime systems, this annual event is one of the most important to the unmanned systems community. This is one event where business happens.
- **Networking Events** – AUVSI hosts meetings and events worldwide, providing education and networking opportunities for key industry leaders, including AUVSI's Driverless Car Summit.

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AUVSI works with its membership to shape policy by advocating on behalf of the unmanned systems industry, monitoring legislation and assessing the impact of the industry. AUVSI plays a key role in addressing critical industry issues, such as National Airspace Access, Frequency Spectrum (GPS), NextGen/SESAR, Coalition Building and First Responder Grants. AUVSI works to influence legislation, including the FAA Reauthorization, Transportation Bill, DOD Reauthorization and Homeland Security Reauthorization.

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- **Print** - *Unmanned Systems* magazine – A monthly magazine providing current industry news, trends and emerging developments; *Unmanned Systems: Mission Critical* – A quarterly supplement dedicated to unmanned systems sectors that, once tapped, will change the way the world works.
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The AUVSI Foundation is a tax-exempt 501(c)3 public charity established to support educational initiatives such as AUVSI's Youth Education Program, discussion groups, forums and other programs. The foundation has provided more than $500,000 to educational programs worldwide. Each year, the AUVSI Foundation hosts and sponsors competitions to challenge students to design, build and deploy autonomous air, ground and maritime systems.

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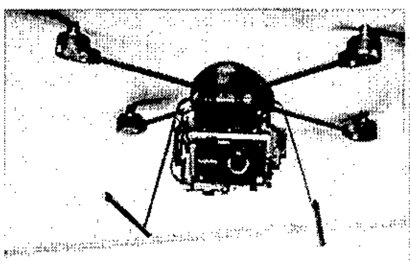
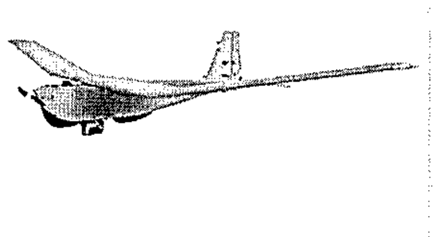
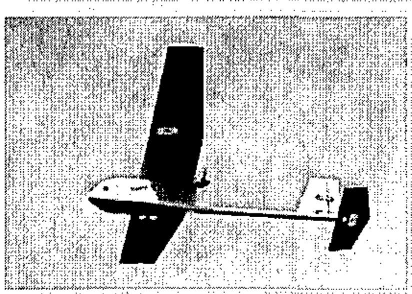
Economic Impact of a

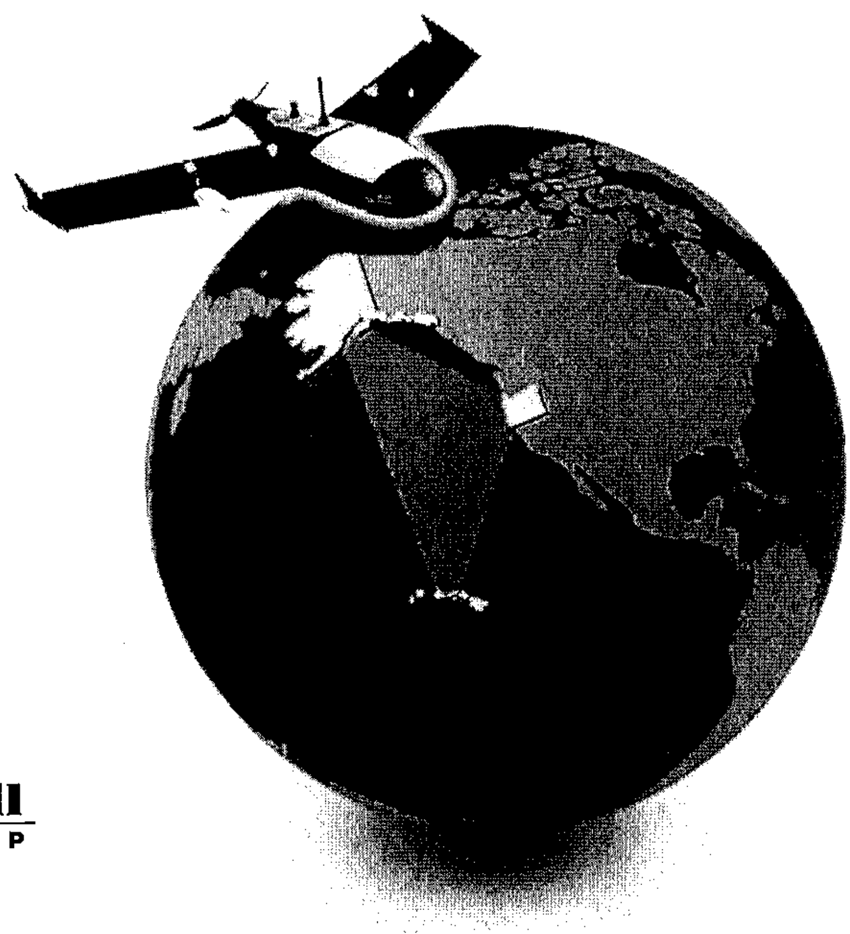
Pan-Pacific Unmanned Aircraft Systems Test Site

May 2013









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Alaska Center for Unmanned
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University of Alaska Fairbanks

PREPARED BY

McDowell
GROUP

Table of Contents

Purpose and Scope

In March 2013, the University of Alaska Fairbanks Center for Unmanned Aircraft Systems contracted with McDowell Group to analyze the economic conditions for unmanned aircraft systems (UASs) in Alaska and measure the projected economic impact of developing a Federal Aviation Administration (FAA) test site for UAS in Alaska. The economic impact assessment (EIA) in this report provides annual projections of the direct, indirect, and induced impacts to employment and wages as well as projections of output and value added related to the test site, called the Pan-Pacific UAS Test Range Complex (PPUTRC) – with test ranges located in Alaska, Hawaii, and Oregon. The EIA focuses on the additional economic activity that is expected in response to the PPUTRC test site selection. Additional information is provided in this report on the economic impact of the commercialization of UAS specifically in Alaska once UAS flights are allowed in the National Airspace System (NAS).

Summary

- UAS represent a new industry that is set to quickly grow once new government regulations increase access to designated test sites and then to the National Airspace System (NAS), the system of air traffic control that enables safe and efficient flight activity in the U.S.
- UAS applications are far reaching for civilian and military purposes; ranging from environmental monitoring to search and rescue to pipeline or powerline inspections.
- The FAA has limited the authorized use of UASs in the U.S. to efforts focused on the public interest. There are currently two ways to operate a UAS with the approval of the FAA (both of these options require that the flight takes place outside of densely-populated areas):
    - Certificate of Waiver or Authorization (COA) for public UAS
    - Special airworthiness certificate for private sector (civil) UAS
- However, the FAA is scheduled to designate six UAS test sites in the U.S., as required under the FAA Modernization and Reform Act of 2012. The sites will operate from January of 2014 to February 13, 2017 to provide opportunities for government agencies, industry, and researchers to access this airspace to aid in the integration of UASs in the NAS.
- According to the Association of Unmanned Vehicle Systems International (AUVSI), integration of UASs into the NAS will generate some $82 billion in activity in the U.S. between 2015 and 2025; employment impacts are estimated at just over 100,000 jobs by 2025.

- In an effort to bring additional UAS activity and related economic benefits to Alaska, UAF is leading the PPUTRC Test Site application process for 13 ranges in Alaska, Hawaii, and Oregon.
- Existing UAS activity in Alaska, Hawaii, and Oregon benefits from unique assets and opportunities, including government facilities (e.g. numerous military bases, universities, and maritime assets), wide-open airspace in largely unpopulated areas, and geographic diversity (e.g. tropical to arctic climates, oceanic or mountainous landscapes, and up/down weather fronts).
- In total, designation of PPUTRC as a UAS test site would be expected to generate 1,065 direct, indirect and induced jobs in 2014, increasing to over 1,400 jobs by 2017. Total labor income would climb from $57 million in 2014 to about $76 million in 2017.
- Output in the PPUTRC states attributable to test site designation would climb from $265 million in 2014 to $333 million in 2017.
- Value added would climb from $109 million to $134 million over the same period.
- Designation of the PPUTRC will provide a four-year total of $20 million of income tax revenue to Hawaii and Oregon.

