

Virginia Space Grant Consortium

# Small Sat Virginia Initiative

For JCOTS Nanosatellite Advisory Committee

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# Small Sats Are Changing Space Business

Considered a disruptive technology.

Strong NASA, DOD and Security Agencies Interest in Small Sats.

Strong commercial interest in Small Sats.

- Shortened development times
- Months to a few years from concept to orbit
- Low cost access to space
- Cheaper launch costs – can often serve as ballast for rockets (shared launch costs benefit launch provide as well)
- More timely technology development and scientific gains (don't lose technology improvements lost in long design and development cycles for large spacecraft; can capitalize on latest scientific understandings)



# Small Sats Are Changing Space Business

- Commercial off the shelf components allow plug and play
- Allows for higher risk tolerance
- Small Sats can be used for missions that larger satellites can't perform, such as setting up a constellation of communication nodes or conducting in-orbit inspection of larger satellites.
- Permits smaller distributed platforms/constellations with more expansive coverage (Like QB-50)

# 2014

SpaceWorks' 2014 Projection estimated between 140 and 143 nano/microsatellites across all sectors would launch globally in 2014; 158 nano/microsatellites were actually launched. This represented an increase of nearly 72% compared to 2013.

# 2015+

In 2014, 107 commercial nano/microsatellites (1-50 kg) launched and thousands of commercial small satellites (101-500 kg) are planned for launch over the next fifteen years. Recent multi-million and multi-billion dollar investments in various ventures confirm the commercial sector's continued interest in the nano/microsatellite and small satellite industries.



# Launch Opportunities Are Growing

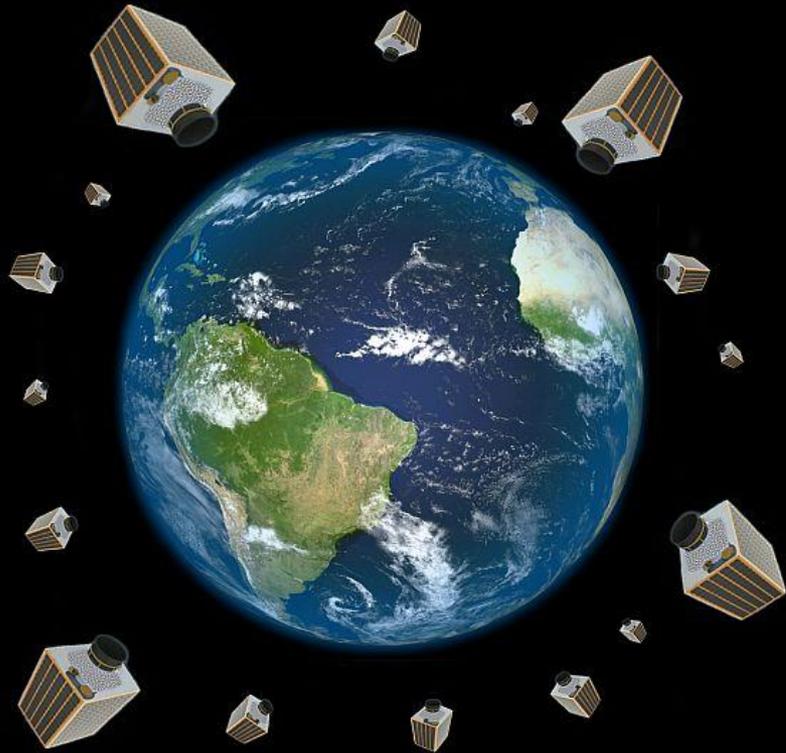
**Key Small Sat Virginia goal** -- Capitalize on Virginia launch capabilities through MARS and NASA Wallops and to work with Virginia companies for launch services as appropriate.

Interorbital Systems, a Californian company, recently carried out a successful suborbital test flight of a small rocket (pictured right) designed to carry a 145kg payload. The company has presold berths for dozens of CubeSats at \$13,000-38,000 per unit, as well as its own TubeSat format, which it offers to academia as kit and launch for \$8,000.

