An Overview of Research at Virginia Tech

Presentation to the

Joint Commission on Technology and Science

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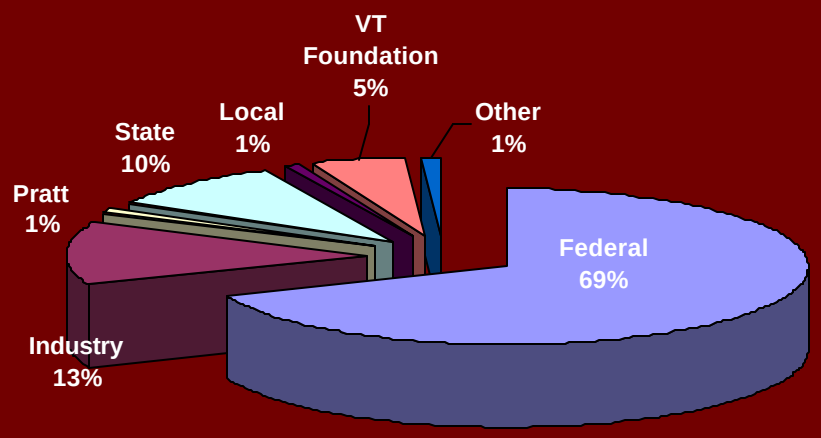
Research Expenditures Reported to NSF 1999 - 2003

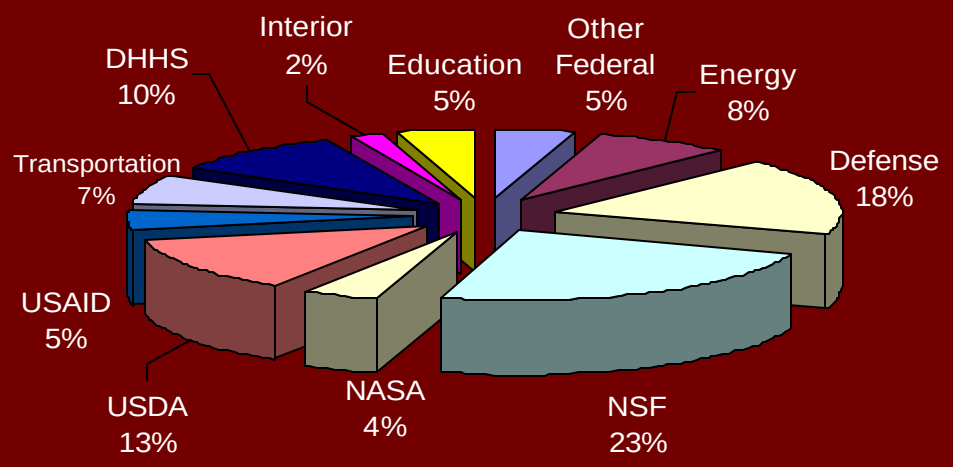
Dollars in millions

Funding Sources for Research Projects

FY 2004 Expenditures From All Sources



FY 2004 Expenditures From Federal Sources



Major Research Initiatives

You’ve heard about:

- Supercomputing
- VBI
- Nanotechnology
- Robotics (after lunch)

