The Florida Senate

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Committee on Military Affairs, Space, and Domestic Security

EXPANDING FLORIDA'S ROLE IN THE SPACE INDUSTRY

Issue Description

Florida is home to the National Aeronautics and Space Administration's (NASA) launch facilities for the former Space Shuttle Program and numerous other scientific and technical programs. Florida is also home to some of the most outstanding colleges and universities in the world – both public and private. Many of the institutions have first class research programs and faculty working on cutting edge processes.

The significant impact which university-based scientific research has on economic growth, global competition, and the enhancement of everyday activities is generally not contested. Likewise, academic research is a crucial element needed to expand Florida's role in the space industry. Despite being a leader in the space industry, there are concerns about the abilities of Florida research universities in attracting federal funds for scientific research and development (R&D).

This report seeks to explore the current programs or efforts in Florida which focus on enhancing academic R&D in Florida, specifically in space-related disciplines, and identify ways for the state to capitalize on these existing opportunities. Additionally, this project also briefly addresses NASA spinoff technology and future opportunities in Florida relating to space tourism and satellite remote sensing.

Background

Florida is a leader in the space industry as the home to a large number of major aviation and aerospace companies as well as other key space industry assets including NASA, Cape Canaveral Air Force Station, and additional U.S. military bases. In addition to the impressive space infrastructure, Florida's geographic location, optimal climate conditions, and extremely knowledgeable technical workforce contribute to the state's ability to be a space industry leader.

With the retirement of NASA's Space Shuttle Program earlier this year, there is a need for Florida to diversify its capabilities in the space technology field. For over 50 years, Florida's geographic features and technological infrastructure has allowed the state to serve the space industry as an exceptional civil and military launch location. In an effort to preserve Florida's existing technological infrastructure and workforce, it is imperative that Florida create an environment that is conducive to exploiting space-based technologies outside the launch industry.

As the fourth largest state in the nation, Florida is equipped with a strong academic research infrastructure with 11 public universities, 28 public colleges, and 29 private, not-for profit academic institutions. Around the globe, university-based R&D has proven to be an economic stimulator, in which technologies are developed and transferred into commercialization and, as a result, create job opportunities. There is widespread agreement that academic R&D is vital to the U.S. global economy and "is a key to economic competitiveness and the technological breakthroughs that improve our lives."[1] Researchers propose that university research should be recognized as a high-growth industry, given that "discoveries, often springing from U.S. universities, drive the growth of new high-technology businesses that propel jobs and prosperity."[2]

[1] National Science Board. *Research and Development: Essential Foundation for U.S. Competitiveness in a Global Economy.* (Arlington, VA, January 2008), 1. http://www.nsf.gov/statistics/nsb0803/nsb0803.pdf

[2] Reilly, K.P., *University Research Benefits Students…and the Economy*. (University of Wisconsin System, 2010). http://www.wisconsin.edu/president/inprint/2010/columnTrusteeshipmag-research-

Academic institutions across the country depend on a variety of sources for R&D funding including: the federal government; state and local government; industry; and the institutions themselves. The federal government is currently and has historically been the primary source of R&D funds for U.S. colleges and universities. Consequently, the vitality of U.S. academic research is highly dependent on federal funding even with support from other sources. The chart below describes the distribution of academic research funds to U.S. colleges and universities for fiscal year 2009, in which the federal government provided approximately 60% of the estimated $55 billion of science and engineering (S&E) R&D funds expended by academic institutions.