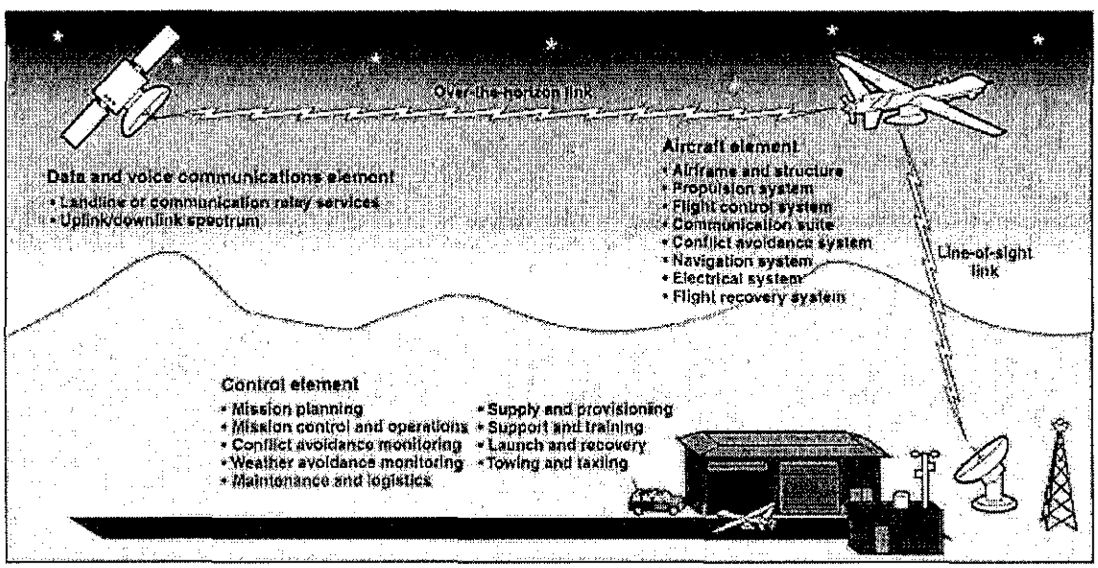
Chapter 1. Unmanned Aircraft Systems in the United States and the NAS

Background

Unmanned aerial vehicles (UAVs) were first described in the late-19th century. Early attempts to develop these UAVs, mostly for combat purposes, soon followed. These remotely piloted vehicles first entered U.S. combat in the mid-20th century to support missions focused on reconnaissance and surveillance, and sometimes they were also used as decoys. Throughout most of the 20th century UAVs lacked real-time data capability and instead focused on collecting images and video for surveillances purposes. Widespread adoption of the technology for U.S. military purposes did not begin until the 1990s and, to a much greater extent, the 2000s during the Afghanistan and Iraq conflicts. It was at this point that technological innovations related to onboard sensors, communication links, and data collection began drastically increasing the potential domestic uses of unmanned aircraft systems.

The increase in complexity for the UAVs required a systems approach to appropriately understand the interactions - and design each component from the start as an integratedsystem - among the on-the-ground control elements, the aircraft, and the communication links. This broader operational perspective is termed "unmanned aircraft system" (UAS). The image below provides a conceptual rendering of the interactions among key elements of a UAS flight.

Figure 1: Conceptual Rendering of an Unmanned Aircraft System



Source: GAO, 2013

UAS Applications

Unmanned aircraft often provide advantages in comparison to manned aircraft. For instance, flights that are dangerous or covert represent potential opportunities where an unmanned vehicle might be preferred over a manned vehicle. Similarly, dull tasks such as extended surveillance missions may be better suited for ground-based operators that can be relieved at the end of their shift. UAVs are often more fuel efficient, quieter, and less disruptive to their surroundings (in comparison to manned aircrafts) and, thus, can allow for fewer environmental disturbances as well as more accurate research results. Finally, initial costs, operating costs (e.g. maintenance costs, fuel costs, storage costs, etc.), and labor costs (e.g. wages, insurances, etc.) are all generally lower for UAVs (Source: Austin, 2010). UASs have already been shown to lead to arrests as well as saving lives during search and rescue missions (Source: The Verge, 2013).

The existing and potential applications for UASs are wide ranging for both civilian uses as well as for military purposes. The lists below provide an abbreviated look at how important this relatively new field may become to sectors throughout Alaska's economy (Source: Austin, 2010):

Civilian

- Aerial Photography - Film, video, stills, etc.
- Agriculture - Crop monitoring and spraying; herd monitoring and driving
- Coastguard – Search and rescue, coastline, and sea-lane monitoring
- Conservation – Pollution and land monitoring
- Customs and Excise – Surveillance for illegal imports
- Electricity Companies – Powerline inspection
- Fire Services and Forestry – Fire detection, incident control
- Fisheries – Fisheries protection
- Gas and Oil Supply Companies – Land survey and pipeline security
- Information Services – News information and pictures, feature pictures (e.g. wildlife)
- Lifeboat Institutions – Incident investigation, guidance, and control
- Local Authorities – Survey, disaster control
- Meteorological Services – Sampling and analysis of atmosphere for forecasting, etc.
- Oil Companies – Pipeline security
- Ordinance Survey – Aerial photography for mapping
- Police Authorities – Search for missing persons, security and incident surveillance
- Rivers Authorities –Water course and level monitoring, flood and pollution control
- Survey Organizations – Geographical, geological, and archaeological survey
- Traffic Agencies – Monitoring and control of road traffic
- Water Boards – Reservoir and pipeline monitoring

Military

- Navy
    - Shadowing enemy fleets

    - Decoying missiles by the emission of artificial signatures
    - Electron intelligence
    - Relaying radio signals
    - Protection of ports from offshore attack
    - Placement and monitoring of sonar buoys and possibly other forms of anti-submarine warfare
- Army
    - Reconnaissance
    - Surveillance of enemy activity
    - Monitoring of nuclear, biological, or chemical (NBC) contamination
    - Electronic intelligence
    - Target designation and monitoring
    - Location and destruction of land mines
- Air Force
    - Long-range, high-altitude surveillance
    - Radar system jamming and destruction
    - Electronic intelligence
    - Airfield base security
    - Airfield damage assessment
    - Elimination of unexploded bombs

UAS Categories

UASs are typically categorized based on the size or capability of the UAV. The five categories below provide a common categorization of UAS that helps simplify requirement assessments and costing estimates (Source: Teal Group, 2008):

- Micro or Mini – A small UAV that ranges in size from something that can be held in the palm of the hand to a UAV that can be carried on your back and launched by hand.

- Naval – A tactical UAV is generally operated with simpler systems over a radius between 100 and 300 km.

- Tactical – A reconnaissance UAV used by the Army for endurance missions ranging several hours over an operating radius up to 200 km.

- MALE – Medium Altitude Long Endurance reconnaissance UAVs fly between 5,000 and 15,000 meters in altitude for approximately 24 hours.

- HALE – High Altitude Long Endurance reconnaissance and surveillance UAVs are usually operated by Air Forces at altitudes over 15,000 meters for periods longer than 24 hours.

National Airspace System

The NAS was developed to allow for safe and efficient commercial aviation. However, commercial UAS flights are currently not allowed in the NAS due to concerns over (1) "the inability to detect, sense, and avoid other aircraft and airborne objects in a manner similar to 'see and avoid' by a pilot in a manned aircraft, (2) vulnerabilities in the command and control of UAS operations, (3) the lack of technological and operational standards needed to guide the safe and consistent performance of UAS, and (4) the lack of final regulations to accelerate the safe integration of UAS into the national airspace" (Source: U.S. GAO, 2012 and Waggoner, 2013).

The first authorized use of UASs in the NAS in the U.S. was permitted by FAA in 1990. Over the past 23 years, the FAA has limited the authorized use of UAS in the U.S. to efforts focused on the public interest. These missions have included border patrol, military training, disaster relief, firefighting, search and rescue, law enforcement, and testing and evaluation. According to the FAA, the Department of Homeland Security currently utilize UASs for border and port surveillance; NASA and NOAA utilize UAS to help with scientific research and environmental monitoring; law enforcement agencies utilize UASs to support public safety; and state universities use UASs to conduct research (Source: FAA Fact Sheet 2013). These efforts are limited to areas outside of major urban areas at elevations less than 50,000 feet. The aircraft range in size from a hummingbird to a wingspan as large as a Boeing 737; although many are the size of a remote-control plane or helicopter. Recreational use of airspace is allowed away from airports and air traffic and below 400 feet above ground level – informal flights for business purposes are specifically excluded (Source: FAA Advisory Circular 91-57).

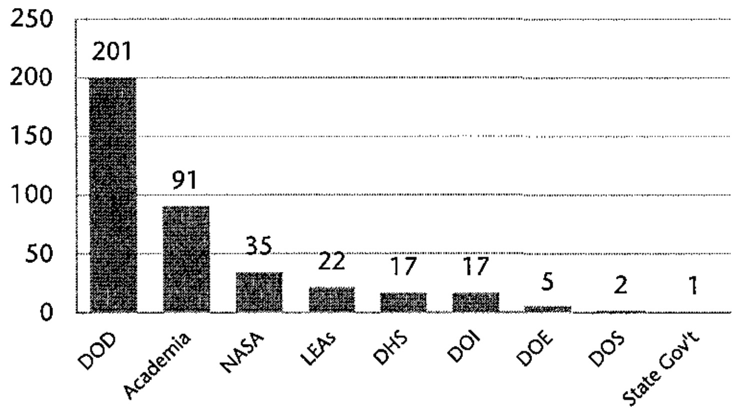
As of 2013, there are currently two ways to operate a UAS with the approval of the FAA: (1) Certificate of Waiver or Authorization (COA) for public UAS's and (2) special airworthiness certificate for private sector (civil) UAS's – both of these options require that the flight takes place outside of densely-populated areas.

Certificate of Waiver or Authorization (COA)

COAs allow public entities to fly UASs in a defined block of civil airspace. The FAA issued the first COAs in January 2007. With COAs, the UAV must remain in view, either of the ground crew or via a chase plane, since UAS technology cannot currently comply with 'See and Avoid' rules. COAs usually require between six and 24 months for approval and cost $40,000 to $60,000 (Source: Economic Development of Central Oregon, 2011). Most of the cost is for specialists in the testing protocols, documentation, and in managing the process through the FAA. Common applications by COA holders include firefighting, border patrol, disaster relief, search and rescue, military training, and other government operational missions (Source: FAA 2013b). The number of COAs issued has increased since 2009, with 146 in 2009, 298 in 2010, and 313 in 2011 (Source: FAA 2013b). In 2012, the FAA issued 391 COAs to 121 federal, state, and local government entities in the U.S. A total of 1,428 COAs have been issued since January of 2007 (Source: GAO 2013). As of February 15, 2013, there were 327 active COAs (Source: FAA 2013b).