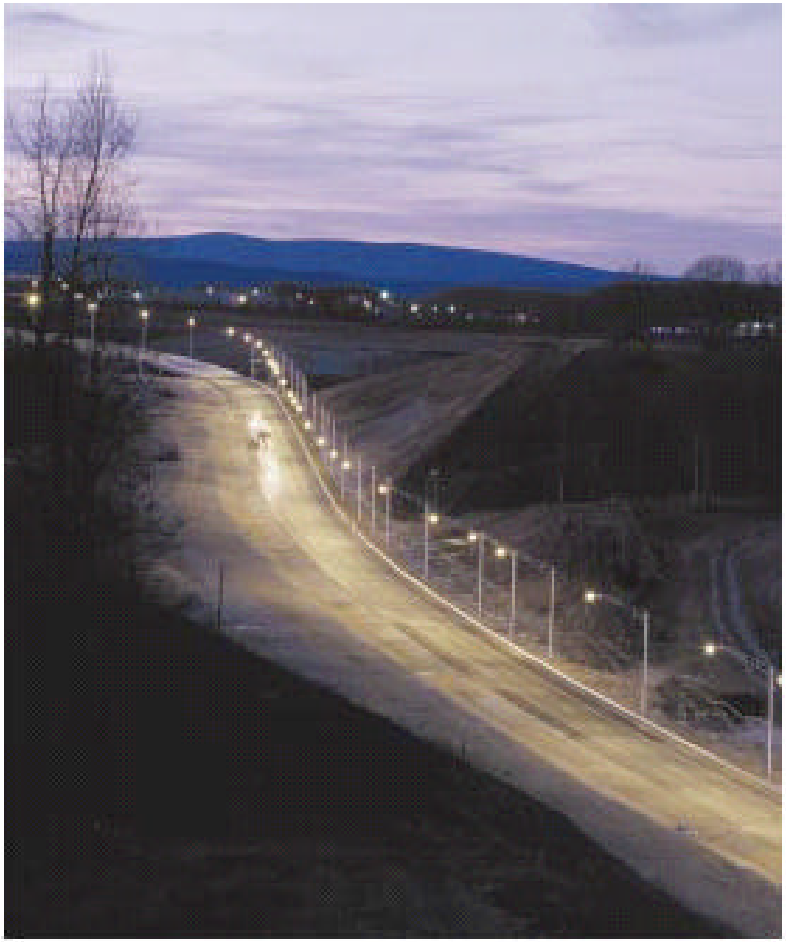
Other centers focus on:

- Transportation
- Power Electronics
- Biomedical Engineering
- Molecular Medicine
- Agricultural and Environmental Issues

Virginia Tech Transportation Institute

- Largest research institute at Virginia Tech
  - 200 staff and students working on over 60 projects
  - Largest supporter of both undergraduate and graduate students

- Research focus areas include:
  - safety and human factors
  - advanced product test and evaluation
  - roadway infrastructure
  - advanced vehicle dynamics transportation systems and operations
  - information applications and technology deployment

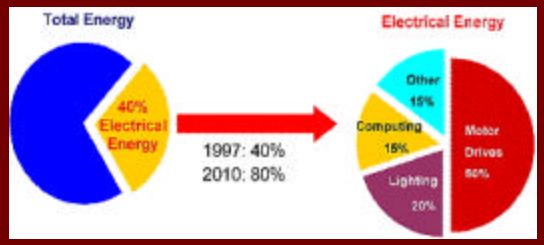


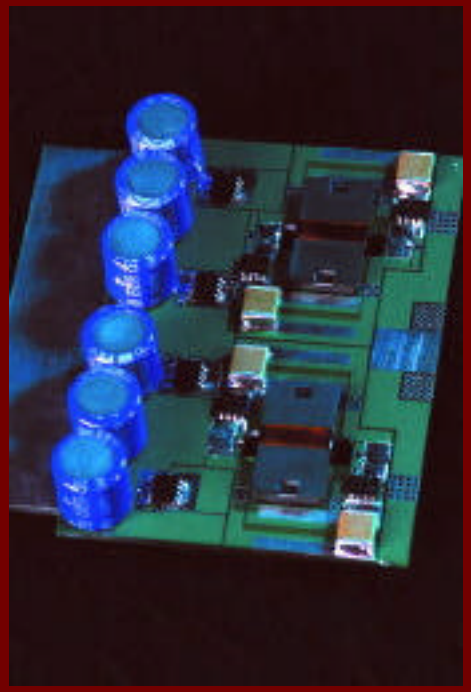
Virginia Tech Transportation Institute

- The Smart Road
- This two-mile road is a collaboration between Virginia Tech and the Virginia Department of Transportation.
- Offers VTTI researchers a state-of-the-art research lab for testing new transportation technologies 24 hours/day, 7 days/week.
- The nation's only fully operational test bed that can simulate most weather and lighting conditions encountered on the nation's highways.