FIGURE ONE[3]
Science and Engineering R&D Expenditures at Universities and Colleges
FY 2009
(Millions of current dollars)

Source of funds	Funds	Percentage of total funds
All R&D expenditures	54,935	100
Federal government	32,588	59
State and local government	3,647	7
Industry	3,197	6
Institutional funds	11,198	20
Other	4,305	8

In recognition of the important role academic research plays in creating jobs and boosting local economies, competition is fierce among academic institutions across the country for federal R&D awards. In addition to the inherent competitive nature of the grant proposal and award process, the current state of the economy may further challenge researchers to compete for awards from a reduced pool of federal funds. A Congressional Research Service report maintains that "the nation's current economic situation, debt, and budget deficits are placing increased focus on cutting discretionary spending, the source of funding for U.S. academic research."[4]

This predicament of declining federal, state, and private sector financial support for U.S. colleges and universities has caught the attention of Congress which has directed the National Academies, Board on Higher Education and Workforce Committee (Committee), to examine the state of the U.S. research institutions and report on how to maintain the health of these institutions. The Committee is tasked with recommending 10 actions that could be undertaken by institutions, state governments, and Congress to enable colleges and universities to "compete, prosper, and achieve national goals in health, energy, the environment, and global security."[5] The committee is expected to release its final report in December 2011.

Findings and/or Conclusions

Florida Academic Research and Development Ranks Low in R&D Expenditures

Data collected by the National Science Foundation (NSF) reveal that Florida ranks low in academic R&D expenditures relative to other states with comparative economies. The NSF reports that for fiscal year (FY) 2009 Florida ranked 10th in the nation for federally funded university R&D expenditures,[6] with over $1.9 billion in R&D expenditures. Figure two below lists the top 10 states leading the nation in total federal R&D expenditures.

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[3] National Science Foundation. Issue Brief: Universities Report $55 Billion in Science and Engineering R&D Spending for FY 2009; Redesigned Survey to Launch in 2010. (Arlington, VA, 2010), 1. http://www.nsf.gov/statistics/infbrief/nsf10329/

[4] Matthews, C.M. *Federal Support for Academic Research* (Congressional Research Service, June 2011), 1. http://www.fas.org/sgp/crs/misc/R41895.pdf

[5] Matthews, C.M. *Federal Support for Academic Research* (Congressional Research Service, June 2011), 11. http://www.fas.org/sgp/crs/misc/R41895.pdf quoting from Mervis, J., *Panel Explores What It'll Take to Keep Universities Strong*, (Science, v. 329, July 9, 2010), 126.

[6] This data is not discipline-specific and represents R&D expenditures collectively.

FIGURE TWO[7]
Total Expenditures for Federal Academic R&D Funds
FY 2009
(Dollars in Thousands)

	STATE	PRIVATE	PUBLIC	GRAND TOTAL
1	California	$2,142,561	$5,519,792	**$7,662,353**
2	New York	$3,100,099	$1,247,672	**$4,347,771**
3	Texas	$582,962	$3,566,785	**$4,149,747**
4	Maryland	$1,867,032	$1,179,257	**$3,046,289**
5	Pennsylvania	$1,285,447	$1,512,100	**$2,797,547**
6	Massachusetts	$2,115,431	$489,859	**$2,605,290**
7	Illinois	$1,120,946	$1,108,116	**$2,229,062**
8	North Carolina	$1,015,208	$1,184,159	**$2,199,367**
9	Ohio	$518,421	$1,430,041	**$1,948,462**
10	Florida	$283,588	$1,616,682	**$1,900,270**

Of particular interest to Florida, given its diverse high-technology industries, is university R&D in S&E disciplines. According to data from the NSF, research universities in Florida, both public and private, are not among the ranks of the top research universities in expenditures of federal grant funding for S&E R&D. Figure three below ranks the top 20 research universities in the country based on R&D expenditures in S&E fields. Florida is not represented in the top 20 universities listed below.

[7] Data provided from SUS staff via e-mail correspondence. July 29, 2011. Original source of data: NSF WebCASPAR database. https://webcaspar.nsf.gov/index.jsp?subHeader=WebCASPARHome

FIGURE THREE[8]
Top 20 U.S. Institutions Reporting
Largest R&D Expenditures in S&E Fields
FY 2009

(Dollars in Millions)