The graph below aggregates the 391 COAs issued in 2012 to nine types of entities: U.S. Department of Defense, academia, NASA, local law enforcement agencies, U.S. Department of Homeland Security, U.S. Department of the Interior, U.S. Department of Energy, U.S. Department of State, and state government.

Figure 2: Number of Approved COAs, 2012



Source: GAO, 2013

Special Airworthiness Certificate

Special airworthiness certificates are the only way for civil operators to fly UASs in the NAS at present. However, these certificates cannot be utilized to carry people or property for compensation or hire – they can only be issued for research and development, crew training, or market surveys (Source: FAA 2011).

Allowing UAS in the NAS

In recent years the FAA has made a concerted effort to integrate UAS regulations into the NAS. In 2009, the FAA, NASA, DoD, and the Department of Homeland Security began addressing pathways to integrating UAS regulations into the NAS through their UAS Executive Committee. Additionally, the FAA chartered a UAS Aviation Rulemaking Committee in 2011 to create operational procedures, regulatory standards, and policies related to UAS flights in the NAS. In 2012, the FAA Modernization and Reform Act of 2012 (FMRA of 2012) was passed by Congress to approve six test sites where UAS integration could be tested prior to a 2015 integration of UAS regulations in the NAS (Source: FAA 2012). Delays within the FAA due to technical, logistical, and public outreach concerns may contribute to a UAS integration date later than 2015. However, six test sites are still scheduled to run from January 1, 2014 to February 13, 2017.

SIX UAS TEST SITES

There is considerable competition over where test sites will be designated, since designation will provide immediate employment in the selected region and support a strong foundation for UAS activity prior to integration of UAS regulation in the NAS. As of March 5, 2013, 50 applicants from 37 states were granted access to the FAA test site application web portal (Source: FAA 2013b). The FAA will consider five key items when deciding the location of the six test sites: (1) geographic and climatic diversity, (2) location of ground infrastructure and research needs, (3) consultation with NASA and DOD, (4) population density and air traffic density of the surrounding area of any proposed location as well as the potential impact areas in the event of incidents, such as "Fly away" given potential safety mitigations; and (5) identification of specific goals and objectives to be accomplished. Additionally, the test sites are expected to provide an environment and opportunity to test conventional takeoff and landing capability, high speed flight (greater than 250 knots indicated air speed), maritime (launch/maneuver/recovery) capability, operations at extremely high altitudes (Class A airspace and above), and evaluation of dissimilar aircraft (including a mix of manned and unmanned aircraft) in multiple altitude structures (Source: FAA 2013a).

The six test sites that are selected will support the following operations and programs:

- Safe designation of airspace for integrated manned and unmanned flight operations in the national airspace system;
- Development of certification standards and air traffic requirements for unmanned flight operations;
- Coordinating with and leveraging the resources of NASA and the Department of Defense;
- Addressing both civil and public unmanned aircraft systems;
- Ensuring that the program is coordinated with the Next Generation Air Transportation System; and
- Ensuring the safety of unmanned aircraft systems and related navigation procedures before they are integrated into the national airspace system (Source: FAA, 2013b).

The test site operators will provide opportunities for government agencies, industry, and researchers to access this airspace to aid in the integration of UAS regulations in the NAS. Additionally, data collection will support development and operations research and professional development opportunities will be available for inspectors, airspace managers, air traffic controllers, and others. The specific goals described by the PPUTRC applicants include (Source: PPUTRC, 2013):

- Develop a set of standards for select unmanned aircraft categories, for aircraft state monitoring, and navigation. PPUTRC goals and objectives work will augment ongoing standards work with research on categories of UAS not yet addressed, and evaluations needed to refine emerging standards under consideration;
- Validate FAA acceptable risk thresholds or safety management system standards for UAS operations;

- Identify safety factors in UAS design; validate certification standards, including protocols for air traffic control interaction. Define and qualify underlying assumptions and a minimum set of air vehicle characteristics critical to safety, reliability, etc.;
- Develop effective, compliant 'sense and avoid' systems to satisfy regulatory guidance;
- Identify gaps in federal and state statutory and case law protections for privacy and recommend policies or legislation to remedy;
- Directly support the federal mandate for "Expanding Use of UAS in the Arctic" (in Sec 332(d) of Public Law 112-95);
- Design experiments and provide data to support American Society for Testing and Materials (ASTM) F38 and Radio Technical Commission for Aeronautics Special Committee (RTCA SC) 203 to evaluate minimum training and operator qualification standards for crew licensing.

Economic Impact of UAS in the U.S.

The economic implications of integrating UAS regulations into the NAS are substantial. According to a study conducted for the Association for Unmanned Vehicle Systems International (AUVSI), integration will generate $82 billion in activity between 2015 and 2025. Employment impacts are estimated at just over 100,000 jobs by 2025.

The direct economic impact of UAS development in the U.S. is expected to climb from $1.1 billion in 2015 to over $5 billion annually by 2025, measured in terms of output. Including indirect and induced effects, the annual economic impact is expected to rise from $2.3 billion in 2015 to $10 billion in 2025 (Source: AUVSI, 2013).

Areas selected as UAS test sites will have an advantage in capturing these economic benefits; thus the fierce competition among the 50 applicants.

Chapter 2. Pan-Pacific Test Range Complex

In 2012, the Alaska Center for UAS Integration (ACUASI) at the University of Alaska Fairbanks Geophysical Institute began collaborating with Oregon State University and the University of Hawaii to propose a Pan-Pacific Test Range Complex (PPUTRC) as one of the six FAA test sites. This proposed PPUTRC contains 13 test ranges located in Alaska, Hawaii, and Oregon. Of the 13 ranges, six ranges are in Alaska (Denali, Kodiak, North Slope, Oliktok, Poker Flat, and Wainwright), three ranges are in Hawaii (Humuula-R-3103, Makua-R-3109, and Maku-R-3110), and four ranges are in Oregon (Juniper MOA, Pendleton, Tillamook Coastal, and Warm Spring).

Existing UAS activity in Alaska, Hawaii, and Oregon benefits from unique assets and opportunities, including government facilities (e.g. numerous military bases, universities, and maritime assets), wide open airspace in largely unpopulated areas, and geographic diversity (e.g. tropical to arctic climates, oceanic or mountainous landscapes, and up/down weather fronts). The diverse testing environments for the PPUTRC are included in the Table 1 below:

Table 1: Diversity of Potential Testing Environments for the PPUTRC

360 degree oceanic airspace access	Arctic landscape	Extreme low temperatures
Oceanic and sea-ice access	High arctic winds	High sea-salt corrosion effect
Able to fully matrix UAS into NextGen and air traffic operating both VFR and IFR; high and low altitude	Operations in all classes and categories of military SUA	Operations in Classes A through F international airspace in the oceanic environment
Class C, D, & E airspace within 5-nautical miles of airports	High and low-land vegetation tundra	Numerous inland waterways and lakes
High density airports integration studies and testing	Class C, D, & E airspace airport approaches/departures	High-humidity high and low-altitude
Hot and cold high-desert testing	Littoral coastal region mountainous area	Class E (high) airspace
Jungle conditions	Class A airspace	Mountainous terrain
Volcanic	Glacier	Ship traffic including open ocean and ports

UAS Activity in Alaska, Hawaii, and Oregon

There are currently 15 active COAs in the PPUTRC area as well as eight in-process COAs and 20 expired COAs.

Alaska

ACUASI at the University of Alaska Fairbanks (UAF) is the lead organization for the proposed PPUTRC. The formal PPUTRC team includes over 80 businesses, universities, tribes, and economic development organizations in Alaska. UAF has actively managed UAS operations since 2004.

ACUASI was formed in 2012 to enhance UAS research in Alaska. ACUASI and the UAF Geophysical Institute have developed and flown a variety of in-situ and remote sensing instruments on various UASs in Alaska and throughout the world. Scientific and research campaigns undertaken in Alaska over the past decade include using UASs to support observation and monitoring of sea lions in the Aleutian Islands, weather forecasting, volcanic plume monitoring, atmospheric sampling during wildfires, monitoring of sea ice build ups, and oil spill mapping. Commercial applications trialed in Alaska include whale monitoring, cadastral mapping, maritime navigation support, industrial plant monitoring, and environmental clean-up. This experience, coupled with the FAA's UAS test site status, would leverage a variety of new economic activities in Alaska.

The following table, which summarizes ACUASI activity in 2012, illustrates the variety of UAS activity supported by the organization. The table also provides revenue and staffing data for each UAS campaign.