Center for Power Electronics Systems

- Virginia Tech leads this 5-university consortium, which is one of the nation's few National Science Foundation Engineering Research Centers.
- CPES is the first broad-based industry/university coalition in academics, research, and education in the field of power electronics.
- Its vision is to make the United States the most efficient user of electric energy in the world.
- Sales of power electronics equipment exceed $60 billion each year, and affect another $570 billion in hardware electronics sales.
- By 2010, about 80 percent of electrical energy will be processed through power electronics devices; only about 30 percent are built in the U.S.
- CPES is working to develop an automated cost effective manufacturing process that will enable US manufacturers to once again be the leaders in PE production.



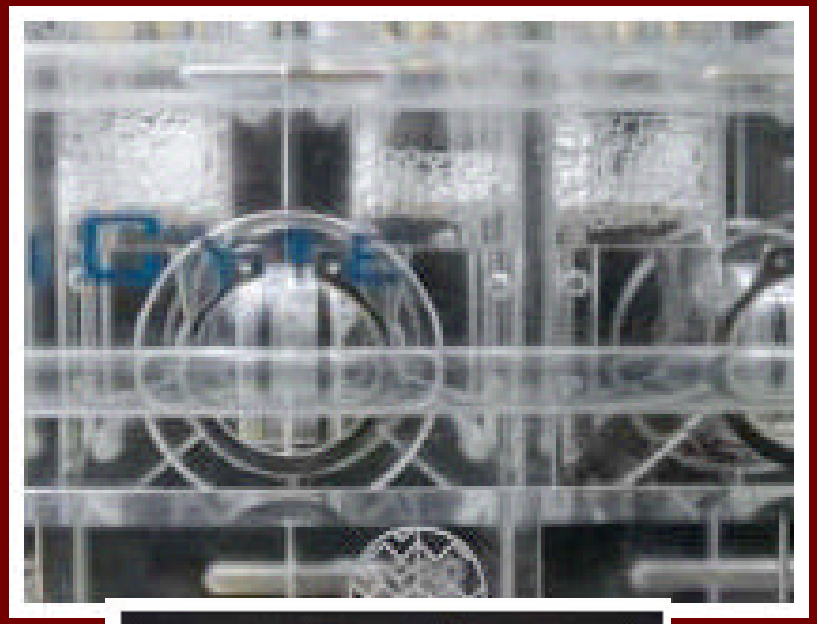


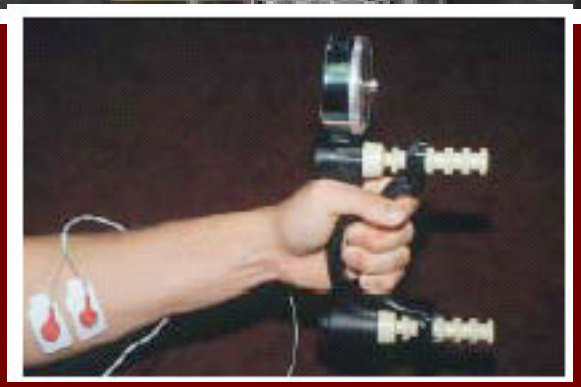
Virginia Tech – Wake Forest University

School of Biomedical Engineering & Sciences

- SBES integrates the capabilities of the:
  - Virginia Tech College of Engineering
  - Wake Forest University School of Medicine
  - Virginia-Maryland Regional College of Veterinary Medicine (VMRCVM)

- Virginia Tech's faculty research specialties include:
  - Biomechanics
  - Cellular transport
  - Computational modeling
  - Biomaterials
  - Bioheat and mass transfer
  - Biofluid mechanics
  - Biotribology
  - Bioinstrumentation
  - Ergonomics
  - Tissue engineering