# Launch Opportunities Are Growing

- WASHINGTON, June 12, 2015 /PRNewswire-USNewswire/ -- NASA's Launch Services Program has issued a Request for Proposal (RFP) for new commercial Venture Class Launch Services (VCLS) for small satellites, often called CubeSats or nanosatellites, and experiments on science missions using a class of rockets smaller than any currently available to the agency.
- NASA will test an air-launched system in 2016 with Generation Orbit, an Atlanta company. It uses a Gulfstream G-IV executive jet to carry aloft a rocket which it fires off to put 45-50kg payloads into low-Earth orbit.
- NASA is also working with Virgin Galactic, a private space venture led by Richard Branson. Virgin Galactic has developed its LauncherOne, another air-launched rocket. It can be flown to a higher altitude and carry payloads up to 225kg.
- NASA launch opportunities for university payloads through Elana program as well as support for student payload development through the Undergraduate Student Instrument Program. NSF also has a small sat support program for universities.

# Small Sat Projections

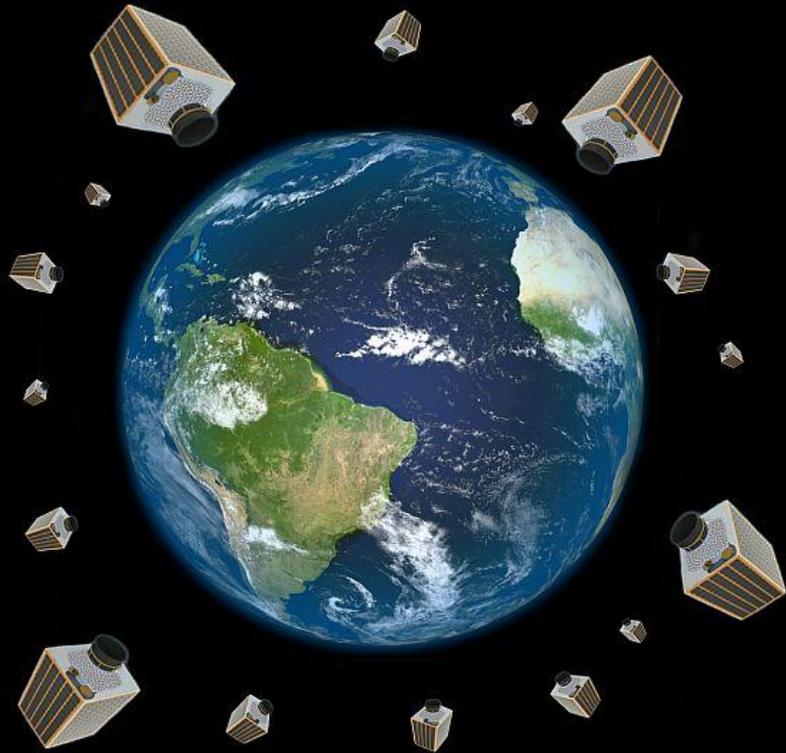


DARPA, the Pentagon's R&D arm, has been working on a number of Small Sat technologies designed to reduce their weight and improve reliability and performance.

NASA, DOD, and National Security Agencies are all investing in small sat technologies and applications.

In the next five years or so some 1,000 nanosats, as small satellites of 1-10kg are called, are expected to be launched. (Technology Quarterly, June 2014)

# Small Sat Projections



- Global small sat market currently estimated at about \$41.6 billion and growing significantly.
- Drawing significant commercial investments.
  - OneWeb – a constellation of 648 small satellites for global Internet coverage (Richard Branson/Virginia Galactic and others)
  - Space X (Elon Musk) is creating “advanced microsattellites “that will orbit the earth in large clusters.



## Nanosatellites Advisory Committee

**Looking at next steps for the Commonwealth with respect to Nanosatellites**

***General charge -- to study the establishment of a Consortium of Space Science Education that would consist of universities, companies and other organizations in the field. The Consortium would advance research and development related to nanosatellite and cube satellites. Will look for possible federal partnerships, identify any impediments to the creation of a consortium and look at other incentives that might foster the creation and sustainability of a consortium.***



*Taking Virginia to Orbit* by growing a small satellite cluster in the Commonwealth which will spur economic development.

# Small Sat Virginia Partners



# Organizational Participants

- Virginia Space Grant Consortium
- Virginia Commercial Space Flight Authority/Mid-Atlantic Regional Space Port (MARS)
- NASA Langley Research Center
- NASA Wallops Flight Facility
- National Institute of Aerospace.
- The American Institute of Aeronautics and Astronautics and the American Astronautical Society have also indicated their strong interest and support.