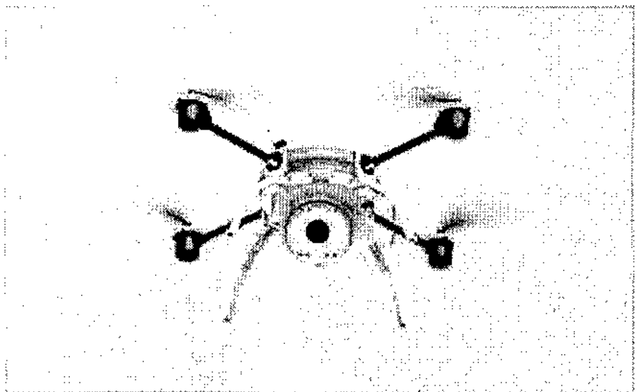
Table 2: UAS Campaigns Supported by the University of Alaska Fairbanks in 2012

Client	Flight Locations	Type of UAS	Purpose of Flights	Revenue for Site Operator	Site Operator Staff	Flight Operator Staff
Aleutians	Aleutian Islands, AK	Aeryon Scout and Puma	Seal observation	$314,200	2 pilots	1 observer
Idaho	Lewiston, ID	Aeryon Scout	Salmon nest observation	$115,000	1 pilot	1 observer
Eglin Air Force Base	Fort Walton Beach, FL	ScanEagle and Aeryon Scout	Controlled burn experiment	$413,000	4 pilots	3 observers
Prudhoe Bay	Prudhoe Bay, AK	Aeryon Scout	British Petroleum flare stack monitoring	$190,000	1 pilot	1 observer
Nome	Nome, AK	Aeryon Scout	Harbor Ice monitoring for USCG	$30,000	1 pilot	1 observer
Ugak Island	Ugak Island, AK	Aeryon Scout	Seal population monitor	$6,500	1 Pilot	1 observer
Fort Greely	Fort Greely, AK	ScanEagle and Aeryon Scout	Flight test	$25,000	2 pilots	2 observers
Chile	Santiago, Chile	Aeryon Scout	Glacier Ice monitor	$9,000	1 pilot	1 observer
Belgium	Belgium	Gatewing	Flight training	$16,000	2 pilots	1 observer
Anchorage	Fort Richardson, AK	Aeryon Scout	Flight test and demonstration	$1,000	2 pilots	1 observer
Fairbanks	Poker Flat Research Range	ScanEagle	Payload test	$347,000	2 pilots	1 observer
Fairbanks	Poker Flat Research Range	Aeryon Scout	Payload test and demonstration	$30,000	2 pilots	1 observer
Fairbanks	Poker Flat Research Range	Raven	Flight test for avionics	$5,000	2 pilots	2 observers
Hawaii	Offshore Hawaiian Islands	Puma	Tsunami debris tracking	$95,000	1 pilot	1 observer

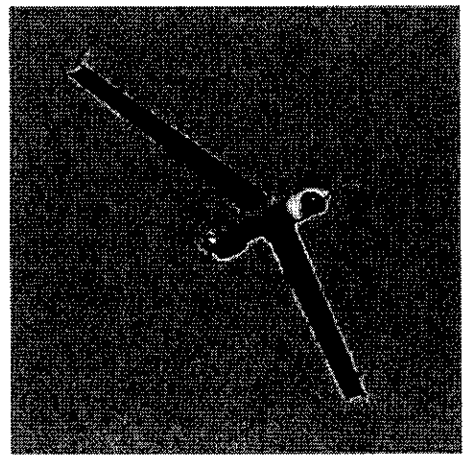
Sources: ACUASI, 2013

Figure 3: Types of UAS Flown in Alaska in 2012

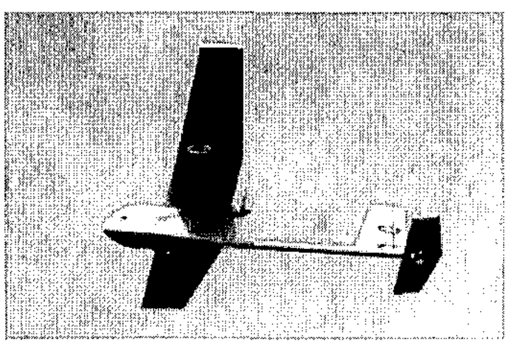
Aeryon Scout



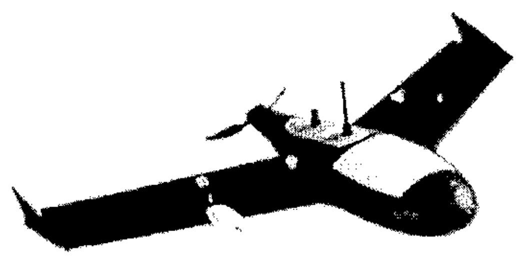
Boeing Insitu ScanEagle



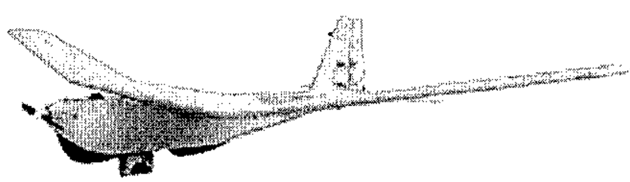
AeroVironment Raven



Gatewing



AeroVironment Puma



Hawaii

Hawaii offers many unique qualities that make UAS operations appealing. These include: (1) expansive over-water areas unencumbered by other aviation uses, (2) proximity to U.S. Pacific Command – a significant user of future UAS systems, (3) opportunities for joint operations with the Pacific Missile Range Facility – a major test range on Kauai, and (4) opportunities for long-range point-to-point tests with partner ranges in Alaska and Oregon. The Hawaii ranges have proven an important focus for the development of scientific applications of UAS, with significant milestones including test flights of the Aerovironment Pathfinder; Pathfinder Plus; and Helios solar-hybrid propulsion high altitude, long endurance UAS, between 1997 and 2001. Scientific applications led by U.S. federal agencies have recently seen Hawaii emerge as a focal point for NOAA's exploration of UAS as a tool for marine park surveillance. NOAA has utilized UAS to monitor Papahanaumokuakea Marine National Monument since 2007 and performed initial trials using small hand launched systems in mid-2012.

Oregon

The Oregon-based PPUTRC team members include 16 businesses, universities, tribes, and economic development organizations. Additionally, six committed team partners will convert to formal team members upon FAA test site designation award to PPUTRC. Engagements are also planned with a wide ranging network in Oregon – including the 111 AUVSI members and numerous startup companies, primarily in sensor, robotics, and other supporting technologies. In comparison to Alaska and Hawaii, Oregon has historically been more engaged in design, development, and manufacture of UAV systems and subsystems.

The two largest Oregon UAS firms are Insitu (design, development, and manufacture of UAS systems) and FLIR Systems (remote sensors). The main Oregon firm involved in UAS applications has been Near Space Corporation (NSC). NSC uses very high altitude unmanned balloons and gliders to perform scientific and commercial test activities, ranging from data gathering on behalf of government agencies to near-space testing of hardware and sensors for commercial firms. NSC is opening a new $6 million flight test and operations facility at the Tillamook Airport on the Oregon coast. Existing UAS activity also includes the Oregon Army National Guard operations in Pendleton. Oregon's UAS efforts are synergistic with a separately funded ground vehicle innovation initiative, Drive Oregon, which requires systems that can be spun out of UAS: quiet, efficient motors, lightweight composite designs, and navigation systems. The potential economic benefits of the test sites, as well as NAS integration, are particularly strong for Oregon's already significant aircraft manufacturing sector.

Recent UAS Funding in Alaska, Hawaii, and Oregon

Since 2004, nine Alaska contractors have received direct U.S. federal agency contracts for UAS goods and services. The largest federal contract in Alaska is a 5-year standing services award, worth $47 million, from the U.S. Navy to the University of Alaska in 2010 for UAS payload integration and flight test services. The second major award made since 2004 to an Alaska firm consists of a series of pacts totaling $17 million from the U.S. State Department to Anchorage-headquartered Kuk Construction (subsidiary of Olgoonik Development, an Alaskan Native Corporation) for the provision of UAS-based security surveillance services in Iraq in partnership with KBR, Inc. UAF has collaborated with commercial entities, such as Idaho Power Company, and manufacturers including AeroVironment to conduct surveys and observe environmental impacts. Additionally, UAF has collaborated with BP for oil spill response and flare stack monitoring, as well as projects focused on detecting and locating gas and oil pipeline leaks and developing new sensors and processes to identify leaks.

Hawaii's large military presence has resulted in defense spending as the primary source of federal funding to UAS vendors in the state. Direct defense contracts accounted for 94 percent of all awards in terms of obligated amounts from 2004-2012, rising to 97 percent when including awards placed by the General Services Administration on behalf of the U.S. Air Force. The remaining awards were placed with Honolulu-based Referentia Systems by NOAA as part of the Papahanaumokuakea Marine National Monument monitoring project. Hawaii supports a dedicated UAS development and manufacturing company, Williams Aerospace, a small firm currently developing new platforms in the fixed-wing, hand launched micro and medium altitude endurance classes. The state is also working to create two commercial UAS services arms, addressing the defense, homeland security, and precision agriculture markets.

In Oregon, a consortium of industry, academia, and public entities has created a 7-year strategic plan to double the size of the UAS industry in the state, with the help of a $2.5 million State of Oregon grant scheduled for the 2013-14 biennium and additional investments of at least $1.15 million from other sources for a total of $3.65 million. The plan specifically creates UAS solutions for commercial applications, and safely integrating those UAS solutions into the NAS. Projects include emergency response; weather; firefighting; search and rescue; wildlife and habitat management; law enforcement; physical and resource surveys (land and water); management of agriculture, livestock, and public lands; and management of public and private infrastructure. Oregon State University (OSU) has already begun UAS flights based on these research objectives.