Center for Molecular Medicine and Infectious Diseases

- A center of the Virginia-Maryland Regional College of Veterinary Medicine

- Primary objectives:
  - Use of molecular biotechnology and immunological techniques in the development of diagnostic tests
  - Address basic problems of infectious, immunological, and biochemical diseases in humans and animals
  - Develop improved vaccines for bacterial, viral, and parasitic diseases
  - Understand the molecular events leading to immunological diseases
  - Answer basic and applied problems in biomedicine
  - Train graduate students

- A biosafety level-3 (BL-3) laboratory is housed in the Center's infectious disease unit.

Agriculture and Environmental Research

- Virginia Agricultural Research and Extension Centers
- Innovation Center for Development of a Value Added Agricultural Economy
- Geographic Information and Remote Sensing Systems
- Center for Advanced Separation Technologies

Agricultural Research and Extension Centers

- Virginia has six distinct climatic zones and five agricultural production areas.
- Production of crops and livestock occupy 8.7 million acres.
- Forestlands of 15.2 million acres support important wood-based industries, as well as hunting, fishing, and other recreation.
- Virginia Tech develops new technologies to serve Virginia's agricultural, forestry, and seafood industries. Faculty and staff provide efficient, state-of-the-art, environmentally sound management ecommendations.

Innovation Center for Development of a Value Added Agricultural Economy

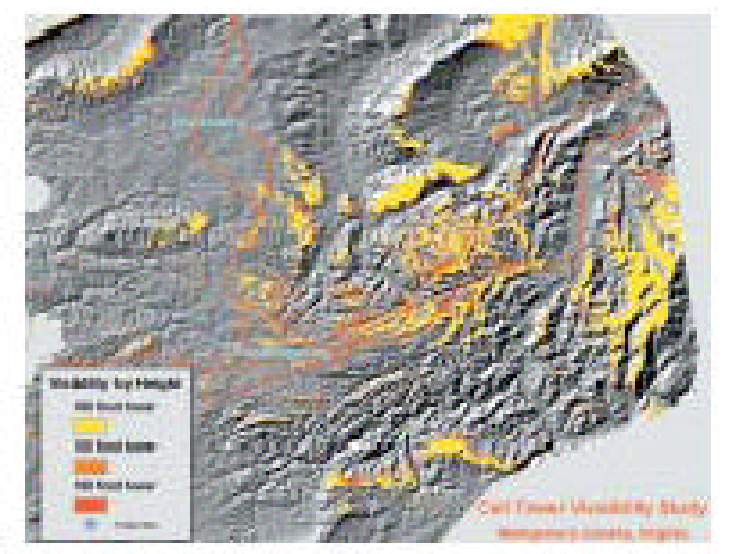
- The revitalization and long-term viability and sustainability of agriculture depend on cutting-edge, science-based technology.
- The Innovation Center will provide science-based education, research, and extension programs to build a biobased agricultural economy.
  - Has the potential for in-state manufacturing, product development, rural economic development, and job opportunities
  - Will facilitate product development, value added commodity products, food safety, and marketing of agricultural, biotechnological, and environmental technologies throughout Virginia and the region
- Virginia Tech is a leader in gene mapping and modification of crop plants.

Geographic Information Systems

- GIS, GPS, and remote sensing are multibillion-dollar industries
  - Growth of 15-25 percent over the past decade

- Virginia Tech researchers assist Virginia companies, state agencies, and federal agencies with research, development, training, and education to make full competitive use of these technologies.