# Industry Participants

## *Companies:*

Aerojet Rocketdyne

Cubic Aerospace

Deep Space Industries

Gas Plume Imaging

Global Atmospheric Technologies and Sciences (GATS)

InTelSat General

Moog

NAL Research

OmniEarth

Orbital ATK

Schafer Corporation,

Science and Technology Corporation

SpaceQuest

VPT

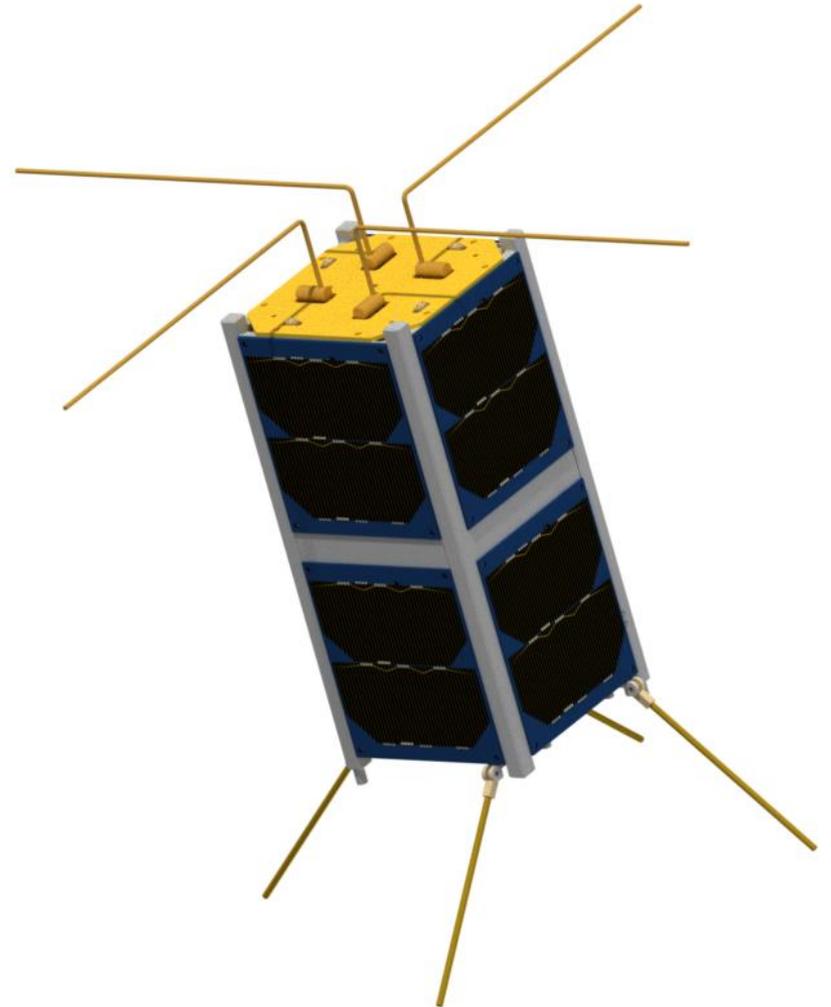
**Others have expressed interest and companies will continue to be added.**

# Collaborators

- Small Sat Virginia will work with organizations external to the Commonwealth who can advance the goals and interests of Small Sat Virginia in ways that benefit the Commonwealth.
- Collaborators who have provided letters of support include: Nanoracks, which provides launch and flight opportunities aboard the International Space Station
- New Worlds Institute, a visionary organization focuses on opening up the Space Frontier.
- Also anticipate working with the Student Spaceflight Experiments Program, which offers flight opportunities for precollege student teams, and potentially Kentucky Space, which offers a research lab on the International Space Station.
- Other collaborators are expected to emerge over time.