Leveraging Current Research Institutes, Community Colleges, and Training Centers

ACUASI is collaborating with the UAF College of Engineering and Mines (CEM) and the Community and Technical College (CTC) to integrate UAS engineering, science, and technology into UAF's teaching, research, and service activities. Additionally, ACUASI is working with the CEM to fill a full-time tenure track engineering faculty position with a professor focused on UAS engineering, science, and technology. ACUASI and CTC also intend to include UAS technology courses in CTC's aviation curricula to train UAS developers, technicians, and pilots as well as to improve outreach to remote Alaskan villages that could benefit from UAS technologies. Cooperation with the CTC at UAA will add air traffic controller participation, offer training for UAS operators, and ultimately build a maintenance program similar to the Aircraft and Powerplant program currently offered.

The University of Hawaii is testing UASs in several of its research programs, evaluating the utility and impact of UAS through analysis of coastal resource management, terrestrial and aquatic environmental monitoring, natural source management and inventory, and human impact studies. University of Hawaii is also developing programs to train students and research professionals on UASs, and plans to integrate this capacity into accredited degree programs.

The new OSU industry-university UAS consortium will depend on test site facilities for collaborative research and development in all phases of operations and applications. Through the Colleges of Engineering, Science, Agriculture, Forestry and Earth, Ocean and Atmospheric Sciences, OSU has expertise and supports ongoing research on control theory and robotics, flexible airframes and flight, sensors, and signal processing, and numerous applications in natural and environmental sciences and environmental monitoring, measuring, and management. OSU-Cascades, located in Central Oregon near the Warm Springs and Juniper test ranges, offers programs in energy engineering, computer science, natural resources, and business, and plans to add programs designed in conjunction with the UAS industry. OSU-Cascades can also provide on-site facilities for OSU-Corvallis researchers leading projects in the region. Central Oregon Community College (COCC) has one of the largest aviation flight training programs on the West Coast – both fixed wing and rotary. COCC offers certifications for UAS flight training and plans to develop a program for data analysis of sensors, building on the school's strong geographic information systems program. Additionally, Blue Mountain Community College (BMCC) in Pendleton, Oregon is developing a UAS curriculum for instructional delivery and course certification. Oregon Institute of Technology (OIT) offers a variety of degrees in engineering and engineering technology, composite engineering, computer and software systems engineering, and electrical engineering, including a master's degree in manufacturing engineering. It offers degrees in professional land surveying and geographic information systems. OIT is collaborating with Rockwell Collins, the aviation electronics company, on real-world projects at a joint campus outside Portland and offers similar hands-on collaborations with other aerospace firms in the northwestern U.S.

Expansion of Existing Businesses and Attracting New Business Investment

The University of Alaska has spun off at least two companies who intend to test their products on the Pan-Pacific test range. These companies were created by University graduate students who were expanding their research in sensors for testing in UASs. UA recently received $5 million from the State of Alaska to support the development of a sustainable high-tech industry in Alaska. Already two companies have established satellite offices in Alaska to improve collaboration with the ACUASI.

Placement of a UAS test site in Hawaii will promote growth within Hawaii and reduce development cycles for manufacturers and researchers. Additionally, it would reduce or eliminate costs to ship sensors, and send knowledgeable staff, to mainland test sites to operate and demonstrate systems. Close proximity to a test site in Hawaii will greatly benefit firms such as BAE Systems, Williams Aerospace, and others – including many military and government contractors working with the Honolulu Fire Department, Honolulu Police Department, U.S. Civil Air Patrol, U.S. Coast Guard, U.S. Department of Defense, U.S. Department of Homeland Security, U.S. National Guard, and others.

In Oregon, more than a dozen companies have said that they will begin testing their sensor packages, propulsion systems, and airframes in Oregon if the Pan-Pacific UAS Test Area is designated as a national test site. Additionally, two companies have informally pledged to open satellite offices at a state test range. The PPUTRC will benefit UAS businesses in the Columbia River Gorge. Over the past seven years, the Gorge's UAS industry grew from a small core of 30 people to an employment base of more than 1,400 employees. Many of these new jobs were created by the UAS companies' suppliers. The two largest Oregon UAS manufacturers are Insitu, manufacturer of UAS platforms and subsystems, and FLIR Surveillance Systems, a manufacturer of electro-optic and infrared imaging systems. Insitu is a major global supplier of high endurance, runway-independent UAS. FLIR Surveillance provides more ER and IR imaging systems for unmanned aircraft, unmanned ground, and unmanned maritime platforms than any other company. Activity in the Gorge from firms such as Insitu, FLIR Surveillance Systems, Cloud Cap Technology, and UTC Aerospace has spun off more than 20 local companies. Central Oregon's general aviation aircraft manufacturing industry had a similar growth pattern over a 15-year period, expanding from a core company of about 30 employees (Lancair) to a cluster of 25 companies that now employs nearly 1,200 people. It is anticipated the PPUTRC will help expand these existing businesses in the Gorge and Central Oregon.

Infrastructure

Alaska expects to invest $1.5 million to construct a test site center at its Poker Flat Research Range, as well as develop and acquire mobile test infrastructure such as fixtures, data collection devices, and monitoring systems similar to its internet-Portable Aerial Surveillance System (iPASS), a web-based application that merges track information from radar, GPS, and a transponder interrogator/receiver. Additionally, large data collection requirements are expected to drive development of a data center for processing and storage.

Hawaii's test ranges link to military/restricted areas used for current UAS operations. These sites include the Pohakuloa training area on the Island of Hawaii, Bradshaw and Wheeler Army Airfields on Oahu, and the Pacific Missile Range Facility on Kauai. Other areas under consideration include Upolu and Dillingham Airfields (on the Big Island and Oahu, respectively). Test points within the ranges would be utilized to support both shore and ship-based development, testing and certification of new UASs, training and crew certification of operational UASs, and development of expanded and joint capabilities involving existing communications systems and operations tactics using UAS.

The budget for the $2.5 million Oregon innovation grant envisions spending at least $1.2 million at test ranges for new equipment and/or infrastructure, with the grant providing $300,000, private enterprise providing $750,000, and public entities providing $150,000. Possible infrastructure development proposed with this funding includes: portable ground radar units; an automatic dependent surveillance-broadcast ground station or a similar 'sense and avoid' technology system; one or more operations management buildings housing computers, calibration components, baseline sensors with a range of capabilities, data analysis equipment, supporting software, maintenance facilities and machine shops; and ground control stations, an observation tower, and ITAR facilities as needed. Additionally, as noted earlier, Near Space Corporation is preparing to open a new $6 million flight test and operations facility at the Tillamook airport.

Chapter 3. Potential Economic Impacts of the PPUTRC

Designation as one of the nation's six UAS test sites promises to have significant economic impacts in the areas where flight activity occurs and support services are provided. Private and public sector UAS activity that has been constrained by restricted access and a restrictive federal authorizing process will have much greater opportunity to conduct UAV flight operations. In this chapter the potential economic impacts in Alaska, Hawaii, and Oregon related to serving as a test site are quantified.

The following economic impact projections were developed by McDowell Group, Inc. utilizing flight activity, flight cost, and flight-related staffing data provided by PPUTRC team members. Direct economic activity was measured by approximating preflight administrative costs, site fees per day, operating costs per day, and total flight days from historical data provided by the applicant. Sector-level information was obtained from the applicant concerning the number of UAS-related firms and jobs per firm. Direct employment estimates were then coupled with multipliers obtained from the IMPLAN economic impact model to estimate total direct, indirect, and induced economic effects. Annual projections from 2014 to 2017 were calculated for each of the 13 ranges utilizing growth rates based on funding forecasts from the Teal Group UAS market profile and forecast report, historical flight activity, and projected growth in flight activity, research, and UAS-related manufacturing as provided by the applicant.

In total, designation of PPUTRC as a UAS test site would be expected to generate 1,065 direct, indirect, and induced jobs in 2014, increasing to over 1,400 jobs by 2017. Total labor income would climb from$57 million in 2014 to about $76 million in 2017.

Table 3: Summary Impacts of PPUTRC Test Site Designation, 2012-2017
Combined Impacts in Alaska, Hawaii and Oregon

Impact of Test Site Designation				
	2014	2015	2016	2017
Total Employment	**1,065**	**1,260**	**1,335**	**1,429**
Direct Employment	490	571	602	642
Indirect Employment	198	243	259	279
Induced Employment	377	447	474	508
Total Labor Income ($ million)	**$56.9**	**$66.9**	**$70.8**	**$75.6**
Direct Labor Income ($ million)	$26.4	$30.5	$32.2	$34.2
Indirect Labor Income ($ million)	$10.4	$12.5	$13.3	$14.4
Induced Labor Income ($ million)	$20.1	$23.8	$25.3	$27.1
Output ($ million)	**$265.0**	**$301.8**	**$315.9**	**$333.5**
Total Value Added ($ million)	**$109.3**	**$121.9**	**$127.1**	**$133.5**
State Income Taxes ($ million)	$4.3	$5.0	$5.3	$5.6

Employment Resulting from UAS and Test Site Operations

In 2014, with designation of PPURTC as a test site, UAS activity in Alaska, Hawaii, and Oregon is expected to account for 581 direct jobs and a total of 1,254 jobs - including direct, indirect, and induced jobs. Approximately 85 percent of that total employment (1,065 jobs) is attributable to test site designation. The remaining 15 percent (189 jobs) is expected to occur in the absence of PPUTRC test site designation. By 2017, employment will rise to an estimated 904 direct jobs and 1,991 total jobs - with 72 percent of that total employment (1,429) attributable to test site designation. A significant number of these direct jobs are expected in smaller communities that tend to have higher unemployment – thus test site designation for the PPUTRC will help improve opportunities where they will provide the most benefits.