- Researchers have received more than $4.8 million in external research funding.
  - Environmental concerns:
    - spread of gypsy moths
    - biodiversity (Virginia Gap analysis project)
    - mine reclamation
    - watershed water quality
  - Technical design projects:
    - sensor and unmanned aircraft design
    - wireless telecommunication system layout and design

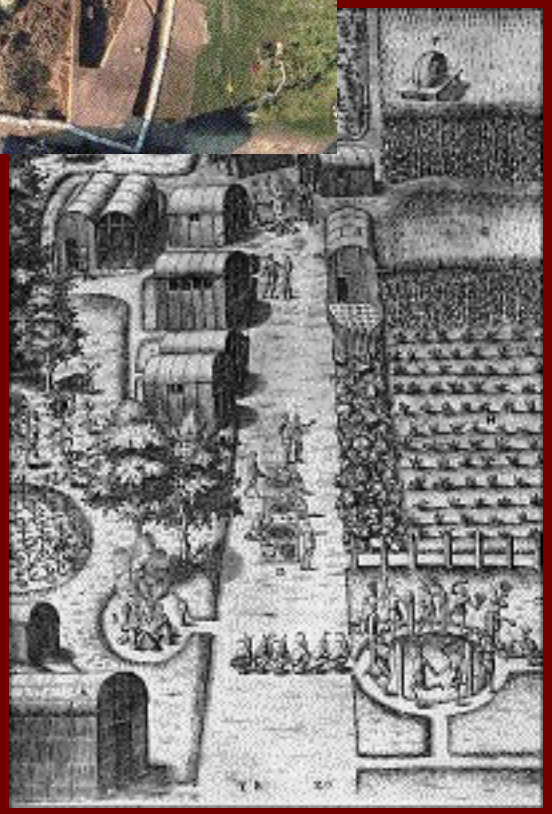


The Center for Advanced Separation Technologies

- CAST has a $7.9 million U.S. Department of Energy (DOE) contract to test processes that will clean coal and reduce the volume of coal that is now discarded during mining operations.
- The center-developed Microcel™column flotation technology is used worldwide.
- An optical sensor is now in use in coal and phosphate plants.
- Novel reagents for dewatering of fine coal and minerals are commercially available.