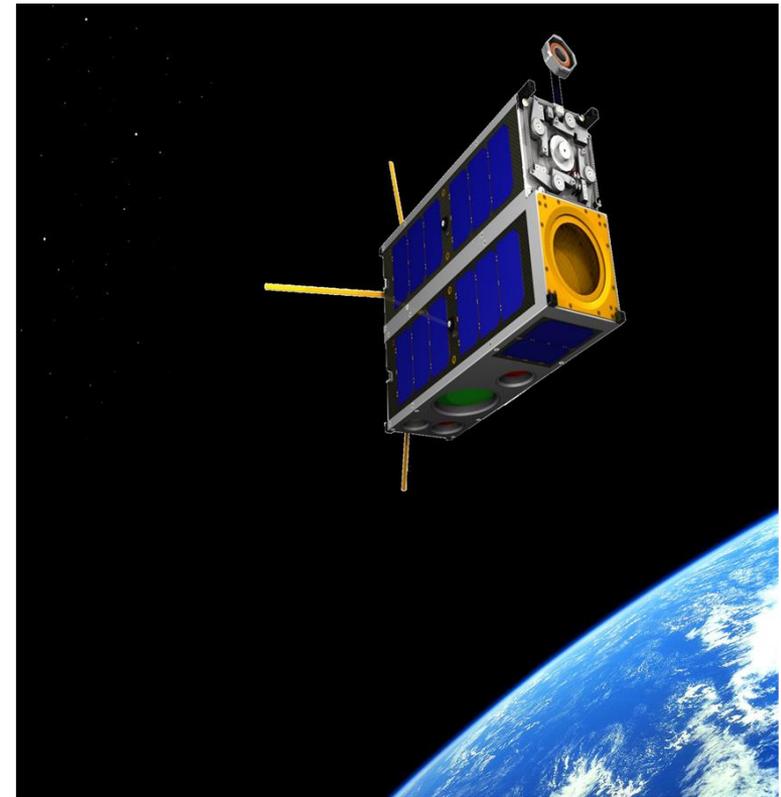
# VSGC as Small Sat Virginia Lead

- Established Virginia aerospace coalition for education, workforce development and research.
- 26 years' experience in development and leading statewide programs
- Strong history of partnership and coalition building – more than 500 nonmember partners
- Outstanding leveraging of resources -- \$10.45/1 in 2014 for each Space Grant core dollar
- Small Sat Work Group since 2011 with numerous small sat projects



# VSGC Flight Programs Heritage

- **Cubesats**
- **Sounding rocket missions**
- **Microgravity experiments**
- **Space Station experiments**
- **Research balloon payloads**
- **Airborne experiments**
- **Design projects**





## Aerospace-Related Education, Workforce Development and Research

### 52 Consortia:

Every state + D.C. and  
Puerto Rico

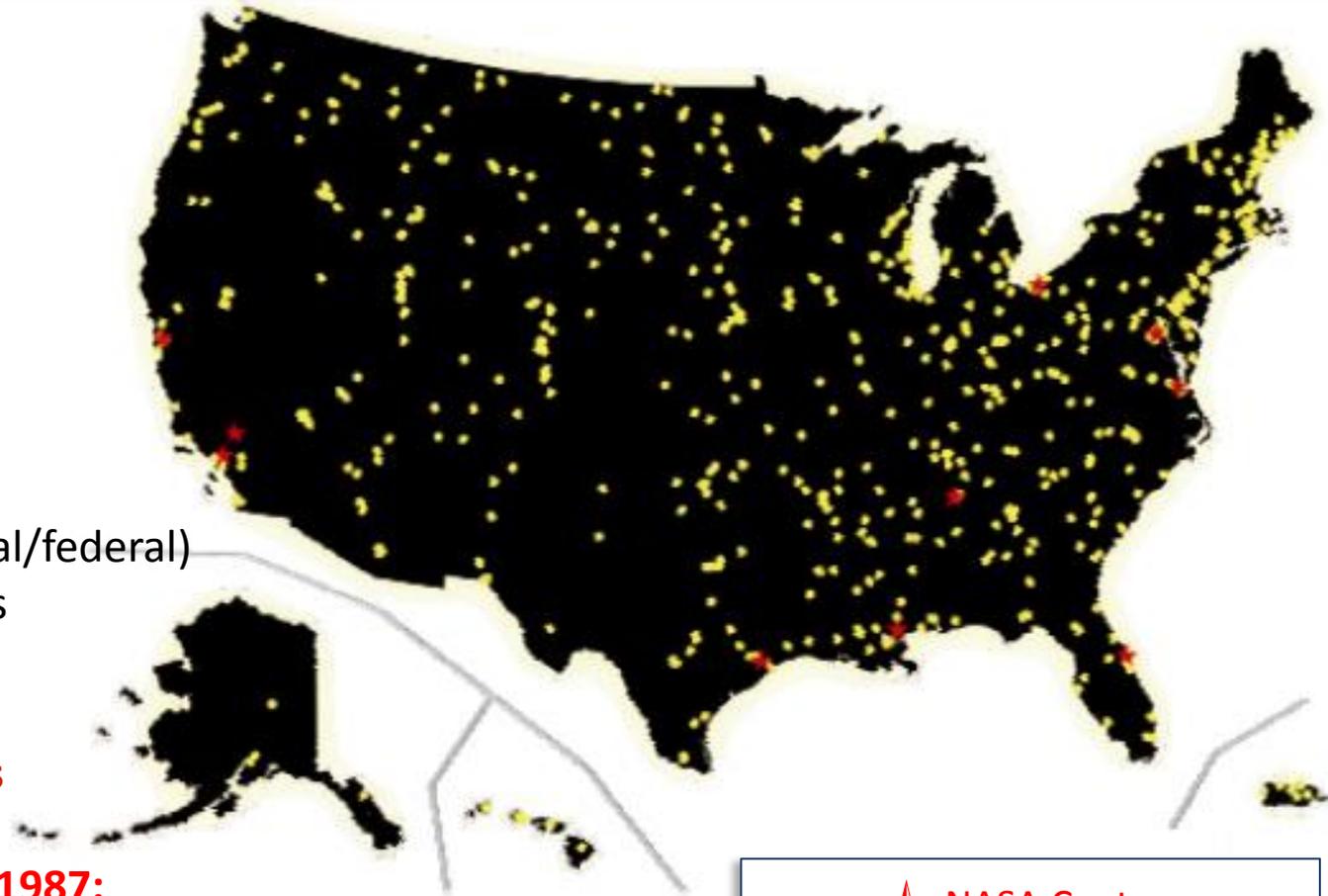
### 987+ Affiliates:

- 652 higher education
- 87 industry
- 83 governmental (state/local/federal)
- 76 museum/science centers
- 89 other local partners

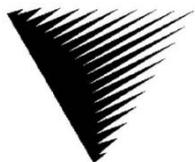
### Public/Private Partnerships

**Established by Congress in 1987:**  
**Public Law 100 - 147**

**Virginia Space Grant began in 1989**



 NASA Centers
 Space Grant Colleges and Universities



# VSGC Member Institutions

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*College of William and Mary*

*Hampton University*

*Old Dominion University*

*University of Virginia*

*Virginia Polytechnic Institute and State University*

*NASA Langley Research Center*

*NASA Goddard Space Flight Center's Wallops Flight Facility*

*State Council of Higher Education for Virginia*

*Virginia Community College System*

*Virginia Department of Education*

*MathScience Innovation Center*

*Science Museum of Virginia*

*Virginia Air and Space Center*

*Center for Innovative Technology*

*VSGC has worked with more than 500 program partners*



# Organizational Structure – Advisory Committee

- VSGC Director and VSGC Program Manager
- University Representatives engaged in Small Sat activity
- MARS
- NASA Langley
- NASA Wallops
- Industry Representatives
- Representatives from Technology, Transportation, Education and Commerce Secretariats.

# Organizational Elements

- Advisory Committee will meet at least twice annually and more frequently as needed.
- Participant meetings will be held at least quarterly with both in-person and WebEx options.
- Virtual meetings will be held as needed between formal meetings
- Establishment of committees as needed for proposal review, proposal development, etc.