Table 4: Direct Employment, 2012-2017

Direct Employment						
	2012	2013	2014	2015	2016	2017
Total Direct Employment						
PPUTRC	**74**	**82**	**581**	**712**	**801**	**904**
Alaska Ranges	43	47	129	142	157	173
Hawaii Ranges	-	-	-	72	95	126
Oregon Ranges	31	35	452	498	549	605
Impact of Test Site Designation						
PPUTRC	-	-	**490**	**571**	**602**	**642**
Alaska Ranges	-	-	77	82	86	91
Hawaii Ranges	-	-	-	72	95	126
Oregon Ranges	-	-	414	417	421	424

Oregon's relatively high direct employment numbers are due to the existing, well-developed aircraft manufacturing sector in Oregon. Oregon is well placed to supply the growing demand for UAS aircraft that will be triggered by UAS integration. Most of the new jobs created in Oregon due to PPUTRC designation include manufacturing jobs (many of which may be created due to designation of test sites anywhere in the U.S.). These numbers for Oregon are based on an analysis provided to McDowell Group by Economic Development for Central Oregon (EDCO).

In addition to direct jobs created from UAS firms, significant indirect and induced jobs will also be created. Indirect jobs represent jobs created throughout the supply chain to support the UAS industry and induced jobs represent jobs created due to changes in household consumption as a result of the UAS industry.

Table 5: Indirect Employment, 2012-2017

Indirect Employment						
	2012	2013	2014	2015	2016	2017
Total Indirect Employment						
PPUTRC	**21**	**24**	**224**	**290**	**328**	**374**
Alaska Ranges	7	8	22	24	27	30
Hawaii Ranges	-	-	-	42	56	74
Oregon Ranges	14	16	202	223	246	271
Impact of Test Site Designation						
PPUTRC	-	-	**198**	**243**	**259**	**279**
Alaska Ranges	-	-	-	42	56	74
Hawaii Ranges	-	-	185	187	188	190
Oregon Ranges	-	-	13	14	15	16

Table 6: Induced Employment, 2012-2017

Induced Employment						
	2012	2013	2014	2015	2016	2017
Total Induced Employment						
PPUTRC	**59**	**65**	**448**	**558**	**629**	**712**
Alaska Ranges	35	39	106	117	129	142
Hawaii Ranges	-	-	-	64	84	111
Oregon Ranges	24	26	342	377	416	459
Impact of Test Site Designation						
PPUTRC	-	-	**377**	**447**	**474**	**508**
Alaska Ranges	-	-	63	67	71	75
Hawaii Ranges	-	-	-	64	84	111
Oregon Ranges	-	-	313	316	319	321

Note: Summation of columns may not match the total due to rounding

Table 8: Indirect Income, 2012-2017 ($ million)

Indirect Income						
	2012	2013	2014	2015	2016	2017
Total Direct Income						
PPUTRC	**$1.1**	**$1.3**	**$11.7**	**$15.0**	**$17.0**	**$19.3**
Alaska Ranges	$0.4	$0.4	$1.2	$1.3	$1.5	$1.6
Hawaii Ranges	-	-	-	$2.1	$2.7	$3.6
Oregon Ranges	$0.7	$0.8	$10.5	$11.6	$12.8	$14.1
Impact of Test Site Designation						
PPUTRC			**$10.4**	**$12.5**	**$13.3**	**$14.4**
Alaska Ranges	-	-	$0.7	$0.8	$0.8	$0.9
Hawaii Ranges	-	-	-	$2.1	$2.7	$3.6
Oregon Ranges	-	-	$9.6	$9.7	$9.8	$9.9

Table 9: Induced Income, 2012-2017 ($ million)

Induced Income						
	2012	2013	2014	2015	2016	2017
Total Induced Income						
PPUTRC	**$3.5**	**$3.8**	**$24.4**	**$30.1**	**$34.0**	**$38.4**
Alaska Ranges	$2.2	$2.5	$6.7	$7.4	$8.2	$9.0
Hawaii Ranges	-	-	-	$3.3	$4.3	$5.7
Oregon Ranges	$1.2	$1.4	$17.6	$19.4	$21.4	$23.6
Impact of Test Site Designation						
PPUTRC	-	-	**$20.1**	**$23.8**	**$25.3**	**$27.1**
Alaska Ranges	-	-	$4.0	$4.3	$4.5	$4.8
Hawaii Ranges	-	-	-	$3.3	$4.3	$5.7
Oregon Ranges	-	-	$16.1	$16.3	$16.4	$16.6

Output, Value Added, & State Income Taxes Resulting from UAS and Test Site Operations

'Output' represents the value of industry production, and 'total value added' is the difference between an industry's total output and the cost of their intermediate inputs. Economic modeling conducted for the purposes of this study indicates output in the PPUTRC states attributable to test site designation would climb from $265 million in 2014 to $333 million in 2017. Value added would climb from $109 million to $134 million over the same period.

Table 10: Output, 2012-2017 ($ million)

Output						
	2012	2013	2014	2015	2016	2017
Total Output						
PPUTRC	**$18.3**	**$20.2**	**$302.4**	**$366.8**	**$411.7**	**$463.6**
Alaska Ranges	$8.6	$9.5	$34.3	$37.8	$41.7	$46.0
Hawaii Ranges	-	-	-	$33.3	$44.1	$58.3
Oregon Ranges	$9.7	$10.7	$268.1	$295.6	$325.9	$359.3
Impact of Test Site Designation						
PPUTRC	-	-	**$280.1**	**$315.5**	**$328.4**	**$344.7**
Alaska Ranges	-	-	$23.8	$24.8	$25.8	$26.8
Hawaii Ranges	-	-	-	$33.3	$44.1	$58.3
Oregon Ranges	-	-	$256.3	$257.4	$258.5	$259.6

Table 11: Total Value Added, 2012-2017 ($ million)

Value Added						
	2012	2013	2014	2015	2016	2017
Total Value Added						
PPUTRC	**$9.5**	**$10.5**	**$127.7**	**$151.8**	**$169.7**	**$190.3**
Alaska Ranges	$5.7	$6.3	$22.7	$25.0	$27.6	$30.4
Hawaii Ranges	-	-	-	$10.9	$14.5	$19.1
Oregon Ranges	$3.8	$4.2	$105.1	$115.8	$127.7	$140.8
Impact of Test Site Designation						
PPUTRC	-	-	**$116.2**	**$128.2**	**$132.8**	**$138.5**
Alaska Ranges	-	-	$15.8	$16.4	$17.1	$17.7
Hawaii Ranges	-	-	-	$10.9	$14.5	$19.1
Oregon Ranges	-	-	$100.4	$100.9	$101.3	$101.7

Designation of the PPUTRC will provide a combined four-year total of $20 million in income tax revenue to Hawaii and Oregon. The effective income tax rate for these calculations was approximated as 7.5 percent for Hawaii, and 9 percent for Oregon (Alaska has no income tax).

Table 12: State Income Taxes, 2012-2017 ($ million)

State Income Taxes						
	2012	2013	2014	2015	2016	2017
Total State Income Taxes						
PPUTRC	**$0.2**	**$0.2**	**$4.7**	**$5.9**	**$6.6**	**$7.5**
Alaska Ranges	-	-	-	-	-	-
Hawaii Ranges	-	-	-	$0.7	$0.9	$1.2
Oregon Ranges	$0.2	$0.2	$4.7	$5.2	$5.7	$6.3
Impact of Test Site Designation						
PPUTRC	-	-	**$4.5**	**$5.2**	**$5.5**	**$5.8**
Alaska Ranges	-	-	-	-	-	-
Hawaii Ranges	-	-	-	$0.7	$0.9	$1.2
Oregon Ranges	-	-	$4.5	$4.5	$4.6	$4.6

NEIL ABERCROMBIE
GOVERNOR

RICHARD C. LIM
DIRECTOR

MARY ALICE EVANS
DEPUTY DIRECTOR

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

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Statement of

RICHARD C. LIM
Director

Department of Business, Economic Development & Tourism

before the

SENATE COMMITTEES ON
PUBLIC SAFETY, INTERGOVERNMENTAL AND MILITARY AFFAIRS
AND
HIGHER EDUCATION

Tuesday, February 11, 2014

2:45 p.m.

State Capitol, Conference Room 224

in consideration of

SB 3053

RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES.

Chairs Espero and Taniguchi, Vice Chairs Baker and Kahele, and members of the Committee. The Department of Business, Economic Development and Tourism **supports** this bill to establish a chief operating officer position and an advisory board to oversee and manage, as well as to appropriate funds to staff and conduct, unmanned aerial systems (UAS) test site operations in Hawaii.

Our State, in partnership with Alaska and Oregon, has been selected by the Federal Aviation Administration (FAA) to serve as one of six national test sites for unmanned aerial systems. The goal is to develop a Pan-Pacific UAS Test Range that will use existing aviation ranges and facilities in all three states to develop operating standards and regulations that will safely integrate these technologies into the national air space, and in so doing develop procedures to protect manned aviation and policies to protect privacy.

The civilian UAS applications to be studied at these test sites are truly diverse and far-reaching, ranging from environmental monitoring and wildlife management to emergency search and rescue, flood and pollution control, power line inspections, air quality monitoring, watershed management, and other applications with substantial civic and commercial benefits.

In developing these applications, multiple research, business, education, and professional training opportunities will also emerge, such as the development of miniaturized high performance remote sensing instruments, aerial tracking systems and related command and control software, training courses and certification programs for UAS operators, and other innovative programs with high revenue generation and job creation potential.