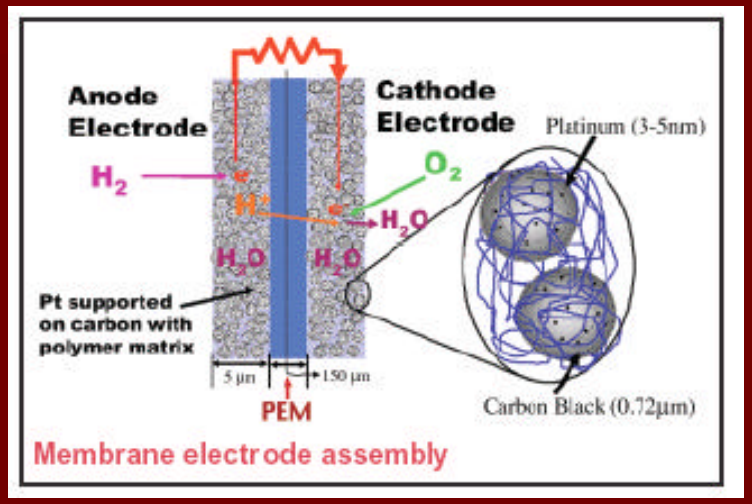
Virtual Jamestown

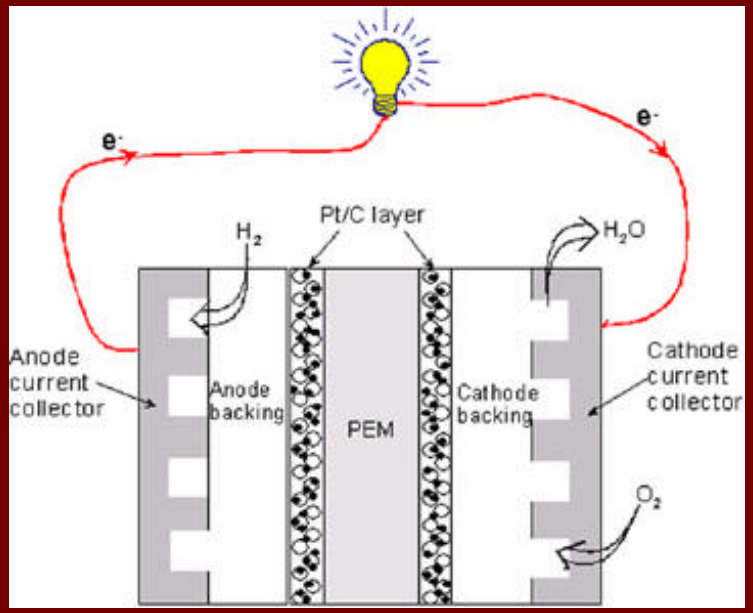
- 400 years later, the world is still learning from Jamestown
- An award-winning web project funded by NEH
- Thousands visit the site each day to learn more about the history and legacies of Jamestown
- Enables access of rarely seen documents, images, maps, and physical materials
- Historical context provided, and technology applied as an analytical tool



Alternative Energy Fuel Cells

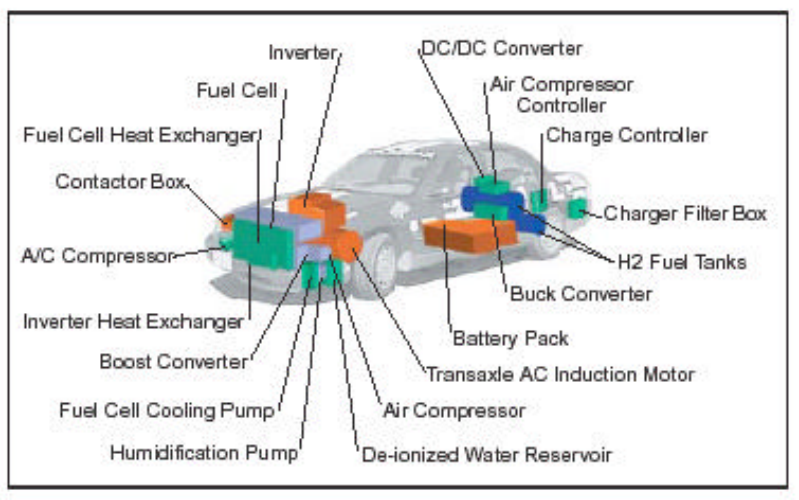
- One focus of materials research is advanced fuel cell materials needed for portable (laptops, cell phones), automotive, and stationary (homes) power.
- Research includes economically viable advanced membrane materials for advanced fuel cells.
- Faculty member James McGrath, in collaboration with Battelle, developed a high temperature proton exchange membrane (PEM) that was selected as one of 100 2004 R&D Award winners by *R&D Magazine*.
  - one of the "100 most technologically significant products introduced into the marketplace over the past year."