# Mission

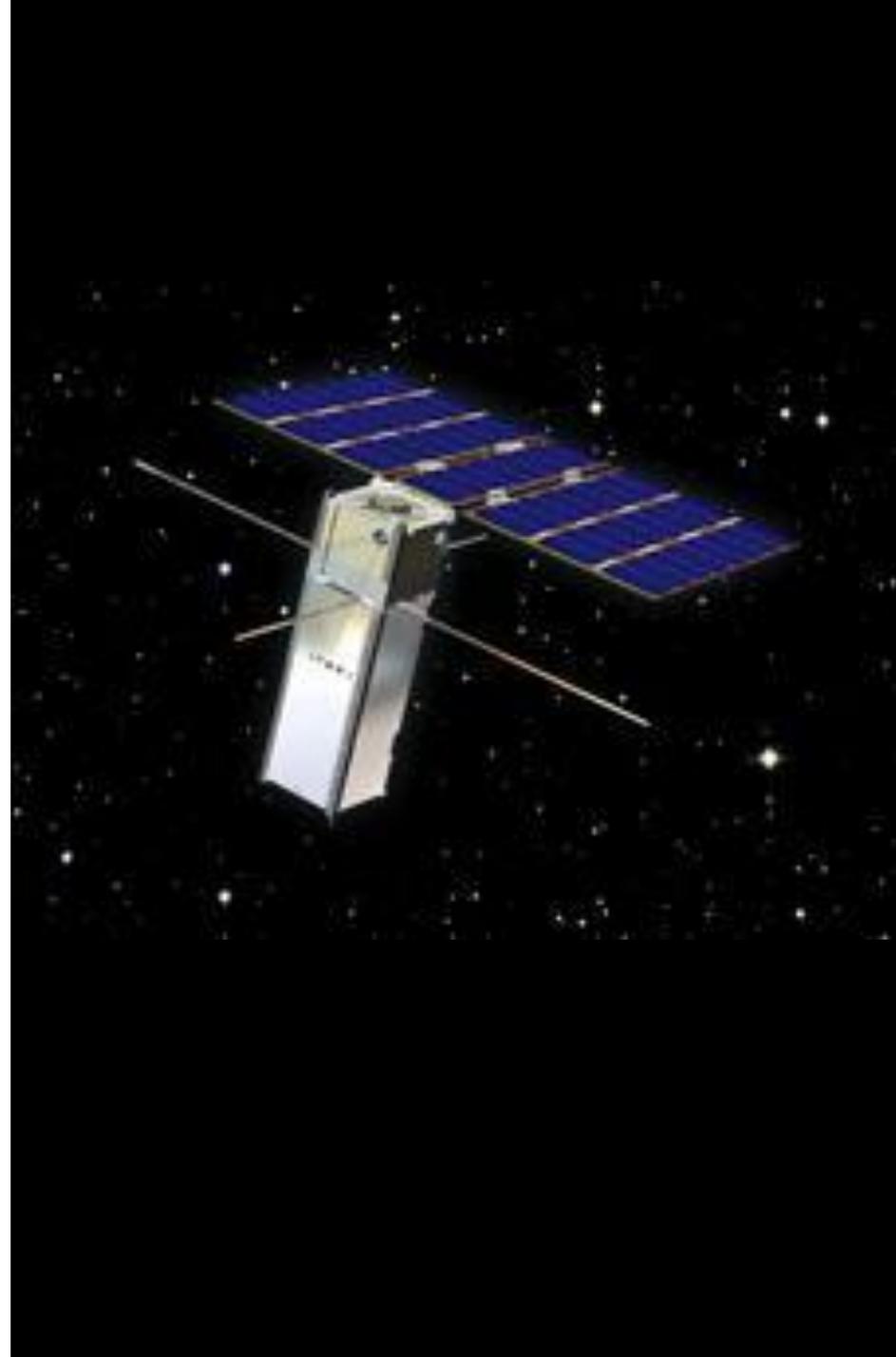
To grow a Small Sat Aerospace Cluster in the Commonwealth to foster economic development.



# Goals

**Leveraging state capabilities, maximize Virginia engagement in Small Sat initiatives for**

- ✓ economic development
- ✓ technology development and demonstration
- ✓ scientific advancement
- ✓ workforce development /  
STEM education
- ✓ enhanced utilization of state aerospace resources and capabilities.



# Goals

- **Make Virginia the “go to” state for Small Sat business, mission and launch support.**
- **Grow Virginia businesses through engagement in the Small Sat Virginia Initiative.**
- **Foster a strong workforce pipeline for the Virginia aerospace sector and build university research capabilities through university involvement in small sat initiatives in partnership with NASA, DOD, and industry, as well as fostering precollege engagement.**



# Objectives

- Foster the development of university Small Sat initiatives at individual institutions and across institutions.
- Support instrument development and science objectives best achieved with Small Sat payloads.
- Engage university, industry and NASA partners.
- In partnership with the Mid-Atlantic Regional Spaceport and NASA Wallops, create opportunities for university as well as industry-led Small Sat launch opportunities/capabilities.





# Objectives

- Pursue opportunities for university-led Small Sat launches with NASA, NSF, DOD and other organizations as appropriate.
- Provide mentoring, professional development and cross training for faculty and students at Virginia universities, colleges and community colleges who wish to undertake Small Sat programs.
- Grow research capabilities and funding at Virginia universities.
- Foster interest in flight projects at precollege institutions to contribute to STEM workforce pipeline.