In addition, UAS test range operations in Hawaii will help reduce or eliminate shipping and other costs associated with demonstrating and evaluating new sensor technologies developed by Hawaii-based companies at U.S. mainland sites, facilitate cost-effective operations of both military and government contractors supporting local fire and police departments, and both strengthen and diversify statewide programs conducted by the U.S. Civil Air Patrol and Coast Guard, the U.S. and Hawaii National Guard, the U.S. and Hawaii Departments of Defense, and other federal and State agencies.

As such, we support this measure, provided that its passage does not replace or adversely impact priorities indicated in our Executive Budget.

Thank you for the opportunity to testify on this bill.

NEIL ABERCROMBIE
GOVERNOR

Testimony of
GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
RANDY GRUNE
AUDREY HIDANO
JADINE URASAKI

IN REPLY REFER TO:

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

February 11, 2014
2:45 p.m.
State Capitol, Room 224

S.B. 3053
RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

Senate Committee on Public Safety, Intergovernmental and Military Affairs

The Department of Transportation (DOT) **supports** this bill which provides funding for the management of Hawaii's participation in the Pan-Pacific Unmanned Aerial System Test Range Complex. Hawaii with partners Alaska and Oregon, were selected as one of only six test sites throughout the country by the Federal Aviation Administration and will play a unique and significant part in the test. This bill provides the funding that will enable Hawaii to fulfill its obligation to this national test program, and to its test range partners.

Thank you for the opportunity to provide this testimony.

STATE OF HAWAII
DEPARTMENT OF DEFENSE

TESTIMONY ON SENATE BILL 3053
A BILL RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

PRESENTATION TO
THE SENATE COMMITTEES ON
PUBLIC SAFETY, INTERGOVERNMENTAL AND MILITARY AFFAIRS
AND
HIGHER EDUCATION

BY

MAJOR GENERAL DARRYLL D. M. WONG
ADJUTANT GENERAL AND DIRECTOR OF STATE CIVIL DEFENSE
February 11, 2014

Chair Espero, Chair Taniguchi, and Members of the Senate Committees on Public Safety, Intergovernmental and Military Affairs; and Higher Education.

I am Major General Darryll D. M. Wong, State Adjutant General and the Director of State Civil Defense. I am testifying in **SUPPORT** of Senate Bill 3053.

The Federal Aviation Administration (FAA) recently selected the Pan Pacific UAS Test Range Complex (involving Alaska, Oregon, and Hawaii) as one of the six national test sites to safely integrate Unmanned Aerial Systems (UAS) into the National Airspace System. Testing UAS at these sites, in restricted, non-public airspace, will lead to the development of federal regulations that will help ensure public privacy and safety during UAS operations.

UAS technologies are already in use include: wildlife counts, fisheries management, disaster management, and has great potential in any application where an aerial task needs completing. In these tasks, UAS offers several advantages over manned flight:

- Lower-costs
- Reduced safety risks and increased capability related to manned operations
- Reduced impacts on the environment
- The growth of intellectual capital

In addition to the intellectual capital gained, there are positive economic impacts to Hawaii as a result of test range users as well as creation of new jobs to support commercial industry testing and services.

The establishment and appropriation of funding for Hawaii's Chief Operating Officer and Advisory Board is critical in both establishing Hawaii's test ranges and tracking both state and national efforts to address UAS safety and privacy concerns, including the development of federal regulations pertaining to such issues.

Thank you for the opportunity to testify in **SUPPORT** of Senate Bill 3053.

UNIVERSITY OF HAWAI'I SYSTEM
Legislative Testimony

Testimony Presented Before the
Senate Committee on Public Safety, Intergovernmental and Military Affairs
Senate Committee on Higher Education
Tuesday, February 11, 2014 at 2:45pm
by
Dr. Vassilis L. Syrmos
Vice President for Research and Innovation, University of Hawai'i

SB3053 – RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

Chairs Espero and Taniguchi, Vice Chairs Baker and Kahele, and members of the committees:

I am respectfully submitting written testimony on behalf of the University of Hawai'i in support of SB3053 relating to unmanned aerial systems (UAS) test sites which proposes to establish the chief operating officer position, establish an advisory board to oversee and manage the test site operations, and appropriates the funds to staff and operate Hawai'i's unmanned aerial systems test site activities.

As a research institution that specializes in technologies and activities related to UAS, the University of Hawai'i supports this bill and perceives it as an opportunity for advancements in innovation, commercialization, and economic development. Hawai'i offers unique qualities to support the operations of a UAS such as its location within the Pacific and its proximity to the U.S. Pacific Command and other military test sites; and is considered to be an attractive location to the UAS industry for real development.

With the current organization and implementation of the Hawai'i/Alaska/Oregon Pan-Pacific Unmanned Aerial Systems Test Range Complex, it is essential that the UAS in Hawai'i be provided the resources to remain an active participant. The University of Hawai'i sees great value and potential in assisting with the establishment of UAS test sites due to its positive impacts for our State which range from emergency search and rescue operations, fisheries management, agricultural monitoring, reef health surveys, lava flow monitoring, disaster management and damage assessment, land use surveys, watershed management, mapping of coastal topography, and many other applications.

Thank you for your consideration and for the opportunity to submit testimony on this matter.

Personal Testimony Presented Before the
Senate Committee on Public Safety, Intergovernmental and Military Affairs
Tuesday, February 11, 2014 at 2:45pm
by
Dr. Peter E. Crouch
Dean of Engineering, University of Hawai'i at Manoa

SB3053 – RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

Chair Espero, Vice Chair Baker, and members of the committee:

I am submitting written testimony in support of SB3053 relating to unmanned aerial systems (UAS) test sites which proposes to establish the chief operating officer position, establish an advisory board to oversee and manage the test site operations, and appropriates the funds to staff and operate Hawai'i's unmanned aerial systems test site activities.

The College of Engineering at the University of Hawaii at Manoa has an active research program that focuses on autonomous and semiautonomous vehicles in various domains: ocean, terrestrial, air and space, and is supported by a number of faculty members. Unmanned Ariel Systems (UAS) is clearly a growing component of such activities, and many technologies related to other domains can be readily transported to the needs of UAS.

Since Hawaii has already been selected by the FAA as a regional test site, with its partners Alaska and Oregon, it is important for the State to respond to this opportunity and take advantage of the economic development opportunities that will follow. In particular the College of Engineering can be an important partner for the State in assisting with the associated workforce development needs through the education and training of students who would take up positions in the associated workforce. In this regard the College has already reached out to the University of Alaska in the related UAS disciplines and will be following up with the institutions in Oregon. The College has for many years had a team of students working on UAS projects.

The College of Engineering has for many years assisted in the STEM outreach to the Hawaii K-12 community, which is partially responsible for the >50% student enrollment increase in the College in recent years and continues to take some leadership roles in programs such as robotics and research experiences for teachers. This gives the College a firm footing from which to deploy similar programs in UAS to the K-12 community that will in turn assist in developing the needed workforce.

The College of Engineering at UH Manoa sees great potential in assisting the University of Hawaii and the State in the establishment of the UAS test sites and related programs and industry, particularly because of the improved opportunities to work with both the military and commercial sectors, as it is already doing in the other domains of oceans and space. This work would develop new technologies in application domains of UAS such as search and rescue operations, agricultural information systems, invasive species mapping and control, lava flow monitoring, disaster management and damage assessment, watershed management, and infrastructure health assessment as applied to structures such as bridges and dams.

Thank you for your consideration and for the opportunity to submit testimony on this matter

Testimony Presented Before the
Senate Committee on Public Safety, Intergovernmental and Military Affairs and
Committee on Higher Education
February 11, 2014 at 2:45 p.m.
by
Donald O. Straney
Chancellor, University of Hawai`i at Hilo

SB 3053 - RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

Chairs Espero and Taniguchi, Vice Chairs Baker and Kahele and Members of the Committees:

Thank you for the opportunity to submit testimony for SB 3053. My name is Donald Straney, Chancellor of the University of Hawai'i at Hilo (UH Hilo). I am testifying as a member of the Hawai'i Island community and I support the intent of SB 3053 to appropriate funds to staff and support Unmanned Aerial Systems (UAS) test site activities in Hawai'i.

The State of Hawai'i offers many unique qualities to support UAS operations in areas of agricultural monitoring, archaeological survey, disaster management and damage assessment, geological monitoring and surveys, invasive species monitoring, fisheries and coral reef management, land-use planning and monitoring and, wildlife detection and management. UH Hilo views the proposal as an opportunity to develop innovative research, business and educational initiatives and provide higher education and career options to the people of our Hawai'i Island.

Thank you for the opportunity to provide testimony on SB 3053. Aloha.

NIIHAU RANCH LLC

P. O. BOX 690229

MAKAWELI, HI 96769

Niihau Ranch totally supports SB 3053. Niihau Ranch has worked extensively with PMRF in past NASA UAS projects; the entire island of Niihau is mostly undeveloped space which cannot be seriously damaged by any possible UAS accidents; and we have lots to offer in terms of future work under the FAA UAS Test Site concept. Funding is urgently needed to facilitate representation at ongoing meetings which will determine in great part, Hawaii's role in this nationwide effort. Other sites which were not selected are pressing forward and our team with Alaska and Oregon must aggressively defend our position as a selected entity.

