

HAMPTON UNIVERSITY
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WHITE PAPER

Virginia Innovate

Towards a **Commonwealth of Virginia Regionally Distributed International Energy Innovation Hub**

Presented to

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Concept Summary/Abstract

Hampton University proposes to establish the Virginia Energy Institute at Hampton University consisting of Hampton University-housed Commonwealth Research Consortia Centers. Through partnerships with corporate, private as well as governmental agency sources, the centers will conduct research in the areas of Innovative Energy Management, End Use Conservation and associated Environmental Technologies advancements, and a commercial and public sector application portfolio of alternative source types of Energy Production, Energy Conservation, Storage, and Efficient Distribution as well as their associated Energy Policy and Economic Development innovation areas. Advancements in assuring so-called “global competence”¹ in Education and outreach improvements will be integrated with these research centers through an Energy Education Center in order to build a pipeline for a well-prepared, traditional as well as “non traditional” and diverse energy workforce. Extensive industry research project components, with Commonwealth and federal agency support as well as appropriate partner university technology venture entrepreneurship supports, will serve to assure a commonwealth-wide impact of commercialization of the Energy Institute’s research product. While the Institute will focus on energy solutions for the nation’s defense, commercial, and security needs of the future, it will seek to enhance that agenda by realizing those objectives through exercising a set of distributed regional programmatic outcomes in all developmental stages of their full commercial dissemination.

Introduction

Energy is a fundamental need in our Commonwealth, vital to its economic, safety, and security strength and vulnerability. The Commonwealth’s and nation’s dependence on non-renewable and foreign energy sources to power the Nation’s cities and to keep its vehicles moving is an obstacle to a stable and robust economy and safety. Virginia must develop practical solutions for its energy future.

Problem

Alternative sources for energy must be developed that address economic and environmental concerns. Biomass-derived fuels, for example, are renewable, and often use what are now considered waste products that must be processed in the nation’s overburdened waste disposal systems. Solar, wind, and nuclear power sources are certainly part of the nation’s energy future.

This future is likely to include a mix of distributed energy sources, inclusive of the range of scale applications captured on the one hand by the more traditional centralized sources of process energy to the other end of that spectrum – i.e., the more remote sources at the household-level of energy production, such as solar and wind energy, or energy-systems that reduce the load on the electricity grid, such as ground source heat pumps.

Figure 1 shows the breakdown of energy in various sectors in the Commonwealth of Virginia. Note that the residential sector, for example uses a considerable amount of electricity from the grid. Clearly solutions that reduce the amount of electricity needed in homes will have a large impact on both energy use and carbon footprint.

¹ “Higher Education, Globalization and Economic Development in Virginia, **State Council of Higher Education for Virginia**, April 27, 2010, see page 6.