Rank	Institution	2007	2008	2009
	All S&E expenditures	49,493	51,934	54,935
	Leading 20 institutions	14,497	15,244	16,424
1	Johns Hopkins U.	1,554	1,681	1,856
2	U. MI all campuses	809	876	1,007
3	U. WI Madison	841	882	952
4	U. CA, San Francisco	843	885	948
5	U. CA, Los Angeles	823	871	890
6	U. CA, San Diego	799	842	879
7	Duke U.	782	767	805
8	U. WA	757	765	778
9	PA State U. all campuses	652	701	753
10	U. MN all campuses	624	683	741
11	MA Institute of Technology	614	660	736
12	U. PA	648	708	727
13	OH State U. all campuses	720	703	716
14	Stanford U.	688	688	704
15	U. CA, Davis	601	643	682
16	Cornell U. all campuses	642	654	671
17	U. CA Berkeley	552	592	652
18	U. CO all campuses	528	536	648
19	U. NC Chapel Hill	477	526	646
20	TX A&M U.	544	582	631
	All other institutions	34,996	36,690	38,511

The NSF reports that colleges and universities share an uneven distribution of federal R&D expenditures. In FY 2007, 82.6% of total federal support for S&E to colleges and universities went to the top 100 academic institutions (in terms of federal R&D expenditures).[9] Additionally, this pattern can be observed over a 10-year period in which the majority of the institutions in the top positions in FY 1997 remained in the top 100 for FY 2007.[10] The most recent NSF data reveals that the following 4 universities in Florida ranked among the top 100 recipients of federal R&D support in S&E disciplines in FY 2009:

- University of Florida ranked #23 with $592,000,000 R&D expenditures;
- University of South Florida ranked #65 with $309,456,000 R&D expenditures;
- University of Miami ranked #77 with $248,029,000 R&D expenditures; and
- Florida State University ranked #95 with $195,244,000 R&D expenditures.[11]

State University System of Florida's University Research Programs

Florida has several programs in place that could be further utilized or expanded to enhance federal grant acquisition and increase R&D in S&E fields, particularly in space-related R&D.

[8] National Science Foundation. Issue Brief: Universities Report $55 Billion in Science and Engineering R&D Spending for FY 2009; Redesigned Survey to Launch in 2010. (Arlington, VA, 2010), 1. http://www.nsf.gov/statistics/infbrief/nsf10329/
[9] Matthews, C.M. *Federal Support for Academic Research* (Congressional Research Service, June 2011), 11. http://www.fas.org/sgp/crs/misc/R41895.pdf citing to National Science Foundation, Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions: FY 2007, Detailed Statistical Tables, NSF09-315, September 2009, Arlington, VA, Table 7.
[10] Id.
[11] Id.

21st Century Technology, Research, and Scholarship Enhancement Act (Repealed as of June 30, 2011)[12]

The 21st Century Technology, Research, and Scholarship Enhancement Act (Act) was established by the 2006 Florida Legislature[13] (which was preceded by similar legislation,[14] and subsequently amended,[15]). This legislation contained an automatic repeal of the Act on June 30, 2011. Although the Act is no longer effective, some aspects offer the potential to have lasting effects on Florida's economy. The overall intent of the Act was to strengthen the research capabilities of Florida public universities in key emerging technology areas and promote economic development. The Act encompasses the following three programs: the 21st Century Centers of Excellence program; the World Class Scholars program; and the State University Research Commercialization Assistance Grant program.

21st Century Centers of Excellence Program[16]

The Act called for the creation of the existing eleven university-based Centers of Excellence (COEs) within the State University System of Florida (SUS), in an effort to "give Florida a clear position of leadership in key emerging technology areas with the unique potential for economic and societal impact in the years to come."[17] The overall objectives of the COEs include:

- Facilitating the identification of collaborative research opportunities between universities and businesses;
- Creating partnerships between industrial and governmental entities to advance knowledge and research to move technologies from academic laboratories and research centers to commercial sectors;
- Increasing the number of graduates and faculty researchers in advanced technology programs while ensuring that a larger percentage of such graduates pursue degrees in Florida industries;
- Recruiting and retaining eminent scholars in advanced technology disciplines; and
- Providing capital facilities necessary to support research and development.