Very Sincerely

Keith Robinson

Keith Robinson for Niihau Ranch

February 10, 2014

From:	mailinglist@capitol.hawaii.gov
Sent:	Monday, February 10, 2014 2:35 PM
To:	PSMTestimony
Cc:	ranoguchi@gmail.com
Subject:	Submitted testimony for SB3053 on Feb 11, 2014 14:45PM
Attachments:	2014-02-11HSLTestimonySB3053Noguchi.pdf

SB3053

Submitted on: 2/10/2014

Testimony for PSM/HRE on Feb 11, 2014 14:45PM in Conference Room 224

Submitted By	Organization	Testifier Position	Present at Hearing
Reid Noguchi	Hawaii Aerospace Advisory Committee	Support	No

Comments:

Please note that testimony submitted less than 24 hours prior to the hearing, improperly identified, or directed to the incorrect office, may not be posted online or distributed to the committee prior to the convening of the public hearing.

Do not reply to this email. This inbox is not monitored. For assistance please email webmaster@capitol.hawaii.gov

February 10, 2014

To the Senate Committee on Public Safety, Intergovernmental and Military Affairs:

I, Reid Noguchi, would like to submit testimony in favor of SB 3053 RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES.

As a leader in the aerospace industry in Hawaii, I strongly support this bill to fund and staff a team that is dedicated to assuring that the State positions itself as one of the Nation's most viable and opportune locations for unmanned aerial system (UAS) testing. Although having succeed in being designated one of six FAA-approved UAS test sites in the country, there is still a significant effort ahead to capitalize on this unique and long-term opportunity. Each of the six FAA test sites are now in competition amongst each other to capitalize on their designation by being the first to start UAS operations, by offering discriminating and compelling reasons to use their sites, and to jump start the establishment of a thriving and self-sustaining industry that will create a wide spectrum of jobs and educational opportunities. For our State to get ahead of the competition and not lose this opportunity, it is imperative that we quickly establish a staff with sufficient authority and funding to make this happen.

There are many contributions to the significant economic benefits to establish the State as a national resource for UAS testing. Being a part of the defense/aerospace industry in Hawaii, I can speak to the challenges that face us with shrinking DoD budgets. With less funding available, there is more competition, and with that an inherent need to identify, establish, and leverage geographic discriminators to improve the chances of being awarded federally funded work in Hawaii. With the established military ranges, like the Pacific Missile Range Facility and Pohakuloa, and the strong support of our military leadership we have a compelling case that initial UAS testing can be done quickly with existing resources. However, the charter of the FAA test sites includes addressing standards and policies extending to operational testing in civil airspace. In this context, there is significant work that must be done to make it simple and cost effective for the existing and emerging UAS industries to select Hawaii as their testing location of choice. If not, they will take their capabilities to other States, who will then start growing and improving their infrastructure, further reducing their operating costs, and giving them an even stronger edge in supporting future UAS business. Hawaii can be in that position if we establish and support a team to bring that to reality.

From the industry perspective, the potential impact to the economy and workforce in Hawaii is significant.

Jobs directly created with a UAS testing site include:

- Test range management and administration
- Test range marketing, community outreach, and STEM education
- Test range maintenance and inspection
- Range safety personnel
- Unmanned aerial vehicle (UAV) maintenance
- UAV safety inspections
- UAV control station maintenance (including Information Technology services)
- Payload calibration and repair
- UAS usage auditing for law enforcement

Derivative jobs that would be created once UAS testing starts to establish itself as a viable UAS industry include:

- UAV maintenance and repair training
- Data processing and analysis services
- UAS data collection services
- UAS parcel delivery services
- UAS private security services
- UAS services for Department of Transportation, Department of Land and Natural Resources, Public Utilities, Police Department, Fire Department
- UAS aerial photography/filmography services
- Small UAV manufacturing
- Sensor/payload development and manufacturing
- Sensor/payload software development
- Research and development (air vehicles, ground control stations, communications data links, sensors/payloads, processing software, multi-vehicle cooperation, etc.)

In addition to the immediate economic benefits directly related to operating a UAS test site and the derivative industry that will build upon constant usage of that site, there will also be a longer-term and broader positive impact in the community. Creation of a significant number of high technology jobs in the State could also lead to the establishment of new college degree programs in Hawaii for UAS-related fields. This would then serve to provide a pipeline for future generations of our workforce and alleviate the current-day challenges to find qualified technologists that are willing to move to Hawaii and have longevity in the State.

There are a wide diversity of benefits to the State of Hawaii to establish itself as a prime national competitor for UAS testing, of which only a few are mentioned here. These, by themselves, are compelling reasons why the State should invest in making sure that we capitalize on our designation as an FAA test site. However, there are just as compelling reasons why it would be looked unfavorably by our partners (Alaska and Oregon), by the nation and the FAA, and even the people of Hawaii if we do not pass this bill.

If we did not invest in a qualified and dedicated team to establish ourselves as a UAS test site, our tri-State partners, Alaska and Oregon, may be discouraged by Hawaii's lack of commitment and support. This might lead them to restructure their operational framework to rely less on Hawaii to mitigate the risk of not having sufficient resources when they're needed. This could result in a reduced level of activity in Hawaii.

Similarly, the States who were not selected by the FAA, as well as the FAA themselves, would question our State's commitment to the national UAS strategy and why we proposed being a key part of it. While this may not have a direct impact on the level of UAS activity in Hawaii, it may make the necessary coordination between Hawaii and the FAA more difficult and prolong regulatory approvals and agreements.

Lastly, one key aspect about UAS testing in Hawaii is regarding public privacy and safety. While these issues will undoubtedly be addressed over the duration of this program, it will be imperative to remain responsive to the communities opinions and concerns, and to do so in a concerted and timely manner. This can only be effectively done with resources that are dedicated to the task and not spread thin with other responsibilities. A lack of responsiveness here may cause unrest in the community and lead to unnecessary setbacks or obstacles in the State's effort to be first and strongest amongst the six test ranges.

In summary, this opportunity provided to us by the FAA to be one of six designated UAS test ranges is one that has significant near-term and long-term benefits to the State, its workforce, and its community. These benefits, however, are only a potential unless we proactively compete against and distinguish ourselves from the other five sites, we mirror the commitment of our tri-State partners, and are responsive and forthcoming to the people of Hawaii along the way. To be successful in this unique opportunity, I strongly support this bill.

Reid Noguchi
Hawaii Aerospace Advisory Committee

Testimony Presented Before the
Senate Committee on Public Safety, Intergovernmental and Military Affairs
Senate Committee on Higher Education
Tuesday, February 11, 2014 at 2:45pm
by
Matthew Kobayashi

SB3053 – RELATING TO UNMANNED AERIAL SYSTEMS TEST SITES

Chairs Espero and Taniguchi, Vice Chairs Baker and Kahele, and members of the Committees:

I am respectfully submitting written testimony in support of SB3053 relating to unmanned aerial systems (UAS) test sites, which proposes to establish the chief operating officer position, establish an advisory board to oversee and manage the test site operations, and appropriates the funds to staff and operate Hawaii's unmanned aerial systems test site activities.

As a Hawaii born professional who has worked in the UAS industry since 1998, I strongly believe, based on a deep knowledge of the UAS field, that Hawaii, with the right support, could establish a strong presence in the national and international UAS industry.

I served as a consultant to Aerovironment Inc. from 1998-2000 and became its Director of Asia Pacific Business Development from 2000-2008. During my time at Aerovironment, we conducted a number of test flights with our PathFinder and Helios Aircraft from PMRF on Kauai. Our flights included gathering data with NASA over coffee farms in Kauai to optimize harvest yields. We also conducted multiple flights with the Japanese government flying payloads developed in Japan at over 60,000 feet, and also set the world altitude record for non-rocket propelled level flight with Helios by flying over 94,000 feet. In the field of small UAS, Aerovironment has more experience using UAS in flight for the DoD than any other competitor worldwide.

During my time at Aerovironment I worked with the U.S. Government, governments from all over Asia (Japan, South Korea, India, Taiwan, Singapore, Thailand and Vietnam), the University of Hawaii, and the Hawaii State government. I was a part of and witnessed the huge expansion of the UAS industry and am concerned that Hawaii is not doing enough to take advantage of its close ties with the DoD and NASA and not taking advantage of its unique assets – such as the Pacific Missile Range on Kauai and the Pohakuloa Training Area on the Big Island, to build a strong UAS industry (as have other states like North Dakota and Oregon). Over the past year, North Dakota's legislature committed $5 million to support and establish a UAS industry. Other states have made substantial investments as well, including Nevada ($4 million), Oregon ($3.65 million) and Alaska ($5 million). A number of other state legislatures have pledged considerable support in money and resources. Hawaii must aim not to "keep up" but rather take a leadership role to advance this industry in the U.S. and Pacific Region.

Thank you for you consideration and the opportunity to submit testimony on this matter.

International Ventures Associates

February 10, 2014

To: Members of the 27th Hawaii State Legislature

Ref: SB 3053

As a member of the Hawaii Aerospace Advisory Committee (HAC), and former chairman of the Japan/U.S Science, Technology & Space Applications Program (JUSTSAP), I would like to add my strong support to the Department of Business, Economic Development and Tourism which also supports this bill to establish a chief operating officer position and an advisory board to oversee and manage, as well as to appropriate funds to staff and conduct, unmanned aerial systems (UAS) test site operations in Hawaii.

Sincerely,

Stephen M. D. Day.
President,
International Ventures Associates.

IVA, 5333 Potomac Avenue, Suite 100, Washington, DC 20016