# Workforce Development

- Workforce development is a key product for Small Sat Virginia.
- University Small Sat programs provide students with invaluable experience in real space missions providing a workforce pipeline to aerospace companies.
- Students learn the parameters and challenges of the space environment.
- Small Sat projects contribute to research infrastructure at Virginia institutions of higher education.

# Virginia's Aerospace Assets for Small Sats

- NASA Langley -- design, development, and environmental test and qualification expertise for cubesat payloads and cubesat and small sat flight systems, as well as participation in other NASA Launch Opportunities.
- NASA Wallops -- engineering and mission planning support services as well as participation in other NASA Launch opportunities.
- Mid-Atlantic Regional Spaceport (MARS) potential for launch services.



# University Aerospace Assets for Small Sats

- Space@VT -- end-to-end expertise and facilities to design, build, test, and fly cubesats, other Small Satellites, and space payloads.
- UVa -- Research and education in space science and technology, including undergraduate flight projects.
- ODU -- expertise in both mechanical and electrical engineering aspects of small satellite systems, as well as systems integration. Specific strength areas include orbital mechanics (navigation, formation flying, orbital rendezvous), thermal physics and hypersonic flow for entry/descent, communications systems and electronic
- Ground Tracking Stations at Virginia Tech and Old Dominion University and potentially at Hampton University (in development).
- The College of William and Mary – support for mission science, detector development, signal, algorithm and computational analysis, and engineering design.
- Hampton University – offers extensive expertise and experience in atmospheric science research and satellite payloads.

# Virginia's Aerospace Industry

Virginia is fortunate to have a wealth of companies engaged in the Small Sat enterprise. Many have already joined the Initiative. Strong interest on the part of industry.

Aerospace firms - 267 with 438 locations

Direct economic output of Virginia's Aerospace Industry of 7.4 billion plus \$4.7 billion in support of additional economic activity in Virginia.

Fourteen companies are currently partners, but *many* Virginia companies are expected to have an interest.

# AEROSPACE IN VIRGINIA



## Major Employers

AERIAL Machine & Tool  
 Aerojet  
 Alcoa Howmet  
 Aurora Flight Science  
 BAE Systems  
 Boeing  
 Cobham North America  
 Dynamic Aviation Group  
 EADS North America  
 Euro Composites  
 General Dynamics  
 Goodyear Tire & Rubber  
 Kollmorgen  
 L-3 Communications  
 Lockheed Martin  
 Measurement Specialties  
 Moog  
 Northrop Grumman  
 Orbital ATK  
 Raytheon  
 Rockwell Collins  
 Rolls-Royce N. A.  
 RTI International Metals  
 The Aerospace Corp.  
 Triumph Aerospace

## Military and Federal

The Pentagon  
 Central Intelligence Agency  
 Dept. of Homeland Security  
 Fort Belvoir  
 Fort Lee  
 Fort Myer  
 Fort Pickett  
 Joint Base Langley-Eustis  
 Marine Corps Base  
 Quantico  
 Missile Defense Agency  
 National Ground  
 Intelligence Center  
 National Reconnaissance  
 Office  
 Naval Air Station Oceana  
 Naval Surface Warfare  
 Center, Dahlgren  
 Navy Commander  
 Operational Test and  
 Evaluation Force  
 Norfolk Naval Base  
 Office of Naval Research  
 Space and Naval Warfare  
 Systems Command

## Research and Development

Commonwealth Center for  
 Advanced Manufacturing  
 Commonwealth Center for  
 Aerospace Propulsion  
 Systems  
 Defense Advanced  
 Research Projects  
 Agency  
 NASA Langley Research  
 Center  
 National Center for  
 Coatings Application,  
 Research & Education  
 National Center for  
 Hypersonic Combined  
 Cycle Propulsion  
 National Institute of  
 Aerospace  
 Virginia Modeling,  
 Analysis, and Simulation  
 Center  
 Virginia Space Grant  
 Consortium

## Education University

Virginia Tech  
 University of Virginia  
 Old Dominion  
 University  
 Virginia  
 Commonwealth  
 University  
 Liberty University  
 Hampton University  
 Averitt University

## *Community College*

Blue Ridge  
 Community College  
 John Tyler  
 Community College  
 Thomas Nelson  
 Community College