Figure four below illustrates the history of Florida's investment in the existing COEs since their foundation.

[12] Section 1004.226, F.S. **NOTE:** Section 1004.226, F.S., has been repealed as of June 30, 2011 and pursuant to s. 242.11, F.S., will be removed from the Florida Statutes via a reviser's bill during the 2012 Legislative Session.
[13] Chapter 2006-58, Laws of Florida
[14] Chapter 2002-265, Laws of Florida
[15] Chapter 2007-189, Laws of Florida
[16] Section 1004. 226, F.S. **NOTE:** Section 1004.226, F.S., has been repealed as of June 30, 2011 and pursuant to s. 242.11, F.S., will be removed from the Florida Statutes via a reviser's bill during the 2012 Legislative Session.
[17] State University System of Florida. The 21st Century Technology, Research, and Scholarship Enhancement Act website. http://www.flbog.org/about/cod/asa/21stcentury.php

FIGURE FOUR **State University System Centers of Excellence** [18]	**Funding Award**
2002-03 Centers of Excellence Awards	
FAU COE in Biomedical and Marine Biology	$10,000,000
UCF Florida Photonics COE	$10,000,000
UF COE in Regenerative Health Biotechnology	$10,000,000
	$30,000,000
2006-07 Centers of Excellence Awards	
USF COE in Biomolecular Identification and Targeted Therapeutics	$8,000,000
FAU COE in for Ocean Energy Technology	$5,000,000
UCF Photonics COE Laser Technology Initiative	$4,500,000
UF Institute for Sustainable Energy/Energy Technology Incubator	$4,500,000
UF COE for Nano-Bio Sensors	$4,000,000
FSU COE in Advanced Materials	$4,000,000
	$30,000,000
2007-08 Centers of Excellence Awards	
FSU COE for Advanced Aero-Propulsion	$14,570,000
FIU COE for Hurricane Damage Mitigation Product Development	$10,006,955
	$24,577,180
Total State Centers of Excellence Investment	**$84,577,180**

The SUS reports that since their inception, the 11 COEs, with an initial State investment of $84.5 million, have returned $251 million in competitive grants and another $24 million in private sector support. Collectively, the COEs have achieved the following:

- Made 223 invention disclosures;
- Executed 43 licenses/options;
- Received nearly $500,000 in license revenues;
- Initiated 30 companies;
- Created 745 jobs;
- Supported 1,100 undergraduate and graduate students ; and
- Created collaborations with 508 private industry entities.

21st Century World Class Scholars Program[19]

The 21st Century World Class Scholars program was designed to recruit and retain the very best faculty in S&E disciplines by allocating state matching funds to attract "21st century world class scholars" to Florida universities. According to a SUS Board of Governor's (BOG) report, "fifteen of the sixteen World Class Scholar positions were immediately filled, and those faculty members continue to work in the SUS, performing extraordinary levels of teaching, research, and service."[20] The report also states that as of FY 2010, the world class scholars have cumulatively received almost $46 million in external competitive grants and have filed and had 16 patents issued.[21]

[18] FAU = Florida Atlantic University; UCF = University of Central Florida; UF = University of Florida; USF = University of South Florida; FSU = Florida State University; FIU = Florida International University.
[19] Section 1004.226(5), F.S. **NOTE:** Section 1004.226, F.S., has been repealed as of June 30, 2011 and pursuant to s. 242.11, F.S., will be removed from the Florida Statutes via a reviser's bill during the 2012 Legislative Session.
[20] Florida Board of Governors. *21st Century Technology, Research, and Scholarship Act Programs. A Report Compiled from the 2009-2010 State University System of Florida Annual Reporting Process* (January 2011), 14.
[21] Id.

The State University Research Commercialization Assistance Grant Program[22]

The State University Research Commercialization Assistance Grant Program is administered by the State University System's Florida Technology, Research and Scholarship Board, and annually provides grants in the form of early-stage capital funding to aid in the development of products and services that result from university research, including patents, establishing start-up companies, developing licensing agreements and attracting private investment. This is a vibrant program that provides initial resources that lead to major technological advances and commercialization of the processes created by academic research.