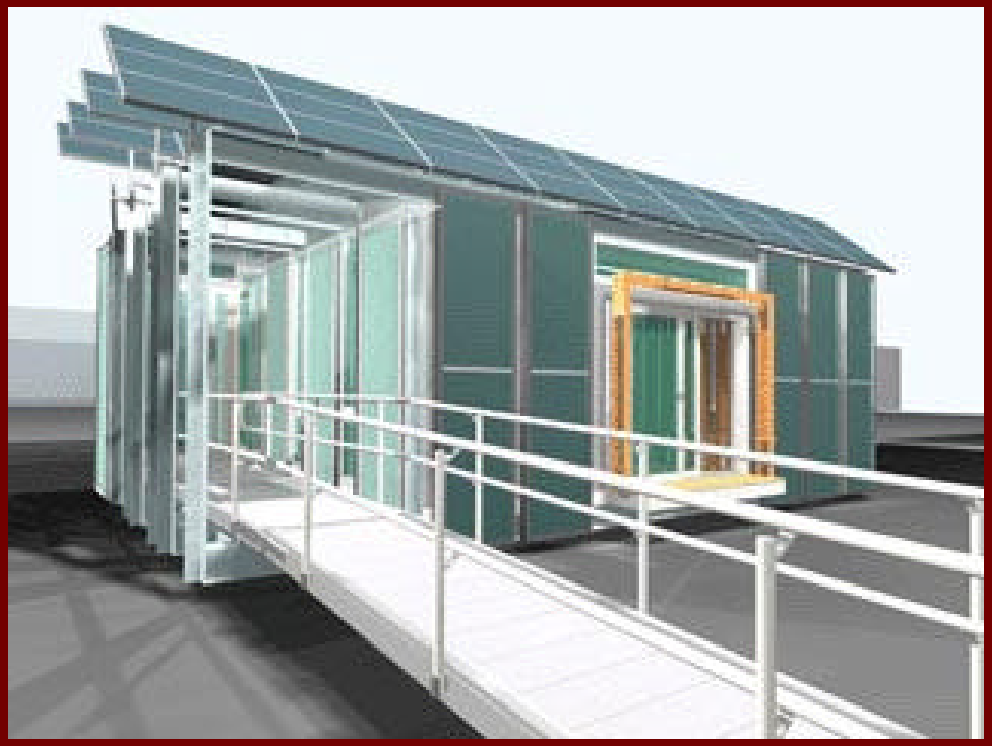
Automotive fuel cell applications

- The Center for Automotive Fuel Cell Systems
- Research on the performance and systems integration of fuel cell stacks and associated subsystems in electric and hybrid electric vehicles
- A Virginia Tech Hybrid Electric Vehicle student Team was selected to participate in the DOE/GM/Ford FutureTruck competition
- Another VT Team built a hybrid electric vehicle for the Futurecar challenge, with sponsorship from Ford
  - Placed second several times and tied once for first



Solar Energy Research Basic to Applied

- Scientists in chemistry, physics, and engineering working to create flexible solar cells
- Solar cells provide power to Derring Hall
- A solar house built by students in the College of Architecture was fifth in the first-ever Department of Energy Solar Decathlon, held on the Mall in Washington, D.C.



Virginia Tech Corporate Research Center

- **Size:**
  - 17 completed buildings totaling 600,000 square feet on 120 acres
  - Currently constructing two buildings - 35,000 square feet, tenant-owned building, and a 45,000 square feet, multi-tenant incubator building.
  - Total build-out is planned to be 28 buildings totaling 1 million square feet housing 3,000 employees in the next 10 years.

- **Population:**
  - 109 Tenants; 1,700 Employees; 150 Students
  - The park attracts about 20 new tenant companies per year.
  - The private company failure rate is less than 3% per year.

Institute for Advanced Learning and Research

- Collaboration between:
  - City of Danville
  - Pittsylvania County
  - Future of the Piedmont Foundation
  - Tobacco Commission
  - Averett University
  - Danville Community College
  - Virginia Tech
- Research Initiatives:
  - Robotics
  - Advanced Polymers
  - High Value Horticulture & Forestry
  - Performance Engineering
  - Bioinformatics
  - Biodefense
  - Motorsports

The Chartered University Initiative

- Initially the University of Virginia, the College of William and Mary, and Virginia Tech
  - Chartered universities require a smaller share of NEW General Funds
  - Provide additional General Funds to the Commonwealth for non-chartered institutions or other state priorities.
- A new governance model that allows chartered institutions the flexibility to optimize their revenue capacity and asset base
  - Fully accountable to the Commonwealth
  - Board of Visitors empowered to set tuition and fees
  - Greater flexibility in managing all sources of income
- Flexibility to pursue new research initiatives
  - Increased opportunities for partnerships with private industry
  - Ability to equip and build research labs
  - More attractive compensation for top caliber faculty