## *High School*

Aviation Academy of  
 Newport News  
 Public Schools

## Airports

Washington Dulles  
 International Airport  
 Ronald Reagan  
 Washington  
 National Airport  
 Charlottesville-  
 Albemarle County  
 Airport  
 Lynchburg Regional  
 Airport  
 Newport News-  
 Williamsburg  
 International Airport  
 Norfolk International  
 Airport  
 Richmond  
 International Airport  
 Roanoke Regional  
 Airport  
 Shenandoah Valley  
 Regional Airport  
 57 general aviation  
 airports

# Budget request is \$4 million dollars per year.

Core/base funding from Commonwealth. Leverage State funding through partnerships with federal, industry and other organizations.

**Estimated  
Contributed Costs  
– \$800K**

**Internships - \$150K**  
for Virginia university students with industry and federal labs.

**Program  
Administration -  
\$225K:** Full time staff lead at VSGC plus half time administrative support, travel; **ODURF  
Indirect Costs - \$305K**

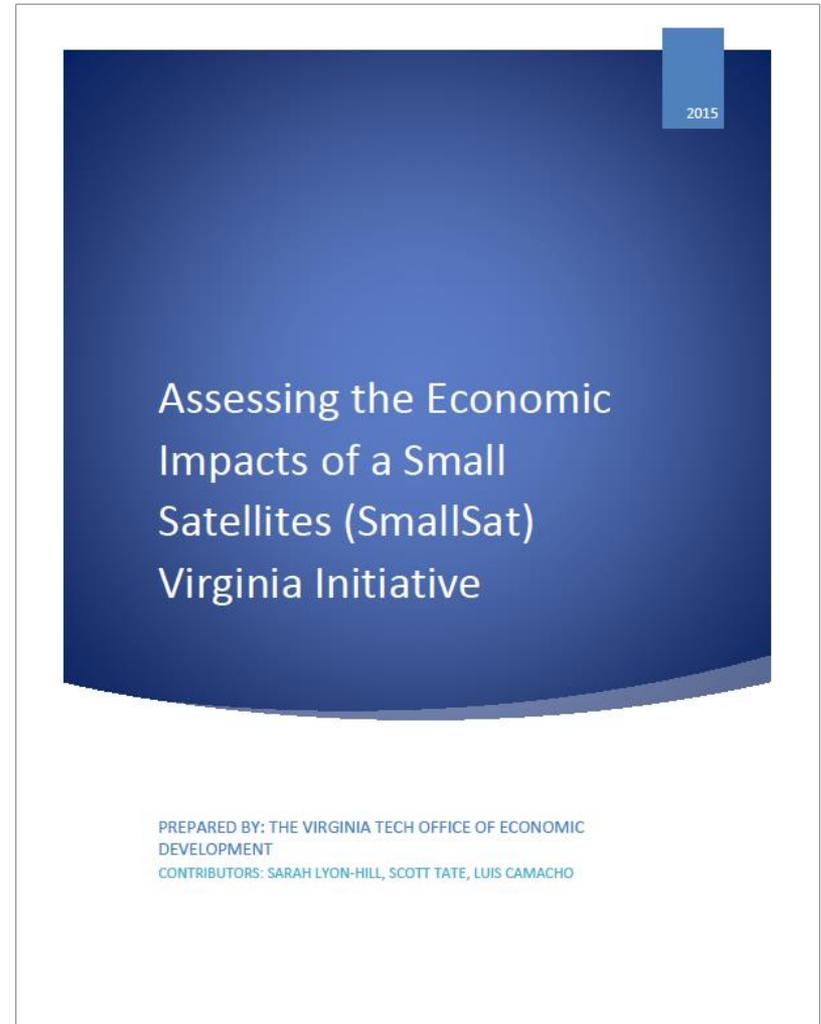
**Funding for Launch  
Opportunities –  
\$920,000**

- *MARS and NASA Wallops opportunities*
- *Funding pool to support other launches as needed.*

**Small Sat Payload  
Projects - \$2.4 million**  
plus any funding the Initiative is able to leverage from other sources (NSF, NASA, DoD, Industry, VSGC).

# Economic Impacts Small Sat Virginia

- Virginia Tech Office of Economic Development retained to do economic impact analysis, including state of the satellite and small satellite industry national and globally.





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