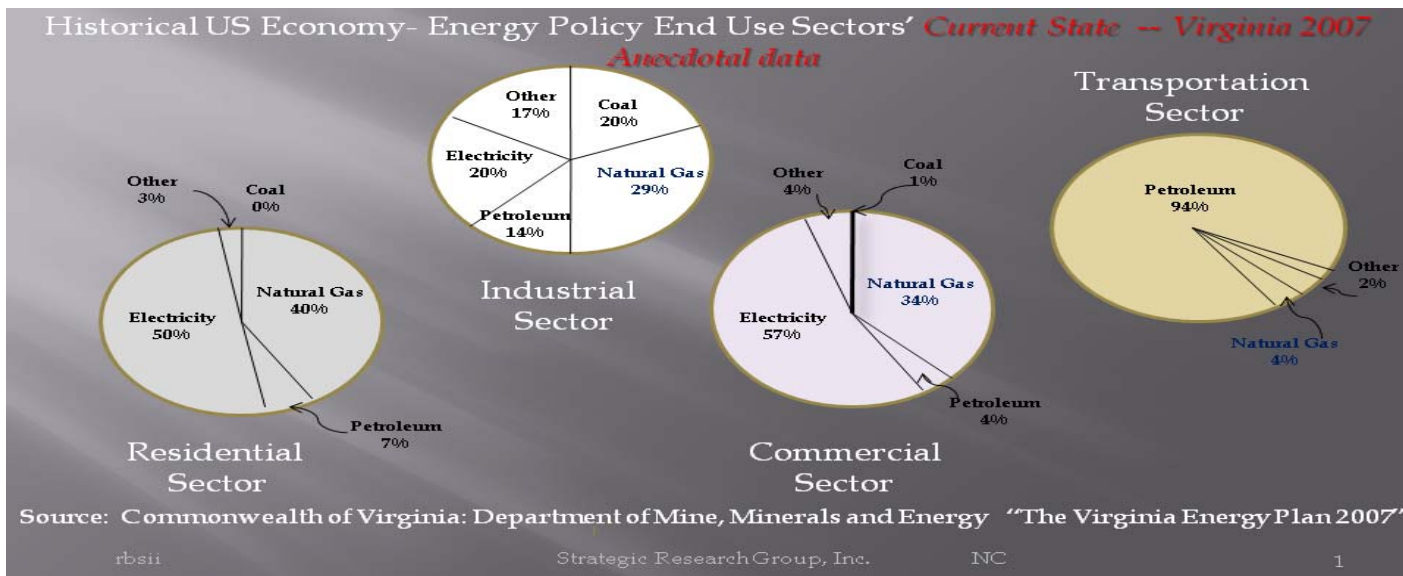


Figure 1. Commonwealth of Virginia’s Energy Sectors Fuel Use Patterns

While it is certainly the case that the vast proportion of societal demand for energy is in the non-defense application areas of the residential and commercial sectors, the transportation sector, the industrial sector, and utilities sector, it is equally recognized that the Department of Defense and the Department of Homeland Security, also have strategic interests in developing domestic – even local (or in-situ) – fuel sources for base power and for ground, sea, and air mobility. This underscores the fact that most relevant Research and Development enterprise grounded advancements in energy production and use technologies have cross cutting favorable impacts – impacting the nation’s security outlook as well as its economic and environmental viability. Therefore, contribution to and collaboration with what could be viewed as traditional defense and homeland security R&D agencies, in their efforts to address advancement in energy use and generation, hold the most promise for effectively devising timely restructuring of the nation’s energy infrastructure and outlook. Given the major defense facilities in Virginia, this is critical.

Strategy and Partnerships

Hampton University, as a private higher educational institution, proposes to establish *the Virginia Energy Institute* to further develop, evaluate and refine different energy production and utilization approaches; different methods for storing and more efficiently and flexibly distributing energy, together with the public and business policy and economics implications of different energy systems improvement choices. The Institute will focus on those potential sources of system improvement that hold the most interest and likely realizable potential to address the Commonwealth’s emerging energy needs. To assure the Virginia Energy Institute is, indeed, a *Commonwealth* activity, extensive use of inter-institutional research consortia and energy policy guidance infrastructure² will be employed³. Thus, the Commonwealth’s various research universities, federal agencies and industrial research, and workforce development partner organizations with well established research programs with sector innovation relevance (University of Virginia, Virginia Polytechnic, Virginia Commonwealth, James Madison, and others) will -- by organizational design, infrastructure development

² See (2007) Dept. of Mines, Minerals and Energy, Virginia Energy Plan: pg 172, Appendix A: Virginia Energy Plan Advisory Group Members

³ See <http://seas.virginia.edu/pubs/uvengineer/rollsroyce.php>, for example where Virginia Tech, UVa and Rolls Royce have created various aerospace research consortia

configuration and collaboration processes -- be co-leaders in the research operations of the Virginia Energy Institute at Hampton University.

“...The key is to *Exploit* R&D regional as well as organizational leverage...”

Hampton University is prepared to build a team of university and industry collaborators to provide national leadership in the development of a practical energy production storage and distribution strategy. This effort is consistent with the 2005 Energy Act, as well as the “American Recovery and Reinvestment Act of 2009 which both support the development of cellulosic ethanol, biodiesel production processes, and education and outreach to producers and users. The 2009 Act accelerates the transformation to more renewable fuel sourced economy outcomes while vastly improving the employment transformation to more environmentally benign and sustainable results.

Innovative Research Management

Updating Research Development Demonstration and Education for Global Competition...and Relevance

With securing commitments from the Commonwealth leadership, Hampton University’s Sector-specific Research University Partners as well as Federal and Selected Industrial Partnerships, the **key** innovation and assurance of the National character of the Energy Institute lays in its strategic *reliance* upon the strategic RDD&E *alliance* captured in the Virtual partnership administration proposed. Thus, it is envisioned that the Energy Institute will also serve as a RDD&E portal for each of the major Federal, Industry as well as university Research Consortia of pertinence to the mission of the Institute. This will be assured through a heavy reliance on Industry as well as thought leader advisory boards, and sector specific R&D management. The Research Structure will be followed with embed intellectual property management practices that assure and incentivize the advanced technology applications discovered will be commercialized in a competitively advantaged scale and timing to strategically support National Energy Plan and Security implementation success.

Summary, Recommendations and Conclusions⁴

The Institute will take a comprehensive approach to energy production, distribution and use systems. The research, development and educational work will be broken down structurally into five Centers. Each Center will focus on a critical component of the nation’s energy future: production, storage, distribution and applications, policy and economics, and workforce development.