The New Florida Initiative

In 2010 the BOG launched what is known as the *New Florida Initiative* (New Florida*)* in an effort to "create a new Florida economy based on knowledge and innovation." New Florida proposes to build Florida's new economy by:

- Focusing each university on fulfilling its distinctive mission;
- Creating a strategic research agenda built on the strengths of each institution in the SUS;
- Dedicating new funding on targeted degrees, such as Science, Technology, Engineering, and Math (STEM) programs and programs with high statewide and regional demands;
- Dedicating appropriate funding for workload increases as well as funding for the construction of additional labs, classrooms, and office space; and
- Increasing attraction of top-level students, researchers and industry.

These steps are critical within the SUS to better position Florida public universities to more effectively compete with universities in other states for federal R&D grants.

The BOG expects New Florida efforts to generate specific outcomes by 2015 and 2030, which will be measured by:

- the increase in annual degree production;
- new faculty who bring in additional research funding;
- the increase in annual patent awards;
- the number and quality of medical breakthroughs;
- improvements of graduation and retention rates;
- the increase in annual new business start-ups; and
- the increase in annual licensing revenue.

The BOG proposed that in order to transform the economy, the Legislature should double the investment of recurring state dollars for Florida's 11 public universities. Specifically, in January 2010, the BOG called for the Florida Legislature to appropriate $1.75 billion of recurring state funds to public universities over five years. The BOG was appropriated $10,000,000 for New Florida during the 2010 legislative session.

In addition to New Florida, the SUS has identified an opportunity to improve the abilities of grant-writing faculty in preparing competitive R&D proposals to federal grant administering agencies. In doing this, the SUS hopes to arrange seminars led by all major federal grant administering agencies (i.e., NSF, National Institute of Health, Department of Defense, etc.) to educate faculty on preparing competitive grant proposals. In January 2012, the SUS will sponsor an "NSF Day" at the University of South Florida, in which all 11 public universities will participate as well as other higher education institutions in Florida. This one-day seminar is intended to target junior faculty members to introduce and familiarize them with the NSF and the opportunities for federal research funding.[23]

[22] Section 1004.226(7), F.S. **NOTE:** Section 1004.226, F.S., has been repealed as of June 30, 2011 and pursuant to s. 242.11, F.S., will be removed from the Florida Statutes via a reviser's bill during the 2012 Legislative Session.
[23] Telephone conversation with NSF staff. August 3, 2011.

Space-related Research Programs in Florida

Florida State University Center of Excellence for Advanced Aero-Propulsion

The Florida State University Center of Excellence for Advanced Aero-Propulsion (FCAAP) is a consortium of four universities (Florida State University, Embry Riddle Aeronautical University, the University of Central Florida, and the University of Florida) which was established in 2008 with the following objectives:

- to help train and sustain the much needed, highly skilled aerospace industry workforce;
- to design and develop new technologies and products required to help sustain the aerospace industry; and
- to transition technology to applications in a timely and efficient manner.[24]

Since its creation with $14.5 million, the FCAAP has received $16.4 million in competitive grants, filed 15 invention disclosures, and has been awarded 8 licenses/options.[25]

Florida Space Institute/Florida Space Grant Consortium

The Florida Space Institute (FSI) was created in 1990 by the University of Central Florida (UCF), currently operates as a consortium of 10 higher education institutions in Florida, and is physically located at the Kennedy Space Center. The mission of FSI is "to support Florida's space industry through university education, applied and basic research in space-related fields, and technical training."[26] Its partners include the following public and private universities and community colleges:

- University of Central Florida
- Florida Institute of Technology
- Broward College
- Florida A&M University
- Florida Atlantic University
- University of South Florida
- University of Miami
- Brevard Community College
- University of Florida
- Embry-Riddle Aeronautical University