Center Structure: Principal Components

1. Innovative Technology Application Practice Development Center: The focus of this Center will be on developing and improving energy applications (domestic, commercial, and military) – this includes optimization of production, distribution and use (including conservation). The first technology area will be the development of ground source heat pumps as the foundation of a new distributed “Utility of the 21st Century”.

⁴ Committed to efficiency and effectiveness, in all cases, all of the specific Energy Center programs that follow will also leverage Hampton Research Enterprise staff collaboration via entering into Memoranda of Understanding for such recently established Commonwealth Centers for Advanced Manufacturing . Again, standing educational collaborations located on the Peninsula will be expanded to afford the Greater Hampton Roads research and entrepreneurial community integration and benefit from their operations.

2. Energy Production Center: Focus on energy creation, centralized and local, and combinations. This Center will cover topics including: coal to gas, biomass, wind, solar, and nuclear as each uniquely applies for each of the four sectors shown in Figure 1

3. Energy Storage and Distribution Center: The focus of this center will be on conducting research related to getting energy to users how, where and when it is needed. This Center will cover topics including: batteries, fuel cells, energy transmission and control.

4. Energy Policy and Economic Development Center: This center will focus on non-technical criteria for energy systems: It will cover topics including: cost benefit analysis, industrial ecology approach to full system costs, and risk analysis

5. Energy Workforce Center: This Center will focus on creating the workforce to develop and apply tomorrow's energy technologies. It will focus on topics including:

- Undergraduate Energy Institute concentration and curriculum
- K-12 outreach
- Mechanical Engineering B.S. Program with Alternative Energy Option
- Graduate engineering program
- Career development for workers changing fields

As with other Inter-institutional Partner universities proposed here, Hampton University is well placed regionally and within its research ecology to maximally leverage the Region's as well as the Commonwealth's Energy Systems Research and development needs. A cursory look at the energy use profile faced by the Commonwealth of Virginia (see Figure 1) readily conveys the characteristic and advantaged nature of the research issues presented to the University.

Consider the following: Within the Commonwealth, the following assets are readily accessed:

- NASA Langley's relevant energy technology development and research assets
- The full complement of the Hampton Roads Research Partnership and its member universities
- The US Army Research Laboratory
- Commonwealth Center for Advanced Manufacturing (Crosspointe, Virginia a Virtual Research (<http://virginia-aero.com/CCAM.html>))
- Commonwealth Center for Advanced Propulsion Systems
- Virginia Coastal Energy Research Consortium

Employing extensive inter-institutional Research and Development Partnerships (virtual, as well as, geographically regionally dispersed), Hampton University will draw on several of these resources in establishing the Virginia Energy Institute, as well as its own expertise.

Recommendations:

Thus, the research agenda and programs will be structured around a Market Oriented Program Planning conception. Thus, for each of the Four Major Energy Sectors identified in Figure 1, research foci will be organized around the refinement, discovery, and commercial translation of the Research Development Demonstration and Education programmatic goals called for by each sectors pressing technical hurdles that must be overcome.

**Invest in Research Development Demonstration and Workforce
Education Capacity Enhancement**

With Figure 1, it can be readily seen that the opportunities for fuel switching, enhanced efficiency of use and system optimization will have implications for each of several commercial application sectors. Each of these have been shown – at the US DOE as well as through various industry trade associations – to call for relatively unique advances in all of the applicable areas – e.g., chemical engineering for refined bio mass production, electrical or mechanical fluidic control systems decision logic optimization of discrete systems modeling decision dynamics development – to yield the fuller promise of alternate sources of energy use.

It is for this reason, that Hampton University is proposing the creation of a strong utility technology and programs development component. Through establishing a working applications research collaboration with major Energy Utilities such as Dominion Power and its industry trade association’s research component the Electric Power Research Institute (EPRI), the Energy Institute will assure practical commercial benefit of its applications research outcomes.

The **Virginia Energy Institute** will apply broad multidisciplinary scholarship to developing viable alternative energy sources. Activities will include teammates with agricultural and agriculture policy experience since much of the biomass will come from agricultural waste (possibly involving USDA); teammates with mobility policy experience including the transportation, vehicle and engine industries (particularly those involved with DOD); and teammates with experience with production and distribution policy – production to user (possibly involving DOE).

Personnel (centers and institute core)

An Institute Director reporting to a board of directors inclusive of Hampton University’s representation will direct the technical and administrative work of the Institute. The technical leads will be the Principal Investigators/Center Directors, who will lead the academic research, design, development, and testing activities in each Center. The Dean of the School of Engineering and Technology will be the liaison for the Hampton University components of the Institute’s administration and educational implementation, and an operations staff led by an Institute clerical staff, working under the Institute Director, will manage the general activities of the Centers. The Centers Directors will be the main liaison to academic and industry teammates in their area. Each academic and industry teammate will have a Principal Investigator to manage their subcontract.