Space Florida recognizes an opportunity to enhance FSI abilities and identifies FSI as a potential research client who may relocate to the Space Life Sciences Laboratory (SLSL)[27] or Exploration Park[28] and provide expertise to entities that will need both payload and rocket launch support.[29]

One critical responsibility for FSI is to administer the Florida Space Grant Consortium (FSGC).[30] FSGC is an affiliate of the National Space Grant College and Fellowship Program, which was formed in 1989 by NASA. FSGC's mission is to provide grants, fellowships, and scholarships to students and educators within the S&E disciplines to diversity and expand Florida's space industry.[31]

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[24] FCAAP website. *Welcome from the Director*. http://www.fcaap.com/index.cfm?p=team&p2=dirwelcome
[25] Florida Board of Governors. *21st Century Technology, Research, and Scholarship Act Programs. A Report Compiled from the 2009-2010 State University System of Florida Annual Reporting Process* (January 2011), 21.
[26] Florida Space Institute website. *About Florida Space Institute*. http://fsi.ucf.edu/index.html
[27] The SLSL is a state-of-the-art laboratory located on the grounds of Kennedy Space Center.
[28] Exploration Park is a high-tech research and office park being developed adjacent to the SLSL.
[29] E-mail correspondence with Space Florida staff. August 12, 2011.
[30] FSGC website: http://www.floridaspacegrant.org/
[31] National Space Grant College and Fellowship Program website: http://www.nasa.gov/offices/education/programs/national/spacegrant/home/index.html

Center for Microgravity Research

Space Florida is partnering with the University of Central Florida (UCF) to establish a Center for Microgravity Research (Microgravity Center), with the goal of establishing Florida as an international destination for microgravity research. According to Space Florida, there are plans to establish the Microgravity Center at both UCF and the SLSL with the intention of attracting both U.S. and international clients who desire research in microgravity environments. Additionally, Space Florida envisions the Microgravity Center research to stimulate both the sub-orbital and orbital rocket business and position Florida at the core of related activities.[32]

FAA Center of Excellence for Commercial Space Transportation[33]

In August 2010, the Federal Aviation Administration (FAA) established the Air Transportation Center of Excellence for Commercial Space Transportation (Center) and designated New Mexico State University as the lead institution. The Center is a partnership of academia, industry, and government, developed for the purpose of creating a world-class consortium that will address current and future challenges for commercial space transportation. Florida has a high representation in the Center in that 4 out of the 9 university members are Florida universities – Florida Institute of Technology, Florida State University, University of Central Florida, and University of Florida. There are currently 19 active Center-funded research projects and each Florida member university is involved in one or more of those projects.[34]

Future R&D Opportunities on Kennedy Space Center Property

With an altering and somewhat uncertain future mission of NASA, it is presumed that a number of NASA's state-of-the art laboratories and facilities will become decommissioned or underutilized. Consequently, there may be an opportunity for universities in Florida to capitalize on their close proximity to the Kennedy Space Center (KSC) and conduct R&D at the laboratories and facilities in which NASA identifies as decommissioned or underutilized. This potential partnership between NASA and the university research community in Florida could prove to be significantly beneficial to NASA, universities in Florida, and also the Florida economy. NASA envisions fostering a strong commercial space industry presence at KSC facilities and launch pads once decisions have been made as to NASA's utilization of the current infrastructure. In January 2011, NASA released a formal Notice of Availability and Request for Information to obtain input from the space industry on potential uses for the facilities that may become available in the near future. It is still uncertain at this time which facilities will be made available. According to NASA, the 45 KSC laboratories listed in the *John F. Kennedy Space Center's Core Technical Capabilities Catalog*[35] will remain in full operation through fiscal year 2013.[36]

The Space Life Sciences Laboratory (SLSL) is a facility which may allow additional opportunities for university R&D activities. The SLSL, located on the grounds of KSC, was built in 2004 with $26.8 million in state appropriation to provide NASA with state-of-the-art lab space to process science experiments or equipment that were headed for or returning from the International Space Station. Current SLSL tenants include the University of Florida, Florida Institute of Technology, and NASA.[37] While NASA has been the primary tenant of the SLSL, the shifting direction of NASA may require a smaller NASA presence in the SLSL, which may allow for greater university tenancy.

Additionally, it is anticipated that Exploration Park, a high-tech research and office park being developed adjacent to the SLSL, will provide opportunities for future Florida academic R&D. Construction on Exploration Park began in March 2011 and it is expected to accommodate up to 450,000 square feet of research, lab, and office

[32] E-mail correspondence with Space Florida staff. July 28, 2011.
[33] FAA Center of Excellence for Commercial Space Transportation homepage: http://www.coe-cst.org/
[34] FAA Center of Excellence for Commercial Space Transportation website: Center of Excellence CST Research Tasks. http://www.coe-cst.org/research.php
[35] http://kscpartnerships.ksc.nasa.gov/documents/2008_CTC_Catalog.pdf
[36] E-mail correspondence with NASA staff. July 29, 2011.
[37] Telephone conversation with Space Florida staff. July 19, 2011.

space.[38] Exploration Park's close proximity to NASA and U.S. Air Force launch facilities, payload processing, and technical labs, makes it "the ideal place to provide support to commercial launch initiatives, as well as NASA and U.S. Department of Defense missions."[39]

NASA's Spinoff Capabilities

Since its inception in 1958, NASA has been responsible for ensuring its mission-specific research and development activities can be shared and applied beyond the space community.[40] The U.S. can recognize a great return on investment in NASA R&D from the remarkable technological innovations that support the U.S. aerospace industry which are subsequently commercialized to meet alternative needs. A NASA technology that is transferred to the private or public sector for commercialization or for other uses is known as a *NASA spin off*, which is officially defined as a "commercially available product, service, or process that takes NASA-related technology and brings it to a broader audience."[41] NASA spinoff technologies, while originating from mission-specific R&D, transfer quite well into commercial products and benefit an array of fields such as health and medicine, transportation, public safety, consumer goods, environmental resources, and computer technology.

NASA's Innovative Partnership Program Office (IPP) is responsible for seeking out potential licenses and negotiating license agreements to transfer NASA technology.[42] To promote NASA technologies and provide information on commercial applications of NASA technologies, IPP produces the annual Spinoff Magazine. Since 1976, NASA has annually issued this publication documenting the commercialization of NASA-generated technology, which has showcased 1,700 significant spinoffs that benefit the public every day.[43]

Products, services, or processes that evolve into a NASA spinoff can have a significant impact on a local economy, creating jobs and efficiencies. An example of a spinoff that is being exploited in Florida with a promising potential for economic stimulation is an automobile prototype to be manufactured by the Florida-based company known as Rivian Motors. Rivian Motors is currently developing a 60 miles-per-gallon sports car with help from NASA engineers and hopes to deliver 1,200 jobs to Florida's Space Coast.[44]

Other Emerging Opportunities for the Florida Space Industry

Space Tourism

Although the space tourism market has yet to develop in the U.S., Florida offers an optimal environment to support such an industry when the time comes. The 2010 Space Florida Spaceport Master Plan (Spaceport Plan) acknowledges the emerging market for U.S. commercial space tourism, which encompasses space travel to both orbital and suborbital levels.[45] The Spaceport Plan provides the following description of commercial suborbital space tourism:

> Typically the goal of suborbital space tourism is to take paying passengers up above an altitude of 100 km (62 miles), which is the internationally recognized boundary of space known as the Karman line, and then promptly return them back to earth. During this suborbital flight the passengers will experience a few minutes of

[38] Exploration Park website: http://www.explorationpark.com
[39] Exploration Park Brochure. Available at: http://www.explorationpark.com/docs/Exploration%20Park%20Brochure_12.pdf
[40] NASA. *Spinoff 2010* (2010),7. http://www.sti.nasa.gov/tto/Spinoff2010/pdf/Spinoff2010.pdf
[41] Id.
[42] NASA. Office of the Chief Technologist. Technology Transfer website. http://www.nasa.gov/offices/oct/partnership/tech_transfer.html

[43] NASA Press Release. *NASA Spinoff 2010 Reveals Benefits of Space Technology in Our Daily Lives*. (Dec. 22, 2010.) http://www.nasa.gov/home/hqnews/2010/dec/HQ_10-347_Spinoff_2010.html
[44] The Wall Street Journal. Region Seeks New Mission. April 29, 2011. http://online.wsj.com/article/SB10001424052748703367004576289301943987570.html
[45] Reynolds, Smith, & Hills, Inc. *Space Florida 2010 Spaceport Master Plan* (2009), 131.

> weightlessness and be able to see the curvature of the earth along with the blackness of space.[46]

Achieving orbital space travel is much more difficult, which entails staying in space for a full orbit and requires a significant velocity boost above that required for suborbital trips.

Florida's current spaceport infrastructure to accommodate space tourism activities includes the spaceports at Cape Canaveral Air Force Station and at Cecil Field in Jacksonville.[47] Space Florida's vision for the future of space tourism in Florida involves the operation of three spaceports. To supplement Cecil Field Spaceport in north Florida and the Cape Canaveral Spaceport in central Florida, Space Florida envisions the utilization of a third not yet developed spaceport in south Florida to provide options for take-offs and landings contingent on weather conditions. Although developments are slow in the space tourism industry and the U.S. has yet to host such an event, experts suggest within the next few years the U.S. will experience advancement in this industry in which Florida will have the infrastructure, workforce, and the physical environment to support it.

Satellite Remote Sensing

Remote sensing is described as a

> "means of obtaining data and images from sensors or cameras located at a distance rather than from direct human observation…sensors on satellites generally provide digital rather than photographic images; they measure the electromagnetic radiation reflected or emitted from vegetation and terrain, which is then converted into the necessary information."[48]

Although the topic of satellite remote sensing and its uses in state and local government are beyond the scope of this report, it is worth noting that the advancement of small satellite technology combined with the increasing availability and usability of remote sensing-derived data make satellite remote sensing opportunities more attractive to state and local governments. State and local governments have a variety of uses for remote sensing data such as in mapping applications, identification of changes in land use, maintenance of the transportation infrastructure, disaster response and recovery and much more.

However, as remote sensing data becomes more easily accessible and applicable to a number of government functions, it may lead to duplication of efforts and resources within governmental units if there is not communication among and within these organizations about the utilization of remote sensing data.[49]

Options and/or Recommendations

The information in this report demonstrates the importance of university R&D to economic development and also acknowledges that Florida universities acquire less federal research grant opportunities than other states of comparative sizes. To assist Florida universities and colleges in becoming more competitive for federal R&D opportunities, the Legislature may wish to:

- Designate a single state entity or office to act as a coordinator, facilitator, and information-keeper of all space-related R&D projects among Florida academic institutions. This entity would assist universities in obtaining state and federal R&D awards and also ensure that the state's goals of supporting space-related R&D and economic development are being addressed;
- Reenact the 21st Century Technology, Research, and Scholarship Enhancement Act; and
- Fund the existing SUS centers of excellence.

[46] Id.
[47] Cecil Field was certified by the Federal Aviation Administration as an official spaceport in January 2010.
[48] The National Academies. *Using Remote Sensing in State and Local Government: Information for Management and Decision Making* (Washington DC, 2003), 9.
[49] The National Academies. *Using Remote Sensing in State and Local Government: Information for Management and Decision Making* (Washington DC, 2003), *25.*

In addition, to learn more about the potential for a space tourism market in Florida and to identify opportunities to make remote sensing data collection in state and local government more efficient, the Legislature may wish to:

- Initiate a study which addresses Florida's abilities in supporting a space tourism market and develops a market strategy in preparation for future development in the space tourism industry; and
- Initiate a study to develop an inventory of the uses of remote sensing data among all public and private entities in Florida (state and local governments, colleges and universities, and private entities) as well as the providers of the remote sensing data (both government and commercial providers).